Knowledge Synthesis Methods

18. Structured Decision Making[1]

Summary of method

Structured Decision Making (SDM) is a well-defined method for analysing a decision by breaking it into components including the objectives, possible actions, and models linking actions to objectives. It aims to compare possible actions in terms of one or more objectives.

It provides transparency by specifying each of these components and providing information that a decision-maker can use to implement and defend a decision.

This method can incorporate other knowledge synthesis methods. For example, Thorne *et al.* (2012) describe a process that uses a Bayesian Belief Network in the context of Structure Decision Making. Expert consultation with elicitation is often used to quantify predictive relationships as part of SDM.

SDM is founded on principles of value-focused thinking and decision analysis and can be conducted in a participatory manner with decision-makers, stakeholders, and experts. It can also provide a basis for adaptive management.

Structured Decision Making typically involves a series of iterative steps called PrOACT (Problem framing, Objectives, Actions, Consequences, and Tradeoffs).

Key references

The method is described in detail in two books (Conroy and Peterson, 2012; Gregory *et al.* 2012). There is an open access online course describing each step in detail, through videos and handouts (Runge *et al.* 2011).

Conroy, M. J. and J. T. Peterson. (2012). *Decision making in natural resource management: A structured, adaptive approach.* John Wiley & Sons, Hoboken, New Jersey, USA. NOT OPEN ACCESS.

Gregory, R., Failing, L., Harstone, M., Long, G., McDaniels, T., & Ohlson, D. (2012). *Structured decision making: a practical guide to environmental management choices.* John Wiley & Sons. NOT OPEN ACCESS.

[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.*

Runge, M. C., J. F. Cochrane, *et al.* (2011). *An overview of structured decision making, revised edition.* U.S. Fish and Wildlife Service, National Conservation Training Center, Shepherdstown, West Virginia, USA. [online videos] https://training.fws.gov/courses/ALC/ALC3183/resources/index.html

Examples of application

SDM is used to inform decisions by US state and federal natural resource management agencies, including Fish and Wildlife Service, National Marine Fisheries Commission, and US Army Corps of Engineers. It has also been used to inform regional decision-making in the San Francisco Bay Estuary and multi-party river management in southern British Columbia and northern Alberta.

It has been implemented in multi-stakeholder planning processes to inform decisions by a private hydroelectric company, local watershed organization, and a township in British Columbia. Also used to inform management decisions by trans-boundary protected areas in Europe involving broad-scale conservation issues.

Some published examples of application to real-world decision-making:

Compass Resource Management. 2015. Feature projects. Compass Resource Management, Vancouver, British Columbia, Canada. http://www.compassrm.com/feature_projects.php

Dalyander, P. S., M. Meyers, B. Mattsson, *et al.* (2016). *Use of structured decision-making to explicitly incorporate environmental process understanding in management of coastal restoration projects: Case study on barrier islands of the northern Gulf of Mexico.* Journal of Environmental Management 183: 497-509.

Gannon, J. J., T. L. Shaffer, and C. T. Moore. (2013). *Native Prairie Adaptive Management: a multi-region adaptive approach to invasive plant management on Fish and Wildlife Service owned native prairies.* US Geological Survey, Reston, Virginia, USA. https://pubs.er.usgs.gov/publication/ofr20131279

Gregory, R., & Long, G. (2009). *Using structured decision making to help implement a precautionary approach to endangered species management.* Risk Analysis, 29(4), 518-532.

Ohlson, D. W., McKinnon, G. A., & Hirsch, K. G. (2005). *A structured decision-making approach to climate change adaptation in the forest sector.* The Forestry Chronicle, 81(1), 97-103.

Ralls, K., & Starfield, A. M. (1995). *Choosing a Management Strategy: Two Structured Decision-Making Methods for Evaluating the Predictions of Stochastic Simulation Models.* Conservation Biology, 9(1), 175-181.

Thorne, K. M., B. J. Mattsson, *et al.* (2015). *Collaborative decision-analytic framework to maximize resilience of tidal marshes to climate change.* Ecology and Society 20. http://www.ecologyandsociety.org/vol20/iss1/art30/

Structured Decision Making	
Cost	Staff time: at least 1 month (FTE). Needs two coaches trained in SDM, one with skills in quantitative decision analysis, and participants committing their time (see below) to participate throughout the process including at least one decision maker Cost depends on • Scale of the problem and sectors, countries involved/addressed • The number of stakeholders/experts involved • How well the decision problem has already been framed by the stakeholders/experts • Level of disagreement among participants • Level of detail discussed, specified, and documented • Quality of facilitator/SDM coach • Decision analysis software needed
Time required	Duration typically at least 4 weeks: one week to frame the decision problem and form an appropriate team to address it, one week to develop a prototype decision framework, and two weeks to develop a final prototype in consultation with team members
Repeatability	If conducted with two different teams, the decision structure and in particular the quantitative components will likely differ
Transparency	High (if properly done). SDM is designed to promote transparency and defensibility of the decision-making process Depends on the quality of the SDM coaches, level of transparency desired by team members, and time availability of team members to provide the desired level of transparency
Risk of bias	Medium. Depends on: • Representativeness of stakeholders/experts • Whether individual input for the decision analysis is incorporated or obtained in group discussion • Quality of any data and predictive models incorporated
Scale (or level of detail)	Flexible; can address detailed fine-scaled decisions to broader transnational decisions
Capacity for participation	Flexible; can be done by one person trained in SDM or by a team of one or more decision-makers, stakeholders, and experts. Increasing number of participants beyond 10 typically requires a professional facilitator

Data demand	Information needs shift from qualitative to quantitative from the earlier to later steps. These needs depend on the desired level of transparency (see above). Can be done without literature review or detailed data analyses and instead rely on stakeholder and expert elicitation, but it can also incorporate data from the literature or existing models
Types of knowledge	Can incorporate scientific, indigenous, expert, and practitioner knowledge to help describe, decompose, and analyse the decision. No known cases where lay (public) knowledge has been incorporated e.g. through surveys, but it could be
Types of output	Concise decision question; objectives hierarchy; influence diagram; lists and definitions of ultimate objectives, management options, and external factors that are at least partly beyond control of managers; Bayesian belief/decision network; consequence table; weights of importance among objectives; expected utilities of management options These outputs can be presented user-friendly concise to detailed written reports and interactive websites
Specific expertise required	Requires one person with background in quantitative decision analysis, and one or more experts who can characterize and quantify the key sources of uncertainty that can influence the decision

Strengths	**Weaknesses**
Can cope with high levels of uncertainty about system dynamics and conflicting stakeholder values Good capacity for participation of stakeholders Can incorporate diverse types of knowledge, including qualitative and quantitative information Outputs can be scientifically defensible and understandable by non-technical audiences Highly transparent (if done well) 'Bottom-up', driven by decision-maker needs and wishes Useful for identifying and overcoming barriers to decision making by deconstructing a decision problem into component parts	Quality of outputs depends on the quality and training of the SDM coach Depends on the availability and trust of the participants, including decision-makers, stakeholders, and experts Often relies on expert elicitation to quantify relationships between specified actions and objectives, as numerical models and data are often lacking Often simplifies a problem so that it is feasible to analyse. Clear documentation of the simplifying process is needed to maintain transparency