University of Missouri

# Week 2:

## Problem Framing Step of PrOACT

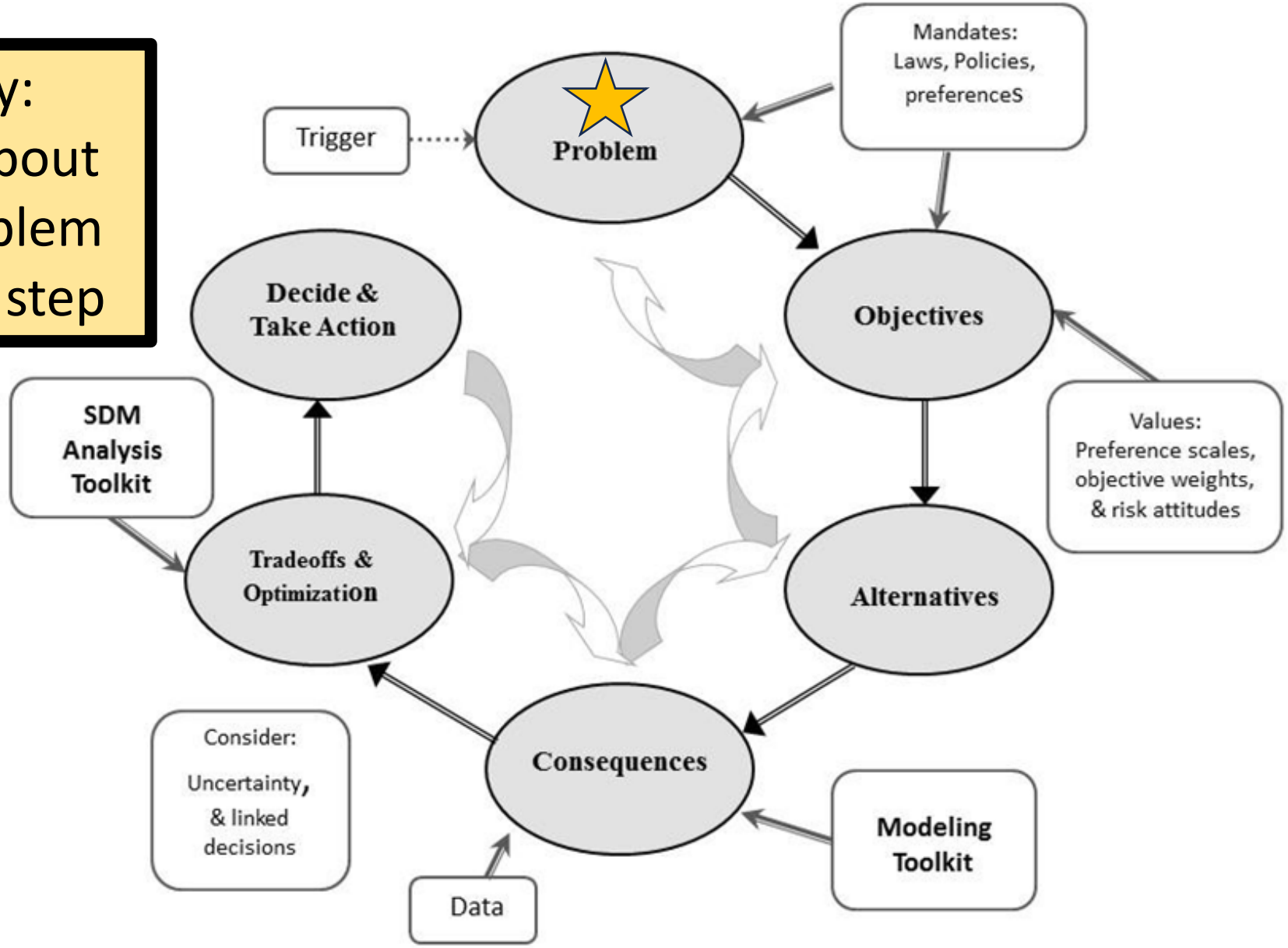
**Instructor:** Brielle K Thompson

**Course:** NAT_R 8001 Decision Analysis for Research and Management of Natural Resources

# Review of last week

- Learned about how cognitive biases impact human decision making
- Learned about system 1 and system 2 thinking
- Discussed key assumptions of Decision analysis/Structured Decision Making (SDM)
  - Values focused thinking
  - Decomposes complex problems (**PrOACT)**
- Provided a brief illustrative case study of SDM using the glen canyon dam as a case study

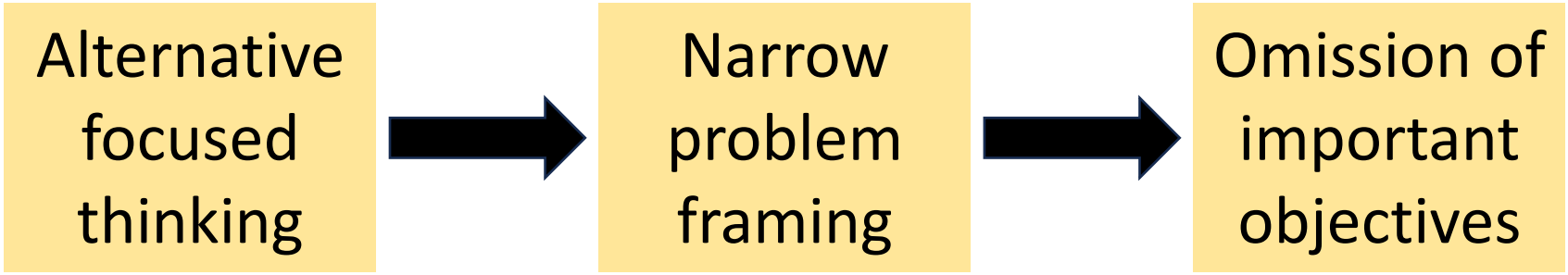
Today:
Learn about the Problem framing step




Source: Jean Fitts Cochrane

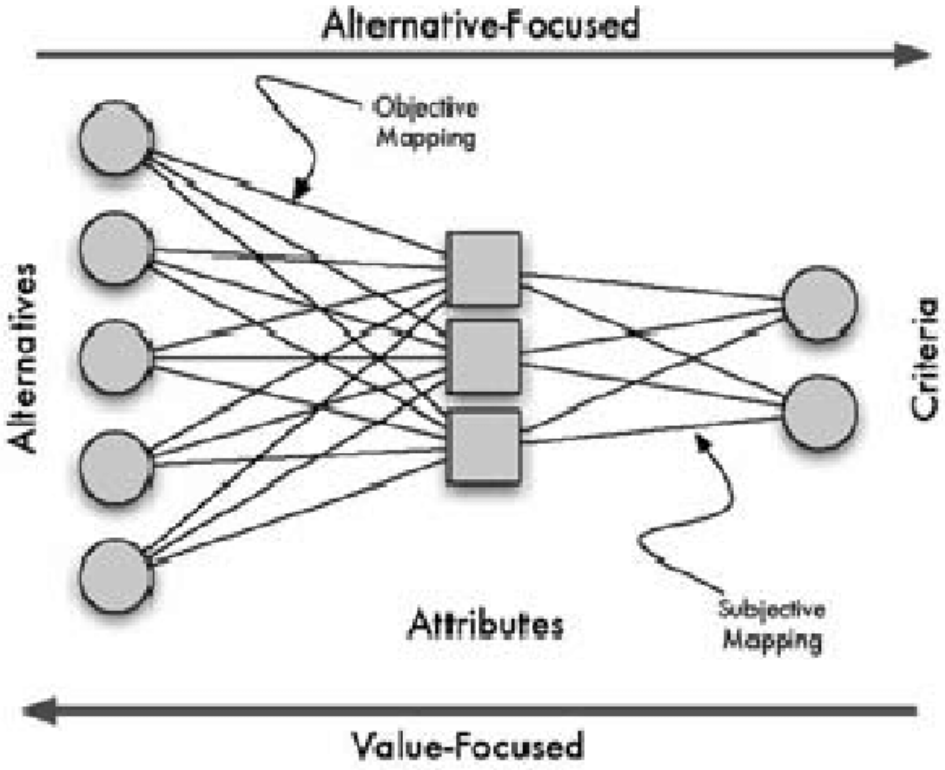
# Common errors:

- Decision makers naturally jump to thinking about alternatives



# Aside: Values focused vs Alternatives focused thinking:

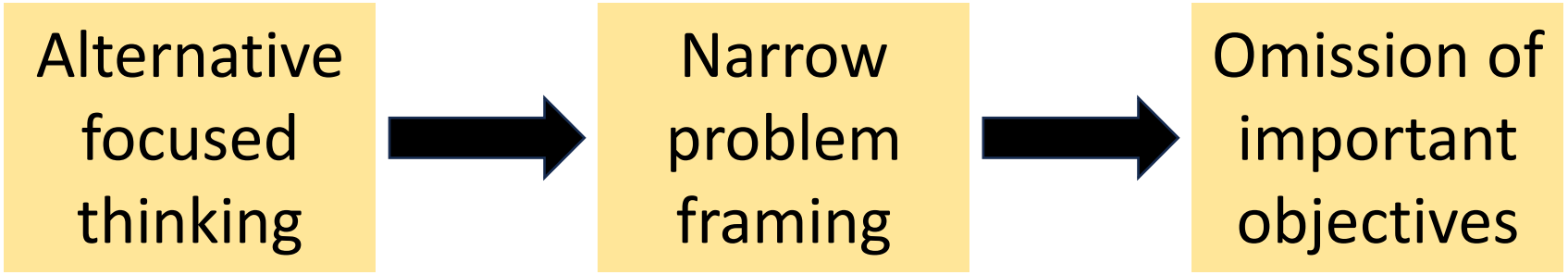
- "Value-focused thinking involves starting at the best and working to make it a reality. **Alternative-focused thinking is starting with what is readily available and taking the best of the lot**" – Keeny 1992
  - In other words: value-focused thinking first decides what you want, then you figure out how to get there




Parnell & West 2008

# 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
- We have relied on a study culture:
  - "A problem is identified … and … a study is launched to provide additional information. Why the study is needed, or how any new information will contribute to a better choice among management options, is rarely specified" (Gregory and Long 2012 Chapter 3)



Developed by Justin Gude, Angela Romito, Mike Runge, Brielle Thompson

# Problem framing

- First and most important task in SDM
- Provides an *a priori*, explicit, and shared understanding of the problem
  - Making **decisions** is the **problem**
- Sets bounds on the problem by identifying spatial, temporal, organizational, legal, and other relevant bounds
- Incorrect problem framing means we are wasting effort solving the wrong problem
- Deciding between a finite set of alternative courses of action should be the focus of problem solving (i.e., decision making).

# Problem framing analogy

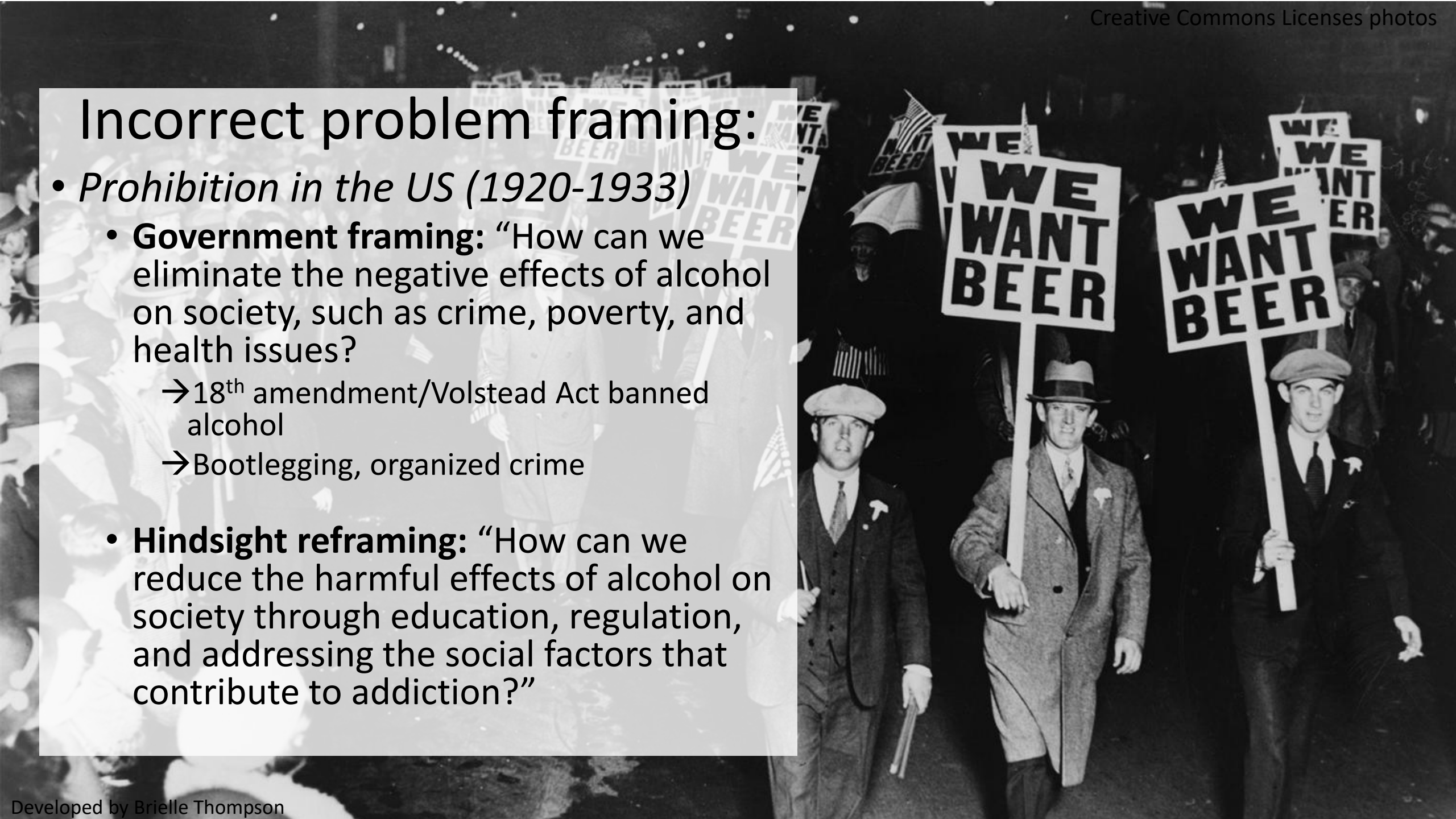
- Can be thought of as a “mission/vision/value statement” for a decision situation

*"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.

# Incorrect problem framing:

- *Prohibition in the US (1920-1933)*
  - **Government framing:** "How can we eliminate the negative effects of alcohol on society, such as crime, poverty, and health issues?
    - →18th amendment/Volstead Act banned alcohol
    - →Bootlegging, organized crime
  - **Hindsight reframing:** "How can we reduce the harmful effects of alcohol on society through education, regulation, and addressing the social factors that contribute to addiction?"

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# Incorrect problem framing:

- *Speed Limits in the 1970s*
  - **Government framing:** "How can we change the speed limit in the US to minimize fatalities?"
    →Debates on speed limit levels
  - **Hindsight reframing:** "What are ways that we can minimize car accident fatalities?"
    - Here we are thinking beyond speed limits


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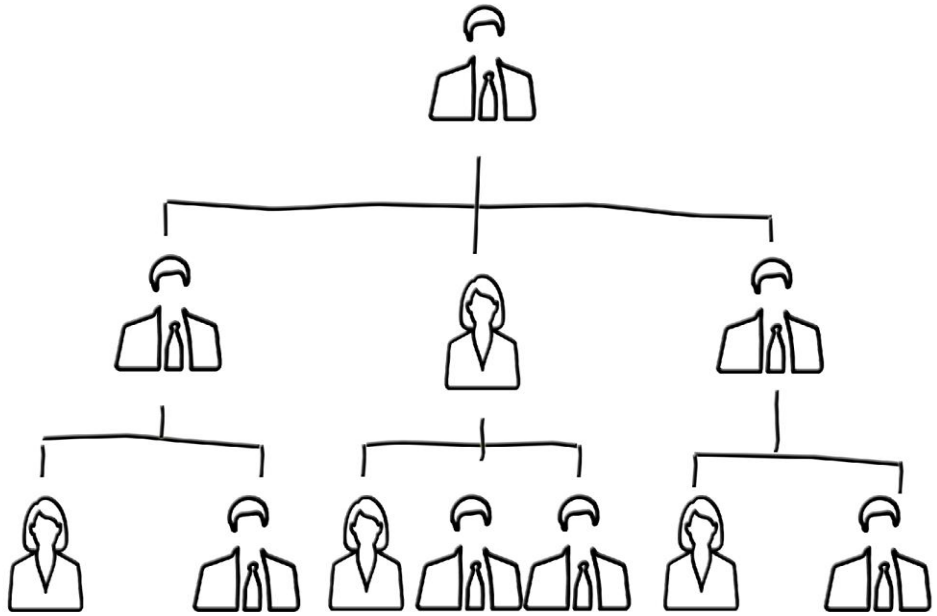
# Incorrect problem framing in natural resources

- “We need to find ways to maximize fish harvests from this lake every year?”
  - Poorly framed because: overlooks population dynamics, breeding cycles, etc.
- “What is the cheapest way to dispose mining waste?”
  - Poorly framed because: Only considers cost and does not mention environmental/human health concerns
- “How can we extract as much groundwater as possible to support agricultural expansion?”
  - Poorly framed because: Does not think about long-term water availability and ecosystem needs
- “How can we eliminate all invasive species from this ecosystem immediately?
  - Poorly framed because: Ignores ecological complexity, overlooks social/economic factors

# Elements of problem framing:

## 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**

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# Elements of problem framing:

## 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?

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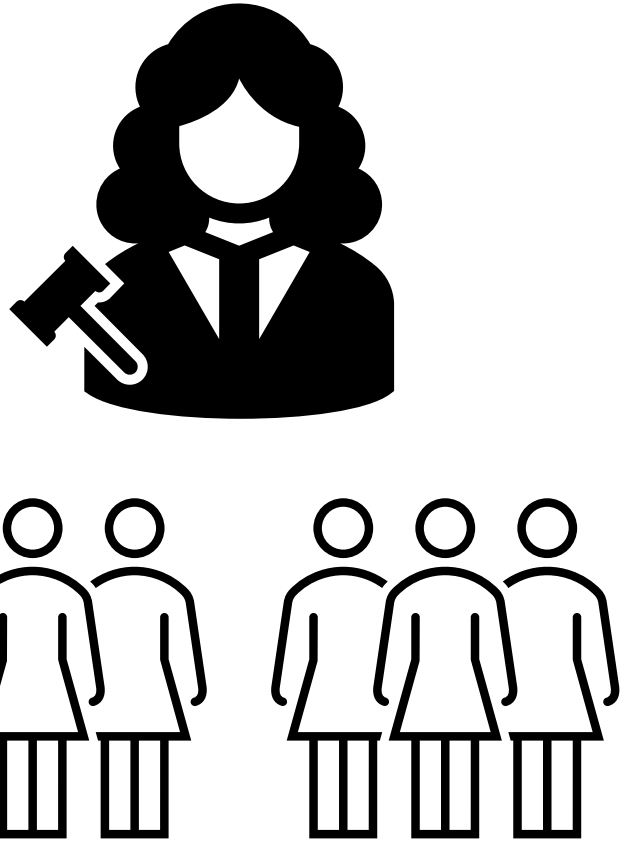
# Aside: Decision makers vs stakeholders

- Decision makers have the authority and resources to implement the selected action (final choice)
- Decision makers have greater responsibility and accountability than stakeholders



# Aside: Decision makers vs stakeholders

- *Who **could** be a stakeholder?*
  - Any person or organization with a vested interest in the outcomes of a decision
  - For natural resource management decisions:
    - Consumers/users (e.g., hunters, anglers, hikers, boaters…)
    - Public management agencies (e.g., FWS, EPA, state agencies)
    - Non-governmental organizations (e.g., The Nature Conservancy)
    - Political agencies or officials (e.g., federal, state, local officials)
    - Economic entities (e.g., businesses, chamber of commerce)

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

The Nature Conservancy

COLUMBIA CHAMBER OF COMMERCE

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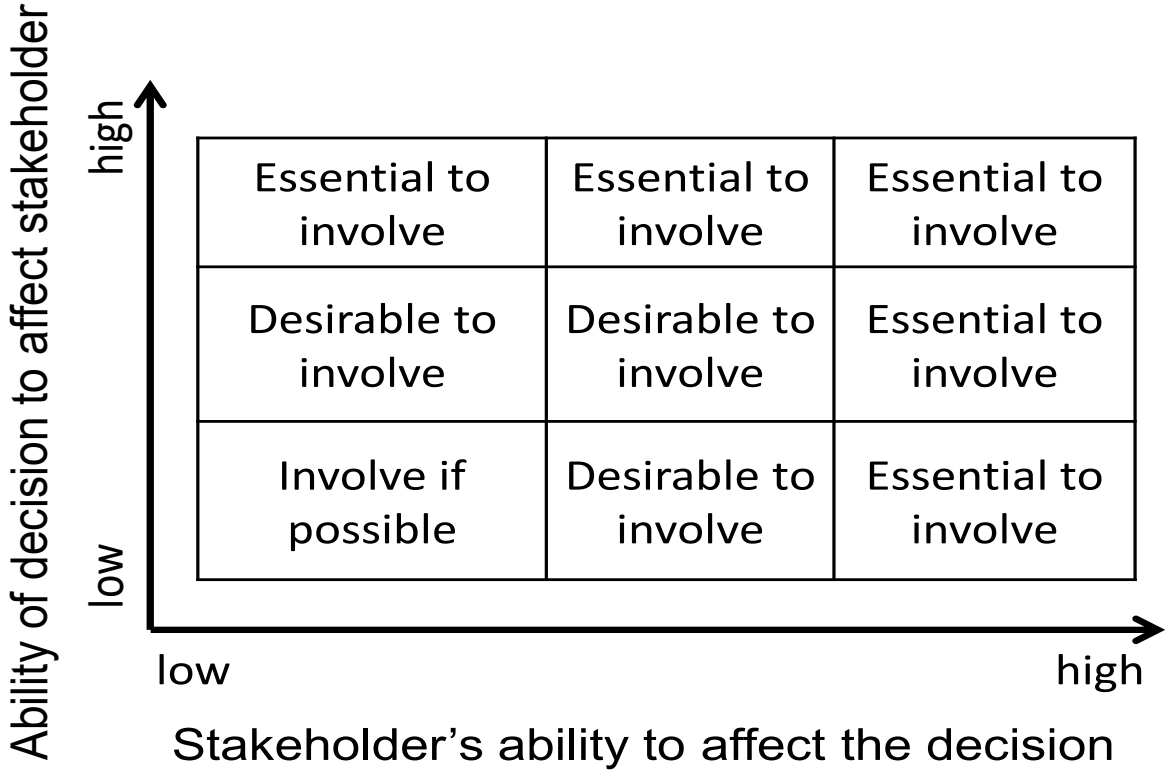
Developed by Romito AM, Cochrane JF, Eaton MJ, Runge MC, Converse SC, Brielle Thompson

# Aside: Decision makers vs stakeholders

- *Who **should** be a stakeholder?*
  - Use Stakeholder Analysis to identify and assess the importance of including potential stakeholders in a collaborative decision process

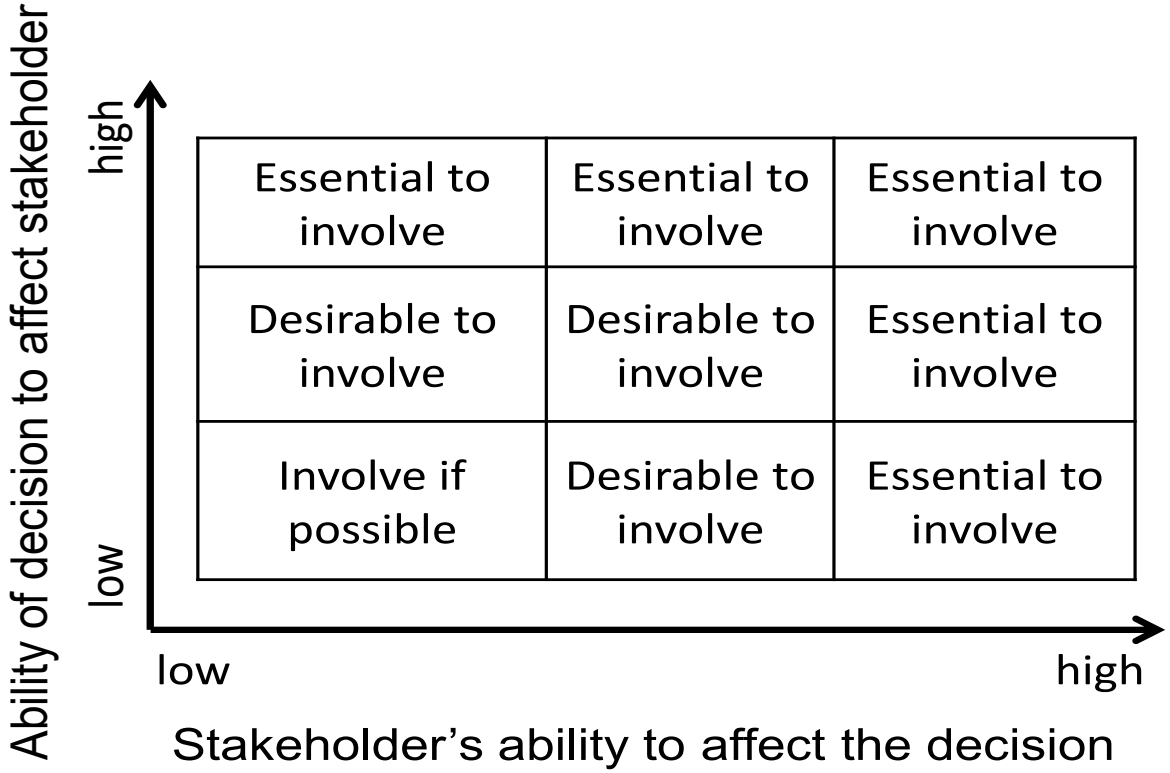



Stakeholder analysis matrix ranks stakeholders in terms of their ability to influence a decision and the ability of the decision outcome to affect the stakeholder.

Figure from Conroy and Peterson (2013).

# Aside: Decision makers vs stakeholders

- *Who **should** be a stakeholder?*
  - Use Stakeholder Analysis to identify and assess the importance of including potential stakeholders in a collaborative decision process



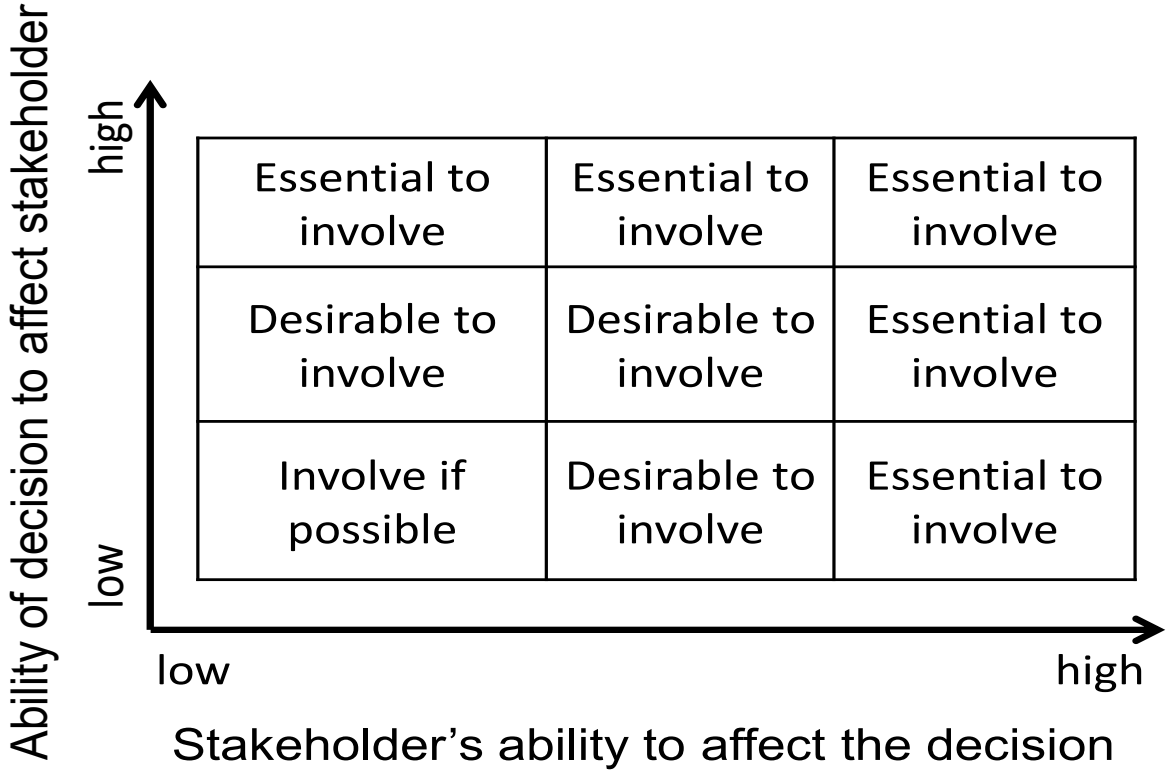

## Conducting a stakeholder analysis

**Step 1: Develop a list of candidate stakeholders by asking the following questions:**

- What are the interest groups potentially affected by the decision?
- Which interest groups are usually involved in similar decisions and which ones are usually excluded?
- Who has the knowledge of how the system works?
- What entities (e.g., management agencies) or people (e.g., farmers) have the legal authority or resources to implement management actions or make recommendations?

# Aside: Decision makers vs stakeholders

- *Who **should** be a stakeholder?*
  - Use Stakeholder Analysis to identify and assess the importance of including potential stakeholders in a collaborative decision process




## Conducting a stakeholder analysis

**Step 2: Rank candidate stakeholders using the following 2 attributes**

1) The ability of the decision to affect the stakeholder

2) The stakeholder's ability to affect the decision

**You can add stakeholders to the matrix for visualization*

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# Elements of problem framing:

## 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


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# Activity – who is the decision maker?

**Scenario 1:**

A local conservation group wants to restore a wetland to improve habitat for migratory birds. However, the land is privately owned, and the owner is considering selling it to a developer. The state wildlife agency has expressed interest in supporting restoration efforts.

**Scenario 2:**

A regional Forest Service office is planning prescribed burns to reduce wildfire risk. Residents are concerned about smoke and safety. Tribal representatives have requested consultation due to cultural sites in the area.

**Scenario 3:**

A multi-state fisheries commission is setting harvest quotas for a shared fishery. Each state has different priorities: some want higher quotas for economic reasons, others prioritize conservation. Tribal nations also have treaty rights to fish in the area.

In groups identify for each scenario:

- Who is the actual decision maker in this situation?
- What authority do they have to commit to action?

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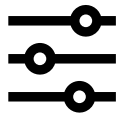
# Elements of problem framing:

## 4. Consider the decision structure

**Frequency & Timing** - How often? When? Are other decisions linked?

**Scope** - How large, broad, complicated is the decision?

**Objectives** –What are the desired outcomes?



**Actions** – 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?

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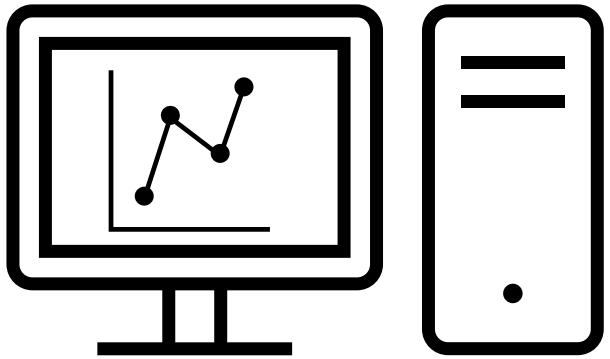
# Elements of problem framing:

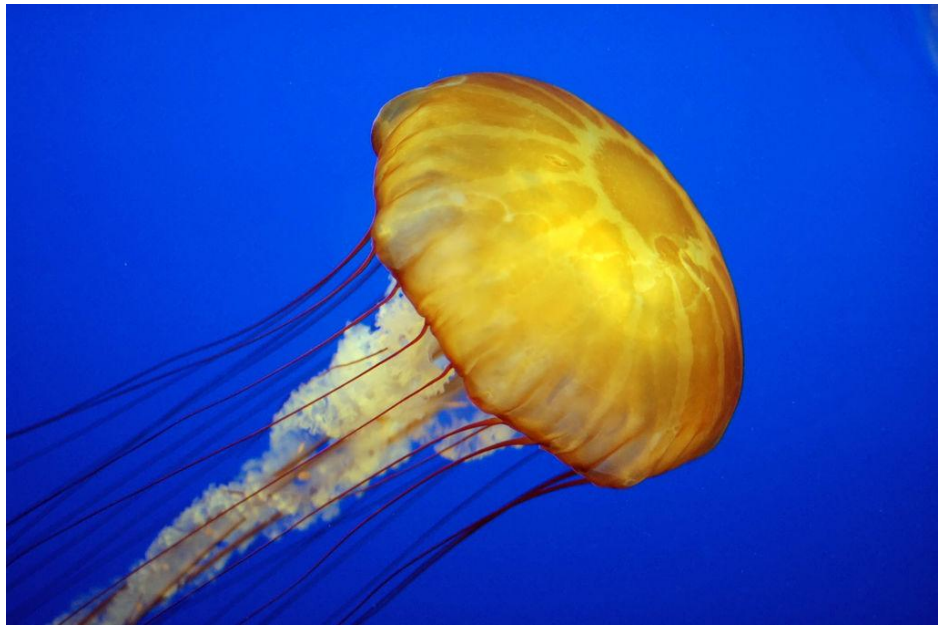
## 5. Consider the type of analysis required

- 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



# Decision problem classes:

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



"Classifying a decision problem can be like trying to find a skeleton in a jellyfish"
- Mike Runge

# 6 decision problem classes:

**1) Prediction Problems** – impediment is ability to predict achievement of objective

**2) Multiple Objective Problems** – impediment is how to trade-off competing objectives

**3) Portfolio Problems** – impediment is having to search among a very large selection of alternatives

**4) Risk Problems** – must make decisions in the face of uncertainty

**5) Information Problems** – impediment is determining value of reducing uncertainty before decision making

**6) Dynamic Problems** – impediment is balancing short-term costs with long-term benefits

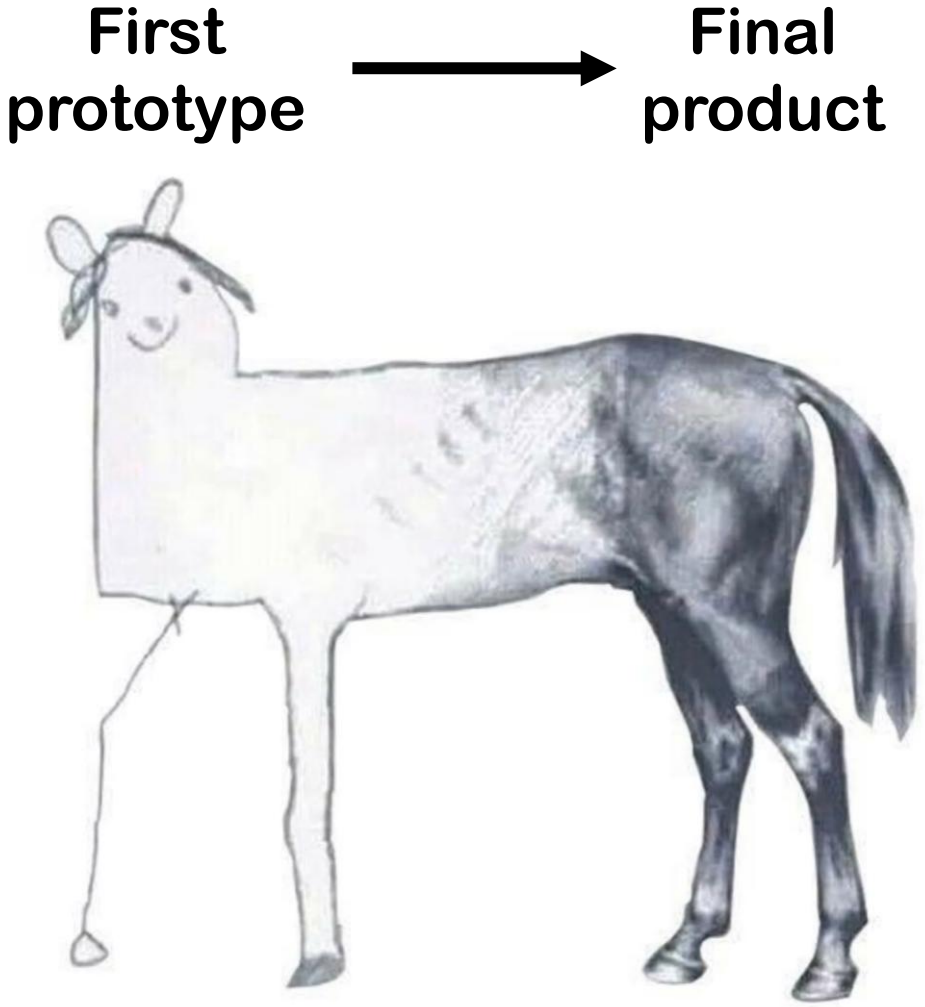
*These are not really mutually exclusive… Most natural resource problems have elements of each of these. It's a matter of thinking how best to structure a problem and which tools are therefore most appropriate to use.*

# Elements of problem framing:

## 6. Revise as needed

- The problem statement is likely to change as development proceeds
- Adopt iterative/ **rapid prototyping** as an approach

  “Good enough for now, safe enough to try”

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# Problem framing: problem 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: prompts

- **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?

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# Example:

Jean Fitts Cochrane, Angela Matz, Mitch Eaton –SDM workshop

[1] What is the decision—what kind of action needs to be taken?
[2] What triggered this decision; why does it matter?
[3] What are the legal context and constraints?
[4] Who is the decision maker?
[5] What is the decision timing and frequency; are other decisions linked?
[6] What is the scope of the problem (how broad or complicated is it)?

[1] A revised program of vegetation treatment needs to be implemented for Rolling Thunder NWR that achieves recovery goals for protected prairie-endemic species. [2] Recently, refuge conservation objectives expanded to include sustaining newly listed butterfly and beetle populations. These species may be harmed by some grassland management practices, particularly prescribed burning that has been used for 25 years to control woody species invasion and benefit rare plant populations. [3] The new program will become part of a multi-species recovery plan to meet ESA requirements, and will also have to comply with the NWR Administration Act and NEPA. Management options may be constrained by nearby residential development and local opposition to prescribed fires; also local ranchers expect economic benefits from grazing cattle on the refuge. [4] The refuge manager must decide on a treatment program, in consultation with the species recovery team. [5] The program must be in place by the summer and will last for five years. Some of the treatments may restrict future management options for up to 10 years, because of infrastructure commitments and ecological effects. [6] While the vegetation management strategy technically only applies to grasslands on about half of this refuge for a five-year program, the decision is considered critical for sustaining these endemic prairie species throughout their limited ranges

# Decision Statement – Example

## 2014 Mountain Lion Hunting Season

The MT Fish and Wildlife Commission is in the process of establishing the mountain lion harvest quotas and permit numbers for 2014 in MFWP Region 2. There is no mountain lion management plan to guide the decision. There is uncertainty regarding current lion population density estimates; harvest levels, and sex and age structure of the harvest that are needed to achieve the desired outcomes; and the impact of lion predation on ungulate population dynamics, especially in areas where ungulate populations are in serious decline and recruitment levels leave populations in jeopardy. The differing expectations of lion hunters and deer/elk hunters regarding lion population density and demographic structure of the lion population are in conflict. There is also disagreement regarding the allocation of the lion harvest between residents and nonresidents, and the impact of season structure options on local businesses—as well as how the various season structure options impact lion hunt quality and public perceptions of hunter ethics.

# Decision Statement – Example

## 2014 Mountain Lion Hunting Season: Decision Maker

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# Decision Statement – Example

## 2014 Mountain Lion Hunting Season: Action

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# Decision Statement – Example

## 2014 Mountain Lion Hunting Season: Temporal extent

The MT Fish and Wildlife Commission is in the process of establishing the mountain lion harvest quotas and permit numbers for 2014 in MFWP Region 2. There is no mountain lion management plan to guide the decision. There is uncertainty regarding current lion population density estimates; harvest levels, and sex and age structure of the harvest that are needed to achieve the desired outcomes; and the impact of lion predation on ungulate population dynamics, especially in areas where ungulate populations are in serious decline and recruitment levels leave populations in jeopardy. The differing expectations of lion hunters and deer/elk hunters regarding lion population density and demographic structure of the lion population are in conflict. There is also disagreement regarding the allocation of the lion harvest between residents and nonresidents, and the impact of season structure options on local businesses—as well as how the various season structure options impact lion hunt quality and public perceptions of hunter ethics.

# Decision Statement – Example

## 2014 Mountain Lion Hunting Season: Spatial extent

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# Decision Statement – Example

## 2014 Mountain Lion Hunting Season: Consider conflict

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# Decision Statement – Example

## 2014 Mountain Lion Hunting Season: Consider uncertainty

The MT Fish and Wildlife Commission is in the process of establishing the mountain lion harvest quotas and permit numbers for 2014 in MFWP Region 2. There is no mountain lion management plan to guide the decision. There is uncertainty regarding current lion population density estimates; harvest levels, and sex and age structure of the harvest that are needed to achieve the desired outcomes; and the impact of lion predation on ungulate population dynamics, especially in areas where ungulate populations are in serious decline and recruitment levels leave populations in jeopardy. The differing expectations of lion hunters and deer/elk hunters regarding lion population density and demographic structure of the lion population are in conflict. There is also disagreement regarding the allocation of the lion harvest between residents and nonresidents, and the impact of season structure options on local businesses—as well as how the various season structure options impact lion hunt quality and public perceptions of hunter ethics.

# 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)

Developed by Justin Gude, Angela Romito, Mike Runge

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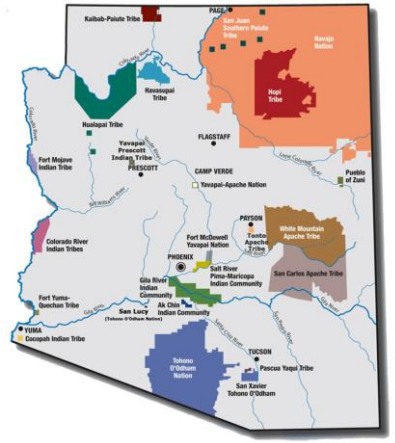
# Example: (Runge et al. 2011)

Arizona Department of Education




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

**Bureau of reclamation** is trying to **make decisions regarding invasive trout management** to **achieve recovery of humpback chub** populations **over the next 5 years** in the **Little Colorado River, below the Glen Canyon** Dam considering **sacred sites and spiritual values of local Native American tribes (e.g., avoid taking of life), humpback chub recovery, trout invasion, recreational values, cost, and local economies.**

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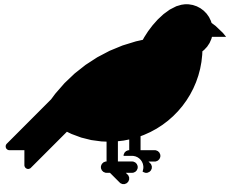
Adapted, modified, and simplified from Runge et al. 2011

# Avoid Common Pitfalls

**What is the scope of the problem?**

- Narrow vs Broad framing
  - Example (*See this week 2 reading)*
    - *Management of red knots and horseshoe crabs*
      - ***Broad frame****:* how to recover red knot so that it is no longer a threatened species (management actions would occur across its full habitat range)
      - ***Narrow frame****:* how to best manage the harvest of horseshoe crabs in Delaware bay while providing forage for migratory shorebirds



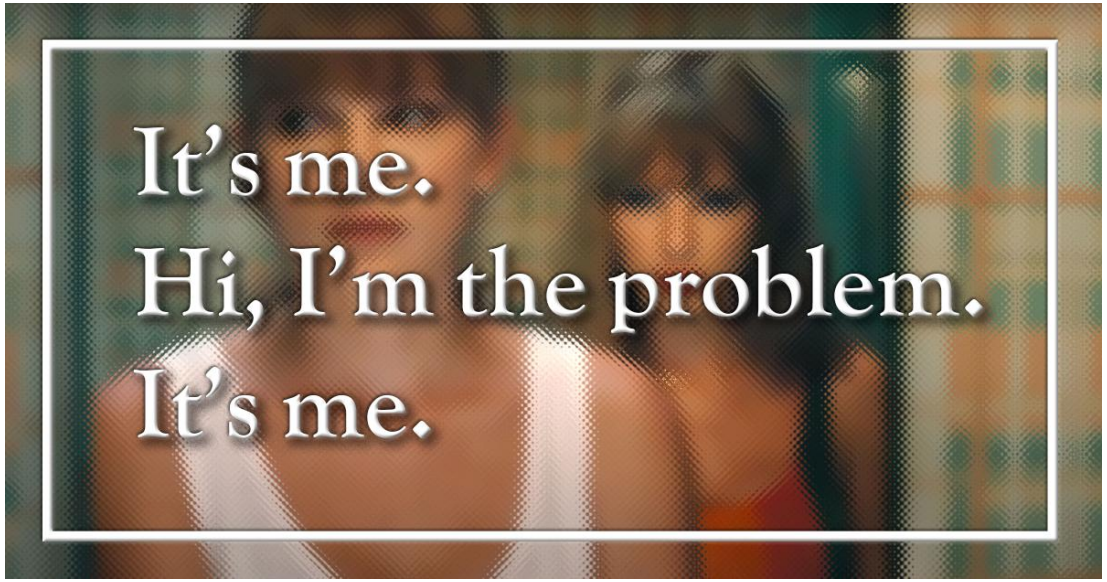
**Discussion:**

- Why do we need to set bounds for the frame “size”?
- How can we decide the size of the frame?

# Avoid Common Pitfalls

## “Frame Blindness”

- Are there other perspectives that aren’t being considered?
- Are any perceived constraints imaginary?
- Are we biased by earlier actions, successes, or failures?
- Are we making any false assumptions?
- Are we solving the right problem and is our scope correct?




WHAT’S THE PROBLEM?
*(warning some adult language)*
*https://www.youtube.com/watch?v=HiB9L3dG-Aw*

Developed by Justin Gude, Angela Romito, Mike Runge, Brielle Thompson

# Activity: Identify how these poorly written problem statements can be improved

1. We need to get rid of all the invasive rats in Central Park as soon as possible because they're bad for nature. This should be easy if we just remove them all at once. They don't belong here and are ruining everything. We don't need to worry about how or what happens after—they just need to go.
2. The forest in Coastal Oregon isn't making money, so we should clear it and use the land for something more useful. It's just sitting there and not helping the economy. If we replace it with farms or buildings, we'll get more value.
3. We should allow more fishing in Lake of the Ozarks because people want to catch more fish, and it helps the local economy. Fish populations will probably bounce back anyway. Regulations are annoying and hurt business. Letting people fish freely is the best way to keep everyone happy.
4. Wolves in Montana are causing problems near farms, so we should remove them all from the area. They're eating crops, killing livestock, and bothering people. Relocation or fencing might be too expensive, so just getting rid of them is easier. It's not worth trying to balance wildlife and farming.

# Activity discussion (5 minutes)

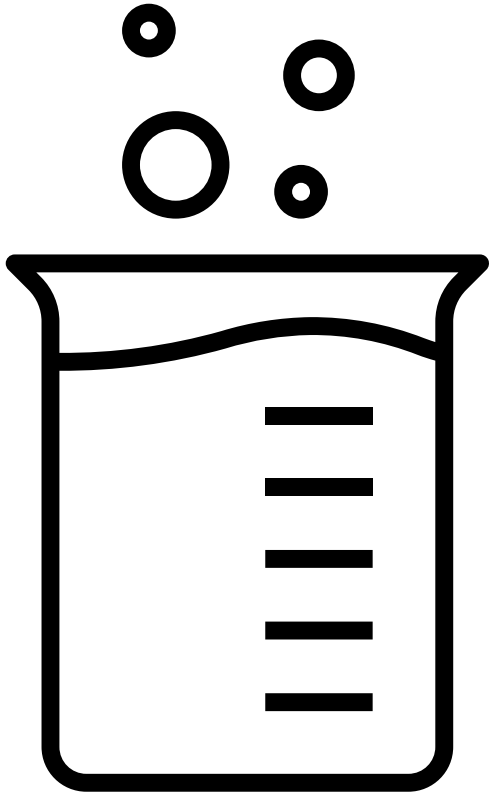
- Was it difficult to edit an existing problem statement?
- How did you improve the statement?
- How do you think changing the statement would affect the decision?
  - Aka: Is there a concern for an outside group to make the decision statement on behalf of the decision maker?

# Skills check 1 (30 minutes)

- I will provide you with details for a real-life natural resource management decision and using this information, you will:
  - Answer the following:
    - What is the decision—what kind of action needs to be taken?
    - What triggered this decision?
    - What are the legal context and constraints?
    - Who is the decision maker?
    - What is the decision timing and frequency; are other decisions linked to this one?
    - What is the scope of the problem (how broad or complicated is it)?
    - What makes this decision hard (what is the primary impediment to the decision)?
  - Then make your own problem statement
- Then I will give you the published problem statement and you will
  - Compare your statement with the published statement

# Group 1:

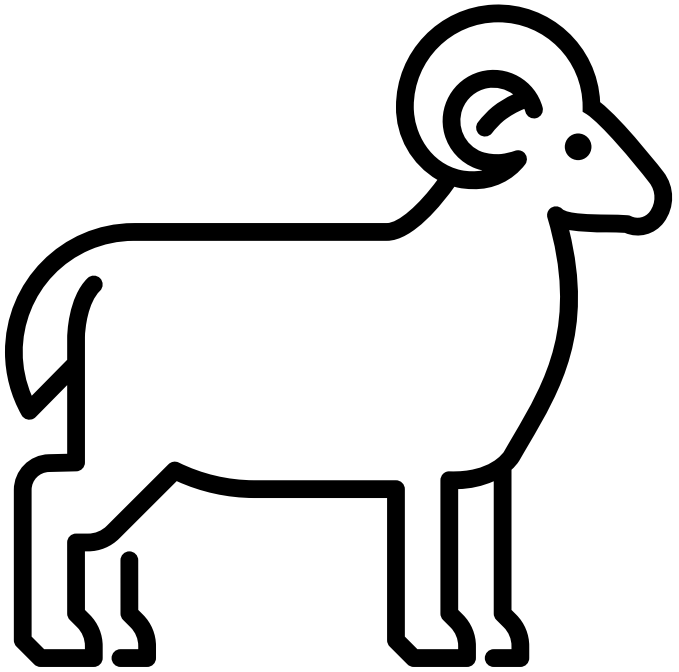
- What did you learn?
- How did your statement compare with the published statement?
- What more information would you have wanted to have?
- Is this process useful for natural resource managers?



**Case Study:** Sepulveda, Adam J., Christine E. Dumoulin, Denise L. Blanchette, John McPhedran, Colin Holme, Nathan Whalen, Margaret E. Hunter et al. "When are environmental DNA early detections of invasive species actionable?." Journal of Environmental Management 343 (2023): 118216.

# Group 2:

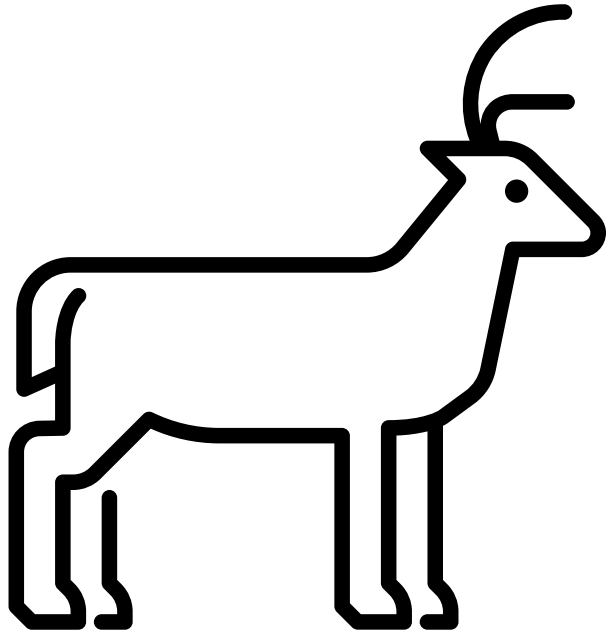
- What did you learn?
- How did your statement compare with the published statement?
- What more information would you have wanted to have?
- Is this process useful for natural resource managers?



**Case Study:** Sells, S.N., Mitchell, M.S., Edwards, V.L., Gude, J.A. and Anderson, N.J., 2016. Structured decision making for managing pneumonia epizootics in bighorn sheep. The Journal of Wildlife Management, 80(6), pp.957-969.

# Group 3:

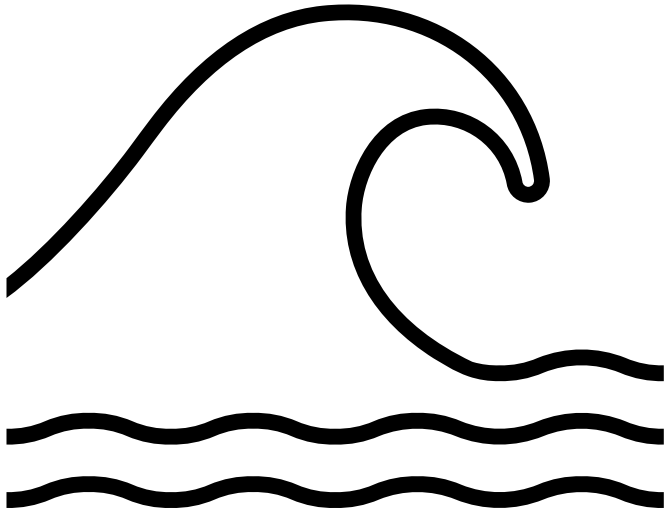
- What did you learn?
- How did your statement compare with the published statement?
- What more information would you have wanted to have?
- Is this process useful for natural resource managers?



**Case Study:** Robinson, K.F., Fuller, A.K., Hurst, J.E., Swift, B.L., Kirsch, A., Farquhar, J., Decker, D.J. and Siemer, W.F., 2016. Structured decision making as a framework for large-scale wildlife harvest management decisions. Ecosphere, 7(12), p.e01613.

# Group 4:

- What did you learn?
- How did your statement compare with the published statement?
- What more information would you have wanted to have?
- Is this process useful for natural resource managers?

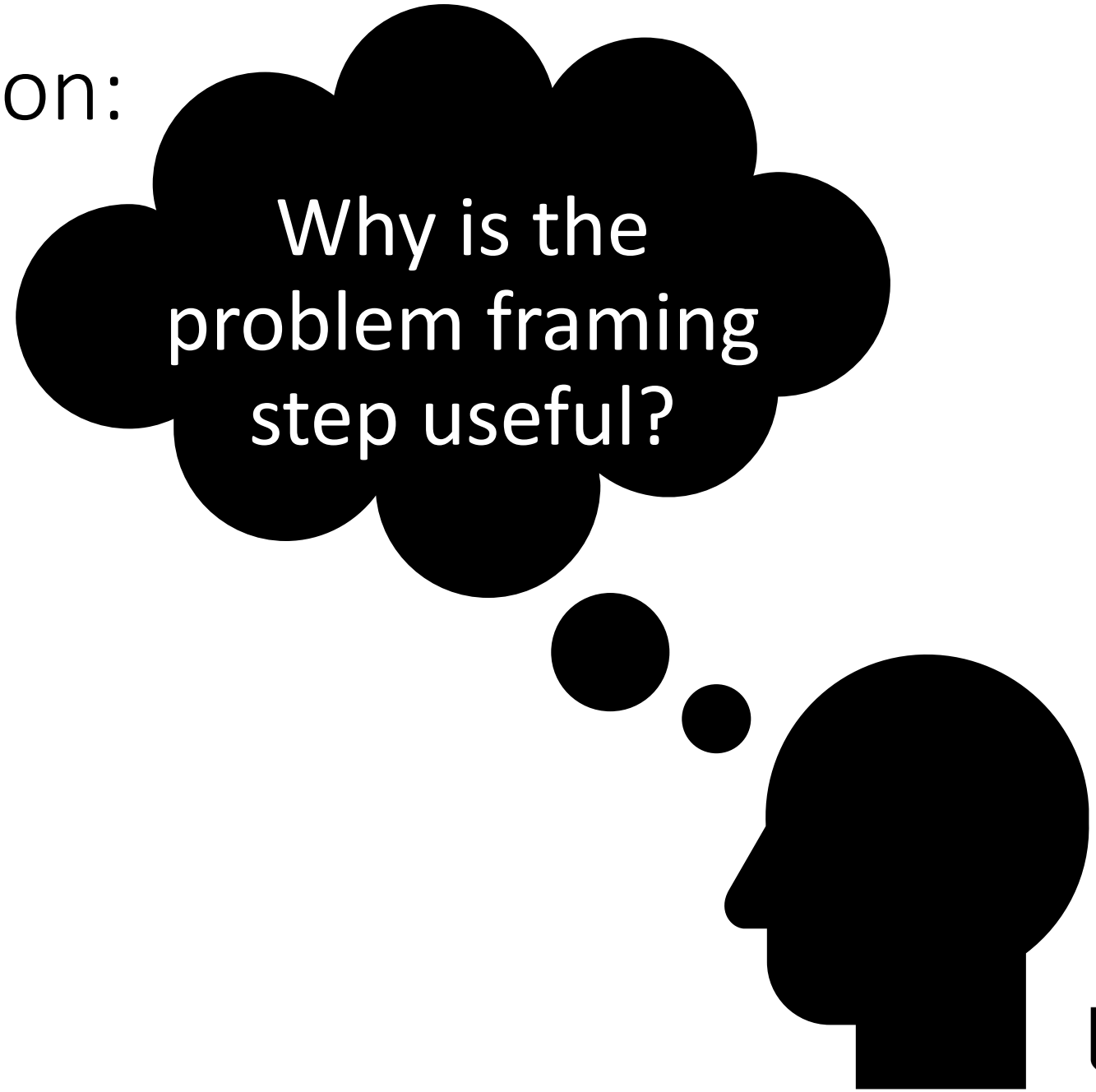


**Case Study:** Peterson, J.T., McCreless, E., Duarte, A., Wohner, P., Hamilton, S., Medellín-Azuara, J. and Escriva-Bou, A., 2024. Prototyping structured decision making for water resource management in the San Francisco Bay-Delta. Environmental Science & Policy, 157, p.103775

# Activity: think about your decision problem

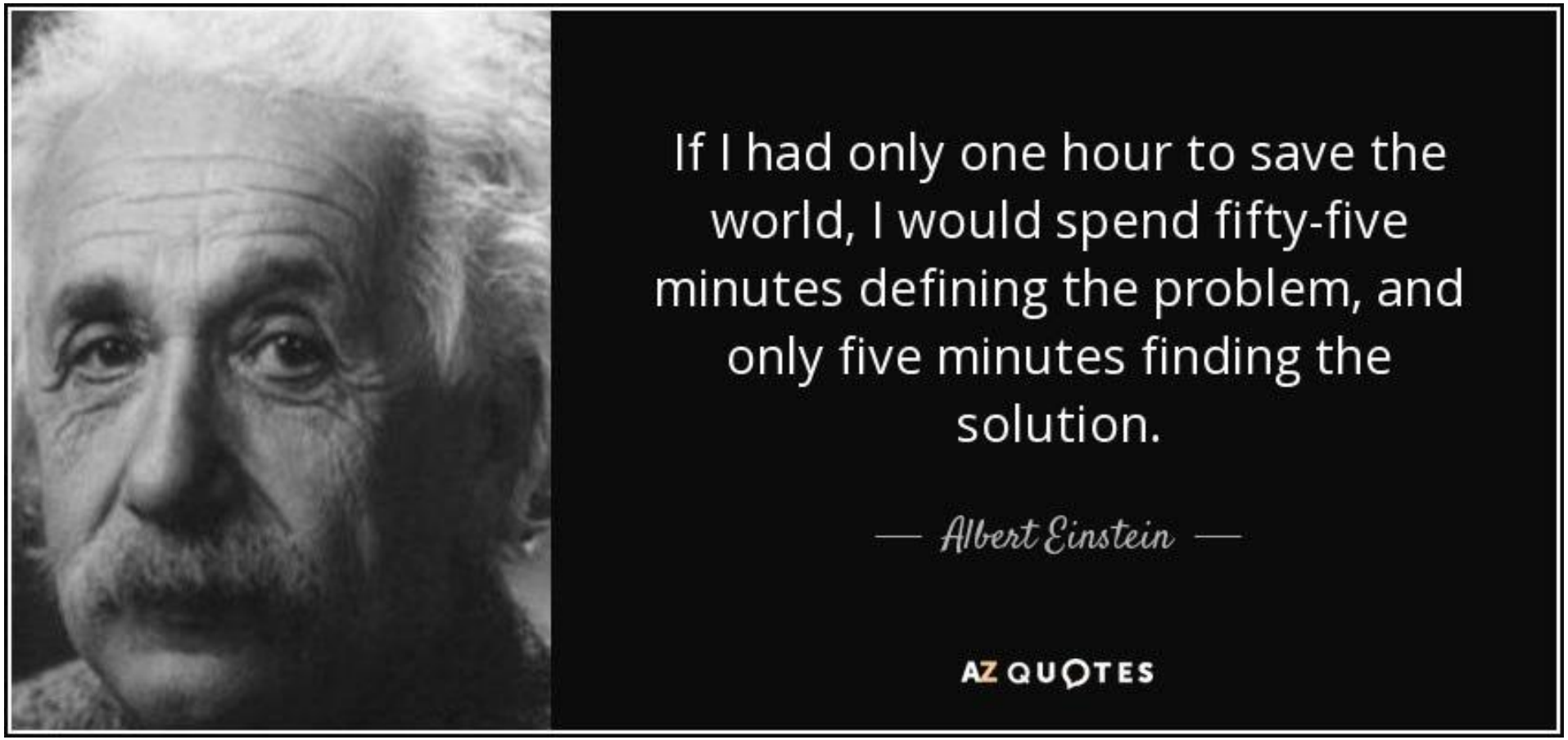
- For your final project presentation, you will provide a slide of your problem framing statement
  - Individually think about your problem and start jotting down elements of your problem statement (see skill check for prompts)
  - With a partner discuss your final project SDM prototype and the **Problem framing step**

# Discussion:



# Problem framing is hard!

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



# Looking ahead:

**Next week:** O step of PrOACT

**Weekly:** Work through a step of the PrOACT process/ learn extra tools

**Last week of class:**

Elevator pitch of your research project in terms of SDM/PrOACT

Note: Abridged PrOACT story slides with a star on the upper right are good examples to use for your presentation

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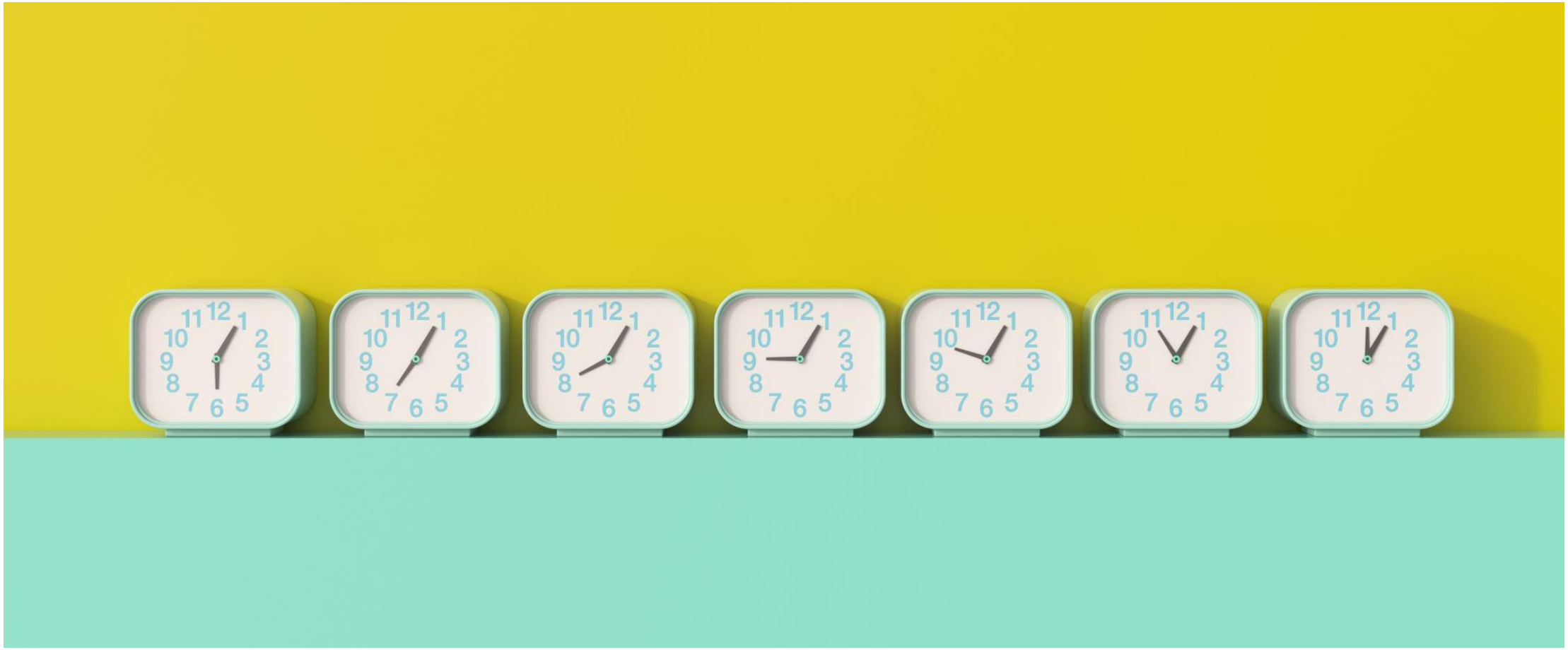
# Extra time activities:



# Reading discussion

Chapter 2 Runge et al. 2020 (DM Smith)

- What is meant by an “error of the third kind” in decision analysis, and why is it important to avoid it?
- How can framing a decision narrowly versus broadly influence the range of possible solutions and stakeholder engagement?
- In the horseshoe crab and red knot case study, how did different frames (narrow vs. broad) affect the management approach?
- Why is identifying the decision maker considered a central challenge in decision structuring, especially in collaborative contexts?
- How does prototyping contribute to refining decision structures, and what are the advantages of a “fail fast” approach?