



# Reactions to causality flaws in impact assessment

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## Abstract

Practical and ethical issues about reasoning and/ or communication flaws associated with the expression of causality in impact assessment.

## 1 Introduction

Causality is a fundamental premise of impact assessment<sup>1</sup> (Perdicoúlis and Glasson, 2009). Perhaps for being so elementary — as opposed to being a ‘cutting edge’ development —, causality is not very prominent in the specialised scientific literature, save for textbooks (Glasson et al., 2012; Théritel and Partidário, 1996). But even if secured in the textbooks, causality is not very explicit in professional practice (Perdicoúlis and Glasson, 2006; Perdicoúlis et al., 2007). Hence, recent attempts have been made to explore, question, and edify explicit causal reasoning in impact assessment — for instance, groundwork R&D (Perdicoúlis and Glasson, 2007), technical re-visits (Perdicoúlis and Piper, 2008), practice reports (Perdicoúlis and Glasson, 2009), documentation of ‘causality flaws’ (Perdicoúlis and Glasson, 2012), R&D experimentation (Perdicoúlis et al., 2016), as well as an interactive column at the newsletter of the Portuguese Association for Impact Assessment (website).

Faced with ‘imperfections’ in the expression of causality, it is important to know what one can and/ or should do upon discovery of ‘causality flaws’ in current work (e.g. impact statements). Obligations may range from ethical<sup>2</sup> (e.g. for authors) to legal (e.g. for statutory reviewers).

<sup>1</sup>For instance, environmental impact assessment (EIA), strategic environmental assessment (SEA), social impact assessment (SIA), territorial impact assessment (TIA), health impact assessment (HIA), appropriate assessment (AA), and/ or sustainability assessment (SA).

<sup>2</sup>From *ἡθικός* [Gk], nature, disposition/ *ἡθῆ* [Gk, plural], customs — concerned with the principles of ‘right’ and ‘wrong’ behaviour; the Latin-based equivalent of ‘ethical’ is *moral* — from *mos* [L], custom.

## 2 Causality

There are many ways to think of ‘cause-and-effect’ relationships (Table 1). Impact assessment, being a policy instrument based on scientific and engineering knowledge, primarily seeks the *mechanisms* that describe ‘how’ (and/ or ‘why’) changes are expected as a result of one or more proposed actions<sup>3</sup>, which ultimately point to their causes. In other words, ‘well-done’ impact assessment should be not satisfied by mere predictions of the impacts (e.g. magnitude, probability, recurrence, or geographic extent), but should seek and trace them to their causes (Perdicoulis, 2012a).

HEURISTICS	PREMISES/ ASSUMPTIONS
Precedence	Effects follow their causes
Proximity	Effects and their causes occur in the spatial and/ or temporal vicinity
Similarity	Effects and their causes relate within common themes (e.g. pollution, health)
Covariation	Effects and their causes follow similar numerical patterns (e.g. time) <sup>a</sup>
<i>Sine qua non</i>	Certain conditions are necessary (but maybe not sufficient) for an effect to occur
Mechanisms	Effects and their causes are related in directed pairs, thus forming chains or networks

<sup>a</sup>See, for instance, ‘Correlation and causality’ (Perdicoulis, 2013).

TABLE 1 There are different ways to understand or ‘prove’ causality (Perdicoulis, 2010, pp.51–55)

Tracing causality involves four semantic categories (Table 2): system elements, dynamic relations between them, one or more actions, and the changes provoked by the action(s) to (some) system elements<sup>4</sup> (Perdicoulis, 2010, pp.54–57). These categories can be found in specialised diagrams such as *reverse blueprints* (RBP<sup>5</sup>, Figure 1(a)) and *descriptive causal diagrams* (DCD, Figure 1(b)), which are part of the Systems Planning<sup>SM</sup> Modelling Language (Perdicoulis, 2014a).

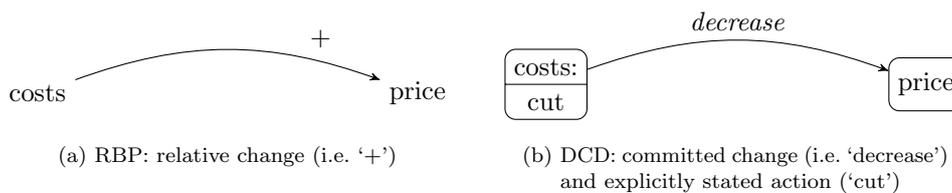


FIGURE 1 Causal views focus on interactions between system elements

RBPs transmit change in *relative*<sup>6</sup> terms, which is suitable for system structures and generic functions (Perdicoulis and Glasson, 2007). DCDs (Figure 1(b)) are designed closer to the mindset of planning and impact assessment, with the action clearly stated and the changes *committed* — e.g. ‘increase’, ‘decrease’ (Perdicoulis, 2012b; Perdicoulis and Jesus, 2014).

<sup>3</sup>*Ceteris paribus*, these changes are also known as ‘effects’ or ‘impacts’ (Perdicoulis, 2014b).

<sup>4</sup>Self-inflicted changes are disregarded, much like in ballistics — for instance, only the effects on the target are significant, ignoring any recoil effects caused to the shooter — save for specials concerns, of course.

<sup>5</sup>RBP are similar to the causal loop diagrams (CLD) of Systems Thinking/ System Dynamics (System Dynamics Society, website).

<sup>6</sup>For instance, a ‘–’ relationship indicates that an increase at the upstream element will provoke a decrease in the downstream element, *ceteris paribus*.

Much of the scientific and/ or engineering advance in impact assessment has been made around measurements, forecasts, and numerical models, many of which are based on a computational perspective that can be generalised in the equation of Figure 2.

$$\text{price}_{\text{initial}} + \text{price}_{\text{decrease}} = \text{price}_{\text{final}}$$

FIGURE 2 Computational views focus on each system element (e.g. ‘indicator’) individually

The computational view of impacts (Figure 2) is quite informative about ‘what is likely to happen’ to each system element in (widely appreciated) numerical terms, but conceals information about causality (Perdicoulis, 2013; Perdicoulis and Jesus, 2014). And with numerical forecasts being the strong interest (and consequently tradition) of impact assessment, it is easy to understand why causality has been sidetracked. Still, the best computational scenario is when the numerical models incorporate causal reasoning in the calculation of each indicator (i.e. system element) and/ or index (i.e. computational agglomerates consisting of various indicators). The worst computational scenario with respect to causal thinking involves probabilistic models, focussed on ‘what’ is likely to happen and featuring numerical techniques such as extrapolation, correlation, or data mining. In such cases, causality practically becomes ‘out of sight *and* out of mind’.

### 3 Flaws

So, what happens if we choose not to ignore causality, and do wish to represent it efficiently in impact assessment, but do not seem to do that clearly enough? And what exactly can go wrong with communicating causality in impact assessment — i.e. tracing impacts?

Knowledge of errors is central to rationality and the learning process: we learn from both instruction and from our errors (Bickard, 2002), and this is even a proper field in the study of mathematics. However, scientific journals discourage negative (together with non-significant) results because these affect fewer readers and produce less citations than ‘positive results’ (Fanelli, 2011), or because they are simply considered as ‘useless’ (Couzin-Frankel, 2013). So, paradoxically, in scientific publications we do not learn from our mistakes as much as we could — or even should. But, for the sake of learning, we defy this tendency: we do deal with causality flaws, starting with some observations from a recent research (Perdicoulis and Glasson, 2012) involving various case studies — Table 2.

CATEGORY	FLAWS	CASE STUDY EVIDENCE
Elements	Omission of elements Generalisations (e.g. ‘hydrology’, ‘ecology’)	Petroleum, Power station Restoration, Mining, Maglev, Power station, Junction
Relationships	Omission of relationships	Petroleum, Power station
Action	No actor, point of application, or receiver No action at all Uncertainty in the type of action	Bypass, Petroleum, Crossrail Junction Maglev
Effects	Incomplete identification and/ or presentation	Bypass, Mining, Petroleum, Maglev, Restoration
General	Uncertainty in time and/ or space specifications Use of esoteric language (jargon)	Aqueduct Mining

TABLE 2 Causality flaws identified in selected case study EISs (Perdicoulis and Glasson, 2012)

## 4 Attitudes

Identifying reasoning and communication flaws in EISs is not a trivial task: its methodic conduct requires special analysis techniques, and allocation of considerable amounts of time and human resources — for instance, within the project/ production team, by the assessment panel/ authority, or by specialised researchers. Causality flaws may also be identified accidentally, as the reader comes across them. At any rate, it is interesting to do something about them — besides any moral obligation (perhaps for the sake of being ‘true to oneself’), there are significant practical motives: for instance, to enhance the technical validity of the working documents (e.g. EISs), boost the reputation of the consultants, and avoid delays in the processes (e.g. caused by re-submissions or addenda) that involve costs for the project proponent, the consultant, and/ or the investors.

### 4.1 Researchers

Researchers coming across causality faults in an impact assessment document (e.g. EIS) may adopt one of several reactions, or compatible combinations. Perhaps the ‘least effort’ reaction is to do nothing. Others may wish to document the case and write to the EIS authors, perhaps suggesting corrections. Yet others may wish to ‘blow the whistle’ on the media (e.g. newspapers, radio, television), or popular online social media (e.g. Twitter). Each one may act according to their conscience, or according to the policies of their institutions (e.g. research centres).

### 4.2 EIS authors

‘Repair as required’ editing is an effective solution for identified shortcomings of an impact assessment document (e.g. EIS). However, this is a reactive approach, not methodic, and perhaps not very professional. A pro-active and methodic approach may include specific text editing (e.g. including causal analysis) before releasing the document, which could help prevent causality flaws, but such an approach may be seen as a waste of resources by overconfident teams or team leaders. Yet a third option may be the drawing of causal diagrams, whose demanding requirements about causality would catch and correct potential causality flaws ([Perdicoulis et al., 2014](#)).

### 4.3 Assessment authority

Depending on their guidelines or standards regarding the expected degree of rigour in the expression of causality in impact assessment documents (e.g. EISs), the assessment authority has two extreme positions, and perhaps various possible positions between them: (a) reject the document (EIS) and request clarifications; or (b) underplay the importance of the causality flaws, accept the document (EIS), and carry on with impact assessment regardless.

In practical terms, the current volumes of text in EISs turn reading into a formidable task for the specialists. Hence, there is a third option for the assessment authorities: request the EIA consultants to be more synthetic, clear, and explicit about causality in their documents. Reviewers should also appreciate this, as they can get to the point easier, and so would EIS authors — although the latter would have to train in order to be more synthetic. This third option might help reduce a certain ‘inflation’ that can be observed in EIS volumes over the last decades.

## 5 Discussion

Quite realistically, EISs in practice do have flaws — including causality. Experienced EIA practitioners, including regulators, defend that this is reasonable in an ‘imperfect world’, and insist only in higher concerns — for instance, that the EIS is *comprehensive*, *objective*, and that it *alerts* the decision-makers and the members of the public (Tromans, 2012).

Comprehending our imperfections makes our limitations more bearable, but it has one significant drawback: it makes us lax. When reasoning is not explicit, it is not verifiable or open to discussion. Besides methodological fragilities, non-explicit reasoning may conceal even more significant faults such as *bias* — either of scientific nature (e.g. systematic error), or of human nature (i.e. to defend someone’s interests).

Causality is known to be quite difficult to ascertain (Perdicoulis, 2010, pp.45–57), and in its pronouncement there lies great responsibility. So, as the detailing of causal relationships is difficult and also produces vulnerable statements, the apparent current practice seems to be focussing on the outcomes — i.e. forecast impacts — and often in a qualitative form. Perhaps the way is being paved for a role shift: ‘*impact assessment is approached as a scientific process with social input. What it should be is a social process with scientific input.*’ (IAIA, 2002, p.1).

## 6 Challenges

Impact assessment is driven by practice<sup>7</sup> rather than by research. And it seems that in regular practice, causality flaws are discovered only when ‘forensically examining’ the EISs. Such flaws are not considered likely to hinder the process, or lower the quality of EIA, so no real concerns are raised about their correction or suppression. It remains a question of principle (e.g. scientific rigour) to continue dealing with causality faults.

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<sup>7</sup>It is considered that the dominant tendencies come from EIA, with its well-established systems and practice worldwide.

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