Impact Significance of offshore oil and gas industry in Brazil

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Introduction

The **impact significance** assessment is an essential step in Environmental Impact Assessment, aiming at determining what is important or acceptable. Significant impacts need to be adequately addressed, requiring commensurate mitigation, and being grounded on a robust baseline and impact prediction (Duarte and Sánchez, 2020). There is no "best" or "effective" procedure to significance determination - practice is variable and should be fit to context (Lawrence, 2007a; 2007b).

Offshore oil and gas (O&G) in Brazil is a prominent sector in the national energy matrix. Impacts are assessed for each major development phase: (i) seismic survey; (ii) drilling; and (iii) production and transportation of oil and natural gas (ARCADIS, 2020). The sector's projects depend on previous environmental licensing following the provisions stated by Ministry of Environment (MMA) Ordinance n° 422/2011. Guidance for determining impact significance of such activities was issued by the federal environmental agency Ibama (2012), but little is known about its actual application. In this paper, we review how impact significance is determined in environmental studies submitted to the environmental licensing process of offshore seismic surveys and drilling activities.

Methods

Eleven environmental studies of seismic surveys and drilling (comprising environmental impact statements and simpler environmental studies), available in the Ibama website[5], were selected for review, considering different periods of time (2010 to 2020), different consulting companies; and location in different sedimentary basins.

The documents were reviewed in search of evidence to respond to three questions: (1) How was the impact significance determination procedure defined in the environmental studies? (2) What are the most significant impacts arising from the seismic surveys and drilling? (3) Which valued social and environmental components are considered to be most impacted? Review criteria are described below.

1. How was the impact significance determination procedure defined in the environmental studies?

Based on the discussion presented by Lawrence (2007a) to evaluate the procedures for determining significance to be "*less biased and distorted, more grounded, more open, inclusive and collaborative, and more effectively linked to decision-making and EIA practice*", it was analyzed which approach (or combination of approaches) of determining impact significance was applied:

- *Technical approach*: application of a technical procedure (qualitative and/or quantitative) to progressively aggregate impact description categories or impact characteristics.

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- *Collaborative approach*: involvement of interested and affected parties to judge what is important.
- *Reasoned argumentation*: use of relevant data, knowledge, analyses, perspectives and preferences to focus, to interpret and to reach conclusions.

Subsequently, it was evaluated how the applied approaches meet the requirements for determining the significance of the impact presented by Sánchez (2020):

- *Transparency*: when there is a clear explanation of the criteria adopted to classify the significance of impacts.
- *Reproducibility*: when similar results can be obtained if the same criteria are applied by other team.
- *Representativeness*: when reflect the values and points of view of different interested parties.

2. What are the most significant impacts arising from the seismic surveys and drilling?
The impacts classified in the environmental studies of seismic surveys and drilling as high or medium importance were selected and compared.

3. Which valued social and environmental components are considered to be most impacted?
Analysis of which social and environmental components evaluated were considered the most impacted by each activity - seismic survey and drilling.

Results

Three environmental studies of seismic surveys and eight of drilling activities, prepared by eleven different consultancy firms in nine sedimentary basins were reviewed, as presented following.

1) How was the impact significance determined in the environmental studies?

The majority (8) of the environmental studies used a technical approach, by applying a procedure which involves the combination of attributes: (i) five studies cross magnitude and sensitivity of the component - or characteristics of the affected component or the affected area - to determine impact significance; (ii) three studies determine significance without considering the sensitivity of the component, by combining some attributes, which varied between the studies: severity and frequency/probability; spatial distribution and magnitude; and magnitude, spatial distribution, and duration.

To determine the magnitude, it was registered that one study does not explain its approach, but the others define magnitude in three different ways. In two studies, the magnitude was defined by the combination of attributes: permanence, spatial distribution, and frequency; or qualification, incidence, permanence/duration, moment/trigger, reversibility, spatial distribution, cumulative potential. In three other studies, magnitude was assessed by providing evidence about the intensity of the change (based on the results of both oil spill and fluids and drill cuttings dispersion modeling and the characteristics of the project) associated with mitigation and reversibility measures. Finally, two studies considered different criteria for changes for each component/environment. of fluids and drill cuttings

Only one study follows an argumentative approach, providing a text based on the expertise of multidisciplinary team professionals to justify the levels of significance. Another study used a combination of argumentation and technique, based on use of selected attributes to provide reasons for the significance of the impact. It is also noteworthy that for one recent study (2020) it was not possible to classify the approach, as there is no explanation of the methodological procedure applied and presents only an impact matrix, taking combining attributes to define

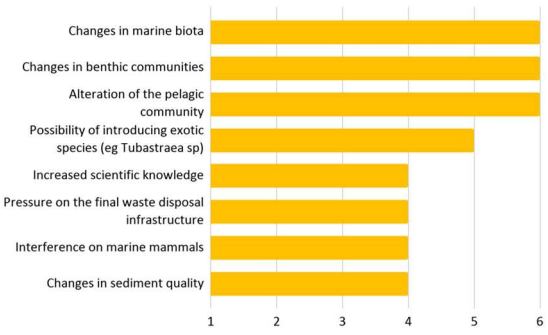
significance. However, by analyzing the results presented in the matrix, it is observed that there was no pattern of crossing the attributes to define the importance.

2 and 3) What are the most significant impacts arising from the seismic surveys and drilling? And Which valued social and environmental components are considered to be most impacted?

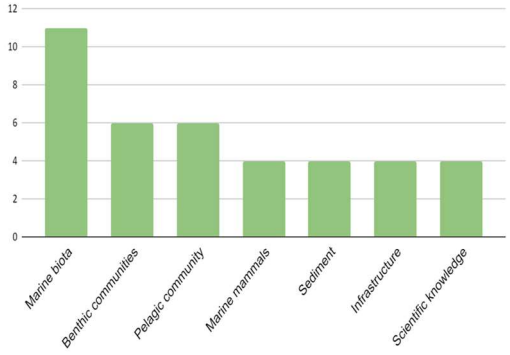
As directed by Ibama (2012), environmental studies always separate the impacts arising from the operation and those arising from accidents. In the analysis of impacts, there were 33 most significant impacts of the operation. Graph 1 shows the 8 most recurring impacts evaluated considering the 11 studies, of which: changes in marine biota, benthic communities and alteration of the pelagic community were recurrent in the studies. The impact of the increase in scientific knowledge draws attention as a significant impact. Among the most affected components (Graph 2), the different groups of marine biota stand out, either considered broadly (marine biota) or according to the characteristic of the occupation area (pelagic or benthic) or even by characteristics of the groups (mammals or turtles). The impact on the sediment is associated especially with the tailings disposal areas and is more frequent in drilling activities, with the generation of cuttings and fluids.

For the assessment of impacts resulting from accident scenarios, related to leaks or collisions between vessels, 35 impacts were listed as the most significant, of which: the change in water quality was mentioned in almost all studies, the impact on traditional artisanal fishing activity was also recurrent among the most significant (Graph 3). Marine biota has been recurrent in different studies, including plankton, benthic, fish and birds. For social factors, impacts mainly affect fishing activities, both due to the activity of the fishing industry and the fishing activity of traditional communities (Graph 4).

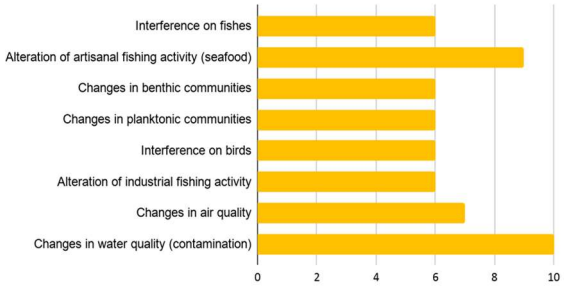
Graphic 1. Eight most significant operational impacts from seismic survey and drilling



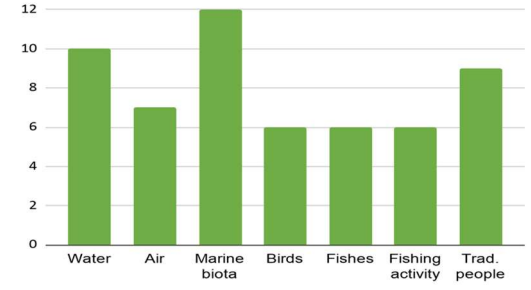
Graphic 2. Affected components related to operational impacts



Graphic 3. Eight most significant accident impacts from seismic survey and drilling



Graphic 4. Affected components related to the accident impacts



Discussion and conclusions

The eight studies that adopted the so-called technical approach have:

i) reasonable possibility of meeting the requirement of transparency, due to the clear explanation of what was considered to determine the impact significance in most studies, mainly represented by the combination of the attributes considering magnitude x sensitivity.

ii) low possibility of meeting the requirement of reproducibility, due to the subjectivity, lack of clear reasons, and coherence for some attributes to determine the impact significance. For example, the change in the sensitivity of each component related to the impacts assessed, resulting in different levels of significance.

iii) very low or no possibility of meeting the requirement of representativeness, due to the lack of participation or consultation of affected and interested parties to reflect values and points of view to support impact significance. Some representativeness can be addressed, if we consider that the compliance with the legislation reflects the society's demand, since the regulations direct society's values.

The reasoned argumentation approach used in one study features: i) low possibility of meeting the requirement of transparency, by only considering the professional judgment to determine the significance; ii) very low possibility of meeting the requirement of reproducibility, due to the subjectivity involved; iii) no possibility of meeting the requirement of representativeness, by the absence of values of interested parties.

The most significant impacts with greater recurrence in the environmental studies of the seismic survey are especially related to the relevant source of noise generation caused by the air gun, as presented by the Ibama (2003) on the seismic surveys impacts. The impacts on the biota are associated with behavioral change or physical injuries. It is important to note the lack of systematized databases in Brazil, which started to be developed only in the last decade, generating more concerns about biota on the coast.

Adding to this, it is noted that almost all environmental studies assessed the increase in scientific knowledge resulting from the feasibility study of the project, the acquisition of seismic data, and the preparation of environmental impact studies. This indicates a need for maturity for the environmental impact assessment process related to the offshore O&G sector.

The most significant impacts with greater recurrence in the environmental studies of drilling are related to the emission of fluids and drill cuttings and the intervention on the seafloor. The impacts are associated with the pressure in the areas of waste disposal and the loss of sediment quality. Those impacts agree with the presented in the Technical Note published by the federal environmental licensing agency, related to the impacts of drilling activities (Ibama, 2009).

We found that:

1. There is not a unique approach to the impact significance determination applied in the environmental licensing processes of the offshore O&G sector.
2. Within the technical approach, there is a preponderance of the combination of attributes to determine impact significance, especially considering “magnitude *versus* sensitivity of the affected component”. This is mostly influenced by technical notes issued by the licensing body (NT IBAMA n.5 /2009 and n. 10/2012).
3. The impacts evaluated as most significant match those presented in the Technical NT IBAMA n.5/2009 and Information ELPN/IBAMA n. 12/2003 of the federal environmental licensing agency.
4. The components most affected are those related to the characteristics of the Brazilian coast (high biodiversity, with routes of reproduction and migration of mammals and

turtles, as well as the presence of traditional fishing communities that exploit fish as a subsistence food resource).

5. Impact significance determination in the environmental studies of offshore O&G sector still deserves progress and better understanding to enable greater reproducibility. Improvements could be achieved by changing individual approaches to composite approaches, as discussed by Lawrence (2007a), in different ways, such as associating technical and collaborative approaches (public participation is increased and greater understanding is achieved). Another possible approach is to support the technical approach with argumentation, based on experienced teams.

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