QUALITY EVALUATION OS ENVIRONMENTAL LICENSING PROCESSES OF MININ ENTERPRISES IN MINAS GERAIS

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Introduction

The incorporation of strategic planning and the dissolution of environmental public policies by using environmental damage control programs have emerged as mechanisms to mitigate impacts due to human expansion and a developmental society. Thus, population growth together with capitalism premises, through industrial activities, are responsible for the greatest environmental changes up to the present day.

In this scenario, according to the International Association for Impact Assessment (IAIA, 1999), as a way of triggering a preventive policy for possible environmental damages, the first model of Environmental Impact Assessment (EIA) was established in the United States in 1969. This instrument aims at carrying out a preliminary assessment of proposals for new projects, programs, enterprises or any other anthropic activities in order to avoid significant environmental damage (NEPA, 2015; SÁNCHEZ, 2013).

EIA were established in Brazil by Law 6,038 / 81 of the National Environmental Policy (PNMA). It is widely used, reaching activities that cause significant impact to the environment. Under these circumstances, still through the PNMA, environmental licensing aims at guiding EIA procedures through regulations from the licensing agency. This way, Brazilian states have an institutional framework that is unique to their geo-environmental and socioeconomic characteristics, complementing the regulations and procedures established by the Federal Government (MONTAÑO, SOUZA, 2015).

This way, it is relevant to mention that the EIA does not refer to a single mechanism to mitigate environmental impacts. Its expansion reflects an integration to the development of projects, allowing satisfactory social development (VANCLAY, 2015). However,

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according to Hanna *et al.* (2014), the certain projects hold governmental interests, which have accelerated the procedures of EIA processes, so these procedures are not completely fulfilled. In these circumstances, the panorama of the EIA at a global level, especially in Brazil, is limited in terms of success. The procedures applied to the different federal sectors show legal and technical gaps, contradicting the premises of sustainable planning. Thus, a considerable number of researches have been developed aiming at improving the EIA system. As a way to illustrate this scenario, Mao *et. al.* (2015) found that government policies, through the implementation of economic projects and programs, are causing serious environmental damages. This indicates that the regulations to elaborate the environmental impact study (EIS) should have priority in order to inhibit such damages.

Similarly, the nonconformities in the normative and technical agreements are reflections of the services provided by consultants, representatives of environmental entrepreneurs and members of the environmental public agencies, who must be qualified professionals to analyze the processes (FOWLER; DE AGUIAR, 1993; GLASSON; SALVADOR, 2000; ALMEIDA; ALVARENGA; CESPEDES, 2014). Tzoumis (2007) mentions the deficiencies in environmental studies and the lack of qualification of the technical staff in charge of analyzing the studies. Also, the late implementation of the EIS in the licensing processes, the request for environmental studies unable to provide information that testifies to the environmental feasibility of the enterprises, legal nonconformities and the lack of technical capacity of the competent agencies are criticisms made by researchers such as Almeida, Alvarenga and Céspedes (2014), Doelle and Sinclair (2006), Jay *et. al.* (2007), Lima and Magrini (2010), Paliwal (2006) and Santiago, Alvarenga and Almeida (2016).

Therefore, strengthening researches regarding EIA is of the utmost importance, where three basic sections must be especially improved: decision-making considering sustainability practices, the assessment of methods and practical procedures, improving the acceptance of the affected public, and the evaluations of the adopted methods (NISHIKIZAWA, 2015). According to Sinclair, Peirson-Smith and Boerchers (2016), the adoption of mechanisms, by using digital resources such as the Internet and social media, has the potential to spread EIA guidelines among participatory agents. In this context, this type of communication medium increases society participation in decision-making processes.

It may, therefore, be verified that EIA developments (through environmental licensing) have led to uncertainties about its effectiveness. In this scenario, the use of improvement tools in the normative and technical-executive panorama is irrefutable. This way, the state of Minas Gerais is characterized by having divergences regarding the environmental licensing process of mining enterprises. This is shown by some studies which found out that the type of regulation requested, the commitment regarding environmental management measures and the disconnection between the licensing practice and the previously established guidelines culminate in socio-environmental impacts that could be mitigated (GUIMARÃES et al., 2012; VIANA; BURSZTYN, 2010; PRADO FILHO; SOUZA, 2004).

Therefore, as a way of showing the legal scenario used as an analytical tool in this research, the main norms related to the environmental licensing of mining enterprises

in Minas Gerais are presented: Federal Decree nº 227/1967 (Mining Code); Conama's Resolution nº 01/1986; Decree 97,632 / 1989; Conama's Resolution nº 237/1997; Normative Deliberation (DN) nº 74/2004; Decree nº 44.309 / 2006; DN nº 127/2008; DN nº 144/2009; DN nº 145/2009.

Thus, it is possible to confirm the need for measuring the quality of the environmental licensing processes of mining enterprises in the state. Therefore, the goal of this study was to evaluate the legal agreement and the best-disseminated techniques of the environmental licensing processes of mining enterprises approved by the Regional Superintendence of Environmental Regulation of the South of Minas Gerais.

Materials and methods

Materials

The proposal of this study was carried out by the elaboration and application of checklists (ZANZINI, 2001; ALMEIDA; ALVARENGA; CESPEDES, 2014). The checklists and their respective variables are described below with details about the weight distribution. It is important to highlight that this distribution was carried out by taking into account the methodology proposed by ZANZINI (2001), where the values were adopted empirically and related to their respective importance for the licensing process. This methodological procedure was also used in the works of Almeida, Alvarenga and Céspedes (2014) and Santiago, Alvarenga and Almeida (2016).

These lists comprise items and subitems that singularize each variable in order to summarize the textual content of this article. This way, only the variables are described. For further details of these checklists, it is recommended that you refer to the entire material of Silva Junior (2016). (https://repositorio.unifei.edu.br/xmlui/bitstream/handle/123456789/493/dissertacao_silva_junior_2016.pdf?sequence=1&isAllowed=y).

Legal Variables (Pre-approval):

- (VL1) Assesses the type of regularization requested (weight 17);
- (VL2) Assesses the necessary documents for issuing the license (weight 26);
- (VL3) Assesses the type of environmental study (weight 12);
- (VL4) Assesses the elaboration of EIS/EMR (weight 17);
- (VL5) Assesses EIS/EMR components (weight 28).

On the one hand, the variables that received the highest weights were VLs 2 and 5, with 26 and 28 respectively, since the documents for issuing the licenses and the basic components of the EISs or EMRs were considered to be the most significant for the licensing process. These, in relation to the other variables may cause the environmental licensing request to be rejected if their demands are not completely fulfilled. On the other hand, VLs 1 and 4 received lower and equal weights (17), given that the type of environmental regularization and the compliance with the term of reference are elements

that may disqualify the enterprise in relation to the licensing legal fulfillment. However, it is important to have in mind that these aspects can be remodeled by the environmental agency. Finally, VL 3, which deals with the type of environmental study (EIS or EMR) was considered relatively less significant in relation to the others, since both EIS and EMR must or, at least, should be elaborated with special attention to the details of their main components regardless of the greater level of coverage of the EIS, as mentioned in VL 5.

Process Technical Variables (Pre-approval):

- (VTP1) Assesses the correct fulfillment of the Enterprise Characterization Form (FCE) and the approval of the documents according to the Basic Guidance Form (FOB) (weight 22);
- (VTP2) Assesses the physical presence of all the documents of the process (weight 20);
- (VTP3) Assesses the digital presence of all the documents of the process in the SIAM (weight 20);
- (VTP4) Assesses the organization of the documents of the process (weight 18);
- (VTP5) Assesses the requirement of complementary documents (weight 20).

In general, the five variables in the VTP checklist presented few discrepancies regarding their degree of importance to the licensing process. Thus, only VTP1 was given a higher weight (22) due to the fact that FCE and FOB establish which documents are required for the licensing process to begin, configuring this variable as being far more important than the others. VTPs 2, 3 and 5 received a weight of 20, given that they corroborate the entrepreneur commitment to the approval of the documents by the environmental agency, the systematization of the environmental agency, making all the documents received and supplied available and updated and, finally, the entrepreneur noncompliance with the approval of the documents, since the request of additional documentation was necessary, respectively. However, VTP 4, which deals with the organization of the documents of the process, received lower weight (18), since it does not compromise the environmental process itself, but leaves the functionality and environmental organization of the environmental agency vulnerable to administrative failures.

Enterprise Technical Variables (Pre-approval):

- (VTE1) Assesses the homologation of the necessary documents for license granting (weight 24);
- (VTE2) Assesses the type of approach given to the EIS/EMR (weight 18);
- (VTE3) Assesses the structure of the EIS/EMR (weight 20);
- (VTE4) Assesses the quality of maps, figures and attachments of the EIA/EMR (weight 18);
- (VTE5) Assesses whether the enterprise has ever been fined by the environmental agency (weight 20).

In this checklist, only VTE 1 received a weight (24) higher than the other variables, given that it specifically deals with the homologation of the necessary documents to obtain the licenses. This may delay the licensing process in case there are any documents missing. VTEs 3 and 5 received a weight of 20, since they, respectively, deal with the structuring of the EIS or EMR and tohe fining of the enterprise by the environmental agency, which may give the impression that the enterprise in negligent or is not fully committed. Finally, VTEs 2 and 4 received the lowest weight (18), once they deal with factors that may interfere in the decision-making related to the other variables, for they refer to the type of approach (obejctive/detailed) given to the EIS or EMC (and the quality of maps, figures and attachments.

Legal Variables (Post-approval):

- (VL1) Assesses the homologation of the Environment Management Plan (EMP) and the Recovery Plan for Degraded Areas (RPDA) (weight 30);
- (VL2) Assesses the EMP components (weight 10);
- (VL3) Assesses the EMP elaboration (weigh 20);
- (VL4) Assesses the RPDA elaboration (weight 40).

The variables presented in this first checklist included variables about the legal aspects that guide the post-approval stage. VL 4 received a weight of 40, as the RPDA is one of the main documents of mining enterprises. This study, which involves the final stage of mining activities, deals with the measures that will be taken so that the affected area returns to its nearest natural conditions. This way, it deserves greater relevance in relation to the other variables. VL 1 received a weight of 30, since it specifically deals with the homologation of the documents that must address the environmental management measures that will be adopted, through EMP and RPAD itself. VLs 3 and 2 received lower weights, 20 and 10 respectively, for they deal with the contextualization (compliance with the term of reference) used in the EMP, which relatively are less significant than VLs 4 and 1, since these two must comply with the requirements from previous studies and the requirements of the environmental agency.

Process Technical Variables (Post-approval):

- (VTP1) Assesses the homologation of the post-approval stage documents (weight 26);
- (VTP2) Assesses the physical presence of all the process documents (weight 25);
- (VTP3) Assesses the digital presence of all the process documents in the SIAM (weight 25);
- (VTP4) Assesses the organization of the process documents process (weight 24).

The VTPs of this stage received relatively similar weights, except from VTP 1 (26), which specifically deals with the homologation of the EMP, RPDA and self-monitoring

reports. VTPs 2 and 3 aimed at identifying how available the documents of the process are, both in physical and in digital (SIAM) forms. Their weight was 25. Finally, VTP 4, which analyzes the organization of the documents attached to environmental licensing physical and digital processes, received a weight of 24, given that the organization in relation to the other variables does not compromise the process significantly.

Enterprise Technical Variables (Post-approval):

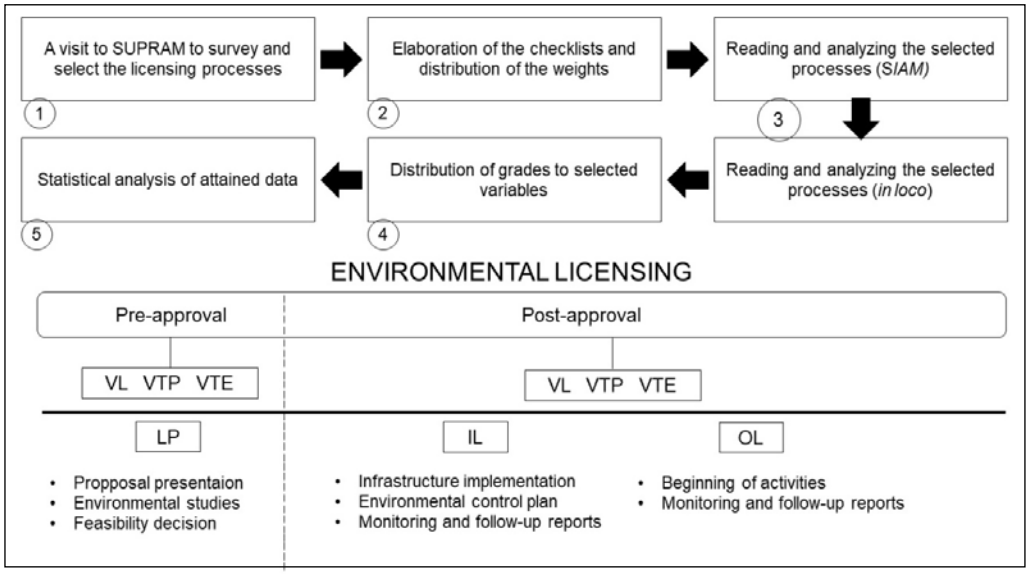
- (VTE1) Assesses the type of approach given to the EMP/RPDA (weight 11);
- (VTE2) Assesses the EMP approach regarding the significant impacts present in the EIA/EMR (weight 17);
- (VTE3) Assesses the self-monitoring programs in the EMP and RPDA (weight 12);
- (VTE4) Assesses the fulfillment of the license constraints (weight 17);
- (VTE5) Assesses the homologation of the self-monitoring reports (weight 16);
- (VTE6) Assesses the structure of EMP and RPDA (weight 16);
- (VTE7) Assesses the quality of maps, figures and attachments of the EMP and RPDA (weight 11).

The last checklist of the post-approval stage refers to the technical variables of the enterprise, *i.e.*, it assesses the entrepreneur's administrative presence during the post-approval stage. Out of the seven variables of the checklist, two of them received a weight of 17 (VTEs 2 and 4), given that they address the entrepreneur's commitment to elaborate executive measures to mitigate the environmental impacts mentioned by EIS or EMR and the fulfillment of the constraints established by the granting of the environmental licenses. These VTEs received the highest weight because the noncompliance of any demand may delay the licensing process. The homologation of the self-monitoring reports (VTE 5) and the written structure of the environmental studies regarding such stage, EMP and RPDA for example, received a weight of 16, given that these variables may establish more inspection activities carried out by the environmental agency and compromise their technical analyzes, as well as the decision-making. Finally, VTEs 1 and 7 received weights of 11 and VTE 3 a weight of 12, the lowest assigned weights, since they do not compromise the environmental procedures as the other variables.

Methods

The proposed methodology can be better understood by referring to Figure 1, which presents an executive flowchart of the actions performed. Each stage is detailed described afterwards.

Figure 1. Methodological application and environmental licensing functionality flowchart, where



VL: Legal Variable; VTP: Technical Variable of the Process; VTE: Technical Variable of the Enterprise; LP: Previous License; IL: Implementation License; OL: Operation License.

In stage 1, a sample corresponding to 50% of the mining projects related to piles of reject/sterile of ornamental rock extraction was selected. All of which were in the stage of obtaining IL or OL, *i.e.*, in the post-approval stage. The randomly selected enterprises were named M1 to M13, forming a representative sample of the analyzed processes.

Three checklists were, then, prepared for the two stages of the process, Pre-approval and Post-approval. The lists consisted of legal variables (VL), process technical variables (VTP) and enterprise technical variables (VTE). The elaboration of the variables encompassed, primarily, the legal prerogatives for the object of study, taking into account the federal and state (MG) legal aspects and technical and administrative procedures required by the environmental agency, through the forms and terms of reference available.The variables of each checklist were weighted according to their respective degrees of importance to the environmental licensing process. These weights were based on the legal apparatus and technical norms of the environmental regulation. Details about the singularity of the weights of each variable are going to be addressed in the checklists. This way, each list was given a random total of variables that, when their weights are summed up, the total comes to 100 (SILVA JUNIOR, 2016).

In step 3, the methodological application of the study was carried out in a documentary way. The documents were analyzed by using the Integrated Environmental Information System (SIAM) on the Internet and in the physical processes. Afterwards, they were filed in the database at Environmental Regional Superintendecy (SUPRAM) headquarters in the city of Varginha - MG.

The measurement of the variables, using grades, was basically carried out by verifying 2 criteria: (1) fulfillment of the variable or not; (2) percentage of fulfillment of the variable, which is the fourth stage.

Stage 5 classified the variables according to their respective levels of agreement and later they were also classified in levels of similarity by using Cluster analysis.

Data Analisis

Agreement Rates

In order to calculate the agreement rates of each checklist variable (ICV), the sum of the grades given to each item of the variable (i (V) j) was related to the weight corresponding to the variable (V (L)) (Equation 1). The agreement rates ranged from 0 to 1.

$$ICV = \frac{\sum_j i(V)_j}{\sum_j V(L)} \quad \text{Equation 1}$$

Classification of agreement levels

After the equation was applied, the results obtained in both evaluated stages and verified in the three lists were multiplied by 100 in order to estimate the agreement percentage. In this context, the sample of analyzed processes showed levels of agreement for each variable. This can identify which variables represent the best and the worst behavior of the enterprises. This way, the classification of the agreement levels was as follows:

- From 0.0 to 20.0: very low;
- From 21.0 to 40.0: low;
- From 41.0 to 60.0: average;
- From 61.0 to 80.0: high;
- From 81.0 to 100.0: very high.

Statistical Analysis

In order to verify the behavior of the variables regarding their application to the environmental licensing processes, a multivariate statistical analysis was carried out by using the Cluster technique with the software Statistica® version 7.0 (STATSOFT, 2005). This is an important technique, given that it divides the elements of the sample (or population) in groups, in such a way that the elements that belong to the same group are similar among each other in relation to the variables that they measure and the elements of different groups are heterogeneous in relation to the same characteristics (MINGOTI, 2013). For the application of such technique, it is necessary to select a similarity or dissimilarity measure, so that the elements can be compared. Thus, the Euclidean distance

was used. This is a commonly used dissimilarity measure, where the lower its values, the more similar the elements that are being compared. The Euclidean Distance formula is shown by Equation 2.

$$\sqrt{[\sum_{i=1}^{p}(x_{il} - x_{ik})^2]} \quad \text{Equation 2}$$

"p" is the number of random variables (VLs, VTPs, VTEs of both stages) and Xl and Xk represent the value of the variable in each analyzed enterprise I and k. Afterwards, the Single-Linkage Clustering is used as a hierarchical agglomerative clustering, where the similarity between two groups is defined by the two elements that present the shortest Euclidean distance between them. Such elements are the variables of each checklist (a total of 6) until a single cluster comprising all elements is formed (MINGOTI, 2013).

Thus, the dendrograms were generated by displaying the variables of the respective checklists on their "x" axis and the value of the Euclidean distance in which all variables were grouped on the "y" axis. In order to make the analysis easier, the percentages of similarity levels of each cluster were also shown in the dendrograms. These levels of similarity are calculated according to Equation 3.

$$S_{il} = \left(1 - \frac{d_{il}}{\max\{d_{jk}, j, k = 1,2,...,n\}}\right) x100 \quad \text{Equation 3}$$

"S" corresponds to the level of similarity between two elements (A, B), "d" represents the distance between two elements (A, B) and max{d_{jk}, j, k = 1,1, ..., n } is the largest distance between the sample elements in the distance matrix D_{nxn} of the first clustering stage. Thus, the dendrograms from this analysis are used to confirm what the levels of agreement show for this set of enterprises. This statistical technique is used to corroborate the behaviors of the rates that were found.

Results and discussion

Pre-approval stage

The analysis of the pre-approval stage could be evaluated by taking the behavior of the environmental agency and the mining project proponents into account. This way, Table 1 shows the classification of the percentages of the agreement levels of the variables and Figure 2 presents the dendrograms of VLs (a), VTPs (b) and VTEs (c).

It was possible to observe that 46.2% of the enterprises were correctively regularized, in contrast to the preventive principles of EIA and the environmental licensing (VL1). This scenario corroborates the perception of Hanna *et al.* (2014), who mention the pressure of the public authorities to accelerate environmental processes as a way to favor economic pillars.

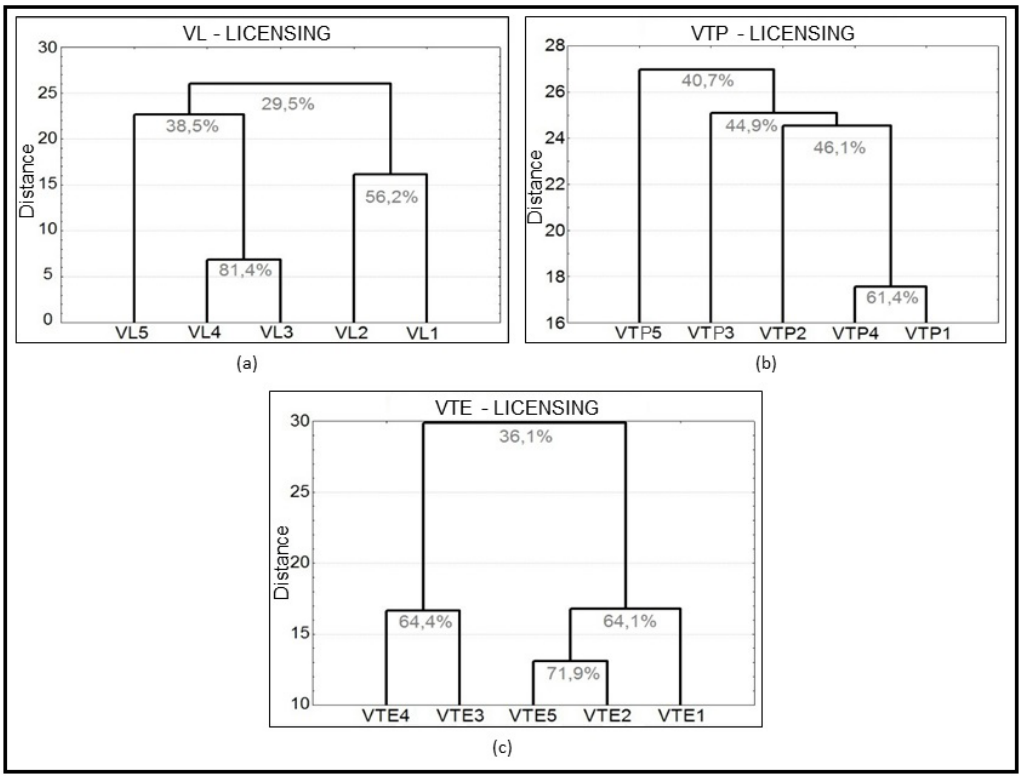
In the VL checklist, it is important to highlight variables 3 and 4, which assess the type of environmental study presented and its the technical quality. The first one indicated that only 30.8% of the projects elaborated an environmental impact study/environmental impact report as an environmental study, even though it was a requirement established at Federal level by Resolution CONAMA 01/86 for mining enterprises. Thus, this normative conflict happened during the technical quality assessment of the environmental studies (VL4). It was observed that 69.2% of the enterprises present low agreement with such VL. It is important to mention that all the enterprises presented EMR instead of other more detailed reports, such as EIS for example.

Table 1. Percentages of agreement levels of Legal Variables (VLs), Technical Variables of the Process (VTPs) and Technical Variables of the enterprise (VTEs) of the Pre-Approval stage.

	CLASSIFICATION	VL1	VL2	VL3	VL4	VL5
VL	Very low	-	-	-	-	30.8
	Low	-	7.7	-	69.2	15.4
	Average	-	53.8	69.2	-	15.4
	High	46.2	15.4	-	15.4	38.4
	Very High	53.8	23.1	30.8	15.4	-
	CLASSIFICATION	VTP1	VTP2	VTP3	VTP4	VTP5
VTP	Very low	-	-	-	-	61.5
	Low	-	53.8	100.0	-	-
	Average	46.1	-	-	-	23.1
	High	30.8	-	-	100.0	-
	Very High	23.1	46.2	-	-	15.4
	CLASSIFICATION	VTE1	VTE2	VTE3	VTE4	VTE5
VTE	Very low	-	-	7.7	7.7	-
	Low	-	-	30.8	23.1	-
	Average	7.7	-	7.7	23.1	15.4
	High	38.5	-	30.8	46.1	-
	Very High	53.8	100.0	23.0	-	84.6

Figure 2(a) corroborates such diagnosis, showing that VLs 3 and 4 presented the highest similarity when compared with the others with a similarity value of 81.4%. This way, the quality of environmental studies is questioned by several researchers, as Tzoumis (2007) and Paliwal (2006), for example, stating that it is inferred that the environmental study is the document that may cause inconsequent decision-making by th environmental agencies due to the technical deficiency in their elaboration, which was carried out by the proponents and environmental consultants.

Figure 2. Dendrograma resulting from the variable cluster analyzed in the pré-approval stage.



(a) Legal Variables (VLs); (b) Technical Variables of the Process (VTPs); (c) Technical Variables of the Enterprise (VTEs). The percentage values indicate the similarity level of each cluster carried out.

Regarding the VTPs, it was observed that VTPs 2, 3 and 5 were highlighted negatively. They are responsible for assessing the physical filing and SIAM document availability and the requests for further documents, respectively. The availability of physical documents and digital documents (SIAM) presented 53.8% and 100% of low agreement. As it was expected, 61.5% of the enterprises presented a very low agreement and 23.1% an average agreement in VTP5, hence the need to request additional documents, configuring the proponent non-compliance on the project.

The dendrogram presented in Figure 2 (b) showed a certain similarity among the variables with a difference of approximately 5%. It is possible to say that there was coherence in clustering these variables, given that they are related to the proponent technical noncompliance. In this context, Sánchez and Morrison-Saunders (2011) state that the environmental agency has been acting in the same way over the past decades, applying the environmental instruments. Cyclically, in turn, the agencies accumulate new knowledge and experiences, mainly regarding new procedures and policies that comprize EIA,

theoretically favoring improvements in the organization systems. From this perspective, it is possible to consider that those authors' statements are important to the practice of environmental licensing in the South of Minas Gerais. However, it is important to highlight the challenge faced by the servers of the environmental agency regarding the adhesion to an application based on the accumulation of experiences and the daily and repetitive execution of a practice based on pre-existing rules and regulations.

On the other hand, the VTEs that are responsible for assessing the technical behavior of the enterprises showed a better performance. However, it was observed that VTEs 3 and 4 confirmed the low level of commitment of the proponents, once the experts hired to elaborate the environmental studies might provide insufficient or incoherent information for the decision-making. The same VTEs assessed the structure and quality of the text and graphic elements of the environmental studies.

It was verified that approximately 44% and 53% of the enterprises had agreement levels from average to very low for VTEs 3 and 4, respectively. The remarkable technical similarity regarding the licensing process among these variables was also confirmed in Figure 2 (c), presenting a similarity percentage of 64.5%. That is, the entrepreneurs presented average-structured environmental studies, lowering their quality. Thus, the poor quality of these studies is a commonly observed deficiency in environmental licensing procedures, resulting in unnecessary or the lack of information that is important to the decision-making (TZOUMIS, 2007). According to Almeida *et al.* (2015), IBAMA's officials point out some significative deficiencies regarding environmental diagnosis in the EIS, such as the dissociation between the environmental diagnosis and the impacts, the absence of necessary information, compartmented studies and an excess of unnecessary information. In this scenario, the improvement in the EIA, as mentioned by Vanclay (2015), must focus on actions that make environmental studies effectively able to transmit information that is important to the decision-makers; just as Nishikizawa (2015) and Sinclair and Peirson-Smith and Boerchers (2016) indicate the improvement in procedures and methods.

Post-Approval stage

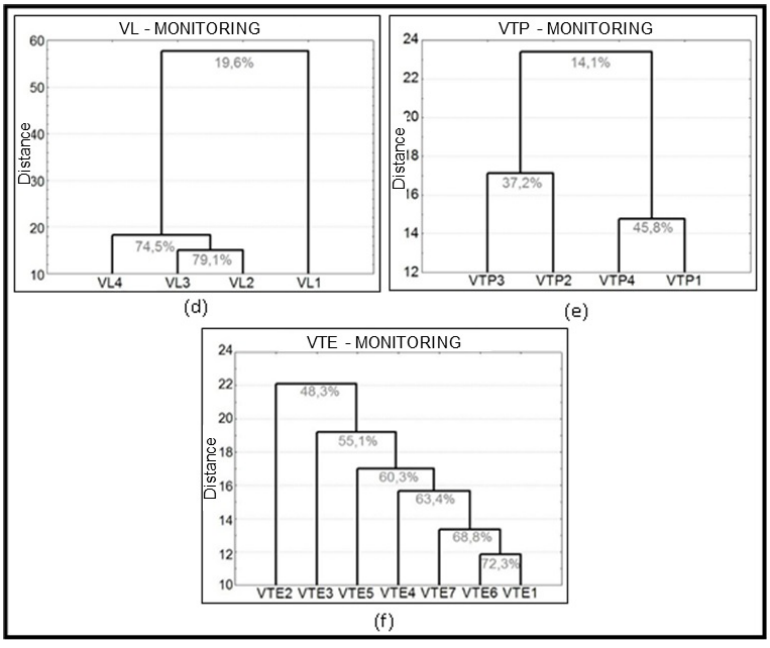
The post-approval stage, as well as the previous one, tried to bring into light the legal and technical behavior of the proponents and the environmental agency, emphasizing environmental management plans. Thus, Table 2 presents the classification of the percentages of the agreement levels of the variables and Figure 3 shows the dendrograms of VLs (d), VTPs (e) and VTEs (f) checklists.

Table 2. Percentages of the agreement levels of Legal Variables

VL	**CLASSIFICATION**	VL1	VL2	VL3	VL4	-	-	-
	Very low	-	7.7	7.7	30.8			
	Low	-	-	46.1	53.8			
	Average	30.8	53.8	30.8	7.7			
	High	-	-	15.4	-			
	Very high	69.2	38.5	-	7.7			
VTP	**CLASSIFICATION**	VTP1	VTP2	VTP3	VTP4	-	-	-
	Very low	-	-	-	-			
	Low	-	92.3	100.0	-			
	Average	92.3	-	-	46.2			
	High	-	-	-	53.8			
	Very high	7.7	7.7	-	-			
VTE	**CLASSIFICATION**	VTE1	VTE2	VTE3	VTE4	VTE5	VTE6	VTE7
	Very low	-	-	23.1	30.8	92.3	7.7	7.7
	Low	-	-	-	7.7	-	15.4	7.7
	Average	15.5	7.7	-	30.8	-	30.8	7.7
	High	-	38.5	-	15.4	-	30.8	53.8
	Very high	84.6	53.8	76.9	15.4	7.7	15.4	23.1

(VLs), Technical Variables of the Process (VTPs) and Technical Variables of the Enterprise (VTEs) of the post-approval stage

Figure 3. Dendrograms resulting from the variables clusters analyzed during the post-approval stage.



(a) Legal Variables (VLs); (b) Technical Variable of the Process (VTPs); (c) Technical Variables of the Enterprise (VTEs). The values expressed in percentages indicate the similarity level of each cluster carried out.

The checklist corresponding to the VLs presented four variables, where VL4, which evaluated the presentation of the RPAD, is the most relevant. However, the legal performance was regarded as insufficient, considering its real importance. About 85% of the enterprises presented low and very low agreements. According to Venturoli *et al*. (2013), besides elaborating the RPAD, mining enterprises must carry out the proposed measures in a coherent an efficient way, taking the local particularities into account. This is due to the fact that after the mineral mined is exhausted, the landscape of the area is considerably changed. Returning the superficial land to the community or its owner, meeting sustainability demands, is mandatory (LIMA; FLORES; COSTA, 2006). This way, these researchers highlight the importance not only of the elaboration and homologation of this environmental study, but also its quality, which presented significant deficiencies as it was observed.

In this context, Figure 3(d) presents assumptions that the homologation and the technical quality of the document elaboration are different variables, given that VL1, which addressed the EMP and RPAD homologation, was grouped into the cluster formed by VLs 2 (EMP components), VLs 3 (EMP elaboration) and VLs 4 (74.5% of similarity) with a similarity of only 19.6%.

Thus, as the VLs checklist, VTPs checklist also presented four variables, where, similarly to the pre-approval phase, the VTPs that called the most attention were numbers 2 and 3, which assessed the presence and the availability of the physical documents and the digital documents in SIAM, respectively. However, the percentages rose at this stage with 92.3% of low agreement in VTP2 and 100% of low agreement in VTP3. According to Arts and Marrison-Saunders (2001), this process deficiency favors the absence of data about the environmental status of the enterprise, makes it difficult to analyze its environmental performance, causes environmental management to be insufficient and causes communication conflicts. This statement leads to the inefficiency of the environmental licensing process, a condition which might be shared with other studies.

Therefore, it was observed that Figure 3(e) corroborates such diagnosis, showing the cluster comprising the mentioned VTPs with a 37.2% of similarity. In this context, Ramjeawon and Beedassy (2004) also mention that the environmental licensing process often presents a post-approval stage lagged or even absent, making it difficult for EIS objectives to be imposed. According to Marshall, Arts and Morrison-Saunders (2005), governmental officials must manage the whole process of document exchange, requiring the appropriate documents from the proponents, so that the post-approval stage can be started.

Regarding the VTEs, whose number of variables was higher than the others (7), variables 3 and 5, which assessed the proposition of self-monitoring programs (actions that follow the environmental management plans that were implemented, generating performance reports) in the EMPs and RPADSs and their homologation in the competent environmental agency, respectively , are negatively highlighted. It was also possible to observe that 77% of the projects proposed the reports. However, VTE 5 showed that 92.3% of all the analyzed enterprises did not approbate such document. In a study carried out at Central SUPRAM, Florencio (2010) found out that the submitted self-monitoring

reports are not verified in relation to their periodicity and whether the data supplied corresponds to the requested amount. In this context, the passivity of the environmental agency regarding the entrepreneur commitment to homologate the self-monitoring reports, reflects, exactly, the fragility of the post-approval stage.

This way, Figura 3(f) presents the behavior of this checklist, showing that the initial cluster formed by VTEs 1, 6 and 7 (68.8% of similarity) represents the technical quality of the environmental studies. Also, VTEs 4, 5, 3 and 2 were respectively and consecutively grouped in the initial cluster. These variables are responsible for the technical fulfillment of the environmental control measures. This way, the core of the post-approval stage is lagged, given that the environmental control measures were not fully homologated. Therefore, the lack of documents explaining the details of the control measures make it impossible to verify the uncertanties in predicting the impacts and the occurance of unexpected impacts, to notice differences between the planning and the implementation and to assure the efectiveness of the mitigating measures and, mainly, the feedback, which allows the adjustments to EIA pratcies (ARTS; MORRISON-SAUNDERS, 2001; GALLARDO; SÁNCHEZ, 2004; NOBLE; STOREY, 2005).

Conclusions

The interface between EIA and anthropic activities, such as mining, comprise several agents that influence the whole environmental licensing process directly or indirectly. Agents that belong to the public and private sector and to the society as a whole. This social heterogeneity makes this environmental policy instrument unique and dynamic. It can even disarticulate the efficiency of the environmental licensing process.

Thus, it was observed that corrective regularization occurred in approximately 50% of the analyzed projects. This configuration of the licensing process grants some flexibilization to EIA principles. This way, there is a need to promote campaigns, inspections and programs in order to minimize the occurrence of this type of regularization.

Regarding the pre-approval stage, it was possible to notice that the main deficiencies or abnormalities refer, mainly, to the type of environmental study and the technical quality of their elaboration. This arrangement directly confronts the normative set that rules the environmental processes. Also, there was a lower protection level from the state of Minas Gerais in relation to the Federal Government regarding the type of environmental study presented for mining enterprises. Based on this conflicting principle, the homologation of environmental studies of lower quality (EMR) for such activity caused an agreement level even lower for the technical requirements issued by terms of reference. This is the reason why the restructuring of the state legal apparatus is mandatory in regards to the required environmental studies, in addition to a more cautious and critical performance when the studies as presented.

The post-approval stage presented a worse performance than the pre-approval stage. The reason for such poor results was the RPAD, which is the most important study of this stage and provides the procedures regarding the termination mining activities. It was elaborated in an incoherent way and did not meet the technical demands. Also, the proponents neglected some of their legal duties, such as the homologation of conditioning

factors and self-monitoring reports, increasing the inefficiency of monitoring procedures. This way, the elaboration of the RPAD must be improved and present a better quality. In addition, the government environmental agencies must have enough available personnel to verify and fulfill all of the observed incompatibilities.

This way, it is important to highlight that the operational system that carries out mining environmental licensing in the south of Minas Gerais presents remarkable difficulties in using this tool. The low technical performance and the noncompliance with the homologation of the documents of the process as a whole by the proponents are of the utmost importance for the effectiveness of the environmental licensing. Hence, it is necessary to improve the technical evaluation system of the environmental studies as a tool to improve EIA processes.

References

ALMEIDA, A. N. et al. Deficiências no diagnóstico ambiental dos estudos de impacto ambiental (EIA). **Revista de Gestão Ambiental e Sustentabilidade**. São Paulo – SP, v. 4, n. 1, p. 33-48, 2015. DOI: 10.5585/geas.v4i2.168.

ALMEIDA, M. R. R.; ALVARENGA, M. I. N.; CESPEDES, J. G. Avaliação da qualidade de estudos ambientais em processos de licenciamento. **Revista Geociências**. Rio Claro – SP, v. 33, n. 1, p. 106-118, 2014.

ARTS, J. P. C; MORRISON SAUNDERS, A. Environmental impact assessment follow-up: good practice and future directions: findings from a Workshop at the IAIA 2000 conference**. Impact Assessment and Project Appraisal**. Guildford, v.19 n. 3, p 175- 185, 2001. DOI: 10.3152/147154601781767014.

DOELLE, M.; SINCLAIR, A. J. Time for a new approach to public participation in EA: promoting cooperation and consensus for sustainability. **Environmental Impact Assessment Review**. Norwich - England, v. 26, n. 2, p. 185–205, 2006. DOI: 10.1016/j.eiar.2005.07.013.

FLORENCIO, E. O Automonitoramento no Estado de Minas Gerais – Estudo de Caso: Bacia Hidrográfica do Rio Itabirito. 2010. 115 p. **Dissertação (Mestrado em Sustentabilidade Socioeconômica e Ambiental)** - Universidade Federal de Ouro Preto, Ouro Preto, 2010.

FOWLER, H. G.; DE AGUIAR, A. M. D. Environmental impact assessment in Brazil. **Environmental Impact Assessment Review**. Norwich - England, v. 13, n. 3, p. 196-176, 1993. DOI: 10.1016/0195-9255(93)90030-F.

GALLARDO, A. L.C.F.; SÁNCHEZ, L. E. Follow-up of a road building scheme in a fragile environment. **Environmental Impact Assessment Review**. Norwich – England, v. 24, n. 1, p. 47-58, 2004. DOI: 10.1016/S0195-9255(03)00136-7

GLASSON, J.; SALVADOR, N. N. B. EIA in Brazil: a procedures–practice gap. A comparative study with reference to the European Union, and especially the UK. **Environ-**

mental Impact Assessment Review. Norwich - England, v. 20, n. 2, p. 191-225, 2000. DOI: 10.1016/S0195-9255(99)00043-8.

GUIMARÃES, J. C. C. et al. Avaliação dos aspectos e impactos ambientais decorrentes da mineração de bauxita no sul de Minas Gerais. **Enciclopédia Biosfera**. Goiânia – GO, v. 8, n. 15, p. 321 – 333, 2012.

HANNA, P. et al. Improving the effectiveness of impact assessment pertaining to Indigenous peoples in the Brazilian environmental licensing procedure. **Environmental Impact Assessment Review**. Norwich – England. v. 46, p. 58-76, 2014. DOI: 10.1016/j.eiar.2014.01.005

IAIA – International Association for Impact Assessment. **Principles of environmental impact assessment best practice**. Institute of Environmental Assessment. Fargo - EUA, v.1. 1999. Disponível em: < http://www.iaia.org/publicdocuments/>. Acesso em: 8 mar. 2015.

JAY, S. et al. Environmental impact assessment: retrospect and prospect. **Environmental Impact Assessment Review**. Norwich - England, v. 27, n. 4, p. 287–300, 2007. DOI: 10.1016/j.eiar.2006.12.001.

LIMA, L. H.; MAGRINI, A. The Brazilian Audit Tribunal's role in improving the federal environmental licensing process. **Environmental Impact Assessment Review**. Norwich - England, v. 30, n. 2, p. 108-115, 2010. DOI: 10.1016/j.eiar.2009.08.005.

LIMA, H. M.; FLORES, J. C. C.; COSTA, F. L. Plano de recuperação de áreas degradadas versus plano de fechamento de mina: um estudo comparativo. **Revista Escola de Minas**. Ouro Preto – MG, v. 59, n. 4, p. 397-402, 2006.

MAO, X. et al. A review of EIAs on trade policy in China: Exploring the way for economic policy EIAs. **Environmental Impact Assessment Review**. Norwich - England, v. 50, p. 53-65, 2015. DOI: 10.1016/j.eiar.2014.08.010.

MARSHALL, R.; ARTS, J.; MORRISON- SAUNDERS, A. International principles for best practice EIA follow-up. **Impact Assessment and Project Appraisal**. United Kingdom, v. 23, n. 3, p.175–181, 2005. DOI: 10.3152/147154605781765490.

MINGOTI, S. A. **Análise de dados através de estatística multivariada: Uma abordagem aplicada**. 2 ed. Belo Horizonte – MG: Editora UFMG, 2013. 297 p.

MONTAÑO, M.; SOUZA, M. P. Impact assessment research in Brazil: Achievements, gaps and future directions. **Journal of Environmental Assessment Policy and Management.** v. 17, n. 1, 8 p., 2015. DOI: 10.1142/S146433321550009X

NEPA – National Environmental Policy Act. What is the National Environmental Policy Act? **EPA – Environmental Protection Agency.** Washington – EUA, 2 nov. 2015. Disponível em: <http://www2.epa.gov/nepa/what-national-environmental-policy-act>. Acesso em: 16 de nov. 2015.

NISHIKIZAWA, S. Environmental impact assessment research In Japan: retrospective and prospective. **Journal of Environmental Assessment Policy and Management.** v. 17, n. 1, 9 p., 2015. DOI: 10.1142/S1464333215500131

NOBLE, B.; STOREY, K. Towards increasing the utility of follow-up in Canadian EIA. **Environmental Impact Assessment Review**. Norwich – England, v. 25, n. 2, p. 163-180, 2005. DOI: 10.1016/j.eiar.2004.06.009.

PALIWAL, R. EIA practice in India and its evaluation using SWOT analysis. **Environmental Impact Assessment Review**. Norwich – England, v. 26, n. 5, p. 492–510, 2006. DOI: 10.1016/j.eiar.2006.01.004.

PRADO FILHO, J. F.; SOUZA, M. P. O licenciamento ambiental da mineração no Quadrilátero ferrífero de Minas Gerais – uma análise da implementação de medidas de controle ambiental formuladas em EIAs/RIMAs. **Revista de Engenharia Sanitária Ambiental.** Rio de Janeiro – RJ, v. 9, n. 4, p. 343 – 349, 2004.

RAMJEAWON, T.; BEEDASSY, R. Evaluation of the EIA system on the Island of Mauritius and development of an environmental monitoring plan framework. **Environmental Impact Assessment Review**. Norwich – England, v. 24, n. 5, p. 537-549, 2004. DOI: 10.1016/j.eiar.2004.01.001.

SÁNCHEZ, L. H.; MORRISON-SAUNDERS, A. Learning about knowledge management improving environmental impact assessment in a government agency: The Western Australian experience. **Journal of Environmental Management**. California – EUA, v. 92, p. 2260-2271, 2011. DOI: 10.1016/j.jenvman.2011.04.010.

SÁNCHEZ, L. H. **Avaliação de impacto ambiental: Conceitos e métodos**. 2. ed. São Paulo – SP: Oficina de Textos. 2013. 583 p.

SANTIAGO, C. S.; ALVARENGA, M. I. N.; ALMEIDA, M. R. R. Avaliação da etapa de acompanhamento do licenciamento ambiental de abatedouros e laticínios em Minas Gerais. **Revista Brasileira de Geografia Física**. Recife – PE, v. 9, n. 3, p. 940-954, 2016.

SILVA JUNIOR, L. Avaliação da efetividade dos processos de licenciamento ambiental de empreendimentos de mineração do Sul de Minas Gerais. 2016. 121 p. **Dissertação (Mestrado em Meio Ambiente e Recursos Hídricos)** – Instituto de Recursos Naturais – Universidade Federal de Itajubá, Itajubá – MG, 2016.

SINCLAIR, A. J.; PEIRSON-SMITH, T. J.; BOERCHERS, M. Environmental assessments in the Internet age: the role of e-governance and social media in creating platforms for meaningful participation. **Impact Assessment and Project Appraisal**. Fargo – EUA, v. 35, n. 2, p. 148-157, 2016. DOI: 10.1080/14615517.2016.1251697

STATSOFT. **Statistica 7.0 Software**. Tucksa, USA, 2005.

TZOUMIS, K. Comparing the quality of draft environmental impact statements by agencies in the United States since 1998 to 2004. **Environmental Impact Assessment Review**. Norwich - England. v. 27, n. 1, p.26-40, 2007. DOI: 10.1016/j.eiar.2006.08.003.

VANCLAY, F. Changes in the impact assessment family 2003–2014: implications for considering achievements, gaps and future directions. **Journal of Environmental Assessment Policy and Management.** v. 17, n. 1, 20 p., 2015. DOI: 10.1142/S1464333215500039

VENTUROLI, F. et al. Incremento de espécies arbóreas em plantio de recuperação de área degradada em solo de Cerrado no Distrito Federal. **Bioscience Journal**. Uberlândia – MG, v. 29, n. 1, p. 143-151, 2013.

VIANA, M. B.; BURSZTYN, M. A. A. Regularização ambiental de minerações em Minas Gerais. **Revista Escola de Minas**. Ouro Preto, v. 63, n. 2, p. 363-369, 2010.

ZANZINI, A. C. S. Avaliação comparativa da abordagem do meio biótico em Estudos de Impacto Ambiental no Estado de Minas Gerais. 2001. 225 p. **Tese (Doutorado)** – Escola de Engenharia de São Carlos, Universidade de São Paulo. São Carlos, 2001.

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Original Article

AVALIAÇÃO DA QUALIDADE DOS PROCESSOS DE LICENCIAMENTO AMBIENTAL DE EMPREENDIMENTOS DE MINERAÇÃO EM MINAS GERAIS

***Abstract*:** The environmental licensing has generated uncertainties about its effectiveness; making it necessary to encourage mechanisms to improve the political-institutional setting. Thus, this study aimed at evaluating the legal and technical concordances of the environmental licensing processes of mining enterprises in the south of the state of Minas Gerais. Using checklists, thirteen licensing processes were analyzed, where the pre- and post-approval stages were assessed. It was observed that the environmental studies didn't correspond to the terms of reference and the expected quality, as well as the noncompliance of the proponents regarding the approval of the environmental management reports. Therefore, it was concluded that there is a lack of technical performance of the analysts of the competent environmental agency and, therefore, it is necessary to improve the technical evaluation system of environmental studies as a tool to improve EIA processes.

Keywords: Environmental impact assessment; Environmental studies; Environmental control measures; Checklists.

***Resumo*:** O licenciamento ambiental tem gerado incertezas acerca de sua eficácia, tornando-se necessário incitar mecanismos de aperfeiçoamento, no cenário político-institucional. Assim, este estudo buscou avaliar as concordâncias legais e técnicas dos processos de licenciamento ambiental de minerações no Sul de Minas Gerais. Utilizando listas de verificação, treze processos de licenciamento foram analisados, onde se avaliou a fase de pré e pós-aprovação. Observou-se que, os estudos ambientais não corresponderam aos termos de referência e a qualidade esperada, assim como houve o descumprimento dos proponentes quanto à homologação dos relatórios de controle ambiental. Logo, concluiu-se que há uma carência no desempenho técnico dos analistas do órgão ambiental competente e, posto isto, faz-se necessário aprimorar o sistema de avaliação técnica dos estudos ambientais, como ferramenta de melhoria ao processo de AIA.

***Palavras-Chave*:** Avaliação de impacto ambiental; Estudos ambientais; Medidas de controle ambiental; Listas de verificação.

***Resumen*:** El licenciamiento ambiental ha generado incertidumbres acerca de su eficacia, por lo que es necesario impulsar mecanismos de perfeccionamiento en el escenario político-

-institucional. Este estudio tuvo como objetivo evaluar los acuerdos y las técnicas de los procesos de concesión de licencias ambientales de la minería legales en el sur de Minas Gerais. El uso de listas de control, se analizaron trece procedimientos de autorización, que evaluaron el pre y post-aprobación. Se observó que los estudios ambientales no correspondieron a los términos de referencia y la calidad esperada, así como hubo el incumplimiento de los proponentes ya la aprobación de los informes de control ambiental. Se concluyó que hay una carencia en el desempeño técnico de los analistas del órgano ambiental competente y, puesto que esto, es necesario mejorar el sistema de evaluación técnica de los estúdios ambientales, como herramienta de mejora del proceso de EIA.

***Palavras-Chave*:** Evaluación de impacto ambiental; Estudos ambientais; Medidas de control ambiental; Listas de verificación.