

9-30-2023

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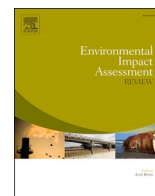


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10.1016/j.eiar.2023.107210

de Oliveira, A. R., Bento, S., Partidário, M., & Morrison-Saunders, A. (2023). Understanding stakeholder experiences with visual communication in environmental impact assessment. *Environmental Impact Assessment Review*, 102, article 107210. <https://doi.org/10.1016/j.eiar.2023.107210>

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Understanding stakeholder experiences with visual communication in environmental impact assessment

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ARTICLE INFO

Keywords:

Visual communication
Public engagement
Visual literacy
Co-design
Environmental impact assessment

ABSTRACT

Visual communication is widely and commonly used in environmental impact assessment (EIA) practice by all stakeholders. It includes maps, photographs, tables, info-graphics and other images used in environmental impact statements, as well as videos and graphics in online materials or in face-to-face consultation sessions (e.g., posters and PowerPoint presentations). The purpose of this research was to understand the practice of visual communication in EIA, focusing upon the perceptions and experiences of stakeholders. Surveys were conducted with international EIA practitioners along with observations of consultation sessions for three EIA projects in Portugal and interviews with proponents, regulators and members of the public involved. Specific focus was on (i) understanding stakeholder perspectives on the advantages and disadvantages of visual communication in EIA; (ii) proponent perceptions about the creation and use of visual communication; and (iii) public perceptions regarding their understanding and experience of visual communication as recipients of this material during public engagement in EIA. The mode and content of presentation, visual literacy of stakeholders and technical arrangements interact to determine the efficacy of visual communication. All stakeholders expected visual communication to be employed in EIA, but proponents and public were found to have low visual literacy. Proponents had pre-conceived notions for visual communication, without considering the needs of their audience, resulting in complex content being delivered inappropriately – too fast, without opportunity for reflection and dialogue. Frustrated public recipients tended to distrust proponents and be opposed to their projects, an unintended emotional response arising from cognition challenges with visual communication, combined with insufficient time for explanation, interpretation, and dialogue. This paper seeks to trigger reflection by practitioners and researchers on how and by whom visual communication in EIA should be designed, and what inhibits their comprehension and understanding. Considering visual literacy levels of EIA stakeholders and tailoring the mode and style of delivery accordingly is critical for effective visual communication.

1. Introduction

Visual communication using maps, photographs, and other images, is common in environmental impact assessment (EIA) practice (e.g., González et al., 2008; Mwenda et al., 2015; Oliveira and Partidário, 2020). It is employed by all stakeholders (proponents, regulators and the public) alike, although perhaps in the main by proponents as they attempt to communicate the nature of their proposed development and its likely impact on the environment. If a picture is worth a thousand

words, as the old adage has it, then it is useful to have an understanding of the contribution of visual communication to EIA practice. This includes realising what the creators and promoters of visual communications had in mind when including such content in EIA materials shared with stakeholders, as well as how this content is perceived and understood by recipients.

In this paper we present the results of research into understanding the efficacy of visual communication in impact assessment. Our work builds upon the theoretical and design principles for utilising visual tools

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<https://doi.org/10.1016/j.eiar.2023.107210>

Received 25 January 2023; Received in revised form 8 July 2023; Accepted 10 July 2023

Available online 17 July 2023

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for inclusive public participation in impact assessment presented in [Oliveira and Partidário \(2020\)](#); as such we do not duplicate that content. In the work reported on here, the application of visual communication in EIA is mainly examined from the perspectives of project proponents and the public involved in several Portuguese projects, with some additional insights from regulators for these case studies and the results of a survey conducted with other impact assessment professionals. This means that we are focusing on the practice of visual communication and the way it is applied or developed in real contexts. The research question underpinning this paper is: *What is the efficacy of visual communication in EIA practice?* Here we use the term efficacy in a simple dictionary conception as the capacity to produce a desired effect (e.g., <https://www.merriam-webster.com/dictionary/efficacy>); our interest being in understanding how visual communication in EIA is interpreted and experienced by stakeholders. This is a topic that has received relatively little specific attention in the literature to date. For example, while there is considerable literature advocating for the use visual approaches to public participation in impact assessment and other similar environmental planning related applications (e.g. [Lejano et al., 2013](#); [Ehrlich, 2021](#); [Sleigh and Vayena, 2021](#); [Witkowski et al., 2021](#); [Adams et al., 2022](#); [Chassin and Ingensand, 2022](#); [Sinclair et al., 2022](#); [Smith, 2022](#)), works that critically evaluate the practices of visual communication are comparatively rare. Later, we review works of this nature in relation to our own research findings.

To further contextualise our research, the next section briefly reviews literature regarding the use of visual communication in EIA. Three lines of inquiry were then used to address our research question:

- (i) EIA professional perspectives on the advantages and disadvantages of visual communication in EIA;
- (ii) Proponent perspectives on the creation and use of visual communication; and.
- (iii) Public perspectives regarding their understanding and experience of visual communication as recipients of this material during public engagement in EIA.

The methods we employed for each of these components of the research are explained in [Section 3](#), followed by results ([Section 4](#)) and discussion ([Section 5](#)). In the Conclusions ([Section 6](#)) we return to addressing our research question overall. We anticipate that our findings will be of interest and value to EIA practitioners seeking to ensure the greatest value is accomplished when visual communications are employed in the EIA process.

2. Use of visual communication in EIA

There has long been advocacy for the use of visual communication in EIA with the implication that it facilitates ease of comprehension. For example, the [CEQ – Council on Environmental Quality Executive Office of the President \[US\] \(1978\)](#) directed that: ‘Environmental impact statements [EIS] shall be written in plain language and may use appropriate graphics so that decisionmakers and the public can readily understand them’ (s1502.8, p55995). The [ESPOO Convention on Environmental Impact Assessment in a Transboundary Context](#) makes a similar provision for EIA reports in regard to specifying for the inclusion of a ‘non-technical summary including a visual presentation as appropriate (maps, graphs, etc.)’ ([United Nations, 1991](#), p15). The move to digital or web-based EIA systems, rather than traditional reporting in print or pdf, invites greater emphasis on visual communication including photos, maps, tables, infographics, innovative communication approaches, use of hyperlinks, and embedded multimedia (video, sounds), being some of the suggested approaches of [Eijssen and Jesus \(2015\)](#) and [IEMA \(2017\)](#). Visual communication is also used during public consultation sessions, including posters and PowerPoint presentations, typically utilising the same images that appear in the EIS. Despite the common and long-standing acceptance for the use of visual communication in EIA, it is

interesting to note that consideration of this aspect of practice is missing from the well-known and oft-applied Lee and Colley review package for evaluating the quality of EIS (e.g., [Lee and Colley, 1991](#); [Sandham et al., 2020](#)).

Specific benefits of employing visual communication in EIA are explained in the review of [Oliveira and Partidário \(2020\)](#) and can be characterised in four ways, based on the work of [Bresciani and Eppler \(2015\)](#). In summary these are as follows ([Oliveira and Partidário, 2020](#)):

- Technical – e.g., enabling better access to spatial information, overcoming language barriers, and simply conveying complex information (relative to textual accounts alone);
- Cognitive – e.g., better perspective of alternatives, utilising the right side of the brain for perceptive analysis and helping to understand geography and scientific criteria, while reducing the quantity of information to assimilate;
- Social – e.g., promoting meaningful and participatory dialogue through facilitating effective communication between individuals, or groups of individuals, from different cultures or with varying levels of literacy; and
- Emotional – e.g., utilising pleasant colour combinations and attractive images.

Some particular examples of the use of visual communication in EIA include mapping the location and extent of impacts (e.g. depictions of the footprint of a development overlaid on aerial photographs to demonstrate areas of habitat to be cleared), assessment of development aesthetics and visual impact (e.g. through photo-simulations of how a development will look once constructed when viewed at ground level), and determining the efficacy of measures in post-project assessment (e.g., through comparison of pre- and post-development photographs). As indicated by [Blangy et al. \(2008\)](#), images create a sense of ownership, through which interested parties commit to support and defend proposed projects. Useful information flows in a two-way communication channel, building trust and bridging the gap between the public and the scientific knowledge while expanding the public’s critical visual literacy ([Northcut, 2006](#)). Indeed, ‘a visually literate person should be able to read and write visual language. This includes the ability to successfully decode and interpret visual messages and to encode and compose meaningful visual communications’ ([Bamford, 2003](#), p.1).

In practice, though, this encompassing concept may refer to a multitude and diversity of players and their aptitudes: teams of professionals (including designers) who work together towards the encoding and composing of visual communications; and those decoding and interpreting images (members of the public). It is important to realize that the effectiveness of communication processes may be compromised by socio-political aspects falling outside of visual communication design and interpretative skill levels, such as hegemonies and power imbalances between EIA stakeholders or simply where there is distrust among stakeholders due to political, economic, social or other interests (e.g. [Oliveira and Partidário, 2020](#); [Harris et al., 2021](#); [Witkowski et al., 2021](#); [Sinclair et al., 2022](#)). Furthermore, critical visual literacy implies that members of the public ‘are questioning, challenging, and otherwise interacting with the subjects under discussion, rather than merely consuming the information (...) naively’ ([Northcut, 2006](#), p.12).

These views suggest that EIA stakeholders (including the concerned public as well as the project proponents) need to interact, confronting potential different purposes and practices regarding the choice and design of visual communication. [Oliveira and Partidário \(2020\)](#) pointed out that this is seldomly considered in the literature on environmental planning and management (including EIA and Social Impact Assessment), land, urban and community planning, and development projects. Further, their literature review, which dwells on the importance of visual communication in EIA, also concluded that visual tools are pre-set by project proponents, disregarding cultural, social, structural, or political specificities of the reality they intend to serve. A recent and

comprehensive review of 20 years of studies in visualization in environmental policy and planning stresses the importance of visual communication in public participation cocreation and dialogue and debates the public's involvement in the development of visual tools (Metze, 2020). However, apart from not relating to EIA, in the above-mentioned review the involvement of the public refers to the choice of alternatives depicted in imposed visualisations (e.g., in visual preference surveys), or to alternative visualization perspectives (e.g., different angles in Geographic Information System tools) and not to the choice or design of the specific visual tools themselves.

Some literature on effective engagement in EIA advocates the inclusion of the public in the design of visual communications and of participatory programs overall (e.g. Lovett et al., 2015; Sinclair et al., 2022). Other works on visual communication, but not necessarily specific to EIA, are less forthcoming in this regard. For example, Higgs et al. (2008, p597) noted that “citizens should be partners in the use of the technology for the production and communication of information and the knowledge that results” (p. 597), but they do not refer to the involvement of the public in the choice and design of the visual communication tools (in this instance being maps and geographic information systems - GIS). A study of participatory planning of practice cases using a specific online mapping tool by Kahila-Tani et al. (2019) noted that planners were involved in the design of the tool, which creates map-based surveys to be used specifically for getting idea and insights from community members, but they did not involve the public in the actual choice and application of the tool. Other studies advocating visual communication approaches are likewise silent on involving the public in the choice and application of visual communication tools (e.g. Lejano et al., 2013; Mak et al., 2006; Wanarat and Nuanwan, 2013; van Herk et al., 2011). In addition to giving consideration to how visual communication is designed for use with public participants, there is need for evaluations of the utility of these approaches. For example, Yovanovic et al. (2021, p106) wrote that: “it is not enough to use visualization strategies. Rather, the effectiveness of public processes requires that institutions provide evidence of the relevance of these visualization tools” (p. 106).

To address such literature gaps, in this paper we examine stakeholder perceptions of the effective use of visual communication as elicited by the two sides of consultation processes, that is, the EIA project proponents and the concerned public, through three qualitative research methods.

3. Methods

The research strategy used for our qualitative study is illustrated in Fig. 1. It is based on three independent research methods: (i) an international exploratory (on-site and online) survey; (ii) participant observation; and (iii) in-depth interviews. The survey was utilised to obtain perspectives of EIA professionals about the use of visual communication during public participation in EIA. Observations and interviews were used in tandem, like the pairing of these methods in field research documented by Neuman (2014), to determine proponent perceptions about the creation of visual communication and public perceptions regarding their understanding of visual communication in EIA. Along with our literature review, our use of multiple methods was an attempt at triangulation of our qualitative study (e.g., Jonsen and Jehn, 2009). In the following sections, we further detail the tools used in each data collection method as well as noting limitations in the research design.

3.1. Survey: EIA professional perspectives on the use of visual communication

An international exploratory survey was developed and conducted in 2017–2018. It was self-administered (e.g. de Leeuw, 2008; Fowler, 2009) utilising closed questions to determine each respondent's role in EIA (i.e. proponent, EIA regulator or public) and to record the types of visual communication being used during public engagement in EIA. The types of visual communication listed on the survey were: maps, diagrams, photographs, drawings, paintings, graphs, videos, scale models and ‘other’. Also, open-ended questions were posed regarding the perceived advantages and disadvantages of the above visual tools in EIA and suggestions for improvement in visual communication.

An on-site deployment of the survey was directed to participants attending the *Tomorrow's Arctic EIA: Nordic possibilities and new perspectives* workshop in Finland in 2017. These participants included local, regional, and central governmental agencies, representatives of indigenous peoples, NGOs, private consultants, and other interested parties. A printed copy of the survey was distributed to the participants immediately after an oral presentation on ‘Visual Tools in Inclusive Public Participation’ by the first author. Of the 60 participants in the workshop, 42 of the answers obtained 70% were considered valid responses to the questionnaire due to the level of completeness. In addition, an online version of the survey was broadcasted through the IAIAConnect

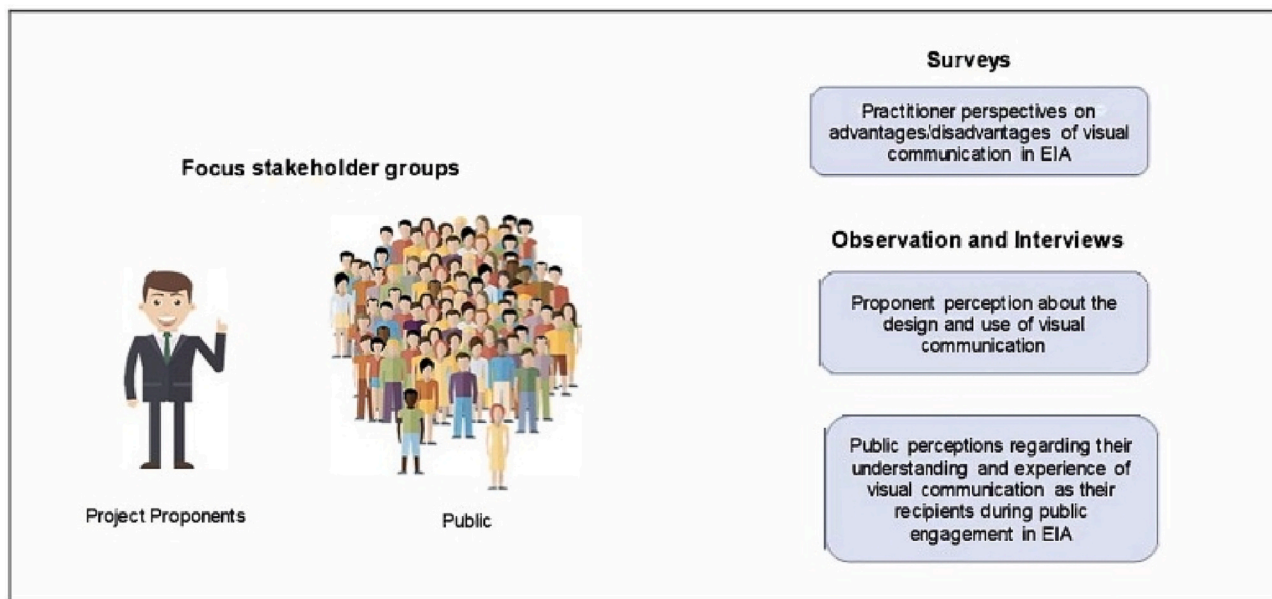


Fig. 1. Methods for understanding the efficacy of visual communication in EIA practice.

platform of the International Association for Impact Assessment. It targeted the Public Participation, Indigenous Peoples, and Social Impact Assessment IAIA Sections, from January 15 through March 15, 2018, producing 9 valid responses.

3.2. Participant observations at EIA public consultation sessions

Participant observations were carried out by the lead author during three EIA public consultation sessions/venues held in Portugal in 2018 and 2019. In one case, EIA information was displayed in a room, allowing for ongoing public consultation. The main purposes were to:

1. identify the modes of interaction (e.g., presentation methods such as projection of slides or poster sessions, and dynamics for the discussion of proposed projects and their environmental impacts – order and timing of presentations and discussion –; and use of visual tools); and
2. register the characteristics of the physical setting and chronology of events in the above-mentioned sessions/venues (presentation of participants, project presentation and discussion, etc.).

This ethnographic approach (Cresswell, 2007) pertained to three distinct and unrelated industrial and infrastructural projects (case studies), in rural, urban and industrial settings in Portugal.

Access to public meetings varied across the three cases: advertisements through the website of the EIA Authority; referral by consulting colleagues to more restricted EIA meetings; and participation in public participation processes of the proponent during EIS preparation. Observations, thoughts and interpretations pertaining to the use of visual tools and other means of communication, as well as about the conditions, configurations, and dynamics of the sessions were registered in field diaries (e.g., following Gale et al., 2013). Field diaries were then elaborated to reconstruct the events observed in the public sessions.

3.3. Interviews with stakeholders

Following the participant observation, additional data collection was sought in 2019 and 2020 to capture the perspectives of proponents and public about the quality and usefulness of the presentations/project information, both regarding visual tools and non-visual elements such as text. An interview protocol was followed using a structure based on a series of main questions, follow-up questions and probes (e.g., Rubin and Rubin, 2005). Proponents were asked to reflect upon their design choices regarding visual communication such as the mixture of visual and textual content, what determined the design decisions and how they helped convey intended understanding. Public interviewees were asked to reflect upon the amount and quality of visual (and textual) communication they experienced and how this helped them (or otherwise) to participate and convey their opinions on the EIA projects. The views of EIA regulators in attendance were also obtained.

Twenty-one in-depth interviews were conducted with 19 stakeholders involved in the EIA consultation processes for the same suite of projects outlined previously (two stakeholders present at two of the EIA public meetings were interviewed twice). Stakeholders included project proponents and their consultants, the general public, associations, and other interested/affected stakeholders. The sample included (12) men and (7) women aged 27 to 75 (21 to 40 years old: seven participants; 41–60: five; over 60: seven participants), with basic to higher education, and with current and former occupations in very diverse areas, including agriculture, law, health care, social services, tourism, engineering, and environmental and other natural sciences. Most of the interviews were conducted in person; with 3 interviews conducted via videoconferencing applications (Skype and Zoom), due to the Corona Virus national state of emergency. The interviews were recorded and transcribed, and the transcripts imported into qualitative data analysis software (NVivo) for subsequent content analysis following Brinkmann and Kvale (2018).

3.4. Study limitations and efficacy

While our research has incorporated the perspectives of a broad range of EIA stakeholders, sample sizes and number of case studies examined are not intended to be representative of practice either in Portugal or internationally. Nevertheless, there is richness and value to be derived from what can be learned and understood from focused information-oriented case study research (Flyvbjerg, 2011). We believe our findings will be of interest to EIA practitioners and researchers interested in enhancing practice.

In presenting our results, we specifically opted to adopt visual communication approaches where possible, rather than simply reproducing text alone. This was intended to further showcase or invite reflection on ways in which EIA professionals might employ visual communication in their own practice.

4. Results

We present the results of our research for the three methods of inquiry in turn or combined, as applicable. For example, we combine the survey and interview results concerning the advantages and disadvantages of using visual communication in EIA. This was because they returned similar and complementary results. Illustrative extracts from the stakeholder testimonies are provided along with the key findings. For the sake of simplification, a comparative analysis is performed for two main categories of stakeholders, namely project proponents (including the consultants representing them) and the public (general public, NGO, and other interested or affected parties). Some survey responses from EIA regulators are also included. When applicable, differences in opinions by each individual stakeholder were duly reported.

4.1. Stakeholder perspectives on the use of visual communication

Stakeholder perspectives on the advantages and disadvantages of using visual communication in EIA fell into three categories: general issues about the perception of adequacy of the specific tools, the representation of the proposed project, and the characteristics of a presentation to its audience. A summary of the findings is presented in Box 1 and some specific comments of respondents follow.

General findings regarding the adequacy of visual tools indicate that stakeholders share most of their opinions about what is important for their design. For example, project proponents said that they used images that are understandable by the entire audience; as one interviewee put it: *'Not just the experts, but to those less knowledgeable in this area'*, and that are already known to the stakeholders, such as those publicly available in the EIS. The capacity of visual communication to describe and present the proposed project in a common representation is also a consensual condition across stakeholders. Here, we noted two particular issues concerning capacity to depict reality, using *'elements around it that people recognize as existing'* (as one proponent put it) such as conceptual models like the illustrative example provided in Fig. 2 or videos, and to provide an adequate or appropriate spatial context for the development project.

The assumption that projects deserve to be presented using visual means was found to be quite consensual across all stakeholders participating in our study, although the public interviewees dwelled more extensively on this subject than others. Project proponents particularly mentioned the appealing nature of visual communications as a key advantage, being a way to contain or convey a meaning or story, which in turn is more easily associated with other ideas or memories by their audience. Both proponent and public interviewees also pointed out the need to complement visual tools with explanatory texts or oral explanations. While some members of the public highlighted the advantage of having visual communication means this helps them to understand and memorize the proposed project, they also suggested ways to enhance their visualization and to help them follow the explanations. For example, some visual tools could be printed (e.g.,

Box 1

Summary of survey and interview findings regarding the use of visual communication in EIA

General issues about the design of visual communication and adequacy to the public – In relation to the four categories in the classification of Oliveira and Partidário (2020) outlined previously, the design of visual communication should uphold the following design attributes.

(i) **Cognitive effects:** Illustrate, clarify, communicate (e.g., what proponents want the public to see, such as the need for the project and the underlying arguments), help memorize, build awareness, and take into account common colour-blindness considerations.

(ii) **Cultural/social effects:** Enable conflict avoidance or resolution. Serve to illustrate issues that are recognizable by the public (e.g., already in the Environmental Impact Study – EIS) and/or address what is important to the audience. Provide adequate information for the target audience. Be relevant for the (cultural) context in which they are used. Match the technical and visual literacy levels of the audience (i.e. be accessible for lay and illiterate people).

(iii) **Emotional effects:** Facilitate emotions that will ‘turn the perception and the understanding’ of project needs and difficulties. Be appealing/attractive and enjoyable to encounter. Create a positive sense of trust.

(iv) **Technical effects:** Be accurate and realistic with adequate scales. Provide geographic references (orientation) and access to spatial data.

Representation of the proposed project – Visual communication should represent development in the following ways.

- Be specifically designed for the presentation and its location with relevant and relatable project information that is truly representative of the proposed development activity and provides the physical context (surroundings) of the project area.

- Presents the proposed project in realistic ways (e.g., through conceptual models, drawings)

- Considers the planned evolution of the project over time (e.g. showing visuals depicting changes as the project advances those utilising techniques such as photo-visualisations).

Presentation – Visual communication should be presented in the following ways.

- Be simple, and used sparingly (i.e. only when relevant).

- Tell a story.

- Promote interactive participation (e.g., conceptual models).

- Be presented one at a time (e.g., in a PowerPoint presentation), in combination with explanatory text (keeping it short, e.g. utilising bullet points) and/or oral explanation.

- Be printed (e.g., as maps, posters or individual handouts) to allow better visualization at the speed of engagement of individual participants.



Fig. 2. Example of a physical model being used in public consultation.

photographs, maps) and even be displayed in a poster session (an illustrative example is provided in Fig. 3). Participants can then engage with and interpret the material at their own pace.

One stated effect of such improvements would be to avoid or reduce potential conflicts that usually arise in public consultation processes due to the lack of interest, understanding, and interaction during the project presentation. The public also mentioned that it would be important to visit the project site, for example:

I have heard (...) that there are things [regarding the project] that are not

true, so, that is the question, that is the doubt, and I keep saying that it is important to see the site, things in their places, what is happening on-site. Now, the rest is all relative.

Such site visits would allow for full visual communication of project sites, at least in the pre-development state, as well as building trust in the EIA participatory processes and improving public engagement. However, such practice is seldomly applied in Portugal and was not utilised in any of the three cases in our research.



Fig. 3. Example of an interactive poster session during EIA consultation phase.

4.2. Proponent perceptions about the creation and use of visual communication

Some perspectives of proponents regarding their use of visual communication have already been revealed in the previous section, and some others appear in the next section. With respect to creation, project proponents and their EIA consultants acknowledged the authorship of the visual communications used in the three case studies. In one case, a proponent interviewee revealed that contracted professionals were also involved in the design of PowerPoint presentations used in the public session.

We defined, together with the consultants that we used to conduct the environmental impact report, the presentation guide. So, we defined what we wanted to communicate and how we wanted to communicate (...). I believe, in fact, that it was well structured and involved the people that it should involve (...).

This opinion, which also reveals that the public were excluded from the design process, is in stark contrast with the opinions stated by international survey respondents representing project proponents and EIA regulators. Survey respondents from the latter expressed the need to involve the public by considering their preferences or alternative ways of visualizing projects and their impacts. For example, project proponents may conduct prior consultation, showing visual tools to reference groups and considering their input for public events. As one proponent interviewee remarked: ‘visual tools are good when the audience chooses them’; a point emphasised previously in our literature

review.

4.3. Public perceptions regarding their understanding and experience of visual communication

Previous results have indicated public expectation for and appreciation of receiving information about EIA projects and their likely impacts in visual formats. However, members of the public interviewed in this study, as well as one survey respondent, pointed out multiple constraints to good understanding of visual communication. Four main groups were evident: mode of project presentation, content of the project presentation, visual literacy of the audience, and technical and logistic constraints for accessing or viewing the information. These are depicted in Fig. 4 in an Ishikawa (cause-and-effect) diagram and a brief explanation of each of the types of constraints follows. Our explanations here include some illustrative transcription excerpts highlighting variances in perception among different categories of stakeholders.

4.3.1. Mode of project presentation

Each of the EIA public sessions consisted of long PowerPoint presentations followed by a period of questions by the public and did not foster two-way interaction. The lead author observed that no time for dialogue was given to the public in any of the sessions attended. Such time was needed as questions would arise when people were initially exposed to material, and not after hours of uninterrupted presentations. One public interviewee put it this way:

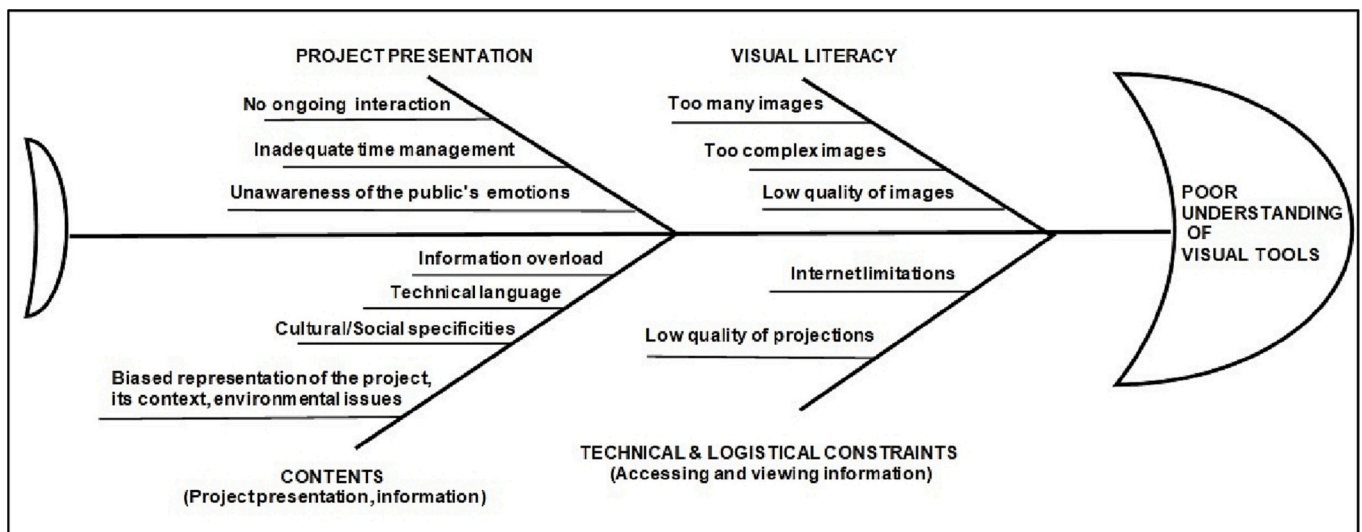


Fig. 4. Constraints to understanding visual communication in EIA identified by respondents.

So they had to show it, slowly, and as someone had a question, they would ask it, 'so, what is it over here?', 'I don't understand this or that'. Now, after unloading all that quickly, [they asked] 'do you have any questions?' That is not how it should be. (...).

It was apparent from observation of the lead researcher that the speed at which the slides were shown was very high, and specifically detrimental for the full understanding by the public of certain visual images such as drawings, maps, and charts. The effect of this was a sense of distrust with some of the public interviewees indicating some uncertainty regarding the true intentions of the project proponent; for example: [They should present] and explain as they go – if that was the objective, to explain to people!

Another feature of the public consultation processes studied was that they each entailed just a single and continuous public session, not allowing the public enough time for reflection on the information provided, as revealed in the following public interviewee response.

Afterwards I talked with the lady that went with me, she is my neighbour, and she told me: 'but I did not understand well that aspect, and the other', because meanwhile the information settled in, right?, and then we stay there processing, and only later we remember that, hey, and what if we had asked this or that?

It was observed by the lead author that these presentation features led to rather passive and silent audiences, even when technical difficulties would prevent the proper visualization of the PowerPoint presentation. Consequently, project proponents were apparently not aware of the public's suppressed emotions or were dismissive of them. Subsequently, when given a chance (through interviews) to voice their feelings about the use of visual tools, the public expressed distrust in the project proponents and a feeling of lack of power, namely about:

- what the visual communication actually represents;
- the truthfulness of 'well-rehearsed' oral information; and
- the real intentions of proponents – e.g., seemingly being to simply comply with an obligation or to overcome the public through weariness.

Also, public interviewees expressed a degree of contempt (by not

reacting during the presentation sessions) and a range of other strong feelings, such as:

- that they have no legitimacy to intervene: 'The oral part did not seem that bad, but who am I to say so?, right?';
- fear (of making a fool of themselves);
- indignation (about not being heard in the project design, or about not being well informed about the project's impacts); and
- frustration: 'Oh, those numbers [pictograms with statistics], don't ask me because I don't know how to read that!'

Finally, some members of the public were unyielding in their opposition to the projects presented to them. For example, one interviewee said that: 'Any attempt [by the company] to explain (...) ...it is always badly accepted because the bottom line, the [project] should not exist. From that moment onwards, everything is evil'. This more radical opinion perhaps indicates inflexibility to accept the proposed project regardless of the adequacy of the visual communication used.

4.3.2. Content of the project presentation

Several interviewees, including both proponent and public respondents, mentioned that the use of excessive amounts of information in visual tools may prevent the public from understanding their meaning or relevance. In the case depicted in Fig. 5, the project proponent used pictograms associated with statistical analysis of predictive modelling, in an effort to use a more representative, clear, accurate, and attractive mode of presentation. To someone well versed in this kind of diagram, it might prove to be very informative and useful, but the public had a contrary opinion regarding their adequacy. In another case, although the project proponent acknowledged an overload of visual information, the quality of the presentation was assumed as good, as there were no complaints from the public.

Highly technical information presented in the public sessions was hard to understand by some members of the public, who found it to be inadequate. One public interviewee said:

Those who make these presentations are very technical people, very technical engineers, very familiar with the project, and with the concepts and

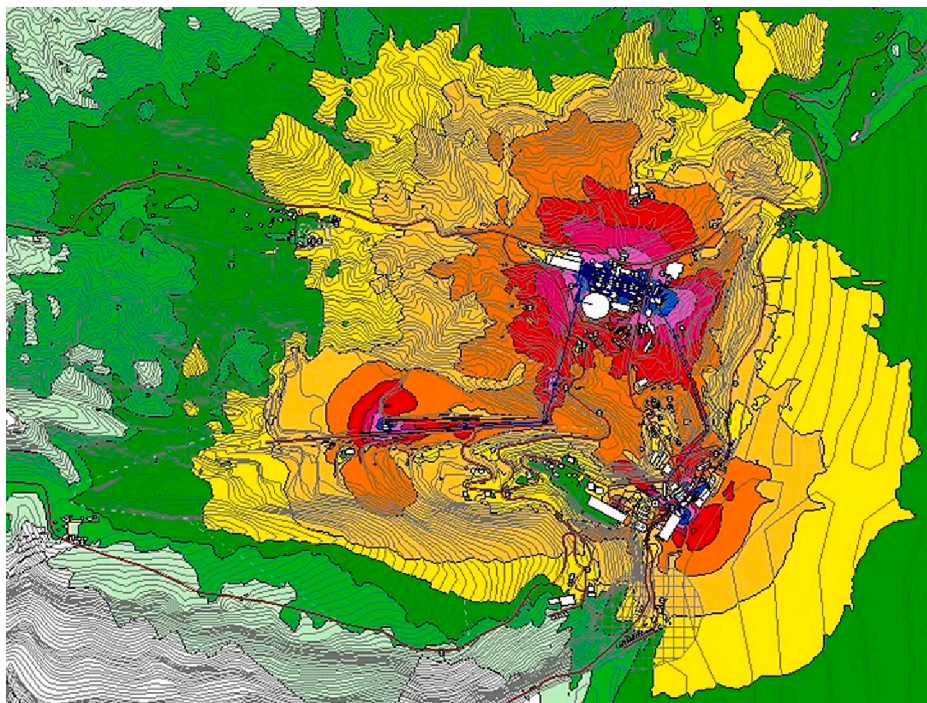


Fig. 5. Example of (excessively) complex project impact diagram (without explanation).

the technical terms, right? And this is a presentation made for the general public, right?, and the public does not have this knowledge and does not understand some of the terms, (...) Because there one speaks a...almost tribal language, right?

Although environmental information is available before the presentation sessions (in EIS), public interviewees expressed some concerns about their capacity to read environmental impact studies (including their non-technical summaries), even with the help of images; for example:

'(...) the non-technical summary was also extremely technical, so I think that it also complicated [the understanding]. It [the images] made it easier, yes, of course, but even so it is a bit...unpalatable, for the public'.

Some believed that this failure in communication, causing distancing among stakeholders, may have been intentional: *'those who make the projects, hide, or try to hide the impacts, and hide behind a technical or very specific, or very hard to understand language to do so'*. On the other hand, public interviewees also questioned whether project proponents, who are responsible for these communication processes, have the competency and skills to do so: *'the one that presents has to come down off the pedestal, to come down to earth, and place him/herself in a position of providing [their] service, it is their role, right?, to provide a [service], to everybody'*. Either way, what was clear in the public perceptions expressed in the interviews was that complex imagery accompanied by highly technical language conveys an imbalance in the power dynamic, being an attempt by project proponents to exclude them from the decision-making process.

Two cultural/social specificities failed to be accounted for in some cases. On one hand, the use of foreign language (mixed up with the native language) was perceived as inadequate by members of the public, as they do not have or otherwise hold only limited foreign language skills. As noted in the lead researcher's field diary, *'some slides had text in two languages, either Portuguese and English or Portuguese and Spanish'*. On the other hand, in the case of an EIA public venue, the project proponent displayed project information in a community without public consultation and approval. This created a sense of fear among members of the public, as they thought other people in the community would see them entering such premises and would assume that they held a favourable opinion towards the project. One public interviewee put it this way:

I had no motive not to enter, I believe nobody would beat me up, nor... Yes, I went there [to the location with project information] because she was a person I knew and just because she is working at [the project] does not mean I will stop liking her, right?

This comment also reveals social cleavages between the potentially affected community (public) and those representing an imposed activity (project proponents). As before, it constitutes a power dynamic that inhibits interaction.

Perceptions of biased representation of project features, its context, and/or of environmental issues had a two-fold effect: rendering visual communication ineffective and creating a sense of distrust. Because project proponents and the affected population may have different perceptions about the way environmental issues can be visually represented, the former may convey a wrong or biased message. As an international survey respondent explained: *'the public is not aware of how data is collected and visualized and thus cannot analyze data reliability'*.

Finally, some visual communication approaches (e.g., visioning or photo-simulations) representing environmental impacts were not perceived (or not believed) by public interviewees as being correct or 'real'. In one case, a member of the public expressed a perception of intentional bias by the project proponent, i.e., that visual communication using photo-simulations were designed from a point of view that would benefit the proponent, showing perspectives that would minimize its visual impact, thus denoting lack of impartiality. In another case, some visual communication did not include the surroundings of the project (e.g., roads and traffic around the project site), which were important to understand its overall impacts. A public interviewee said:

'one does not expect that it [the project] will be an island, and everything around it will remain without an answer', thereby expressing their disapproval and lack of trust in the proponent.

4.3.3. Visual literacy

There was considerable divergence in the perspectives of proponent and public interviewees regarding the use of visual communication in EIA relating to visual literacy. In short, proponents were keen to make greater use of images, while the public expressed comprehension difficulties and objections to this approach, notwithstanding our earlier finding that they expected to encounter the use of visual communication in EIA engagement processes. The proliferation of visual communication in the PowerPoint slides (i.e. a sense of information overload) was a commonly identified constraint by public interviewees. They expressed a clear preference for fewer images and topics per slide, so they could more easily keep their focus and follow the explanation provided by the project proponent. In one session it was observed by the lead author that simultaneous display of videos compounded the expressed sense of information overload. Furthermore, public respondents drew attention to the low quality of some images (hard to read or with unreadable captions) and their complexity (especially when tables were used to convey information).

All of these constraints reflect one feature of low visual literacy, that is, lack of capacity of proponents or desire to produce meaningful and effective visual communication about their planned development projects. On the other hand, public interviewees also expressed an inability or lack of competence to interpret certain visual communication. For example, respondents identified experiencing difficulties reading maps and understanding the contents of graphs and tables; as one public interviewee remarked: *'[we spent] some time trying to understand what the charts were about, and they kept talking but you also were supposed to understand the chart in itself'*. One such example observed by the lead author was the use of noise contour maps (such as the example depicted in Fig. 5). These were perceived differently by the two categories of stakeholder, as we denote in images and text within Fig. 6.

Interestingly, one project proponent indicated that visual tools were chosen and designed by taking into account what they perceived to be in the best interest of the public, namely, using images that they believed or intended would clearly convey a positive sentiment or message. However, it became apparent from the interviews that a different message or understanding was received by the public. Fig. 7, combining individual interview excerpts, illustrates the key diverging perception capabilities regarding visual communication in EIA in this regard.

In sum, the combination of low visual literacy of both proponent and public participants in our study, constituted a major constraint to the efficacy of visual communication used in the sample EIAs investigated. This concern was also raised by an international survey respondent, who stated that: *'You have to make sure that you speak the same visual language'*.

4.3.4. Technical and logistic constraints

The technical and logical constraints to visual communication in EIA noted in our research are context-specific, being related to the hardware available to EIA stakeholders rather than the design or content of imagery utilised. Two key constraints were mentioned by survey respondents and interviewees alike, regarding the quality of technical support and logistical aspects, respectively: absence of/low speed internet and low quality of slide projection equipment or exhibition screens or other surfaces used (e.g., walls). As pointed out by a public interviewee, individual access to environmental information in images (including videos) in rural and remote areas entirely without or with only limited internet connectivity, represent limitations regarding the feasibility of utilising certain visual communication across all EIA stakeholders. Similarly, poor quality image projection during public consultation sessions impedes the efficacy of visual communication as voiced by interviewees for two the projects. In one case, a member of the public noted (while arguing about the advantage of making available

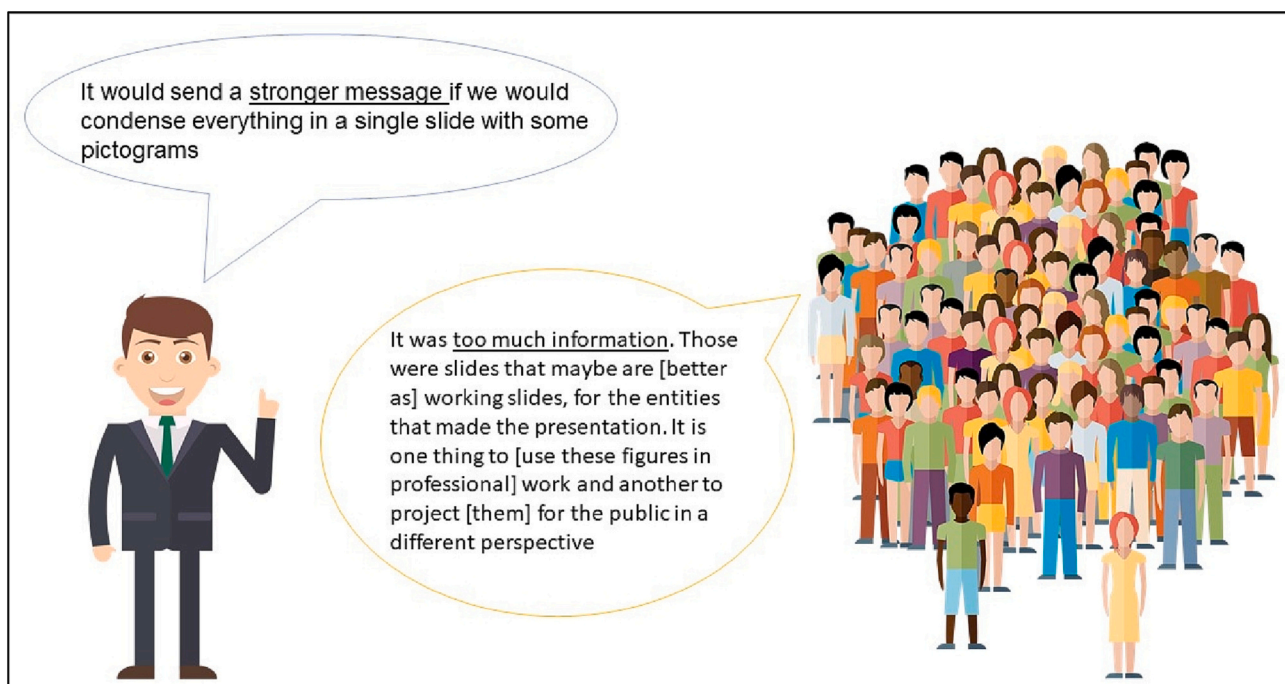


Fig. 6. Proponent and public interviewee perspectives on noise maps.

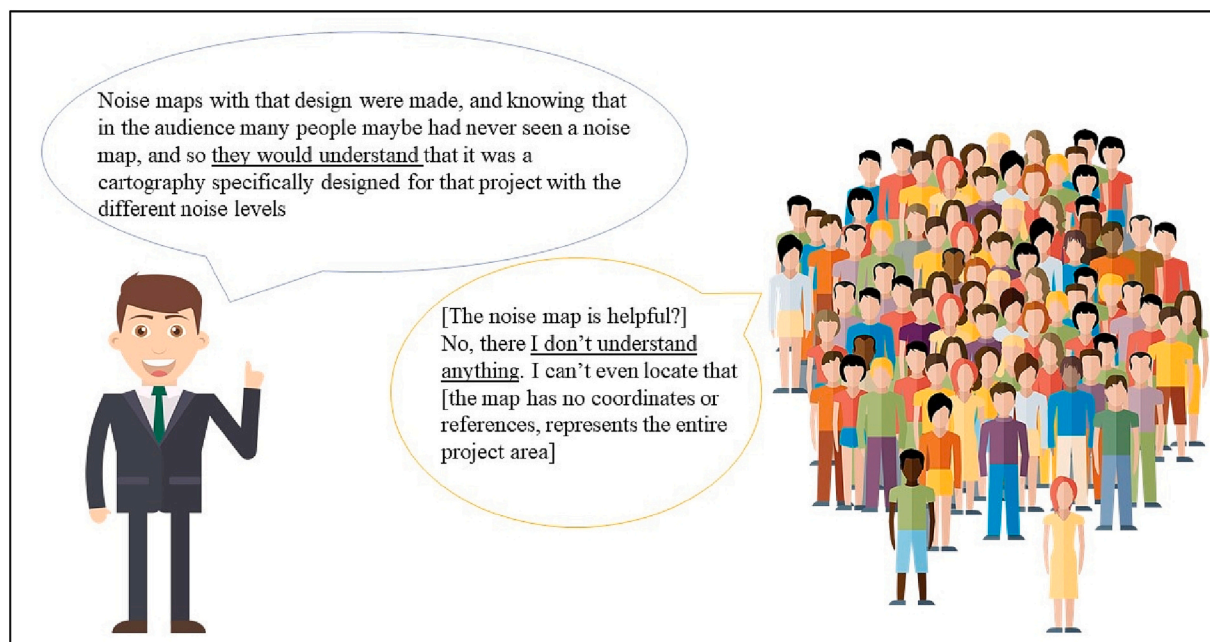


Fig. 7. Proponent and public interviewee perspectives on visual communication in EIA.

printed materials) that: 'when projected it [the images] always loses quality'. In another case, the unexpected absence of a canvas projection screen (the equipment was not tested prior to the presentation day) forced the proponent to project onto a timber wall. Consequently, a combination of great brightness, lack of contrast and the blurred appearance of some images, prevented the complete visualization of the visual tools in most slides of the PowerPoint presentation. In the words of the proponent:

We had several slides that effectively were not visible for the audience, so, our entire communication objective was somewhat lost in there, because we lost our visual support, and it ended up being almost an oral communication.

In both cases, no alternative viewing of the visual information was provided to the public, neither during nor after the public sessions. Clearly, it is important that proponents take due account of the technical and logistical aspects of engagement sessions with the public if their attempts to communicate visually are going to succeed.

5. Discussion

Here we discuss our key findings along with the identification of solutions for improving the efficacy of visual communication in EIA including perspectives from literature.

5.1. Stakeholder acceptance of visual communication as normal

Overall, testimonies from the EIA stakeholders participating in our research in their individual survey and interview responses indicate some consensus about the importance of visual tools in EIA public engagement. This matches the advocacy for using visual communication in public engagement processes in the studies noted previously in [Sections 1 and 2](#). The survey and interviewee respondents in our research identify the need to account for key aspects for the design of visual tools, namely their technical, cognitive, social/cultural, and emotional effects discussed previously in [Section 2](#). Also, proponent and public interviewees alike shared similar aspirations regarding the way images should represent the proposed project.

5.2. Stakeholder differences in how visual information should occur

However, there was a perception, most frequently expressed by members of the public, of a gap between what should be considered (or what was the initial intention of those designing the visual communication), and what is in fact practiced in EIA public participation, namely regarding the way visual information is presented to the audience. Indeed, stakeholder perceptions about the way proposed projects and their environmental impacts are presented differ significantly in many aspects and may have undermined adequacy or efficacy of the visual communication in practice. Public interviewees in our research actively suggested alternative tools (e.g., printed maps as opposed to projected images with low quality) or site visits, to improve comprehension. Interestingly, and somewhat counter to our findings here, there is contemporary literature specifically advocating for digital forms of visual communication, especially via phones or other electronic devices owned or operated by the public and where stakeholders can manipulate the material they access (e.g. [González et al., 2008](#); [Eijssen and Jesus, 2015](#); [González Del Campo and Gazzola, 2020](#)). In this regard, [Chassin and Ingensand \(2022\)](#) identify five benefits or dimensions to such approaches regarding: “immediate participation, ease of use, flexibility, place-based engagement, and immersivity” (p. 1). The key point in common between our research and these other studies is that the choice of technology and processes of designing visual communication must be suitable for the intended audience and ideally undertaken in collaboration with them.

In each of our three case studies, project proponents selected and designed the visual communication. Although some claimed that they based their decision on what the audience would require, they did not directly involve members of the public to learn about local specificities or any aspect related to the project and its impacts. In fact, some mentioned that they need to listen to the public when conducting EIA, but did not specify what for, aside from it being ‘*part of life in a democracy*’. For example, the preference for printed maps expressed by some public respondents, which is also advocated in the literature review conducted by [Petts and Leach \(2000\)](#), was not upheld by proponents who imposed their projection in PowerPoint presentations. In one case, the proponent assumed that the public would already be familiar with the visual communication already publicly available in the EIS and in the NTS. However, the public expressed difficulties understanding such technical documents and few interviewees acknowledged engaging with them. This suggests to us that audience preferences are imagined by the project proponents, that is, they were not actually tested with nor assessed by those (the public) receiving the message during the public sessions. The feedback, if any, is given during the public sessions – and the only feedback stakeholders mentioned to us indicated disapproval of the project or its impacts, and not specifically about the visual tools used in the communication process. That said, our international survey results did indicate that some project proponents are aware of the need to listen to and include the public in the choice and design of visual tools. What is left to realize is to what extent such concern is a current practice worldwide.

5.3. Visual literacy

What became clear to us in this study was that lack of visual literacy and a pre-set mode of project presentation may affect the understanding of visual tools and the capacity for critical visual literacy. The conclusion of [Yovanovic et al. \(2021\)](#) resonates here where they note that “visualization strategies have to account for the expected cognitive operations of their final users” (p. 115), notwithstanding that this may add to the “the complexity of giving back information to the public” (p. 115) where task-specific or audience-specific considerations may result in different approaches being adopted. Our illustration in [Fig. 8](#) seeks to capture the intertwined nature of visual communication challenges identified in our study, which ultimately can be seen as a manifestation of power imbalances between EIA stakeholders (and thus feelings of disempowerment by the public, as they feel their concerns are not reflected in the visual communication) and the importance of opportunities for reflection and dialogue.

Considering that the role of visual tools is, in part, to overcome language obstacles and to promote effective communication among stakeholders, and that the visual tools did not require, in the case studies herein discussed, sophisticated technologies or internet capacity, one would expect them to be simple and contain accessible information. This is a point emphasised in literature on engaging Indigenous Peoples in EIA with visualisations associated with understanding likely impacts and mitigation for proposed development being generated by EIA proponents, regulators and community members alike (e.g. [Ehrlich, 2021](#); [Adams et al., 2022](#)). In contrast with this, interviewees and survey respondents in our study reported on the use of relatively low-tech visual tools with high levels of complexity and technical information.

One possible explanation is that project proponents are not aware of the need to account for public needs and knowledge in the choice and design of visual communication, as indicated in the literature review of [Oliveira and Partidário \(2020\)](#) on EIA public participation and visual communication. It appears to be the case that proponents are not used to providing understandable information to the public and may not have the necessary visual skills. For example, when probed about this topic, interviewees did not seem aware of the implications of visual information overload, such as the lack of competence to make deliberate choices ([Kahneman, 2012](#)), and did not acknowledge the need for simpler presentations, arguing that they would lose information and relevance.

So, in the cases we observed, a dominant and undisputed technical language overrode non-expert knowledge. Not surprisingly, interviewed members of the public expressed their perception of manipulation of information through inappropriately technical language and imagery as a misuse of power. Consequently, given the reinforced division of roles, those potentially affected by the projects feel frustrated, and lose confidence and ability to intervene, constraining public participation and inclusivity ([Pflughoeft and Schneider, 2020](#)). As stressed by [Vanclay et al. \(2015\)](#), it is the ethical responsibility of project proponents to avoid the exclusion of individuals from participation.

On the other hand, when prompted during the interviews to address the use and importance of visual communication, the public interviewees generally revealed low literacy levels. They were intensely concentrated on the projects and their impacts, namely those that would directly affect them – or the people they represented. In a sense, the public had to be ‘brought down’ by the researcher to the theme of visual communication, as some were probably discussing them, in depth, for the first time. Indeed, they mentioned the need to have more time to interpret such matters. This may partially explain the overwhelming silence of the participants observed during the public sessions.

A few members of the public referred to their relative advantage of having some knowledge about the environmental issues or about the project location and local constraints, allowing them to better understand, the visual communication and what was discussed during the public presentations. This distinction, between those who do have and those who not have resources (e.g., knowledge) to participate, is

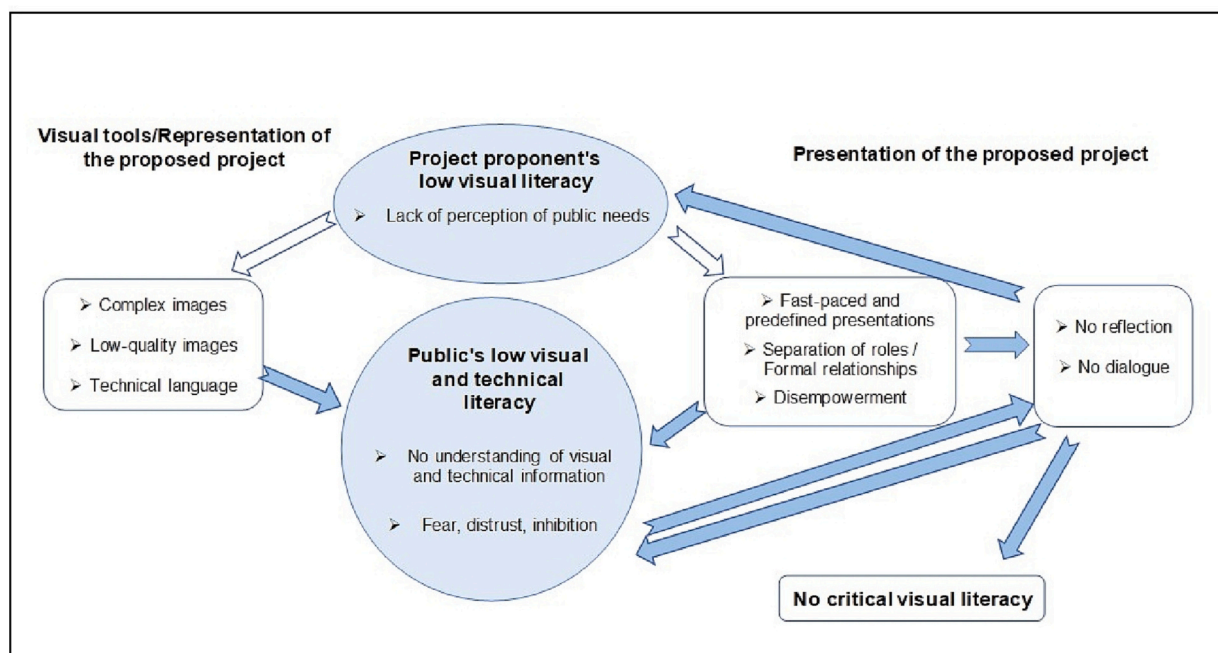


Fig. 8. Synthesis of intertwined issues in visual literacy of proponents and the public.

discussed in Batel (2018). Knowledge allows affected communities to be insiders, that is, 'communities affected by issues with relevance to them and their everyday, to which they react as insiders, whether by opposing, supporting or tolerating them' (Batel, 2018, p.357). This comparative advantage is used by associations that attended the public meetings in representation of the general population (affected by the project but usually with a lower level of technical and visual literacy). However, even relatively well-informed members of the public revealed difficulties in interpreting or accepting as real seemingly simple visualisations (e.g., noise maps, photo simulations) of environmental concerns.

In sum, we maintain that the low visual literacy (capacity to design visual tools) of proponents, promotes the use of inadequate visual communication. This, in turn, compounds low literacy (capacity to interpret visual communication) and limited technical knowledge of the public, ultimately impeding understanding of the complex issues discussed during EIA public sessions. Moreover, the power dynamics of these two EIA stakeholders, undermine the capacity and willingness of the public to intervene.

5.4. Opportunity for reflection and dialogue on visual communication

Some members of the public participating in our study referred to the need for time for reflection on the information contained in the visual communication, especially during one-off events. For example, the need for appropriate project contextualization (framing), a focal point to elicit what the public needs (Jasanoff, 2003), would likely be resolved with additional time and interaction. Opening-up participatory practice to render it more reflexive is one of the pillars of the new, co-productionist approach to public engagement advocated by Chilvers and Kearnes (2016), Adams et al. (2022) and Sinclair et al. (2022) among others. In this context, effective participation is centred around partnerships and collaboration between stakeholders. Ongoing dialogue is also a key requisite to build and maintain trust among stakeholders (Senecah, 2004). Furthermore, '[g]roup discussion based on visualization requires more time than verbal discussion.' (Bresciani and Eppler, 2015, p. 7). Indeed, '[i]t is important to recall that each map/diagram is a mental construct, which can tell something about how different groups of people see reality. Large differences can be expected between the

maps/diagrams made by different groups' (Leeuwis, 2004, p. 228). The need to reflect upon the images is explored in the concept of casual/cognitive maps, as defined by Weick (1979, quoted in Anderson, 2006, p. 1683): 'Over time, the accumulation of retrospective accounts may foster the assignment of meaning to present experiences and facilitate the creation of new cognitive maps.' This concept is one among multiple interpretations of the well-known point from Weick: 'How can we know what we think until we see what we said?'. Thus, with not enough time or appropriate forum for reflection, the public is not able to process the visual (as well as the non-visual) information and act upon it in a constructive dialogue with the project proponents.

In one case, an effort was made to allow reflection by the public, in a location set up with project information. However, the information display was designed and chosen by the project proponent alone, in consultation with a few members of local authorities and communities but without resorting to a full-scale public consultation process. As cautioned by Chilvers & Kearnes (2016, p.280) consulting individuals and aggregating the 'unique preferences of autonomous and individual publics' does not reflect preferences of the community. As a result, some members of the public participating in our research associated the acceptance of such offer of information with a public expression of a favourable opinion towards the project, which was not desirable nor respectful, and thus such location was altogether avoided by its members.

The presentation model being employed for all three of the case studies, featuring long and fast-paced project presentations by project proponents followed by time for questions by the public, did not allow quality time for dialogue, which, in turn, would facilitate understanding of the presentation contents. Moreover, asking for an explanation in a formal relationship is always a demonstration of vulnerability, namely in this context where the speakers are experts and the legitimacy of knowledge is on their side. One way to demonstrate openness to this vulnerability is to use time for building a space of confidence where speakers and listeners can have reciprocal opportunities to voice their opinions. This can be reflected in the time given to intervention, and the possibility of reflection by the public.

Another consequence of the observed presentation model is that it underplays 'the role of emotions, beliefs and affective dimensions in the co-production of collective participatory practices' (Chilvers and

Kearnes, 2016, p.40), which would have assisted project proponents in gaining knowledge about the needs of the public affected by their development proposals. Building in time for reflection would similarly have enabled proponents to reflect upon the feedback given by the public. Such two-way interaction and understanding was an opportunity lost in the case studies we observed.

Alternative and additional presentation models to promote ease of understanding of environmental issues and interactive participation were suggested by the public during the in-depth interviews, including:

- more restricted discussion of themes around visual tools such as posters and conceptual models;
- the use of leaflets and other printed materials (e.g., maps, photographs), to take home or to exhibit in public locations or venues; and
- site visits to the location of proposed projects.

Some of these proposed solutions are concurrent with recommendations of Portuguese publications on public participation more generally (e.g., Carvalho et al., 2015).

6. Conclusion

This research examined the practice of visual communication in EIA, focusing upon the perceptions and experiences of a broad range of EIA stakeholders. Through literature review, surveys of EIA professionals and case studies of public engagement events for three projects in Portugal, we have identified three key considerations for the use of visual communication in EIA that we believe will be relevant to practice anywhere in the world.

Firstly, we suggest that the efficacy of visual communication may be determined by the interplay of technical, cognitive, social and emotional parameters. While individual EIA stakeholders have no control over the abilities of others involved in the process to engage with and comprehend visual communication, there is much they can do when designing and using visual communication in EIA to increase the likelihood of success.

Secondly, it is apparent that all EIA stakeholders expect to use and to be exposed to visual communication in EIA. We also registered broad consensus regarding the need to consider audience specificities and preferences in the choice and design of visual tools used to explain EIA projects during public engagement (both in the literature and our survey and interview findings). It is not appropriate for visual communication to be solely designed by project proponents or other experts.

Thirdly, it is important to be aware of visual literacy of EIA stakeholders and to ensure that the mode and style of delivery of visual communication is tailored accordingly. Simple and accessible forms of visual communication are desirable. Where complex visualisations are necessary, so too is adequate explanation, provision of additional time for interpretation and opportunity for dialogue. This will simultaneously help build public acceptance of new development proposals and trust between EIA stakeholders, whilst avoiding or breaking down power imbalances.

Further research could investigate strategies to raise awareness among EIA stakeholders, including regulators, regarding the hindrances to effective use of visual communication identified previously in this research. Based on the experiences of the public in Portugal identified in this research, it would be beneficial to promote the adoption of alternative modes of participation, such as poster sessions, discussion around conceptual models, printed maps or photographs, and, when feasible, site visits to proposed project sites. Also, future studies could deepen the knowledge about the effect of ongoing dialogue and reflection about the adequacy of visual tools and their contents on building trust among stakeholders, and on opening up a collaborative pathway for constructive public engagement through critical visual literacy.

Authors' contribution

The qualitative study is part of the PhD thesis of the first author.

Funding

The first author received financial support from the Ministry of Environment of Finland, to participate in the workshop 'Tomorrow's Arctic EIA: Nordic possibilities and new perspectives' in Rovaniemi, under the Arctic EIA Project, and to conduct the online survey.

Declaration of Competing Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this paper.

Data availability

Data will be made available on request.

References

- Adams, M., Tulloch, V., Hemphill, J., Penn, B., Anderson, L., Davis, K., Avery-Gomm, S., Harris, A., Martin, T., 2022. Inclusive 2023, 00, pp. 1–15. <https://doi.org/10.1002/pan3.10447>.
- Anderson, M.H., 2006. How can we know what we think until we see what we said?: a citation and citation context analysis of Karl Weick's the social psychology of organizing. *Organ. Stud.* 27 (11), 1675–1692.
- Bamford, A., 2003. The Visual Literacy White Paper. Art and Design University of Technology, Sydney. Available: <chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://aperture.org/wp-content/uploads/2013/05/visual-literacy-wp.pdf> (accessed 2 Jan 2023).
- Batel, S., 2018. A critical discussion of research on the social acceptance of renewable energy generation and associated infrastructures and an agenda for the future. *J. Environ. Policy Plan.* 20 (3), 356–369.
- Blangy, Sylvie, Chevalier, Jacques, McGinley, Robin, 2008. Aboriginal tourism in northern Canada: how collaborative research can improve community engagement in tourism projects. In: Buckles, Daniel J. (Ed.), *Proceedings of Celebrating Dialogue: An International SAS2 Forum*, November 3, 2008. Carleton University, Ottawa. Available: https://www.academia.edu/73646860/Aboriginal_tourism_in_northern_Canada_how_collaborative_research_can_improve_community_engagement_in_tourism_projects (accessed 2 Jan 2023).
- Bresciani, S., Eppler, M., 2015. The pitfalls of visual representations: a review and classification of common errors made while designing and interpreting visualizations. *SAGE Open* 5 (4), 1–14.
- Brinkmann, S., Kvale, S., 2018. *Doing Interviews*, 2nd edition. Sage, Thousand Oaks.
- Carvalho, Anabela, Seixas, Eunice, Jesus, Maria Fernandes, Guedes, Mafalda, 2015. Participação em processos de consulta pública: Percepções dos cidadãos e recomendações para autoridades responsáveis. Relatório produzido pelo projecto COMPOLIS - Comunicação e Envolvimento Político com Questões Ambientais. Projecto financiado pela Fundação para a Ciência e a Tecnologia (EXPL/IVC-COM/1717/2012). In: *Centro de Estudos em Comunicação e Sociedade*. Universidade do Minho, Julho, 2015.
- CEQ – Council on Environmental Quality Executive Office of the President [US], 1978. Regulations For Implementing The Procedural Provisions Of The National Environmental Policy Act, Reprint 40 CFR Parts 1500–1508 (2005). available at: http://energy.gov/sites/prod/files/NEPA-40CFR1500_1508.pdf (accessed 2 Jan 2023).
- Chassin, T., Ingensand, J., 2022. E-guerrilla 3D participation: approach, implementation, and usability study. *Front. Virtual Reality*. <https://doi.org/10.3389/frvir.2022.1054252>.
- Chilvers, J., Kearnes, M. (Eds.), 2016. *Remaking Participation: Science, Environment and Emergent Publics*. Routledge.
- Cresswell, J.W., 2007. *Qualitative Inquiry & Research Design: Choosing among Five Approaches*, 2nd edition. Sage, London.
- de Leeuw, E., 2008. Self-administered questionnaires and standardized interviews. In: Alasuutari, P., Bickman, L., Brannen, J. (Eds.), *The SAGE Handbook of Social Research Methods*. Sage, Thousand Oaks, pp. 313–327. <https://doi.org/10.4135/9781446212165>. Chapter 18.
- Ehrlich, A., 2021. Collective impacts: using systems thinking in project-level assessment. *Impact Assess. Project Appraisal* 40 (2), 129–145.
- Eijssen, P., Jesus, J., 2015. Non-Technical Summary, FasTips no.9, March, 2015, International Association for Impact Assessment, Fargo. Available: https://www.iaia.org/uploads/pdf/Fastips_9NonTechnicalSummary.pdf (accessed 2 Jan 2023).
- Flyvbjerg, B., 2011. Case study. In: Denzin, N., Lincoln, Y. (Eds.), *The Sage Handbook of Qualitative Research*, 4th edition. Sage, Thousand Oaks, California, pp. 301–316.
- Fowler, F., 2009. *Survey Research Methods*, 4th ed. Sage, Thousand Oaks.
- Gale, N., Heath, G., Cameron, E., Rashid, S., Redwood, S., 2013. BMC Med. Res. Methodol. 13 <https://doi.org/10.1186/1471-2288-13-117.pdf>, 117 [8 pages].

- González Del Campo, A., Gazzola, P., 2020. Untapping the potential of technological advancements in strategic environmental assessment. *J. Environ. Plan. Manag.* 63 (4), 585–603. <https://doi.org/10.1080/09640568.2019.1588712>.
- González, A., Gilmer, A., Foley, R., Sweeney, J., Fry, J., 2008. Technology-aided participative methods in environmental assessment: an international perspective. *Comput. Environ. Urban. Syst.* 32 (4), 303–316.
- Harris, P., McManus, P., Sainsbury, P., Vilianni, F., Riley, E., 2021. The institutional dynamics behind limited human health considerations in environmental assessments of coal mining projects in New South Wales, Australia. *EIA Rev.* 86, 106473.
- Higgs, G., Berry, R., Kidner, D., Langford, M., 2008. Using IT approaches to promote public participation in renewable energy planning: prospects and challenges. *Land Use Policy* 25 (4), 596–607.
- IEMA, 2017. Delivering Proportionate EIA. A Collaborative Strategy for Enhancing UK Environmental Impact Assessment Practice. IEMA, Lincoln. Available: <file:///Users/anmorri0/Downloads/Delivering-Proportionate-EIA.pdf> (accessed 2 Jan 2023).
- Jasanoff, Sheila, 2003. Technologies of humility: citizen participation in governing science. *Minerva* 41, 223–244.
- Jonsen, K., Jehn, K., 2009. Using triangulation to validate themes in qualitative studies. *Qual. Res. Organ. Manag.* 4 (2), 123–150.
- Kahila-Tani, M., Kyttab, M., Geertman, S., 2019. Does mapping improve public participation? Exploring the pros and cons of using public participation GIS in urban planning practices. *Landsc. Urban Plan.* 186, 45–55.
- Kahneman, D., 2012. *Thinking, Fast and Slow*. Penguin, Farrar, London.
- Lee, N., Colley, R., 1991. Reviewing the quality of environmental statements: review methods and findings. *Town Plan. Rev.* 62 (2), 239–248.
- Leeuwis, C., 2004. *Communication for Rural Innovation: Rethinking Agricultural Extension*. With Contributions from Anne Van den Ban, Third edition. Blackwell Science Ltd.
- Lejano, R., Tavares-Reager, J., Berkes, F., 2013. Climate and narrative: environmental knowledge in everyday life. *Environ. Sci. Pol.* 31, 61–70.
- Lovett, A., Appleton, K., Warren-Kretzschmar, B., Von Haaren, C., 2015. Using 3D visualization methods in landscape planning: an evaluation of options and practical issues. *Landsc. Urban Plan.* 142, 85–94.
- Mak, A., Lai, P., Kwong, R., Leung, S., 2006. Too much or too little: Visual considerations of public engagement tools in environment impact assessments. In: Bres, R., Stéphane, Laurini (Eds.), *Visual Information and Information Systems*. 8th International Conference, VISUAL 2005, Amsterdam, the Netherlands, July 5, 2005, Revised Selected Papers, Vol. 3736, pp. 189–202.
- Metze, T., 2020. Visualization in environmental policy and planning: a systematic review and research agenda. *J. Environ. Policy Plan.* 22 (5), 745–760.
- Mwenda, A., Bregt, A., Ligtenberg, A., 2015. How is spatial information used in environmental impact assessment in Kenya? *J. Environ. Assess. Policy Manag.* 17 (3), 1–22.
- Neuman, W.L., 2014. *Social Research Methods: Qualitative and Quantitative Approaches*, 7th edition. Pearson Education Limited, Harlow.
- Northcut, Kathryn, 2006. Images as facilitators of public participation in science. *J. Vis. Lit.* 26 (1), 1–14.
- Oliveira, A.R., Partidário, M., 2020. You see what I mean? – a review of visual tools for inclusive public participation in EIA decision-making processes. *Environ. Impact Assess. Rev.* 83 <https://doi.org/10.1016/j.eiar.2020.106413>, 106413 [11 pages].
- Petts, J., Leach, B., 2000. *Evaluating Methods for Public Participation: Literature Review*. R&D Technical Report: E135., Environment Agency.
- Pflughoeft, B.R., Schneider, I.E., 2020. Social media as E-participation: can a multiple hierarchy stratification perspective predict public interest? *Gov. Inf. Q.* 37, 101422.
- Rubin, H., Rubin, I., 2005. Structuring the interview. In: *Qualitative Interviewing* (2nd ed.): The Art of Hearing Data. SAGE, London, pp. 129–151.
- Sandham, L.A., Huysamen, C., Retief, F.P., Morrison-Saunders, A., Bond, A.J., Pope, J., Alberts, R., 2020. Evaluating environmental impact assessment report quality in south African national parks. *Koedoe* 62 (1), 1–9. <https://doi.org/10.4102/koedoe.v62i1.1631> a1631.
- Senecah, S.L., 2004. The trinity of voice: The role of practical theory in planning and evaluating the effectiveness of environmental participatory processes. In: Depoe, S. P., Delicath, J.W., Elsenbeer, M.A. (Eds.), *Communication and Public Participation in Environmental Decision Making*, Chapter 1. State University of New York Press.
- Sinclair, J., Diduck, A., Parkins, J., 2022. Innovative approaches to achieving meaningful public participation in next-generation impact assessment. In: Hanna, K. (Ed.), *Routledge Handbook of Environmental Impact Assessment*. Routledge Taylor & Francis Group, London, pp. 239–258. <https://www.routledge.com/Routledge-Handbook-of-Environmental-Impact-Assessment/Hanna/p/book/9780367244477>.
- Sleigh, J., Vayena, E., 2021. Public engagement with health data governance: the role of visibility. *Hum. Soc. Sci. Commun.* 8, 149. <https://doi.org/10.1057/s41599-021-00826-6>.
- Smith, C.A., 2022. Community drawing and storytelling to understand the place experience of walking and cycling in Dushanbe, Tajikistan. *Land* 12, 43. <https://doi.org/10.3390/land12010043>.
- United Nations, 1991. *Convention on Environmental Impact Assessment in a Transboundary Context*, United Nations. available: https://www.unece.org/fileadmin/DAM/env/eia/documents/legaltexts/Espoo_Convention_authentic_ENG.pdf (accessed 2 Jan 2023).
- van Herk, S., Zevenbergen, C., Ashley, R., Rijke, J., 2011. Learning and action alliances for the integration of flood risk management into urban planning: a new framework from empirical evidence from the Netherlands. *Environ. Sci. Pol.* 14, 543–554.
- Vanclay, F., Esteves, A.-M., Aucamp, I., Franks, D., 2015. *Social Impact Assessment: Guidance for Assessing and Managing the Social Impacts of Projects*. International Association for Impact Assessment, Fargo available: <https://www.iaia.org/pdf/IAIA%202015%20Social%20Impact%20Assessment%20guidance%20document%20copy.pdf> [accessed 4 Jan 2023].
- Wanarat, K., Nuanwan, T., 2013. Using 3D visualisation to improve public participation in sustainable planning process: experiences through the creation of Koh Mudsum plan, Thailand. *Procedia Soc. Behav. Sci.* 91, 679–690.
- Witkowski, K., Reyes, A., Padilla, M., 2021. Teaching diversity in public participation through participatory research: a case study of the PhotoVoice methodology. *J. Pub. Aff. Educ.* <https://doi.org/10.1080/15236803.2020.1858534>.
- Yovanovic, I., Goñi, J., Miranda, C., 2021. Remote usability assessment of topic visualization interfaces with public participation data: a case study. *JeDEM – eJ. eDemocr. Open Gov.* 13 (1), 101–126. <https://doi.org/10.29379/jedem.v13i1.640>.