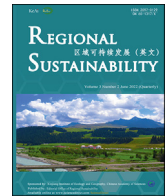




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Full Length Article

# Transaction costs for collaboration in the watershed management of the Cuyahoga River Area of Concern

Scott Daniel Hardy\*

Ohio Sea Grant, The Ohio State University, Columbus, OH, 43212, USA

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## ABSTRACT

This study examines the transaction costs of collaborative watershed management in the Cuyahoga River Area of Concern (AOC)—one of the 43 geographic areas designated by the U.S. and Canada Great Lakes Water Quality Agreement (GLWQA), where significant impairment of beneficial uses has occurred as a result of human activities. The Cuyahoga River is located in Northeast Ohio, the U. S. and flows through the City of Cleveland before draining into Lake Erie—one of the five Great Lakes of North America. The watershed is degraded due to municipal and agricultural discharges, streambank erosion, and contamination from urban and industrial sources. This research explores how a diverse group of stakeholders convened under the Cuyahoga River AOC Advisory Committee to share information, coordinate activities, agree on activities that restore beneficial uses, and support strategic management actions. In this study, 23 semi-structured interviews with members of the advisory committee were conducted between January 28, 2020 and April 20, 2020, with follow-up emails and phone calls as needed to corroborate information. A review of research articles and government documents supported the interviews, including United States Environmental Protection Agency (U.S. EPA) and Ohio Environment Production Agency (OEPA) reports on the GLWQA and Cuyahoga River Remedial Action Plans. A third source of data is from direct participant observation at quarterly meetings of the advisory committee during 2017–2020, binational AOC conferences in 2017 and 2019, and other professional events geared towards restoring the Cuyahoga River AOC in 2016–2020. Results help to explain the collaborative process within the advisory committee and measure the institutional performance of the advisory committee in terms of efficiency, equitability, accountability, and adaptability. Results of this study include a set of recommendations to help guide group structure and decision-making processes, including (1) employing best available technology to organize AOC events and disseminate information; (2) supporting new members with an orientation and/or mentor to clearly define formal and informal committee rules; (3) assuring equal access to detailed information on management action plans with a real time dashboard; (4) updating voting procedures and the prioritization of management actions; and (5) better incorporating underrepresented local communities and high-level decision makers from municipalities, government agencies, and nongovernmental organizations located within the Cuyahoga River AOC.

## 1. Introduction

Collaborative approaches to environmental management are often praised for increasing community participation, incorporating

\* Corresponding author.

E-mail address: [Hardy.116@osu.edu](mailto:Hardy.116@osu.edu).

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local knowledge, and producing more sustainable environmental and social outcomes compared to traditional top down and command and control methods (Wondollock and Yaffee, 2000; Koontz et al., 2004; Fox et al., 2020). However, scholars point out that when not properly supported, collaborative approaches will generate transaction costs that take more time and money and lead to the “lowest common denominator” decisions (Reed, 2008; Wang and Zhao, 2021). For this reason, it is important to understand the institutional performance of collaborative groups and develop strategies for overcoming such costs.

One area where collaboration has been adopted broadly is watershed management (Leach and Pelky, 2001; Imperial, 2005; Sabatier et al., 2005; Narendra et al., 2021). Collaborative watershed groups have proliferated to address the myriad sources of pollution and habitat destruction that can plague a river or lake ecosystem. Collaboration is seen as an important step towards bridging administrative and political boundaries of watershed, and combining the resources of a watershed's stakeholders to conduct ecological studies and implement management actions (Koontz et al., 2004). In contrast to government-led approaches, collaborative watershed groups seek to develop strategic planning and restoration initiatives along the biophysical scales of watersheds rather than the political boundaries.

Although collaborative watershed groups have been lauded for inclusive decision-making processes and community engagement, some of them have also been criticized for delaying the restoration work due to over-deliberation and catering to entrenched political and economic interests (Sabatier et al., 2005; Bellanger et al., 2020). Such drawbacks or transaction costs of collaborative processes lead to inefficiencies in management, which in turn further lead to compromised environmental and social outcomes. Conversely, identifying the causes of transaction costs and developing strategies for addressing them may hold the promise of ensuring more sustainable environmental and social outcomes. This supports broader studies of socio-ecological systems and recommendations about equitable and inclusive governance arrangements that are more capable to overcome external variables that can hinder sustainable management (Ostrom, 2009).

A growing body of work has begun to examine the role that transaction costs can play in collaborative watershed management and the relationship between overcoming external variables and assuring sustainable environmental and social outcomes. For example, voting procedures and limitations in information sharing have been identified as barriers to optimal institutional performance in watershed management by the members of Total Maximum Daily Loads Program executive committees in Florida (Borisova et al., 2012). Sabatier et al. (2005) studied the National Estuary Program of the United States Environmental Protection Agency (U.S. EPA) to investigate the role of transaction cost economics on facilitating collaboration. They found that the decision to cooperate is a function of the perceived benefits and the transaction costs of participating in the collaborative process. Elsewhere, Scott (2016) showed that the efficacy of collaborative watershed councils is related to their institutional capacity and attributes. Ananda and Proctor (2013) suggested that in fact the transaction costs that are generated by the nested hierarchical institutions in multi-jurisdictional watersheds could impact the decision structures of collaborative watershed groups, and they thought that supporting such processes plays a role as big as financial or technical resources in watershed management. Other major influence on transaction costs is the environmental policies that structure decision-making processes.

Collaborative watershed management in the Great Lakes is catalyzed by several binational (i.e., the U.S. and Canada) and federal (i.e., the U.S.) policies that establish rules for state and local stakeholders who participate in water resource governance. The most prominent policy is the Great Lakes Water Quality Agreement (GLWQA) (The Government of Canada and the Federal Government of the United States, 2013). The GLWQA establishes the framework for local collaborative advisory committees to guide the implementation of watershed restoration actions in the 43 most polluted rivers (26 in the U.S., 12 in Canada, and 5 across binational) draining into the Great Lakes Basin (The Government of Canada and the Federal Government of the United States, 2013). Areas of concern (AOCs) contain beneficial use impairments (BUIs), such as impediments to the chemical, physical, or biological integrity of local water due to human activities (The Government of Canada and the Federal Government of the United States, 2013). Advisory committees develop their own procedural policies in accordance with the GLWQA for making decisions, sharing information, and codifying recommendations on watershed management actions to state and provincial authorities. Based on Annex I of the 2012 amendments to the GLWQA, the collaborative watershed groups address watershed restoration through the implementation of remedial action plans (RAPs) (U.S. EPA, 2019). RAPs to the AOCs in the cities of Cleveland and Akron, Ohio, and embedded with input from stakeholders ranging from the U.S. EPA and Environment and Climate Change Canada, to other federal and state environmental agencies and many local governments, nongovernmental organizations, business enterprises, and independent residents. The decision-making processes among these stakeholders have a major effect on project outcomes.

This study focuses on the Cuyahoga River AOC Advisory Committee and the way that the members of this committee share information, make decisions, and ultimately provide recommendations on watershed management actions to the U.S. EPA. The goal of this study is to help identify barriers to effective collaboration among the members of Cuyahoga River AOC Advisory Committee and formulate strategies to help optimize the effectiveness of this committee. The Cuyahoga River AOC Advisory Committee is made up of a wide variety of stakeholders representing government, business enterprise, and nongovernmental organization. In 2020, the Cuyahoga County Soil and Water Conservation District took over the responsibility as the facilitating organization of the Cuyahoga River AOC Advisory Committee, helping the committee to organize and schedule meetings, support decision-making, maintain public-facing aspects (e.g., the official webpage, social media accounts, etc.), and contribute to public outreach and education.

As stated in the Cuyahoga RAP, the mission of Cuyahoga River AOC Advisory Committee is to make recommendations to the Ohio Environment Production Agency (OEPA) that can remove BUIs from the Cuyahoga River AOC (Goodman and Gigante, 2018). BUIs either restrict people's ability to use resources, e.g., negatively impact the survival of fish and other aquatic communities, or degrade water quality. For the Cuyahoga River AOC, there were originally ten BUIs that the Cuyahoga RAP targeted for restoration, although by the time this manuscript is published four of them may officially be removed.

Collaborative watershed management in the Cuyahoga River AOC was productive, as evidenced by the timely removal of four BUIs (the BUIs of public access and degradation of aesthetics were removed in 2017, the BUI of restrictions on fish consumption was removed

in 2018, and the BUI of eutrophication or undesirable algae was removed in 2021) from a strategic management action list approved by the OEPA in 2013 (updated in 2015). Despite the success already achieved in the collaborative watershed management of the Cuyahoga River AOC, the members of the Cuyahoga River AOC Advisory Committee suggest that there remain opportunities to refine the group structure and decision-making processes. This study aims to identify the existing transaction costs to optimize institutional performance within the Cuyahoga River AOC Advisory Committee and seek opportunities for improving collaboration within the committee and between the advisory committee and external stakeholders who share a connection to the Cuyahoga River.

## 2. Study area and method

### 2.1. Study area

The Cuyahoga River is located in the northeast of Ohio, U. S., and flows through the cities of Akron and Cleveland before draining into Lake Erie—one of the five Great Lakes of North America. The downstream 75 km of the Cuyahoga River is included in the Cuyahoga River AOC, besides, all of the tributaries that drain into the downstream 75 km section of the Cuyahoga River, the shoreline adjacent to the river's mouth, and the tributaries that flow directly into Lake Erie are also included in the AOC. In total, the area of the Cuyahoga River AOC spans parts of Cuyahoga County, Lake County, Geauga County, Portage County, Summit County, and Medina County. Contamination of the Cuyahoga River comes from lots of different places. Municipal and industrial discharges play a role, including commercial and residential development, hazardous waste disposal, urban stormwater runoff, and combined sewer overflows (i.e., during heavy rain periods, the untreated stormwater and wastewater combine and discharge directly into the river). Pollution from these sources fills the river with runoff containing oil, sewage, industrial waste, and floating debris. Incompatible development along the riverbanks also causes erosion that leads to problems with sedimentation. All contamination results in poor water quality, damage to wildlife habitats, and ultimately a major loss of biodiversity.

Restoration efforts along the Cuyahoga River began in earnest in 1969 when the river caught fire and catalyzed the change of federal policy. The national attention was brought on by pictures of fire on the water, this helped lead to the passage of both the U.S. Clean Water Act and the U.S.-Canada GLWQA in 1972. During the decades that followed, most restoration efforts focused on point sources from industry and wastewater treatment plants. Municipalities along the river soon realized that a broader group of stakeholders were needed to address all sources of pollution in the watershed, thus leading to the development of the first RAP under the GLWQA. These collaborative efforts have been continued by the current Cuyahoga River AOC Advisory Committee and have grown to include the considerations for public access to the river, expanded recreation opportunities, aesthetics of river landscape, and other ecological benchmarks denoting a healthy riverine ecosystem. Restoring the Cuyahoga River AOC is important for improving water quality, fish and wildlife habitat, and economic development for communities located along the river.

### 2.2. Methods

This study is guided by the institutional analysis and development (IAD) framework, conceived by Elinor Ostrom and her colleagues (Kiser and Ostrom, 1982; Ostrom, 1990; Ostrom et al., 1994). The IAD framework is helpful for this study because it allows for the examination of formal and informal rules that shape the actors and actions in collaborative institutions, such as the Cuyahoga River AOC Advisory Committee. The framework identifies several external variables that determine what the actors involved in collaborative arrangements must do or must not do or may do, as well as the decision-making processes and shared strategies that shape management actions (Crawford and Ostrom, 1995). The rule- and decision-making processes established by actors occur in “action situations” which structure interactions among actors and ultimately play a role in determining environmental and social outcomes.

The IAD framework can also be useful for measuring institutional performance and evaluating the influence of external variables or transaction costs on project outcomes (Ostrom et al., 1993; Imperial, 1999). While institutional performance can be evaluated according to the outcome of effort or policy, transaction costs and institutional outputs serve as a viable precursor to long-enduring outcomes (Imperial, 1999). For this study, transaction costs can be grouped together as information costs, coordination costs, and strategic costs (Ostrom et al., 1993). Following Ostrom (2011), the analysis goes further to help analyze overall institutional performance by exploring the efficiency, equity, accountability, and adaptability of the advisory committee. Results are aggregated and reported to the members of the advisory committee in an attempt to help highlight some of the social external variables that might hinder optimal institutional performance and propose a series of recommendations for improving administrative rules within the advisory committee that affect environmental and social outcomes.

### 2.3. Data collection

Semi-structured interviews with the members of the Cuyahoga River AOC Advisory Committee form the basis of inquiry of this study. The interviews are bolstered with a review of previous research articles, government documents (e.g., the GLWQA and Cuyahoga RAP), and contents of meetings including quarterly meetings of this advisory committee during 2017–2020, binational AOC conferences in 2017 and 2019, and outreach events within the Cuyahoga River AOC during 2016–2020. Key informants are those people who have firsthand knowledge of the events being studied and provide factual information about the organization from an insider perspective.

In this study, 23 members out of 25 individuals of the Cuyahoga River AOC Advisory Committee (including one alternate) were interviewed (one representative each from an environmental consulting firm and a government agency declined the interview). Members of this advisory committee form a diverse group of stakeholder organizations representing government agencies and regional

government-backed collaborative entities (10), environmental consulting firms (5), non-governmental organizations (5), members of the public (4), and academia (1) (Table 1). Members of this advisory committee have served from as little as 2 months to more than 20 years. The distribution is bimodal, with 6 members having served this committee for 10 years or more while 6 members only served for 2 years or less. The tenure is 2 years and renewable, meaning that some members have been re-elected multiple consecutive times.

The semi-structured interviews were conducted between January 28, 2020 and April 20, 2020 and lasted 30–90 min each, with follow-up emails and phone calls to corroborate information. Interviews focused on the institutional performance of the Cuyahoga River AOC Advisory Committee, the patterns of interaction among key decision makers, and the decision situations within this adversity committee that impact the restoration outcomes of the Cuyahoga River AOC. Recommendations were solicited to help improve environmental and social outcomes.

Primary and secondary data were collected from documents pertaining to the Cuyahoga River AOC, including the reports of the U.S. EPA and OEPA on the GLWQA and BUIs, Cuyahoga River RAPs, completed watershed action plans, and information of organization and watershed characteristics (i.e., information about group history, goals, activities, financial resources, and partner organizations).

### 3. Results

#### 3.1. Transaction costs

Transaction costs associated with the collaborative process can be generated due to the way individual actors or organizations share information, coordinate meetings and other activities, and participate in the decision-making process of strategic planning. While collaborative approaches like the formation of AOC advisory committees under the GLWQA have been lauded for network building, increasing private-public partnerships, and producing more sustainable environmental and social outcomes than traditional command and control methods (Wondolleck and Yaffee, 2000), some detractors suggest that collaboration would take excess time and money, and lead to a weakened democratic process that may result in “lowest common denominator” decisions (Sabatier et al., 2005; Reed, 2008). For this reason, it is important to investigate the institutional performance of collaborative groups at a given point in time, including the impact of undesired transaction costs associated with the collaborative process and strategies for overcoming such costs.

Transaction costs in collaborative watershed management can be high for several reasons. Typically, transaction costs increase when everybody who is involved in the collaborative process does not have the same knowledge or access to information (Imperial, 1999). According to the members of the Cuyahoga River AOC Advisory Committee, this can manifest itself in terms of historical knowledge of management actions in the Cuyahoga River watershed, understanding of the power structures among decision-makers, familiarity with Annex I of the GLWQA and other related policies, and acquainting with the role of each committee member. In short, there is a lot to learn for new members of the Cuyahoga River AOC Advisory Committee. One member suggests that there could be a better way to share information, because newer members do not know why some management action decisions were made. Besides, trust is also a factor. If the individuals of a collaborative group do not trust each other or their leadership, it can be more difficult to create and implement operating procedures (Kauneckis and Imperial, 2007). Fortunately for the Cuyahoga River AOC Advisory Committee, trust does not seem to be a problem, and in fact, the high level of trust among the members could be seen as a strength for this advisory committee. One

**Table 1**

Category of the members of the Cuyahoga River AOC Advisory Committee in 2021.

Category of stakeholders	Number of members	Organization of member belonging to
Government agency and regional government-backed collaborative entity	10	Cleveland Metroparks City of Cuyahoga Falls Cuyahoga County Board of Health Northeast Ohio Areawide Coordinating Agency Akron Engineering Bureau Mayor's Office of Sustainability, City of Cleveland Summit Metro Parks Cuyahoga County Planning Commission Northeast Ohio Four County Regional Planning and Development Organization Northeast Ohio Regional Sewer District
Environmental consulting firm	5	Tetra Tech, Inc. EnviroScience, Inc. Stantec, Inc. Partners Environmental Consulting, Inc. Davey Resource Group, Inc.
Non-governmental organization	5	Organic Connects, Inc. Tinkers Creek Watershed Partners West Creek Conservancy Friends of Euclid Creek Cleveland Water Alliance
Member of the public	4	Residents of Northeast Ohio
Academia	1	Ohio Sea Grant

Note: AOC, area of concern.

member suggests that trust matters because everyone needs to feel that they are working towards a common goal. Lastly, transaction costs tend to rise as institutions become more complex (Levi, 2008). The more people share in decision-making process, the more opportunity exists for disagreement and bargaining. Luckily for the Cuyahoga River AOC Advisory Committee, at present, that is not perceived as a problem given the relatively small size, collegial interactions, and shared goals among members. All the 25 members are Northeast Ohio residents who volunteer their time and represent their agencies or organizations in AOC restoration efforts, therefore social networks among people who live and work in the watershed help the group to function effectively.

### 3.1.1. Sharing information

Transaction costs associated with sharing information increase when people are forced to spend time finding and sorting different materials in order to make informed decisions (Imperial, 1999). The organizational structure of the Cuyahoga River AOC Advisory Committee contains a chairperson, a vice chairperson, and three subcommittees for strategic implementation and planning (SIP), governance, and education and outreach. The Cuyahoga River AOC Advisory Committee incurs information costs when recommending management action plans to the OEPA, sharing guidance on specific restoration actions among members of the SIP subcommittee, or even discussing planning documents and other organizational materials between chairpersons and members or within subcommittees. In the Cuyahoga River AOC Advisory Committee, members acknowledge that with so many watershed planning studies ongoing and subsequent management action plans submitted to the OEPA and Ohio Lake Erie Commission (OLEC), sharing information is an imperative and taxing part of collaboration among involved stakeholders. Internally, sharing information among members has been generally seen as much improved in recent years under current leadership. Despite the recent gains, however, members point out several possible inefficiency areas and potential areas for improvement.

The most commonly noted transaction costs associated with sharing information among the members of the Cuyahoga River AOC Advisory Committee are added time commitments in terms of reviewing, organizing, and disseminating information. For new members, this can create further work to review and understand all the committee procedures and tasks necessary for participation in the collaborative process, as well as where all essential information is stored. Transportation is also seen as a time cost with some members driving more than an hour each way to attend the quarterly meetings. Even the way in which meetings are scheduled and organized is brought up by some members who feel there are untapped opportunities to increase efficiency.

The members of the Cuyahoga River AOC Advisory Committee suggest several options to improve the way of information sharing, especially in terms of using technology to be more efficient. One innovative idea is to create an internal evaluation tool that can report the progress of specific projects within each BUI, similar to a real-time dashboard for BUI removals. The Cuyahoga River AOC website hosts some of these data, but the members indicate that the data have traditionally been difficult to understand and not always updated. Recently, some improvements have been made to the Cuyahoga River AOC website by the Cuyahoga County Soil and Water Conservation District to address this cost by making the information about the status of BUI and watershed management actions easier to find and understand for all the members. In fact, not all the members are aware that the delisting status of BUIs could be found on the Cuyahoga River AOC website. Upgrading, updating, and simplifying website information access methods would save time when trying to identify and understand the status of different BUIs, and help to improve the ability of members to educate the public and brand the committee actions to external stakeholders. Another suggestion proposed by members is to utilize live notetaking during meetings (e.g., a Google doc.) instead of the traditional information storage method such as word documents uploaded to a shared cloud-based folder sometime after meetings. Several respondents further suggest that the data storage approach that expressly identifies where all of the information is stored, catalogued, and updated should be introduced to all new members via a short onboarding exercise conducted by the facilitating organization. Some members also lament the way of voting by email. Concerns focus on the lack of conversation and due diligence during voting. Suggestions to address this problem include blind voting, justifying for each yes or no vote, and providing an opportunity for members to more thoroughly voice their opinions and debate options. The members also indicate that the way meetings are scheduled can be more efficient. Many members believe that a better use of technology, like Outlook or Google calendar invite instead of multiple email reminders, would be easier and less time consuming.

### 3.1.2. Coordinating activities

Coordination costs take place when trying to plan for group projects and events (Ostrom et al., 1993), such as committee meetings, the development of planning and outreach materials, or educational activities. In the Cuyahoga River AOC Advisory Committee, coordination costs are generated during the organization and negotiation of different management action plans and watershed programs. These activities include high level strategic planning among different subcommittees or more general efforts to coordinate full committee meetings and organize AOC events such as the international AOC conference or public BUI removal announcement. Ideological differences or personal conflicts among actors contribute to coordination costs, while all the members of the Cuyahoga River AOC Advisory Committee have their own specific beliefs and motivations for participating, everyone must interact with others in order to plan and recommend watershed restoration programs to the EPA, as stipulated in the GLWQA.

When asked about transaction costs associated with how the Cuyahoga River AOC Advisory Committee coordinates activities, members feel it is similar to sharing information—it takes time, whether organizing management plans or AOC events can be confusing for new members who are less familiar with the way that the committee operates. Some members feel that coordinating activities can be contentious at times, especially in terms of identifying specific projects and making recommendations on how and where to distribute funding. Many members indicate that some actions are more difficult to coordinate than others, such as reducing impervious surfaces throughout communities in the AOC. One recommendation to improve the way that the Cuyahoga River AOC Advisory Committee coordinates activities is to seek additional funds to better support the facilitating organization. This would provide more staff and allow staff to have more time to follow up on individual member suggestions, and allow the facilitating organization (i.e., Cuyahoga County

Soil and Water Conservation District) to serve as a public outreach arm of the Cuyahoga River AOC Advisory Committee, advocating for resource allocation and project development. Another suggestion to improve coordination is to send out minutes and notes of each committee meeting as soon as possible (within 1–2 days), including anything that the chair or members of the executive committee would like to highlight. This could also be an opportunity to assign specific action items for individual members to complete prior to subsequent meetings, thus making the coordination of future activities more efficient.

Negotiating the terms of specific projects may or may not involve substantial coordination costs, depending on the type of project and the leader of the project. Two types of transaction costs that correspond to comments from members in this regard are “free riding” and “path dependency”. The free riding problem occurs when an actor shares excess work burden because one or more actors do not contribute their fair share of effort towards a common goal. In the Cuyahoga River AOC Advisory Committee, some members suggest that, due to different cognitive levels of historical knowledge on the function and structure change of the Cuyahoga River AOC Advisory Committee and alignments with host organization missions, a few individual members often lead specific projects and “do all the work” while others involuntarily end up acting as free riders. It is important to note that many of the respondents who speak of the free rider issue are eager to contribute more towards collaborative efforts, but not sure how to do so. Thus the free riding problem is not due to an unwillingness to participate, but rather a lack of opportunity or understanding about how or when to contribute.

Another common transaction cost associated with coordinating activities is path dependency. Path dependency means that what has occurred in the past will continue in the present and future due to a resistance to change. Thus for the Cuyahoga River AOC Advisory Committee, there is a notion that certain ways of doing things are ingrained, which may not leave room for new ideas or innovative approaches to solve problems. This is most likely to play a role in the involuntary free riding mentioned by some committee members. A recommendation to address both free riding and path dependency issues among the Cuyahoga River AOC Advisory Committee relates to the operational rules set forth by the GLWQA, guidance from the U.S. EPA and OEPA regarding the mission of this advisory committee, and detailed description of the actual job responsibilities and the potential to support committee functions as individual committee members. In order to coordinate activities more effectively, many members suggest that it would be helpful if the OLEC and/or OEPA attend a committee meeting and conduct a brief presentation that explains the specific responsibilities of the committee and how members can contribute.

### 3.1.3. Agree on conservation strategies

Strategic costs associated with agreeing on conservation actions accrue when different stakeholders in a collaborative group attempt to benefit individually or bring benefits to their home organization at the expense of others (Imperial, 1999). In environmental management groups such as scientific advisory committees, this kind of cost could be manifest in terms of “turf protecting”—when an individual tries to sway management actions to benefit their own firm or community, or “rent seeking”—when an individual attempts to inflate the importance of a specific project or management project in an effort to favor specific benefits for themselves or their own firm or community. In the Cuyahoga River AOC Advisory Committee, the responses from members indicate that the overall strategic cost is minimal, and that neither turf protecting nor rent seeking is a problem.

According to the members of the Cuyahoga River AOC Advisory Committee, the advisory committee generally agrees on recommendations for BUI delisting actions and congenially comes to consensus on management action plans, although the process can be “anarchistic” and more “contentious for some BUIs”. While some members admit that at least part of their motivation is to contribute to the advisory committee for professional networking and advancement, all members agree that participation is genuine and the collaborative process is both professional and transparent. Given the criteria for management actions, agreeing on conservation strategies is a group process based on science. While it may “appear messy” and “take time”, there is a degree of order. All members vote according to majority rule, which substantiates group decision-making. As with coordinating activities, agreeing on BUI delisting strategies is more difficult for some BUIs than others. In the end, good leadership and policy guidance from the GLWQA and OLEC are seen as key to successfully reducing transaction costs in this area.

One concern among some members on strategic costs is path dependency again—some issues have been the focus of the advisory committee for a long time, the new approaches to address these issues, or moreover, ideas for new projects beyond what is already being addressed, may not always be welcome. Some members address this by saying that projects are already mapped out or the RAP is set and there is not much opportunity for additional information or expertise. Several members suggest this could be minimized by prioritizing management actions. The subcommittees are seen as helpful in this regard, and further view as a means to reduce additional time sinking during full committee meetings. One person mentions that the SIP subcommittee has done some of this, but the full committee should vote the priority of the management projects list, or at least a top three and bottom three projects. Another suggestion asks for more real-time updates on individual projects, so that everyone has the same information and can be an equal contributor to strategic decision-making processes. As mentioned above, a real-time dashboard of BUI project progress would be helpful in this area.

## 3.2. Institutional performance

The job of AOC advisory committees is to collaborate on a series of recommendations to the local and state or provincial environmental management agency for watershed restoration actions in a particular AOC and surrounding watershed. According to the stipulations under the GLWQA, the goal of advisory committees is to bring a representative group of stakeholders into the decision-making process, rather than adopt traditional models that rely on individual practitioners. In theory, this creates an opportunity for more local voices to be heard and a wider array of local expertise to express their perspective to watershed management planning. Given the concern over the role collaboration plays in environmental management, it is important to better understand the collaborative process within groups and measure the institutional performance overall by investigating if a collaborative body operates efficiently,

equitably, accountably, and adaptably (Imperial, 1999).

### 3.2.1. Efficiency

Efficiency is based on the ability of an institution to achieve its goals while wasting as few of its resources as possible (Ostrom, 2011). While no institution is 100% efficient, high performing arrangement is a way to minimize transaction costs and maximize available resources. When asked if the Cuyahoga River AOC Advisory Committee is efficient, members express wide range of opinions—from “very efficient” to “not efficient at all”. Most responses are some combination of the two. Those who feel the committee runs efficiently generally attribute it to the leadership of the chair of the advisory committee, OEPA, and OLEC, along with consistent funding through the Great Lakes Legacy Act and Great Lakes Restoration Initiative. For those who feel the advisory committee could operate more efficiently, a couple of common themes emerge: (1) coordination of meetings and events could be improved and (2) everyone needs to be equally aware of the core mission and goals of the advisory committee, and how each member can contribute to decision-making.

The first concern with efficiency deals with coordinating meetings and developing or implementing action plans for the existing BUIs. The members of the Cuyahoga River AOC Advisory Committee generally feel that meetings would be more efficient if members come with prepared actionable items, rather than spending time in updating the progress of management actions to everyone. Regarding the planning and implementation of management actions, members further believe that the current approach is efficient for some and not for others. For example, dam removal is efficient because it is easier to assess the benefits and identify which organizations should take the lead role. Other projects, like riparian restoration, are inefficient because there are many stakeholders, funding opportunities are disparate, and identifying who to be included is complicated.

The second inefficiency point mentioned by the committee members deals with information asymmetries. With a bimodal distribution of time served on the advisory committee and wide disparity of institutional history, it appears that not all the members are on the same page regarding overall goals and vision of the advisory committee. Many respondents note their lack of understanding of the core mission of the committee, as well as the ways they could contribute. Other questions are raised with regard to the status quo, and a perceived reluctance to adopt new and innovative ideas now because the management action list has been approved by the OEPA. Interview responses suggest that, as with the transaction costs associated with sharing information, coordinating activities, and agreeing on conservation activities that restore beneficial uses, some of these issues could be addressed by making sure the members possess a strong understanding of the structure and function of the Cuyahoga River AOC. As mentioned in the previous section, the members recommend an onboarding exercise for new members that covers processes, tasks, and responsibilities of the advisory committee, and how and where all information is stored, as well as a short presentation by the OLEC or OEPA on the history of the Cuyahoga River AOC, the goals of Annex I of the GLWQA, and specific responsibilities of the members of this advisory committee in the restoration process.

### 3.2.2. Equitability

Equitability refers to how resources are allocated and which items take precedence within a collaborative group (Imperial, 1999). Evidence suggests that people are more likely to contribute to a collaborative group if they think that the benefits of participating are related to the amount of their efforts (Ostrom, 2011). For the Cuyahoga River AOC Advisory Committee, most members feel the group is equitable, yet some voices get lost in the discussion. A few members of the advisory committee note that organizations that provide funding and in-kind services have a larger impact on the recommendation of restoration strategies, despite what individual members might prioritize. This speaks to the advisory role of the Cuyahoga River AOC Advisory Committee, as opposed to state and federal agencies that are responsible for the processes of management and appropriation. For example, one member points out that the U.S. Army Corps of Engineers has financial resources and the OEPA has regulatory power. This explains why they are influential in decision-making processes. Others express concerns that new members do not fully or equally participate because they do not always have the history or institutional knowledge to affect change. This is despite the chair of the advisory committee offering to hold one-on-one discussions with all new members at the time of their appointment to review operating procedures and answer any questions about the advisory committee. Also, some members' personalities may not lend themselves to speaking out during meetings. In this case, the smaller and more focused subcommittees are lauded as a means to achieve greater equitability. One suggestion from a member of this advisory committee to further improve equitability focuses on building more details in agendas prior to meetings. Sending more directions on preparing for meetings is seen as a means to improve participation. One member suggests that new members can be assigned a mentor to help explain the history of management actions and how it relates to current decision-making processes. A related suggestion builds on prior calls for the facilitating organization to hold an onboarding for new members on how the advisory committee and subcommittees work, including how action plans for individual BUIs are developed and implemented.

Politics also appear to play a role in the equitability of this advisory committee. Members note an “interesting dynamic” because everyone has their own reason to be there and nobody wants to offend anyone, regardless that all opinions are welcome. One person suggests asking all members what they hope to accomplish as a member of the advisory committee. This already occurs as part of the written application submitted by individuals when applying to the advisory committee. There is also an update every other year when members reapply for subsequent two-year terms, thus offering the opportunity to reevaluate individual goals and targets. Possibly offering the option to update application goals on a yearly basis would be welcome by some committee members. Others point out that some member organizations are more aligned with the restoration goals of the AOC than others, such as the Northeast Ohio Regional Sewer District, thus they should be leaders in the group. One member suggests that during meetings members should be asked questions directly, so that everyone will be required to give their opinions. Although this would improve participation and the sharing of ideas, it would dramatically increase the committee's time commitment. One common concern is that there are people missing from the conversation, and that more representatives from underrepresented neighborhoods should be invited to the table. Overall, committee members indicate that meetings run thoughtfully, and everybody has an equal opportunity to contribute, even if some opinions get lost

in the crowd.

### 3.2.3. Accountability

Accountability deals with internal systems for self-monitoring behavior and imposing penalties or sanctions for misconduct. The members of the Cuyahoga River AOC Advisory Committee roundly praise the leadership for keeping the group on track and accountable to guidelines established by the EPA via the GLWQA for creating a viable list of management actions. Most individuals (except for members of the public) are accountable to the agencies or organizations they represent. Furthermore, different experience levels of working within the AOC restoration process allows some members to contribute more on decision-making processes than others. From the perspective of committee members, accountability is tied to federal policy. The U.S. EPA and OEPA are accountable for obtaining and spending money in and for the Cuyahoga River AOC.

On the operational level of specific BUIs, some actions are seen as accountable due to the Clean Water Act and GLWQA precedent and guidance, while others less so. The job of advisory committees is to frame and understand issues in the AOC and provide recommendations on restoration actions. Given the mix of stakeholders who impact river restoration, guidance from the oversight agency has helped with accountability. For instance, the GLWQA is still implemented by binational and federal government agencies, yet financial resources are not offered to the Cuyahoga River AOC Advisory Committee for oversight or accountability practices. Committee members raise additional questions about how the facilitating organization's and the advisory committee's responsibilities differ, including exactly who holds both the groups accountable. Again, the OLEC and/or OEPA could include this information in a short presentation for the advisory committee.

Overall, committee members overwhelmingly feel that the Cuyahoga River AOC Advisory Committee is self-accountable given that the committee's goals are being met in a timely manner and the members are accountable to the chairperson and each other. The reappointment process also serves as an important accountability mechanism because someone or some organization could lose their seats on the committee if they do not meet their obligations, such as attending meetings and contributing to subcommittees. The committee is also viewed as accountable to guidance from the GLWQA, as well as the OEPA and OLEC, and most importantly, the general public. One suggestion offered by a committee member to improve accountability is to invite higher-level decision makers from each representative organization to participate. Another common refrain suggests that members need more clear expectations of what responsibilities are for each member.

### 3.2.4. Adaptability

Adaptability within collaborative institutions is closely tied to sustainability, and the ability to change with social, political, economic, and environmental circumstances (Ostrom, 2011). Similar to the biophysical nature of a river system, in order to be resilient, a collaborative group must have the ability to change over time and bounce back from deviations from the equilibrium. Annex I of the GLWQA has guided actions for AOC advisory committees since 1987, thus individual advisory committees must constantly change in order to meet emerging challenges associated with river restoration. By in large, the members of the Cuyahoga River AOC Advisory Committee praise the committee's adaptability. The diversity of organizations or agencies that make up this advisory committee is seen as the source of the committee's flexibility because each member brings unique expertise and access to resources for collaboration. Also, changes in group membership over time, due to the 2-year time term limits and the guidance from the OEPA and OLEC, have shown flexibility. Since the inception of the advisory committee, members have adapted their focus from conducting studies of BUIs in the Cuyahoga River AOC to creating management action lists to making recommendations to the OEPA and helping to advise and monitor the actual implementation of restoration actions. One area where committee members perceive a lack of adaptability is post-submission of management action plans. Once the advisory committee's recommendations are sent to the OEPA, there is a concern that opportunities do not exist to provide continuous feedback.

In 2015, the framework for the Cuyahoga River AOC Advisory Committee changed, shifting focus from studies on BUIs to recommending the implementation of management actions, thus demonstrating its adaptability. In fact, the Cuyahoga River AOC has transformed since then, having fully delisted four BUIs. There have also been several changes in leadership at the OEPA and OLEC. This has altered the committee's approach and focus, as well as prioritizations among the project list. The advisory committee is able to pivot and look to different funding sources for project needs. There are more resources available now than in the past, and as the Cuyahoga River AOC approaches closer to the proposed delisting date established by the EPA, the federal government provides more incentives and emphasis on completing restoration actions.

## 4. Discussion

This study builds on a growing body of work focused on the transaction costs of collaborative environmental management (Imperial and Yandle, 2005; Sabatier et al., 2005; Levi, 2008; Reed, 2008; McCann, 2013; Lubell et al., 2017). Results align with past research that suggests appropriate strategic investment in transaction costs can improve decisions and increase net benefits from an environmental programme (Pannell et al., 2013). Semi-structured interviews with the members of the Cuyahoga River AOC Advisory Committee yield a robust set of findings that help to better understand the transaction costs associated with collaboration within the Cuyahoga River AOC and guide the subsequent design of strategies for overcoming those costs. While results from this study seek to provide information to decision-making within the advisory committee, they also contribute to the literature in the fields of ecological economics, policy design and analysis, and collaborative watershed management.



#### 4.1. Efficiency

Results from this study indicate that employing the best available technology to organize events and disseminate information can improve efficiency among the advisory committee. This adds to our understanding of the growing role that technologies play in transaction costs associated with environmental policy design and implementation (McCann, 2013). Committee members cite desired technical improvements to the way that meetings and AOC events are organized, meeting agendas are created and distributed, and notetaking during meetings occurs. For example, committee members suggest that the minutes of meetings should be created and posted promptly, and the record should include notes from the chair of the advisory committee and highlight important information that provides action items. These actions address concerns that Reed (2008) and others (Sabatier et al., 2005) have expressed regarding the extra time and money needed to facilitate the collaborative process. Employing the best available technology helps improve not only temporal efficiency through the instantaneous dissemination of information, but also fiscal efficiency by reducing costs associated with in-person meetings and the use of paper documents for planning and outreach purposes. Such findings related to technologies and transaction costs contribute to calls from new institutional economists to decrease transaction costs by fostering technical change (McCann, 2013). What this study does not explore are the potential added costs associated with learning how to use new technologies. Although embedded in the information technology literature (Cordella, 2001), this represents an innovative area where future research on collaborative watershed management could be extended.

#### 4.2. Equitability

Results of this study also align with the literature on ecological economics indicating that transaction costs can occur due to the way information is collected and used for administration and implementation (Coggan et al., 2010). Interview data indicate that supporting new committee members with an orientation and/or mentor to clearly define formal and informal committee rules would help reduce information costs. This would also alleviate information asymmetries among members and explain how the advisory committee and subcommittees work, where information on management actions is stored, what the expectations are for committee participation, where opportunities for participation exist, and what the differences in scope and oversight are between the advisory committee and the facilitating organization. Such results echo findings from Ostrom (2009) that show how information sharing influences the equitability and inclusiveness of collaborative governance arrangements. Addressing limitations in information sharing has helped to avoid conflicts in similar cases (Borisova et al., 2012; Lubell et al., 2017), as well as to adapt management strategies within socioecological systems to address concerns with free riding and path dependency (Imperial and Yandle, 2005).

Interview data further indicate that committee members want equal access to detailed information on management action plans, specifically with a real time online dashboard. Committee members further believe this would help prevent path dependency and free riding, because all committee members would have the same information on opportunities to contribute, thus encouraging participation and bringing more diverse expertise to decision situations. Prioritizing management actions among all committee members and tracking completed action plans once submitted are seen as vital. These findings extend our understanding of the relationship between information sharing and decision-making processes (Ananda and Proctor, 2013), and imply that equal access to administrative and technical documents can help offset power imbalances in collaborative groups, thus equating to more sustainable group structure and decreased transaction costs of collaboration. Findings from this study also align with previous research on common property theory which demonstrates how watershed management can benefit from improved mechanisms to understand and track management actions and resource use (Kerr, 2007).

#### 4.3. Accountability

Another issue raised by committee members focuses on updating voting procedures and prioritizing management actions. Past studies argue that the voting rights and procedures of watershed management organizations can play a large role in the equitable representation of local voices and development of sustainable management strategies (Blomquist and Schlager, 2005). For the Cuyahoga River AOC Advisory Committee, this would improve accountability by including opportunities for individuals to explain or justify their votes on management actions. Committee members also indicate that accountability could be improved by instituting “blind voting”, so that responses are not affected by path dependency; and accountability could also be improved by inviting the full advisory committee to vote on the prioritization of projects identified on the management action list instead of just subcommittees, as it is now. These findings add richness to a growing body of research on voting procedures suggesting that unsustainable practices, such as limiting voting on actionable items to executive committees or subcommittees, can create barriers to optimal performance of watershed management partnerships (Borisova et al., 2012). Results contribute to this field by exploring how technology can enhance voting procedures, especially as it relates to the alleviation of transaction costs among collaborative watershed initiatives.

#### 4.4. Adaptability

Lastly, this study supports research on the impact of group membership on collaborative outcomes (Hardy and Koontz, 2009; Hardy, 2010), as well as research related to environmental justice in watershed management (O'Neill, 2005; da Costa Silva, 2011). Findings of this study highlight the need to better incorporate underrepresented local communities and high-level decision makers from municipalities, government agencies, and NGOs located within the Cuyahoga River AOC. This is thought to improve adaptability by seeking additional municipal funds to bolster the facilitating organization and enlisting diverse members from underrepresented communities

located throughout the Cuyahoga River AOC to join the advisory committee. Inviting higher-level decision makers from each representative organization to participate in the governance of the Cuyahoga River AOC Advisory Committee would also increase social capital among committee members and create a clearer pathway to institutional resources which are vital to the advisory committee's success, but inviting higher-level decision makers might also contribute to existing time and decision-making costs. These costs are justified if the underrepresented communities within the AOC can gain access to higher levels of institutional resources, thus creating positive feedback loops that increase diverse participation and funding opportunities for restoration. The empirical research by Scott (2016) indicates that the attributes of a collaborative committee can help to predict its ability to achieve its goals. Sabatier et al. (2005) went a step further and suggested that actors will be more likely to join a collaborative group if they perceive there will be tangible benefits of their effort. In turn, by inviting a more diverse and impactful group of actors to contribute, committee members hope for added resources, more equitable decision-making processes, and better-informed management actions.

## 5. Conclusions

This research seeks to better understand the collaborative decision-making processes of the Cuyahoga River AOC Advisory Committee in relation to the restoration of the Cuyahoga River AOC. Results suggest that transaction costs to optimal institutional performance within the advisory committee stem from: (1) perceived inefficiencies in sharing information and coordinating activities; (2) asymmetrical levels of institutional knowledge among members regarding the committee's history, mission, and goals; (3) questions about the accountability of voting processes and individual committee members' contributions; and (4) a desire to better incorporate underrepresented populations in AOC decision-making and explore innovative restoration strategies.

Interviews with the members of the Cuyahoga River AOC Advisory Committee help to identify opportunities to reduce transaction costs and improve the advisory committee's efficiency, equity, adaptability, and accountability. Feedback from the committee members includes employing best available technology to organize AOC events and disseminate information, supporting new members with an orientation and/or mentor that explains how the advisory committee and subcommittees work, assuring equal access to detailed information on management action plans, updating voting procedures and the prioritization of management actions, and incorporating underrepresented local communities and high-level decision makers from municipalities, government agencies, and NGOs located in the Cuyahoga River AOC.

These recommendations can also inform the direction of future research on transaction costs of collaboration. In this study, the ability of technology to reduce information costs is seen as an important consideration, but what about the added costs of learning how to use new technologies? Could the learning curve be so steep that adopting the best available technologies decreases efficiency in some cases? Another important set of questions deal with voting procedures. For example, how do voting procedures impact the equitability of decision-making processes? A final area that merits further investigation is the impact of group membership. Can heterogeneity among committee members increase social capital and access to institutional resources?

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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