Transformative effectiveness: Evaluating how EIA may transform stakeholders' frames of reference to deliver strong sustainability outcomes

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1

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Abstract: Since its inception, environmental impact assessment (EIA) was envisioned to bring about transformative change, it has evolved into a tool with the principal aim of fostering sustainable development. Sustainability can be conceived along a 'weak' and 'strong' continuum, in which the latter holds that substitution of natural capital is severely limited, but evidence suggests that weak sustainability prevails in decision-making supported by EIA. Therefore, based on the assumption that strong sustainability is the required goal to protect biodiversity and mitigate future climate change, the aim of this paper is to better understand and evaluate how EIA may foster the transformation of stakeholders' frames of references towards strong sustainability. The methodology consisted of a literature review. Such transformation occurs through communicative learning via sustained and meaningful public participation throughout the EIA process that results in changes in stakeholders' frames of reference. From this, a new dimension of transformative effectiveness is characterized that can help to evaluate the extent to which EIA practice is transforming towards strong sustainability as a goal. The US, EU, and Brazil served as case studies to analyze the implicit transformative purpose in these EIA systems and assess their ability to deliver such transformation. While the systems reviewed lack the legally binding implementation measures to fulfill such visionary purposes for EIA, the objectives established in their foundational legislation represent a roadmap for transformation towards strong sustainability. It is hoped that this paper will generate more research on the transformative potential of the practice of EIA.

1 Introduction

Environmental impact assessment (EIA) as currently practiced is failing to halt net biodiversity loss. While it has advanced in aspects of limiting biodiversity loss, it has not yet in general achieved maintenance or enhancement of biodiversity and ecosystem services (Brownlie et al. 2013; Moilanen and Kotiaho 2021; Rainey et al. 2015). EIA, which is a part of the larger Impact Assessment (IA) family, is established in most countries in the world with the aim of promoting sustainable development (Morgan 2012; UNEP 2018). The plural nature of the understanding of sustainable development is often used as the basis for arguments that more dialogue during the EIA process is needed to find mutual agreement about the definition of sustainable development (Bond et al. 2013), which can lead to a lowest common denominator

consensus that environmental capital can be traded against socio-economic gain, meaning that no transformation of the development status-quo takes place, and weak sustainability is delivered from this frame of reference (Runhaar et al. 2013). We consider this to be a significant failing in the way effectiveness is perceived in the literature, given that transformation is implicit in EIA policies worldwide. Thus, in order to evaluate the tool's effectiveness, it is argued in this article that EIA has the potential to deliver 'strong sustainability' through the transformation of stakeholders' frames of reference via transformative learning. Strong sustainability is a paradigm characterized by the protection of environmental capital rather than its substitution which is often not advisable (Ekins et al. 2003). This is aligned with pleas by Partidario (2020) to show how impact assessment might need to be changed to address global problems including current shortcomings in progress to address climate change (IPCC 2021), and the need to reorientate EIA with international policy such as the Sustainable Development Goals (Koff 2021).

EIA has evolved from a conservation focus concerned primarily with the physical, chemical, and biological aspects of environmental impacts, to sustainable development aims that are more holistic (Cashmore et al. 2007; IAIA 2009). It has, nevertheless, been envisioned to bring about transformative change (Culhane et al. 1987), potentially by reforming institutions and organizations, and changing the underlying assumptions of decision-making by changing stakeholders' world views and values (Bartlett and Kurian 1999). Taylor (1984) envisioned that EIA could reform institutions internally where there was an internal group committed to the values of EIA, whereas Cashmore et al. (2008) found evidence for EIA changing the values and culture of organizations as well as whom they hire, although it has been speculated that such transformation would take decades (Bartlett and Kurian 1999; Caldwell 1984).

Evaluating whether EIA is meeting its stated goals is essential to ensure effective practice, and led to global collaboration over the "International Study of the Effectiveness of Environmental Assessment" (Sadler 1996). This study conceptualized effectiveness through three key dimensions: procedural, substantive, and transactive. Respectively, these dimensions deal with the adherence to established provisions and principles; achieving EIA's objectives, supporting well-informed decision-making, and contributing to environmental protection; and finally, the temporal and cost efficiency of the process. A fourth dimension, normative effectiveness, was added by Baker and McLelland (2003), which acknowledged the need to reflect on the extent to which EIA

achieves normative goals, such as more participatory decision-making and wider policy goals such as sustainable development.

The effectiveness framework was further expanded by Bond et al. (2013) who added two more dimensions: pluralism, and knowledge and learning. Pluralism has been widely discussed in the EIA literature (e.g., Cashmore 2004; Cashmore et al. 2004; Morgan 2012) and recognizes that sustainable development is itself a contested concept, and that there is a need to integrate different framings of sustainability into impact assessment instruments. The second dimension, knowledge and learning, recognizes that the generation and sharing of knowledge as well as how EIA facilitates both instrumental and conceptual learning, are important measures of its effective implementation and reconceptualization. Pope et al. (2018) proposed to combine all the normative dimensions (normative, knowledge and learning, pluralism) and instead consider that they could all be subsumed into a legitimacy dimension.

While these effectiveness frameworks include aspects of change and learning, they tend to focus on procedural effectiveness (Geißler et al. 2019; Loomis and Dziedzic 2018) and are embedded in a mindset that impacts represent change from a baseline situation. As such, they do not capture the fundamental and structural transformative change and learning implied by 'strong sustainability' (Hopwood et al. 2005; Illge and Schwarze 2009).

Therefore, the aim of this paper is to establish the concept of a new effectiveness dimension known as transformative effectiveness to better encapsulate and evaluate the degree to which EIA can foster the transformation of stakeholders' frames of references to deliver strong sustainability. In order to meet this aim, the paper is structured as follows. Section two briefly introduces the methodology. Following this, different framings of sustainable development are introduced that are relevant to EIA in section three; in particular, this section explains what strong sustainability means, which is the basis for the required transformation. In section four, the transformative purpose of EIA and its strong sustainability characteristics are identified by referring to the statutes and regulations of three different EIA systems: the United States (US), Brazil, and the European Union (EU). The US was chosen as it was the first EIA system in the world and has served as the role model for subsequent EIA systems (Köppel et al. 2012). Brazil was chosen since it is a major middle-income developing country that developed its EIA system early on (1981) and has conceptually advanced EIA legislation and regulations (Loomis et al. 2021). The EU's EIA Directive was chosen since it guides the development of EIA legislation in the 27 member States

and European Economic Area States. Whilst other examples would also be suitable, pragmatically, the authors have more knowledge and experience of these jurisdictions. Section five describes how transformation of stakeholders' frames of reference take place and introduces the concept of transformative effectiveness as a means of evaluating the extent to which EIA is directed towards strong sustainability outcomes. Section six concludes with a consideration of the implications for EIA research.

2 Methodology

Since the aim of the paper is to establish the concept of transformative effectiveness that evaluates how EIA may deliver strong sustainability via transformation of stakeholders' frame of reference, it also aims to understand how this transformation occurs and thus is exploratory in nature. The approach taken was to conceptualize transformative effectiveness in the context of EIA. After Jabareen (2009), this involves a series of steps:

1) Mapping the selected data sources
2) Extensive reading and categorizing of data
3) Identifying and naming concepts
4) Deconstructing and categorizing concepts
5) Integrating concepts
6) Synthesis, resynthesis, and making it all make sense
7) Validating the conceptual framework

The first step involved a literature review from 1996 to 2021 using the Scopus database, supplemented with Google Scholar. Searches were made using the search term EIA 'OR' "impact assessment" 'AND' the search terms (all separate using the Boolean operator 'OR'): environmental impact assessment; transformation; EIA effectiveness dimensions; quality; policy transformation; conceptual learning; transformative learning; environmental governance; policy learning, reform, and change; and strong sustainability.

The literature review therefore initially focused on understandings of transformation within the impact assessment field, as the contextual setting for the conceptualization. To supplement

understanding of transformation from other fields of study, literature on adult learning and transformative learning was also examined via searches in the same databases using the search terms "adult learning" 'OR' "transformative learning", which led to research publications about the transformative paradigm and transformative change research. As studies were reviewed for inclusion, a qualitative 'snowball' approach (Lecy and Beatty 2012) was taken for backward citing, which was complemented by forward citation search via either Scopus or Google Scholar as appropriate. This approach inevitably led to some engagement with literature from the organizational development field, and literature dealing with climate change adaptation, although we did not undertake a comprehensive literature review in any field where transformational change is considered. Instead, we restricted our analysis to understanding in the field of application (impact assessment), along with key learnings from other fields of study that were found to add valuable perspectives. From these search and review techniques a total of 110 references were included and form the basis of this article's analysis. Engaging with transformative learning literature was important for understanding how this transformation occurs, which became important for determining how to evaluate EIA's ability to deliver this outcome, i.e., transformative effectiveness.

Evaluation of EIA effectiveness can be conducted at various levels. Morrison-Saunders and Arts (2004) described three scales: micro; macro; and meta. Micro-scale EIA involves a particular EIA project case study and the practice within it. The macro scale deals with the EIA system that includes not only individual EIA processes, but also the actors and institutions involved, regulatory framework, and the societal context. Meta-scale EIA focusses on EIA as a concept with questions pertaining to its purpose. As Sadler (2004) goes on to discuss, analysis at the macro-scale focuses on learning, process development, and decision-making, while the meta scale is concerned with broader concepts beyond single systems. These concepts include state-of-the-art analysis, principles, trends, good practice guidance, and EIA theory. As this study is theoretical, the focus is on the meta-scale of EIA, but examples from the macro and micro-scales serve to illustrate the concepts discussed herein.

The remaining steps (2-7) based on the conceptualization approach of Jabareen (2009) then involved making sense of the data in a highly inductive way. Whilst developing an understanding of transformative change in EIA, the case studies introduced in section four were simultaneously

analyzed to ensure the potential validity of the understandings emerging. That is, their relevance to the meta-level of EIA.

3 Strong Sustainability

Sustainable development is a vague concept that has gained widespread appeal partly due to its ambiguity (Mebratu 1998; Mensah 2019). The most established definition still being that of the United Nations World Commission on Environment and Development (UN WCED 1987) that defines it as development that meets the needs of present generations without compromising future generations' needs.

Yet, this definition leaves considerable room for interpretation. It holds inherent contradictions about economic growth, environmental degradation, poverty, often proposing techno-economic fixes to such problems while ignoring underlying sociopolitical structures and cultural values that contribute to these problems (Lélé 1991). The lack of resolution among these contradictions has led to the development of the three pillars approach, where the connections, compatibility, tradeoffs, and substitutability among the environmental, social, and economic pillars of sustainable development are affirmed. Unlike its predecessor eco-development, sustainable development recognizes the inherent connections between economic needs of individuals and communities to fulfill social needs and goals whilst recognizing the limitations placed on the use of environmental resources, meaning that sustainable development is context dependent (Mensah 2019). The reality of increasing levels of development is that tradeoffs and substitutability (between environmental resources and socio-economic capital) are encouraged (Sneddon et al. 2006). The environmental consequences of this 'weak sustainability' paradigm lead to arguments that trade-off rules are required to ensure the future integrity of social-ecological-technological systems upon which modern day society depends (Gibson et al. 2005).

Neumayer (2013) considers that weak sustainability, with its assumption that all forms of capital (natural, human, man-made, social, and financial) are substitutable, is a paradigm of resource optimism, i.e., that rising living standards (even with rising consumption) will eventually lead to the stock of renewable resources and natural pollution sinks returning to sustainable levels,

which is to believe that technical progress can overcome resource challenges. On the other hand, strong sustainability infers that deep structural changes to our economic system will be required, such as ending the promotion of unfettered consumerism, economic growth, and declining utility of future capital (Illge and Schwarze 2009). Furthermore, Ekins et al. (2003) argue that viewing industrialization as the transformation of natural capital into manufactured capital, with waste production as a by-product, illustrates the imperfect substitutability. Sustainable development must meet social needs while not crossing certain thresholds of earth's life supporting biophysical systems (Hajer et al. 2015). Thus, in this paper we take the view that EIA needs to set its goal more clearly towards strong sustainability. And given that decision-making currently favors a weak sustainability framing of sustainability development, it underlines a need for a transformation towards strong sustainability. In order to measure progress in this transformation, the notion of transformative effectiveness of EIA processes will be helpful. Based upon the literature reviewed, the principles of strong sustainability that can be identified are listed in Table 1.

Table 1 Principles of strong sustainability

- Substitution of natural capital for other kinds of capital should be severely limited.
- Critical natural capital exists which should not be substitutable.
- There should be no net loss of any kind of capital in development.
- The stocks, sinks, and life support of natural capital should be restored and enhanced as their loss may be irreversible.
- The economic system is a subsystem of the social system, which is a subsystem of the environmental system.
- Unlimited economic growth based on increasing levels of material use is impossible on a planet of finite resources.
- The precautionary principle should guide decision-making

For the necessary sustainability transformations, which occur over long time periods, there is argued to be a fundamental role for governance and guidance to ensure the multi-dimensional change of a given social-ecological-technological system (Markard et al. 2012; Pelling 2010; Geels 2019). General principles can act as the drivers for sustainability transitions, or specific procedural requirements that lead to gradual changes in institutions' organization and decision-making (Kindler 1979; Zimmermann et al. 2011). Transformational changes to the dominant paradigm involve learning among stakeholders (Macintyre et al. 2018). They must critically reflect on their

beliefs and values that can change their frames of reference and ultimately become more open to other points of view, and this requires a communicative form of learning among stakeholders through greater public participation (Sinclair et al. 2008). It is also argued that meaningful stakeholder participation is essential to meet the governance transformations towards sustainability of complex socio-ecological systems (McGinnis and Ostrom 2014). This involves inter- and transdisciplinary approaches, including local and traditional knowledge (Zimmermann et al. 2011). At the same time this must be accompanied by reflection in order for collective learning to take place (Pelling 2010) and to develop the necessary capacity and capabilities to guide and facilitate such transformation (Wise et al. 2014). In social-ecological-technological systems, communities of actors, each with their sustainability framing and particular interests act to obtain their goals. Therefore, effective governance outcomes require analysis of their interdependencies and connections as well as their collective actions (Ojha et al. 2016). Subsequently, this requires transformations of stakeholders and organizations' frames of reference and their paradigms (Termeer, Dewulf, and Biesbroek 2017) as vulnerability and risk are framed as wider societal problems (Pelling 2010; Wise et al. 2014).

The need for transformations in EIA practice towards achievement of strong sustainability is not explicitly mandated in any EIA system of which we are aware. In order to underpin arguments that a transformational change is needed, the next section identifies the transformative purposes of the mandates in the three case study EIA systems.

4 Discerning Transformation in EIA and Transformative Effectiveness

Having discussed strong sustainability (section 3), this section discusses the concept of transformation of stakeholders' frames of reference, how this occurs in EIA, and how this can be evaluated. Transformative effectiveness within EIA can be understood as the extent to which it accomplishes EIA's transformative purpose of fundamentally changing stakeholders' frames of reference (Sinclair and Diduck 2001; Sinclair et al. 2008), as proposed in the literature (Culhane et al. 1987; Bartlett and Kurian 1999) with observations that EIA changes stakeholders' values and

beliefs from a purely developmental or weak sustainable development paradigm to a strong sustainable development paradigm (Cashmore et al. 2007; 2008; Jones and Morrison-Saunders 2017). This change means stakeholders are learning through EIA, which has been recognized in the literature (Bond and Morrison-Saunders 2013) and furthermore that this fosters environmental awareness (Runhaar et al. 2013).

Learning has been conceptualized as falling into three types: single-loop, double-loop, and triple-loop learning. Single-loop learning reflects the process of problem correction without questioning the underlying assumptions. Double-loop learning questions the underlying assumptions of the problem conception (e.g., the cause-effect relationships) within a value-normative framework (Argyris and Schön 1978). Triple-loop learning involves reconsidering underlying beliefs and values (Pahl-Wostl 2009) - this is similar to the concept of first-, second, and third-order schemata described by Bartunek and Moch (1987). Triple-loop learning involves a transformation in the frames of references, i.e., the underlying cognitive, psychological, and emotional mental schemes that shape a person's beliefs, values, and feelings, and thus how they interpret and experience reality. As the purpose of EIA is strong sustainability, as we argue in this paper, transformation in EIA means the changing of stakeholders' frames of reference towards this paradigm with potential to reshape organizations as argued elsewhere in the literature (Caldwell 1988; Taylor 1984; Bartlett and Kurian 1999; Cashmore et al. 2007). Therefore, transformative effectiveness would be the degree to which EIA achieves this. However, this concept of transformation is largely absent in the EIA effectiveness literature.

Thus, triple-loop learning equates to transformative learning, which is a term ascribed to Mezirow (1978) who used the term 'perspective transformation' to describe the identity shift of women during the women's movement in the 1960s and 70s. Mezirow (2009) describes learning as a series of interpretations or reinterpretations of experiences. He defines transformative learning as a process of fundamentally changing frames of reference to become more inclusive, discriminating, reflective, and emotionally able to change. According to the author, such transformation can generate beliefs and opinions that are more justified in guiding action. This is crucial as shifts in problem framing changes its meaning, which can produce radically different identified needs and solution alternatives (Watzlawick et al. 2011). In the context of sustainability, this captures the aspect of the need for openness, adaptiveness, and interaction as sustainability is a learning process (Lafferty 2004).

In order to better understand Mezirow's definition, the terminology must be explained (illustrated in **Error! Reference source not found.**). Frames of reference involve cognitive, psychological, and emotional parts that have two dimensions, habits of mind and the resulting points of view. The former are broad and abstract ways of thinking influenced by assumptions that stem from educational, cultural, political, religious, social, economic, and other factors. The interpretation of these through personal experience constitutes the latter: a point of view. Each point of view comprises clusters of meaning schemes, which are the expectations, beliefs, feelings, attitudes, and judgments which will influence interpretations of experiences (Kitchenham 2008). Collections of frames of reference can constitute a paradigm (Mezirow 1997). These terms and how they relate to transformation in EIA are shown in Table 2.

Table 2 Transformation concepts

Concept	Definition
Transformation in EIA	The change in a stakeholder's frame of reference that is more open, inclusive, discriminating, reflective, and that adheres to strong sustainability principles.
Frame of reference	It consists of habits of minds and resulting points of views that will be influenced by individual cognitive, psychological, and emotional parts.
Habits of mind	The broad and abstract ways of thinking influenced by assumptions that stem from educational, cultural, political, religious, social, economic, and other factors.
Points of view	The interpretation of habits of mind through personal experiences. Each point of view comprises clusters of meaning schemes, which are the expectations, beliefs, feelings, attitudes, and judgments that will influence interpretations of experiences.
Paradigm	Collections of frames of reference.

(Pahl-Wostl 2009; Cashmore, Bond, and Cobb 2007; Jones and Morrison-Saunders 2017; Sinclair and Diduck 2001; Sinclair, Diduck, and Fitzpatrick 2008; Kitchenham 2008; Mezirow 1997; 2009)

How this transformation occurs can be individual or collective (Kitchenham 2008; Mezirow 2009) via instrumental or communicative domains (Mezirow 2009). This change, whether

individual or collective, can be epochal (e.g., a life changing event or a disaster) or it can be cumulative from a series of insights changing the frame of reference (e.g., a series of meaningful engaging dialogues with people of different frames of reference), both require critical self-reflection. Habermas (1984) introduced the concepts of instrumental and communicative domains. The former deals with hypothesis testing and transformation occurs through critical reflection. The latter deals with learning how to understand the meaning of what others communicate, e.g., values, ideas, feelings, moral decisions; here transformation occurs through dialogue. In transformative learning terminology this is the process by which individuals or groups develop more functional frames of reference that are more inclusive, differentiating, permeable, critically reflective, and integrative of experience (Sinclair and Diduck 2001). Environmental decision-making falls into the communicative domain and transformation emerges from dialogue (Manuel-Navarrete et al. 2004). EIA is envisioned to produce transformational change, as one potential means of sustainability transformation (Lafferty 2004), through its procedures that incorporate environmental values into organizational decision-making. Transformational change in an organizational context then is a process-oriented strategy that is part of organizational transformation through the change of abstract underlying concepts such as consciousness raising, understanding alternative perspectives, and challenging the fundamental belief system, versus transitional organization change that involves a step-by-step method towards a specified change (Levy and Merry 1986).

Transformation as the breakdown and reconstruction of a paradigm (Kegan 2009) is similar to the 'critical consciousness' awakening as described by Freire (1987) who influenced Mezirow's theories (Phillippi 2010), whereby the learner is liberated. Freire (1987) posits that such learning is iterative between the teacher and student, which like Habermas' (1984) communicative action theory involves dialogue. In the context of EIA, this means interactive and meaningful participation (versus solely passive informative participation) that adheres to what Mezirow (2009) identified as ideal conditions for reflective discourse (**Error! Reference source not found.Error! Reference source not found.**). These ideal conditions can serve as guides before the formal EIA process begins, through the phases (e.g., screening, scoping, impact identification), to post-decision (i.e., follow-up) activities, and these were operationalized by Sinclair and Diduck (2001). Prior to an EIA process, open and iterative dialogue can help establish parameters for desired uses of a given territory. During the process, these conditions can serve to encourage more active and

participative decision-making among different stakeholders as well as mutual learning among participants, although such transformative learning is likelier to take place early in the process, as Sinclair et al. (2008) observed in Canada. Finally, during the follow-up these guidelines can foster constructive criticism and feedback of a given EIA process, as a 'lessons learned' exercise (Arts and Morrison-Saunders 2004), which can help with the accountability, legitimacy, and transparency of the process (Morrison-Saunders et al. 2021).

Yet, since sustainable development is a value-laden concept (Bond et al. 2010), stakeholders often arrive predisposed to a certain sustainability discourse making deeper transformative learning difficult (Pope et al. 2018). Therefore, EIA must overcome the ambiguity of the term sustainability (Bond et al. 2020) and in so doing orient stakeholders towards strong, long-term sustainability concepts (Connelly and Richardson 2005). Other outcomes from more discursive participation and conceptual learning have been raising environmental awareness among stakeholders (Runhaar et al. 2013; Wang et al. 2012), changing the power dynamics (Argote 2013; Sánchez and Mitchell 2016), and fostering greater collaboration among private and public sectors (Wang et al. 2012). These results require investment in staff, time, and materials, which are major constraints in EIA (Sánchez and Mitchell 2016).

Table 3 Ideal conditions for reflective discourse

• Accurate and complete information
• Free from coercion
• Open to alternative points of view
• Be able to assess arguments objectively
• Awareness and critical reflection of the context of ideas and assumptions
• Equal opportunity to participate in the various roles of discourse
• Testing validity of judgments until new perspectives, evidence or arguments are encountered that result in better judgments

(Mezirow 2009)

EIA as a decision-support tool is a learning vehicle (Bond and Morrison-Saunders 2013), and it shapes as well as is shaped by its practitioners (Pahl-Wostl 2009). Transformative learning in EIA is likely to arise over a series of EIAs whereby the practitioner or organization critically reflect on such processes and gain insights that change their frames of reference (Mezirow 2009).

This highlights the necessity of institutionalizing post-decision activities such as monitoring, auditing, and adaptive management practices as these offer continuous learning opportunities and a means of refining performance criteria to improve future EIAs (Morrison-Saunders et al. 2021). For EIA, the stakeholders with the most exposure are often the agencies tasked with overseeing the EIA process and the consulting firms that conduct the studies and compile the EIA report, but other stakeholders critical to EIA are the project proponent, non-governmental organizations (NGOs), and the affected local public (Ahmad and Wood 2002; Glasson and Therivel 2019). Transformational learning in specific stakeholders is enhanced through the communicative domain of learning, i.e., understanding the values, morals, ideas, feelings that others communicate, which is accomplished through reflective discourse (Habermas 1984). Yet, open and participatory discussions on the appropriate sustainability goals to be achieved through EIA must be constrained by clear strong sustainability principles (Sheate 2012; Lafferty 2004) (Table 1) that can operationalize the transformative purpose inherent in EIA.

The level of transformation, as previously mentioned, can be individual or collective, and needs to occur at each of the micro-, macro-, and meta scales. Starting with NEPA, EIA was envisioned to be an action-forcing mechanism applied within the US federal government's project decision-making whereby transformative change occurs at the micro-scale. However, Taylor (1984) recognized the possibility to reform institutions from the inside and posited necessary conditions for this to happen: having clear goals for EIA and a group committed to the values of EIA, with the autonomy and power to promote these values. Here the transformation is envisioned at the macro-scale via changes to personnel who can subsequently change institutions and regulations. Changing people with responsibility for particular tasks within organizations can lead to changes in the values, culture, structures, and goals of organizations (Bartlett and Kurian 1999), and such an approach has been taken in many companies through their introduction of Chief Sustainability Officers (Miller and Serafeim 2014). In the context of EIA, Jones and Morrison-Saunders (2017), studying decades of documents of an organization involved in numerous EIAs in Western Australia, observed a similar evolution in the organizations' attitudes towards EIA and sustainability. At the meta-scale this is evident in the evolution in EIA's conceptual purpose from a conservation tool to one promoting sustainable development (Cashmore et al. 2007; UNEP 2018) with strong sustainability potential in aspects of the three EIA systems examined in this article.

This section has discussed what transformation of a stakeholder's frames of reference means, how this occurs, and how this can be evaluated. The effectiveness of this transformation is called transformative effectiveness, and here a working definition is proposed. In the case of EIA (although it is applicable to other IA instruments), transformative effectiveness is the extent to which the IA tool accomplishes its transformative purpose, which is to fundamentally change a stakeholder's frames of reference, from a purely developmental or weak sustainable development paradigm to a strong sustainable development paradigm (Bina 2008; Cashmore et al. 2007; 2008; Jha-Thakur et al. 2009; Jones and Morrison-Saunders 2017; Mezirow 2009; Rees 1995; Sinclair and Diduck 2001; Sinclair et al. 2008). This occurs in the communicative domain of learning (Habermas 1984; Mezirow 2009), at the individual or organizational level (Bina 2008; Culhane et al. 1987; Nalau and Handmer 2015; Wallington et al. 2007), and likely over the long-term (Nalau and Handmer 2015; Pahl-Wostl 2009; Wallington et al. 2007) and will be more visible at the macro-system EIA level rather than in an individual process (micro-scale EIA) (Cashmore et al. 2008; Cashmore et al. 2009). The concepts related to transformative effectiveness are listed in **Error! Reference source not found.** to provide a summary.

Table 4 Transformative effectiveness concepts

Transformative aspect	Description	References
Working definition	The extent to which the IA tool accomplishes its transformative purpose, which is to fundamentally change a stakeholder's frames of reference, from a purely developmental or weak sustainable development paradigm to a strong sustainable development paradigm.	(Bina 2008; Cashmore et al. 2007; 2008; Jha-Thakur et al. 2009; Jones and Morrison-Saunders 2017; Mezirow 2009; Rees 1995; Sinclair and Diduck 2001; Sinclair et al. 2008)
Domain	Transformation in IA instruments, as a form of conceptual learning, deals with communicative learning, which is concerned with the understanding of values and beliefs resulting from reflective discourse.	(Habermas 1984; Mezirow 2009)
Level	Can occur on the individual or organizational levels. This involves improving individual learning capabilities, team learning, updating mental models, and open systems thinking. This can change institutional arrangements, personnel choices, and power dynamics, e.g., horizontal and vertical integration of environmental policies.	(Bina 2008; Culhane et al. 1987; Nalau and Handmer 2015; Wallington et al. 2007)
Time	Transformation in socio-ecological-technological systems often takes place over long time periods with sustained engagement,	(Nalau and Handmer 2015; Pahl-Wostl 2009; Wallington et al.Thissen 2007)

	i.e., regular interaction with EIA processes, actors, and networks.	

5 The Transformative Purpose Inherent in the EIA systems of the US, EU, and Brazil

In order to illustrate the potential transformative aspects inherent in the purpose of the EIA, the systems in the US (as the world's first legislation), the EU (as a system covering 30 countries, including those in the European Economic Area, at the time of writing, and with wider reach through EU capacity development activities), and Brazil (as an example of a system in a major developing country), are briefly discussed here and summarized in Table 5.

Despite being mandated in some countries since 1970, EIA is often criticized for not fostering sustainable development (Eccleston 2011; Glasson and Therivel 2019) even though it was explicitly seen as a tool for achieving sustainable development in the UN Rio Declaration (UN 1992). The National Environmental Policy Act (NEPA) of the United States of America (USA), which created the first EIA system, was envisioned through its action-forcing mechanism to be an agent for transformative change from the beginning of its implementation (Cashmore et al. Cobb 2007). It forces federal agencies to produce statements (the environmental impact statement) detailing the environmental impacts of any federal action. Furthermore, in the regulations of the US Council on Environmental Quality (1978) the purpose of the environmental impact statement (EIS) is explicitly detailed to be an action-forcing device to infuse the policies and goals of NEPA into the federal government. Such broad visions of harmony between man and nature and infusing the goals of NEPA into decision-making across the entire federal government is why NEPA has been called one of the most innovative policy instruments ever (Caldwell 1988). It was believed to accomplish this by integrating considerations of environmental impacts based on scientific evidence via standardized mandatory procedures that would produce EISs with predictive capabilities (Culhane et al. 1987) across all US federal agencies that would gradually bring about changes in personnel and values (Caldwell 1982) necessary for institutionalizing intelligent decision-making around tradeoffs, risks, and other environmental considerations of public interest (Taylor 1984). From this early period it was envisioned that EIA as an informing and testing

process is more than a technical document and that it would expand beyond biophysical considerations to socio-economic considerations requiring more integrated multidisciplinary approaches to bring about a sustainable future (Caldwell 1988).

The European Union (EU) adopted the EIA Directive in 1985 (and has subsequently amended it four times) that established the purpose and guidelines for member states to implement (EU 1985). The EU invokes the precautionary principle, which cautions against actions the consequences of which are uncertain for the environment (O'Riordan and Jordan 1995), and so is a strong framing of sustainability that protects natural resources. Within the academic literature, environmental principles such as the precautionary principle and the polluter pays principle have been envisioned to bring about transformation in science and policy (O'Riordan and Jordan 1995; Shah et al. 2012). The implementation of Directives is subject to periodic review (every five years) by the European Commission, with the fourth review concluding that "Finally, implementation of the Directive has created specific national dynamics. MS [Member States] have often built on the minimum requirements of the Directive and have gone beyond them, by introducing more stringent provisions (on the basis of Article 176 of the EC Treaty), which aim to ensure better environmental protection and more transparency" (Commission of the European Communities, 2009, p.4).

In Brazil, the National Environmental Policy Act (in Portuguese – Políticia Nacional do Meio Ambiente – PNMA) (1981) mentioned EIA as one of the instruments of the PNMA to achieve its objectives. Specific EIA regulations from the National Environmental Council (Conselho Nacional do Meio Ambiente – CONAMA) detail the EIA process that must be conducted by multidisciplinary teams, in a systematic manner, and at the cost of the project proponent (BR CONAMA 1986). Its objective is not simply to prevent or mitigate negative impacts, but to also restore and enhance the environment, here understood to include human society, which is transformative in its understanding of the relationship between development and the broader environment.

Table 5 Transformative purposes in EIA systems

EIA System	Law or regulation	Transformative purposes	Reference
United States	The National Environmental Policy Act – Pub. L. 91-190, 42 U.S.C. 4321-4347	Sec. 2 The purpose of the act is to encourage the natural harmony between man and the environment and stimulate the welfare of humanity. Sec. 101 Congress recognizes the interrelations of nature, population growth, high-density urbanization, industrial expansion, resource	(NEPA 1970)

		exploitation, importance of restoring and maintaining environmental quality, responsibility between current and future generations, enhance the quality of renewable resources and obtain maximum recycling rates of finite resources. Sec. 102 For all federal actions that potentially impact the environment, federal agencies shall use a systematic and interdisciplinary approach to compose statements discussing the environmental impacts.	
United States	Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act	Sec. 1502.1 The primary purpose of the environmental impact statement is to be an action-forcing device and that the policies and goals of NEPA are infused into the actions of the federal government.	(US CEQ 1978)
European Union	Directive 85/337/EEC (as amended)	European policy should be based on the precautionary principle and on the principles that preventative action should be taken, and that the polluter should pay. Important elements in EIA include considering resource efficiency, sustainability, biodiversity protection, climate change, and risks of accidents and disasters.	(EU 1985) as amended
Brazil	Law nº 6938 1981 – National Environmental Policy Act (PNMA)	Art. 2 The objective of the PNMA is to preserve, enhance, and restore the environmental quality conducive to life with the aim of socio-economic development that protects the dignity of human life.	(PNMA 1981)

Assessing the purposes and objectives of EIA across the systems of Brazil, the EU, and the US, it is clear that EIA is envisioned to be more than simply a tool of conservation. In Brazil the PNMA (1981) recognizes that the environment includes society, a more holistic definition, and that impacts must be considered in a systematic manner. Similarly, the EU EIA Directive (as amended) recognizes the connection between the environment and the quality of life. The US NEPA (1969) states that its purpose is to encourage harmony between man and the environment. These objectives all recognize the connection between society and the wider environment, yet all three systems lack explicit focus on strong sustainability in specific regulations or binding guidelines necessary to implement them.

Within the US federal system, the Council on Environmental Quality (CEQ) has produced guidance documents on a variety of topics, since it oversees federal compliance with NEPA. With regards to elements of strong sustainability it has highlighted the profound potential of scoping for environmental analyses (US CEQ 1981), the need for ecosystem perspectives in biodiversity

analyses in NEPA (US CEQ 1993), the need to establish sustainable resource levels as part of baseline conditions (US CEQ 1997a), and the importance of identifying and addressing environmental justice concerns of minority populations (US CEQ 1997b), yet none of these guidance documents are legally binding. The joint guidance by the CEQ and the Office of Management and Budget (OMB) on environmental conflict resolution provides directed guidance and resources on how to effectively integrate different stakeholders' views (US OMB and US CEQ 2012). The US federal system has backtracked by removing the Environmental Protection Agency's rating system of all draft environmental impact statements (US EPA 2018), this institutionalized rating system, which overly focused on procedural aspects, was potentially a means of incorporating strong sustainability principles into EIA evaluation.

The EU EIA system has provided less additional guidance than the US or Brazil given the flexibility afforded Member States in implementing the EIA Directive. The evolution of the EU sustainability strategy has been characterized as focused on environmental policy integration given its supranational status (Zimmermann et al. 2011), where environmental considerations were integrated into various sectoral policies similar to the idea of NEPA in the US. Thus, the EIA Directive establishes a framework that member states then codify into law for implementation. The EU does respond to international policy drivers and amended the EIA Directive to align it with obligations for transboundary consultations through the Espoo Convention (UNECE 1991) and enhanced public participation and access to justice commitments through the Aarhus Convention (UNECE 1998). The strengthening of EIA accountability in public participation addresses some social aspects of sustainability, which could provide a means for stronger sustainability in decision-making through advocacy (Sheate 2012), but can equally open up space to argue for the socio-economics benefits that derive from the use of natural resources. Nevertheless, this procedural approach to sustainability in EIA, potentially changing the frames of reference in actors and organizations through adaptable and reflective policy instruments echoes the ideas of many authors in the literature (Caldwell 1984; 1988; Taylor 1984; Bartlett and Kurian 1999; Jones and Morrison-Saunders 2017) however without clearer operationalization of general sustainability principles, the EU EIA system has not fully transitioned from an environmental policy integration to a strong-sustainability oriented strategy.

From its inception, the EIA system in Brazil has been conceptually advanced for its holistic and multidisciplinary conception of the environment as well as incorporating sustainability

principles such as the polluter pays. The Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), the Environmental Ministry's (MMA) administrative branch, has issued supporting guidance documents. IBAMA has overseen guidance on environmental compensation for both projects impacting protected areas (BR MMA et al. 2011) and projects with significant sources of greenhouse gas (GHG) emissions (BR MMA 2013). While these are welcome developments as opposed to their absence, they remain in the weak sustainability paradigm still often sacrificing natural capital for other forms. More promisingly in terms of strong sustainability, IBAMA has overseen the Strengthening Federal Environmental Licensing Program (ProLAF) in an attempt to continuously improve the EIA system (IBAMA 2021a) and promote continual learning by actors via the regular issuance of EIA guidance documents and a transparent data depository of projects (IBAMA 2016). Overtime this could serve as a platform for transformative learning (Jones and Morrison-Saunders 2017). However, as of 2020 (the latest year for which data are available at the time of writing) the online system is not yet operational (IBAMA 2021b).

While the systems reviewed lack the legally binding implementation measures to fulfill such visionary purposes for EIA, the objectives represent a roadmap for transformation towards sustainable development and inherent in them is a transformation of systems, institutions, and thinking best captured by the concept of strong sustainability. Evaluating an EIA's system for such fundamental change can be better expressed by the concept of transformative effectiveness.

6 Conclusion

This article has discussed transformative change in EIA that involves changes to stakeholders' frames of reference resulting in deep shifts towards a strong sustainability paradigm. Observing such deep changes will likely involve long-term studies. This paper has argued that especially EIA, but other IA tools as well, should be tools for learning, specifically deeper conceptual forms of learning that transform values. Given EIA's goal of sustainable development, this means explicitly recognizing this goal and anchoring EIA statutes and regulations in strong

sustainability principles. This is an inherently value-laden concept, but emphasis on pluralistic and procedural means of resolving sustainability questions has been shown to not result in strong sustainable development outcomes. While recognizing the value-laden nature of IA tools does not automatically resolve conflicts, it does serve as an orienting factor that these tools currently lack.

This article has focused its discussion of transformative change and transformative effectiveness (i.e., the extent to which that change is brought about) on the meta-scale of EIA, i.e., its conception and purpose. At the meta-scale this may involve observations of changes in conceptualizing EIA and other IA tools not towards no net loss, but towards net-positive impacts of EIA. At the same time, it has drawn on examples from the micro and macro-scales. At the micro-scale this could be operationalized, for example, through changes to decision-making methodologies such as the mitigation hierarchy. Since its conception, EIA was envisioned to bring about transformative change through mandatory environmental considerations in project decision-making (micro-scale), but this visionary transformative purpose while inherent in EIA systems has not been fulfilled. This is due to a lack of operationalizing criteria in regulations (macro-level) that are anchored in strong sustainability principles that can provide the necessary parameters and guidance to reflective discourse that is requisite for the kind of cumulative transformative learning that changes stakeholders' frames of reference towards a strong sustainability paradigm to deliver strong sustainability outcomes that are the inherent transformative purpose of EIA (meta-scale).

A consideration of the EIA mandates in the three systems has shown there is reference to transformative purposes towards principles and concepts that align with the strong sustainability paradigm inherent in EIA. Transformative effectiveness involves the assumption that EIA, like all IA tools and many other public policies, requires continued change and improvement. Interest in transformative change and learning across policy contexts means these findings can be of interest to practitioners and researchers in other policy contexts.

This study contributes to the field by reviewing the literature and conceptualizing how EIA might change stakeholders' frames of references through transformative learning to deliver strong sustainability. It is hoped that it will generate more research on the transformative potential of the practice of EIA. This may involve studies that observe changes in stakeholders' values over the course of an EIA process (micro-level), including before the formal process as many considerations about project design happen before the formal EIA process is initiated. It may, as previously noted involve long-term studies about changes in organizations' mission and values

and subsequent projects (micro-level). Perhaps studies focusing on public participation regulations and practices at the EIA system level (macro-level) that more closely adhere to the ideal conditions for reflective discourse. Future research could involve a mixed-methods approach observing changes in stakeholders' values with changes of projects' impacts measured against strong sustainability criteria. Such future research that measures the extent to which this is accomplished is defined as transformative effectiveness.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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