Knowledge Synthesis Methods

12. Causal Criteria Analysis[1]

Summary of method

Causal Criteria Analysis synthesizes understanding of causal linkages in a system, by testing against a set of pre-defined criteria for causality.

It combines pictorial relationships between factors depicting hypothesized or known causal linkages in a system, with literature review to synthesize evidence for specific links in the chain. The diagrams (called influence diagrams, if they include management actions or policy options) are used as scaffolds to synthesize and present evidence. They can also serve as a first step to more elaborate modelling approaches.

The review stage preferably employs the systematic review or rapid evidence assessment method, in which studies are critically appraised and weighted. It could also employ expert consultation, using formal consensus method such as Delphi, or a Bayesian Belief Network approach to elicit knowledge.

The six casual criteria used in the Eco-Evidence software (references below), against which evidence is tested, are: plausibility, evidence of response (e.g. biological response); evidence of a dose-response relationship with the causal agent; consistency of association; evidence of the causal agent found in biota; agreement among hypotheses.

Key references

The Eco-evidence software is one route to conducting Causal Criteria Analysis, and includes a literature review method. This is available from: http://toolkit.ewater.org.au/Tools/Eco-Evidence.

Norris, RH, Webb JA, Nichols SJ, Stewardson MJ and Harrison ET (2012). *Analyzing cause and effect in environmental assessments: using weighted evidence from the literature.* Freshwater Science, 31(1):5-21.

Nichols S., Webb A., Norris R., and Stewardson, M. (2011). *Eco Evidence analysis methods manual: a systematic approach to evaluate causality in environmental science.* eWater Cooperative Research Centre, Canberra.

[1] A guidance note from Dicks LV, Haddaway N, Hernández-Morcillo M, Mattsson B, Randall N, Failler P, Ferretti J, Livoreil B, Saarikoski H, Santamaria L, Rodela R, Velizarova E, and Wittmer H. (2017). *Knowledge synthesis for environmental decisions: an evaluation of existing methods, and guidance for their selection, use and development – a report from the EKLIPSE project.*

Examples of application

The causal criteria approach was famously used to demonstrate the health effects of smoking in the US.

USDHEW (1964). *Smoking and Health.* Report of the Advisory Committee to the Surgeon General of the Public Health Service. U.S. Dept. Health Education and Welfare, Washington, U.S.

Causal Criteria Analysis	
Cost	Staff time: One month to several years FTE. Stakeholder time and travel expenses. Depends on: • Whether or not a formal literature review stage is included (see costs for Systematic Review or Rapid Evidence Assessment) • Number of stakeholders/experts involved • Level of disagreement among stakeholders/experts • Level of detail: text or tabular explanation of the CCA, and number of nodes (factors) and relationships (links) in CCA • Facilitator/moderator, if done in participatory mode • Scale of the problem (no of sectors, countries involved/addressed)
Time required	The system diagram can be done within one day (or less, e.g. if done as desk research). Reviews of evidence for each link take 1 week - 24 months, depending on method
Repeatability	Moderate. If done with two different groups of people or individuals, the chain will likely differ
Transparency	High (if well documented)
Risk of bias	Moderate. Depends on representativeness of knowledge holders involved, and whether individual input is incorporated or obtained in group discussion
Scale (or level of detail)	Flexible Potential to address detailed questions or broader problems
Capacity for participation	Potential to be moderate to high

Data demand	Low Can point to further data demands Requires expert judgement Requires stakeholder input if done in participatory manner
Types of knowledge	Scientific, technical, opinion-based; explicit, tacit
Types of output	Flow diagram, causal chain, can be an influence diagram that includes possible management actions or policy decisions Explanatory report/information attached
Specific expertise required	Does not necessarily require specific expertise For participatory CCA, need skills in creating teams and in facilitation

Strengths	**Weaknesses**
System perspective of a problem: can include multiple scales, multiple sectors, multiple actors	Can be biased, depending on facilitation and representativeness
Flexible level of complexity: can be done in a very simple manner by one person or in a complex participatory manner	Final results are only as robust as the literature review method employed
Visualization	
Can be used transparently	
Good for a starting point/ scoping/prototyping, can lead into a quantitative model	
Can point to data/information needs	
Can inform decision/policy making especially if done as an influence diagram that includes one or more possible actions or policies	