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Centering equity in an NSF engineering education alliance: Considerations for complex, multi stakeholder work

Rebecca Zarch, SageFox Consulting Group
Monica McGill, CSEdResearch.org

Monica McGill is President & CEO of CSEdResearch.org and a Temporary Research Specialist at Knox College. 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.

Centering equity in an NSF engineering education Alliance: Considerations for complex, multi-stakeholder work

Abstract

The underrepresentation of women and Black, Indigenous, and People of Color (BIPOC) in engineering degrees is a long-standing issue in the United States. The National Science Foundation's (NSF) Eddie Bernice Johnson INCLUDES (Inclusion Across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science) program aims to address this disparity by increasing diversity in science and engineering. The Engineering PLUS Alliance, one of the NSF INCLUDES Alliances, seeks to create networked communities to drive systemic change and increase the number of BIPOC students and women earning engineering degrees. This study investigates how equity is understood and centered in the work of the Alliance from the collaborators' perspective, using the Getting Equity Advocacy Results (GEAR) model to frame the interview protocol. Fifteen collaborators participated in semi-structured interviews, which were analyzed based on the four foundational components of GEAR. Key findings indicate that the absence of a clear governance structure, siloed decision-making, and communication challenges impacted the early phase of the project. The study emphasizes the importance of inclusive collaboration in conducting equity-focused work and provides insights for other Alliances seeking to promote diversity and equity in STEM fields. Implications for the Alliance include adopting the GEAR approach more widely, forming a working group to address communication challenges, and engaging in a series of sprints to refine and scale practices across the Alliance. This work will lead to a stronger base for accomplishing Alliance goals and serve as a guide for other multi-institutional collaborations focused on equity within the engineering field.

Keywords: Engineering, Equity, Alliance, National Science Foundation, collaboration, partners, women, BIPOC

Introduction

Initially funded in Summer 2021, Engineering PLUS (Partnerships Launching Underrepresented Students) is a growing collaborative network that comprises individuals, organizations, and institutions involved in engineering education, brought together in a coordinated fashion. Its vision is to leverage and grow existing networks of partners to surface and scale evidence-based practices to achieve transformative, systemic and sustainable change that will increase the growth rate in the number of BIPOC and women obtaining undergraduate/graduate engineering degrees and establish a future growth rate that can substantially close the participation gaps. The share of engineering degrees awarded to women and/or those who are Black, Indigenous and

People of Color (BIPOC) in the United States over the past decade reflects only slow progress in the efforts to increase representation of these groups at the undergraduate and graduate levels. And for men who identify as Black, Indigenous, and/or People of Color, the percentage of master's and doctoral engineering degrees being awarded has actually declined in recent years [1].

The Engineering PLUS Alliance is a National Science Foundation (NSF) funded Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES) program Alliance [2] and the only Alliance focused on engineering [3]. It exists to understand *why* these disparities persist, with a focus on the systems that uphold these inequities, including interrogating how the individual and institutional behaviors and structures that set up barriers to diversity and inclusion are built on systems of inequity that go back hundreds of years and that often play out among well-meaning people who are either poorly equipped to interrogate the stubborn conditions supporting these systems and/or have few models or incentives for critical interrogation of these deeper systemic conditions. Rather than creating new networked communities and strategies, the Alliance is designed to surface, leverage, and scale existing ones, as well as the evidence-based practices that decades of research have produced. We can then equip change agents to deploy this knowledge institutionally and regionally, building on existing networks.

There are six strategic areas to the Alliance:

1. A **backbone organization** to support Alliance efforts
2. **Partnerships** with organizations and institutions invested in engineering education, like the American Society for Engineering Education, the National Society of Black Engineers, the Society of Women Engineers, the American Indian Science and Engineering Society, the National Action Council for Minorities in Engineering and the National GEM Consortium
3. **Regional hubs** in which institutions come together to consider how local context influences disparities in their institutions
4. The **stEm PEER** academy which prepares STEM professionals to serve as change agents within their institutions of higher education
5. **Sustainability** to ensure an on-going strategy and that resources will exist beyond the life of the grant
6. A **CIDER (Continuous Improvement, Data, Evaluation and Research) group** to support the learning infrastructure for the Alliance.

The Engineering PLUS Alliance was designed using the Engineering Research Center (ERC) model. ERCs are a group of interdisciplinary research centers also funded by NSF. Similar to an INCLUDES program, these centers bring together engineers, scientists, and industrial partners to tackle challenging problems in engineering and technology. The difference is that the goals of the

NSF ERC program are highly technical, designed to advance the state of the art in engineering research and education and to transfer new technologies and knowledge to the broader scientific community and to industry.

The Engineering PLUS Alliance posits that networked communities are needed to build an inclusive infrastructure that will drive the transformative, systemic and sustainable change needed to increase the annual number of BIPOC students and women[1] earning undergraduate and graduate degrees in engineering to 100,000 and 30,000 respectively by 2026. Increasing the graduation rates of BIPOC and women in the engineering field is at the core of this multi-institutional Alliance.

As an Alliance centered on equity, it is critical for Engineering PLUS to intentionally prepare pathways for inclusive collaboration that ensure all partners have equitable opportunities to engage in the Alliance. We engaged in a research study to investigate in what ways the Alliance walks the equity walk and how it can be improved. Our research question for this study was: How is equity understood and centered in the work of the Alliance from the perspective of the collaborators? To support the exploration of our research question, we leverage a qualitative research design centering on the voices of members of the Alliance who are close collaborators, but not necessarily leaders of the Alliance.

This study is important in defining a standardized, repeatable process for ensuring that leaders remain in the position of facilitating and enabling all partners to succeed as well as ensuring that the diverse set of partners have a sense of belonging in the Alliance which will lead to maximum engagement. Not only can this process be used in the Engineering PLUS Alliance, it can also be applied as a process for other Alliances as well.

Early Challenges

A major challenge that the Alliance faced in the first 18 months of implementation was that the ERC model was not designed for equity work, nor does it provide a model for technical innovation to translate to social disruption. The project weathered some significant contextual changes early on (i.e., a shift in leadership, a simultaneously awarded large grant which pulled the human resources, and a change in partners) for which there was not a supportive infrastructure set in place to help navigate. Though there was a clear goal and vision, there was no work done early to understand how the Alliance members were conceptualizing the challenges framing the inquiry, and what they could bring to the community in terms of coordinated solutions building. Additionally, information flows within the Alliance were highly

[1] To date the Alliance has implicitly prioritized Black, Indigenous, and Hispanic/Latinx students under the BIPOC banner and women. People with disabilities, LGBTQA+ students, those with economic disadvantage and other marginalized groups have not been an explicit focus of the work.

siloed, communication systems had not been established, and the governance structure was not explicit.

The work described in this paper is part of a larger project centered on an equity-lens for both internal and external collaborative work with the common goal of diversifying the engineering field. As a sign of the coordination of equity work across the Alliance, there has never been a discussion of what "equity" means, beyond reaching greater parity in the quest for increasing the number of people earning degrees in engineering. The authors, therefore, have used interviews over the course of the project to try and discern the different ways in which participants conceptualize equity.

Engineering PLUS' Backbone organization, as originally conceptualized, might have been sufficient for a traditional ERC; in fact the people running the Engineering PLUS backbone were highly successful in running prior ERC backbones. Yet under the INCLUDES model, the Backbone required a different set of skills and tasks, particularly as a backbone organization is a key component of a collaborative infrastructure, serving as the central coordinating entity that helps to manage and support the efforts of multiple partners. These functions are essential for the success of a collaborative infrastructure, and are often critical for the ability of partners to work together effectively to achieve their goals [4].

The GEAR Model

The Engineering Research Center model is the prescribed form of *structure change* embedded into the Engineering PLUS Alliance, and Alliance stakeholders concluded that adding a *process change* framework would guide the development of processes for the ERC. Institutional pressures, difficulties of intra-disciplinary exchange, and other concrete conditions can impede equity-focused collaborations just as they can impede any other, and a critical, reflexive focus on Alliance processes was needed. The leadership team asked the research component of the CIDER strategy to recommend a framework to help the Alliance consider equity. After reviewing over a dozen equity-focused process change frameworks that could be adopted and adapted by Engineering PLUS and would be compatible with the ERC model, the research team developed a recommendation to integrate an equity-focused, systemic change framework. The final recommendation for process change within the Engineering PLUS Alliance is: GEAR: Build the Base for Equity Advocacy [5], a framework that is informed by the STELAR Center's Equity Systems Change Compass [6] and that can be integrated with ERC.

The Getting Equity Advocacy Results (GEAR) model (Fig. 1) is a framework for understanding and addressing disparities in science, technology, engineering, and mathematics (STEM) education and the workforce. The GEAR model is designed to help organizations and individuals

understand the factors that contribute to disparities in STEM fields and to develop strategies for addressing these disparities.

Figure 1: The GEAR model

The GEAR model consists of four key elements: advocacy, equity, results, and sustainability. Advocacy refers to the efforts to raise awareness and support for addressing disparities in STEM education and the workforce. Equity refers to the development of policies and practices that promote fairness and provide equal opportunities for all individuals, regardless of their background or identity. Results refer to the outcomes that are achieved as a result of these efforts, such as increased diversity in STEM fields and improved educational and career outcomes for underrepresented groups. Sustainability refers to the long-term impact and continued success of these efforts.

The GEAR model provides a roadmap for addressing disparities in STEM education and the workforce, and highlights the importance of taking a comprehensive, systemic, and evidence-based approach. The model emphasizes the need for sustained and coordinated efforts, and for a commitment to equity and social justice in STEM education and the workforce.

Methodology

Our research question for this study was: How is equity understood and centered in the work of the Alliance from the perspective of the collaborators? To investigate this research question, we used the GEAR model to frame the interview protocol. Further details about our methodology are described below.

Interview Protocol

Prior to using the GEAR model to grow the inclusiveness of the Alliance, as part of the research team, we used it to develop a set of semi-structured interview questions for the Alliance's collaborators. We structured the interview protocol around the four gears of Ongoing Organizing,

Ongoing Capacity Building, Ongoing Research and Ongoing Communications. Prompts were intentionally broad and were designed to relate to either the internal operations of the Alliance or the broader context for change. By understanding the opportunities and limitations of the equity work within the Alliance, the research team hoped to inform the development of the GEAR process as it was implemented with the broader Alliance.

Discussing equity can be difficult for several reasons. One reason is that equity is often a sensitive and emotional topic, and people may have strong opinions and beliefs about what equity means and what is required to achieve it [7]. This can lead to conflicts and disagreements, and can make it challenging to engage in open and constructive dialogue about equity. Another reason why it is hard to talk about equity is that it often involves difficult and complex issues, such as systemic discrimination, bias, and unequal distribution of resources. These issues can be difficult to understand and address, and may require deep, systemic changes to address [8]. Additionally, because equity often involves challenging dominant power structures and challenging prevailing social norms, it can be seen as a threat to the status quo. The research team was sensitive to the range of comfort and experiences as well as the political sensitivities our participants might have in discussing the Alliance. A journal was kept and during research team meetings we regularly reflected on what we were hearing in the context of the larger project implementation. This strategy potentially improved our ability to understand the complexity of participant's narratives but may also have let in researcher bias.

Statement of Researcher Positionality

The research team involved in this study included three white women. Two of the women are trained in social sciences (education, history and organizational management) and led the coding effort, while the other is trained in both social sciences and a technical field and helped with the interpretive analysis. The team members have all devoted significant personal and professional resources to developing a deep understanding of equity in STEM education. All members of the team have observed and experienced various levels of marginalization professionally writ large and within the Alliance itself, either due to sexism and/or racism and/or an underappreciation of how the social sciences can contribute to the broader Alliance mission by the leadership, which is primarily composed of people with training in engineering disciplines. In addition to these forms of marginalization, being the bearers of critical, reflexive research on the conducts of Alliance stakeholders involved the researchers in unexpected challenges. However, additional unexpected opportunities for critical community- and self-reflection also emerged.

Participants

Participants had been previously introduced to the GEAR model during a collaborators' meeting in September 2022 and in the November and December 2022 interviews and were reminded of the key components, but informed they would not need to know the model intimately to

participate in the interview. The Engineering PLUS Alliance is organized with concentric circles of participation and for these interviews, we focused on the collaborators, those who are regularly involved in the key strategy areas and meetings but not in the inner leadership circle. Of the 18 people identified for interviews, 15 participated. Interviews ranged from about 30 to 60 minutes, with most lasting 45 minutes. We recorded with participant consent and transcribed the interviews using a subscription service to artificial intelligence software (otter.ai).

Analysis

In advance of transcription, the research team developed a set of codes based on the GEAR model. Interviews were then analyzed around the four foundational themes. Table 1 presents the four key themes (gears), the definition of the theme/gear and the codes used.

Table 1: Coding scheme

Theme	Codes
Ongoing Organizing Assures that those closest to community challenges are central to seeking solutions and building power to bring them about.	● Centering voices ● Empowering individuals and Groups ● The project strategy
Ongoing Capacity Building Involves strengthening the knowledge and skills of equity advocates and their organizations to effectively engage in efforts for change.	● Decision making/makers ● Strengthen collective knowledge ● Time bandwidth
Ongoing Research Informs every aspect of the advocacy process, from documenting conditions and soliciting community participation to assessing prospective solutions and projecting the impact of change.	● High impact practices ● Identification of barriers
Ongoing Communications Involve a range of tools to strategically disseminate ideas and information and to educate stakeholders and decision makers to advance equity.	● Clarity/lack of clarity ● Dissemination of ideas ● Inclusion/Exclusion of collaborators

A priori coding based on the theoretical or conceptual framework [9] provided by GEAR ensured the coding process was focused and structured [10]. Two researchers coded the transcripts using the “Gold Standard,” which is an approach where one member of the research team codes all of the narratives in the data set, setting the standard. A second member of the research team serves as the reliability coder. The reliability coder codes a subset of the total data set, but that person’s

coding is used only to establish interrater reliability with the master coder; it is the coding of the master coder that is used in the final analysis. Any discrepancies were discussed and resolved through consensus. The final coding scheme was then used to re-code the transcripts and ensure consistent and accurate data analysis. This approach was used for efficiency and based on prior experience of the researchers.

Findings

The results suggest that there are complex interactions between the four gear components which have had a significant impact on the early phase of the project. These include:

- In the absence of a clear governance structure for the Alliance, a segmented approach with a top-down decision making strategy has emerged.
- Siloing and gatekeeping information (even if unintentional) within strategic areas also influences how feedback, support, and collaboration are conducted.
- It is difficult to find information and to keep track of what is happening in each key strategy area.
- The key strategy areas are beginning to work together; however, currently the knowledge base guiding the development of each strategy is defined or developed within the strategy area, rather than guiding multiple strategies in a consistent and cohesive manner.
- There is a clear purpose (increasing the number of women and BIPOC engineering graduates), but the underlying assumption for why this is an important objective and what the barriers are to increasing the graduation rate have not been developed at the Alliance level.

The Engineering PLUS Alliance is still undertaking the development of a robust set of systems to govern the Alliance including communications, clarity around decision-making authority and shared strategy. Without these systems the issues with bandwidth are exacerbated. In Collective Impact this is called a Backbone organization [11]. In the GEAR model it is the foundational four gears discussed below and organized early through the “building the base” efforts.

Most of the comments centered on the themes of communication and organizing, however an analysis of code co-occurrence shows that themes co-occur frequently with capacity building. (see Fig. 2).

	CODES	CAPACITY BUILDING			COMMUNICATIONS			ORGANIZING			RESEARCH		TOTALS
		Decision Making / Makers	Strengthen Collective Knowledge	Time Bandwidth	Clarity / Lack of Clarity	Dissemination of ideas	Inclusion / Exclusion of	Central Voices	Empowerment of Individuals / Groups	Project Strategy	High Impact Practices	Identification of Barriers	
CAPACITY BUILDING	Decision Making / Makers		4	9	7	8	10	5	12	11			66
	Strengthen Collective Knowledge	4		1	6	6	10	9	5	13	7	1	62
	Time Bandwidth	9	1		4	4	8	4	5	9	1		45
COMMUNICATIONS	Clarity / Lack of Clarity	7	6	4		16	19	1	4	9	2		68
	Dissemination of ideas	8	6	4	16		19	2	3	8	4	1	71
	Inclusion / Exclusion of	10	10	8	19	19		9	10	12	1		98
ORGANIZING	Central Voices	5	9	4	1	2	9		13	10	2	2	57
	Empowerment of Individuals / Groups	12	5	5	4	3	10	13		7			59
	Project Strategy	11	13	9	9	8	12	10	7		7	3	89
RESEARCH	High Impact Practices		7	1	2	4	1	2		7		2	26
	Identification of Barriers		1			1		2		3	2		9
	TOTALS	66	62	45	68	71	98	57	59	89	26	9	

Figure 2: Interaction between codes (figure notes: A color heat map has been applied to this figure to visually show the density of code co-occurrence. The darkest shades, where there was greater co-occurrence, are around communications and organizing and around communications and capacity building.)

Ongoing Organization

Ongoing Organizing assures that those closest to community challenges are central to seeking solutions and building power to bring them about. From an equity perspective the participants are optimistic about the Alliance internally and externally recognizing that the mere willingness to explore structures for equity-explicit conversation is prioritized.

Participants were quick to comment on the talent and commitment of other members of the Engineering PLUS Alliance. Given the expertise available, structures that maximize the contributions and create mutually beneficial participation are highly desirable. One person noted, however, that *"Individually — incredibly talented, devoted, amazing people. Together, the chemistry seems to be somehow off."*

There are multiple levels of influence that need to be organized across the Alliance:

- **Leadership Team (PIs, Co-PIs, Sr. Personnel.)** The leadership team is composed of diverse individuals, many of whom "*are the products of these kinds of obstacles and opportunities are part of the Engineering PLUS Leadership… We're really excited we have a representative leadership team, representing the very communities that we're trying to address."* Yet serving in professional roles that are focused on diversity and inclusion also silos the work being done within an institution. This is an important consideration as the Alliance expands through the stEm PEER Academy and Hubs; how will people who are potentially siloed within their own institutions to do DEI focused work be able to make systems-change?

- **Collaborators.** Currently, collaborators are not well centered in the governance of the Alliance. Structurally, the role of collaborators has not been clearly defined for all involved, with questions as to who will define the role and how remaining open. There is a perception that those running the Alliance had pre-existing relationships and there has been little time spent building relations with collaborators who are not part of the core team. As a result, there may be some distrust, confusion and feelings of condescension. The collaborators are clear assets to the Alliance and where the diversity of voices and perspectives can be elevated. Example comments include:

  "When we look at the data, often we are completely left out and invisibilized as a group. It's really important to make sure we are present and have an equitable footing at the table, making sure that who we are representing are represented and visible here in this setting" [edited for clarity]

  "When you're trying to get people to collaborate, what is the reasoning or benefit so that they're not losing their own individual, I guess power might be part of it, but influence?"

- **Students.** Almost all of the participants note that the systems-level goals and reorganization of the Alliance means that student voice is not present in the Engineering PLUS structure. One person noted that *"That's part of what this grant could do, is gather those voices and push them to the front."*

With so many people and groups connected to the Alliance, the absence of a clear governance structure for the Alliance has resulted in a siloed approach with a top-down decision making

strategy. In every conversation other than those with members of the PI/CoPI team respondents report that they feel they are missing information because they are not at all the meetings. Lack of information creates barriers to organizing as it slows decision-making. The hierarchical structure coupled with an unclear strategy has resulted in a lack of empowerment of groups to take action. This is evidenced by one person noting that *"Sometimes decisions cannot be made, because I think people don't feel empowered to make them"* and another noting that *"There is a very top-down structure in this project, and it doesn't allow for a broader range of inputs from everybody that's involved in this project."*

Siloing and gatekeeping of information (even if unintentional) also influences how feedback, support, and collaboration are conducted. Groups aren't feeling well-informed so they may not be empowered to take ownership. Those that do sometimes feel *"knocked down"* when their work is shared, as others are highly critical of things that could have been avoided with more information or regular feedback.

An additional issue that arose during the interviews is that of compensation. There are people working on the grant who are not being compensated for their time, some of whom expected to be paid as part of signing on to the Alliance. This is particularly problematic as the Alliance depends on unpaid labor from marginalized groups. As the Alliance grows it will be important to consider who is being paid to and have clarity around why some collaborators will be compensated and not others.

Ongoing Capacity Building

Ongoing Capacity Building involves strengthening the knowledge and skills of equity advocates and their organizations to effectively engage in efforts for change. The foundational work wasn't done early in the project to set up the systems needed for the project capacity building efforts. Without this cohesion, people consistently report that while they are working on the project individually or within their teams, how the work connects is unclear. One person noted that *"It's a little frustrating, I sort of feel like I'm doing work, that I think I'm doing the right thing, but no one's asking for it…I know what my deliverable is, and I'm working toward that. But at the same time, it's not not clear how that fits into the bigger picture."*

Not understanding the bigger context of the work leaves many open questions concerning how the collective knowledge is being strengthened. For example, though the idea of scaling best practices is clear, there are questions as to how these practices will be identified, and even the value proposition for all participating organizations and groups. One participant asked *"Am I off base, that we're not even really putting up any best practices?"* while another was questioning the strategy for collective knowledge.

Building capacity as an Alliance is also hindered by the confusion around decision-making as there is not a clear decision-making strategy, nor are people being empowered to make decisions within their strategy.In the absence of this autonomy and authority, collaborators would like more direction and clarity. One person noted that *"allowing others into the thought leadership of the project is what's also missing."*

Finally, as with most projects, time is a barrier. There are two ways time is factoring into this project. The first is individuals' time. Many of the participants recognize that no one has the time allocated to do the work that is needed; however later in conversations there is also a sense of frustration that colleagues are not completing the work expected, all while rarely (only three people) acknowledging their own time limitations.

The second way that time factors into the discussions is in the pace of the project. In many ways there is frustration that there is so little to show for being so far into the grant, with one person noting "*If I had to characterize where was this grant, it exhibits more like a grant that is at a six month mark, you know, trying to get organized, trying to figure its footing out, trying to figure out who's on first, trying to get some things off the ground. Whereas we really should be exhibiting a profile more like we're headed towards the 1.5 mark."* Highly relatedly, the grant is also moving too quickly in that the foundational work (to develop a common understanding of the barriers, strategy, and systems to support governance) is not yet robust enough to support the work.

Ongoing Research

Ongoing research is needed to inform every aspect of the advocacy process, from documenting conditions and soliciting community participation to assessing prospective solutions and projecting the impact of change. When we asked participants about their reflections of ongoing research practices in the Alliance, they recognized that they were unsure about how research that is conducted will be shared and used within the Alliance. There is also a perspective that the Alliance leadership is *"not stepping back and thinking about what it is about this community that we're trying to win, to affect, engage and help, that we're missing out in elements of communication to those groups, so that we can be more effective."* This comment also shows how closely research is embedded with communications and organizational structure of the Alliance and that the GEAR models can be looked at individually, but also must be looked at holistically.

Participants raised several points about a general lack of baseline knowledge that is critical to understand as the Alliance is engaged in systemic change. The Alliance members have voiced a lack of understanding when it comes to the baseline measures of BIPOC and women currently enrolled in and graduating from engineering programs. They are not sure how to create systemic

change, why people stop pursuing engineering degrees, the barriers to pursuing and achieving engineering degrees, how to create a sense of belonging, or if high-impact practices will be effective. They also lack understanding of the resources needed for partners to do their work, particularly within the context of their geography, locale, and culture of the people that they serve.

The Alliance and partners will propagate a range of high-impact practices in order to help students achieve their engineering degrees. These include leveraging mentoring, scaling tools to bring about change, co-designing practices with critical partners, and leveraging the knowledge of the stEm PEERs Academy and working groups to share data, research, and high-impact practices. These practices are sourced in evidence and institutions and are meant to help students stay in their respective programs and ultimately achieve their degrees. The research will inform the peers in the stEm PEERs Academy to activate, operationalize, and fuel their work and have a direct, wider, and systemic impact. However, currently the Alliance members are still figuring out how research will inform the selection and/or design of the high impact practices and in turn contribute back into the collective knowledge. Participants' comments range from looking entirely to external sources to co-creating equity solutions.

Ongoing Communications

Ongoing Communications involves a range of approaches to strategically disseminate ideas and information and to educate stakeholders and decision makers to advance equity. The lack of time to discuss problems and solutions during meetings is a major obstacle for the Alliance. Members reflected that they are not able to have meaningful conversations about the issues they face and develop solutions that can help the Alliance move forward. This lack of dialogue has led to a lack of collaboration, siloing, and contributed to an overall lack of effective and efficient processes.

Many team members recognized that processes and tools are critical for the Alliance to achieve its goals, yet 16 months into the project there is recognition that the Alliance is still critically struggling with adopting and enforcing communication norms in a way that enables success. There is recognition that there is movement in the right direction, but communication processes and tools must be put in place immediately. One participant noted that *"we're not creating collaborative glue that makes the project stick all together."*

A lack of clarity has left everyone feeling confused and unclear about their role moving forward. Participants shared their experience of feeling powerless to communicate using their own voice in the larger group. They also discussed the lack of progress in addressing issues that were identified in the past and how this is related to a systemic communication and organizational leadership problem.

While one person did state that *"we are pretty inclusively involved. I think we keep each other abreast of major decisions that are made or actually, we participate in major decision-making,"* others shared dissimilar thoughts, for example stating *"I don't think there's a clear direction, or understanding of what anyone should be doing and the Engineering PLUS"* and *"no real direction given to us of what our role should be, has just made things harder."*

Diversity and inclusion

Diversity and inclusion in communications have not been built into the culture of the Alliance. Some participants also stated that they personally don't feel excluded and have confidence that the Alliance will be governed to lead and entertain different voices and perspectives. However, multiple participants expressed concern that the implementation of strategy areas is not living up to the Alliance goals of diversity, inclusion, and equity with the result being missed voices and opportunity. For example, one participant noted *"So in terms of diversity, inclusion and equity. I mean, we're not walking, we're not, we're not walking the talk. And so we're losing out on that, you know, we're losing out on that."* They feel that some members are not feeling empowered to communicate their voice.

Some participants expressed frustration at not being included in certain meetings as well as not receiving cancellation notices. They feel like there is tension and issues with decision-making, and that there is a lack of strong leadership in terms of gender and representation. They also mentioned the annual report, which they felt was done under pressure and with a number of people not even seeing what was going into it. While one person remarked that *"I think that they are aware that perhaps there may be gaps, you know, that they may need to address that, that they will, I think so I have a lot of confidence in them, in that they can lead. And when they need to have different voices or perspectives at the table, that they're willing to entertain that. So I have a lot of confidence in them at this point,"* others were less certain.

Implications and Future Work

Despite the challenges the Alliance members have been very open to embracing the GEAR model. Based on this research, the Alliance is moving forward with recommendations centered on inclusive voice and advocacy to ensure the voices of the engineering education practitioners and other experts in the Alliance are amplified and de-siloed. The Alliance has decided to marry the GEAR model with the Engineering PLUS model (see Fig. 3).

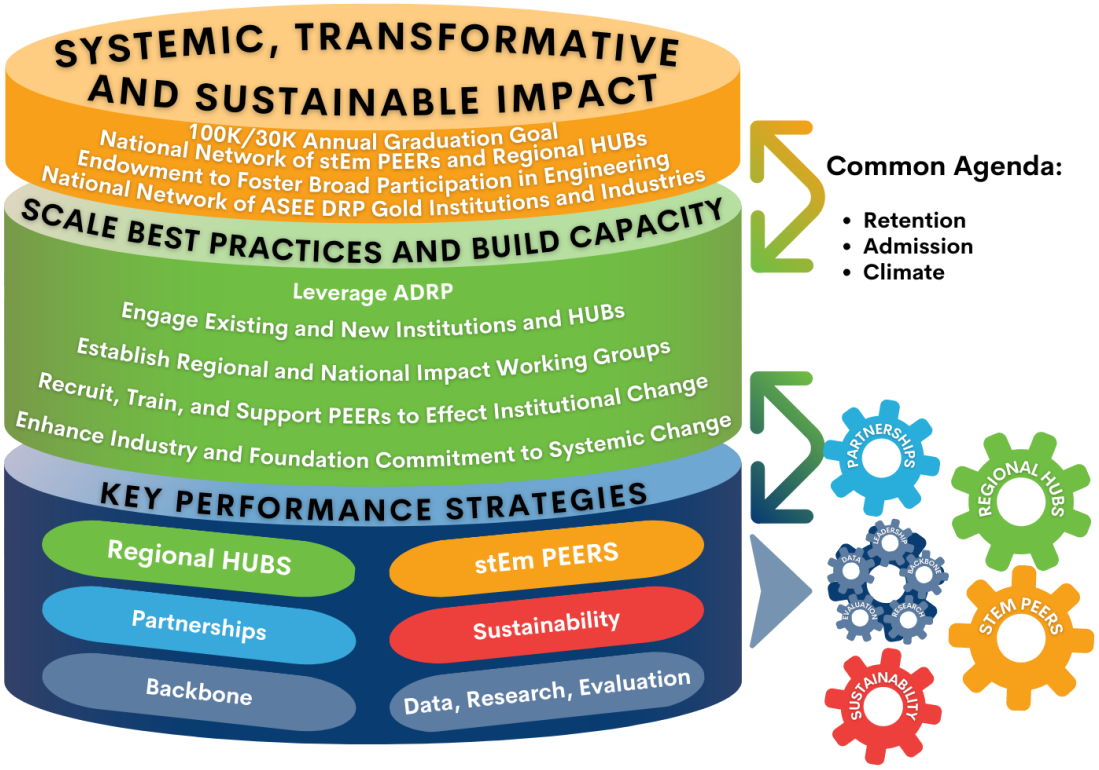

Figure 3: Engineering PLUS' GEAR adaptation

The first step is to form a working group guiding the implementation of the GEAR model to focus on equity. Additionally, the work within this Alliance will provide a guide for other multi-institutional collaborations that focus on equity within the engineering field. The GEAR Ad Hoc committee has formed and is made up of representatives from the leadership and collaborators' circles. The group's goal is to better understand the GEAR model and how it will intersect with the Engineering PLUS structure while also resolving some of the communication challenges. The GEAR Ad Hoc group has currently prioritized the first pilot campaign to apply GEAR inward. The campaign is exploratory for the working group and will allow us to test our implementation of the GEAR framework. Doing this work will lead to a stronger base for accomplishing Alliance goals. The pilot campaign is designed to bring about change by:

- Decreasing Alliance members' concerns about organizational structure
- Increasing Alliance members' knowledge about how the Alliance operates
- Widening Alliance members' understanding about Alliance operations in a way that better meets its goals
- Increasing inclusion of diverse voices engaged in the Alliance.

This campaign will also take into consideration the changes that have taken place in the last few months to help mitigate some of the perspectives shared in these findings. The campaign will be realized through four sprints, facilitated by this Ad Hoc working group. Based on recent research

and evaluation measures, the two primary areas within the Alliance that require improvement to build a stronger, more effective and better functioning Alliance are to define its organizational practices and policies and the functioning of the backbone to support those practices and policies.

- Sprint 1: Purpose is to engage Alliance members in defining the issues negatively impacting the Alliance that need solutions. The findings from the interviews provide the base of this knowledge.
- Sprint 2: Purpose is to define the equity solutions to those issues and put those into a proposal. Proposal will also include metrics for measuring success. This sprint includes a deep dive into the power structures within the Alliance that are upholding the current state.
- Sprint 3: Purpose is to implement the proposal, keeping equity at the forefront.
- Sprint 4: Purpose is to sustain and grow the equity solutions.

In preparing for the first sprint, the working group developed the following campaign:

> Our vision for the way that Engineering PLUS Alliance operates is to cultivate, champion and elevate all partner and individual voices within the Alliance by creating well-defined operational practices and spaces. This may be accomplished by 1) inviting and valuing all voices through clear and consistent communications and supporting materials that are intentionally designed to increase individual and partner belonging, commitments, engagement and activities, 2) relying on evidence to inform our decisions, and 3) using equitable practices to build capacity of the Alliance.

Ultimately, the Alliance is poised to adopt the GEAR approach more widely. One idea that has surfaced is for the Alliance to engage in setting a campaign based on the vision of increasing the number of engineering degrees awarded to BIPOC and women undergraduate and master's students. By nature, the campaign will have a more explicit understanding of the underlying barriers challenging the equity solutions. From there, each key strategy area would develop a sub-campaign (or set of campaigns) in which they will apply a series of sprints to address the strategy-specific campaigns. We will develop a toolkit to guide, refine and scale the practices across the Alliance.

Conclusion

The GEAR framework offers a guide to centering the voices of the Alliance membership as we interrogate the institutional pressures, difficulties of intra-disciplinary exchange, and other concrete conditions that can impede equity-focused collaborations. The next phase of this study is to explore how readily and in what ways seasoned engineering professionals think outside the

box to implement new best and promising practices for recruiting, retaining and graduating BIPOC and women engineering students.

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