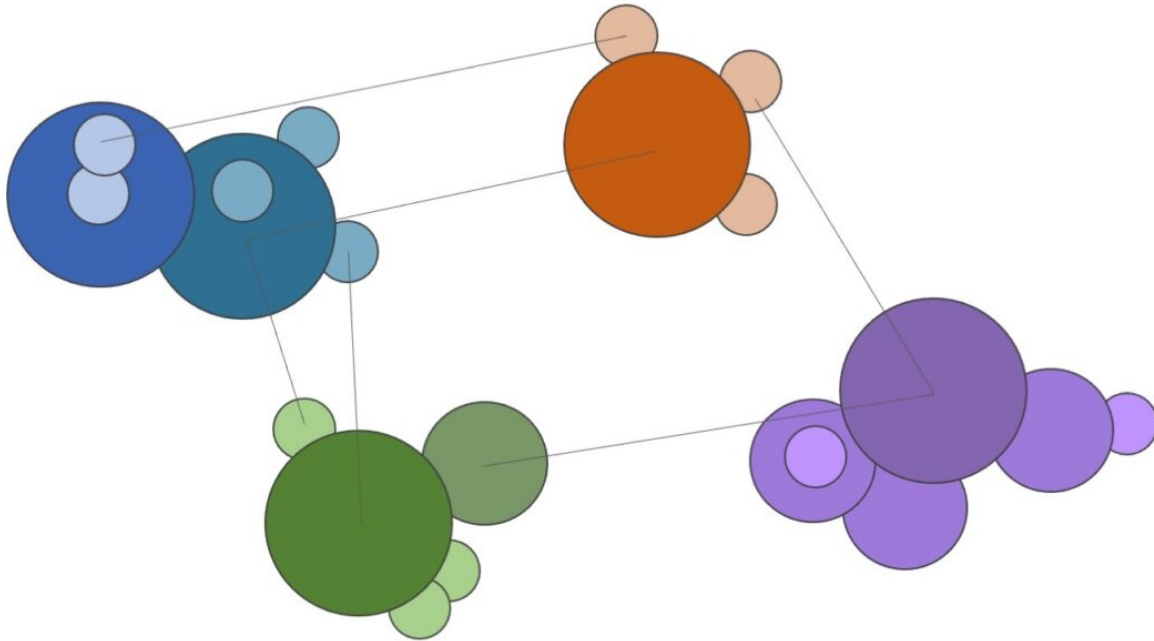# Handbook on Inter-Agency Coordination

by Harrington, Milman, Perides

This handbook depicts the critical decisions and issues that agencies must address as they plan for and navigate the process of coordination. In order to coordinate, agencies must decide how they will make and enforce decisions and the commitments they will make to one another. Chapter 1 provides an overview of Inter-Agency Coordination. Chapter 2 addresses the topic of structuring coordination. As agencies are bound by a variety of procedural requirements that affect not only their choice of structure for coordination but also how they can operate within that structure, Chapter 3 discusses the administrative aspects of coordination. Further, as inter-agency coordination frequently entails sharing or information of data, information or knowledge, Chapter 4 addresses the topic of mechanisms and barriers to coordination of knowledge. Cumulatively, these three chapters provide the reader with an overview of practical details that often receive scant attention yet are critical to accomplishing inter-agency

HANDBOOK ON INTERAGENCY COORDINATION

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Chapter 1.   Introduction – The Need for Coordination

One of the greatest challenges of developing and implementing law and policy in multi-level governance systems is the question of coordination.[1,2,3,4] **Coordination**, which refers broadly to processes and practices that aim to synergize activities, aims, and objectives, is needed because our world is comprised of many deeply interconnected and complicated parts. Overlap in or externalities resulting from these parts creates the potential for both positive synergies and counter valiance across actions.[4,5] How to engage in coordination to address fragmentation and to improve environmental governance is the focus of this handbook.

1.1. Benefits of Coordination

Coordination aims to avoid conflicting impacts of one organization's actions on another's actions, goals, etc. and/or to create mutual gains and find synergistic solutions that provide benefits broader than can be achieved in the absence of coordination.[6]

Coordination to prevent negative impacts is necessary because organizations may have contradictory goals, may undertake actions that are countervailing, or may take actions that create negative externalities. For example, use of ground water by one agency may reduce and prevent the use of that groundwater for another agency. As another example, building a berm to protect one property from flooding may increase flood risk downstream. Not only may some actions have unintentional impacts, impacts may also go unrecognized, making it even more difficult to address and mitigate the effects of uncoordinated actions.

Coordination to provide positive gains moves beyond simply avoiding harm to taking advantage of synergies between organizations. Coordination can lead to gains in efficiency by reducing redundancies or lowering resource requirements. Coordination may also allow agencies to benefit from economies of scale. Through coordination, agencies may also be able to leverage their resources and abilities to jointly address cross-cutting problems and respond to changing conditions. Coordination can also provide socio-political gains by building public confidence and/or support for coordinating agencies.

Coordination can occur between any variety of agencies including, but not limited to, government agencies, non-profit organizations, and corporations. Coordination can be vertical, horizontal, or both.

Vertical coordination occurs among organizations working with different levels of authority and is often instituted using a top-down approach. For example, a state may institute a collaborative planning process through which it brings together all agencies that manage land and water to develop a regional water plan.

Horizontal coordination occurs amidst organizations working with the same level of authority that are separated often by either geographic or sectoral boundaries. For example, neighboring municipalities may coordinate their floodplain management strategies to create consistent rules across the watershed.

Agencies may coordinate across one or more aspects of an organization.[7,8] They may coordinate their higher-level missions, strategic objectives, or goals. For example, two agencies may coordinate on broad mission of achieving equity in environmental protection or the removal of an invasive species from a body of water that they both actively protect. Agencies may also coordinate their policies and programs by aligning their procedures and methods. For instance, agencies may agree upon who is eligible to participate in programs or align the service delivery activities offered. Lastly, agencies may coordinate resources and responsibilities, defining who will undertake specific actions or otherwise arranging sharing or contribution of tasks, resources, and staffing.

1.2. Why is Coordination Needed

These entities function at many levels. Within the national level governments, frequently multiple branches (executive, legislative, judiciary) co-exist. Similar divisions may exist at the state/provincial level. There are also hundreds of lower-level entities, including counties, cities, and towns each with their own local government system. Further, even within a level and branch of government, there can be multiple divisions. For example, many towns have a planning department, a department of public works, and committees, such as for wetlands protection or health and safety.

While each governing unit has its own specific mission, goals, authorities, and responsibilities, the relationships between governing units vary. In some instances, each unit operates fully independently; in other instances, they are institutionally tied to one another; while in others, authorities and jurisdictions can overlap. Jurisdictional areas may intersect geographically, such as when the agencies cover some of the same "territory" (i.e. geographic, demographic, etc.), topically, such as when agencies address the same or related issue areas, or institutionally, such as when agencies are legally intertwined with one another. For example, higher levels of government may delegate decision-making to lower-levels governments. Lower-level units of government may also be subject to laws or regulations from higher-levels. Some interactions between governing units occur through designated roles within a process, such as when one agency sets standards that another is responsible for enforcing. Other interactions are more informal or ad hoc. Further, all levels of government interact with the many associations, community organizations, and individuals that have their own autonomy and influence environmental outcomes.

> **Box 1a. Institutional Fragmentation**
>
> Creation of new and restructuring of existing agencies is not uncommon. Institutional structures are changed as new circumstances or needs arise, in efforts to streamline processes or improve efficiency, and/or as part of political processes. As an example, in the aftermath of the Deep Horizon oil spill, the US Secretary of the Interior separated the US Minerals Management Service into three new agencies: the Bureau of Ocean Energy Management, the Office of Natural Resources Revenue, and the Bureau of Safety and Environmental Enforcement. The objective of this restructuring was to create a system through which safety management would be overseen independently from resource development and management, to provide a structure that ensured robust environmental analyses would be conducted, and to strengthen the role of environmental review and analysis.

This complex institutional structure for environmental governance results from the history human and societal development. Governmental structures and agencies are created and morph over time, in response to specific issues and changing needs and cultural paradigms (**See Box 1a**).

The complexity of institutional structures for environmental governance is also a reflection of the challenge of apportioning responsibility over socio-ecological systems. Due to the web of interactions within and between human and environmental systems, there is no perfect fit between jurisdictional authority and the issues that need to be addressed. Spatial and ecological boundaries generally do not align with the boundaries that define human governance regimes. Further, the boundaries of both ecological and human systems are not well-defined (**See Box 1b**).

Box 1b. Boundaries of Ecological Systems

Within ecological systems, there is no intrinsic unit around which to draw a boundary.[13] Any one unit can often be divided into subunits. For example, a watershed may be based around first level a stream, yet a first-level stream is generally a tributary within a larger watershed, which may itself be a subunit of an even larger watershed.

Figure 1b: *The Missouri River Watershed in the USA (light blue) is comprised of many subwatersheds, including the Missouri-Oahe watershed (medium blue), within which is the Apple Creek watershed, within which are multiple smaller subwatersheds (darker blues).*
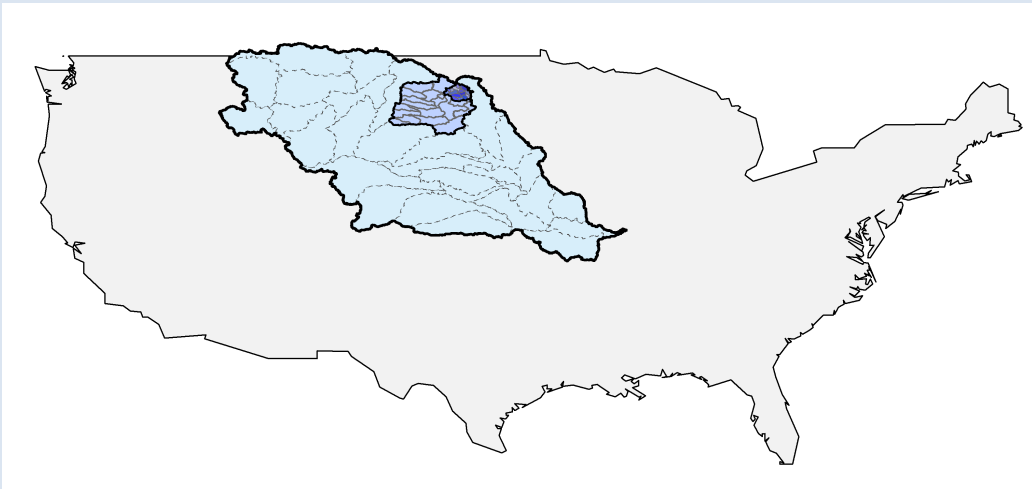
Complicating the selection of boundaries is the fact that natural resource systems are comprised of many interconnected physical processes. For example: the boundaries of a surface watershed do not necessarily match exactly with the boundaries of one of its groundwater basins. Moreover, human interventions often altered the physical boundaries of ecological systems. For example, diversions of water through canals may convey water from one watershed to another.

Human systems are as interconnected and overlapping as ecological systems, making it difficult to align the boundaries of any one governing unit with all facets of a social system.

Economic systems, political systems, and cultural systems intersect but generally do not follow the same boundaries. Natural resources are often governed by sector, yet activities related to one

sector influence another. Further, broader economic and social policies also influence natural resources use and management. For example, water resources are tied to energy, agriculture, ecology, and recreation. Renewable energy policies that support hydropower may impact water deliveries for farming yet may also support boating and fishing in a reservoir. Even within a sector, there may be divisions. For example, water quality is generally addressed by environmental and public health authorities, while water quantity may be governed by natural resources or agricultural authorities. The combination of these multiple boundaries makes it extremely challenging, if not impossible for policies, programs, and projects implemented by any one governing unit or actor to span the full set of processes and actors that influence or are influenced by an environmental issue

1.3. When Coordination Occurs

Whether and how agencies coordinate can depend on how they interpret the impacts of coordination.[15,16,17] While coordination can provide benefits, such as increased efficiencies and prevention of countervailing actions, coordination has its costs. Coordination requires time, energy, and resources. Agencies may be concerned about how costs and responsibilities are distributed, particularly when there are unequal capacities and expertise across coordinating agencies. Agencies may also be concerned about how coordination may affect their broader mandate and objectives.[18,19,20,21] While many agencies have a public service mission, they still retain a motivation for self-protection, growth, and good standing. Agencies may have apprehensions about how coordination affects their autonomy and independence.[6] Agencies may think that that coordination with other organizations will endanger their 'turf', thus reducing control over issues, prominence, sets of responsibilities, and clout.[9] Agencies may also be concerned about the implications of coordination on identity or branding. Further, agencies may be averse to implementing policies and programs or otherwise taking actions that are not aligned with their ideology. Such concerns can be particularly prominent when there are strong differences in perspective between the agencies that are considering coordination. Lastly, agencies may be constrained in how they coordinate by the legal and regulatory requirements governing them.

The willingness of an agency to coordinate and how it chooses to coordinate will be moderated by past experiences and relationships with the agencies with which it is coordinating.[18,22] A positive history of working together can build trust and good will, while less positive experiences may augment concerns about the risks of coordination. Further, through prior relationships, agencies may have developed mechanisms for reducing the transaction costs of working with one another making coordination more appealing. Lastly, it is important to note that organizations are not monolithic entities. Within each agency, there are varying divisions, programs, and offices, and within each of those are individuals who make and enact decisions. Entrepreneurs, key actors, and boundary spanners within an organization have an immense influence on coordination decisions and coordination outcomes. It is these individuals who go to meetings, discuss the coordination, and share information. The social capital that is developed between them can facilitate or impede coordination across agencies.

1.4. Steering Coordination

Where the motivations for interagency coordination are low, or where barriers are substantive, coordination may not autonomously emerge and may need to be steered by outside forces. At the international level, coordination across organizations may be motivated by public pressure and linkages such as incentives or sanctions from other fields beyond that being coordinated. In polycentric systems, when barriers or concerns regarding coordination between agencies are strong, higher levels of government can encourage lower levels of government to coordinate through information-based, incentive-based, and mandate-based approaches.[19,23,24]

Information-based approaches to steering coordination involve pressures, encouragement, and the provision of knowledge that can facilitate coordination or reduce the transaction costs of coordination. These approaches may involve aspirational statements aimed at generating interest in support for coordination. For example, a public statement to pursue a goal may incentivize coordination if the statement sparks other agencies with overlapping goals or activities to initiate conversations. Information-based approaches can also provide guidance regarding what coordination needs to occur or how coordination could be useful. For example, states may provide local-level governments with databases and information on potential partner agencies in order to lower the transaction costs associated with initiating coordination processes.

Coordination can also be incentivized through the provision or withholding of resources. Such incentive-based approaches may include the provision of financial or technical assistance in order to coordinate. These may come in the form of 1) grants to fund the process of coordinating, 2) grants and loans contingent upon agencies coordinating, 3) advice and training on coordination, or 4) relaxation of standards or costs for agencies that work together. For example, California makes grants available for agencies to coordinate in development of integrated water resources management plans and then has additional funding available for implementation of coordinated projects. While incentive-based approaches to steering coordination may foster coordination, they may also lead to nominal coordination that meets the bare minimum requirements of the incentive, without extending beyond it.

Lastly, coordination may be mandated via legislation, regulation, or the courts. Mandates may specify a forum for coordination such as the requirement for organizations to participate in a newly created network or forum. For instance, a state may create an annual meeting amongst each county within the state to give reports on the past year's water needs, crises and future broadcasts for their regions. Mandates may also take the form of laws that require reporting on coordination or production of joint plans. Mandates can entail joint performance standards that organizations are unable to meet without coordination. Coordination mandates can only be used to steer coordination when a higher-level government has the jurisdictional authority over lower-level agencies in a way that allows it to create the mandate. Additionally, mandates may be difficult to monitor and enforce.

Chapter 2.   Formalizing Coordination

Coordination between agencies can occur through either informal or formal means. Each level of formality is associated with benefits and drawbacks; therefore, the most appropriate form of coordination will be situation specific.

Informal coordination involves efforts between agencies to work together in either verbal or written form, without official contractual agreement. Informally coordinated actions may take place on a regular and planned basis or may occur in an ad-hoc manner. A major benefit of this form of coordination is the relatively low transaction costs (e.g., time, effort, and financial obligations) associated with negotiating coordination. These lower transaction costs may allow informally coordinated actions to begin sooner than through formal coordination. Another benefit of informal coordination is adaptability, as where change is needed, terms and conditions do not need to be renegotiated through a structured formal process. Lastly, withdrawal from informal coordination does not require navigating legal or administrative processes.

A significant disadvantage of informal coordination is that the roles, rights, and responsibilities of each agency are not always fully delineated and there are risks of change, defection, or withdrawal. The lack of well-specified roles and responsibilities may lead to confusion or miscommunication that negatively impacts how efficiently the parties can complete their agreed-upon actions. It may also result in resentment or a loss of trust between the parties if the informal nature of the agreement leads to mismatched expectations. Further, a lack of legally defined consequences, makes it easier for defection – during which one agency fails to follow through on a commitment – to occur.

Formal coordination entails a concrete commitment between agencies, with details that are negotiated, written, and verified by signature from each party in the agreement. A key benefit of formal coordination is that the roles, rights, and responsibilities of each party are clearly defined. By specifying the details of the commitment, formal coordination can help to minimize or avoid miscommunication, confusion, or mismatched expectations. Therefore, this form of coordination may increase the efficiency at which the agreed-upon actions are executed. Formal coordination is also enforceable; there is a consequence for parties that do not act in the agreed-up manner, and this consequence is legally enforceable if necessary.

The drawbacks of formal coordination are primarily related to transaction costs. Time, effort, and in some instances, resources, are needed to negotiate and draft the terms of a formal agreement. In additional, formal agreements are less adaptable than their informal counterparts, either because of the high transaction costs associated with re-negotiating the terms or because the original terms prevent modification to the agreement.

Whether formal or informal coordination is merited in any given situation will depend on factors such as the number of parties included in the coordination effort, the prior relationships between the parties or their desired relationship in the future, the transaction costs for coordination, the projected duration of the coordination, and the consequences should a party fail to comply with the terms of the agreement. Informal coordination may be an ideal way to begin a partnership

between agencies because it can help establish trust while minimizing transaction costs. It might also be the simplest way for agencies with a history of working well together to accomplish shared goals. In contrast, formal coordination might be the most effective method when many parties are involved, when the nature of the coordinated action is complex, or if the parties want the option to legally enforce contract noncompliance. When selecting the form of coordination to use, agencies will need to consider the goals of the coordination effort as well as the benefits and risks of each form. Even within formal coordination, a variety of options exist. The remainder of this module examines the key characteristics of formal agreements and the potential structures used within them.

2.1. Types of Formal Agreements

There are several broad categories of formal agreements between governing bodies. The type of agreement is largely determined by the level of governance – such as international, inter-state, or local – as well as the types of provisions necessary to complete the agreement.

International agreements are legally-binding agreements between nations in written form. These agreements govern the rights, duties, and obligations of all participating nations. Formal international agreements are commonly referred to as treaties, conventions, charters, protocols, and pacts, among other titles.[25] International agreements can be established bilaterally between two nations, or multilaterally between three or more nations. International agreements cannot bind non-participating nations. Generally, these agreements contain provisions that specify the date on which the agreement becomes legally binding, how compliance will be monitored and measured, how other nations may join the agreement, how and whether the agreement may be amended or modified, and how and when the agreement will terminate.[25]

At the sub-national level, agreements can also exist across independent governmental jurisdictions, including states or provinces. An example of formal coordination agreements within the United States is that of **inter-state compacts.** Inter-state compacts are written, legal agreements between states that bind member states to their provisions. These compacts create an agreement between states to adopt certain standards, cooperate on regional or national matters, or address a particular policy issue that transcends state boundaries.[26]The agreement is negotiated between the involved states and establishes a framework for administering and implementing the compact's provisions. These frameworks vary in content depending on the subject matter, complexity, and scope of the agreement. For example, simple frameworks may prescribe certain conditions in which member states must comply with the compact, or that require the states to coordinate in furthering the purpose of the compact. In contrast, complex frameworks may delegate authority to commissions and describe the organizational structure, powers and authorities, dispute resolution, and public accountability for these commissions.[27]

Another example of coordination at the sub-national level occurs through **inter-agency agreements.** This type of agreement can take place between agencies at the same level of governance – such as between two counties or between two or more executive branch agencies – or across levels of governance, such as between state and local agencies. Interagency agreements can take several forms, such as a Memorandum of Agreement (MOA) or a Joint Powers Agreement (JPA), each of which set up a differing legal structure for coordination (See Box 2a).

Box 2a. Legal Structures for Interagency Agreements – Example from California

Under California's Sustainable Groundwater Management Act (SGMA), interagency coordination agreements were created to collaborate on the planning of sustainable groundwater management. Agencies partnering to form Groundwater Sustainability Agencies and develop groundwater sustainability plans could choose to form a Joint Powers Agreement (JPA), thus creating of a new legally distinct collaborative agency through which coordination would occur or they could choose to sign a Memorandum of Understanding (MOU), under which coordination occurred through the existing institutional structures. Choices varied across the state, and often reflected considerations of the depth of collaboration sought, whether or not agencies wanted to delegate implementation responsibilities to a newly formed entity, and concerns about liability and legal contracting.

In the Eastern San Joaquin Subbasin, twenty-one local level agencies joined together using a **JPA** in order to fulfill the state's groundwater sustainability mandate. The "Joint Exercise of Powers Agreement Establishing the Eastern San Joaquin Groundwater Authority" creates a new governing body, the Eastern San Joaquin Groundwater Authority (ESJGA), which is legally distinct from the agencies that formed it. The ESJGA is governed by a Board of Directors, which is comprised of representatives from each member agency, and has the authority to make binding decisions on behalf of its members. Under the JPA, ESJGA has the power to borrow funds; to adopt rules and policies; to perform all necessary actions to carry out the terms of the agreement; and to coordinate the exercise of the common powers of the member agencies. The JPA does not grant the ESJGA the authority to control individual member agency's internal matters, which include police powers, land use authorities, and legal rights to water supplies.

In the Merced Subbasin, fourteen agencies jointed together using a **MOU** in order to fulfill the state's groundwater sustainability mandate. The sets up a formal mechanism through which agencies will coordinate, yet does not create a new legally distinct entity. Rather, individual agencies retained their authority and agree to a process through which they will jointly make decisions and take action. The MOU formed a Coordination Committee, which has equal representation from each member agency. Unlike ESJGA, the Coordination Committee does not make binding decisions; rather, it makes recommendations to its members agencies, each of which decides individually whether or not to accept the recommendation. The Coordination Committee has the authority to make recommendations on the following actions: adoption of rules and policies, approval of contracts, budgets, and approval of the finalized groundwater sustainability plan.

A **MOA** is a written document describing the specific responsibilities of, and actions to be taken by, each of the agencies in the agreement. Some agencies use the term "MOA" interchangeably with a similar term called an **MOU** (Memorandum of Understanding). While there is no established legal distinction between the two terms,[29] some agencies designate MOUs as legally-binding contracts and MOAs as less formal and non-binding agreements.[30]

MOA/MOUs serve a wide variety of purposes, so they may contain variable levels of detail and different sets of provisions.[28] In general, MOA/MOUs will list each cooperating party and describe their roles and responsibilities.[29] In addition, MOA/MOUs often include a description of the mutual goals of the coordinating parties, as well as provisions about decision-making procedures, agreement implementation, funding, dispute resolution, communication standards, and amending or terminated the agreement.[28] MOA/MOUs come into force once all parties sign it. Importantly, both parties continue to operate as distinct entities and their commitment to

collaborate is limited to the terms of the agreement.

A **JPA** is a written agreement between public entities that formalizes coordination on the exercise of a common power. Unlike an MOA/MOU, a JPA creates a new, public agency that operates as a separate legal entity from its members.[28,30]The acronym "JPA" can have multiple meanings, as it may refer to the agreement itself (a Joint Powers Agreement) or to the new agency created through the agreement (called a Joint Powers Authority or Joint Powers Agency).[31]

Like an MOA/MOU, JPAs describe the parties involved in the agreement along with their roles and responsibilities. However, JPAs also regularly include sections about the parties' intent to form a separate entity, their purpose in doing so, the powers of the JPA, and the manner in which those powers will be exercised. JPAs also typically describe the internal organization of the newly formed partnership, including membership and voting procedures. This type of agreement comes into force once it has been authorized by the member agencies' governing bodies, once representatives from all parties have signed the agreement, and once proper notice has been given to any necessary authorities such as the Secretary of State.[28]

2.2. Agreement Design and Key Components

Irrespective of the type of formal agreement that is established, coordination commitments need to delineate specific information related to the process of coordination and the commitments of the parties involved. Broadly, coordination agreements usually contain sections that list the parties that will be included in the agreement, what actions the parties agree to accomplish, and define each party's responsibility towards accomplishing those actions (See **Box 2b**). Within these sections, details are listed in the form of **provisions**.

When drafting the provisions of an agreement, coordinating agencies have the opportunity to determine important aspects of their new relationship, such as how they will allocate power and how they will balance the transaction costs of coordinating. Therefore, the

> **Box 2b Provisions of Coordination Agreements – Example from California**
>
> Under California's Sustainable Groundwater Management Act (SGMA), agencies sharing a groundwater basin are required to coordinate development of their groundwater sustainability plans. Agencies must ensure that the groundwater sustainability plans use the same data and methodologies and demonstrate how plans, when implemented in concert, achieve sustainability at the basin level.
>
> In the Delta-Mendota groundwater basin, agencies signed a coordination-agreement during the early stages of groundwater sustainability plan formation. This agreement spelled out in detail the roles, responsibilities and practices that would be used for development and coordination of groundwater sustainability plans across the basin. This approach had the benefit of clarifying for all parties how the coordination process would unfold. [See the Delta-Mendota Basin Coordination Agreement]
>
> In the Tule groundwater basin, agencies developed their formal coordination-agreement after planning was substantially underway. The agreement details the decisions made as to data, methodologies and assumptions to be included in the final plans and formalized the decision-making process used to reach that agreement. This approach left the initial coordination process more informal, yet solidifies how coordination will be ensured and proceed into the future. [See the Tule Basin Coordination Agreement]

success of a partnership between agencies can depend on which topics are included in the agreement and the level of detail in which each of these topics is described.

Effective agreements generally address the topics of membership, roles and responsibilities, the decision-making process, dispute resolution, and agreement termination. The following sections provide further details about each of these components and briefly discuss why each section is important to coordination.

2.3. The Decision-Making Process

While **membership** determines which agencies have a role in the decision-making process, **representation** determines the relative level of influence each of these agencies will have on the decision-making process. In addition, **decision rules** detail the process that will be used to determine how agencies jointly engage in decision-making. Agreements between agencies may include a provision about representation to ensure that each entity has an appropriate and agreed-upon designation of power. Examples of representation structures include one-vote-per-member, proportional voting, and multi-tiered voting, all of which we will discuss here **(See Box 2c).**
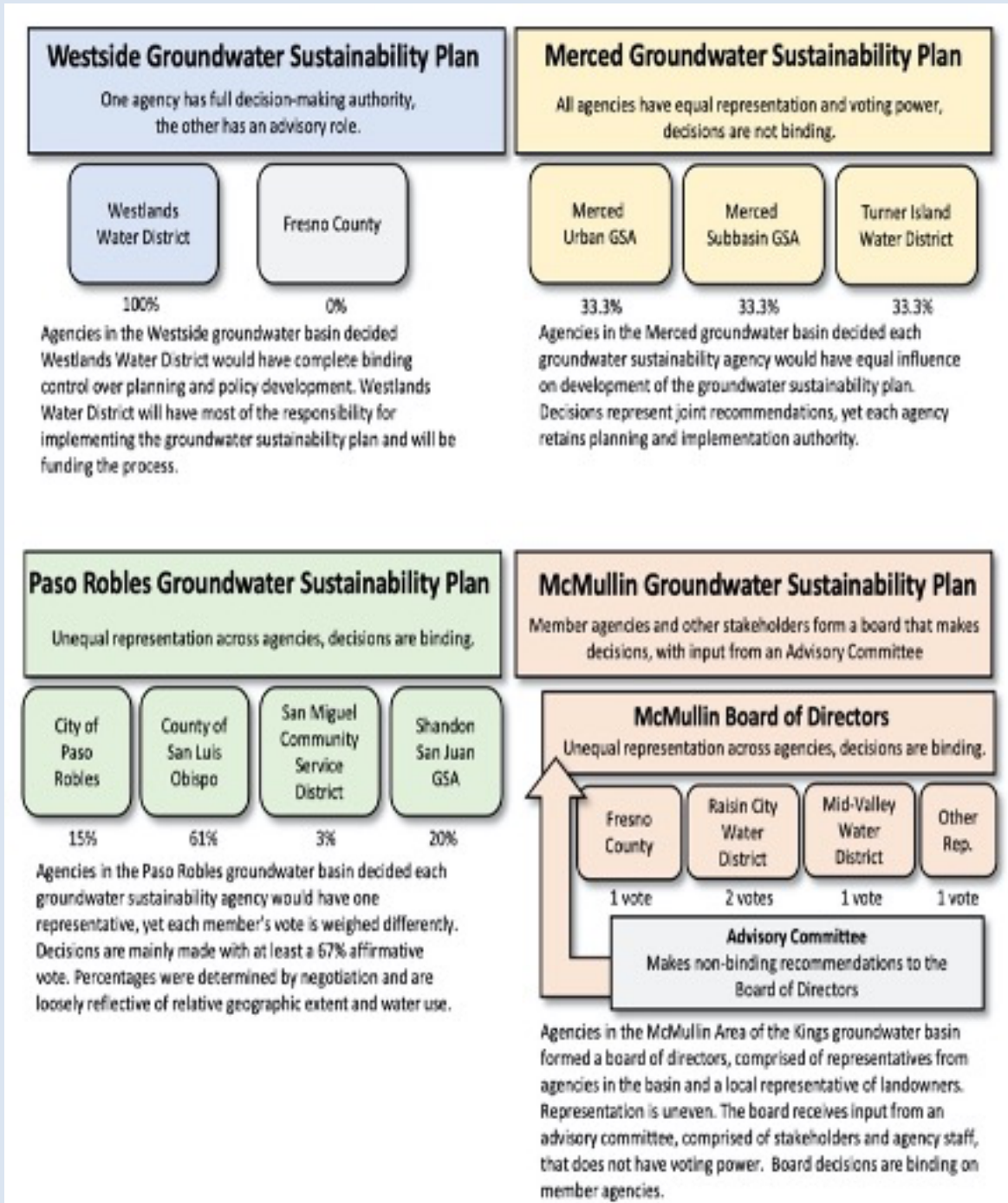
One of the simplest ways to designate power in an agreement is to give **one vote to each member**. In this system, typically a quorum must be present, and a decision is made based on the number of votes from the majority of the governing members present. This system of representation may be ideal for parties that wish to have an equal voting structure that is easy to understand. In addition to allocating votes across members, decision-rules (see below) also structure how power is exercised within the agreement.

Another method for allocating voting power is through **proportional voting**. Instead of giving one vote to each member, this system assigns voting power proportionally based on another factor. Common factors used in agreements include the proportion of a shared resource allotted to each member or the amount of financial contributions from each member. Instead of giving each member an equal voice, this system distributes power based on the relative impact a decision may have on each member. This structure might be particularly desirable in situations where members do not have equal financial obligations to the agreement, or where natural resources are not equally accessible to each voting member.[28]

A voting system that combines one-vote-per-member and proportional voting is called **multi-tiered voting.** Coordinating agencies that use this system may contain multiple sets of voting bodies, each specializing in a certain subject. A matter before the general governing board may need to be approved by a majority in a one-vote-per-member system, and then confirmed by a second voting body that specializes in that subject based on the proportional voting system.[28] Multi-tiered voting may be ideal for complex agreements involving many parties, or for specific topics like budgeting where parties may be disproportionally affected by a decision.

Box 2c. Structures for Representation, Voting, and Decision-making – Example from California

In California, agencies working together to develop a joint groundwater sustainability plan adopted a variety of institutional structures for plan development. Below are four examples of structures adopted.

Westside Groundwater Sustainability Plan

One agency has full decision-making authority, the other has an advisory role.

Westlands Water District — 100%

Fresno County — 0%

Agencies in the Westside groundwater basin decided Westlands Water District would have complete binding control over planning and policy development. Westlands Water District will have most of the responsibility for implementing the groundwater sustainability plan and will be funding the process.

Merced Groundwater Sustainability Plan

All agencies have equal representation and voting power, decisions are not binding.

Merced Urban GSA — 33.3%

Merced Subbasin GSA — 33.3%

Turner Island Water District — 33.3%

Agencies in the Merced groundwater basin decided each groundwater sustainability agency would have equal influence on development of the groundwater sustainability plan. Decisions represent joint recommendations, yet each agency retains planning and implementation authority.

Paso Robles Groundwater Sustainability Plan

Unequal representation across agencies, decisions are binding.

City of Paso Robles — 15%

County of San Luis Obispo — 61%

San Miguel Community Service District — 3%

Shandon San Juan GSA — 20%

Agencies in the Paso Robles groundwater basin decided each groundwater sustainability agency would have one representative, yet each member's vote is weighed differently. Decisions are mainly made with at least a 67% affirmative vote. Percentages were determined by negotiation and are loosely reflective of relative geographic extent and water use.

McMullin Groundwater Sustainability Plan

Member agencies and other stakeholders form a board that makes decisions, with input from an Advisory Committee

McMullin Board of Directors

Unequal representation across agencies, decisions are binding.

Fresno County — 1 vote

Raisin City Water District — 2 votes

Mid-Valley Water District — 1 vote

Other Rep. — 1 vote

Advisory Committee

Makes non-binding recommendations to the Board of Directors

Agencies in the McMullin Area of the Kings groundwater basin formed a board of directors, comprised of representatives from agencies in the basin and a local representative of landowners. Representation is uneven. The board receives input from an advisory committee, comprised of stakeholders and agency staff, that does not have voting power. Board decisions are binding on member agencies.

In terms of decision rules, common processes include consensus, unanimity, majority voting, and super-majority voting, each of which we will describe here. The system best-suited for a

coordinating group will depend on the nature of the parties involved, any prior relationships they have regarding coordination, and the types of decisions they will be making.

Consensus is an informal decision-making process. A consensus is achieved once a decision is formulated that no party disagrees with.[32] This decision-making strategy involves group discussions to ensure that each party's opinions are understood, therefore requiring high levels of participation and cooperation. This process helps coordinating parties move forward with a common decision, but it can take more time and effort from each party than other forms of decision-making.[33]

Unanimity is a formal decision-making process. Unlike consensus – where no one entity disagrees – unanimous decisions occur when every party specifically agrees to the proposal. This decision-making rule gives all parties equal power, which may be important for decisions with highly significant consequences or for parties that are distrustful of each other. However, the requirement for unanimity may inhibit the group's ability to reach an agreement, even when the bulk of the participants agree, because this structure effectively gives each party veto power.[34]

Like unanimity, **majority voting** is a formal decision-making process. However, a majority voting system requires only a simple majority to agree for a decision to be made.[35] Therefore, a majority voting system relies on the principle that decisions can be made based on what the larger proportion of the parties agree upon, regardless of the impact of the decision to those in the minority. While this system reduces the deliberation time needed to come to a decision, it does not necessarily maximize the welfare of those in the minority. This is especially true if the relative impact of the decision varies greatly between the majority and minority.

A **super-majority** is another type of formal decision-making rule which requires more than 50% of voters to agree. Often, a super-majority requires either 2/3 or 3/4 of the parties to agree in order to make a decision. A super-majority system is one method for balancing the benefits and drawbacks between majority rule and unanimity. A super-majority encourages deliberation and compromise between more of the parties involved, while preventing any one party from stopping the decision-making process from moving forward.

Irrespective of the method of aggregating parties' voices into a decision, there remains the question of how those decisions translate into commitments. **Binding decisions** are those that legally bind the parties affected by it. These decisions are enforceable, although the method of enforcement may be variable depending on the type of agreement. In contrast, a **non-binding decision** is a resolution that expresses approval or disapproval yet does not hold the force of commitment. A non-binding decision may take the form of a recommendation, letter of intent, or memorandum of understanding. In inter-agency coordination, an executive board or coordination committee may have the authority to make binding decisions that commit member agencies to their resolutions. In other decision-making systems, the executive board or coordination committee may only have the authority to make strong recommendations to member agencies, and member agencies must individually approve the decision for it to go into effect.[28]

2.4. Decision Rules

While developing processes for parties to engage in joint action and decision-making is critical to coordination, also needed are processes for resolving differences between parties and options for terminating the coordination agreement. Coordinating agencies may decide to include provisions in their agreements regarding dispute resolution with the goal of avoiding litigation, such as arbitration, mediation, negotiation, or administrative appeals.[27] Agencies may also find it prudent to decide on a structure for exiting the agreement (**See Box 2d**).

Arbitration is a process through which the parties refer a dispute to an agreed-upon, independent third party for resolution.

Mediation, in contrast, is a process by which a neutral person facilitates a discussion between the disputing parties and assists them with reaching an agreement themselves. Similar to mediation, negotiation between parties is an attempt to reach agreement through discussion and compromise, but it does not usually involve a third party. Lastly, **administrative appeals** are an appeals process that allows individuals to request that a decision be reversed by a committee or governing board.[27]

If a major dispute between members of a coordinating group cannot be resolved, or if the coordination is no longer in an agency's interests or no longer necessary, a member may wish to withdraw from the agreement. Formal agreements commonly contain provisions regarding the policy and procedures for member withdrawal and agreement dissolution. For example, withdrawal provisions may instruct all parties to bring disputes to the executive committee before withdrawing from the contract. Another common requirement is the formal notification of withdrawal to the other parties in the contract and the fulfillment of outstanding obligations. Dissolution clauses may include procedures regarding the return or transfer of funds and property. The inclusion of withdrawal or dissolution provisions in a coordination agreement provides guidance that may reduce major conflict and improve efficiency during times of disagreement or transition among the parties.[28]

Box 2d. Termination Clauses in Agreements – Example from California

Agencies entering into agreements under California's Sustainable Groundwater Management Act included a variety of rules and conditions that must be met for any agency to either exit from or terminate the agreement. Below are examples of rules and conditions used in termination agreements.

Example: Voting Rules For Termination

Unanimous Vote

Ex: Merced & Tri-County Agency

Majority Vote

Ex: Eastern San Joaquin
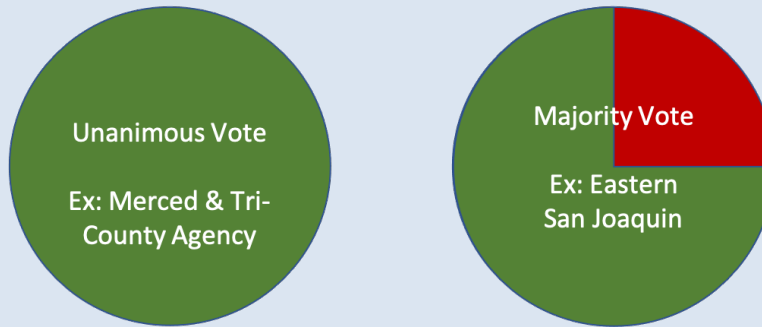
Voting rules dictate the process through which a decision to terminate the agreement will be made.

Unanimous Vote: Both the Merced Subbasin Agreement and the Tri-County Agency Agreement require a unanimous vote of members prior to termination.

Majority Vote: The Eastern San Joaquin Planning Group Agreement states a majority vote of members is required to terminate the Agreement. Upon termination, the agencies will remain responsible for their share of any obligations incurred by the planning group and any assets of the authority will be divided proportionally among the agencies, assuming no public entity follows.

Example: Conditions For Termination

Re-evaluate on X Date

Ex: Madera Joint Plan Group

Boundary Modification to Ensure Compliance

Ex: Tri-County Plan Group

Terms of SGMA Expire & No Outstanding Terms of Agency Indebtedness

Ex: Tri-County Agency

Conditions for termination set forth requirements that must be met for an agreement to be ended.

Re-evaluation: The Madera Joint Plan Group Agreement states that the agreement will continue until October 2019. At that point in time, the group members will decide whether the agreement will continue or if it should be terminated.

Boundary modification to ensure compliance: The Tri-County Plan Group Agreement states that it can only be terminated upon modification of agency boundaries to ensure the entire geographic expanse of the groundwater sustainability plan is under the jurisdiction of an agency that is part of the agreement.

Expiration of terms of SGMA and no outstanding terms of agency indebtedness: The Tri-County Agency Agreement states that no members can terminate the agreement before 2040. Additionally, an agency can only exit the agreement if that has no outstanding terms of indebtedness.

Chapter 3. Coordinating Administrative Practices

For inter-agency coordination to occur, agencies must navigate and comply with each agency's own sets of administrative practices for planning and implementation of projects. These practices reflect regulations and norms regarding actions such as deliberation and decision-making, record-keeping, information tracking, budgeting, accounting, and purchasing. For some coordinating agencies, these administrative processes may complement each other, while for others the systems may diverge or even conflict. Coordinating agencies may also be subject to different laws, regulations, or other external constrains. When coordinating agencies face different internal or external constraints, careful planning and communication is necessary to ensure that each agency can find ways to work across their systems and complete projects in a manner satisfactory to all parties involved. In the following sections, we detail some of ways in which varying administrative processes can present challenges to coordinating agencies, as well as provide some recommendations for overcoming those challenges

3.1. Processes for Meeting

Agencies typically utilize administrative procedures to conduct activities in an efficient, organized, and legally-sound manner. While there are many types of actions or activities associated with administrative procedures, those connected to the process of governing often have a high impact on inter-agency planning. Different agencies, however, may have different administrative practices to address governing processes. These practices may be set by the agency themselves, or by local, state, or federal law. In the following we will describe common sets of administrative practices related to governing and discuss the impact of these different practices on inter-agency coordination.
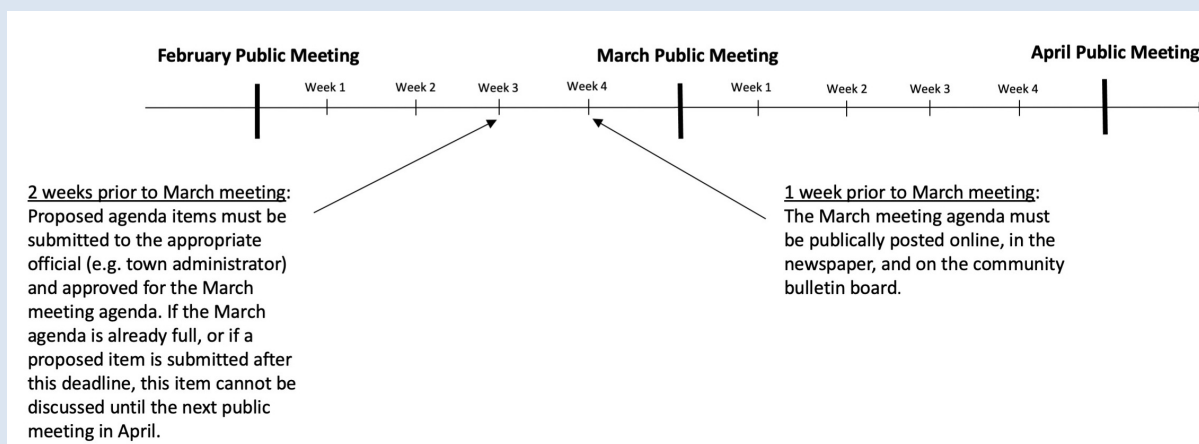
3.1.1 Holding Meetings

Administrative rules commonly dictate specific practices for announcing and holding meetings. These rules may detail procedures for actions like creating and following a meeting agenda, providing formal notice to the public, or meeting a quorum. In the following we will discuss these three common examples and explore how they can impact interagency coordination efforts. For many government agencies, specific procedures exist to agendize or formally add – topics to the planned discussion for a meeting.[37] For agencies which operate under open meeting laws, decision-makers may be forbidden from discussing an item unless it formally appears on the agenda. Under these rules, if a non-agendized item is brought up – say by a member of the public during a public comment period – that item will need to be placed on the agenda for a future meeting before it can be deliberated and acted upon by decision-makers. This administrative procedure helps keep meetings organized and increases transparency with the public about the topics being discussed at each meeting, but it strictly limits the speed at which new topics can be introduced and deliberated. In contrast, other agencies may not have such constraints about introducing new topics during meetings and may therefore have the flexibility to deliberate and make ad-hoc decisions. These different levels of flexibility regarding which topics can and cannot be discussed during specific meetings can lead to vastly different timelines for making decisions between coordinating agencies.

As part of agenda procedures, some agencies operate under rules or laws which require the public to receive formal notice of their meetings (see **Box 3a**). For some governments, such as the state of California, these laws require the agenda to be made available for public review at least 72 hours before the meeting.[37] This is also a common procedure for local government organizations, although the specific amount of time required for prior notification varies. In addition to specifying timeframes, prior notice rules generally dictate where the agenda must be published. These locations might include the local newspaper, the agency's official website, or a community center bulletin board. Some groups may have an additional requirement to mail a formal notice directly to individuals who will be affected by an item on the agenda.[36]

Box 3a. Timelines for Public Notice and Agendas – General Example

Each agency has its own rules about the amount of advanced notice necessary and the process for entering an item on the agenda. The below timeline is an example for proposing, notifying, and deliberating an agenda item within an agency that meets once a month.

2 weeks prior to March meeting: Proposed agenda items must be submitted to the appropriate official (e.g. town administrator) and approved for the March meeting agenda. If the March agenda is already full, or if a proposed item is submitted after this deadline, this item cannot be discussed until the next public meeting in April.

1 week prior to March meeting: The March meeting agenda must be publically posted online, in the newspaper, and on the community bulletin board.

Formal notice and agenda rules help increase transparency with the public but greatly restrict flexibility for deliberation and decision-making. Failure to recognize these different constraints can impede planning efforts between coordinating agencies and may cause tension between partners, especially if perceived delays are inaccurately attributed to incompetency or an unwillingness to coordinate. The different deliberation and decision-making timelines between agencies can also affect the scope of coordinated projects, as some partners may be unable to make rapid decisions or deviate from certain plans.

A final common administrative rule that can affect inter-agency coordination is that of the **quorum**, or the number of decision-making members of an organization that must be present to conduct business.[36] The number of members which constitute a quorum can differ by agency, but typically the number is high enough to represent at least half of the governing body. This rule ensures that decisions are made only when a majority of decision-makers are present, but also prevents meetings from being held if a quorum is not met. Meetings without a quorum must be cancelled or re-scheduled, which can cause significant delays to a project depending on the agency's rules regarding agenda-setting and formal notice. For coordinating agencies, quorum rules for each partner are important to consider because the agencies will have to decide which

rule applies to the collective, and they must be prepared for delays if there are problems reaching this quorum.

3.2. Processes for Deliberating

Deliberation is an important part of the decision-making process for natural resource agencies. Like the administrative practices regarding announcing and holding meetings, practices regarding the structure of deliberation sessions can also vary between different organizations. Some of these differences are formed by internal policies and norms, while others are dictated by local, state, or federal law. Common deliberation structures reflect rules of procedure, open or closed meeting laws, and public comment laws.

Rules of procedure dictate how an item gets placed on the agenda for a meeting, formalize the process for bringing forth, discussing, and voting on an item, and specify how that decision is recorded and announced.[36] Examples of rules of procedure include Robert's Rules of Order and Rosenberg's Rules of Order (see **Box 3b**). Agencies which follow formalized rules of procedure often start with one of the aforementioned standards, and then revise the rules over time based on the agency's needs and the outcome of relevant lawsuits. Rules of procedure facilitate the decision-making process by allowing business items to be handled and discussed in a transparent and efficient manner. Specifically, these procedures provide an objective set of rules which help ensure that the decision-making process was legitimate and legally-sound. However, there may be variability in these rules between different agencies, and some organizations may not follow a set of formalized rules. Cooperating agencies will therefore need to coordinate their practices for joint-agency meetings, and those who are accustomed to following certain rules may need to assist in training any partners who have not followed the same rule-set in the past.

Box 3b. Public Transparency Rules

Many governments have passed laws stipulating administrative processes that must be processed to ensure transparency and accountability.

For example: California's Ralph M. Brown Act (*California Government Code § 54950*) was enacted in 1953 to ensure transparency and public access to information.

Provisions include:
- Decision-making bodies of local governmental agencies may not deliberate and make decisions among themselves except in open and publicized meetings.
- Local governmental agencies must publicize when and where all meetings will occur, as well as what will be discussed, so that the public can observe those meetings.
- No action can be taken by a decision-making body until such item has been placed on the agenda for consideration.
- The public has a right to be heard on matters on the agenda before decisions are made.
- Closed sessions, during which private conversations between decision-makers can occur during an otherwise open meeting, are allowed only under strictly limited circumstances.

As with rules of procedure, **closed** or **open meeting** laws also have a large impact on the structure of deliberation. Closed meetings do not need to be open to the public and notes from

these meetings do not need to be available for public review. In contrast, open meeting laws dictate that virtually all conversations among members of a governing body must occur during a public meeting and that notes from these meetings must be made available to the public. Open meeting laws apply to committees, commissions, and boards created by these governing bodies as well. Within open meetings, closed sessions – where brief, private conversations between decision-makers can occur – are only allowed for a strictly limited set of topics, such as pending litigations or real estate negotiations.[36,37] Overall, open meeting laws are an important consideration for coordinating agencies because if one partnering agency has open meeting laws, likely all partnering agencies will have to comply with open meeting procedures during joint meetings. This fact may potentially become problematic, especially if partnering agencies wish to discuss an issue in private or discuss a rapidly developing topic without having to wait for the next public meeting.

Lastly, **public comment laws** also have a strong influence on the ways in which deliberation can occur. Agencies impacted by these laws are required to notify the public of any proposals to change or create new rules, as well as to accept written or oral comments from the public about these changes. Federal agencies, in particular, are required to publish a notice about proposed rules in the *Federal Register* and to provide the public with at least 30 days to submit written data, views, or arguments in response.[40] Agencies must then respond in some form to all the comments they received, analyze any relevant data submitted by the public, and provide justification for their ruling. Therefore, any requirements for public comment are important for cooperating agencies to consider because of the impact of these laws on the scope and timeline of deliberation.

3.3. Processes for Decision Making

Administrative rules regarding how decisions are made – and who gets to make them – constitute another set of practices that agencies may find important to consider during the coordination process. Different agencies can have different types of leadership positions, and each of these positions may have different levels of decision-making power. For some organizations, decisions will be made by an individual leader, such as an executive director. Other groups may make decisions via a governing group, such as a county board of supervisors, a board of directors, or a council.[36] Within this group-decision making framework, voting power may be evenly distributed amongst members, or may vary between individuals based on specific circumstances. Lastly, some groups may have multi-tiered systems for decision-making, wherein recommendations are made by one branch of a governing body but must be approved by another group for the decision to become formalized. Examples of this system include boards or commissions which have the authority to make decisions regarding specific topics – such as the spending of their own funds – but must otherwise receive approval from a governing board or via a public vote before their decisions can become finalized. For coordinating agencies, the number of decision-makers and their relative decision-making power can influence the speed and ease of decision-making, and proper planning is required to ensure that topics requiring decisions are brought forth to the appropriate person or governing body.

3.4. Coordinating Financial Matters

Similar to the actions of meeting, deliberating, and decision-making, the management of an agency's finances is also typically associated with specific administrative procedures. In the following we will outline some common sets of administrative practices regarding financial management and will describe how these practices might impact coordination efforts.

3.4.1. Budgeting Considerations

Governments at the local, state, and federal level have different procedures for creating budgets and spending funds, but most follow a formalized set of steps. In general, budget committees for agencies meet months or even years before the beginning of a fiscal year to propose annual budgets, which must then be deliberated and authorized by the agency's governing body.[38] Designating funds for specific projects may require an additional vote, and money cannot be spent until the start of the fiscal year. Furthermore, funds are often appropriated for a specific amount of time – such as one or two years – meaning that money must be obligated or spent before a certain date.

Agencies that are coordinating on financial matters may therefore need to plan and formally propose any projects that require funding well in advance of the start of the project. A common complication for this process involves the different budgeting timelines of the coordinating agencies, such as the start of their respective fiscal years. For example, the federal U.S. fiscal year begins on October 1, while many state fiscal years begin July 1. Towns or other local governments may match their state's fiscal year, may match the calendar year (Jan 1), or might operate based on another date entirely.

Different fiscal years or other budgetary incongruities between coordinating agencies need to be considered to ensure smooth project implementation. Agencies may need to incorporate their partners' different fiscal years into their project planning so that everyone is aware of when funds will and will not be available. Understanding the different fiscal year systems is also important for securing matching grant funds on time and for accurate grant reporting. If the financial components of projects are not adequately planned – or if unforeseen circumstances cause interruptions to plans – the consequences to a project may be significant. Projects may be forced to exceed time or budget projections, payments to contractors may be substantially delayed, negotiated agreements could be nullified, and funding sources may expire before they were able to be fully utilized.

3.4.2. Constraints on the Use of Funds

Depending on budgeting processes and funding designations, agencies may have different constraints on the ways they can spend money (see **Box 3c**). Some agencies may have access to general funds, while others might have access only to funds that have been set aside for a specific purpose. For example, agencies that receive funds through appropriation bills often have specific guidance on what projects those funds can or cannot support. Other agencies may have more flexibility, especially if they have the authority to raise funds through methods such as taxes, tariffs, or the sale of natural resources (e.g. timber sales).[40] Raising these funds may need approval, such as through a congressional bill, a town warrant, or a public vote. Any associated revenues may or may not have restricted uses. Coordinating agencies need to carefully consider

which partners can contribute funds, for which purpose, and under what constraints for successful project planning.

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Box 3c. Rules Influencing Finance Management – Example Londonderry's Conservation Fund

The Town of Londonderry, New Hampshire dedicates a certain percentage of revenues collected via the Land Use Change Tax (a tax generated sporadically by land development) to the town's "conservation fund." Per New Hampshire law (NH RSA 36-A), money from a town's conservation fund must be used for the protection and proper utilization of the town's natural resources.[39] The law specifies that expenditures from the conservation fund must be authorized by the town's Conservation Commission and provides further guidance on the activities for which conservation fund dollars can be used. For example, the law indicates that funds can be used for the acquisition, maintenance, or improvement of open space.[4] Therefore, the Conservation Commission is able to use conservation fund dollars to contract with a professional land manager (e.g., a forester) to maintain the town's open spaces. However, even though it is legally and administratively permissible to use the funds to employ a land manager, the Commission is unable to directly employ one using conservation fund dollars because the sporadic nature of land development projects leads to an intermittent revenue stream. Inconsistent availability of the tax revenue impedes the ability to guarantee wages for a staff member.[40]

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3.4.3. Approval Processes and Spending Rule

In additional to incorporating each agency's budgeting processes and spending constraints into project planning, cooperating agencies may also need to consider each group's approval processes and rules for spending their funds. This is because agencies often have specific sets of requirements to approve of major purchases or to hire contractors. Some may have rules for selecting vendors or contractors intended to promote agency goals or to lower total project costs. For example, some agencies are required to receive bids from at least three contractors to ensure a competitive price and may be required or incentivized to include bids from specific groups such as veteran or minority-owned businesses.[40] Other agencies may simply require majority approval from their governing body to select a contractor, while others may authorize certain employees to make decisions on the agency's behalf.

Another financial factor to consider is the variation in billing and payment procedures between different agencies. For some agencies, bills from contractors or other major purchases need to be approved during a meeting and then sent to a specific person with the authority to make payments (e.g., the treasurer). Depending on billing cycles, the frequency of regular agency meetings, and the schedule of the person with payment authority, bills may take several months to process between the date they are received and the date they are paid.[40] Therefore, coordinating information regarding billing cycles can be important to ensure contractors are paid in a timely manner and to accurately estimate the timeframe when funds will be removed from an account. Agencies may also have different restrictions on the use of funds for certain items or circumstances. For example, an agency may have a specific rule against using funds to purchase alcohol or gifts. These restrictions might apply only to the funds from certain accounts or may apply agency wide. Another circumstance that may be associated with special restrictions or procedures is the use of advanced payments. Paying in advance for a service – such as paying the fees to apply for a required permit before a management activity can begin– can cause administrative challenges because a service has not yet been rendered.[40] Some agencies may have

restrictions on the use of advance payments, while others may require special permissions, specific forms of payments, or may have no extra steps or considerations. Sharing an understanding of these restrictions is important to make sure funds are spent in an appropriate manner according to each cooperating agency.

Lastly, agencies often have different degrees of flexibility to engage in **deficit spending,** which occurs when expenditures exceed revenues within a given fiscal year.[38] Some agencies, particularly at the federal level, are allowed to run deficits to ensure that funds are available quickly to respond to emergencies or acts of war. In contrast, agencies at the state or local level are typically required to balance their budgets every year. Some government groups can issue bonds to cover additional expenses, while others are unable to spend money unless it has already been raised and specifically appropriated for their use. An agency's ability to engage in deficit spending may be important in a variety of circumstances, such as when planning the potential magnitude of a long-term project.

3.5. Navigating Diverse Administrative Practices

Due to the potential for vastly different administrative procedures between coordinating agencies, it is important for agencies to discuss their procedures for deliberation, decision-making, and financial management early in the coordination process. If differences are discovered, there are several strategies that agencies can implement to help their coordination efforts succeed.

Specifically, it may be helpful for coordinating agencies to jointly develop a list of regulations and legislation that affect each party, and clearly outline the actions that will be required of one or all parties based on these requirements. If not already included in this list, agencies should discuss their processes for scheduling and holding meetings to ensure that their deliberation and decision-making timelines are compatible. Details to discuss include agenda procedures, methods for disseminating meeting materials, and plans for note taking. Discussing each agency's financial management procedures is also important, especially as these procedures relate to project budgeting, approval processes, and spending rules. If these administrative processes are found to be compatible, or if they can be reasonably modified for the purpose of coordination, agencies may benefit from assigning specific roles to each agency to increase the efficiency of their coordination efforts. Overall, navigating different administrative procedures can be complex and challenging, but effective planning and communication can reduce these obstacles and allow larger goals to be achieved through successful collaboration.

Chapter 4.   Coordinating Knowledge

Interagency coordination typically requires knowledge sharing between the parties involved. In some instances, knowledge sharing is the primary goal of coordination efforts. Yet even when coordinating knowledge is not the central goal, agencies cannot effectively coordinate objectives, policy, or management without also coordinating certain aspects of knowledge.

Knowledge includes data (discrete observations of phenomena), information (systematic and linked observations), and understanding (explanations of why phenomena occur).[41] While sharing *data* is often important during interagency cooperation, the sharing of *knowledge* involves the coordination of data analysis and interpretation in order to successfully transform data points into shared understandings. Key processes for translating data into knowledge include monitoring, which provides continued data about the system in question, and modeling, which addresses the system's dynamic interactions and causal mechanisms.

Cooperating agencies must create joint goals or objectives for purposeful coordination, and knowledge is needed to build the shared norms that are used to set these goals. Knowledge then enables agencies to identify the range of possible actions or policy options that can be taken to achieve their shared goals, as well as evaluate their decision choices and the outcomes of those decisions. Coordination of data from across agencies may also be necessary for data integration, joint modeling, and shared monitoring protocols.[42,43] Periodically updated information is then needed to help agencies respond to change through iterative governance and adaptation.[43,44]

Knowledge coordination may also be important during the initial stages of a coordination agreement. For example, shared knowledge of the system can help each coordinating entity decide which actions need to be taken, by whom, to achieve both their individual and shared goals. Once an agreement has been reached, data and information exchange can also provide coordinating agencies with mutual assurances of joint compliance, which can help establish transparency and trust.[45,46,47] Overall, coordination of knowledge can provide the first step towards broader cooperation, agreement formation, conflict resolution, and consensus building between coordinating agencies.[48,49]

Coordination of knowledge can also lead to innovative solutions, such as through the process of **social learning.** Social learning occurs when the parties involved develop mutual understandings of the systems they govern and of one another as the result of their interactions and exchanges.[50,51] Social learning can lead to improved decision-making because it helps increases awareness of human-environment interactions, build better relationships, and improve problem-solving capacities for participants.[52] Through social learning, participants may also re-evaluate their assumptions, underlying values, and beliefs in a manner that better aligns the goals and objectives of the agencies while simultaneously providing solutions to environmental, social, or institutional challenges.[53]

4.1. Sharing Knowledge for Natural Resource Management

For effective natural resource management, common types of data, information, and knowledge that frequently need to be coordinated include descriptive data, knowledge of environmental processes, monitoring data, information on prior and ongoing management activities, and knowledge related to the human-dimensions of the natural resource.

Descriptive data about the system includes the system's characteristics, such as natural and political boundaries, geophysical and climatic properties, and current ecological state. Descriptive data helps decision-makers understand the severity of any problems with the system and determine the actions that may be needed to address those problems. Descriptive data can be particularly useful when paired with knowledge about **environmental processes,** which are the drivers of change within a system. These processes encompass the interactions between or amongst biotic and abiotic factors, as well as the impact of these factors on the system's functions. Together, descriptive data and knowledge of environmental processes can be used to make statistical models, which can improve the scientific understanding of the system and can help decision-makers predict the effects of their policies or actions on the system.

When combined with descriptive data, **monitoring data** helps provide information about the average conditions in the system as well as trends in the system over time. This type of data helps decision-makers better understand the state of the system by providing historical context, which may help to fill in gaps in understanding regarding the current state or help create more refined models for predicting future states. Monitoring data also provides support for maintaining, refining, or changing management policies, which allows management goals to be achieved more efficiently. Lastly, monitoring the system enhances an agency's ability to track changes to the system and identify any emerging concerns.[54]

Knowledge regarding **prior management actions and policies** is important for understanding the ways in which human decisions have impacted the system in the past, present, or future. Agencies need to be able to account for these actions in order to accurately describe the current state of the system or to predict its future state. Knowledge regarding prior policies and management actions also allows decision-makers to learn from their past actions by analyzing what was successful, what failed, and what has the potential to be changed to help the system reach the desired state.

Knowledge regarding policies and management actions is incomplete, however, without understanding the **human dimensions** of the natural resource system. Human dimensions information encompasses the political, economic, and social factors that affect the system. This includes knowledge of political and administrative conditions, institutional contexts, and paradigms that characterize policy making and implementation.[55,56] Human dimensions information is also important because resource management often requires working with multiple stakeholders, some of whom may have beliefs or values which conflict with those of the agency or another stakeholder on certain issues. Knowledge about these value systems can help agencies navigate the decision-making process and negotiate conflict resolutions.[56]

4.2. Factors Influencing Knowledge Sharing

Even if agencies have a clear understanding of the types of knowledge they need to share for successful coordination, there are many factors that can impact the efficacy of their efforts to share that knowledge (See **Box 4a**). These factors include challenges with interoperability, barriers at the agency level, constraints on the individuals within the agencies, and different systems for interpreting information and developing knowledge. We discuss the aforementioned challenges in the sections below.

Box 4a. Conceptual Diagram of Factors Influencing Coordination of Knowledge Across Agencies
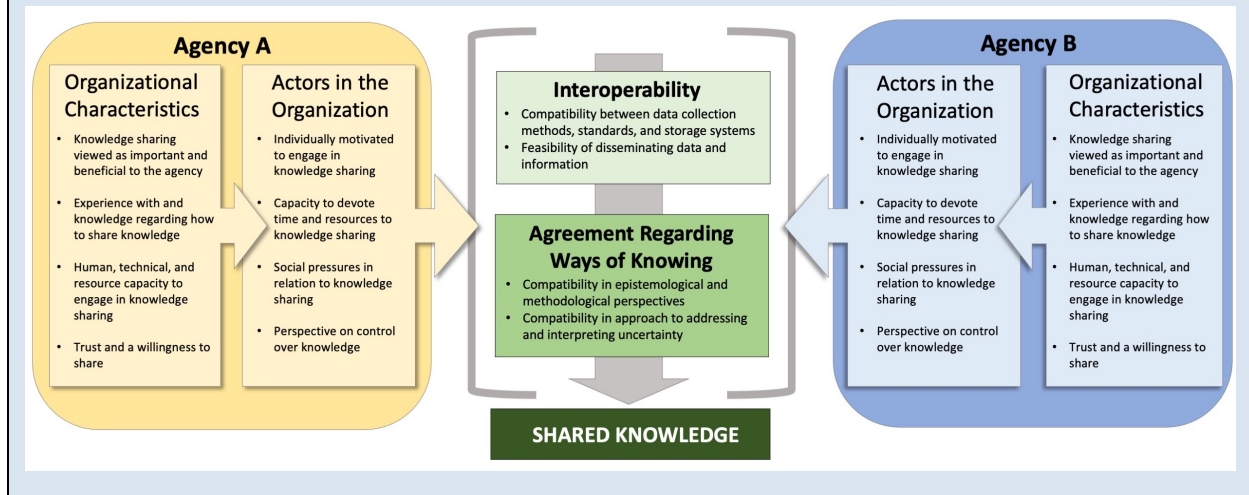
4.3. Interoperability

One of the primary obstacles to sharing knowledge stems from interoperability issues. **Interoperability** refers to the technical ability and/or capacity to exchange and make use of information (see **Box 4b**). Issues with interoperability begin when data are collected and maintained by different agencies to meet their specific needs. This may result in data being collected, stored, and described using very different methods and protocols. The variation between agencies can make the process of aggregating data difficult or impossible.[57] Overall, interoperability issues include problems related to data integration, storage and transmission, and administration.

Data integration is the process of combining data so that it can be used jointly for evaluating trends, developing new understandings, answering specific questions, or creating models.[58] There are multiple ways in which integrating data can be challenging, but one of the most significant issues is caused by differences between agencies in defining the system of study (e.g. differing definitions of what constitutes a "drainage basin", differing definitions of the term "species", etc.). Another frequent issue relates to incompatible **data standards,** which are the rules by which data are described and recorded. Well-implemented data standards result in a consistent format and meaning for the data.[57] These standards address aspects such as the format of the data (e.g. character, numeric), measurement metrics (e.g. metric, imperial), and provide names, descriptions, and definitions of specific data elements. When consistently applied to metadata, data standards help users identify and discover relevant data.[59] Overall, data standards improve a dataset's usability by helping to clarify ambiguous meanings, minimize redundancy, and improve accuracy.

In addition to incompatible data standards, issues due to different data collection techniques are a common cause of data integration problems. When agencies use distinct methods for collecting data, such as utilizing different technologies for measurement or different schedules for collecting data, these disparate methods may result in data that are incompatible to combine.

Additionally, if clean datasets or analyses are not available across agencies within agreed-upon timeframes, larger-scale analyses must be delayed until all data can be aggregated.

Box 4b. The Challenge of Interoperability – Example Harmonization of Data along the United States and Canada Borderlands.

Agencies along the border between the United States and Canada often need to coordinate knowledge and information to address concerns about their shared waters. Hydrographic datasets for each country were developed independently, with their boundary as the international border. As a result there was some inconsistencies in the definitions and methodologies used, impeding seamless use of the data. The lack of a uniform dataset was a barrier to conducting detailed analyses of flows and water quality.

An example of disconnected geospatial data on transboundary watersheds that the Data Harmonization Task Force worked on harmonizing and joining.
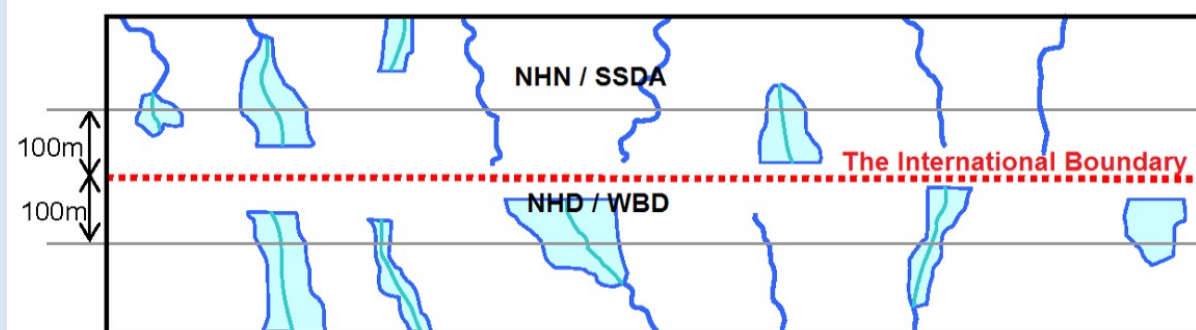

Photo and Caption Credit: Data Harmonization Task Force

To address this problem, the two countries set up a data harmonization task force, through which binational technical work groups reconciled and synchronized existing data, creating a new harmonized dataset for use now and into the future. For more see: International Joint Commission. *Data Harmonization.*

Data integration is similarly impacted by issues related to variable quality data. Even when agencies use compatible methods to collect the data, variable data collection techniques can result in data that is less precise or less accurate than other data (e.g., using measurement instruments with different levels of accuracy). This variability can potentially cause problems when combining the data. Additionally, the training and capacity of the personnel collecting the data may impact the accuracy or precision of the data being collecting. In these cases, combining the data may lower the overall quality of the dataset, which in turn can limit a coordinating agency's willingness to utilize the data.

Outside of data integration issues, further interoperability issues may still arise if there are technical issues with storing or transmitting data. These issues include hardware and software incompatibilities between the entities collecting, aggregating, analyzing, or interpreting the data. Technical issues are especially likely to arise when hardware or software become obsolete or when there is limited information technology (IT) capacity to assist with maintenance or training in data storage/transmission systems. Technical interoperability issues also frequently occur

when trying to integrate digitized information with handwritten data, such as field notes or historical maps.[60,61]

A final common cause of interoperability challenges is due to data administration issues. These challenges include situations related to personnel capacity, such as limitations on the staff time available for data sharing tasks like report writing or computer programing. There may also be financial limitations, especially if a third party is needed to oversee data-sharing responsibilities or if budgetary cycles affect long-term planning for data sharing activities.[61] Obtaining permission to share data can also pose an administrative challenge, especially if the nature of the data is sensitive or proprietary. Agencies may need to ensure that they have the legal authority to share their data, and employees may need specific authorization and training to share data. Lastly, if agencies wish to implement long-term information sharing strategies, they must ensure that their process is clear and well-documented so that new employees or third parties can continue the established protocols.[60]

\4.4. Organizational and Individual Factors

While interoperability challenges are common, they reflect a set of barriers to knowledge sharing which are predominantly technical in nature. However, non-technical factors such as the values and norms of the coordinating agencies and the individuals within them will also strongly influence the success of knowledge-sharing efforts. These factors influence whether an agency or individual will see sharing knowledge as beneficial or detrimental, and consequently impact if, how, and with whom they are willing to share information. In the following section we will describe how these factors at both the agency level and the individual level can impact willingness to share knowledge.

At the organizational level, sharing knowledge is often incentivized by a clear and pressing problem which makes coordination between the agencies necessary.[62] Sharing knowledge may also occur as a response to pressures from internal policy, super-ordinated organizations, or the public. Once this necessity or pressure is established, organizations may view sharing knowledge as helpful if it enhances the quality and quantity and data and information available. This enhanced data, in turn, can help improve decision-making while reducing redundancy in data collection efforts.[63] Coordinating knowledge may also help agencies make plans at larger scales, which can improve the efficacy of management actions.[64]

While there are many potential motivations for agencies to share knowledge, there are also common sets of concerns regarding data-sharing processes or outcomes. Specifically, some organizations may be uncertain about if, or how, to share their data. These situations can arise if the agency lacks experience with identifying opportunities to share data, or if there is ambiguity about whether the agency has legal or political authority to share information.[61] Concerns related to capacity are also common, as organization must allocate their limited resources and staff time towards processing and publishing data, providing training in data sharing mechanisms and policies, and overcoming interoperability challenges.[63] If agencies lack the willpower to share, or if sharing is not mandated, other agency initiatives may be seen as more important to devote agency resources towards.[64]

Concerns related to retaining control over information are also common barriers to knowledge sharing between agencies. Maintaining control over data may be especially important if there are privacy or national security implications should the data be misused.[64] Likewise, sharing data could

cause concerns over data misinterpretation, especially if there is a lack of trust between the data-sharing agencies.[61] In some situations, agencies may view information as a source of power and authority, which in turn encourages that agency to maintain strict control over their data. Sharing data may be viewed by these agencies as having negative political ramifications, hurting the agency's autonomy or self-interest, or reducing their competitiveness.[60,63,64]

While many decisions regarding information sharing are made at the organizational level, the implementation of these decisions is affected by the individuals within the agency who are directly or indirectly responsible for knowledge sharing. Even when an agency sets the goal of coordinating knowledge, knowledge may not be shared if the individuals within the agency do not comply. In contrasting situations, where agencies do not intend to share knowledge, knowledge sharing may still occur if an entrepreneurial individual within the organization takes it upon themselves to do so.

Overall, for coordination of knowledge to occur, individuals within the organization must have the motivation to share knowledge. These individuals are motivated by both intrinsic and extrinsic factors. For example, an individual may be self-motivated to share knowledge because it helps them build a relationship or establish trust with a colleague. The individual might also have a personal investment in the problem being addressed through the coordination efforts and be eager to assist by sharing information. Extrinsically motivated individuals may feel compelled to share knowledge because it is mandated by organizational policy or their superiors, or they feel pressure from social norms to do so.[63]

In contrast, barriers at the individual level can impede or prevent knowledge sharing efforts. One commonly occurring barrier is related to an individual's capacity to devote time and energy to knowledge sharing activities, as well as their access to the mechanisms needed to share. Additionally, an individual's perceptions about the personal-level effects of knowledge sharing may prevent sharing. For example, some individuals may be disinclined to share knowledge if they feel social pressure from their superiors or peers to devote resources towards other priorities.[63] Individual may also avoid sharing knowledge if they have a personal conflict with the knowledge recipient or are competing for professional recognition. Lastly, if an individual holds the viewpoint that their knowledge is a form of property or a mechanism for retaining power, they may be motivated to hoard information to protect their status or identity.[60]

4.5. Ways of Knowing

The potential for multiple methodologies for interpreting data, gaining information, and developing knowledge can also make knowledge sharing difficult. The various methodologies through which knowledge is produced and acquired are referred to as ways of knowing. Agencies and the individuals within them may have different ways of knowing because they have different underlying perspectives on the proper methods for 'sense'- making. Oftentimes, different backgrounds and goals lead to different ways of knowing, such as the differences in vocabulary, technical expertise, analytical methods, and use of conceptual models that can arise from different types of education or training. These differences can create barriers to knowledge sharing if agencies and the individuals within them disagree on the appropriate methods to produce and interpret information.

One barrier that may be of particular importance for knowledge sharing occurs when agencies hold different perspectives on the most appropriate approach for interpreting complex information. Oftentimes multiple analysis and interpretation methods exist to make sense of information, especially if the data that built this information are describing a complex system. These differing methods for sense-making can result in dissimilar conclusions about the meaning of the information. Consequently, these divergences can cause a barrier to coordination if one of the agencies is unwilling to accept the other's conclusions, especially if the conclusion was produced through methods with which they were unfamiliar or did not perceive to be accurate or legitimate. This barrier may be especially significant when the information will be used for decisions of high concern to the agencies involved or if the information will be subject to political scrutiny.

As an example, two common approaches to information interpretation that can cause knowledge-sharing barriers are the use of statistical models versus simulation models.[65] Statistical modeling involves the fitting of models to observational data and is designed to provide direct information on the relationships between different variables. This approach, however, does not provide information about the underlying processes that cause these relationships.[66] In contrast, simulation modeling is used to mathematically represent underlying causation processes. This approach may be useful for understanding why two data points have a certain relationship, but only if the theoretical basis for the model includes all critical processes.[65] Agencies may differ in which of the two methods they see as most appropriate for analyzing their data, and they might be unwilling to accept analysis results or other knowledge based on the use of a different model type.

Another potentially problematic barrier relates to knowledge sharing in the context of uncertainty. When there is uncertainty about the system, such as epistemic uncertainty or ambiguity regarding underlying concepts, the potential for multiple interpretations of data and information arises. This plurality of interpretations can make it difficult for agencies to develop shared or unified knowledge. In particular, having inadequate information can lead individuals with different methods of interpretation towards diverging conclusions, some of which may support certain goals of the agency better than others. In these circumstances, there is no objective knowledge, which can be problematic because subjective knowledge may be contested between agencies that are attempting to coordinate with a unified vision. Therefore, uncertainty may add to barriers regarding knowledge sharing because it can compound issues regarding multiple interpretation methods and different ways of knowing.[67,68]

4.6. Mechanisms for Knowledge Sharing

In the previous sections we discussed the different types of information that coordinating agencies may find useful to share, as well as common challenges they may face when doing so. In this final section, we will provide an overview of the different mechanisms agencies might utilize to coordinate their information sharing efforts (See **Box 4c**). These mechanisms include communication through ad-hoc methods, via a spokesperson, through a third party, through a centralized system, and through joint production. These different approaches are associated with benefits and drawbacks that balance factors such as speed, effort, and efficiency in communication. Therefore, the most appropriate mechanism for each set of coordinating

agencies depends on their specific situations and the relative influence of these factors for their coordination success.

Box 4c. Coordinating Knowledge – Example Methods Used by Some Agencies in California to Develop Groundwater Sustainability Plans

California's Sustainable Groundwater Management Act mandated agencies sharing a groundwater basin coordinate to use the same data, methodologies, and assumptions in development of their groundwater sustainability plan(s). Agencies adopted a variety of strategies for coordinating information. The figure depicts strategies adopted by agencies in three separate basins. These strategies are not mutually exclusive; agencies could choose to utilize more than one strategy concurrently.

Strategies for Coordinating Knowledge		
A. Shared Foundational Data	B. Shared Methodologies	C. Shared Consultant
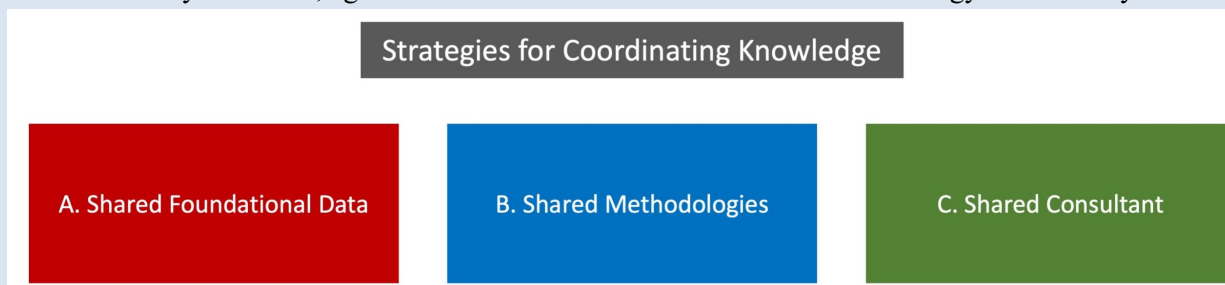
A. Shared Foundational Data: The Delta Mendota groundwater basin contains thirty-nine agencies that formed six groundwater sustainability planning groups. Agencies in the basin decided to use the same foundational data across the six groundwater sustainability planning groups. Representatives from each group worked together under the auspices of ad-hoc technical workgroup to coordinate the datasets used to develop a hydrological conceptual model and a water budget. Technical memorandums were produced to outline which data was going to be used to support certain aspects of the planning process. Some foundational data was shared among all agencies in the subbasin, whereas other data was local and shared among agencies within the same planning group.

B. Shared Methodologies and Assumptions: The Kings groundwater basin contains fifty-two agencies that formed seven groundwater sustainability planning groups. Agencies decided to use the same methodologies for groundwater data collection and analysis; for establishing a water budget; and for setting sustainability criteria. The coordination workgroup, containing members from each of the seven groundwater sustainability planning groups, jointly developed and formally approved the shared set of methodologies that would be used by each groundwater sustainability plan.

C. Shared Consultant: The Madera groundwater basin contains seven agencies that formed four groundwater sustainability planning groups. The agencies collectively hired two consultants to help with coordination of knowledge. The consultants coordinated data compilation, developed a hydrogeologic conceptual model, calculated water budgets, and identified data gaps. They then provided this information in reports to the groundwater sustainability planning groups.

Ad-hoc information sharing is an informal system where sharing occurs through chance meeting. In ad-hoc information sharing, each member of one agency has access to each member of the other agency, and communication occurs at the individual level. Ad-hoc systems tend to be the default when no other mode for information sharing is set up. The benefits of this mechanism include its tendency to broaden social learning and build morale amongst those communicating. The informal nature of ad-hoc sharing may also help more group members feel comfortable

expressing new ideas. However, this informal nature also means that there is no record of who has spoken to whom, which can lead to redundancy or gaps in information sharing. Knowledge received by one group member may not be shared among all group members. There is also a greater chance for contradictory information to be passed along because of the large number of individuals involved in information sharing efforts.[69]

Unlike ad-hoc sharing, communication via a **spokesperson** tends to be a formalized system whereby each agency has one member through whom all knowledge is shared. This spokesperson may be assigned, elected, or volunteer. Compared to ad-hoc sharing, the main benefit of a spokesperson system is that it tends to be more efficient when many parties need to coordinate or a formal decision needs to be made. Because all information must flow through one individual, however, spokesperson systems tend to slow down the rate of communication. There is also a greater potential for bias in information sharing because only one person is responsible for interpreting and sharing information.[69]

Similarly to spokesperson systems, **third-party** communication is a formalized system. However, an external party such as a consulting group or information clearinghouse is responsible for knowledge sharing instead of an internal agency member.[69,70] Third-party systems may be particularly useful if there is antagonism between the groups because the third-party serves as a neutral intermediary. Third parties may also have knowledge sharing expertise and capacity that an agency may need. Lastly, third parties may be especially useful for agencies with data that must remain confidential. In these situations, utilizing a third party may help the agencies address privacy concerns because the third party can analyze data and present results in aggregate form. Drawbacks of third-party systems include the need for trust, respect, and confidence in an outside party. Time and effort are required to find the right entity to serve as the third party, and this entity must be financially compensated for their service.[69]

A fourth system frequently utilized by coordinating agencies is **centralization,** whereby information sharing occurs through a central repository. Centralized information sharing may take several forms, such as hierarchical networks or central forums. In hierarchical networks, subordinated organizations submit information to a super-ordinated organization, which in turn is responsible for coordinating interactions and making integrated data accessible to the subordinated organizations. In central forums, agencies submit information to an entity at their same level of governance that they jointly created, such as a technical committee or online database. This entity serves as an intermediary information service through which information is shared and exchanged.

One of the main benefits of centralized systems is that information can be found in one place, which tends to increase the speed at which information can be obtained. Centralized systems may help reduce the cost of sharing information and can help increase the quality of shared information because the centralized system reduces the complexity of transferring, recalculating, and integrating information from different sources.[70] However, for agencies with a pre-established information system, switching to a centralized system requires extra time, effort, and usually money. Centralized systems also need to be designed to match the broad range of data that will be aggregated, and consequently this system may not be tailored to the specific needs of an individual agency. In addition, relevant datasets can become very difficult to discover,

identify, or utilize if data standards are not successfully matched when integrating data between the systems.[71]

The final approach to knowledge sharing that we wish to highlight is called joint production. **Joint production** is a direct collaboration between agencies, with each source contributing knowledge, capacity, and the shared intention of generating usable knowledge and tangible project outputs.[72,73] This mechanism is likely to produce knowledge that is highly relevant, useable, and trustworthy for all stakeholders because the agencies work together to define which data, information and knowledge will be produced – and jointly implement the methods for producing that knowledge. Joint production may also be viewed as fairer and more ethical for the stakeholders involved.[74,75] However, joint production tends to be complex; agencies have to work together to define the scope, select methods, allocate responsibilities and develop knowledge. The collaboration process requires a significant amount of time and effort from all parties, and it is not always possible for the direction of the research to reflect the values or priorities of all stakeholders.[73,74] This may also increase financial costs and administrative burdens. There is potential for increased conflict, as tensions can arise more frequently due to the large number of interests involved.[74] Lastly, the parties involved may also have different views about what the research findings show and what to do with these findings, resulting in delayed action.

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