

Analyzing interdisciplinary research team development at the 2024 Kansas Water Institute  
CoSearch competition

by

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## **Abstract**

Water is inherently interdisciplinary, and it is one of the most urgent and complex challenges for the state of Kansas. Addressing such issues requires collaboration that crosses disciplinary boundaries. In response to this need, Kansas State University's Kansas Water Institute (KWI) hosted CoSearch, a two-day interdisciplinary research competition focused on the theme of water. The event was designed to catalyze collaboration and accelerate ideation. This study examined how interdisciplinary teams formed during the 2024 KWI CoSearch event.

The purpose of this qualitative research was to explore how interdisciplinary collaboration unfolds within a structured event and to identify patterns that influence progress. Guided by Tuckman's (1965) Stages of Group Development, this study aimed to better understand the dynamics of interdisciplinary collaboration. Semi-structured interviews were conducted with 13 participants from the four teams that competed in KWI's CoSearch, representing faculty from ten departments across Kansas State University. The interview data were analyzed using open, axial, and selective coding to uncover themes describing how teams evolved and the patterns that supported their progress.

Findings revealed evidence of all five of Tuckman's stages, though development was more fluid than linear. Teams developed and progressed through cycles of Forming, Storming, and Norming as they learned to navigate disciplinary differences and establish shared understanding. By the Performing stage, teams demonstrated cohesion and synergy, enabling high productivity. The Adjourning phase brought divergent outcomes. The winning team continued their research due to seed funding, while others dispersed, highlighting how external incentives influence sustainability.

Four unique patterns emerged for the KWI CoSearch teams' interdisciplinary progress: recognition of the value of diverse expertise, ownership of the project, collaboration catalysts, and focused attention. These findings suggest that successful interdisciplinary collaboration depends not only on enthusiasm and shared purpose but also on tangible support and opportunities for sustained engagement. This study contributes to the growing body of literature on interdisciplinary team development and offers practical insights into how structured events like CoSearch can foster collaboration, accelerate innovation, and help institutions of higher education fulfill their interdisciplinary research endeavors.

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## **Chapter 1 - Introduction**

In the Fall of 2024, faculty, students, and professionals from across Kansas State University filed into a conference room with little more than open minds and shared curiosity. They came from fields as wide-ranging as agriculture, veterinary medicine, hydrology, chemistry, mathematics, and nanotechnology; they were united by one pressing issue, water. Over the course of the weekend, they would form teams, pitch ideas, and pursue the challenge; how can collaborative research help solve the complex water issues facing Kansas? This was CoSearch, an interdisciplinary research competition designed to catalyze collaboration and accelerate ideation. What unfolded that weekend was a glimpse into the future of collaborative academic research.

### **Background and Setting**

Kansas faces severe water challenges across the state. The Kansas Water Plan (KWP) serves as evidence of the diverse water issues stakeholders are working to address including groundwater depletion, sedimentation, water quality and climate variability (Kansas Water Office, 2022). The management of water resources is a historically interdisciplinary problem and because water does not fall neatly within the boundaries of a single academic department or discipline it requires diverse expertise working together to solve problems that arise (R. M. Vogel et al., 2015).

As Kansas' original land-grant institution, Kansas State University is uniquely positioned to lead problem-solving that directly benefits the state. Kansas State University (2023) recognized a need to focus on interdisciplinary research when launching the University's Next Generation Land Grant Strategic Plan 2030, specifically in Imperative 4:

We will grow our research enterprise and annual research expenditures to \$300 million and our faculty initiated competitive awards to \$270 million with a strong focus on conducting world-renowned, problem based interdisciplinary research that solves grand challenges and makes transformative impacts (p. 9).

The opportunity agenda in the strategic plan also highlights sustainability and focuses on water resources (Kansas State University, 2023). To support this vision, the university elevated the existing Kansas Water Resources Institute, established under the 1964 Water Resources Research Act, by creating a new university-level interdisciplinary institute focused on collaborative research, teaching, and engagement (*About the Institute*, n.d.). The Kansas Water Institute (KWI) officially launched in 2023 and works to elevate collaborative research, teaching, and engagement focused on the five guiding principles of the Kansas Water Plan (*About the Institute*, n.d.). As part of this initiative, the KWI hosted an interdisciplinary research competition, called CoSearch, focused on water, in hopes of catalyzing new collaborations that might lead to answer the pressing water questions Kansas faces.

KWI's CoSearch event took place in October 2024 and was facilitated by the CoSearch model's developer, Dr. Michael Burns. CoSearch was designed to bring together individuals from diverse disciplines to create innovative, research-based solutions for real-world problems (Burns, 2017). While aspects of the structure of CoSearch may have influenced collaboration, this study does not evaluate the program itself. Rather, CoSearch serves as the context through which researchers studied the processes of interdisciplinary team development and collaboration.

## **Significance of the Study**

Kansas State University is not alone in recognizing that interdisciplinary collaboration is a cornerstone of innovation with the potential to deliver solutions to complex problems (Porter et al., 2006). While the importance of interdisciplinary research is well established, creating and sustaining such collaboration in practice remains a challenge (Hall et al., 2018; Leahey et al., 2017). This research project examines the formation and development of interdisciplinary teams through the lens of CoSearch. By studying how teams form, collaborate, and generate ideas, this study aims to better understand what makes interdisciplinary work successful. This study not only aligns with Kansas State's strategic goals but also contributes to a growing body of knowledge about how we can solve some of our most pressing challenges, starting with water.

This study used Tuckman's (1965) Stages of Group Development as a framework to explore how interdisciplinary teams evolved during KWI's CoSearch. Tuckman's model emphasizes that effective collaboration requires progression through identifiable phases of relationship and task development. When applied to interdisciplinary contexts, the framework provides a useful lens to examine how teams balance the interpersonal and task-oriented challenges of coming together across disciplines (Wang et al., 2019).

Despite growing institutional support for collaboration (Sá, 2008), there is little known about how interdisciplinary research teams form and function in real time. This gap makes it difficult for institutions to effectively support, design, and scale interdisciplinary initiatives (Cummings & Kiesler, 2011). This study begins to address the problem by examining patterns and developmental stages of interdisciplinary research teams formed during KWI's CoSearch.

## **CoSearch Model**

CoSearch is a collaborative research competition designed by Dr. Michael Burns to accelerate interdisciplinary collaboration and idea generation in academic settings. Developed in response to the slow and siloed nature of traditional research, the model creates a fast-paced environment where individuals from diverse disciplines work together to develop actionable research proposals in two days. The goal of CoSearch is to catalyze new partnerships that might not have formed under conventional circumstances. The hope of CoSearch is for teams to generate project ideas that address real-world challenges and are capable of securing funding (Burns, 2017).

The Kansas Water Institute hosted CoSearch to spark collaboration around water-related research. While water was the theme of this event, a theme is not necessary. Other CoSearch events have taken place with no theme, only the goal of bringing together professionals to create interdisciplinary research proposals (M. Burns, personal communication, 2024).

During personal communication, Dr. Burns (2024) explained that the CoSearch model was inspired by John Dewey's problem-solving process and the design of startup weekends and hackathons. Dewey's model of reflective thinking emphasizes defining a problem, brainstorming solutions, testing ideas through experience, and reflecting on the outcome (Dewey, 1998). This approach mirrored in CoSearch's process of ideation and refinement. Likewise, startup weekends and hackathons share CoSearch's emphasis on collaboration under time constraints, creativity, and tangible results. The event also draws from interdisciplinary team-science research, which highlights that collaboration flourishes when diverse perspectives are intentionally integrated through dialogue, mutual respect, and shared purpose (personal communication, M. Burns, 2024).

## **CoSearch Structure and Execution**

The KWI CoSearch event follows a structured but adaptable process that can be replicated at other institutions interested in fostering interdisciplinary collaboration. Below is a framework for implementing a CoSearch event. The researcher used previous event materials, personal communication with Dr. Burns and personal experience to create the below comprehensive overview of CoSearch's Structure:

### **Day 1: Ideation and Team Formation**

1. Welcome and Introduction
  - a. The event opens with an introduction by the event hosts with an introduction of the facilitator, who explains the purpose of CoSearch.
  - b. Participants introduce themselves, including their research focus and a fun fact, so everyone in the room is familiar with who is present.
2. Icebreaker Activities
  - a. Attendees participate in a round of "speed dating" that introduces participants to the network of collaborators in the room.
  - b. A lighthearted "worst research idea" exercise helps participants step outside their comfort zones and engage creatively.
3. Idea Pitching and Selection
  - a. Participants propose research ideas they are interested in pursuing.
  - b. Student volunteers record, synthesize, and display these ideas on flip charts.
  - c. A voting process using sticky notes on the flipcharts allows participants to select the most compelling research topics.

- i. In round 1, each participant casts three votes. Ideas receiving no votes are eliminated.
    - ii. In round 2, each participant cast one vote. Ideas receiving no votes are eliminated.
  - d. Final teams are formed around the highest-ranked research ideas, typically consisting of 4-6 members.
4. Team Strategy and Initial Planning
- a. Once teams form, they move to a private, designated collaboration space to develop their research proposals.
  - b. Teams outline research objectives, methodologies, potential impact, preliminary timelines, and a budget.
  - c. The evening session introduces research mentors who provide feedback, challenge assumptions, and help refine ideas.

## **Day 2: Research Development and Pitch Preparation**

5. Continued Team Collaboration
- a. Teams reconvene and continue refining their research concepts.
  - b. Research mentors may return to offer additional guidance on methods and feasibility.
6. Presentation Coaching
- a. Communication coaches work with teams to develop compelling research pitches.

- b. Communication coaches are briefed on the CoSearch process prior to meeting with their assigned group, so they have the information they need to help their team succeed.
- c. Teams finalize their slide decks and practice articulating their proposals effectively.

#### 7. Final Pitch Competition

- a. Each team presents their research idea to a panel of judges, typically composed of university administrators, community stakeholders, and funding representatives. The number of judges will vary, but they typically consist of 3 or 5, so there is a tie-breaker.
- b. Pitches are limited to five minutes, followed by a brief Q&A session.
- c. Judges deliberate and select a winning project, which receives funding to advance the research.
- d. Although only one team will be declared the winner, all participating teams are encouraged to seek additional funding opportunities to support their research efforts.

#### 8. Networking and Celebration

- a. A post-event gathering provides a space for continued networking, potential research partnerships, and informal discussions about next steps.
- b. The event fosters long-term collaboration beyond the competition itself.

### **Key Considerations for Replicating CoSearch**

The following description of key considerations for replication of CoSearch is drawn from the researcher's personal experience facilitating and helping host the 2024 Kansas Water

Institute CoSearch event, consultation with others involved in organizing the program, and personal communication with Dr. Burns. Several elements should be considered if seeking to implement a CoSearch. First, diverse participation is essential; the success of the model depends on bringing together individuals from a wide range of disciplines. This will be dependent on how and to whom the event is marketed. Equally important is maintaining a clear structure that provides direction but still allowing flexibility to adapt to institutional needs and available resources. Skilled facilitation, such as Dr. Burns, ensures smooth execution and helps sustain a collaborative tone throughout the event. The inclusion of research and communication mentors further enhances the quality and practicality of proposed projects by offering guidance and constructive feedback. Finally, providing seed funding or administrative support following the event encourages teams to continue their collaborations beyond the competition, turning short-term ideation into long-term interdisciplinary partnerships and is a valuable recruitment tool.

### **Research Purpose and Objectives**

The purpose of this research is to uncover patterns that can improve how institutions support interdisciplinary collaboration in research settings. Interdisciplinary research is essential for addressing today's complex challenges, yet little is known about how interdisciplinary teams form, develop, and succeed within structured research competitions like CoSearch. The following objectives guide this study.

1. Explore how interdisciplinary teams progress through the lens of Tuckman's Stages of Group Development.
2. Identify patterns that impact interdisciplinary progress when participating in CoSearch.

## **Chapter 2 - Review of Literature**

### **Introduction**

Researchers have frequently adopted interdisciplinary research as an approach to solving complex challenges that exceed the scope of a single discipline (Cummins et al., 2018; Hall et al., 2012; Lang et al., 2012; Owan et al., 2024; Poole et al., 2004; Stokols et al., 2008; Vogel et al., 2014). CoSearch, an interdisciplinary research competition designed by Dr. Michael Burns, provides a structured yet flexible environment where researchers from diverse disciplines come together to develop interdisciplinary research projects while leveraging their unique expertise. CoSearch accelerates ideation, team formation, and project development within a two-day event, culminating with a pitch before a panel of judges who award funding to the most promising project (Burns, 2017). Looking at the literature on interdisciplinary research and group formation, there is an opportunity to use the CoSearch framework to examine and refine the group formation process as it applies to interdisciplinary research.

### **Conceptualizing Interdisciplinarity**

The terms interdisciplinary, multidisciplinary, cross-disciplinary, and transdisciplinary, although often used interchangeably in academia (Nancarrow et al., 2013; Townsend et al., 2015), carry distinct meanings that can influence how research is structured and understood. Nissani (1995) was among the first to define these terms and used a fruit metaphor to illustrate the conceptual boundaries. He described individual disciplines as distinct fruits, such as apples or oranges, served separately. He likened multidisciplinary work to a fruit salad, bringing together components from different disciplines while allowing each to retain its individual identity. Interdisciplinary work resembles a smoothie, blending elements from various disciplines into a unified product (Nissani, 1995). Austin et al. (2008) extend this metaphor by imagining

transdisciplinary research as the creation of an entirely new dessert where you can no longer distinguish the differing parts.

Despite attempts to clarify distinctions, the literature reveals that these terms are used inconsistently (Hall et al., 2012; Newman, 2023). Townsend et al. (2015) found that university researchers frequently struggled to differentiate between multidisciplinary and interdisciplinary approaches. Similarly, cross-disciplinary research is sometimes described as borrowing methods between disciplines without integration (Gardner, 2013), while in other contexts, it serves as an umbrella term synonymous with interdisciplinary research (Stokols et al., 2008; Townsend et al., 2015). The term team science is described as overlapping with interdisciplinary science (Stokols et al., 2008).

Given the fluidity in terminology in the literature and the challenge of maintaining definitional boundaries across different studies and institutions, this study uses the term interdisciplinary as an umbrella term encompassing multidisciplinary, transdisciplinary, cross-disciplinary, and team science. It broadly refers to research that involves the participation of individuals from two or more different academic or professional disciplines working toward a shared research endeavor. Giving interdisciplinary research a definition makes the concept more accessible and lays a foundation to establish what skills are needed to successfully engage in interdisciplinary work (Jones, 2009).

### **Shift Toward Interdisciplinary Collaboration**

A shift towards collaborative research reflects a fundamental change in how knowledge is generated. This trend has been observed across a variety of fields including the sciences, engineering, social science and arts and humanities (Fiore, 2008; Wuchty et al., 2007). The necessity of teamwork is a result of exponential growth in knowledge that has forced researchers

to become increasingly specialized (Jones, 2009). Universities and funding agencies have responded by creating organizational structures, policies, and seed grants to encourage interdisciplinary research (Bennett & Gadlin, 2012; Sá, 2008).

Growth in teamwork is attributed to exponential growth in knowledge which requires greater specialization among researchers and prompts the formation of diverse teams (Wuchty et al., 2007). Fiore (2008) emphasizes that interdisciplinary research is inherently teamwork and the complexity of modern scientific problems requires collaboration across disciplines.

Team-based research enables integration across specialized expertise. Wuchty (2007) found that research teams produce articles that are more frequently cited than research produced by solo authors. This citation advantage has grown over time as teams continue to produce high impact research. Porter and Rafol's (2009) study confirms that science is becoming more interdisciplinary, reporting a 50% increase over three decades in the number of cited references and disciplines per article. However, metrics designed to measure the integration of disciplines suggest a more modest 5% growth. The article explains that while researchers are citing a broader variety of research fields, the knowledge still comes from neighboring disciplines (Porter & Rafols, 2009). This incremental growth shows the practical and cognitive limits of integration, illustrating that interdisciplinarity, while desired, remains difficult to operationalize.

While many recognize the innovation emerging from interdisciplinary collaboration and view it optimistically (Lee & Shipe, 2014; McCance & Blanchard, 2024; Owan et al., 2024) others remain skeptical about its impact. Critics argue that the value-added contributions of interdisciplinary work may not become evident for several decades and are challenging to compare against those yielded by smaller-scale, single-discipline projects (Stokols et al., 2008). Some research even suggests that interdisciplinary collaboration is less disruptive than single

discipline research, contradicting the belief that such collaborations yield groundbreaking innovations (Liu et al., 2023).

Evidence from Leahey et al. (2017) reinforces this skepticism, revealing that while interdisciplinary researchers enjoy higher visibility through citations, they tend to publish fewer articles overall. Analyzing data from nearly 900 scientists and over 32,000 published articles, their study highlighted the benefits and penalties of interdisciplinary research. Specifically, they found a notable production penalty associated with engaging in interdisciplinary work, indicating that the productivity costs often outweigh the potential visibility benefits (Leahey et al., 2017). This finding shows the high-risk, high-reward nature of interdisciplinary research, suggesting that despite its potential long-term value, it comes with tangible challenges that complicate the assessment of its immediate impact compared to single-discipline efforts. Consequently, there is research now focusing on developing best practices that enhance productivity and collaboration effectiveness.

### **Barriers to Interdisciplinary Work**

Interdisciplinary collaboration holds the potential for advancing knowledge and solving complex problems, yet research suggests that it faces barriers that can limit its success. These challenges stem from disciplinary differences, communication gaps, institutional structures, and interpersonal dynamics (Aboelela et al., 2007; Bennett & Gadlin, 2012; Gardner, 2013; Hall et al., 2012; Vogel et al., 2014).

Ghamgosar et al. (2023) identified 42 barriers and 148 facilitators to team science, categorizing them through a Human-Organization-Technology (HOT-fit) model, confirming that interdisciplinary challenges are multifactorial and interdependent. Some human barriers identified included differing philosophies and styles of research that directly reinforce existing

disciplinary divides. This mirrors earlier findings that researchers from different fields, particularly when comparing "hard" sciences to "soft" sciences, may encounter philosophical obstacles related to differing perspectives on research problems (Feng & Kirkley, 2020b; Gardner, 2013). This study gives context for understanding why many of the other barriers discussed below emerge simultaneously.

A fundamental barrier to interdisciplinary work stems from disciplinary differences. Each academic discipline has its own language, fundamental concepts, and common terminology (Austin et al., 2008). Successful interdisciplinary research demands that collaborators dedicate time and effort to integrate concepts, theories, and methods, often requiring investigators to move outside their disciplinary comfort zones (Hall et al., 2012; Vogel et al., 2014). Integration requires developing a methodological understanding of both their own and other disciplines to address the problem at hand which is referred to as a "critical awareness" (Hall et al., 2012, p. 419).

Cummings and Kiesler (2008) found that even when shared goals and understanding exist, geographical distance and disciplinary diversity reduce collaborative strength. However, they also showed that prior collaboration experience mitigates these effects. Their findings illustrate that successful interdisciplinary teams depend not only on intellectual alignment but on structural conditions that enable sustained interaction (Cummings & Kiesler, 2008).

Working across disciplines and bridging conceptual gaps is difficult because academic specialization can lead to the development of "monodisciplinary dialects" (Cummins et al., 2018, p. 437). A study by Cummins et al. (2018) surveyed gastroenterologists and engineers involved in interdisciplinary health research. The group identified obstacles, including communication difficulties caused by specialized terminology and understanding differing

priorities between disciplines. This “monodisciplinary dialect” made communication difficult to clearly get their points across (Cummins et al., 2018, p. 437). The effort required to grasp ideas and perspectives from a distant field is cognitively taxing and reduces productivity (Leahey et al., 2017). Meaningful collaboration becomes difficult when researchers do not share a common language.

Effective communication and exchange of knowledge is paramount to the success of an interdisciplinary team (Aboelela et al., 2007; Hall et al., 2012; Haythornthwaite, 2006). Successfully navigating communication challenges takes time to learn factual knowledge, but also to learn processes, methods, and technologies in order to engage in the research (Hall et al., 2012; Haythornthwaite, 2006). Haythornthwaite's (2006) study examined learning exchanges within three interdisciplinary teams, found that team members reported learning facts, processes, and methods from one another help them better engage in the research. Learning is accomplished through effective communication and knowledge exchange (Haythornthwaite, 2006).

Tkachenko and Ardichvili (2020) expand this argument by identifying 17 factors influencing interdisciplinary teams, including incorrect assumptions about members' skills and traditional views on research roles. Their findings highlight the need for training that addresses both technical and interpersonal team skills.

Teams frequently experience difficulties related to interpersonal dynamics, particularly concerning conflict, trust, and power imbalances (Bennett & Gadlin, 2012). Building and sustaining trust is essential for effective team functioning, as dependence when conducting research together creates vulnerability which, without trust, leads to defensive rather than collaborative action (Bennett & Gadlin, 2012; Hall et al., 2018). Problems around power and disciplinary differences can hinder effective collaboration and diminish mutual respect among

collaborators (Cummins et al., 2018; Gardner, 2013). The goal for productive interdisciplinary research is not to eliminate disagreement, which is important for innovation, but to manage the conflict constructively and ensure that debate focuses on scientific issues rather than personal attacks.

Conflict is a known barrier to small group work. While it can prevent success, it also acts as a powerful driver of innovation. For integrated research teams, encouraging disagreement while managing conflict is vital for success (Bennett & Gadlin, 2012). Jehn and Mannix (2001) illustrated that intragroup conflict is dynamic and influential for team performance through quantitative analysis of task, relationship, and process conflicts. They suggested that conflict can sometimes hinder performance, but when managed correctly, it is beneficial for group performance and can create opportunities for creative problem solving (Jehn & Mannix, 2001). Yean et al. (2024) conducted research targeting university students engaged in collaborative group work, specifically the experiences and outcomes related to conflict during the stages of Tuckman's model for group development (Tuckman, 1965). Based on Tuckman's (1965) group development model, their analysis of survey data indicated that conflicts, particularly in the early "Storming" phase, have a minimal impact on the subsequent "Norming" stage and that progression through the stages (including conflict resolution) is essential for achieving a high-performing team (Yean et al., 2024). Collectively, these findings illustrate that conflict plays a crucial role in shaping team experiences and can be the vessel that propels research and teamwork to new heights.

Disciplinary status and hierarchy further complicate interdisciplinary work. Gardner's (2013) qualitative study which involved interviewing 25 faculty members engaged in a sustainability science project, sought to understand how paradigmatic differences influenced

interdisciplinary efforts. By analyzing interview data, the study identified themes highlighting these differences and the challenges interdisciplinarity presented to faculty. Hierarchical structures and power dynamics influenced collaboration effectiveness, reinforcing the need for more examination of these dynamics to improve interdisciplinary research practices.

### **Conditions for Success**

Despite the challenges in interdisciplinary collaboration, researchers have identified several enablers that foster success. Proximity is crucial in enhancing teamwork, as researchers in close physical spaces can more easily communicate and develop shared goals (Hall et al., 2018; Olson & Olson, 2000). McCance and Blanchard (2024) conducted a quantitative study investigating the perceptions of U.S. faculty, staff, postdocs, and graduate students involved in collaborations between education and science/engineering disciplines. Their study found that positive perceptions of collaboration and interdisciplinarity among scientists, engineers, and educators have a significant correlation with a collectivist orientation, suggesting that a predisposition toward teamwork helps foster successful interdisciplinary environments. Positive perceptions among faculty, staff, and graduate students also facilitate collaboration, reinforcing that a collectivist approach enhances research outcomes (McCance & Blanchard, 2024). Cummings and Kiesler (2008) further emphasize that prior collaboration experience builds a shared foundation that mitigates distance and disciplinary barriers, highlighting the value of repeat partnerships for team success.

Institutional leadership and administrative support are essential in overcoming structural barriers and providing the necessary resources and policies to promote interdisciplinary initiatives (Townsend et al., 2015). High levels of integration, communication, and interaction within teams are fundamental to effective interdisciplinary research, as they contribute to

developing trust and shared understanding (Bennett & Gadlin, 2012). The exchange of knowledge across disciplines further strengthens collaboration, demonstrating that interdisciplinary work thrives when researchers actively share insights and methodologies (Feng & Kirkley, 2020a, 2020b; Haythornthwaite, 2006). Adaptive leadership has been highlighted as a key factor in navigating interdisciplinary challenges, ensuring that teams remain flexible and responsive to evolving research needs (Newman, 2023).

Together, these illustrate how institutions and researchers can work to mitigate barriers and create an environment where interdisciplinary collaboration flourishes.

### **Tuckman's Stages of Group Development**

To better understand the dynamics of interdisciplinary research teams, Tuckman's Stages of Group Development (1965; 1977) provides a valuable theoretical framework for examining how teams form and evolve. His framework emerged from synthesizing prior research and his own observations. Tuckman identified four stages of group development, Forming, Storming, Norming, and Performing. He believed these phases were fundamental and inevitable for teams to grow, resolve conflicts, structure their work, and accomplish goals (Tuckman, 1965). In 1977, Tuckman and Mary Ann Jensen revisited the model and introduced a fifth stage, Adjourning, to account for the conclusion of a team's work, thus completing the framework (Tuckman & Jensen, 1977).

Tuckman's framework distinguishes between two simultaneous aspects of a group's existence: the group structure (i.e. interpersonal realm) and the task activity (i.e. task realm). The interpersonal realm focuses on the members' interpersonal configuration and behaviors meaning the way they act and relate to one another as social entities. The task realm concerns the actual content of the members' interactions as related directly to achieving the task at hand. Though the

content of interaction differs between these two realms their developmental dynamics are considered similar (Tuckman, 1965). The following stages are defined as follows:

1. Forming: In the Forming stage, the primary concern is with orientation and initiating the group structure. Members engage in testing to discover what is acceptable within the group, while simultaneously exhibiting dependence on the leader, powerful members, or existing norms for guidance and support in the unstructured situation. Members attempt to define the task, identify its relevant parameters, and decide how the group will use its experience to accomplish the objective. This involves discovering the "ground rules" for the task. Quite a bit of uncertainty exists at this stage (Tuckman, 1965).
2. Storming: The Storming stage is characterized by conflict. Hostility can be common, as members struggle over power and resist group structure, leading to a lack of unity in the interaction. This stage serves as resistance to advancing into the "unknown" of interpersonal relations (Tuckman, 1965, p. 386). Members react to the task, which serves as a form of resistance to the burdens the task imposes on the individual. This stage is particularly evident when the task involves self-understanding or self-change (Tuckman, 1965).
3. Norming: The Norming stage focuses on overcoming resistance and developing unity. The group becomes cohesive as members accept the group and each other's individual differences. Group-generated norms are established that create harmony and the team avoids conflict but still discusses freely (Tuckman, 1965).
4. Performing: This is where the group attains a functional structure that enables productivity. Issues are largely resolved, allowing the group structure to become a

tool for completing tasks. Roles become flexible and functional and the group energy previously spent on resolving structural issues is now directed fully toward the task (Tuckman, 1965).

5. **Adjourning:** This final stage was added later to account for the process of separation and termination. This marks the conclusion of the team's project or mission, and members may experience a sense of accomplishment or sadness due to the ending of group relationships (Tuckman & Jensen, 1977).

Quantitative methods have been used to study and validate aspects of Tuckman's model of group development. Miller (2003) developed the Group Process Questionnaire (GPQ), a retrospective instrument designed to efficiently measure changes in group processes, while Tyne et al. (2023) provided initial validity and reliability evidence for the Tuckman Team Development Questionnaire in first-year engineering student design teams. These studies demonstrate the ongoing effort to operationalize and test the constructs of Tuckman's framework, reinforcing its enduring relevance as a foundation for examining team dynamics.

While this model has been extensively used to understand teamwork in various settings (Bonebright, 2010), its application to interdisciplinary research teams is limited. Interdisciplinary work is inherently teamwork (Fiore, 2008), therefore, it is appropriate to look at a foundational development model like Tuckman and Jensen's model (1965; 1977) to evaluate its application to interdisciplinary team development. While some studies on interdisciplinary teams have referenced Tuckman's work (Bennett & Gadlin, 2012; Fritz et al., 2005; Wang et al., 2019) the actual testing of its application is limited.

One study conducted by Fritz et al. (2005) supports the fit of the model to interdisciplinary team development. In a case study of a multi-disciplinary, multi-institutional

team of faculty, the development process was found to mirror Tuckman's (1965) stages. During the study, the early stages (Forming and Storming) involved managing typical group doubts and uncertainties, while later stages (Norming and Performing) were marked by increasing trust and camaraderie (Fritz et al., 2005).

Tuckman's model has been widely adopted because of its predictability and the roadmap it provides is a simple and straight forward way to make sense of what individuals observe in their experience on a team (Bonebright, 2010). The model has been also criticized for assuming that groups follow an inevitable, universal linear progression. Critics suggest that development may be far more complex and contingent upon external factors and contexts (Benfield, 2005).

Relying on a sequential model overlooks the role of external factors and context suggesting that development may be far more complex than linear progression (Benfield, 2005; Bonebright, 2010). This limitation has led to the emergence of alternative, nonsequential models that emphasize time, structure and the movement between phases, such as Gersick's Punctuated Equilibrium Model (1988), which offer a more dynamic understanding of how groups evolve. While each model offers valuable insights, direct comparisons between them are often difficult and sometimes inappropriate because they emphasize different aspects of group development and are shaped by varying contextual influences. Chidambaram and Bostrom (1997) explain that sequential models primarily describe how groups develop, the observable stages and patterns, whereas nonsequential models focus on why development occurs, emphasizing the situational and environmental factors that drive change. Although sequential models tend to assume a predictable progression, nonsequential approaches account for contingency and contextual variability, highlighting that development is fluid rather than fixed. In this way, the two

perspectives are not incompatible but instead provide complementary ways of understanding group processes (Chidambaram & Bostrom, 1997).

Tuckman's stages of group development serve as a starting point to observe patterns in KWI's CoSearch that will help create a clearer picture of interdisciplinary team development. Applying Tuckman's model to assess the formation of interdisciplinary teams and analyzing the data collected in these settings could provide valuable insights into optimizing interdisciplinary collaboration.

## **Chapter 3 - Methodology**

### **Introduction**

This chapter describes how the researcher executes this study, including the research design, sample description, and data analysis. This study aims to understand how interdisciplinary teams participating in KWI's CoSearch event develop and evolve, as well as identify patterns that contribute to or hinder interdisciplinary research success.

### **Research Design**

This exploratory qualitative study is grounded in an interpretivist paradigm, which assumes that knowledge is socially constructed and that reality is understood through individuals' subjective experiences (Crotty, 1998). Interpretivism emphasizes understanding human experiences in context rather than seeking objective truths, positioning the researcher as an instrument of inquiry who interprets meaning within participants' lived realities (Thorne, 2025).

Within this paradigm, the study draws on symbolic interactionism as its guiding theoretical perspective. Symbolic interactionism emphasizes that meaning-making is interpretive and that individuals are continuously modifying their understanding based on their interactions (Bhattacharya, 2017). This perspective aligns with the study's focus on how interdisciplinary team members find meaning through interaction and dynamics within the KWI CoSearch setting.

Guided by these philosophical and theoretical foundations, the study employs an interpretive descriptive methodological approach (Elliott & Timulak, 2021; Thorne, 2025). Interpretive description is well suited for exploratory studies seeking to generate practical insights from complex, context-dependent experiences. This methodology enables the integration of collective insights to develop a comprehensive understanding of participants shared and

unique experiences within their institutional and social environments (Thorne, 2025). Special attention is paid to the meanings participants attribute to their collaborative processes.

The chosen methodology supports the investigation of the lived experiences of team members engaged in interdisciplinary collaboration. Interpretive description allows the researcher to integrate collective insights to uncover a comprehensive understanding of participants' shared and unique experiences within their institutional and societal contexts (Thorne, 2025). The researcher has approached this study seeking to uncover meanings and perceptions of the people participating in the research through an interpretive lens.

### **Institutional Review Board**

The Kansas State University Institutional Review Board (IRB) approved this study. The researcher completed all required Collaborative Institutional Training Initiative (CITI) modules before submitting the IRB application. In the original submission, the researcher described plans to administer a post-event survey to collect participant feedback and identify the interview population. The IRB approved the initial application on October 28, 2024. During the following spring, the researcher submitted an amendment to add interview procedures to the protocol, which the IRB subsequently approved. The IRB granted final approval for protocol IRB-12439 on June 13, 2025.

### **Population and Sample**

The population for this study consists of faculty researchers who participated in the KWI CoSearch event. Following the event, a post-event survey was distributed to all 18 participants to gather feedback, identify individuals willing to participate in interviews, and provide the researcher with contextual information about the population. Although the survey collected both event feedback and demographic information as outlined in the IRB protocol, this study uses

only the demographic data. This demographic information serves to enhance the researcher's understanding of the participants while maintaining the primary focus on their lived experiences.

Of the 18 participants, 13 faculty members responded to the survey, and all 13 went on to schedule an interview for this study. Consistent with an interpretive descriptive approach, purposeful sampling guided the inclusion of participants who could provide meaningful insights into the phenomenon of interdisciplinary team development (Thorne, 2025). Capturing the full range of faculty perspectives from those who self-selected into the study strengthens the interpretive depth of the findings. Purposeful sampling is appropriate in qualitative research because its goal is to uncover and understand experiences through information-rich cases, rather than to generalize to a larger population (Merriam & Tisdell, 2015). This sample allows for in-depth exploration of participants' unique perspectives and interactions, aligning with the symbolic interactionist nature of the study.

### **Instrumentation**

The primary method of data collection for this study was semi-structured interviews. This type of interview allows for conversation that has structure and purpose while maintaining flexibility (Merriam & Tisdell, 2015). The interview protocol, provided in Appendix E, outlines a list of 17 open-ended questions designed to obtain descriptive data and rich narratives from the participants. The semi-structured nature of the interview means that while there is specific data required from all respondents, there is no predetermined wording or order, and the interviewer is free to probe and explore emerging themes that arise during the conversation (Merriam & Tisdell, 2015).

Miller's (2003) and Tyne et al.'s (2023) surveys inspired the creation of interview questions for objective one, which aimed to explore how interdisciplinary teams progress

through the lens of Tuckman's stages of group development. These instruments were originally designed to gather retrospective qualitative data measuring small group development, which provided a framework for aligning this study's inquiry with Tuckman's model (Miller, 2003; Tyne et al., 2023). This approach keeps the inquiry appropriately framed within Tuckman's stages.

In addition to evaluating Tuckman's framework, the interview questions were structured to allow themes to emerge that addressed the second research objective: identify patterns that impact interdisciplinary progress. The researcher added additional closing questions to specifically address the second objective, allowing the interviewee to reflect on what factors played a role in the success of their interdisciplinary collaboration. This allowed them to share parts of their experience that may not have emerged in the earlier questions.

All the questions were intentionally written as open-ended prompts, allowing the participants lived experiences to emerge organically without leading them in any direction. The researcher prioritized the avoidance of leading questions that could introduce researcher bias or assumptions, ensuring the participants lived experiences emerge without external direction (Merriam & Tisdell, 2015).

Before formal data collection began, the interview protocol was piloted with a nonparticipant to evaluate question clarity and flow. Minor revisions were made based on feedback from this practice interview to improve the wording and sequencing of questions.

## **Data Collection**

All participants ( $N = 13$ ) who indicated interest in being interviewed in the original survey received an email with an invitation to select an interview time through Calendly. The email explained the purpose of the interview and informed participants that their involvement

was voluntary (see Appendix D). The email states that by scheduling an interview, participants are providing their voluntary, implied consent to participate in this research. Interviews were scheduled in one-hour time blocks, with the average lasting approximately 45 minutes. The longest interview lasted 1 hour and 10 minutes, and the shortest lasted 28 minutes. All interviews were conducted via Zoom to facilitate participation, securely record sessions, and provide accurate transcripts for analysis.

At the beginning of each interview, the researcher reminded the participants of the purpose of the study, confidentiality protections, and their right to decline to answer any question or withdraw at any time. Participants provided verbal consent to record the session before the interview began. Each interview was audio-recorded and automatically transcribed through Zoom. Immediately following each interview, the researcher completed reflective journaling to document initial impressions, emerging ideas, and notable themes for later comparison with the coded data.

The researcher downloaded the Zoom meeting transcript and then watched the recording side by side to edit and check for accuracy. Editing the transcript served as the researchers' first opportunity to become familiar with the data (Merriam and Tisdell, 2015). When editing the transcript, the researcher cleaned up the verbatim text by removing some filler words and correcting grammar to enhance readability. This decision was made to prioritize participant dignity and enhance the clarity of the data for verification (Carlson, 2010). This approach allows the participants to verify the meaning and content of their contributions without being distracted by grammatical imperfections or disfluencies. Once edited, participants received a copy of the transcript for member checking to confirm the accuracy and authenticity of their accounts (Lincoln & Guba, 1985). Participants were told how the original document was altered and asked

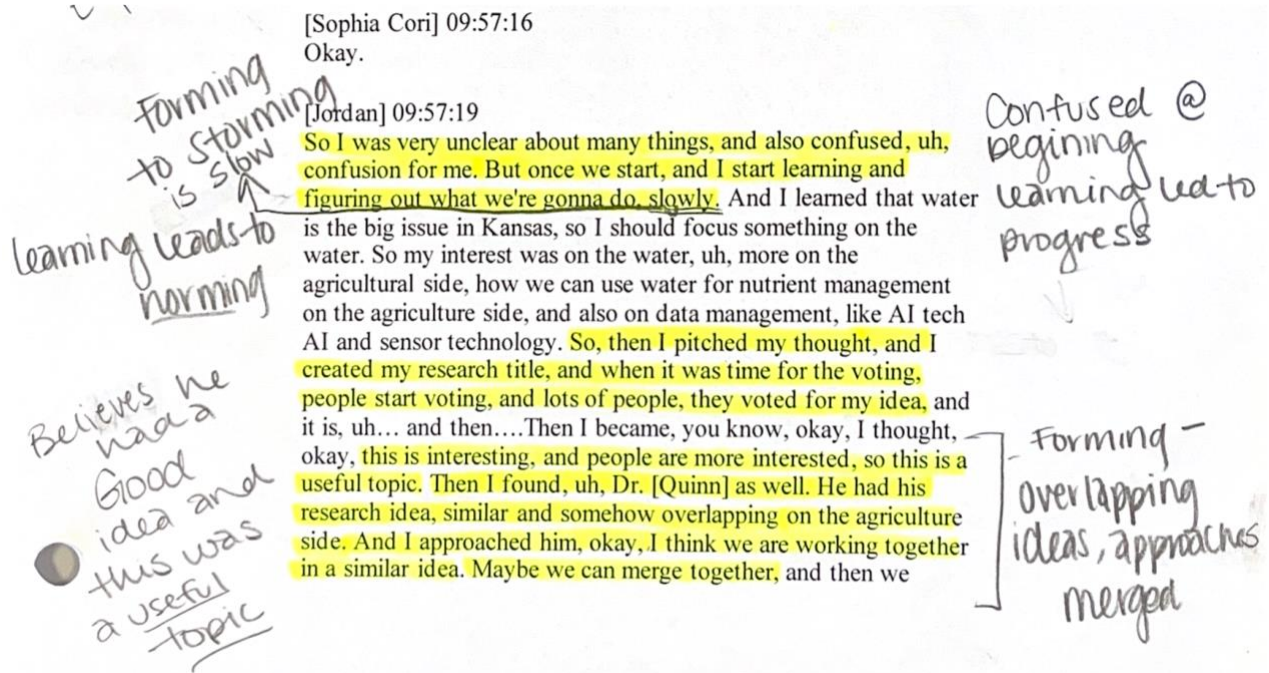
if this data accurately captures their experience and opinions. Any clarifications or corrections suggested by participants were incorporated prior to beginning formal analysis.

## **Data Analysis**

Data coding and analysis in qualitative research is fundamentally rooted in the researcher serving as the primary instrument for both data collection and interpretation, relying on skill and reflexivity to uncover meaning and develop understanding (Merriam & Tisdell, 2015). This study employed an interpretive descriptive approach, which frames analysis as an active, iterative, and inductive process rather than a passive search for emerging findings (Thorne, 2025). The aim was to move beyond description to uncover relationships and patterns in how interdisciplinary teams developed during KWI's CoSearch event.

To begin, transcripts were printed and annotated in order to become deeply familiar with participants' accounts. The researcher had already read through all transcripts during transcription, so in this phase, the researcher wrote analytic memos to capture initial impressions, identify meaningful excerpts, and reflect on connections across participants. An example of these memos can be found in Figure 3.1, which displays an excerpt of the researcher's analytic notes. These memos served as the foundation for developing open codes (Saldana, 2021). Consistent with *The coding manual for qualitative researchers*, coding began broadly, assigning general meaning units and provisional labels rather than rigid categories to avoid premature closure (Saldaña, 2021).

**Figure 3.1. Analytic Memo Example**



All transcripts and memos were uploaded into ATLAS.ti to support the management of codes. Open coding was followed by axial coding, in which connections between categories were identified, refined, and compared across cases. Axial codes are second cycle codes that narrow the initial codes by eliminating redundancy and distinguish what is dominant (Saldaña, 2021). Through constant comparison, the data were examined for both commonalities and variations in participant experiences. Finally, selective coding, also referred to as theoretical coding, allowed the researcher to integrate categories into overarching themes aligned with the study's research objectives (Saldaña, 2021). This final stage allowed the researcher to narrow down to the specific themes that exist within in Tuckman's Stages of Group development and reveal the patterns that exist within interdisciplinary collaboration.

Because this was a team-based event, data were also analyzed within team boundaries. After coding the interviews individually, the researcher grouped the data by team membership to examine how dynamics compared within teams and across the larger event. Tuckman's (1965;

Tuckman & Jensen, 1977) stages of group development (Forming, Storming, Norming, Performing, and Adjourning) served as a framework to identify patterns of team progression, while allowing the data to reveal deviations from the model.

As a participant observer who helped organize the KWI CoSearch event, the researcher recognizes that complete separation from personal context is not possible. Reflexive journaling was maintained throughout analysis to acknowledge biases, track analytic decisions, and ensure credibility. In line with interpretive description, the analytic goal was not to generalize data but to generate an interpretive account that illuminates interdisciplinary team development in an applied setting (Thorne, 2025).

### **Positionality**

I earned my undergraduate degree in Agriculture Education, where I focused on how to connect students to the realities of food production and rural life. I grew up in a community deeply connected to agriculture and was always drawn to the role of education in helping people understand where their food comes from. Through an internship with Central Coast Water Quality Preservation Inc., my interest expanded to include water as a central issue in agriculture. Food cannot be separated from water. The future of agriculture, food security, equity, and sustainability depend on how we manage our water.

My move to Kansas for graduate school deepened my connection to water as a research focus. While working as a graduate student fellow at the Kansas Water Institute, I came to see water as more than a resource, but as a point of intersection between agriculture, the environment, and society. It affects everyone and everything, making it an ideal focus for interdisciplinary research. Working closely with interdisciplinary teams on water issues has strengthened my belief that solving complex problems requires people from many different fields

to work together. I care about this topic because I see its potential to make an impact on academic work. Although I brought enthusiasm for the subject matter and hope that interdisciplinary research efforts are effective, I was committed to approach this data without assumptions. My goal was not to prove a point, but to better understand how teams form, what challenges they faced, and what factors helped or hindered collaboration across disciplines.

My view of research comes from a lens of education, practical application, and storytelling. When designing this study, I built in space for reflection and listening to make sure I did not lead participants toward pre-set ideas but instead allowed them to tell their own stories. I want this work to reflect what really happened in this space, not just what I expected to find.

### **Research Rigor**

Research rigor in qualitative work is established through credibility, transferability, dependability, and confirmability (Trochim, 2001). To ensure credibility, the researcher conducted member checking by sending interview transcripts back to participants for verification, following Lincoln and Guba's (1985) approach. Transferability is supported through thick, rich descriptions that allow readers to assess whether findings apply to other contexts. Dependability is addressed by collecting audio recordings of interviews and typed transcripts. Confirmability was maintained by bracketing the researcher's experiences, documenting data collection and analysis techniques, and reflecting on potential bias through a positionality statement. As a graduate student with the Kansas Water Institute, the researcher recognized the value of interdisciplinary research in addressing complex problems and remained analytical, informed, and transparent in effort to collect and evaluate data honestly.

## **Chapter 4 - Results**

### **Introduction**

This chapter presents the findings from this study, which explored how interdisciplinary teams developed and collaborated during the 2024 Kansas Water Institute (KWI) CoSearch Event. CoSearch is an interdisciplinary research competition designed to bring together faculty, researchers, and graduate students from a wide range of disciplines to form teams, develop research proposals, and pitch their ideas to a panel of judges within a two-day event (Burns, 2017). The competition's structured yet fast-paced format provides a unique opportunity to observe the dynamics of interdisciplinary collaboration as teams move from idea generation to proposal development. The findings in this chapter are organized around the two research objectives guiding the study. Research objective one examines how interdisciplinary teams progressed through Tuckman's (1965) Stages of Group Development, while research objective two identifies patterns that influenced interdisciplinary progress during and after the KWI CoSearch event.

### **Participants**

Participants in this study included 13 of the 18 individuals who competed in the 2024 KWI CoSearch Competition. A post-event survey was administered to collect basic demographic information and identify the sample. The interviewees represented members from all four KWI CoSearch teams, which are referred to as the Orange, Blue, Green, and Purple teams throughout the findings. Collectively, participants represented 10 different departments across the university, spanning both the College of Agriculture and the College of Engineering, as well as other academic divisions. In terms of professional experience, five participants ( $n = 5$ ) had four years or less experience working in academia, three ( $n = 3$ ) had five to nine years, four ( $n = 4$ ) had ten

to twenty-nine years, and one ( $n = 1$ ) had thirty years or more. The sample was predominantly male ( $n = 10$ ), with three female participants ( $n = 3$ ) represented in the total sample.

## **Research Objective One**

Research objective one aimed to explore how interdisciplinary teams who participated in the KWI CoSearch competition progressed through the lens of Tuckman's Stages of group development. Tuckman (1965) explains that the stages of group development have two distinct realms of interpersonal and task behavior. The interpersonal realm reflects how members interact and relate to one another as people, whereas the task realm focuses on the group's collaborative efforts and behaviors directed toward achieving their goal (Tuckman, 1965). Data analysis revealed themes that identified the stage of development each team had reached and described the key characteristics associated with each stage.

In the Forming stage, two themes emerged: (1) alignment around a shared goal and (2) merging of ideas. In the Storming stage, themes included (1) orientation to team members' disciplinary expertise and (2) defining and narrowing the project focus. In the Norming stage, three types of norms were observed, (1) roles and leadership norms, (2) communication and interaction norms, and (3) procedural and task management norms. During the Performing stage, a clear shift toward task execution was observed characterized by the application of lessons from earlier stages, resulting in a singular theme of synergistic productivity. Finally, in the Adjourning stage, some teams disbanded following the event while others pursued continued collaboration, the theme of team dispersal captures both divergent outcomes.

### **Forming**

Forming is the initial stage of group development, characterized by team orientation and the identification of tasks (Tuckman, 1965). As the KWI CoSearch teams began to take shape,

participants entered this stage when they pitched their ideas and selected collaborators. During the process, participants assessed how their expertise could best contribute to a team and worked to establish a shared goal aligned with individual interests. Data analysis revealed two major themes during Forming: 1) alignment around a shared goal and 2) the merging of similar ideas.

### **Alignment around a shared goal**

A factor for team formation was the attraction to a common, overarching goal. Even when specific research ideas or methods differed, participants united around a “big picture” purpose that resonated with their interests. Leo, from the green team, articulated this directly:

Leo: I mean, the idea itself is not similar at all, but the goal was similar, we wanted to develop materials and processes to clean wastewater, yeah so the approaches are different, but what if we combine different expertise together to make a better process and better materials.

Other participants expressed similar sentiments. Avery from the purple team explained that alignment with a common goal was the primary reason she joined her group: “Altogether we all had a similar goal, that's why we went into the same group.” Alex described being drawn to her team because its research focus aligned with her own interests: “I just assumed that probably I should work with these guys, because their research focus is similar to mine.” Collectively, these perspectives suggest that participants were less concerned with pursuing one individual idea than with advancing a shared, collective goal.

Jesse: I think what happened was, we looked around, and when we all talked about what we're doing, what are our interests, research interests were, we immediately took note of those that, in my case, I noticed, and immediately identified folks that had overlapping interests. That was the first point. And while I was doing that, it turned out that the other

folks were doing the same thing. They were saying, oh, who in the room can I talk to?

Who in the room can I collaborate with? Because we all knew that not all 10, 15, I don't recall 16 ideas would make it through. And so, how do we coalesce?

### **Merging of Ideas**

Another common theme across teams was the merging of ideas. Members from the teams described processes of combining or integrating initial pitches into unified team proposals. For example, the orange team repeatedly used the word “merge” to describe their formation. Thomas explained, “Jordan and Quinn and I had all pitched sort of similar things. And we merged. You know, instead of saying, this one's going forward and that one isn't, we just said, we're merging.” Quinn described this as a thematic process, where ideas coalesced into shared categories. Jordan also recalled approaching Quinn directly to merge their efforts: “I approached him, ‘Okay, I think we are working together in a similar idea. Maybe we can merge together?’, and then we discussed.”

The blue team also described merging, though they acknowledged initial challenges in the process. Josh recalled combining his idea with another's to create a stronger project, noting that “at first, when we got to that table, it was very difficult for us to merge the ideas.” Riley described merging as the reason he and another teammate first gravitated toward each other. He said, “Two of us were first standing by the poster because we merged our ideas into one big topic.” Sam emphasized how naturally the group members complemented one another, “We thought, like, hey, we are a good team, you know? Just like we fit each other. That's why we thought, hey, why not merge together.”

The green team described merging ideas and expertise as a strategy to strengthen their proposal. Leo explained, “There was a lot of overlap between our ideas, so we decided, okay,

let's combine them together.” Jesse added that a teammate acted as the group’s “catalyst” by identifying overlaps and introducing members with complementary interests: “Mark came to me and told me that, hey, do you know that this other guy out there also is interested in water. We all need water; we all need some level of purification.”

Together, the findings suggest that KWI CoSearch team formation was characterized by alignment with overarching goals and the merging of multiple individual ideas. These processes created teams that were united in purpose.

### **Storming**

After the teams established their main goal, they moved into the Storming phase. This phase is marked by conflict (Tuckman, 1965). For all three teams, conflict surfaced in the form of needing to take the time to understand each other’s disciplines and have discussions to move closer to the shared goal previously established during Forming. As the teams navigated this challenging stage, two themes emerged 1) orientation to team members disciplinary expertise and 2) defining and narrowing of the project.

#### **Orientation to team members disciplinary expertise**

During the Storming process, the data indicated barriers due to disciplinary diversity. The process of taking time to learn about each other’s expertise was important to navigate differences to ultimately integrate all perspectives into their project. Team members took intentional time to learn about what it is that each of their team members is doing. Participants described this early time in the team’s development as confusing, difficult, and even like a “rollercoaster.”

Sam: “[The] first day was, like, kind of rollercoaster for us. Because... us four people are from completely different backgrounds, right? We had a hard time communicating our ideas to other people.”

Sam further explained that when he spoke in the jargon specific to his field, “nobody understands what I'm talking about.” Jordan described the early stages as “very confusing for me” and that he was “unclear about many things...but once we [started], and I started learning and figuring out what we're gonna do, slowly.” Riley noted that the process was “not really efficient at the very beginning, because we're all trying to understand what it is the other people want to do.” He stated plainly, “it took time to figure out how you fit together.” The individuals needed a clear understanding of what everyone brings to the table to move forward in the evolution of their project.

To move past the initial confusion, teams dedicated significant time and effort to understanding each other's expertise. This is a critical step in overcoming the Storming phase. Josh explained that blue team spent a “couple of hours figuring out who will work what,” which involved discussing past work, expertise, and available resources. Taylor estimated the blue team spent “at least 2 hours” just getting acquainted with the new information and each other's expertise. She continued to say, “[I]n order to fit everybody in we had to learn.”

The green team had a similar experience, Mark stated, “We really did take a lot of time to get to know what everyone's expertise was, and also, everyone was very good about making sure everyone had an opportunity to talk and provide what their opinions are.” The participants shared narratives that expressed how willing they were to learn about what everyone else does to be a better team and create a stronger proposal.

Not everyone struggled understanding the others discipline, but they were still meaningfully contributing to the conversations necessary to get the team onto the same page. Jesse expressed that he did not find it difficult to understand his teammates expertise because, “surprisingly, everyone was very good at communicating and breaking it down. I think when you

understand something well, it's easy to explain it.” Alex had similar views, “I didn't see it as difficult, actually I [saw it] as interesting, and wanted to learn more about that.” She demonstrated this commitment by stating, regarding the animal nutrition aspect: “I don't know anything about cows, but I will learn.” Thomas noted that on his team, “we mostly saw, this is what that person is bringing to the team” evidence of time spent getting to know each other's expertise. Whether or not they viewed it as difficult, time was devoted to the understanding of everyone's discipline to create a project that integrates everyone.

### **Define and Narrow the Project**

The conflict during the Storming phase was less about hostile disagreements and more about taking time to get on the same page. Participants narrowed down and refined ideas, being realistic about the scope and outcomes of the project while keeping the big picture in mind. This theme captures the process of teams moving from a wide array of individual ideas to a single focused project proposal.

Across all teams, the Storming phase started with many ideas. Taylor from the blue team explained at the beginning, “if you had an idea, just throw it out.” She admitted their initial enthusiasm led to technical overload, “I think we were, like, pretty much gonna sell everything and the kitchen sink,” and that they were so excited, thinking, “this is so cool, we can do this, this, and this.” Other participants shared similar experiences.

Josh: There were so many ideas in the beginning that came through, and that's how I realized... any proposal starts with a huge idea, a lot of ideas, and then you realize, okay, that might not be possible, and that's where disagreements started coming up.”

The initial generation of ideas was necessary to have difficult discussions and narrow in on a focused proposal. The data shows that participants recognized the importance of sharing

their ideas and then engaging in difficult discussions to narrow them down. Josh said, “I felt all of us got that space to pitch in all the great ideas we had... and then we narrowed it down.”

Jordan described a similar experience on the orange team.

Jordan: [O]nce we discussed together... I knew that everyone is [an] expert in their field, but bringing down to a common objective was the difficult part. So, we had lots of discussion at the different phases and different steps, and then we got narrowed down to a common topic.

The narrowing process involved constructive disagreements and discussion. Josh described that “constructive criticism of the idea helped us advance it” while they were brainstorming ideas, “we had a lot of things, but it also helped us to narrow it down.” The discussions they were having to narrow the topic were pivotal for advancing the proposal. Quinn described the orange team having “a lot of ideas... putting so many things together, and then we discussed those, and then narrowed them down.” He focused on checking whether tangential ideas were practical or related to the core mission, “You may have an idea, a wild idea, that is way out there, but how does it relate to the water issue?”

Mark on the green team explicitly used the term “mission creep,” to describe the same process on their team.

Mark: “I think probably the biggest thing was keeping the goal in mind, because there were some ideas that, once again, it was kind of what we refer to as mission creep. You know, we had the mission of the project, and some of those goals became very ambitious, and it basically was creeping outside of what the original mission was. So, we had to rein those folks back in, some of those ideas back in, and the overall question is, well, that's a great idea, but how does that fit with what we're trying to do here?”

Josh detailed one of the ambitious ideas his team had to cut, “For example, like, we were pitching up, oh, we should do... four different kinds of sensors and things like that, but is that even possible to do?” He explicitly stated their focus of being realistic when he countered this ambition saying, “We didn't want to pitch something, we would not do, so that was the whole goal.” Sam gave another example of self-regulating his own ambitious idea:

Sam: “I can do some like satellite-based detection of groundwater, right? And then I could have put that idea into that project, but I thought, that’s too much, right? So, let’s just start with this, and then there will opportunities to stretch my arms later.”

Teams anchored themselves in their goals and developed tools and strategies that will be further explained in the Norming stage to help them stay focused. Clarity on scope and objectives is catalyzed by the discussion in the Storming phase.

## **Norming**

In the Norming phase the group develops cohesion and group identity shapes as the team members put their energy towards accomplishing tasks (Tuckman, 1965). Tuckman (1965) explained that process and procedures spoken and unspoken, also referred to as norms, guide how members work together and maintain “harmony” (p. 385). Analysis of the data revealed three themes within the Norming phase: 1) roles and leadership norms, 2) communication and interaction norms, and 3) procedural and task management norms.

### **Roles and Leadership Norms**

In the Norming phase, groups established stable structures by defining individual responsibilities or roles. Roles aligned directly with expertise, and participants consistently described “falling into” responsibilities that matched their disciplinary strengths.

Taylor summarized this simply: “I think we kind of fell into that, like each person would go under their expertise.” Avery described a similar process, explaining that her team “figured out the strength of each one in the group... so that's how we decided which responsibility goes to which person.” Riley gave an example of how this played out in practice: “We kind of take on the roles we need to get into, since we all have a really specific background. There is no need for me to hop on... nanotechnology-related things. I'm more focusing on data methodology and integrate[ing] all the components in our project slides.” Participants were clear on both their teammates’ expertise and how their own skills could best serve the project.

Sam explains that as the research objectives shaped, “then we started talking about, you know, who can contribute in which aspects?” In the Storming phase the members are learning about each other’s expertise, which later directly translated into their role or responsibility as a team member. Quinn explains as a team they had to ask, “Okay, what is everybody's role? What are the individual roles in this?” He goes on further to say, “Identifying what each person is going to do, and agreeing that what you are doing is relevant, and it will support the project.” Leo noted that while roles were discussed briefly, the process “didn’t really happen in a very structured or stepwise manner. It just kind of evolved and we just kind of fell into our roles.”

Alongside role clarity, participants also described how leadership emerged. Leadership often flowed across the team, individuals led in their own areas and supported others in theirs. Josh contrasted his CoSearch experience with typical class projects:

Josh: Often when you go for class projects, there's always one or two students who take the lead in the group... But here, I did not feel a leader emerged out. As we defined the objectives and expertise that person, by default, knew that they are going to speak... I

think that rule came up by itself based on your expertise, and you also take leadership on your areas.

In other cases, however, a single individual was recognized as the natural leader. Jesse recalled how quickly Mark was identified by his team:

Jesse: [H]e had amazing charisma and great communication skills, and immediately understood what each person was doing, and could communicate effectively what each person was doing. While some of us were still trying to learn... [Mark] was already ahead of the game... we knew that he was going to be the natural leader... And when I proposed that [Mark] should lead the team. I looked around the room, and everybody just nodded and said, yes, of course, it's gonna be [Mark]. And so he led the team, and he was a great leader.

Mark himself reflected on this dynamic, admitting uncertainty about whether his administrative title influenced the group's decision: "I don't know if my role as an administrator was the reason why they kind of looked to me as a leader... it just kind of fell into place." Leo confirmed this perspective, describing Mark as "naturally leading the conversation... very good at combining the ideas."

The orange team leadership was distributed across the team, with the two senior faculty members taking on more of a management role. Alex identified these individuals as experienced leaders, noting that "they had great leadership with how our team develop[ed]," emphasizing their "effective communication [ability] to give a structure to the team because as I said, we have clarity on our goals. So that's how everything became kind of an organic development. Trust, communication, similar objectives. That took us to our conflict resolution."

Leadership and role assignment allowed teams to move past uncertainty and channel their energy into collaborative work.

### **Communication and Interaction Norms**

Communication and interaction shaped the overall dynamic of the KWI CoSearch teams during the Norming phase. Discussion and communication were coded across all interviews, underscoring their role in moving teams forward in team development. The team's interactions in the Norming phase were marked by respect, directness and consensus.

Participants described respectful environments where team members were able to speak and be heard. Josh emphasized the importance of having collaborators who “give you space to discuss, rather than shutting you down,” describing his team's environment as “very respectful.” Jesse highlighted that his team had “a lot of mutual respect,” he goes on to say:

Jesse: You know, the usual etiquette, academic etiquette, that's all. You know, you don't talk over other people, you let everyone talk and listen. When someone is talking, you basically allow the person to complete their thought or rest their case. I've been in meetings where, you know, somebody interrupts you, speaks over you, and it's happened to me among academics, but there was none of that there.

The idea that many of the norms were grounded in shared academic culture was shared by other participants:

Thomas: There's some element of, we're all academics. We all know how this game goes. So, I don't know that norms emerged there so much as we all know this is how you do an academic presentation.

Others highlighted mutual respect and consideration for each other's time and contributions. Sam reflected, "We're all at the early career stage, but we are mature. We know how to respect the other people's, time, the other people's schedule, and also their disciplines."

Alongside respect, participants noted the importance of direct and honest communication. Riley observed that "for like a team with only junior faculties or postdocs, it's gonna be aggressive, and it won't affect us, we won't be hurt by those comments... [or] straightforward opinions." He explained that within his team, "we're really straightforward... sometimes, I might say, 'Hey, I don't like this one,' and they respond the same way. But it doesn't hurt our feelings." Riley added that the straightforward style made disagreements manageable, "I didn't confront anyone or see any arguments that lasted more than, like, 20 minutes or 30 minutes. We always figured it out in 5 minutes or less."

Josh described a similar process, emphasizing that feedback was handled without defensiveness.

Josh: Oftentimes, oh, you have a great idea, but we cannot do it... but it was not that any person [was] taking it personally. So... it was not difficult. I think we all have good experiences in research, and it was very easy for us to understand.

Mark echoed the value of open feedback across disciplines and sometimes learning about what each individual brings to the table also has to do with "soft skills." He explains, "if a person isn't able to communicate or ... interact with people outside of their discipline then it doesn't matter." But in the end Mark believes they were successful in communicating and able to "overcome those conversations."

Respect and directness combined to create an environment where teams established practices for discussion to reach consensus. Jordan reflected, "there was so much disagreement at

the beginning... how we should approach, how we should achieve this goal... So, what we discussed based on their experience and expertise, we overcame all the confusion and challenges.” He credited the persistence of dialogue, “The main thing that helped to overcome was discussion, probably.”

Jesse described a similar experience, emphasizing how debate and discussion led to unanimity:

Jesse: [S]omebody would say something, I write it down. Somebody else says something completely opposite... And then when it came to picking ideas, we had to debate those ideas. And what happened was all the good ideas rose to the top, and so it became, there was just this unanimity each time we concluded each topic.

Leo’s account of this experience was consistent, he recalled that after “an open discussion... we naturally reached a consensus on the final ideas to focus on.”

### **Procedural and Task Management Norms**

Teams turned to systems to manage their time and structure their work. Time management practices, workflow processes and the use of whiteboards emerged as norms and helped move through discussions and sustain progress.

Several participants emphasized the importance of setting time limits to keep discussions productive. Josh explained that his team timed themselves to keep their momentum in a forward motion, “this much time we should be discussing, and then let’s just come to a conclusion.” He explained that deadlines were critical to maintaining momentum.

Josh: I like to have some cut offs, some deadlines, it’s always useful so when we got into that room, I said... for next 2-3 hours, let’s just discuss, then take a short break, and then come back, and then start rewriting it down.

He also noted that they deliberately built in space for “silent time, just to write and work on our own pieces... it was very helpful.”

Jordan described a similar practice on his team where they set time limits on discussions. He explained that these rules became necessary because “our discussion was never-ending sometimes.”

Other teams established chronologies and workflows. Sam reflected, “what we developed is we made a chronology, right? First is... we should know how the water is moving, and how the water is being impacted... Second comes to the group’s research expertise.” Taylor described a process of continual forward movement through structured task setting.

Taylor: So, let's all write the abstract, and then we'll give feedback on what we think on each of our projects... Each meeting, we're like, okay, next meeting, we're gonna do this, and the next meeting, we're gonna do that. And then we're always continually working forward together.

Visual tools and the white board also played a central role in structuring collaboration. The majority of participants who were interviewed made a point to bring up the use of the whiteboard. Leo recalled that his team relied heavily on the whiteboard: “we had a whiteboard in the building, so everyone is throwing out ideas, and then we wrote down everything.” Alex described how helpful to was as an elimination process: “we were writing, and then we were erasing. It was, like, an elimination process of ideas.” Jesse emphasized its impact even more strongly: “Do not, do not underestimate the power of a whiteboard. Oh my goodness, that made a difference.” His team used the board to translate discussion into visual form.

Jesse: I took all these markers, and I went to the whiteboard and outlined the points we were making with flowcharts showing the progression of the project, including details of

all tasks... having all of that on a whiteboard and looking at them all at once and eliminating things and highlighting certain things... revising all the things, that really helped us.

Together these adopted practices allowed the teams to work as a unit and make intentional progress. The Norming stage brings out group identity. As the team begins to find a rhythm and routine, they see themselves as a cohesive unit. The synergy developed between team members during this time moved them into the Performing stage.

## **Performing**

As the KWI CoSearch teams entered the Performing stage a perceived shift happened. The earlier stages were a process of navigating diversity, clarifying roles and processes evolved the teams to function as well-oiled machines (Tuckman, 1965). In this stage only one theme emerged, cohesion and synergy.

### **Team Cohesion and Synergy**

Once teams began Performing the findings showed disagreements faded, processes flowed more easily, and energy was channeled into productive work. Multiple participants describe a “shift” that was felt moving into the productivity.

Mark: Once we had that project kind of solidified, that everyone was going to have a piece of it, I think there was a definite shift... We actually have a good group of people with a great idea that involves everybody. So I think once we have solidified those pieces and actually had that project that we could then work off of, that was a tonal shift.

Moving into cohesion allowed team members to refine ideas with little conflict. Taylor said, “by the second day, we were just refining everything.” Sam adds to this point, “once we set out a regional scope... then after that point we didn't have any, you know hiccups about what we

are doing.” Riley emphasized the collaborative process his team found when working on the proposal, “we’re not mean[ing] to go against or veto the ideas of the other team members... we discussed, we thought through, and then we made group decisions.” Together the data reveals a tonal shift to unity, where teams were no longer defining direction and they are experiencing productivity.

This cohesion is also translated into a sense of synergy that participants described when explaining how they enjoyed their experience.

Jordan: At the beginning, it was confusing, but at the end... I feel like it's a very close team actually. It's a very good team feeling. I still have the same feeling, and whenever I see my team members, I think, okay, we work together for the whole two days, so it was always a good feeling with the team members.

Alex expressed similar sentiments when she described her team’s interaction toward the end of the weekend saying, “We gave feedback to each other every single moment.” She goes on to say how she saw some images from the event and reflected, “I saw the pictures from when we were preparing for the presentation... everybody's talking, we were communicating between us... the energy was so great.” Alex confirmed there was “good synergy” within the group. Josh echoed this sense of enjoyment, describing it as productive, “I enjoy working with these people, it's a healthy environment, and we will have productivity.”

Many noted the rare synergy created by working across disciplines. Jesse explained that although he had worked with strong disciplinary teams in the past this one took the cake.

Jesse: “I have not been on a team that involved folks from arts and science, somebody from leadership, engineering, vet med, all in one... Some of those teams I've been on that involve so many people from all diverse fields have not been as synergistic as this one.”

He described the experience as “the epitome of a learning space,” where silos melted away, “Sometimes you all have this... everybody wants to be siloed, people want to think differently, people want to be suspicious of the next person, and there was none of that. None of that.”

By the Performing phase the teams found cohesion and momentum. Taylor described how once responsibilities were aligned, “then we just took off. And we just supported each other. I think that was one of our benefits that we could support what each other does without stepping on each other's toes.” Mark added that the outcome exceeded some participants’ expectations: “I think some individuals just didn't think we were going to be able to incorporate everybody at the beginning... and that’s why they were very happy... that we actually developed something that was cohesive, that did bring everyone's strengths to the table.”

These reflections illustrate how cohesion and synergy were evidently present in the data when the teams shifted from exploring to confident collaboration in the Performing stage.

## **Adjourning**

The final stage of group development, Adjourning, concerns termination and separation (Tuckman & Jensen, 1977). At the conclusion of KWI’s CoSearch, the teams either continue to collaborate or they disperse. The primary goal of KWI’s CoSearch was to create a five-minute interdisciplinary research proposal pitch on a water-related topic. All four teams achieved this goal, as shown in their recorded presentations. The winning team has not yet reached the Adjourning stage because seed funding allowed them to continue collaboration. For the other three teams their work concluded with the final pitch. While the ideas and connections formed may inspire future collaborations, the winning team is the only group whose research has continued in the same form as originally proposed at KWI’s CoSearch. To protect participants

identities pseudonyms are not included with quotes in this section. Team dispersal is the only theme that emerged in this stage.

### **Team Dispersal**

For teams that did not win the funding, the collaboration dissipated quickly. One participant explained, “So we have not met. We have not met. We’ve talked a few times, we talked about meeting, but it’s not materialized... I think the reason is because we lost. I think it’s as simple as that.” Another echoed this sentiment, “We have exchanged a few emails, but as in a proposal, I was never reached out to work on a different proposal or anything. I never met them again so I don’t know if they have the plans to further it.” A third participant when asked about the status of the research reflected, “Um... well, we didn’t win that competition. I think right now ... everybody is working on their own research. I haven’t been in contact with any of them since then.”

The end of collaboration was paired with strong emotions for many. One participant recalled, “I think everyone was proud of what we presented. But I still think there was some disappointment that we didn’t win, so...” Other participants expressed disappointment and frustration as well. One admitted that not getting funded “sucks a little bit.” Another described it as “frustrating” that their highly needed idea did not win.

The most explicit articulation of sadness came from a group that entered the competition with high confidence in their proposal. One member described that the team felt “really, really bad” and was “completely deflated when we lost, because we put in so much.” They described the adjournment as a breakup and went on to say, “the thought that the idea would not be pursued further was heartbreaking” and the realization that they might “never have this team again... was even more painful.”

Team dispersal was often accompanied by feelings of sadness, disappointment, and frustration. For many, the end of KWI's CoSearch meant the end of their collaboration leaving them with pride in their accomplishment and regret that the work would not continue.

## **Research Objective 2**

Research objective two aimed to identify patterns that impacted interdisciplinary progress when participating in the KWI CoSearch competition. Data analysis revealed four key themes that influenced how teams advanced their collaborative efforts: (1) recognition of the value of diverse expertise, (2) ownership of the project, (3) collaboration catalysts, and (4) focused attention. Together, these themes illustrate the conditions that supported or hindered interdisciplinary progress during and after the event.

### **Recognition of the value of diverse expertise**

Participants recognized and relied upon the specialized knowledge each member brought to the team. They acknowledged that the complexity of their research goals required drawing on multiple disciplines and learning from one another. For many, realizing how much they depended on their teammates' expertise was a defining moment of interdisciplinary collaboration.

Several participants described this recognition as a shift from focusing on their own field to appreciating how others' knowledge filled critical gaps. Sam articulated this clearly:

Sam: The problems we have in the world are interdisciplinary. We can solve the problems that the world is facing in an interdisciplinary way. I'm just a hydrologist... I don't know... how do we adapt with, like, agriculture activities? How do we adapt with the irrigation and things like that, right? So I thought, like, okay, I need to collaborate with the people so that we can hit the problem.

Later, he summarized this realization more simply, “We need each other and then each other's expertise is unique.” Jordan echoed this perspective, explaining that collaboration was essential to their success:

Jordan: We have to work together as a team. And I think if we go separately, we're not gonna be able to achieve the goal... We have to find out how to overlap, how to find the overlap of all disciplines... I think we did a very good job finding that overlap for all of the team members.

For others, the event highlighted how interdisciplinary collaboration expands understanding beyond one's comfort zone. Leo, whose research typically falls outside water studies, found the experience “really, really good and interesting... to learn what is important in the area, and what are they doing on the deeper side within the campus.” He described the benefit of being “in the same room with people who know much better than us, so that I could learn a lot about it.” Similarly, Riley reflected that “you really know how the other people are doing research in their field, which maybe benefits yourself to do your research... You actually can learn from the other people.”

Many participants expressed that their team's greatest strength was its diversity of thought and expertise. Jordan noted, “We have team members from all different disciplines and we are including everyone's idea in our proposed work... We have a very good multidisciplinary project developed.” Avery reflected that while the diversity initially created challenges, it ultimately became “a really good strength for us. So my perception in the beginning was entirely opposite when everything was done.”

Josh also emphasized how the diversity of expertise strengthened their project and made it more complete: “I also felt like our individual disciplines helped us a lot... The person

working on nanoparticles also understood agriculture from [the] entomology side of things...  
Drought modeling person has expertise looking from the physical model aspects too.

Mark summarized this collective realization well:

Mark: Just realizing that everyone has value, and that they can potentially provide something that you haven't even thought about. So even though you think you might be on this ivory tower, you are missing something that's going to be vital for you to be successful.

Across all teams, participants described a shift from focusing on their individual research to recognizing that meaningful solutions to water challenges depend on combining diverse forms of expertise.

### **Ownership of the Project**

Ownership of the project is important, and during the interviews, individuals expressed that they saw their ideas and their discipline meaningfully incorporated into the project, incentivizing them to stay engaged. Team members stay committed because they have skin in the game.

Ownership emerged when everyone's ideas were visibly integrated into the final product. This goes hand in hand with the act of merging ideas seen in the Storming phase. Team members described this sense of shared contribution as motivating. Avery reflected on how her team's collaboration evolved naturally, saying, "As we started developing the project... each one's idea mattered a lot. So everyone had contributions, like really good contributions."

Josh explained his team achieved balance by merging ideas in a way that reflected all members' expertise. He explained that his team members "were excited about what they pitched in... If you see our project, it reflects, all the things that we have, at least our expertise, all four

of our expertise.” He emphasized the importance of equal ownership, while it may have been his idea originally, he added, “I would not take 100% credit of the idea, because once it came altogether, it was, like, almost an equal contribution from every individual on the team.”

Sam explicitly linked inclusion to ownership, noting team members must “respect other people's ideas so that every team member in that collaborative project feels respected, and that they own the project.” He reflected, “The reason why I'm owning this project is that my idea is there... my small idea is still there, like, the core idea is still there. That's why I feel that it is my project.”

Mark echoed this sentiment, describing his team's success as a result of integration rather than compromise:

Mark: I think we all had our individual agendas, but we were all trying to figure out how to put it together. So, it was one of those things where nobody actually had to change what they wanted and that was... how can we integrate everyone's idea? How can we have a project that is a culminating of everyone's individual? And I think that's what we achieved... it is this one unified device, but it has individual pieces that everyone's going to contribute to.

When team members participate individually in the integration process, it fosters a sense of ownership over the project. Other participants described how this process evolves as ideas merge and teams align their goals. Quinn reflected that members naturally adapted the proposal around their disciplinary strengths.

Quinn: People will always go back to their strength, right?... You have your ideas, you try to make sure it fits into the overall scheme of things, and what you can do to make it a part of what we are trying to achieve.

Overlapping ideas led to collaboration rather than competition and fostered shared ownership in the project.

### **Collaboration Catalysts**

Participants repeatedly emphasized that while enthusiasm and shared purpose were important, collaboration beyond the KWI CoSearch event depended on a tangible catalyst. Most often, in the form of funding. Excitement alone was insufficient to sustain momentum once the structured environment of the event ended. The presence or absence of incentive emerged as a defining factor that determined whether teams continued working together or dispersed after the event. To protect the identities of participants, pseudonyms are not included with quotes in this section.

For the winning team, the seed funding they received immediately translated into continued activity. They maintained momentum through regular meetings, lab experiments, and manuscript development. One participant described how this ongoing collaboration expanded beyond the original project: “We do meet on a monthly, bi-weekly basis, as time allows... We have already submitted a manuscript related to the sensors, and we have been working on our second manuscript as well. We are also going to hire a student... and then we'll be doing a lab and greenhouse experiment.” Another member reflected that this success exceeded their expectations: “More than was expected and anticipated from this when I was going to that workshop.”

For all other teams, the absence of funding marked a clear turning point. Several participants acknowledged that despite their initial intentions to apply for grants together, momentum faded without a defined next step. One participant explained:

Participant: I know if we had some kind of incentive to meet, maybe if we had a proposal we plan on working on, something that would lead to a project, something that would lead to action I think we would have met.

Another reflected, “The first [challenge] is when there isn't an immediate incentive to collaborate. That’s the number one challenge.”

Many participants described how funding directly shapes research priorities and, consequently, collaboration. As one noted, “If something pops up, like the USDA has a call for proposals... the collaboration just rises to the top, because there is an incentive.” Another participant summarized this relationship bluntly: “If you take money off the table, the project would be killed. If you want people to do research, they need funding.” For some, the changing political and administrative environment further complicated their ability to act on intentions, “We heard that NSF is not funding any more proposals until further notice, and then there is a 50% funding cut... We thought that may not be a good idea, at least for now, to submit a proposal.”

Even for motivated teams, external factors like shifting grant priorities and reduced availability of funds weakened initial enthusiasm. One participant captured this feeling of frustration: “I dedicated my time. But since that window is not open, then I stopped writing proposals, which is unfortunate... I'm really frustrated, you know? With these things.” Another described how broader uncertainty led their team to withdraw: “After January, with the change of things, I think everyone’s mindset changed about what funding is even available... so as a group we all just kind of retracted back to our security zones.”

Despite these challenges, collaboration was not entirely lost. Across teams, participants reported that connections made at KWI’s CoSearch led to smaller partnerships, new manuscripts,

or unrelated grant proposals. One participant shared, “After that CoSearch, I got to know a mathematician, and we started collaboration after that as well, and we already submitted one proposal with the NSF.” Another reflected, “Me and a teammate have worked on different projects outside of this... We just published a paper together that wasn’t on this project.” For many, the opportunity to meet new colleagues was itself a lasting outcome: “Without CoSearch, there’s no way I would have had these contacts.”

Several participants suggested that administrative follow-up could help sustain these collaborations, particularly for promising teams that did not receive funding. One explained, “Maybe administrators could create opportunities for the team to have reunions... for those teams that are promising. There may be ways you can keep that interaction going. Just keep that interaction alive.”

Overall, participants viewed incentive, whether through seed funding, follow-up calls for proposals, or institutional encouragement as essential for turning their enthusiasm into sustained collaboration.

### **Focused Attention**

Team members praised the structure of the CoSearch event. They spoke highly of the opportunity to come into a room and dedicate undivided, face-to-face attention to the project for two days without distractions.

Participants shared how unique the time spent together was compared to their usual academic routine. Josh found it “so valuable to sit at the same table.” He stressed that the event's intensive model was much quicker than traditional collaborations because everything was “all in the same room” and he “didn't have to go out or reach out to people waiting for their emails and all of that.” Alex recalled:

Alex: Our brains were only thinking of that, so... we did not have to worry about anything else. We even got fed (*laughs*) so, yeah, I mean, we just dedicate our time to that, and between us we give feedback to each other.

Ultimately, participants saw focused, uninterrupted time as a key driver of progress. Leo summarized this well: “The idea of having people in the same room for entire two days having really 100% focus on the topic... that really helped.”

The CoSearch format facilitated deep learning across disciplines. Taylor explained how in-person collaboration helped smooth disciplinary differences: “We had to meet in person, because we're from different disciplines, we had to talk it out.” Riley explained that the CoSearch model influenced how they approached collaborations afterward. Riley reflected, “That’s why CoSearch is the model for me, even to manage my own lab right now.” Taylor affirmed that the intense two-day focus enabled them to define their ideas quickly and led their team to prioritize in-person meetings afterward, mirroring the CoSearch model, “We decided, when we write grants, we might do it in the same room because it's nicer to all sit down together and do it” she went on to say:

Taylor: For some reason that model really worked for our team. It's kind of a hassle, because you have to put a large chunk of time to be in a room together... But then it's also good to be in the room with the person and be like, what the heck are you trying to say here? But say it in a much nicer way.

CoSearch creates a rare access to collaborators. Leo described how unusual this type of extended interaction is in academic settings:

Leo: Normally we don't have much time, so we have a 10 to 30 minute conversation... if we are really interested in each other, we set up a meeting... But in terms of the CoSearch, we're really given the time to spend many, many hours in the same room."

Riley explains how finding time to work with other team members is often a barrier but "CoSearch provided us another way":

Riley: Usually those grant writing collaborations happen in... a couple of meetings [over] a month or two [because] everybody during the semester will be busy... But the CoSearch provided us another way, like, hey, if we can focus on working one specific topic for two days, we can really wrap up something in a short turnaround.

Participants agreed that the focused structure of CoSearch was a rare opportunity that made meaningful collaboration possible.

The findings from the 2024 KWI CoSearch competition show that interdisciplinary teams progressed through Tuckman's stages with identifiable, stage-specific characteristics. Research Objective 2 surfaced four patterns that shaped progress, recognition of diverse expertise, ownership of the project, collaboration catalysts, and focused attention. Together, the results suggest that CoSearch's focused, face-to-face format accelerates alignment and momentum, while sustained collaboration beyond the event hinges on tangible incentives and clear next steps.

## **Chapter 5 - Conclusions, Implications, and Recommendations**

### **Introduction**

This chapter interprets the findings of the study and their significance within the context of interdisciplinary collaboration. The purpose of this research was to explore how teams formed and developed during the Kansas Water Institute's (KWI) CoSearch event, using Tuckman's (1965) Stages of Group Development as a framework to understand how participants navigated collaboration across disciplines. The chapter is organized by research question, presenting conclusions and discussion of the findings, followed by implications for practice, study limitations, practical recommendations, and suggestions for future research.

### **Conclusion and Discussion**

#### **Research Objective 1**

RO1: Explore how interdisciplinary teams progress through the lens of Tuckman's Stages of Group Development.

The KWI CoSearch event provided a unique setting for researching and observing rapid team formation, allowing for conclusions to be drawn about the development of these interdisciplinary teams. Analysis of interview data revealed evidence of all five stages of Tuckman's model (Tuckman, 1965; 1977), Forming, Storming, Norming, Performing, and Adjourning uniquely surfaced in the findings. However, these stages did not appear in a linear fashion and some stages co-occurred as the participants responded to the task and team dynamics making it difficult to pinpoint a clear transition between the stages. The stages did not surface as distinct or isolated, they instead tend to overlap and blend into one another.

According to Tuckman (1965), Forming is the initial stage of group development where members orient themselves to the task. During KWI's CoSearch, Forming occurred as members

identified collaborators and teams began to take shape. Two main patterns emerged at this stage: alignment around a shared goal and the merging of ideas. Teams formed from a sense of attraction to a common purpose. Participants gravitated toward others whose research interests and motivations aligned with their own. While some team members may have previously know each other, groups did not form out of convenience or existing relationships (Cummings & Kiesler, 2008), but instead they sought out others because they perceived a shared vision, which is important in interdisciplinary work (Bennett & Gadlin, 2012; Cummins et al., 2018; Stokols et al., 2008). The Forming environment during KWI's CoSearch was not random but intentional and strategic, and this directly impacted their collaboration through the team development process. Members strategically placed themselves onto teams in a way that produced results for mutual benefit. This supports Tuckman's view that Forming involves establishing both structure and purpose (Tuckman, 1965). Tuckman's model discusses individual agendas being problematic but in the case of interdisciplinary teams their own motivations and alignment around a shared goal is the very reason for team formation. Forming therefore was both an interpersonal and a task-oriented process (Tuckman, 1965) where participants identified a goal and selected people they wanted to work with to achieve it.

The Storming phase is marked by conflict, in the case of KWI's CoSearch this emerged not through interpersonal hostility as Tuckman (1965) indicates, instead through difficulties that stemmed from disciplinary differences. During the Storming phase the team members were specifically working through becoming oriented with each team members disciplinary expertise and defining and narrowing the project. Team members faced challenges understanding each other's technical languages, priorities, and approaches which led to confusion and inefficiency. The diversity of expertise posed as a barrier. As one participant reflected, "Each expert area is so

different from the other area that nobody in the room knew enough to be able to challenge the other person.” In this way, conflict became less about disagreement and more about the effort to achieve shared understanding. Teams spent time learning about each other’s work, which also meant learning about each other as people (Haythornthwaite, 2006; Stokols et al., 2008). These findings highlight the transformative potential of Storming in interdisciplinary work, where challenges become mechanisms for learning rather than barriers to progress, echoing Jehn and Mannix’s (2001) argument that well-managed conflict can enhance team outcomes. The process of Storming and learning to communicate across disciplines was essential in setting the foundation for cohesion later.

The Norming stage during KWI’s CoSearch was characterized by the development of roles, communication norms and routines. However, these behaviors did not follow Storming in a strict sequence. Because the interviews took place retrospectively, about 8 months after the event, participants described experiences that overlapped and blurred the lines between Forming, Storming, and Norming. All the themes that emerged in Norming can be tied directly to a need that was established in an earlier stage. Teams established procedural norms based on disciplinary expertise identified during Storming, which directly shaped how roles and leadership emerged. They also created norms around communication and collaboration that supported decision-making, task division, and goal alignment. Rather than distinct stages, Storming and Norming operated as a feedback loop. Teams would brainstorm, clarify, refine, and return to discussion once again as ideas surfaced. These findings indicate that Storming and Norming were recurring stages rather than strictly sequential, suggesting that interdisciplinary teams revisited them as new ideas emerged and relationships evolved.

Tuckman (1965) himself noted that there must be limitations to the model's application and that conditions could alter the order of the sequence. Previous studies have similarly found that development processes are often more complex than what Tuckman's Stages account for (Benfield, 2005; Miller, 2003). The findings allow us to pinpoint the themes occurring in each stage of Tuckman's, but their occurrence does not appear to follow a linear cycle. Although the occurrence of stages in interdisciplinary team development may vary across contexts, the simplicity of Tuckman's model allows it to serve as a practical baseline for analysis, while recognizing that adaptations will be necessary on a case-by-case basis.

Once teams reach the Performing stage there was a shift toward cohesion and synergistic productivity. The groundwork laid during earlier stages such as clarifying scope, assigning roles, and establishing trust, enabled teams to "perform." Successful navigation through the structural and interpersonal challenges of the earlier phases ensures that the resulting group structure is functional and supportive of task execution (Tuckman, 1965). Participants emphasized that mutual respect, open discussion, and shared ownership were hallmarks of their collaboration. This stage represented a point where planning transitioned to doing and progress came more naturally. Without time invested in Forming, Storming, and Norming, teams would not have reached this level of performance, consistent with the correlation shown between effective team development and higher group performance (Benfield, 2005). These stages represent milestones that were only fully recognized in hindsight, as participants reflected on what occurred for their teams to reach what they would describe as success.

The Adjourning stage is where teams dispersed, this revealed both closure and emotional complexity. While all teams met the event's goal of developing a research proposal, most disbanded afterward. Participants expressed pride in their accomplishments, but also

disappointment that collaboration did not continue. The exception was the winning team, which received seed funding and continued pursuing their project. Their experience reinforces how external support can extend the Performing stage beyond the event's structured setting.

The findings demonstrate that while Tuckman's (1965) model offers a useful framework for understanding interdisciplinary team development, the process observed in KWI's CoSearch was more fluid than linear. The findings show the stages are intimately connected with evidence of movement between stages rather than through them, each stage influencing and shaping the next.

## **Research Objective 2**

RO2: Identify patterns that impact interdisciplinary progress when participating in KWI's CoSearch.

The interview data revealed that interdisciplinary collaboration thrives when participants recognize the value of diverse expertise, see their contributions integrated into the team's work, are supported through tangible incentives, and have structured time for collaboration.

The first pattern to emerge was the recognition of diverse expertise. Early in the process, disciplinary differences initially created uncertainty as participants worked to understand one another's perspectives. However, as they spent time discussing and asking questions, those differences became the strength of the collaboration. Participants described how each person's knowledge filled a gap the others could not, making the group more capable together than any individual would have been alone. Many participants directly expressed the importance of everyone on the team, for example Sam said, "We need each other, and each other's expertise is unique." This finding reinforces that recognizing and valuing each other's expertise is foundational to interdisciplinary progress. It also highlights the interpersonal side of

collaboration, learning what someone does often means learning who they are, which strengthens both understanding and trust (Bennett & Gadlin, 2012; Stokols et al., 2008). These relational and intellectual exchanges worked in tandem to build shared commitment.

A second pattern was ownership of the project. Participants were more engaged when they saw their ideas reflected in the team's proposal. Ownership provided a sense of investment and pride in the collective outcome. Quinn explained, "People will always go back to their strength... you want to see how this fits into your overall research program." This sentiment was echoed across teams; members wanted to contribute in ways that aligned with their expertise and personal goals. When individual ideas were woven into the group product, participants viewed the project as 'ours' instead of 'mine' or 'theirs.' Teams that achieved this balance described smoother collaboration and higher motivation. These findings suggest that ownership in interdisciplinary work functions as both a personal and professional anchor, it connects one's identity as a researcher to the shared goal of the team. This is related to the findings of Tkachenko and Ardichvili (2020) who explained that the degree to which interdisciplinary researchers jointly contribute to research purpose appears beneficial, helping researchers see themselves as contributors versus contractors.

The third pattern, collaboration catalysts, emerged as the most critical factor in determining whether collaboration continued after KWI's CoSearch. While excitement and shared purpose initially fueled teamwork, sustained collaboration required tangible structure and support. The winning team, which received seed funding, continued working after the event, while other teams dispersed. Several participants mentioned intentions to apply for additional grants but were ultimately unable to do so because opportunities were limited at the time. For example, one individual explained, "that particular funding in USDA, which we are interested in

does not exist anymore.” This year’s lack of available funding opportunities can be traced to administrative changes that impacted federal budgets and delayed proposal cycles (Palmer, 2025). Another team noted that a change in the environment led to a shift in mindset regarding available funding, resulting in the group viewing pursuit of new proposals as “a little bit more of a risk, and so as a group we all just kind of retracted back to our security zones.” This suggests the continuation of interdisciplinary work was shaped not only by team motivation but also by the external funding landscape, something that was beyond participants’ control. It is reasonable to conclude that in a typical year, more teams might have sustained collaboration had institutional incentives or funding been available. The findings reinforce that interdisciplinary collaboration is not self-sustaining; it requires ongoing organizational and financial support to move ideas beyond the initial stage. Funding is necessary for teams to have successful interdisciplinary collaborations and is often recognized as an organizational obstacle (Ghamgosar et al., 2023; Hall et al., 2018; Stokols et al., 2008; Vogel et al., 2014).

The final pattern of focused attention reflects the impact of the CoSearch event structure itself. The two-day, immersive format created the conditions for deep concentration and high engagement. Participants emphasized how valuable it was to have uninterrupted time dedicated to a single task, noting that being “in the same room for two days” accelerated both idea development and relationship building. The format was praised, and many explained they liked having the time “to focus and dedicate ourselves to the project.” This concentrated time frame allowed participants to focus on collaboration without the distractions of their regular responsibilities. The event design, which intentionally combined structure, proximity, and shared purpose, played a central role in how quickly teams formed and developed. This intense face-to-face environment allowed participants to achieve a quick and deep understanding of each other's

expertise and working styles, a benefit noted as "incredibly valuable" for building new collaborations. Initial face-to-face contact and socialization are essential in establishing trust, facilitating social norms, and aiding in the establishment of group identity (Fritz et al., 2005; Stokols et al., 2008). This close proximity plays a role in facilitating productivity (Olson & Olson, 2000).

Taken together, these patterns show that interdisciplinary collaboration depends on both human connection and structural conditions. Recognizing diverse expertise and fostering ownership led to trust and motivation, while institutional structure, funding, time, and follow-up, determined whether teams could sustain progress. The lack of available grants in the year of this study serves as a reminder that context matters. Even well-functioning teams cannot maintain collaboration without tangible support. These findings reinforce the idea that enthusiasm is the spark that begins interdisciplinary work, but structure is the fuel that keeps it going.

## **Implications**

The primary theoretical contribution lies in refining the application of Tuckman's Stages of Group Development (1965; 1977) to complex interdisciplinary contexts. While the data revealed evidence of all five stages, Forming, Storming, Norming, Performing, and Adjourning, the developmental progression was characterized as fluid rather than following the linear progression proposed by Tuckman's original framework.

The study challenges the traditional view of the Storming phase, which often emphasizes interpersonal hostility, deriving heavily from early work on therapy groups (Tuckman, 1965; Tuckman & Jensen, 1977). Instead, conflict emerged primarily as conceptual and cognitive friction stemming from disciplinary differences. The process of Storming (orienting to expertise) was intricately woven with Norming (developing shared language and protocols), acting as a

feedback loop where initial barriers became mechanisms for learning and achieving shared understanding. This supports the research by Jehn and Mannix (2001) that task-oriented conflict, when managed constructively, is beneficial to group performance and promotes innovation.

## **Limitations**

Although 18 participants were eligible for interviews, only 13 chose to participate. While this sample was large enough to reach data saturation and provided rich, detailed accounts of the KWI CoSearch experience, the findings could have been strengthened by including all 18 participants. The addition of more voices would have offered a broader range of perspectives and further validated patterns observed across teams.

The timing of data collection also posed a limitation. This study relied on post-event interviews, meaning participants' reflections captured their experiences retrospectively rather than in real time. As a result, perceptions of team development were shaped by hindsight and influenced by the overall success or outcome of their projects. The KWI CoSearch event took place in October, but interviews were not conducted until July. This gap may have affected the accuracy or detail of participants' memories. However, the delay also offered a unique benefit, as it allowed participants to reflect on how their collaboration evolved over time and share whether their teams continued to engage after the event concluded.

Lastly, while the interview data provided valuable insight into participants' experiences, real-time observation during the event would have strengthened the findings. Field notes or video recordings of team interactions could have provided additional evidence of when and how each stage of development occurred, helping to create a more precise timeline of team progression. Future research could build on this work by pairing retrospective reflections with direct

observation to triangulate the data and more accurately capture the dynamic, fluid nature of team development.

## **Recommendations**

### **Practical Implementation**

The study yields actionable recommendations for researchers, university administrators, and funding agencies seeking to catalyze and sustain effective interdisciplinary research initiatives. The findings underscore that success in interdisciplinary research is contingent not just on the quality of collaborators, but on the design of the collaborative environment. Providing a period of focused, uninterrupted attention accelerates the crucial work of team development, efficiently moving teams past the initial challenges of disciplinary differences. Immersive, in person events reduce the high transaction costs associated with coordinating busy schedules and translating specialized knowledge.

To put these findings into practice, institutions should consider hosting structured interdisciplinary ideation events, such as a CoSearch model, to intentionally create space for researchers from diverse disciplines to form teams, ideate, and develop proposals. These events provide a concentrated environment that fosters early team cohesion and accelerates group development. They also allow participants to engage in collaborative problem-solving with tangible outcomes that can serve as the foundation for long-term partnerships.

Visual tools (e.g., whiteboards) were essential for bridging conceptual gaps by allowing participants to externalize complex discussions. They provided a shared point of reference that facilitated consensus and idea refinement. Additionally, the research highlights the importance of external incentives in sustaining momentum beyond the Performing phase and translating

successful teamwork into ongoing research collaborations. The lack of a tangible incentive, like seed funding or a clear next step, led to the immediate dispersal of otherwise successful teams.

Interdisciplinary research requires ongoing organizational and financial support to sustain momentum. Enthusiasm alone is insufficient to overcome institutional demands once an event concludes. Funding agencies should invest in flexible, fast-turnaround seed grant opportunities specifically designed to maintain momentum immediately following collaborative ideation events. Administrative follow-up is necessary to transition enthusiasm into sustainable research.

This study demonstrated that ownership of the project acts as a powerful motivator, sustaining commitment and productivity. This process is tied directly to the successful navigation of the Storming phase. Teams were most successful when they integrated, rather than compromised, individual ideas, ensuring that every member's disciplinary expertise was visibly reflected in the final project. This validates each researcher's investment and commitment.

Promoting mutual respect and dedicating time to orient to teammates' specific expertise fosters the trust necessary for effective communication and constructive disagreement. This made sure that disciplinary status differences, a common barrier in academia, are mitigated by focusing on the value of every contributor.

## **Future Research**

Future research should build on this study by exploring how interdisciplinary teams form, develop, and sustain collaboration beyond structured events like CoSearch.

Additional studies should examine which components of the CoSearch model most effectively facilitate collaboration and contribute to the formation of successful interdisciplinary teams. Identifying which design elements, such as team composition, facilitation style, event pacing, or post-event follow-up, enhance communication and cohesion could inform best

practices for future interdisciplinary research initiatives. This inquiry would not only strengthen the CoSearch framework but also provide transferable insights for institutions seeking to replicate or adapt similar models for fostering engagement with interdisciplinary work.

While the CoSearch model provides a valuable case, it represents only one format of team formation. Comparing short, intensive models like CoSearch with longer, semester-based collaborations could reveal how time structure influences group cohesion, communication, and productivity. Similarly, examining how institutional incentives and support mechanisms, such as seed funding, administrative follow-up, or recognition programs, affect the longevity of partnerships would offer practical guidance for both administrators and funding agencies.

Further research should also place greater emphasis on team dynamics and the communication and relational skills that sustain collaboration. Understanding who makes an effective interdisciplinary team member, and how trust, communication, and leadership evolve within diverse groups, remains a critical gap. Because this study relied on retrospective interviews, future work would benefit from incorporating real-time observation of team interactions to capture how groups move through and between Tuckman's stages. Field notes, video documentation, or short reflection surveys during the event could provide a clearer view of how collaboration develops as it happens.

Most existing studies on interdisciplinary collaboration rely on qualitative accounts, which provide valuable depth but often limit generalizability. Developing a quantitative survey instrument to assess factors contributing to team formation, development, and sustainability could expand sample sizes and strengthen the field's empirical foundation. Pairing such tools with qualitative approaches would allow researchers to identify broader patterns while still interpreting results through participants lived experiences.

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## Appendix A - IRB Confirmation



Office of Research Integrity,  
Compliance and Security

TO: Susan Metzger  
School of Leadership Studies

Proposal Number: IRB-12439

FROM: Lisa Rubin, Chair  
Committee on Research Involving Human Subjects

DATE: 10/28/2024

RE: Proposal Entitled, "CoSearch Post Event Survey."

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written - and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §104(d), category: Exempt Category 2 Subsection ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.

Electronically signed by Lisa Rubin on 10/28/2024 5:43 PM ET

## Appendix B - IRB Modification Confirmation



Office of Research Integrity,  
Compliance and Security

TO: Susan Metzger  
School of Leadership Studies

FROM: Lisa Rubin, Chair  
Committee on Research Involving Human Subjects

DATE: 06/13/2025

RE: Proposal #IRB-12439, entitled "CoSearch Post Event Survey and Interview."

MODIFICATION OF IRB PROTOCOL #IRB-12439, ENTITLED, "CoSearch Post Event Survey and Interview"

EXPIRATION DATE: Exempt

The Committee on Research Involving Human Subjects (IRB) has reviewed and approved the request identified above as a modification of a previously approved protocol. **Please note that the original expiration remains the same.**

All approved IRB protocols are subject to continuing review at least annually, which may include the examination of records connected with the project. Announced in-progress reviews may also be performed during the course of this approval period by a member of the University Research Compliance Office staff. Unanticipated adverse events involving risk to subjects or to others must be reported immediately to the Chair of the IRB, and / or the URCO

It is important that your human subjects activity is consistent with submissions to funding / contract entities. It is your responsibility to initiate notification procedures to any funding / contract entity of any changes in your activity that affects the use of human subjects.

Electronically signed by Lisa Rubin on 06/13/2025 12:12 PM ET

## Appendix C - 2024 KWI CoSearch Post Event Survey



### Default Question Block

Select your CoSearch Team

- ☐ Renew Crew
- ☐ Team Forage
- ☐ CLARA Team
- ☐ HydroInk Alliance

How would you describe your discipline or area of expertise?

Have you participated in interdisciplinary research projects before this experience?

- ☐ Yes, frequently
- ☐ Yes, occasionally
- ☐ No, CoSearch was my first experience

How confident were/are you in your ability to accomplish each of the following items? Focus on BEFORE and AFTER CoSearch.

|                                                         | BEFORE CoSearch              |                            |                            |                              |                             | AFTER CoSearch               |                            |
|---------------------------------------------------------|------------------------------|----------------------------|----------------------------|------------------------------|-----------------------------|------------------------------|----------------------------|
|                                                         | Not at all<br>Confident<br>1 | Slightly<br>Confident<br>2 | Somewhat<br>Confident<br>3 | Moderately<br>Confident<br>4 | Extremely<br>Confident<br>5 | Not at all<br>Confident<br>1 | Slightly<br>Confident<br>2 |
| Finding interdisciplinary research opportunities.       | <input type="radio"/>        | <input type="radio"/>      | <input type="radio"/>      | <input type="radio"/>        | <input type="radio"/>       | <input type="radio"/>        | <input type="radio"/>      |
| Networking with professionals outside of my discipline. | <input type="radio"/>        | <input type="radio"/>      | <input type="radio"/>      | <input type="radio"/>        | <input type="radio"/>       | <input type="radio"/>        | <input type="radio"/>      |
| Understanding discipline-specific jargon.               | <input type="radio"/>        | <input type="radio"/>      | <input type="radio"/>      | <input type="radio"/>        | <input type="radio"/>       | <input type="radio"/>        | <input type="radio"/>      |
| Developing an interdisciplinary idea.                   | <input type="radio"/>        | <input type="radio"/>      | <input type="radio"/>      | <input type="radio"/>        | <input type="radio"/>       | <input type="radio"/>        | <input type="radio"/>      |

How well do you think the workshop fostered interdisciplinary collaboration?

☐ Not well at all   
 ☐ Slightly well   
 ☐ Moderately well   
 ☐ Very well   
 ☐ Extremely well

Did you encounter any new perspectives, methods, or ideas from other disciplines that you hadn't considered before?

- ☐ Yes  
☐ No

Please describe the new perspective or method:

How likely are you to continue working with your **established CoSearch team** or select members of your team?

Extremely unlikely      Somewhat unlikely      Neither likely nor unlikely      Somewhat likely      Extremely likely

☐      ☐      ☐      ☐      ☐

How likely are you to collaborate with **individuals from other disciplines as a result of this workshop?**

Extremely unlikely      Somewhat unlikely      Neither likely nor unlikely      Somewhat likely      Extremely likely

☐      ☐      ☐      ☐      ☐

Do you plan on pursuing any of the research ideas developed during the CoSearch workshop?

- ☐ Yes
- ☐ No

Please describe which ideas you plan to pursue.

Please elaborate on why you will not be pursuing any ideas

developed at CoSearch.

Did the experience meet your expectations for this event?

Yes, exceeded  
expectations

Yes, met expectations

No, fell short of  
expectations

No, did not meet  
expectations

What were positive takeaways from this workshop?

What aspects of the workshop could be improved?

Any additional comments or suggestions for future events?

Please select your department(s).

☐ Applied and Interdisciplinary Studies

- ☐ College of Agriculture, Agronomy
- ☐ College of Agriculture, Entomology
- ☐ College of Engineering, Biological and Agricultural Engineering
- ☐ College of Engineering, Department of Chemical Engineering
- ☐ College of Engineering, Industrial and Manufacturing Systems
- ☐ College of Health and Human Sciences, Food, Nutrition, Dietetics and Health
- ☐ Department of Mathematics
- ☐ Department of Statistics
- ☐ Division of Biology
- ☐ Leadership Studies
- ☐ Veterinary Medicine
- ☐  Other

How many years have you been in academia (not including graduate school)?

- ☐ 4 years or less
- ☐ 5-9 years
- ☐ 10-19 years
- ☐ 20-29 years
- ☐ 30 years or more

What is your gender?

- ☐ Male
- ☐ Female
- ☐ Non-binary / third gender
- ☐ Prefer not to say

Would you be open to being contacted for follow-up

discussions or invited to future events?

☐ Yes

☐ No

What is your name?

What is your email address?

Thank you for taking the time to participate in my research study on the Kansas Water Institute's CoSearch event. I truly appreciate your willingness to share your experiences and insights from the event.

Your responses will help us improve future CoSearch events and inform the value of interdisciplinary research, in alignment with Kansas State University's Next-Gen Land Grant strategic plan. The feedback you provided will also be valuable in evaluating how interdisciplinary collaborations foster innovation and contribute to successful research outcomes.

If you have any additional comments or questions, If you have any questions about the study, feel free to contact me at [scori@ksu.edu](mailto:scori@ksu.edu) or Dr. Susan Metzger at [smetzger@ksu.edu](mailto:smetzger@ksu.edu). For any questions regarding your rights as a participant, you may

contact Lisa Rubin with the Kansas State University Research  
Compliance Office at 785-532-3224 or by email  
[rubin@ksu.edu](mailto:rubin@ksu.edu).

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## Appendix D - Interview Recruitment Email

Dear Dr. \_\_\_\_\_ ,

I hope you are well! I'm reaching out to ask for your help with my thesis research, which explores how interdisciplinary teams formed during the Kansas Water Institute's CoSearch event in October 2024. To better understand the outcomes of this interdisciplinary research workshop, I will be conducting interviews to explore how teams developed and collaborated during and after the CoSearch event. Your feedback will help us better understand the impact of interdisciplinary research experiences and guide future efforts to support collaborative work.

The title of this research project is *Analyzing Interdisciplinary Team Development in CoSearch*.

Should you choose to participate, you and I will schedule a Zoom interview consisting of 17 questions. The interview will take between 45 - 60 minutes of your time and will be recorded so I can better analyze the findings. (If video is not available or preferred, we can conduct the Zoom session with cameras off so only your voice is recorded.) Confidentiality of your responses is a top priority. After the interview is finished, I will transcribe your responses and assign you a pseudonym. All responses will be stored in a secure location, and I will use pseudonyms when reporting the data to protect your identity. I do not foresee any risks to participants. However, your participation is completely voluntary, and you may withdraw from the study at any time without penalty.

I appreciate your willingness to contribute to this research, which will provide valuable insight into the effectiveness and long-term impact of interdisciplinary events like CoSearch.

**If you agree to be interviewed, please follow the link to select a meeting time:**

<https://calendly.com/scori-ksu/cosearch-interviews>

By scheduling an interview, you are providing your voluntary, implied consent to participate in this research. **Please reply by June 27 to set up your interview.**

If you have any questions, please contact me, Sophia Cori ([scori@ksu.edu](mailto:scori@ksu.edu)) or either of the principal investigators, Dr. Susan Metzger ([metzger@ksu.edu](mailto:metzger@ksu.edu)) or Dr. Gaea Hock ([ghock@ksu.edu](mailto:ghock@ksu.edu)). For questions about your rights as a research participant, you may contact the

Kansas State University Research Compliance Office (URCO) at 785-532-3224 or Lisa Rubin, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, KSU, Manhattan, KS.

Thank you,  
Sophia Cori

**Kansas State University**

**Kansas Water Institute Graduate Student Fellow**

**Department of Communications and Agricultural Education**

[scori@ksu.edu](mailto:scori@ksu.edu)

## Appendix E - Interview Protocol

### Beginning of Interview

Hello and thank you for taking the time to participate in my study. This research is a follow-up to the Kansas Water Institute's CoSearch event you participated in during October 2024. This interview is meant to be conversational, so feel free to speak freely as we go.

I want to start by bringing you back to that weekend and thinking about what it felt like, who you worked with, and how your team came together. CoSearch was a fast-paced, two-day interdisciplinary research competition where participants formed teams, developed project proposals centered on water-related issues, and pitched their ideas to a panel of judges.

The purpose of this study is to better understand how interdisciplinary teams form and develop in the context of CoSearch. I'm particularly interested in your reflections on collaboration, team dynamics, and the ways this experience has influenced you and your team. The title of this research project is *Analyzing Interdisciplinary Team Development in CoSearch*.

The interview will take between 45 - 60 minutes of your time and will be recorded so I can better analyze the findings. (If video is not available or wanted, we can conduct the Zoom session with cameras off so only your voice is recorded.) Confidentiality of your responses is a top priority. After the interview is finished, I will transcribe your responses and assign you a **pseudonym**. All the responses will be stored in a secure location, and I will use pseudonyms when the data is reported to protect your identity.

I do not foresee any risks to you however, your participation is voluntary, and you may discontinue your participation at any time.

By continuing with this interview, you are giving your consent to use the information from this recorded interview. The audio and video will be recorded during the interview to help with the data analysis after the interview. This recording will be kept on a password protected computer and cloud for a year after project completion. Dr. Hock, Dr. Metzger and myself will be the only ones with access to this data.

Your information will not be distributed for future research. Constant comparative coding will be used to discuss the results from your experience. Findings will be shared with others through my research.

If you have any questions, please contact me, Sophia Cori ([scori@ksu.edu](mailto:scori@ksu.edu)) or either of the principal investigators, Dr. Susan Metzger ([metzger@ksu.edu](mailto:metzger@ksu.edu)) or Dr. Gaea Hock ([ghock@ksu.edu](mailto:ghock@ksu.edu)). For questions about your rights as a research participant, you may contact the Kansas State University Research Compliance Office (URCO) at 785-532-3224 or Lisa Rubin, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, KSU, Manhattan, KS.

## **Interview Questions**

1. How would you define your discipline and the disciplines of your fellow team members?
2. Please describe the scope, overarching goal, and the current status of your research project to me.

### **Forming:** *Team orientation, task clarification, and role definition*

3. Please describe what the early stages of your team development looked like as you began working on the task.
4. How did your team go about deciding who would take on which roles or responsibilities?
5. What discussions did your team have as you were defining your project?

### **Storming:** *Conflict, resistance, and competing ideas*

6. What kinds of disagreements or challenges arose as the team began working more closely together?
7. How did your team navigate differing ideas when creating the project proposal?
8. Did you feel like any members of your team had individual agendas and how was this combatted?

### **Norming:** *Team cohesion, shared norms, and constructive collaboration*

9. Describe when you felt like your project was clearly defined?
10. What does giving and receiving feedback look like in your team?
11. Have you noticed any unspoken rules or group norms emerge over time?

### **Performing:** *High-functioning collaboration and productivity*

12. What does your group do well?
13. What are things your group still struggles with and what does navigating solutions look like?
14. What does progress and success look like for your team?

### **Closing questions:**

15. In your experience with this interdisciplinary project, what makes it difficult to collaborate across disciplines?
  - 15 A. Have you worked on other interdisciplinary teams and how did it compare?
16. What factors do you think helped your team make progress across disciplinary boundaries?
17. Is there anything else you would like to share about your experience with CoSearch or interdisciplinary research?

## **End of Interview – Debriefing Statement**

Thank you for all the information you've shared. I really appreciate your willingness to participate in this study. Your insights will provide valuable information to help me better understand interdisciplinary team development and the lasting impacts of the CoSearch experience. I will send you a copy of your interview transcript to review before I begin data analysis. Thank you again for your time and for contributing to this research.

If you have any questions, please contact me, Sophia Cori ([scori@ksu.edu](mailto:scori@ksu.edu)) or either of the principal investigators, Dr. Susan Metzger ([metzger@ksu.edu](mailto:metzger@ksu.edu)) or Dr. Gaea Hock ([ghock@ksu.edu](mailto:ghock@ksu.edu)). For questions about your rights as a research participant, you may contact the Kansas State University Research Compliance Office (URCO) at 785-532-3224 or Lisa Rubin, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, KSU, Manhattan, KS.