University of Missouri

Problem framing

Module 2:

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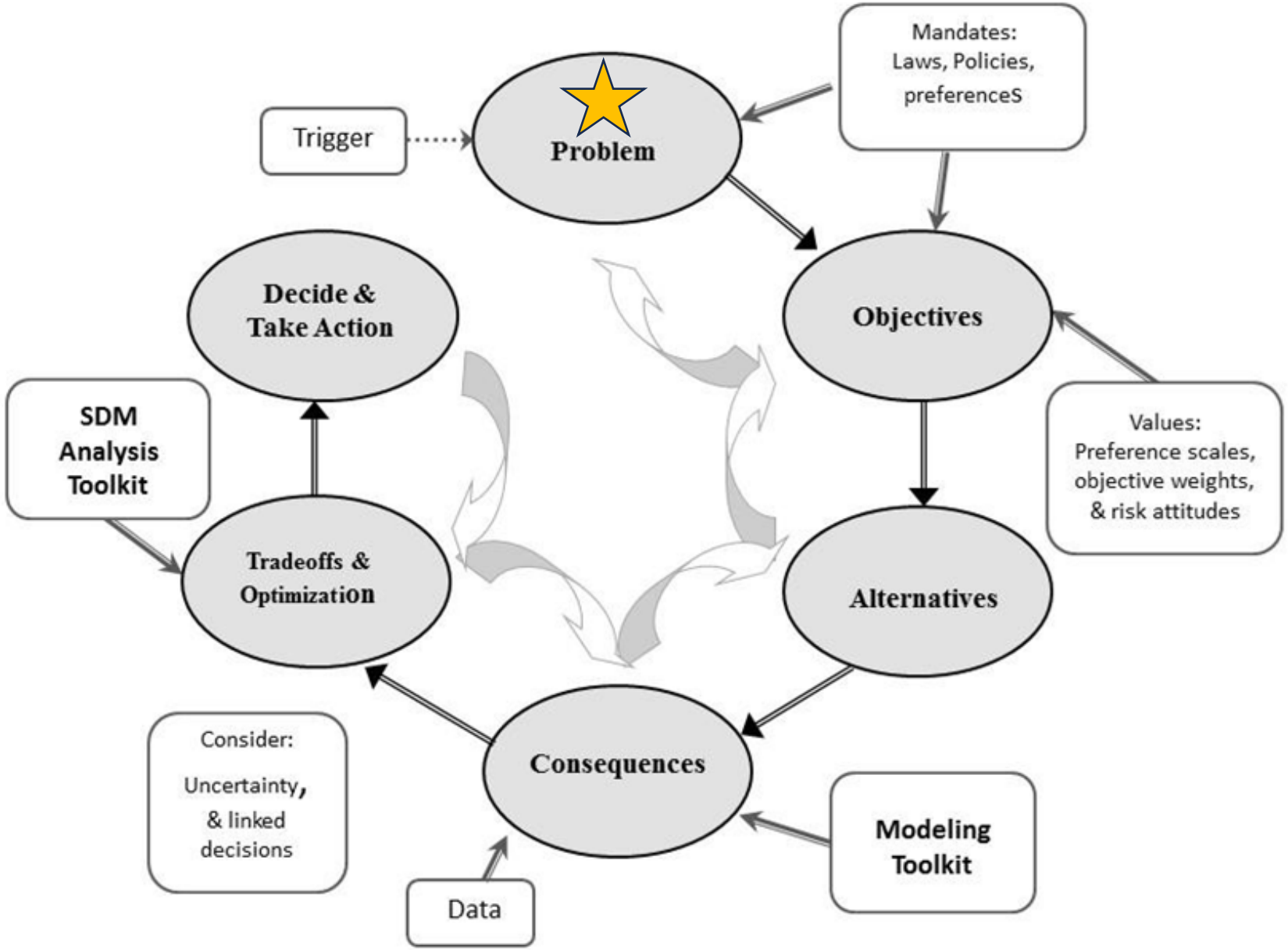
Modified from: Fundamentals of Structured Decision Making TWS Conference Workshop 2023 & an Overview of Structured Decision-Making Washington Department of Fish and Wildlife 2022-2023



Source: Jean Fitts Cochrane

Problem framing

- First and most important task in SDM
- Provides an *a priori*, explicit, and shared understanding of the problem at hand
- Sets bounds on the problem by identifying spatial, temporal, organizational, legal, and other relevant bounds

"A good solution to a well-posed decision problem is almost always a smarter choice than an excellent solution to a poorly posed one."
~ Hammond et al.

Common errors:

- Decision makers naturally jump to thinking about alternatives
- We assume the problem has defined itself, so we don't frame the problem or think about what we really want to achieve.
- Alternative focused thinking → narrow problem framing → omission of important objectives
- Incorrect problem framing → wasting effort solving the wrong problem

Defining “problems” as decisions

- Making **decisions** is the **problem**
  - Think about word problems in math class

- Sometimes we fail to realize that the problem revolves around a decision

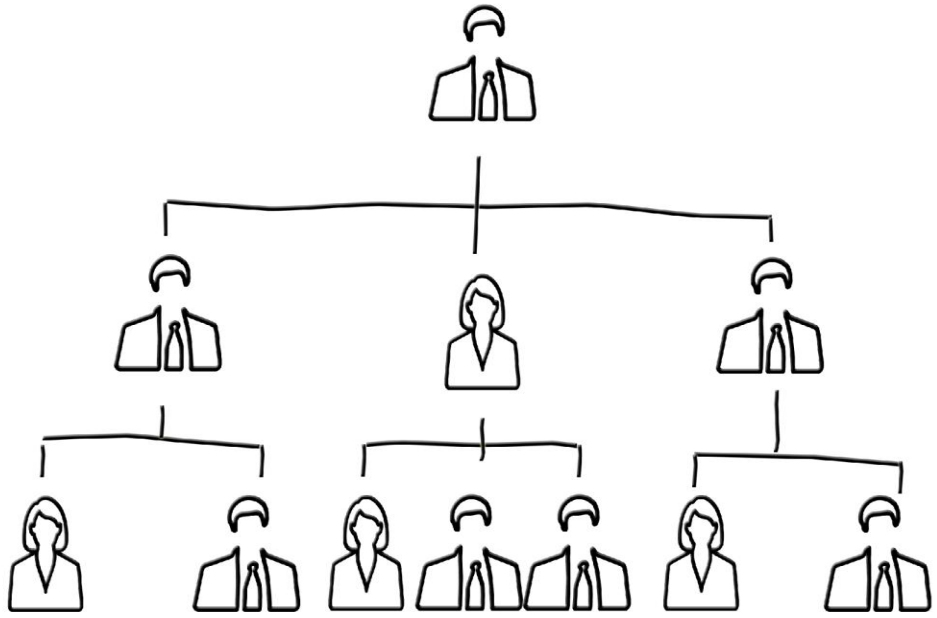
- Deciding between a finite set of alternative courses of action should be the focus of problem solving (i.e., decision making)

Elements of problem framing

1. Identify the decision maker(s)
2. Identify other key players
3. Consider legal and regulatory contexts
4. Consider the decision structure
5. Consider the type of analysis required
6. Revise as needed

1. ID the decision maker(s)

- **Who has the authority to commit to action?**
  - Can be surprisingly difficult/complex!
- **Some scenarios**
  - Single decision-maker
  - Multiple decision-makers
    - Willing to work together for joint aims
    - Competing with each other (not SDM)
  - Delegated authority
    - E.g., Governor → Director→ Administrator



- **Failure to ID & include all DMs in the process will make things difficult and confusing**

2. ID other key players

- Decision Implementers
- Stakeholders/ interest groups
- The public
- Technical advisors

Interest group analysis

- Who has the ability to influence the decision?
- Who is influenced by the decision?

3. Consider the legal and regulatory context

- Particularly for decisions by public agencies
- What laws confer authority for the decision?
- How does the legislation or associated regulations bound the decision problems?

- Example: USFWS is the decision maker and must follow Migratory Bird Treaty Act regulations

4. Consider the decision structure

- **Frequency & Timing** - How often? When? Are other decisions linked?
- **Scope** - How large, broad, complicated is the decision?
- **Objectives** – Roughly, what are the desired outcomes? Single or multiple objectives? Conflicting objectives?
- **Actions** – Roughly, what kinds of alternatives are being chosen from?
- **Constraints** - Legal, financial, political, perceived or real constraints?
- **Uncertainty** - What degree of uncertainty is present? Can it be ignored?

5. Consider the type of analysis required

- To choose among alternatives, what analysis will be required?
- How much detail is needed?
- Do the data and analytical methods exist?
- Do you have access to the expertise?
- Is uncertainty an impediment?
- What class of decision problem do you have?

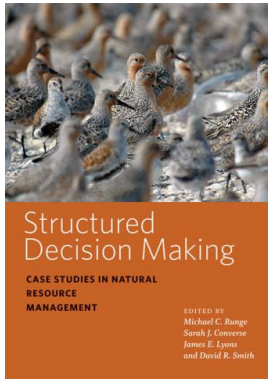
Classes of decision problems

- Certain decision structures appear again and again.
- Being able to recognize these classes of decision problems helps structure the problem and identify analytical tools.

**THESE WILL NOT BE COVERED IN DEPTH TODAY but see (Runge et al. 2020 textbook)

6 “Classes” of Decisions**

1) Prediction Problems
2) Multiple Objective problems
3) Portfolio Problems
4) Risk Problems
5) Information Problems
6) Dynamic Problems



6. Revise as needed

- Problem framing is one of the most difficult and important steps.
- The problem definition is likely to change as you proceed with development
- Adopt iterative/ **rapid prototyping** as an approach to development of a decision analysis
    - “Good enough for now, safe enough to try”

Problem framing: decision statement

- About a paragraph long (or sometimes a very long, run-on sentence)
- Captures the essential outline of the problem
- Helps participants focus
- Reframes a vague task as a decision to be solved
- Limits objectives and alternatives to those relevant to the problem

Problem framing: decision statement questions

Answering the following questions:

- **Decision Maker** – Who will make the decision?
- **Trigger** – Why does a decision need to be made? Why does it matter?
- **Action** – What is the decision? What action needs to be taken?
- **Constraints** – legal, financial, political? Are these perceived or real?
- **Frequency and Timing** – Periodicity of decision. Are other decisions linked to this one?
- **Scope** – How broad or complicated is the decision?
- **'Class' or Type of Decision Problem** – Which of the six classes does the decision fall into? What are the impediments to making the decision?

The equation for problem framing

Using the following template:

"Decision Maker (**D**) is trying to do **X** to achieve **Y** over time **Z** and in place **W** considering **B**."

where,

D = the Decision maker(s)

X = the type(s) of action that needs to be taken

Y = the ultimate goal(s) to be achieved by "X"

Z = the temporal extent of the decision problem.

W = the spatial extent of the decision problem

B = potential constraints (legal, financial, and political) and important uncertainties (scientific or other)

Problem trigger and background

The Minnesota Invasive Carp Action Plan (hereafter "Plan") was developed in 2011 by the Minnesota DNR, partners, and stakeholders to limit the spread and impact of invasive carp. The Plan was revised in 2014, and an addendum was added in 2020 to document invasive carp status in Minnesota and scientific developments. An updated Plan is needed because invasive carp in Minnesota have 1) become more abundant, 2) the availability of new invasive carp monitoring and control techniques, 3) a perceived urgency to implement management actions based on the best available science and interest group values, and 4) the limited likelihood of successful population control if invasive carp become established. MNDNR staff will draft the Plan to guide the implementation of invasive carp management actions in the Mississippi River Basin (within Minnesota) and statewide watersheds at risk of carp invasion through high streamflow connections or artificial connections over 10 years (2023-2033). However, decisions among alternative management actions should be related to the values and objectives of interested parties, incorporate varying uncertainty sources, promote coordination among interest groups, and ideally provide a framework to reduce uncertainty.

Problem statement continued

A structured decision making process will be used to elicit 1) the values of interest groups (values group), 2) potential management actions (technical group), 3) key uncertainties (values and technical groups), 4) evaluate the expected consequences of implementing a management action, and 5) evaluate tradeoffs among values elicited from the interest group. The SDM process aims to be inclusive by including many interested parties and building trust among the interested parties through facilitated virtual and face-to-face meetings. The process also aims to provide a transparent and repeatable science-based decision making process that can be used to inform subsequent updates of the Invasive Carp Action Plan. Additionally, the SDM process expects to develop analyses to evaluate potential decisions given interest group values framed as management objectives, make clear the role of constraints like management action cost, and help identify decision-relevant uncertainties and monitoring efforts. MN DNR authors will use the outcomes of the SDM process to draft a revised Plan.

Problem statement continued

1. Evaluate potential management actions, including potential actions that may be implemented by adjacent and downstream natural resource agencies, that tradeoff impacts to non-target species, ecological impacts, recreation, and near-term and long-term costs.
2. Consider uncertainties associated with the action effectiveness, species life history, location-specific invasive carp population status, invasion risk uncertainties, implementation logistics, implementation authority, and public perception, the impacts of implementing no actions.
3. Identify tradeoffs and uncertainties associated with implementing management actions to aquatic systems where the system can be unoccupied by invasive carp or occupied by invasive carp where reproduction is not occurring (invaded) or occurs consistently (established).
4. Identify invasive carp management action implementation constraints associated with factors, but not limited to, funding, permitting, long-term operation and maintenance, personnel, agency capacity to execute available funds, and potential approaches to reduce or overcome constraints like expected funding needs.

Another Example Problem Statement

The plan was developed in 2011 by the MNDNR, partners, and stakeholders to limit the spread and effects of invasive carp. The plan was revised in 2014, and an addendum was added in 2020 to document invasive carp status in Minnesota and scientific developments. An updated plan was triggered because of an increase in invasive carp abundance in Minnesota, the availability of new invasive carp monitoring and control techniques, political interest in the issue, and additional funding opportunities. The geographic scope of the plan includes the Upper Mississippi River Basin in Minnesota and watersheds at risk of invasion through high streamflow connections. The plan aims to guide MNDNR's implementation of invasive carp management actions over the next 10 years by doing the following:

- evaluating potential management actions;
- considering uncertainties associated with the effectiveness of an action, current invasive carp status, implementation logistics, implementation authority, and public perception; and
- identifying and acknowledging constraints associated with funding, permitting, long-term operation and maintenance, and personnel.

Another Example Problem Statement

The Invasive Mussel Collaborative (IMC) Planning and Implementation Work Group (IMCP & IWG) intends to inform future applied research and management activities at a site and regional scale by i) collaboratively developing a strategic road map for the advancement of the site and regional scale control tool development and testing and ii) identifying decision-relevant uncertainties to implementing a site or regional scale control tool. The strategic roadmap is needed to i) communicate the decision-relevant research priorities to the IMC, ii) inform research funding priorities, iii) provide a framework to incorporate learning, iv) promote continued innovative control measures, v) guide and prioritize control tool effectiveness monitoring efforts, and vi) support control tool implementation decisions at the site or regional scale. The strategic road map is intended to serve researchers in developing and coordinating decision-relevant research projects (proposals, study design), and state regulatory agencies and research funders (e.g., GLRI) in identifying funding priorities and implementing site or regional control actions. Sovereign Nations and non-governmental agencies may also use the roadmap to inform dreissenid mussel control tool implementation, post-implementation effectiveness monitoring, or research to support control tool development. The roadmap intends to inform dreissenid mussel control at the site and regional scale.

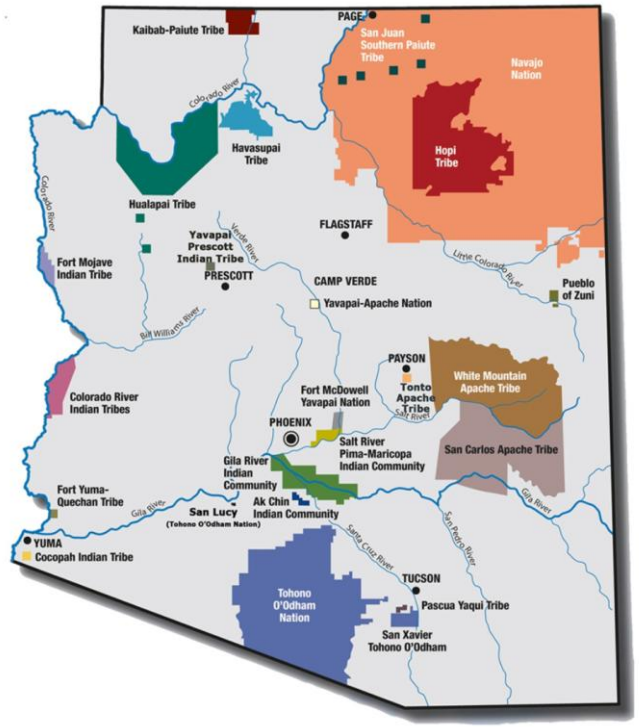
Another Example Problem Statement continued

The IMCP & IWG will use a structured decision-making (SDM) process to inform the IMC strategic roadmap development. Specifically, the SDM process is intended to collaboratively and cooperatively develop among interested participants a shared understanding of the problem, the objectives , and the factors influencing the likelihood of alternative control tools achieving site-level or regional-scale control. The SDM process will develop site-level and regional-scale decision models needed to inform control tool implementation decisions (including a no-control alternative) and decision-relevant uncertainties. Model sensitivity analyses will prioritize uncertainties that will inform research efforts (e.g., control tool effectiveness, abiotic and biotic responses to dreissenid mussel control), post-implementation monitoring, and alignment with research funder priorities.

The initial emphasis will be on site-level control and associated uncertainties and regulatory constraints. The focus of the SDM workshops will shift to identifying regional-scale management objectives (e.g., fish production, commercial harvest), identifying alternative dreissenid mussel control tools, developing a regional-scale decision model, and lastly, using sensitivity analysis of the decision model to the “stops” along the regional-scale portion of the IMC strategic roadmap.

Case study: (Runge et al. 2011)

- See attachment of case study description (CaseStudyDescription.pdf)



Arizona Department of Education

Exercise: Generate a decision statement

Hint: remember the equation…

"Decision Maker (D) is trying to do X to achieve Y over time Z and in place W considering B."

Problem framing is hard!

- It's worth taking the time to get it right…

"I used to think that decision analysis helped solve decision problems, but now I include figuring out what the decision problem is as a key, and perhaps the most important, part of decision analysis."

~Ralph Keeney

"Never enough time to do it right… always enough time to do it over"

~Anonymous