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Impacts of offshore wind farms: significant for whom?

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ABSTRACT

Significance determination is one of the most complex and least understood elements of Environmental Impact Assessment (EIA). In offshore projects, especially in sensitive coastal zones, this task becomes even more critical. This study evaluates the quality of significance determinations in Environmental Impact Statements (EISs) for offshore wind projects. A purposive sample of 11 EISs from England, Scotland, the United States, and Brazil was analyzed using criteria drawn from three recognized review protocols. The evaluation focused on three dimensions: clarity in communicating 'what' is considered significant, 'how' significance was determined, and 'for whom' the impact is significant. Findings reveal a consistent lack of clarity regarding for whom impacts are significant, as none of the EISs explained if or how community perspectives influenced judgments. While some aspects of what and how were addressed, other weaknesses emerged: lack of distinction between facts, assumptions, and professional judgments; limited disclosure of uncertainty; and insufficient consideration of social values. These issues were especially pronounced in Brazilian EISs, where they were compounded by conceptual and methodological gaps. Overall, practice appears to remain technically led, limiting EIA's potential as a participatory and deliberative tool. The study highlights the need for context-sensitive, participatory approaches and clearer communication in significance determination.

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1. Introduction

Offshore wind energy has emerged as a key pillar of the global energy transition (Couce Montero et al. 2025), experiencing rapid growth driven by the pursuit of low-carbon development and energy security (Esteban et al. 2011). Its strategic relevance extends beyond decarbonization, contributing to national energy resilience by reducing reliance on geopolitically sensitive and imported fossil fuels. The sector is projected to expand significantly, with a compound annual growth rate of 27% between 2025 and 2030, and annual installations are expected to quadruple by 2030 compared to 2024 levels (GWEC 2025). This expansion, once concentrated in traditional markets, now reflects a broader global trend. Emerging economies such as Brazil exhibit substantial technical potential (de Vasconcelos et al. 2022; World Bank Group 2025), estimated at 1200 GW (GWEC 2025), positioning them as new frontiers for offshore wind development. In light of this expansion and the increasing complexity of offshore wind projects, assessing their environmental impacts is essential to ensuring development proceeds in a fair and sustainable manner (Laurino et al. 2025).

Within this context, Environmental Impact Assessment (EIA) plays a vital role as a decision-support tool for evaluating proposals likely to cause significant adverse environmental impacts (Rozema et al. 2012). EIA has been widely adopted worldwide to foster sustainable development, integrate environmental considerations into planning, and enhance democratic governance (Bond et al. 2022). At the project-level, it aims to embed the informed consideration of environmental impact significance into decision-making processes (Bond et al. 2024). Over the past decades, EIA has gained international recognition as a foundational tool for promoting sustainable development and remains the most commonly applied instrument for environmental decision-making (Yang 2019).

A central function of EIA is to identify and communicate the likely significant impacts of proposed developments to decision-makers and stakeholders (Wood 2008). The determination of impact significance is therefore a core component of EIA process (Fonseca et al. 2020; Aaen et al. 2022; Gómez-Priego and Bojórquez-Tapia 2023), informing each phase, from screening and scoping to impact analysis, consultation, regulatory review, and post-approval follow-up (Ross et al. 2006).

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The Environmental Impact Statement (EIS) is the principal technical output of the project-level EIA process and plays a central role in both environmental decision-making and project permitting (Candiani et al. 2025). It serves not only as the basis for analyzing the predicted environmental impacts, but also as the primary vehicle for communicating their potential significance to decision-makers and stakeholders (Bond et al. 2024). Therefore, the quality of information presented in EIS is critical and is often used as a criterion for assessing the effectiveness of EIA (Bond et al. 2018; Veronez and Montaño 2024). Beyond completeness, EIS content should be coherent and logically structured, with clear justifications for impact significance determinations based on baseline conditions, project characteristics, predicted magnitudes, and proposed mitigation measures (Duarte and Sánchez 2020). In addition, the EIS is expected to communicate 'what' is considered significant, 'how' significance was determined, and 'for whom' the impact is significant (Lawrence 2007a, 2007b). Nonetheless, the practical utility of EIA outputs has long been subject to criticism (Ross et al. 2006; Pazhoor et al. 2025). Concerns include poor EIS quality (Anifowose et al. 2016), weaknesses in the determination of impact significance (Rozema et al. 2012), limited public participation (Rozema et al. 2012; Hasan et al. 2018), and the potential manipulation of findings (Enríquez-de-Salamanca 2018) all compromising the identification of mitigation measures and, as a consequence, the internalization of project externalities and the assessment of the project acceptability.

Although the literature on significance determination is substantial (Noble 2020), few empirical studies have investigated how the meaning of significance is negotiated and communicated in practice through EIS (Lyhne and Kørnøv 2013). To address this empirical gap, this study evaluates the quality of significance determinations in EISs for offshore wind projects. A total of 11 EISs were reviewed, covering both mature and emerging offshore wind markets. The following section discusses the concept and challenges of significance determination. Section 3 outlines the methodology, Section 4 presents and critically analyzes the findings, and Section 5 concludes by summarizing key results and identifying opportunities for improving practice and future research.

2. Significance determination in the EIA process

The EIA process translates predicted environmental impacts into statements that inform decision-makers and stakeholders about their potential significance. This involves synthesizing project characteristics, the nature and magnitude of impacts, and the sensitivity and value of the receiving environment (Therivel 2004). Significance, therefore, is a foundation concept in EIA. It defines the threshold for triggering formal assessment during screening and guides the selection of key issues and alternatives during scoping (Lyhne and Kørnøv 2013). Determining significance begins at the earliest stages of the EIA process, when deciding whether a proposal requires assessment, and continues throughout scoping, impact prediction, mitigation planning, and follow-up (Wood 2008; Noble 2020). However, uncertainties related to prediction methods and data quality often complicate interpretations of what is considered significant (Sadler 1996). Therefore, determining whether and why an impact matters is a fundamental step in judging project acceptability (Duarte and Sánchez 2020). This requires consideration of social values and community perspectives (Vanclay 2003; Lawrence 2007b, 2007c; Andrade and Turra 2021; Pazhoor et al. 2025) especially because negative impacts are generally concentrated in the local scale (Gonçalves et al. 2020).

Despite being a foundational element of EIA, the concept of significance carries inherent complexities that complicate its determination. Although widely acknowledged as a core component of EIA (Lyhne and Kørnøv 2013; Ehrlich and Ross 2015), significance determination remains among its most debated and least understood aspects (Ross et al. 2006; Lawrence 2007c; Wood 2008; Noble 2020). Since the 1980s, scholars have highlighted the need to understand how significance is determined in practice (Duinker and Beanlands 1986; Lawrence 2003; Ehrlich and Ross 2015; Noble 2020). This difficulty arises from the subjective nature of the concept, the uncertainties involved, and the influence of diverse, and often conflicting, values and interests (Gómez-Priego and Bojórquez-Tapia 2023). Contextual factors, such as spatial and temporal scales, ecological and social vulnerability, ethical values, economic priorities, and institutional arrangements, further complicate judgments (Wood 2008). As a result, what may be considered significant in one context may be perceived as negligible in another (Lawrence 2003). These difficulties are intensified by information gaps and methodological limitations, making the determination of significance both essential and elusive.

Building on the conceptual difficulties, one core challenge is deciding whether the expected impacts of a project are indeed 'significant' (Lawrence 2007c; Ehrlich and Ross 2015; Noble 2020). Although several principles exist, the assessment is not purely technical; it is shaped by stakeholder perceptions, social values, institutional norms, and the personal values and judgments of the assessors themselves (Noble 2020). Judgments may vary across time, place, and communities (Lawrence 2007c). While the magnitude, duration, and reversibility of impacts are central to determinations, significance is inherently context-dependent (Lawrence 2007b). Duinker and Beanlands

(1986) present four perspectives that help frame these judgments: statistical, ecological, social, and project-based. EIS review protocols emphasize that significance determination should incorporate factors such as magnitude, duration, and location of impacts, as well as the sensitivity, rarity, and value of affected resources (see Lee and Colley 1992; European Commission 2017; Glasson et al. 2019). The protocol of Lee and Colley (1992) also calls for incorporating local community values into the determination process.

In essence, significance determination involves two key components: measuring the impact and interpreting its meaning (Noble 2020). This interpretative process involves applying societal values and informed judgment to assess whether predicted impacts are acceptable (Ehrlich and Ross 2015). Engaging stakeholders in this judgment process helps reduce conflict and opposition (Pazhoor et al. 2025). Lawrence (2007b) argues that no single method is sufficient; rather, a composite, context-dependent approach is needed. Such an approach combines technical, collaborative, and reasoned argumentation, enabling practitioners to offset the limitations of any one method and arrive at more robust conclusions.

In practice, however, turning the concept of significance into a clear and communicable evaluation remains highly problematic. Although the guiding principle for preparing an EIS seems straightforward, aiming to summarize environmental impacts, mitigation measures, the significance of residual impacts, and required follow-up (Ross et al. 2006), experience shows that determining and communicating significance remains one of the weakest aspects of practice (Wood 2008; Noble 2020). The challenge lies not in grasping the concept but in operationalizing it. When the basis for significance is vague or poorly defined, the quality of EISs suffers, undermining the effectiveness of the broader EIA process. For instance, during screening and scoping, imprecise criteria may lead to unnecessary assessments, inflated studies, and misdirected efforts (Snell and Cowell 2006). Reviews of EISs often note the absence or ambiguity of methods for assessing significance (Sandham et al. 2020). Transparency in how judgments are made, and how decisions involving major effects are justified, is essential (Bond et al. 2024). EISs should clearly communicate: (i) which impacts are considered significant (including residual ones); (ii) the methods, assumptions, and professional judgments used; and (iii) the rationale for conclusions (Lee and Colley 1992; European Commission 2017; Glasson et al. 2019). There is a strong link between the procedural robustness of EIA and the information quality of EIS (Zhang et al. 2013), with effectiveness depending on the clarity, analytical rigor, and coherence of the information presented (Malepe et al. 2022).

3. Methodology

This study employed a qualitative document analysis to evaluate the quality of significance determinations in EISs for offshore wind projects in target countries. A set of criteria was applied, based on three internationally recognized EIS review protocols.

3.1. EIS selection

We analyzed EISs from England, Scotland, the United States, and Brazil, selected based on two main criteria: (i) availability of EIS written either in English or in Portuguese, and (ii) the strategic relevance of these countries in the global offshore wind sector as both, mature and emerging markets (GWEC 2025).

England and Scotland, as part of the United Kingdom, represent mature markets with a long history of offshore wind projects and well-established mitigation practices, making them suitable for examining current assessment practice (Durning and Broderick 2019). The United States represents a prominent market where challenges related to gaining social license to operate are particularly evident (GWEC 2025). Brazil, in contrast, is an emerging market with considerable technical potential and a recently formalized offshore wind regulatory framework (Brazil 2025b; GWEC 2025). Across these jurisdictions, EIA systems are also advancing through offshore wind-specific rules and guidance, aiming to better address the sector's distinctive environmental and social impacts (Dibo et al. 2025; Siqueira-Gay et al. 2025).

To capture current practices in significance determination, we used a purposive sampling strategy to select EISs (Table 1). Documents available as of July 2024 were retrieved from official EIS repositories in England (2025), Scotland (2025), the United States (2025), and Brazil (2025a, 2025c), based on two inclusion criteria: (i) recency, and (ii) diversity of consulting firms. Four EISs from England and two from Scotland met the inclusion criteria: only EISs prepared in 2024 by different consulting firms were considered. In the United States, where all EISs are produced by the Bureau of Ocean Energy Management (BOEM) – the federal agency responsible for managing developments in the U.S. Outer Continental Shelf – we selected the three Final Environmental Impact Statements (FEISs) published until July 2024. In Brazil, only two EISs were identified (from 2019 and 2021), and both were included. The URLs for accessing all documents listed in Table 1 are provided in Supplementary Material.

Consistent with previous research on EIA/EIS quality and practice (Gontier et al. 2006; Karlson et al. 2014), we used purposive sampling to enable an exploratory comparison of how significance is determined across contrasting institutional contexts, aiming to capture

Table 1. Characteristics of the EISs analyzed.

Country	ID	Year	Entity responsible for EIS preparation	Project name	Number of turbines*	Installed capacity (MW)*
England	EN1	2024	GoBe Consultants	Five Estuaries Offshore Wind Farm	79	> 100
	EN2	2024	Royal Haskoning DHV	Morecambe Offshore Windfarm Generation Assets	30–35	~480
	EN3	2024	SLR Group	Outer Dowsing Offshore Wind	Up to 100	1,500
	EN4	2024	RWE	Dogger Bank South Offshore Wind Farms	Up to 200	3,000
Scotland	SC1	2024	RPS Group	Ossian	Up to 265	2,600
	SC2	2024	ERM	Salamander Offshore Wind Farm	Up to 7	100
USA	US1	2024	Bureau of Ocean Energy Management	New England Wind 1 and 2	Up to 129	~2,600
	US2	2024		Atlantic Shores Offshore Wind South	Up to 200	2,837
	US3	2024		Maryland Offshore Wind	Up to 121	~2,200
Brazil	BR1	2019	Ten Project Estudos e Projetos de Energia Brasil	Caucaia Offshore Wind Farm	59	598
	BR2	2021	Energo Engenharia e Consultoria	Dragão do Mar Offshore Wind Complex	128	1,216

*The information regarding the number of turbines and the installed capacity of each project was obtained from the EIS.

variation in recent practice within the offshore wind energy sector. Accordingly, the sample should be read as illustrative of approaches observed at the time of analysis, not as statistically representative of offshore wind EIA practice in each country.

Other criteria could also be used to select EISs for quality review studies, depending on the research objectives and data availability. For example, some studies have applied random sampling from a defined population of EISs within a given time period (e.g. Peterson 2010; Kabir and Momtaz 2012). Other authors have selected a fixed number of EISs per year from comprehensive repositories, ensuring temporal coverage while limiting sample size (Kamijo and Huang 2016). An alternative approach consists of analyzing the full universe of EISs associated with a specific project type (Candiani et al. 2025), within a national or subnational jurisdiction (Cele 2022), or across an entire EIA system over a defined time frame (Veronez and Montaño 2024), while a cross-temporal sample of EISs of mining projects prepared by the same consultancy was used by Landim and Sánchez (2012) to investigate possible changes over time.

3.2. Review protocols and analytical approach

EIS quality review studies commonly draw on one of three internationally recognized protocols: Reviewing the Quality of Environmental Statements (Lee and Colley 1992), which contains 52 criteria; the Environmental Impact Statement Review Package (Glasson et al. 2019), with 99 criteria; and the Guidance on the Preparation of the Environmental Impact Assessment Report (European Commission 2017), with 176 criteria. These protocols represent established best practices in EIA. Although they address similar themes, they vary in structure and level of detail. Regarding significance determination, each protocol offers distinct strengths. For example, Lee and Colley (1992) is the only one that explicitly recommends discussing significance from the perspective of affected communities and society in general. Glasson et al. (2019), in turn, includes criteria that consider the effects on local communities, although this may reflect a technical rather than participatory viewpoint. This protocol also uniquely requires a clear distinction between fact, assumption, and professional judgement.

These differences motivated the development of a unified set of criteria based on all three protocols, focusing solely on items directly related to significance determination. The full set of criteria and their correspondence with the original protocols are presented in Table 2. No items were added or excluded, only reorganized and rephrased for clarity and transparency. Each item was framed as a direct question to facilitate interpretation and improve usability and grouped into three categories: (i) clarity in communicating what is considered significant, (ii) clarity in communicating how significance was determined, and (iii) clarity in communicating for whom the impact is significant.

In terms of assessment format, all three protocols adopt a qualitative grading scale (A to F), but several studies have highlighted the difficulty of applying these scales in practice due to the subjectivity involved in interpreting qualitative judgments (McGrath and Bond 1997; Sandham and Pretorius 2008; Põder and Lukki 2011). We opted to categorize the evaluation using three levels: 'met', partially met', or 'not met'. This reformulation aimed to reduce subjectivity and enhance practical applicability, both for future research and for EIA practitioners, while maintaining alignment with established methodological frameworks.

All EISs were evaluated by one of the authors with prior experience in EIS quality review to ensure consistency in the application of the criteria. To enhance reliability and minimize potential bias, five EISs (45%) were randomly reanalyzed by the same expert after a time interval. This single-reviewer design with partial

Table 2. Set of criteria and their correspondence with criteria from international review protocols on significance determination.

Criterion	Correspondence with international protocols*		
	Lee and Colley (1992)	European Commission (2017)	Glasson et al. (2019)
Clarity in communicating what is considered significant			
1. Is it clearly stated which impacts are considered significant and which are not?	2.5.1	3.30	4.13
2. Is a justification provided for why impacts are considered significant or not?	2.5.3	3.36	4.13
3. Is the significance of residual impacts (where mitigation is proposed) clearly evaluated and described?	2.5.1	5.2	6.5
Clarity in communicating how significance was determined			
4. Does the determination of significance consider the nature of the impact (e.g. magnitude and duration) and the sensitivity or value of the affected component?	2.5.2	3.31	4.11
5. Is the basis for determining significance clearly described (e.g. assumptions, value judgments, or criteria used) and justified?	2.5.3	3.36	4.9
6. Are legal or policy requirements, environmental standards, or technical guidelines used in the significance evaluation? Where no formal standards exist, are alternative approaches or justifications provided?	2.5.2	3.31	4.10/4.11
7. Is there a clear distinction between facts, assumptions, and professional judgement?	_	_	4.10
8. Is uncertainty explicitly acknowledged and discussed in the evaluation of impact significance?	_	3.33/3.34	4.4
Clarity in communicating for whom the impact is significant			
9. Is the significance of impacts discussed from the perspective of the affected community and society in general?	2.5.1	_	4.8
10. Are local or societal values explicitly considered when evaluating impact significance?	2.5.2	3.30	4.11/4.8

*Codes refer to the number of each criterion in the original document.

reanalysis has been adopted in several studies (Anifowose et al. 2016; Gwimbi and Nhamo 2016; Veronez and Montaño 2024). For comparison, previous applications of this approach used reanalysis rates of approximately 14% (Gwimbi and Nhamo 2016), 32% (Anifowose et al. 2016), and 67% (Veronez and Montaño 2024).

4. Results and Discussion

The results of applying the set of criteria are presented in Table 3. Significance determination in EISs from England, Scotland, and the United States generally met or partially met the criteria across the three analyzed categories, indicating higher quality compared to those from Brazil. However, a common gap was identified across all the EISs: the lack of consideration of affected communities' perspectives in determining impact significance. Even in cases where public consultation was clearly documented, none of the EISs explained whether, or how, community concerns were reflected in significance judgments. This omission, rooted in a technical-rational paradigm, aligns with what Costanzo and Sánchez (2019) describe as a technicist model of impact assessment, in which expert judgment dominates and stakeholder input is marginal, contrasting with more deliberative approaches that emphasize inclusive dialogue and the integration of community perspectives. It is a technicist approach that risks producing socially incomplete or flawed evaluations (Rozema et al. 2012). Three additional weaknesses were also identified. In England, Scotland, and the United States, these weaknesses were partially addressed, whereas, in Brazil, they were not addressed at all. These weaknesses include the lack of clear distinction between facts, assumptions, and professional judgments; the absence of uncertainty disclosure; and the insufficient integration of social values. When these aspects were not consistently addressed across environmental components, the EISs in this group received 'partially met' ratings, while the Brazilian EISs received 'not met' ratings because these aspects were entirely absent.

Brazilian EISs were consistently rated lower than those from the other countries. A relatively weaker performance could be expected, given that EIA systems tend to become more effective over time as institutional maturity develops (Veronez and Montaño 2024). However, the deficiencies observed in the Brazilian documents go beyond what might be attributed to limited procedural experience; they reflect deep conceptual and substantive weaknesses in the foundations of significance determination, a problem also identified in previous studies on practitioners' perceptions of EIA in Brazil (Duarte et al. 2017). Importantly, these weaknesses are closely connected to structural problems in EIA teaching in the country, where undergraduate programs often provide only a reductionist and incomplete view of the assessment process, which has been shown to negatively influence EIA practice and contribute to a persistent cycle of poor-quality assessments (Almeida et al. 2022). This concern is relevant for offshore wind projects – the focus of this study. Inadequate determinations of significance in these EISs may result in a disconnect between government approval and social acceptance.

None of the Brazilian EISs achieved a satisfactory rating, with many key elements either inadequately addressed (criteria partially met) or entirely missing (criteria not met). Methodological choices, evaluation criteria, assumptions, and underlying value systems were not disclosed in any of the analyzed EISs.

Table 3. Results of applying the set of criteria on significance determination.

Criterion	England				Scotland		United States			Brazil	
	EN1	EN2	EN3	EN4	SC1	SC2	US1	US2	US3	BR1	BR2
1. Is it clearly stated which impacts are considered significant and which are not?	met	met	met	met	met	met	met	met	met	partially met	partially met
2. Is a justification provided for why impacts are considered significant or not?	met	met	met	met	met	met	met	met	met	not met	not met
3. Is the significance of residual impacts (where mitigation is proposed) clearly evaluated and described?	met	met	met	met	met	met	met	met	met	not met	not met
4. Does the determination of significance consider the nature of the impact (e.g., magnitude and duration) and the sensitivity or value of the affected component?	met	met	met	met	met	met	met	met	met	not met	not met
5. Is the basis for determining significance clearly described (e.g., assumptions, value judgments, or criteria used) and justified?	met	met	met	met	met	met	met	met	met	not met	not met
6. Are legal or policy requirements, environmental standards, or technical guidelines used in the significance evaluation? Where no formal standards exist, are alternative approaches or justifications provided?	met	met	met	met	met	met	met	met	met	not met	not met
7. Is there a clear distinction between facts, assumptions, and professional judgement?	partially met	partially met	partially met	partially met	partially met	partially met	partially met	partially met	partially met	not met	not met
8. Is uncertainty explicitly acknowledged and discussed in the evaluation of impact significance?	partially met	partially met	partially met	partially met	partially met	partially met	partially met	partially met	partially met	not met	not met
9. Is the significance of impacts discussed from the perspective of the affected community and society in general?	not met	not met	not met	not met	not met	not met	not met	not met	not met	not met	not met
10. Are local or societal values explicitly considered when evaluating impact significance?	partially met	partially met	partially met	partially met	partially met	partially met	partially met	partially met	partially met	not met	not met

Moreover, environmental sensitivity was not considered in the determination of significance, and none of the EISs included an assessment of the significance of residual impacts. Notably, one EIS (BR1) did not include any significance analysis at all, merely classifying impacts as 'significant' or 'not significant' without explanation. This alarming analytical gap was also reported by Veronez and Montaño (2024), who identified similar poor-quality information on significance determination in Brazilian EISs. As a result, significance judgments appear to have been made under uncertain and incomplete conditions (Noble 2020). The lack of transparency regarding evaluative assumptions creates space for distorted assessments that may overstate benefits or downplay impact significance (Enríquez-de-Salamanca 2018), compromising a just energy transition.

4.1. Limitations in significance determination

Although significance determination is both a technical and social process (Aaen et al. 2022), the EISs reviewed revealed a predominantly technically led understanding of significance, with minimal integration of social values. While EISs from England, Scotland, and the United States presented community profiles and documented public consultation, none explicitly demonstrated whether or how those concerns influenced significance judgments. Two hypotheses may explain this gap: (i) public concerns were collected but not considered into determination process; or (ii) they were considered but not reported in the EISs. The first hypothesis reflects a coherence failure, compromising the information and, consequently, the credibility and effectiveness of the EIA process (Duarte and

Sánchez 2020), while the second represents a communication failure. Both undermine transparency and reduce the EIA's utility for decision-makers and stakeholders.

There is broad agreement among scholars that lack of clarity in significance determination is a persistent weakness of EIA, arising both from the subjectivity and inadequacy of commonly used methods and from poor communication of results (Nita et al. 2022). Regardless of the cause, the lack of transparency in how social values are considered (or excluded) constitutes more than a technical flaw; it is a systemic vulnerability. This opacity creates opportunities for stakeholders to influence outcomes based on private interests, thereby undermining the legitimacy EIA (Enríquez-de-Salamanca 2018). Lele (2023), among others, argues that EIA not only tends to overlook certain environmental impacts but, more critically, fails to acknowledge and address the disproportionate impacts on marginalized communities. This suggests a deeper disregard for equity and people-centered decision-making.

The active involvement of affected communities in the significance determination process has been widely advocated (Aaen et al. 2022). Such engagement contributes to a more grounded and context-sensitive interpretation of what is considered significant (Rozema et al. 2012), and improves the quality of information produced by the EIA (Hasan et al. 2018). Participation must go beyond procedural formalities; it should substantively inform decision-making by incorporating local knowledge and values (Rozema et al. 2012), especially in the context of offshore wind expansion (Gorayeb et al. 2024). In particular, the impacts on coastal communities and fisheries activities are broadly discussed in the context of offshore wind developments (Watson et al. 2024) requiring proper consideration of values and perceptions of these impacted communities. Moreover, communities potentially affected by offshore wind developments may also include communities of place, communities of interest, tourism-related actors, and maritime users, such as shipping and other potential users of the seabed. Therefore, recognizing that different stakeholders may hold diverse, yet equally legitimate, understandings of significance is essential (Ross et al. 2006).

In this context, deliberative tools such as Deliberative Mapping (Rozema et al. 2012), offer valuable mechanisms for bridging conflicting perspectives. These tools promote structured dialogue between experts and affected communities, transforming significance determination from a purely technical procedure into a socially constructed process. Such approaches shift EIA from a top-down, expert-driven process to one that is participatory and responsive to local realities. The call for integrating multiple perspectives into significance determination is echoed in the work of Lawrence (2007b, 2007c), who proposes a composite, context-sensitive framework combining scientific criteria with social values. His approach highlights the importance of structured dialogue and collaborative learning as essential strategies for achieving consensus, especially in conflict-prone settings. These recommendations reinforce the idea that significance should be determined through a process that integrates multiple forms of knowledge, rather than relying solely on technical parameters, and perhaps represent a pathway toward meaningful participation in EIA process emphasized by Fonseca and Fitzpatrick (2024). In support of this need, Rozema et al. (2012) provided compelling evidence of cases in which technical significance assessments diverged from community perceptions, underscoring the limitations of technocratic models and the importance of socially inclusive evaluation frameworks.

Although such participatory approaches are widely supported in the literature (Aaen et al. 2022), they remain largely theoretical. EIA systems appear not to have fully learned how to operationalize them in practice. This disconnect raises important questions: does it make sense to conduct public consultation if the perspectives gathered are not clearly reflected in significance judgments? Are environmental authorities requiring such consideration, or is it simply not being documented in the EISs? While the present study does not evaluate terms of reference or technical reviews, the consistent absence of these linkages in the analyzed EISs suggests that this requirement may not be sufficiently emphasized by regulatory agencies. These findings point to the need to reinforce the role of participation in EIA and ensure a more explicit connection between participation and significance determination.

Beyond the challenges of participation and methodological pluralism, the effectiveness of EIA also depends on how clearly its findings are communicated. Bond et al. (2024) emphasize the importance of effectively transferring EIA findings from the EIS to decision-makers and other stakeholders. Ideally, this communication should be clear, focused, and transparent (Ross et al. 2006). However, the use of overly complex, exaggerated, or incomplete information can hinder effective communication by diverting attention away from what truly matters (Enríquez-de-Salamanca 2018). For communication to be effective, it must enable readers to generate meaning, not merely access data. Overly technical language, excessively long documents, and biased content undermine the communicative value of the EIA (Bond et al. 2024). According to Lawrence (2007b), for significance determination to be meaningful, it must go beyond technical justification and include a rationale that is clear, relevant, and accessible to all interested parties.

Another communication gap relates to the treatment of uncertainty. Most of the EISs analyzed failed to clearly disclose uncertainties associated with the impact assessment. This omission may result in decisions based on flawed or incomplete information, with unintended environmental consequences. Moreover, democratic influence over decision-making may be weakened when relevant information is withheld or obscured (Tennøy et al. 2006).

Despite these limitations, EISs from England, Scotland, and the United States exhibited a consistent pattern of internal coherence. In these documents, there was a clear alignment between the baseline information provided and the criteria used to determine impact significance. By contrast, the Brazilian EISs showed a marked disconnect: although they presented extensive baseline data, much of it was not integrated into significance determinations. This gap, observed specifically in the Brazilian EISs, compromises the overall quality of the assessment and may create opportunities for manipulation. As Enríquez-de-Salamanca (2018) warns, such inconsistencies can be exploited to influence outcomes in ways that conflict with democratic principles. When coherence is lacking, the EIA process risks becoming performative, appearing participatory and evidence-based while, in practice, serving strategic or political interests. In such cases, the EIA no longer functions as a space for deliberation, learning, and legitimacy-building (Rozema et al. 2012), but instead becomes a battleground where information is instrumentalized, participation is symbolic, and outcomes are shaped by power dynamics rather than the pursuit of better socio-environmental solutions.

4.2. Communication challenges and transparency gaps

This risk is closely tied to a deeper methodological challenge: identifying the value attributed to environmental components. This inherent subjectivity can be misused by stakeholders to manipulate assessments in their favor (Enríquez-de-Salamanca 2018). For example, a stakeholder may intentionally downplay the value of a component to diminish the perceived importance of an impact, or exaggerate an effect to justify an alternative. Most of the researchers interviewed by Nita et al. (2022) agreed that methods for predicting impacts are often inadequate or overly simplistic, and interpretations tend to be subjective. In our study, we also observed that lack of clarity extended to how significance determinations were communicated. This lack of transparency hinders stakeholders, including decision-makers, from understanding the basis upon which judgments about significance were made.

Paradoxically, the subjectivity often regarded as a flaw of EIA can also be one of its most constructive features. Wilkins (2003) argues that, instead of attempting to eliminate subjectivity, it should be embraced as a catalyst for public discourse. Such dialogue may foster social learning, helps develop long-term community values, and contributes to achieving sustainable development goals. From this perspective, public participation, and the deliberation it enables, is a critical factor in legitimizing EIA. It is not enough to simply 'listen' to stakeholders; the EIS must clearly communicate how, and to what extent, public input was considered in significance determinations (Rozema et al. 2012). Thus, articulating the constructive use of subjectivity in straightforward methods for determining significance remains a challenge, as noted by Ehrlich and Ross (2015). The EIA process must evolve toward genuine stakeholder involvement, with public participation integrated throughout, from baseline analysis to final significance judgments (Nita et al. 2022). We reaffirm that many of the deficiencies in significance determination can be mitigated by improving communication and by placing affected communities at the center of the process, as suggested by Aaen et al. (2022). One promising strategy is the WeValue InSitu approach proposed by Pazhoor et al. (2025), which facilitates the identification of shared social values in specific local contexts, providing concrete support for assessing which impacts matter most to those affected.

Finally, as recommended by Lawrence (2007b), combining multiple approaches to significance determination can help practitioners and stakeholders better understand their needs and select the most appropriate strategies and their possible combinations. This balance is essential to strengthening both the procedural quality of EIA and the legitimacy of the decisions it informs.

5. Conclusion

This study evaluated the quality of impact significance determinations in EISs for offshore wind projects by applying a set of criteria organized around three dimensions: clarity in communicating 'what' is considered significant, 'how' significance was determined, and 'for whom' the impact is significant. This framework allowed for a structured examination of the transparency, coherence, and inclusiveness of current EIA practice.

The results indicate that, although current practice demonstrates some degree of clarity in communicating 'what' is considered significant and 'how' significance was determined, there is a gap of clarity in communicating 'for whom' the impact is significant. Across all EISs analyzed, the perspectives of affected communities were absent from the rationale used to define significance. Although public consultation was formally conducted in many cases, EISs failed to indicate whether (or how) community concerns influenced

the judgment made. When the significance of impacts is defined without integrating the perspectives of affected communities, EIA risks becoming a technocratic exercise disconnected from social realities. This not only undermines the credibility and transparency of environmental decision-making but also reduces the potential for EIA to function as a tool for fairness, learning, and democratic governance.

In addition to this core gap, the analysis revealed three weaknesses: a lack of distinction between facts, assumptions, and professional judgment; limited disclosure of uncertainty; and insufficient consideration of social values. These limitations compromise the communicative quality of significance determinations. In the Brazilian cases, the poor quality of EISs was particularly pronounced, reflecting deeper conceptual and methodological deficiencies. These findings highlight a vulnerability of the Brazilian EIA process.

From a practical standpoint, there is a clear need to establish more structured and transparent spaces for public participation within the EIA process, especially in how those contributions inform significance determination. Participatory components should be designed not only to gather input but to link it directly to impact evaluation criteria and justification. Addressing this challenge will require a shift in both practice and institutional culture. There is a pressing need for methodological approaches that are participatory, context-sensitive, and capable of incorporating diverse knowledge systems. At the same time, overcoming barriers such as limited resources, political resistance, and lack of guidance will be essential for advancing change.

This study was designed to explore and illustrate how significance is determined and communicated in recent offshore wind EISs across contrasting regulatory settings; it was not intended to provide an exhaustive characterization of national practice. The purposive sample and language constraint (English/Portuguese) may omit relevant variation within countries and across project types. Findings should therefore be read as indicative of recurring patterns and communication gaps observed in the sampled EISs, with the expectation that practice is heterogeneous within each jurisdiction.

Future research should focus on testing and refining participatory significance determination methods in EIA practice. Such efforts can help bridge the gap between expert-driven assessments and the values of those most affected by environmental decisions. Ultimately, improving how significance is defined and justified is not just a technical concern, it is central to making EIA more legitimate, inclusive, and responsive in an increasingly complex world. Further investigation is also needed into the role of regulatory agencies. Examining terms of reference and technical review reports may help clarify whether criteria related to the 'what', 'how', and 'for whom' of significance are being effectively required (or overlooked). This line of inquiry may offer critical insights into the institutional drivers behind technically led tendencies in current EIA practice.

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