

Examining an Equity-Focused Collective Impacted Project through the Lens of Alliance Members' Prior Experiences

Rebecca Zarch, SageFox Consulting Group

Rebecca Zarch is an evaluator and a director of SageFox Consulting Group. She has spent almost 20 years evaluating and researching STEM education projects from K-12 through graduate programs.

Dr. Monica McGill, CSEdResearch.org

Monica McGill is President & CEO of CSEdResearch.org. Her area of scholarship is K-12 computer science and cybersecurity education research with a current focus on diversity and improving the quality of research.

Examining an Equity-focused Collective Impact Project through the Lens of Alliance Members' Prior Experiences

Rebecca Zarch¹ and Monica M. McGill²

¹SageFox Consulting Group

²CSEdResearch.org

¹rzarch@sagefoxgroup.com, ²monica@csecresearch.org

Abstract

Research Problem: A Collective Impact (CI) model provides a foundation for bringing together independent organizations, networks, and societies in a structured way to achieve large-scale social change. However, when siloed organizations are brought together, efforts towards finding ways to intersect, rather than work in parallel, to impact social change can be greatly influenced by Alliance members' previous experiences and how they perceive themselves within the broader Alliance.

Research Questions: In this study, we considered how members' prior experiences shape a newly formed National Science Foundation (NSF) Alliance to broaden participation in engineering. Our research questions were: *What were the Alliance members' prior experiences in collaborative networks that they bring into the new Alliance?* and *In the context of equity, how are the newly formed Alliance's members' funds of knowledge being honored and valued?*

Methodology: We conducted semi-structured interviews among the members ($n=13$). We then used a codebook established *a priori* from the CI model to code the interviews.

Findings: The data analysis shows a connection between members' previous experiences in collaborative groups and the perception of current practices within the newly created Alliance. Overall, the findings display heterogeneity of members' experiences with the conditions of collaborative work, which impacted the early stages of this Alliance. The Alliance has a common goal, but based on findings, there are several impediments. The perceptions and circumstances of members are varied, which impact the members' ability to create authentic collaboration that will impact the social change needed to broaden participation in engineering. However, all members report cautious optimism regarding the work ahead for the Alliance.

1 Introduction

In the field of engineering education in the U.S., Black/African Americans, Hispanic Americans, American Indians, Alaska Natives, Native Hawaiians, and Native Pacific Islanders represent a disproportionately small number of those graduating with engineering degrees. In 2020, only 20% of students seeking bachelor's degrees, 10% of master's degrees, and 6% of doctorates self-identified as Black/African Americans, Hispanic Americans, American Indians, Alaska Natives, Native Hawaiians, or Native Pacific Islanders [1]. Similarly, women represented only 24% of students seeking bachelor's degrees in engineering, 27% of master's degrees, and 25% of doctorates

[1]. When compared to the general U.S. population, these numbers are only a fraction of these populations, indicating a significant gap in representation. These gaps have been long recognized in engineering with little progress relative to other STEM fields [2].

The importance of having a diverse workforce should not be understated. The legislative aims of the Civil Rights era made clear that discrimination in U.S. education and employment violated fundamental stated commitments of the democratic nation [3]. Additionally, diverse teams perform better than more homogeneous ones, thus yielding higher productivity and higher yields for companies [4, 5]. The 2019 McKinsey Report on diversity moves this discussion directly into corporate profits. Based on their analysis of top-ranked companies, the “...most diverse companies are now more likely than ever to outperform less diverse peers on profitability” [5, online].

Further, students who matriculate with engineering degrees have access to some of the highest-paying jobs upon graduation [6]. Since there is a well-established correlation between poverty and race [7], engineering can be a path that students take to help improve their long-term financial position¹.

Broadening participation in undergraduate and graduate engineering is a step in the right direction towards equity. However, demographic diversity alone cannot fix the systemic cultural issues at play that contribute to students feeling unwelcome in the field [9]. Social structural and institutional change is imperative to increase opportunities and broaden participation in engineering (BPE) fields for all.

It is unlikely that any single intervention can significantly broaden participation in engineering, let alone drive the effort for systemic change. However, broader change could be possible through the processes enabled through *collective impact*. Collective impact (CI) is defined as bringing isolated organizations, networks, and societies together in a structured way to achieve a goal impacting social change [10].

As part of a new effort to broaden participation of marginalized students studying engineering through a National Science Foundation (NSF) funded Alliance, the Alliance leadership team has adopted the CI model to bring significant change to systems for equitable inclusion. This Alliance has brought together multiple partner organizations from across the U.S. who have worked within their own organizations to BPE (e.g., racial/ethnic, gender). The coordinated efforts are designed to address problem of participation at a significantly larger scale.

In this qualitative study, we wanted to understand the experiences, culture, beliefs, and dynamics that Alliance members brought with them based on their previous experiences, which ultimately may influence early dynamics within the Alliance as it formed, particularly as agendas were being set and five-year plans were being created. Our two research questions for this study are:

RQ1: What were the Alliance members’ prior experiences in collaborative networks that they bring into the new Alliance?

¹We use the definition of racial/ethnically underrepresented groups as defined by one of the partner organizations, which aligns with U.S. federal statute and the National Action Council for Minorities in Engineering. However, as researchers we recognize a need to include Southeast Asians, such as Hmong Americans, who are also underrepresented in STEM undergraduate degree in the U.S. [8]

RQ2: In the context of equity, how are the newly formed Alliance's members' funds of knowledge being honored and valued?

The Alliance is led by a small team of principal investigators, all with PhDs and from historically marginalized groups in engineering and leaders in their respective fields, that is guiding the work of leaders from a variety of partner organizations, including educational institutions of different scales and types, and professional societies. Three main drivers are evident in the partner organizations: academic, industry, and community perspectives. Members from the partner organizations are also at different points in their career paths, including early-, mid-, and late-career experience. These factors influence their perspectives and lens on collaborative work and CI partnerships, both in general and related to this Alliance. Understanding the basic heterogeneity of members involved in this Alliance is important for interpreting the nuances of the findings and wider Alliance insights. All are collectively working towards the broader goal of increasing the number of students from historically marginalized groups that are graduating from post-secondary institutions, approaching the work through different lenses and networks.

This study is important since NSF-funded alliances are a significant award designed to support organizations that seek to broaden participation in the sciences and engineering. Understanding how these alliances form and operate can expose some of the affordances as well as barriers to accomplish their broadening participation goals. Other CI groups may also be able to use these findings when forming and mitigate barriers in advance of potential issues that may arise.

2 Background

In this section, we discuss the CI model (including its theoretical framework) and how funds of knowledge [11] can be honored within a collaborative group. Moll et al. define funds of knowledge as “These historically-accumulated and culturally-developed bodies of knowledge and skills essential for household or individual functioning and well-being” [12, p. 133]. Applied to this Alliance, funds of knowledge are the historically-accumulated and culturally-developed bodies of knowledge and skills essential that members bring with them into the Alliance. Both areas are important to ground the work of gathering historical and current experiences around members' shared, social impact goal of changing systems to increase the number of underrepresented engineering graduates in higher education.

2.1 Collective Impact

CI is a practical model [13] and approach for large scale social change [14]. The model offers a structure for cross-sector partnerships that bring together disparate groups around a common goal. The structure has five conditions: common agenda, shared measurement, mutually reinforcing activities, continuous communication, and backbone support (Table 1). We chose this model in our research study to understand where the Alliance's strengths and weaknesses are with respect to working collectively to maximize impact. However, while in this paper we describe experiences within the U.S. engineering field, there are multiple examples of CI that span countries and fields [15–17].

For this study, membership in the Alliance presumes a general commitment to BPE. Having an explicit and actionable common agenda is critical, since each partner organization has their own goals, operating strategies and perspectives based on the lens in which they view and work to make change [14]. When partner organizations come together, a common agenda can mitigate the

Table 1: Conditions of the Collective Impact Model [18]

Condition	Definition
Common Agenda	All stakeholders have a shared vision for change, including a common understanding of the problem and a joint approach for solving it through agreed-upon activities.
Shared Measurement System	All service-providing participants (schools, nonprofits, and government agencies) consistently collect data and measure results to ensure efforts remain aligned and accountable.
Mutually Reinforcing Activities	Service activities are aligned through a mutually reinforcing action plan.
Continuous Communication	All stakeholders agree to consistent and open communication to build trust, articulate mutual objectives, and foster cooperation.
Backbone Support Organizations	A separate organization, called a backbone, is created to manage CI and is staffed with personnel to serve the initiative and coordinate participating organizations and agencies.

splintering effect that can occur as these organizations start working together. Having members that commit to a common agenda can help mitigate this potential fracturing and articulate the concrete benefits of working together.

Using a common set of measures provides the ability for an alliance to track progress toward its goals and to provide formative feedback. Shared measurements are one of the most challenging of the five conditions to achieve [19], since partner organizations have different goals and priorities and different ways to measure their achievements. Developing shared measurements also costs considerable resources and time. Further, trust comes into play as it can be unclear how the varying measures across organizations will be used, such as comparing progress across partner organizations conducting similar activities.

Mutually reinforcing activities are those activities that members engage in to accomplish the goals of an alliance. This includes the need for the partner organizations to understand each others' missions and goals, as well as the coordination of activities to accomplish those goals. Continuous communication includes the style and consistency of communications between members and partner organizations. This also relates to trust and the need for alliances to build trust through active and participatory communication that all contribute to relationship building.

Backbone support is described as the network administrative or lead agency that increases the CI group's effectiveness [20]. Effectiveness is increased when the backbone focuses on communication, sharing information, building trust, and engaging in activities that are mutually reinforced throughout the wider CI [21].

Researchers and practitioners often describe the CI model as the "multiplier effect", meaning that the results of the wider group will continue and spread [22]. However, it is important to note that small changes must be made in the organizations that are part of the alliance to enact change at the

broader level. In other words, continuing with the same operations of an individual organization and only coming together on the premise, rather than the active articulation, of a shared mission will not result in the goals of a CI [22].

2.2 Dynamics of Past Organizational Practices

While the benefits of partnering to embrace CI are great, successful CI partnerships are dependent on the dynamics between and within the partner organizations. One researcher emphasized the importance of tapping into the “local knowledge” of the leaders in the partnership who represent the organizations, which, in turn, enables the leaders to gain legitimacy within the partnership [23]. Actions that can impede successful partnerships include conflict over goals and objectives, different philosophies among partner organizations, power relations, and community exclusion [24]. Power imbalances can inhibit equity-focused goals as well as inclusivity in partnerships. Further, power imbalances can inhibit the building of trust among members [25–28]. Balancing the power dynamics and honoring values of the partner organizations in CI partnerships is an acknowledged challenge that is critical to address [29–31].

There is a need to build capacity for cooperation and mutualism (engagement in mutually reinforcing activities) among partner organizations, including ensuring sufficient and comparable incentives to establish a “symbiotic inter-dependency” [24]. If partnerships are to be effective, then mutual benefit and reciprocity are needed [32, 33]. Further, Ostrom describes the connection between communication and trust, stating that in general, “...the efficacy of communication appears to be related to the increased trust that individuals acquire when promises are made to them in a face-to-face setting” [33, p. 158]. Loss of trust can lead to partner organizations leaving (or disengaging in) the partnership [33].

Specific partnership goals may not be clear, or members may differ in their understandings and interpretations of what the goals mean [34]. This can quickly lead to further distrust and misunderstandings and can potentially lead to conflict between partner organizations. This only further emphasizes the importance of establishing shared language and norms, as well as the necessity of truly understanding each member’s organization and the contexts of the people that the organizations serve.

2.3 Honoring Partner Organizations and Individual Members

Honoring members’ expertise and background is also essential in building trust. It has been found that, due to the newness of the model and the lack of inclusive community voices, the CI model has not yet proven to be effective [35]. One criticism of the CI model points to a failure of the model to ensure groups employing the CI framework are adequately addressing equity. This includes ensuring that community members of the partner organizations have a voice within the group, which is centrally related to the research that states groups are more effective when they study the issue and its *context* [36]. Context, in this case, includes the community’s voice in identifying and addressing problems through shared decision making. Because these organizations represent students and other communities of color, the silencing of any member in Alliance operations can enact further exclusion of those communities.

A group of researchers sought to understand what makes CI an effective approach to partnership work that leads to systemic social change. They found that the “...promise, as well as challenges,

lie in its inherent demand for relationships between ‘unlikely partners’, its call to establish equitable practices in relationship building and its goal to foster systemic change through collective responsibility” [37, online].

As stated by Kania and Kramer, “Without purposefully bringing an equity lens to bear on every aspect of the collective impact process, practitioners inevitably miss opportunities to seek out, recognize, and purposefully resolve inequities in their local context that can block the change they seek to achieve. [Simply] adding ‘equity’ to the collective impact agenda is not enough. Organizations engaged in collective impact initiatives should first consider and act on *how they need to change within by applying an equity lens to their own people and practices*” [14, p. 2]. This includes navigating through the discomfort often experienced when discussing concepts associated with equity, such as racism and misogyny [38, 39]. Regardless of the uncomfortable conversations that may arise, it is important to develop common language, as well as shared methods for disaggregating student data [14] based on the demographic changes sought by the CI.

3 Methodology

Our research questions were *What were the Alliance members’ prior experiences in collaborative networks that they bring into the new Alliance?* and *In the context of equity, how are the newly formed Alliance’s members’ funds of knowledge being honored and valued?*. To answer these questions, we used the Framework Method [40] for conducting a qualitative study using a semi-structured interview protocol with members from partner organizations within this Alliance².

3.1 Data Collection

Two of the researchers conducted the interviews in which participants reflected on the first four months of the start of the Alliance to gain baseline knowledge of the type of early patterns and norms being established and factors that may contribute to their establishment. We asked questions designed to elicit a clear picture of members’ frame of reference for beginning the collaboration. The members interviewed represent the partner organizations. The questions were derived from the definitions of the CI model (see Table 1). For example, under the Common Agenda code “Identification of Problem to Address Collectively”, we could tag this as experiences in their existing/prior teams (“how prior teams identified problem to address collectively”) or we could tag this as related to the Alliance (“how the Alliance identifies problems to address collectively”). This provided an easy way for us to identify the experiences that members brought into the Alliance and how those previous experiences influence the Alliance to date.

We conducted interviews with 13 leaders from each of the networks and partner organizations to understand their institutions’ historical context and their own professional background in their networks, societies, and organizations through the lens of wider CI. These members included five people from academic institutions, five organization leads from their respective partner organizations, three organization leads from their respective grant-driven networks, and one external partner organization responsible for research and evaluation. These leaders are all associated with and actively engaged in activities to broaden participation in engineering programs.

²Protocol and questions can be provided upon request

3.2 Data Analysis

The interviews ranged from 24 to 58 minutes, averaging 44 minutes. During the semi-structured interviews (conducted virtually using Zoom), the two primary researchers documented in-the-moment, synchronous reflections about members' responses to the questions. Through this process, they were able to hone in on specific topics, themes, and questions that were highly referenced during the interviews.

Prior to starting the asynchronous coding and following the Framework method for qualitative analysis [40], two of the researchers established a set of codes based on the CI model to engage in a deductive coding process. In addition to those, we formed new codes that we defined as *preconditions*. These codes evolved from discussions after interviews were conducted and were based on the synchronous note-taking taken during the interviews, as well as documented literature regarding best practices when beginning collaborative work (see Section 2). The preconditions included how the partner organizations were formed, the motivations of the partner organizations to join the partnership, members' expectations, members' work styles, and relationship building among members and partner organizations. These were found in the interviews but are not included explicitly in the CI model from which the other codes were formed.

After establishing the codes *a priori*, the primary researchers and one additional researcher asynchronously coded one of the interviews using Dedoose [41]. We used descriptive coding (first round) and focused coding (second round) to classify responses [40?]. One of the researchers initially coded the data, then the research team reconciled the analysis through a process of collaborative coding and discussion [42]. Once one researcher completed their interview, one of the other researchers examined 10-20% of the codes and recorded any additions and disagreements. All three researchers then met to discuss the few coding differences and came to a consensus on the codes. The remaining interviews were divided between the three researchers for the first pass of coding, which was followed by a second coding pass of 10-20% of text and codes. After we completed coding, we met again to discuss discrepancies and arrive at a consensus on how these minimal coding differences should be resolved.

After coding and categorizing the data, the three researchers, along with the fourth, met to discuss themes and findings based on theoretical frameworks and scholarship. These discussions contributed to findings in Sections 4 and 5. When referencing the quotes, we edited for brevity and clarity by taking out unintended or unneeded repetition or filler words.

3.3 Positionality Statement

All four researchers identify as cis-gender white women with research experience. We recognize that our work is in part only possible due to the structural racism and injustice in our communities. Without disenfranchisement of students in STEM, we would not have funding for our work. Researcher 1 has over 15 years of experience as a researcher, with extensive expertise in the field of diversity and equity in PK-16 environments. Researcher 2 has been a STEM education researcher and evaluator for over 15 years. Her work has a focus on broadening participation in computer science and engineering. Researcher 3 has industry experience as a computer scientist and systems analyst combined with formal training in education research. Her research has focused on broadening participation in computer science. Finally, Researcher 4 holds a tenured academic position at a U.S. university. She conducts historical research on framings of human differences (including

conceptions of race, gender, sexuality and disability) in higher STEM education, and on understandings of racism, misogyny, and other forms of harm and violence in the context of engineering knowledge and practice.

4 Results and Implications

After the semi-structured interviews were transcribed and coded, we examined the data based on 1) the foundational structures that members bring with them to the Alliance and 2) structural constructs within the Alliance that will impact the work moving forward. The CI model was disaggregated into prior experiences in other collaborative work and current experiences within the first four months of the Alliance.

4.1 Previous Experiences

To answer our RQ1, we examined the results along the Alliance members' previous experiences. Since members with previous and varying experiences work collaboratively, we focused on those experiences for conceptualizing the frame of reference each member has regarding structural aspects of networks, organizations, or institutions.

4.1.1 Preconditions

In the context of CI, preconditions refer to various ways members have built relationships through experiences and beliefs about member engagement. Although various members have worked together in formal and informal ways in the past, they have not worked as a full group. Preconditions consist of team formation, motivations for doing the work (organization and personal), expectations, work styles, and building relationships within the Alliance.

Many of the interviewed members reflected on the need for authentic buy-in from all members to collaborate on the goals of the work put forth. That is, shared commitment across the Alliance is required in order for any individual commitment to bring results. The buy-in is often in the form of personal or professional motivation and relationship building. One participant stated, the work of the network "should be very much tied" to their "individual [student's] development plan and professional development to move along a career pathway guided by evidence-based practices that will be implemented and supported by their institution." Supported by research [23], this statement speaks to the motivation and importance of relationship building and using "local knowledge" to meet the needs of the specific members, which is to increase student success, especially among historically marginalized students in the engineering field. Further, when buy-in is acquired, there is an increased sense of legitimacy to the work [23].

Additionally, members documented the importance of empowering the stakeholders to be change agents in the previous networks they have been part of, while also providing avenues for collaboration within the CI. One interviewee stated, "...the work that got done (focused on) bottom-up top-down, collaboration of the stakeholders, empowering stakeholders as change agents, providing adequate support and resources for them to be able to collaborate and network, leveraging professional societies and expertise." The list of needs for work to get done provided by this participant supports the concept that power imbalances need to be addressed. Bottom-up and top-down collaboration or empowering members at various levels to complete work will not be accomplished if members feel dishonored or lack trust [29–31].

4.1.2 *Common Agenda*

A common agenda among members is critical as it lays the foundation for a common understanding of the problem and a joint approach for solving it [14]. For this, we examined problem identification, members' relationship to the problem, vision for change and goal setting, and that the goals match with the objectives of members. As previously stated, members are all committed to BPE through diversifying pathways to engineering learning and livelihoods, with expertise in working across the engineering pathway. Members also have extensive personal and professional experience working broadening participation in engineering.

In previous experiences, most of the members speak about setting goals collaboratively with partner organizations. The members and partner organizations that have partnered with others often do so to access the assets that include expertise, networks, political capital or influence, monetary support, and more expertise of another organization. This is a way to maximize resources and share efficiencies. Typically, as evident in the interviews, members have experience with collaboration that has been goal-focused and well defined. For example, one member speaks of past collaborative partnerships with the recognition that "there's only so much bandwidth so let's find the low hanging fruit, where it's going to be a benefit to both our organizations, both our memberships and let's work on those couple of things to get started. And again, if it expands and grows, or in the course of our work we find other things that make sense then great, we'll do it." This is supported in research through the concept of mutualism [24].

4.1.3 *Shared Measures*

Shared Measures within an alliance allow a team to consistently collect data and measure results to ensure efforts remain aligned and accountable. This includes the examination of data collected and analyzed and aligning the data with goals for accountability. Members discussed shared measures in three different ways to evidence change in previous collaborative networks: 1) report to funders or other stakeholders, which are often connected to metrics that verify participation (such as attendance records, transcripts to monitor grades, demographics etc.), 2) measure for how funds were spent in more of a budgetary capacity or 3) set strategies for the organization. The types of shared measures discussed by members varied based on needs such as entering data for Federal grants or focusing on target resources for their demographics. For example, one member noted data may show that they are successfully recruiting diverse talent, but not retaining talent. Or, provide shared shares "to translate some of those best or promising practices over so folks can use that to evaluate what they're doing, make corrections, adjustments and changes and see if we can see some change in the numbers moving forward." Finally, the varied way shared measures were discussed in the interviews regarding previous experiences is supported by research that states shared measures are one of the most challenging of the CI conditions because of varied programmatic goals [19].

4.1.4 *Mutually Reinforcing Activities (MRA)*

We examined MRAs for mission alignment and coordination of services. Successfully defining these MRAs means understanding the value proposition for both sides of a partnership. Many of the members bring a history of collaboration around establishing student support, recognizing that students are often tapping into multiple organizations' resources. It has been a more efficient use of resources and expertise to leverage the programmatic expertise of each organization rather than any one group trying to offer more comprehensive work with one member noting that "every time we collaborate, it's out of purpose and most things we collaborate around our programming."

This concept is supported by the multiplier effect, or the interactions of small changes making a larger impact [22]. Members are also cognizant that not all communities are the same, and so coordinating activities allow even under-resourced member networks to meet the needs of all students when there is programmatic alignment.

Most of the members spoke to the importance of a value proposition alignment when developing MRAs for both the Alliance and partner organizations, which is supported by the concept of mutualism [24]. One stated, “the value proposition has to be both for the individual and the institution they come from, in addition to their connection to the hub, and its work”. While another participant recognized that “there’s a realization that if we don’t share, if we don’t figure it out together, we’re all going to be in a lot of trouble.” By recognizing the collective power, collaboration is supported because members see value in sharing and exchanging knowledge to reach an end goal. For example, when working with industry stakeholders, competing companies can come together to exchange best practices because “we all need to retain and advance our talents. So, we’re kind of all in this together.”

In addition to programming, there are also opportunities to leverage one member’s political capital in support of the greater good. This form of capital is exemplified within institutions where one stakeholder may be better situated than others to talk to senior administrators serving as the final “yes” in a line of decision-makers. For example, one participant stated, “Typically, their (program managers) voices are not held in high esteem because they’re at lower levels. Whereas I can talk to presidents and chancellors. I have some sway with them.” This concept is in direct opposition to the foundational tenets of CI partnerships, which focus on relationship building and trust, breaking down barriers, and balancing the power dynamics to include all voices and stakeholders [29–31]. If these previous experiences with power dynamics are brought into the Alliance, it could create difficult or adversarial collaboration at times [26], which could lead to a lack of trust [25–28] or partner organizations leaving the partnership [33].

4.1.5 Continuous Communication

Continuous communication in CI refers to the various ways members have engaged in communication structures that foster trust, consistency, and either opened or closed paths of communication in previous networks. Some members stated formal meetings had set agendas while others used informal meetings to communicate needs of stakeholders and discuss steps to address issues. In response to a question regarding regular meetings and agendas for sharing knowledge, one participant stated “Do we have a meeting agenda? No, and we will never go that route.” Further, the concept of top-down or bottom-up decision-making and communication differed among members’ past experiences. One participant stated, “I don’t like to make top-down kind of decisions. I try to make sure that they (all stakeholders) are involved in the decision making, even sometimes without it slowing the progress of the project.” In essence, this speaks to the highly varied ways members have engaged in collaborative or non-collaborative communication in the past, all of which could influence the current Alliance [33].

4.1.6 Backbone Support

Backbone support, within the context of CI, refers to a sub-group of the larger Alliance tasked with managing the entire project [20]. For the backbone support to be successful, sufficient funding and resources are needed, as well as strategies for knowledge generation and knowledge sharing. How-

ever, in the coding of the interviews, the researchers had a difficult time finding true measures of backbone support due to the limited knowledge of what backbone support truly is in a CI. Therefore, we pulled the closest configuration of quotes to support research of the current Alliance's backbone support. Organizing accountability measures within prior networks is one frame of reference that members reported. Specifically, “[anon] kind of doles out money and expects people to do things and report about it, [but] there's no shared learning.” Another participant stated, “my day to day responsibilities [include] just making sure I have control over the budgetary oversight on the grant making sure that all members remain engaged and doing what we had proposed to the funding agency.”

Intentional knowledge sharing with the wider network is another piece of backbone-related support that was prevalent among members. One participant specifically stated, “So that there is the structural support and providing resources beyond just getting people together to talk. We have resources like newsletters and other things that help you participate casually as well as deeply. [These] are really important. And that there's utility to being part of that community. And that comes from a growing sense of resources. And the best resources are when they're curated, and are crowd sourced.”

4.2 Honoring and Valuing Knowledge of Members

For a successful Alliance, it is important that the individual organizations, societies, and networks feel they are being honored, valued, and as if their voice is being heard in the Alliance. To answer RQ2, we focus on the current reality of the Alliance, again based on the CI model.

4.2.1 Preconditions

The members are “truly invested in trying to build capacity in this (diversity in the Engineering field) space”, with a group of individuals who are and have been motivated and dedicated to BPE for years. This is evident through the collaborative work and relationship building between and among organizations and societies with similar missions and goals. The Alliance team's formation process, however, has created a sense of siloing among some members. Several members stated that a major goal of the Alliance is to “break down silos” to “recognize that their value proposition can only be strengthened by a collective value proposition in collaboration and in concert with all of the other stakeholders.” Essentially, for future success, members stated that there needs to be an importance placed on interlocking the missions of the various groups to decrease siloed efforts towards the work of the overall goal of the Alliance [34].

4.2.2 Common Agenda

Though the Alliance came together in response to a major solicitation, members reported that it was created quickly and focused on a theoretical concept of BPE rather than defining actions to address it [14]. Now that the Alliance is funded, there seems to be cautious optimism for its potential impact. One member says “the reason why we were excited about what this Alliance was going to look like is that it was essentially bringing together all of these heads of the family, if you will, to align our goals where they could ally to make something bigger than we could do on our own.” Despite this, there remains a critical need for more deeply defining roots of the problem and Alliance goals [34]. Another noted that “we haven't even really spent the time understanding the problem that we're trying to engineer the solution to.” Others echoed this sentiment, stating “I think clearly defining what that common goal is, is part of an essential, successful Alliance so

that we're not going in different directions and not understanding ultimately what we need to do to support the overarching goal that we all agree upon."

In addition, the required systems change at the heart of the Alliance's goals is complicated and has arguably been ignored in the first four months. One member noted that "there isn't enough attention paid to the to the uniqueness of the different communities involved. . . sometimes I feel like we're not even at the point of recognizing that indigenous communities are separate from Black communities are separate from next communities and I think that, you know, this idea that if we just promote diversity, it will appear is problematic and is doesn't work." This statement supports the concept of "local knowledge" described in the background section [23]. Further, the implementation context is also complex with members representing multiple stakeholders. One participant stated that they (the member) are still trying to define "why do I want to be a part of this other than the greater good because at the end of the day, you know, there's only so much time for the greater good in the work we're all doing right."

4.2.3 *Shared Measures*

Research shows that the concept of shared measures in CI is one of the most challenging of the CI conditions because of varied programmatic goals [19], and the Alliance's shared measures are still evolving. When coding the interviews, we had a difficult time aligning the member quotes to shared measures due to the members' limited knowledge regarding shared measures within a CI. Therefore, we pulled the closest configuration of quotes to support research of the current Alliance's concept of shared measures. The leadership team is focused on the grant-management components, specifically creating systems to monitor progress of each strategy area. It is noted that moving towards a more collective and strategic use of data may just take more time, as we are in the infancy of this Alliance. One member of the team noted that "I think we have to build some initial successes with your one or two groups, and then replicate that. So I think once one group sees that (initial success), buys into a vision, then you can be successful with influencing others. Until that happens, everyone's gonna keep saying it's too hard. We basically have gatekeepers on networks here. And there's a tendency to be protective of those." Conversely, one member stated, "I feel like we can't see the forest for the trees [and] we're more preoccupied in the first quarter of putting things on Excel sheets. than having deep dive discussions."

4.2.4 *Mutually Reinforcing Activities*

Developing authentic partnerships takes time. The Alliance is still in the early stages of developing the strategies to be used for meeting Alliance goals. Structures are being put in place to coordinate activities, however "we meet regularly, but it's not clear what the actions are" according to one participant. Though the project is currently developing, many of the groups involved in the Alliance have prior (and current) working relationships and are optimistic about the potential impact of the program.

4.2.5 *Continuous Communication*

The importance of continuous communication was clear in the data. While continuous communication structures are outlined, there are members who identify as part of a historically marginalized group in engineering and who reported a sense of being ignored or undervalued. A participant stated, "I think there is a sense that people (the project backbone support) think they are being honored. But the framework by which they're honoring is one that says you have expertise; we're

helping you amplify your expertise in a siloed environment.” Arguably, members are ‘unlikely partners’ in the wider community, therefore establishing equitable relationship building practices is a documented challenge for this Alliance [37, online].

4.2.6 Backbone Support

The most prevalent theme of backbone support evidenced in the interview data was funding. There is not a common understanding of how funds are being equitably allocated and how the allocated funds will create impact. To summarize this, one participant stated, “How are those resources being used to build capacity to affect change, versus resources that are being used to just build a website?” Supporting this concept is the lack of structure in the Alliance around knowledge sharing. Questions that members are asking include, “How do we engage people to be part of the community?” and “How do we engage institutions?”

An important piece to note, regarding the backbone support this early in the Alliance collaboration, is that there is work being done behind the scenes that is not yet visible to all of the members. They are working on hiring a program manager, developing a library and website as a resource, and other behind the scenes work that will become visible to the wider group in the coming months, therefore creating a platform for mutually reinforced activities in the Alliance [21].

5 Identifying Early Stage Issues

Overall, we found a wide variance in most areas of analysis, which supports the need for greater alignment and for addressing the foundational concepts of culture and trust. This analysis opened the door for us to identify early stage issues related to the way that the Alliance collaborates. The members we interviewed were forthcoming in their previous experiences as well as perceptions of the current Alliance. Based on the results, there are early stage issues that can be addressed.

Here, we compare pre-alliance collaborative work and the collaborative work reported thus far in the Alliance.

5.1 Identifying Early Stage Issues

Inherent in both the power dynamics and historical contexts of the Alliance partner organizations, there is a sense of a hierarchical culture, common in educational and policy and other professional settings, that impacts the organization’s impact of support and intervention. This is experienced as an inequitable situation in which the organizations and their individual representatives are impeded in bringing about social change [29–31]. However, as seen in other types of collaborative research and practitioner practices, a balance of trust and a shared orientation for authentic collaboration between and among all of the partner organizations and societies is essential to influence social change [43]. Further, there is a need to recognize the imbalance of power and oppression based on gender, professional identity, and race/ethnicity, all which lead to power dynamics that could make collaboration difficult or adversarial at times [26, 44]. Arguably, the Alliance needs authentic collaboration to impact social change (e.g., increase diverse engineering higher education graduates), recognize and address inherent power and oppression dynamics, and work towards eradicating inequity in the Alliance.

5.1.1 Early Stage Implications

Members are invested in the overall work of BPE, both in previous experiences and within the context of the current Alliance. A challenge for the Alliance is to empower all voices to come

together as change agents in a collaborative relationship. This challenge has already started to be addressed through sharing and connecting individual goals to the collective goals during biweekly meetings. Through this process, we predict members will develop a deeper connection, therefore breaking down silos, which will strengthen the collective value proposition.

5.1.2 Common Agenda

All members are joining the Alliance with the best intentions and optimism for broadening participation in engineering. We found a distinct difference in the process of setting a common agenda and creating collaborative relationships between organizations that have a more diversified funding model with a more “bottom-up” approach, as compared to organizations that have a primarily grant-driven with a more “top-down” approach. It remains to be seen how the Alliance members refine the goals and objectives over time to have greater impact, especially since each of the members have their own organizational goals, missions, and stakeholders that hold them accountable. It will be important to fully develop a shared understanding of 1) root causes of underrepresentation and exclusion in engineering, 2) assets that each partner organization brings to the team, and 3) how to coordinate and leverage the social capital, political capital, and programmatic expertise from each group so that the Alliance’s impact is greater than it would be if each group continued working in a siloed effort.

5.1.3 Shared Measures

The evidence suggests that the Alliance is currently focused on setting up grant accountability rather than identifying measures to better design MRAs in support of collective agendas. Understanding the data landscape to support further work in defining the common agenda could be an opportunity for members to engage in creative problem solving. Importantly, collectively defining the success measures and accountability towards achieving systemic change, and not purely monitoring, can help build a sense of shared commitment, trust, and accountability towards each other, not just to the funding organization.

5.1.4 Mutually Reinforcing Activities

Developing MRAs that add value to the member organizations and the Alliance is an active and on-going process. The greatest risk is that the Alliance funds “more” of what the member organizations are already doing and not developing strategies for systemic change. Avoiding this trap will depend on refining the common agenda, nurturing continuous communication, and identifying appropriate shared measures.

5.1.5 Continuous Communication

Continuous communication ensures that all members have shared knowledge of decisions and all voices are heard and valued within the Alliance. However, a current challenge is involving all voices equitably. As evident, the Alliance involves thought leaders in their respective fields. However, engaging in reflective knowledge generating and sharing to specifically include the voices of silenced members is imperative for CI.

5.1.6 Backbone Support

Four months into the Alliance, it is important to note that the backbone support concept and definition are among the least understood aspects of the overall project, somewhat due to the lack

of backbone support visibility. As evident in the data, many members do not have specific experiences related to the purpose of a backbone within the context of the CI model. Therefore, generating new knowledge is a concept many were unable to report during their interviews. Generating new knowledge, especially within the context of the perceived siloing among members' networks and organizations, will need to be thoroughly outlined by the wider group and supported through the efforts of the backbone.

5.2 Limitations

The CI model is relatively new to most members of the newly developed Alliance and there is a limited shared understanding of the definitions of a CI overall and the specificity of the purpose of backbone support in the light of CI aims. Therefore, a current limitation is a gap in the foundational definitions needed to complete the Alliance work with fidelity. Another limitation is the timing of the interviews, which were completed in the early stages when the team was still forming and evolving with new members added frequently. Due to the timing, some of the key personnel were not able to participate. Finally, our codebook has only been vetted in this one context, so there is a lack of use in a wider context.

6 Conclusion

There are three main takeaways from this study. First, the Collective Impact model can be used as a method of inquiry for teasing out how well members function as an Alliance and what types of previous experiences members bring in that might influence the collaboration either positively or negatively. Second, based on our results, *it is inferred that experiences in previous networks influence members' collaborative work within a CI group*. Finally, based on members' previous experiences, all of the CI key components may not be equally valued or implemented, and this can influence the group dynamics.

It is important to emphasize that Alliance members have optimism for the future work of this collaborative. Members are considering elements in a more robust way than is customary and there is excited anticipation for the project looking different in the coming months, primarily through the behind the scenes work of the backbone support team.

Acknowledgment

This material is based upon work supported by the U.S. National Science Foundation under Grant No. HRD-2119930.

References

- [1] National Center for Education Statistics, "Iped data explorer," 2020. [Online]. Available: <https://nces.ed.gov/ipeds/Search>
- [2] J. S. London, W. C. Lee, and C. D. Hawkins Ash, "Potential engineers: A systematic literature review exploring black children's access to and experiences with stem," *Journal of Engineering Education*, vol. 110, no. 4, pp. 1003–1026, 2021.
- [3] J. Munro, "Nikhil pal singh, black is a country: Race and the unfinished struggle for democracy (cambridge, ma: Harvard university press, 2004,£ 19.95) pp. 285. isbn 0-674-01300-x." *Journal of American Studies*, vol. 39, no. 3, pp. 571–572, 2005.

- [4] S. Page, *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies*. Princeton University Press, 2007.
- [5] V. Hunt, S. Prince, S. Dixon-Fyle, and K. Dolan, “Diversity wins: How inclusion matters,” McKinsey, Tech. Rep., 2020.
- [6] salary.com, “Entry level civil engineer salary in the united states,” 2022. [Online]. Available: <https://www.salary.com/research/salary/alternate/entry-level-civil-engineer-salary>
- [7] R. Reeves, E. Rodrigue, and E. Kneebone, “Five evils: Multidimensional poverty and race in america,” *Economic Studies at Brookings Report*, vol. 1, pp. 1–22, 2016.
- [8] T. Her, “The underrepresentation of hmong american college students in stem majors,” Ph.D. dissertation, California State University, Fresno, 2019.
- [9] E. Blosser, “An examination of black women’s experiences in undergraduate engineering on a primarily white campus: Considering institutional strategies for change,” *Journal of Engineering Education*, vol. 109, no. 1, pp. 52–71, 2020.
- [10] W. DuBow, S. Hug, B. Serafini, and E. Litzler, “Expanding our understanding of backbone organizations in collective impact initiatives,” *Community Development*, vol. 49, no. 3, pp. 256–273, 2018.
- [11] Funds of Knowledge Alliance, “The Funds of Knowledge approach,” 2023.
- [12] L. C. Moll, C. Amanti, D. Neff, and N. Gonzalez, “Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms,” *Theory into practice*, vol. 31, no. 2, pp. 132–141, 1992.
- [13] A.-M. Boyer, K. R. Cooper, S. M. Dougherty, R. Wang, and M. Shumate, “Predicting community adoption of collective impact in the united states: A national scan,” *Nonprofit and Voluntary Sector Quarterly*, p. 0899764020964583, 2020.
- [14] J. Kania and M. Kramer, “The equity imperative in collective impact,” *Stanford Social Innovation Review*, pp. 1–6, 2015.
- [15] N. Nguyen, “The collective impact of service workers and servicescape on the corporate image formation,” *International Journal of Hospitality Management*, vol. 25, no. 2, pp. 227–244, 2006.
- [16] C. E. Walker, T. Mahede, G. Davis, L. J. Miller, J. Girschik, K. Brameld, W. Sun, A. Rath, S. Aymé, S. R. Zubrick *et al.*, “The collective impact of rare diseases in western australia: an estimate using a population-based cohort,” *Genetics in Medicine*, vol. 19, no. 5, pp. 546–552, 2017.
- [17] S. Amed, P.-J. Naylor, S. Pinkney, S. Shea, L. C. Mâsse, S. Berg, J.-P. Collet, and J. W. Higgins, “Creating a collective impact on childhood obesity: Lessons from the scope initiative,” *Canadian Journal of Public Health*, vol. 106, no. 6, pp. e426–e433, 2015.
- [18] Collective Impact Forum, 2022. [Online]. Available: www.collectiveimpactforum.org

- [19] FSG, “Shared measurement for collective impact,” 2011. [Online]. Available: <https://www.fsg.org/blog/shared-measurement-collective-impact/>
- [20] K. G. Provan and P. Kenis, “Modes of network governance: Structure, management, and effectiveness,” *Journal of public administration research and theory*, vol. 18, no. 2, pp. 229–252, 2008.
- [21] K. Emerson, T. Nabatchi, and S. Balogh, “An integrative framework for collaborative governance,” *Journal of public administration research and theory*, vol. 22, no. 1, pp. 1–29, 2012.
- [22] M. J. Hornsey, C. M. Chapman, and D. M. Oelrichs, “Ripple effects: Can information about the collective impact of individual actions boost perceived efficacy about climate change?” *Journal of Experimental Social Psychology*, vol. 97, p. 104217, 2021.
- [23] R. W. McQuaid, “The role of partnerships in urban economic regeneration,” *INTERNATIONAL JOURNAL OF PUBLIC PRIVATE PARTNERSHIPS*, vol. 2, no. 1, pp. 3–18, 1999.
- [24] R. McQuaid, “Theory of organizational partnerships: partnership advantages, disadvantages and success factors,” 2010.
- [25] M. P. Ghiso, G. Campano, E. R. Schwab, D. Asaah, and A. Rusoja, “Mentoring in research-practice partnerships: Toward democratizing expertise,” *AERA Open*, vol. 5, no. 4, p. 2332858419879448, 2019.
- [26] B. Bevan and W. R. Penuel, *Connecting research and practice for educational improvement: Ethical and equitable approaches*. Routledge, 2017.
- [27] T. Lash, S. Wortel-London, L. A. Delyser, and L. Wright, “Building trust in computer science research-practice partnerships: A theme study,” in *Proceedings of the 50th ACM Technical Symposium on Computer Science Education*, 2019, pp. 1266–1266.
- [28] J. Denner, S. Bean, S. Campe, J. Martinez, and D. Torres, “Negotiating trust, power, and culture in a research–practice partnership,” *AERA Open*, vol. 5, no. 2, p. 2332858419858635, 2019.
- [29] B. Kennedy and A. Sisk, “Rebalancing power: Examining the role of advocacy and organizing in collective impact,” 2021. [Online]. Available: <https://frontlinesol.com/wp-content/uploads/2021/11/Collective-Impact-Forum-Research-Study-design.pdf>
- [30] E. Henrick, M. A. Munoz, and P. Cobb, “A better research-practice partnership,” *Phi Delta Kappan*, vol. 98, no. 3, pp. 23–27, 2016.
- [31] G. Ennis and M. Tofa, “Collective impact: A review of the peer-reviewed research,” *Australian Social Work*, vol. 73, no. 1, pp. 32–47, 2020.
- [32] M. Lubell and J. T. Scholz, “Cooperation, reciprocity, and the collective-action heuristic,” *American Journal of Political Science*, pp. 160–178, 2001.
- [33] E. Ostrom, “Analyzing collective action,” *Agricultural economics*, vol. 41, pp. 155–166, 2010.

- [34] I. Mitchell and R. McQuaid, "Developing models of partnership in economic regeneration," *Public and Private Sector Partnerships—The Enterprise Governance*, pp. 395–406, 2001.
- [35] T. Wolff, M. Minkler, S. M. Wolfe, B. Berkowitz, L. Bowen, F. D. Butterfoss, B. D. Christens, V. T. Francisco, A. T. Himmelman, and K. S. Lee, "Collaborating for equity and justice: Moving beyond collective impact," 2016.
- [36] J. Smart, "Collective impact: evidence and implications for practice," 2017. [Online]. Available: <https://apo.org.au/sites/default/files/resource-files/2017-11/apo-nid121301.pdf>
- [37] M. Mayan, A. L. Pauchulo, D. Gillespie, D. Misita, and T. Mejia, "The promise of collective impact partnerships," *Community Development Journal*, vol. 55, no. 3, pp. 515–532, 2020.
- [38] B. Blaisdell, "Beyond discomfort? equity coaching to disrupt whiteness," *Whiteness and Education*, vol. 3, no. 2, pp. 162–181, 2018.
- [39] S. Hauk, A. F. Toney, A. Brown, and K. Salguero, "Activities for enacting equity in mathematics education research," *International Journal of Research in Undergraduate Mathematics Education*, vol. 7, no. 1, pp. 61–76, 2021.
- [40] N. K. Gale, G. Heath, E. Cameron, S. Rashid, and S. Redwood, "Using the framework method for the analysis of qualitative data in multi-disciplinary health research," *BMC medical research methodology*, vol. 13, no. 1, pp. 1–8, 2013.
- [41] L. SocioCultural Research Consultants. Dedoose version 9.0.17. [Online]. Available: www.dedoose.com
- [42] M. Syed and S. C. Nelson, "Guidelines for Establishing Reliability When Coding Narrative Data," *Emerging Adulthood*, vol. 3, no. 6, pp. 375–387, 2015.
- [43] M. R. Warren, J. Calderón, L. A. Kupscznk, G. Squires, and C. Su, "Is collaborative, community-engaged scholarship more rigorous than traditional scholarship? on advocacy, bias, and social science research," *Urban Education*, vol. 53, no. 4, pp. 445–472, 2018.
- [44] V. Tseng, J. Q. Easton, and L. H. Supplee, "Research-practice partnerships: Building two-way streets of engagement," *Social Policy Report*, vol. 30, no. 4, pp. 1–17, 2017.