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Causal networks in EIA

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Abstract

Causal networks have been used in Environmental Impact Assessment (EIA) since its early days, but they appear to have a minimal use in modern practice. This article reviews the typology of causal networks in EIA as well as in other academic and professional fields, verifies their contribution to EIA against the principles and requirements of the process, and discusses alternative scenarios for their future in EIA.

Keywords: Causal networks; Environmental Impact Assessment (EIA); Environmental Impact Statement (EIS); Data mining; System dynamics

1. Introduction

Causal networks are used in many academic and professional fields with various names, graphical implementations, and applications. For disciplines dedicated to the study of effects, such as Environmental Impact Assessment (EIA), causal networks seem like a useful instrument to easily relate and transparently demonstrate causes and effects. In fact, causal networks have been used in EIA since its early days, but they have never been particularly popular.

This article aims to (a) review the typology of causal networks in EIA, both from the literature and current practice, (b) briefly examine causal networks in other academic and professional fields, and (c) draft scenarios for the future of causal networks in EIA.

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2. Review

2.1. Characteristics of causal networks

Succinctly defined, causal networks are diagrams that demonstrate causal relations between their elements. The special identifiers of causal networks are a diagrammatic representation of relationships among elements and the attribution of causality to these relationships.

Networks are abstract diagrams with nodes and links. Nodes can be points, text, or shapes, and they represent the network elements such as activities, wildlife, stakeholders, etc. Links can be lines of various properties, such as pattern, thickness, direction, and colour, and they can represent relations between the network elements. With these combinations of nodes and links, it is possible to create many different types of networks, and some of them are illustrated in this article–especially in Sections 2.4 and 2.5. Causality deals with the functional relations between entities, thus enabling people to explain effects by diagnosing possible causes or to predict effects from the observation of relevant factors. To date there are two main alternative methods to identify and use causality, deductively or inductively (Williamson, 2005), which are illustrated in Fig. 1.

In the deductive method, a hypothesis about a causal relation is formed (near the central circle of Fig. 1), tested, and then proven or rejected—much like in the classic scientific method (Williamson, 2005). In a deductive approach, the conclusion about particulars follows necessarily from general or universal premises—i.e., the tested and approved causal relation, labelled “general rule” in Fig. 1. This type of thinking about causality is also known as variance theory, which sets out to determine experimentally or semi-experimentally (with statistical analysis)–but always in a “black box” approach–that certain effects are present when certain presumed causes are also present (Morris, 2005)—i.e., replicate the “individual observations” of Fig. 1.

In the inductive method, data are collected after observations, and a causal relationship is induced—i.e., a generalised conclusion is inferred from particular instances (Williamson, 2005). This type of thinking about causality is also known as the process theory, which draws

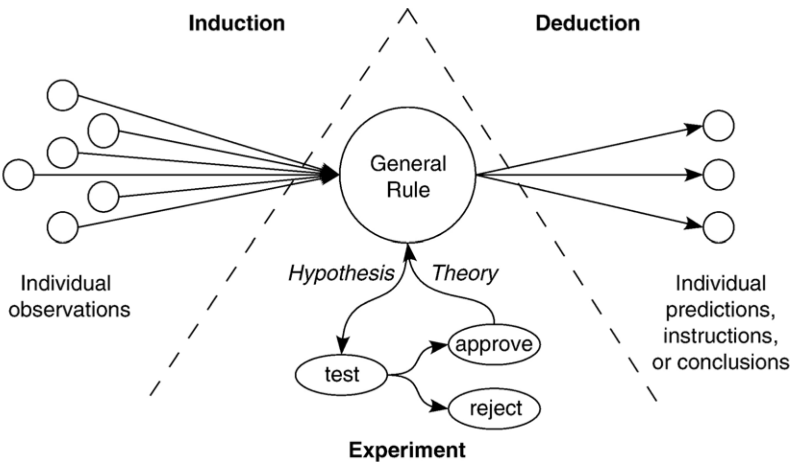

Fig. 1. Schematic layout of induction, deduction, and experiment.