

Beyond Broader Engagement:

Evaluation of the NSF-sponsored BeBE project

COLORADO EVALUATION & RESEARCH CONSULTING

2012-2013

Authored by: Dr. Sarah Hug

Beyond Broader Engagement:

Evaluation of the NSF-sponsored BeBE project

The purpose of the Beyond Broader Engagement grant is three fold:

- Increase the number of individual BE participants at SC conferences
- Increase the professional networks of BE participants via BPC Alliances and mentoring
- Develop nascent researchers and leaders from under-represented groups in the leadership of SC, HPC communities

Evaluation questions and methods

In this third year of the Beyond Broader Engagement grant, we shift focus from a survey of all Broader Engagement participants to measure satisfaction and continued activity beyond the conference to a more in-depth study of the Beyond Broader Engagement attendees' experiences with HPC. The research questions that led the evaluation for year three include the following:

What are barriers BeBE participants perceive in furthering their careers in high performance computing?

How does the BeBE experience help participants build leadership skills, abilities, and opportunities in high performance computing?

How do BeBE participants intend to remain engaged in the SC conference?

How do BeBE participants extend the impact of the conference beyond the individual attendee?

Participants

All Beyond BE funded participants were asked to take part in interviews during their time at the SC12 conference, and received multiple requests via email to schedule a time to meet the evaluator at the BE hotel lobby and/or at the SC12 venue. Fifteen of the sixteen participated in the interviews, either in person (13), via telephone (1) or via email (1), a 94% participation rate. A description of each participant appears below, including demographic information and current role in high performance computing. Participation spanned undergraduate, graduate, academic, and professional careers. All participants were underrepresented in computer science, either as women (gender underrepresentation) as members of underrepresented minority groups (African American, Hispanic/Latino/a, Native American), or underrepresented in both categories. Participants were selected with cooperation from the Broader Engagement committee—the majority of those who received Beyond broader engagement financial support came from the pool of applicants from the Broader Engagement program.

Participant #	Gender	Ethnicity	Professional role
1	Female	Asian	Graduate student, CS
2	Male	African American	Graduate student, MIS
3	female	Caucasian	Graduate student, CS
4	Female	Caucasian	Undergraduate student, CS
5	Male	African American	Community college student, CS
6	Male	Latino	Graduate student, CS
7	Male	Latino	Data analyst, school district
8	Male	Latino	Software developer
9	Male	Latino	Graduate student, CS
10	female	Latina	Data analyst, school district
11	female	Caucasian	Graduate student, engineering
12	male	Asian	Professor, computer science
13	Male	African American	Graduate student, CS
14	female	Asian	Graduate student, CS
15	Female	Caucasian	Professional, recruitment role

Barriers to participation in High Performance Computing

Participants describe multiple barriers that inhibit participation in high performance computing, including issues of bias, environmental constraints, and educational barriers. Four participants describe a feeling of intimidation, of not feeling like he or she belongs in the technical high performance computing community (4 participants, 4 instances). In addition, gender bias was viewed as a barrier to high performance computing participation in some but not all cases (3 participants, 3 instances), and a lack of female role models in the field (1 participant, 1 instance) can dissuade participation. One participant noted she felt she must always work harder than her male peers to assure success, because gender bias may affect how others perceive her work. Some of the student participants who attended SC12 through Beyond BE attend schools with few resources in high performance computing (3 participants, 3 instances). They say awareness of the field is lacking in their local areas (4 participants, 4 instances). In addition, students attend schools where professors have high teaching loads—for these and other reasons they experience a lack of research mentorship (3 participants, 3 instances). Financial barriers constrain Beyond BE participants' access to higher education—participants described a need to work full time through their PhD studies to make ends meet (2 participants, 2 instances). In addition, participants listed educational barriers to their greater participation in high performance computing (5 participants, 5 instances). For some, this referred to a need for graduate education, while others noted the need for related coursework in their own programs. Participants indicated an ability and desire to overcome the barriers they faced regarding greater participation in high performance computing. The following sections describe how experiencing Broader Engagement at SC12 helps them overcome some of the barriers listed.

Developing leadership capabilities through supercomputing

A goal of the Beyond Broader Engagement program is to develop leaders in High Performance Computing. In order to address this goal through evaluation, a clear definition of leadership must be offered. The theory of leadership skills

defined by Mumford and colleagues (2000) fits best with the Beyond BE program’s theory of change model, in which participants are supported to engage more deeply with the high performance computing community through networking, knowledge development, and taking on more responsibility within and beyond the Broader Engagement program. Mumford, Zaccaro, Harding, Jacobs, & Fleishman’s theory of leadership moves beyond an assumption that leaders are born not made—common in “trait theories” of leadership which identify personal traits that have historically defined strong leaders. Beyond BE assumes that leadership ability can be developed. Our conception of leadership also differs from leadership theories tied directly to “leader/follower” relationships. As many of Beyond BE participants are students, they typically do not have subordinates assigned to them, and so directly measuring their current leadership abilities by surveying their colleagues would not be appropriate.

The leadership competency theory is empirically based, and focuses on the skills and knowledge that leaders need to be effective at multiple levels of leadership (Mumford, et. Al. 2000). The table below describes leadership competencies shown to impact leadership performance.

Leadership Competency	Examples of leadership competency needed for effective leadership
Problem solving skills	Ability to solve new and ill-defined problems (involves gathering information, developing new perspectives for formulating the problem, generating plans for problem solution)
Social Judgment	“Understand people and social systems” (involves perspective taking, behavioral flexibility, effective communication)
Knowledge	Gathering of information in a structured, organized way (developing knowledge and expertise, ability to see connections among and between ideas)

Beyond BE participants were asked to describe how attending the Beyond BE program at SC12 has influenced their careers, developed them professionally, and increased their professional networks and knowledge of opportunities. They were asked specifically about how they may have developed leadership skills, but also asked about leadership competencies throughout the interview. See Appendix A for the interview protocol developed for use with SC12 Beyond BE participants. Data were coded iteratively for emergent themes related to leadership development. While the definition of leadership competencies shaped the evaluators’ perceptions of leadership, the theory did not constrain the development of additional codes beyond the themes illustrated in Mumford’s theory.

Developing leadership through access to HPC leaders

Beyond BE participants noted how they appreciated access to leaders in the high performance computing community through specialized BE programming and sessions. One participant described how this access to leaders allowed for close observation of strong leaders who present well and have well-developed social skills. These leaders serve as role models for participants, and for many (5 participants, 5 instances) were inspirational because they were giving back to the underrepresented community involved in high performance computing, an activity participants aspired to do when they were more seasoned. One participant put it this way:

I LOOK UP TO [BE LEADER] IN THE FACT THAT HE IS WILLING TO REACH BACK AND HELP ANOTHER PERSON GET TO WHERE THEY WANT TO GET. SO IF I HELP SOMEBODY MAYBE THEY CAN GET THE SAME OPPORTUNITY THAT I HAD.

Gaining technical, interpersonal knowledge and skill in support of leadership

In order to lead, one must have a depth of knowledge about subject matter, see the “bigger picture” and application of that knowledge, and must be able to see connections across subjects. All Beyond BE participants expressed developing new technical knowledge at the conference (15 of 15). For participants who described the circumstances leading to new knowledge, 13 said the content delivered in sessions led to their knowledge development (20 specific instances), nine learned in conversations with peers (11 instances), and seven from conversations with mentors (12 instances). A graduate student explained her knowledge development through interactions with mentors in this way:

I'VE GOTTEN THE CHANCE TO MEET SOME GREAT PROFESSORS, SOME GREAT PEOPLE AT NATIONAL LABS AND THEY HAVE GIVEN ME SOME WONDERFUL ADVICE ON HOW TO PROCEED WITH MY RESEARCH AND HOW TO GET INVOLVED IN OTHER WAYS WITH MY FUTURE GOALS.



Four participants note how the Beyond BE speakers represented the best of the best in their fields, and described how having those high-caliber speakers helped see a broad picture of high performance computing. According to one Beyond BE participant from the advanced track:

I WENT TO TWO VERY GOOD GENERAL BE SESSIONS. I DID NOT KNOW MUCH ABOUT TWO TOPICS SO I WANTED A HIGH-LEVEL OVERVIEW OF WHAT IS HAPPENING AND BE DOES AN EXCELLENT JOB. THEY JUST BRING THE BEST PEOPLE IN THOSE AREAS AND THEY GIVE VERY HIGH LEVEL VERY BROAD OVERVIEW OF THE AREA.

Creating a network of support for leadership

Leaders need strong networks of peers and colleagues. They advance strong social judgment skills through repeated interaction with other professionals, in which they learn to communicate their ideas effectively, build consensus, and take on multiple perspectives. Two thirds of Beyond BE participants note that their participation in BE at SC12 gave them opportunity to *develop their networks through supported practice*, specifically through activities and social arrangements that reinforced burgeoning relationships (10 participants, 14 instances). Some examples include rooming with a BE colleague, the BE reception, attending a mentor/protégé session, and participating in improvisational training. A new professor noted:

I DEVELOPED RELATIONSHIPS WITH COLLEAGUES OFTEN AFTER TECHNICAL TALKS, DURING THE BE POSTER SESSION, AND DURING DINNERS AND LUNCHEES. THE CONFERENCE RECEPTIONS AND OTHER EVENTS REALLY HELPED FOR NETWORKING AND EXCHANGE IDEAS.

A Beyond BE participant who returned several years in a row noted how BE participation influenced her networking skill and attitude:

IN TERMS OF COMMUNICATION BE HAS DONE ME WONDERS BECAUSE WHEN I CAME HERE FOR SC09 I WAS EXTREMELY SHY, EXTREMELY RESERVED, AND I NEVER COMMUNICATED. IT WAS THE FIRST CONFERENCE I'VE EVER BEEN TO AND IT WAS OVERWHELMING. ... THAT YEAR THE BROADER ENGAGEMENT PROGRAM HAD ICEBREAKERS AND HAD MULTIPLE ACTIVITIES JUST SO THAT YOU SIT BESIDE SOMEBODY AND YOU HAVE TO TALK TO THEM AND YOU HAVE TO ASK QUESTIONS AND LEARN ABOUT THEM. THAT EXPERIENCE HAS DONE ME WONDERS BECAUSE I

NEVER THOUGHT THAT IT WOULD WORK. ... NOW I TALK—I CAN'T STOP. I HAVE LEARNED HOW TO INTRODUCE MYSELF, HOW TO LISTEN TO PEOPLE AND THEN HOW TO RESPOND TO THEM.

Beyond BE participants are creating relationships with SC attendees beyond the confines of the BE program, in fact 80% of interviews explicitly note that their developing network grew beyond BE participants (12 participants, 15 instances). For example, a graduate student explained how he was making connections beyond BE:

COMING TO SC12 I'M ABLE TO INTERACT WITH PEOPLE WHO ARE POTENTIAL EMPLOYERS AND I CANNOT ONLY INTERACT WITH THEM BUT ALSO COMMUNICATE AT THE LEVEL OF GETTING TO KNOW WHAT THEY DO. SO FOR EXAMPLE, PEOPLE WHO WORK IN THE NATIONAL LABS, I HAD CONVERSATIONS WITH THEM ABOUT WHAT THEY DO.

For some, the connections they make at SC will impact them locally because they find mentors and colleagues close to home (9 participants, 10 instances). One graduate student had an opportunity to meet with his advisor at SC, and one BE participant met a colleague en route to the conference. A graduate student in an applied field describes how she met high performance computing professionals from her own university at a talk:

I MADE A COUPLE OF CONTACTS WITH SOME OF THE COMPUTER SCIENCE PEOPLE AT (UNIVERSITY NAME) SO HOPEFULLY IF I HAVE ANY TROUBLE (WITH PARALLEL PROGRAMMING) I CAN GO TO THEM FOR HELP.



While Beyond BE participants extend their networks past the BE participant roster, they did note that BE serves as a secure “home base” from which to branch out to other high performance computing communities (8 participants, 10 instances). The BE community is described as supportive, and gives participants a sense of belonging that they bring with them to the wider conference. A graduate student from a predominantly white university described it this way:

I FOUND MANY PEOPLE FROM PUERTO RICO THAT CAME FOR THE BROADER ENGAGEMENT PROGRAM AND IT WAS REALLY NICE. WE INTERACTED A LOT DURING THE CONFERENCE. THAT WAS A REALLY NICE EXPERIENCE FOR BROADENING MY NETWORK OF OTHER HISPANICS IN THE HPC FIELD.

A graduate student described the way BE structures a new participant's engagement with the SC conferences:

HIGH-PERFORMANCE COMPUTING BROADER ENGAGEMENT IS A VERY NICE PLACE BECAUSE IT IS A SMALL OPENING FOR YOU INTO A VAST SEA. YOU CANNOT REALLY ABSORB ANYTHING FROM A SEA BUT IF YOU'RE IN A SMALL SWIMMING POOL YOU CAN LEARN. THIS HAPPENED TO ME AND NOW I'VE MOVED BEYOND BROADER ENGAGEMENT. I THINK IT CAN HAPPEN TO EVERYONE.

A third of participants describe how their networks and professional experiences with high performance computing are deepened with repeated exposures to the conference (5 participants, 7 instances). They state that the first exposure, particularly for undergraduates, is overwhelming, yet still inspiring and motivating for participants. By the second or third visit to the conference participants are setting goals for their experience, including networking goals, learning goals, and professional opportunity goals.

BE participation promotes personal advancement

Beyond BE participants describe ways in which their participation in high performance computing has been shaped by their experiences in the BE program. By following the trajectories of participants, we can understand the leadership trajectories prevalent in Beyond BE participants. Leadership trajectories often begin with the identification of role models who have come before, and embody the type of researcher/industry professional/scholar/professor one hopes to become. Nearly half of the Beyond BE participants interviewed identified professionals whom they admired professionally or personally, and described them as role models in the field (6 participants, 6 instances). For example, a prospective PhD student noted how BE presenters' descriptions of their academic and professional pathways helped the participant see that he was not alone in arriving at high performance computing from a non-traditional route.

I LIKED HOW BE PRESENTERS INITIALLY BROUGHT UP THEIR OWN BACKGROUND AND HOW THEY GOT TO WHERE THEY WERE. A LOT OF TIMES PEOPLE THINK YOU REALLY NEED TO MAKE YOUR OWN PATH BUT ALSO (THE PRESENTERS HIGHLIGHTED THAT) IT'S OKAY TO DEVIATE FROM THAT PATH. WHILE IT WASN'T SPECIFIC ADVICE IT WAS ONE THING THAT I GOT FROM THE TALKS AND HAVING THEM TELL A LITTLE BIT ABOUT THEMSELVES FROM THE BEGINNING. FOR ME IT WASN'T THAT DIRECT (OF A PATHWAY) THERE ARE VERY FEW PEOPLE WHO KNOW WHAT THEY WANT TO DO IN LIFE AND THEN ACTUALLY GO AND DO IT.

BE participants received mentoring at SC12 through formal and informal means (5 participants, 6 instances).¹ Mentoring, like advising, involves providing guidance towards one's professional goals, and involves some measure of personal relationship building, one that extends beyond formal professional affiliations. A graduate student describes two mentoring relationships, one he describes as more "casual", in which the pair discuss topics beyond high performance computing. The mentor with the casual approach to assisting less experienced scientists attended SC11 as a Beyond Broader Engagement attendee, and attended SC12 through company



¹ Due to communication error, Beyond Broader Engagement participants were not included in the matched mentor-protégé program, and so only a few of them participated in the event.

funding.

I WAS PART OF THE MENTOR PROTÉGÉ PROGRAM AND I MET A REALLY NICE PERSON OVER THERE. WE HAD A CHAT OVER DINNER —WE STARTED AT THE SESSION BUT WE ENDED UP GOING OUT TO HAVE DINNER. ... I MET DR. [PARTICIPANT NAME] AT THE DATA MINING CONFERENCE AND MET UP WITH HIM AGAIN HERE AT SC12. I THINK I JUST REALLY LIKE THE WAY HE INTERACTED WITH US... IT IS MORE CASUAL YOU KNOW WE HAD A CONVERSATION OUT AT ONE OF THE PARTIES AND IT WASN'T NECESSARILY ALL ABOUT WORK.

Beyond BE participants view their experiences at SC as promoting their advancement in more concrete ways as well. Of the fifteen Beyond BE participants who took part in this study, the conference led to *research aspirations* for a third of them, most often the less advanced students (e.g., Master's students considering a thesis, MS graduates considering a PhD) (5 participants, 5 instances). More specifically, conference involvement also led to participants' *research inspirations* (8 participants, 10 instances). For example, researchers interested in new technical tools or applications were able to tailor their conference engagement towards learning that fulfilled personal needs. Those with less clarity about research aims were able to sample multiple fields and make decisions about future directions. For example, a first semester Master's student decided on a general area of research interest during his time at SC12:

(ATTENDING BE) HELPED ME TO NARROW DOWN WHAT I WANT TO DO FOR MY RESEARCH...AND THAT'S DATA MINING USING CLUSTER ANALYSIS.

At the other end of the graduate school experience, a seasoned PhD student chose a tutorial that would improve his research progress through hands-on experience with a new technology:

I WENT TO A TUTORIAL BECAUSE IT WAS VERY CLOSELY RELATED TO MY DISSERTATION. WE PLAYED AROUND A LOT WITH DIFFERENT TECHNIQUES. ... IT WAS NICE TO HAVE THE EXPERIENCE USING A PROGRAM (WITH GUIDANCE) IT WAS ACTUALLY VERY REWARDING.

BE participants practice the art of sharing knowledge with others

Leaders use their extensive technical knowledge and their ability to persuade in their efforts to shape a community's vision, direction, and tool use. Sharing this information builds leadership ability of Beyond BE participants. The majority of Beyond BE participants described some form of "ambassadorship" they take on (or plan to take on) in their local communities (10 participants, 14 instances). Nearly half of the fifteen participants also describe how they will bring back the knowledge they gain at SC to improve their local labs, institutions, departments, and communities, formally through local presentations, formal courses, and outreach and informally through one on one and group conversations with colleagues (7 participants, 10 instances). For example, a new professor describes how his attendance at SC influences his department, providing access the HPC for all of his students:

I'M THE ONLY FACULTY IN THE CS DEPARTMENT (OR WHOLE SCHOOL) WHO ATTENDED SC. I BRING BACK THE ADVANCED COMPUTING TECHNOLOGY AND NEW DEVELOPMENT IMMEDIATELY TO MY SCHOOL AND IN MY CLASS. IN THAT SENSE, I HAVE DIRECT IMPACT ON MY STUDENTS' EDUCATION. I'M ALSO SEEKING COLLABORATIONS FROM OTHER FACULTY ABOUT OPPORTUNITIES TO OFFER NEW COURSES IN THE HPC AREA.

A student described how the applications of HPC to her field became clear to her at the conference. This realization is inspiring her to learn to program in parallel to simulate more data. Her excitement for the possibilities fuels her aspirations for sharing the information across her local laboratory.

THERE WAS ONE PRESENTATION ON (APPLIED FIELD) WHERE THEY WERE USING 200 BILLION ELEMENTS IN THIS SIMULATION. THIS IS RIDICULOUS—MY SIMULATIONS USE LIKE 1000 ELEMENTS BECAUSE I DON'T WANT TO TAKE A LONG TIME. ... TWO HUNDRED BILLION—THAT IS A WHOLE NEW LEVEL, SO I AM GOING TO BE A VERY STRONG ADVOCATE FOR MY GROUP TO START DOING PARALLEL COMPUTING. I STARTED TALKING TO SOME PEOPLE AND THEY SAID THE WAY TO START IS TO USE OPEN MP. ... I HAVE ALREADY STARTED PLANNING A PRESENTATION FOR MY RESEARCH GROUP ON PARALLEL COMPUTING I THINK IT IS A REALLY EASY SELL.

An undergraduate student also described how her excitement for high performance computing fuels her desire to share the information with undergraduate colleagues:

(HPC IS) SOMETHING I AM EXCITED ABOUT AND I WANT TO SHARE MY KNOWLEDGE WITH THEM AND GET THEM EXCITED ABOUT IT TOO. THAT MAKES YOU WANT TO LEAD BECAUSE YOU WANT THEM TO DO THE SAME THINGS YOU ARE DOING.

Two professionals charged with making data management decisions for their professional organizations described how they will use the information gained at SC12 to shape their organizations' five year plan for data storage. They describe the arguments they will make to their superiors about the state of the art in data storage. According to one professional participant:

THIS TIME I ACTUALLY GOT TO SIT IN ON SOME OF THE TALKS (IN THE EXHIBIT HALL). IT WASN'T JUST VENDORS IT WAS ACTUALLY REAL TECHNOLOGY BEING SHOWN TO US, 'WHAT IS THE FUTURE? WHAT IS EXASCALE?' -THINGS THAT I CAN TAKE BACK TO MY WORKPLACE AND SAY, "WELL, THIS IS THE FUTURE IN TERMS OF DATA STORAGE. THIS WOULD BE AN OPTION THAT YOU COULD CONSIDER."

BE participants plan their futures in HPC

The most common way participants intend to increase their level of commitment with SC in the future was through academic contribution, with more than half of the participants indicating this intention (8 participants, 9 instances). For some, this would build on their body of work in HPC, though for others it would represent a first opportunity to present research. A prospective PhD student describes his aspirations this way:

YES, I PLAN TO RETURN AS AN ACADEMIC CONTRIBUTOR ESPECIALLY ONCE I GET INTO MY PHD PROGRAM. I HAVE A LOT OF IDEAS RIGHT NOW OF PROJECTS THAT I COULD WORK ON SO YES, I WOULD DEFINITELY LIKE TO SEE MYSELF AS A TECHNICAL POSTER PRESENTER AND SEE MYSELF MORE INVOLVED IN SC.

Some of the undergraduates who attended Beyond Broader Engagement are considering industry positions in the near future- for them increased participation would be more likely as technically expert vendors or exhibitors (4 participants, 4 instances). One student, who attended BE in hopes of finding a job, described how one of the positions she was considering would have an extensive role at the SC conference to promote a university.

I KNOW THAT THE POSITION AT (SCHOOL) WOULD REPRESENT THEIR SCHOOL AT THESE CONFERENCES TO DO PRESENTATIONS OR TO GET INVOLVED IN LITTLE FE AND THINGS LIKE THAT AND GET THEIR UNIVERSITY MORE RECOGNIZED AS A HIGH-PERFORMANCE COMPUTING SCHOOL. ... THEY NEED SOMEBODY WHO HAS AT LEAST HAD A LITTLE BIT OF EXPERIENCE AND WHO IS INTERESTED IN HIGH PERFORMANCE COMPUTING.

For two of the Beyond BE participants, their aspirations will take them into applied areas of HPC—their academic work would fit in HPC conferences as application domains, but they intend to remain working primarily in their applied field. They describe how their facility with HPC will extend their abilities to do computational science.

COMPUTING BIG DATA PROBLEMS IS ALWAYS VERY EXCITING TO ME. (IN TEN YEARS) I WILL PROBABLY BE DOING SOME KIND OF COMPUTATIONAL BIOLOGY WORK IN [CITY] BUT BEYOND THAT I AM WILLING TO DO ANYTHING IN THE DOMAIN ... BECAUSE THERE IS A SMALL LIST OF PEOPLE WHO ARE CAPABLE OF WORKING ON THESE PROBLEMS.

Recommendations for future conferences

Beyond BE participants provided a few recommendations for future conferences, including logistic concerns, opportunities for greater engagement before, during and after the conference, and recruitment concerns.

Participants note how BE sessions are concentrated at the beginning of the conference. Multiple members had ideas about changing this structure. For two participants, dispersing the sessions throughout the week would be useful, to ensure greater visibility of Broader Engagement throughout the entire pool of SC12 attendees. Another attendee in the advanced track wished to attend BE sessions as well, and suggested scheduling BE content apart from tutorial and workshop content. One participant expressed a need for flexible attendance at the conference (e.g., not requiring Saturday through Thursday participation). He noted this more flexible attendance could allow for more attendees, given the hotel savings for those who do not stay the entire week. One participant recommended greater communication between leadership and participants before the conference. Similarly three participants wished the communication about the mentor/protégé program had been clearer—some Beyond BE participants did not receive mentors at the conference. We note that some of the communication issues may have been due to the separate administration of Beyond BE and BE participant streams. This occurred to allow for flexibility in the organization of Beyond BE participants' SC experiences.

Beyond BE participants wanted more opportunities to meet with their BE peers, before, during, and after the SC12 conference. They recommend creating small working groups based on specific HPC interests (e.g., power, computational biology) that would communicate before the conference to select sessions of interest and strategize knowledge gathering (4 participants, 4 instances). They saw these groups as providing social and academic networking opportunities that could extend beyond the conference. Two participants felt BE lunches would help members get to know one another during the conference, particularly during the Broader Engagement days when participants are together but primarily listening to speakers. As BE activities are dependent upon the allocations received through the SC committee, deciding on a networking event may involve changing the number of participants funded to attend the conference. One participant described a BE webinar that could occur before paper and poster session applications that would outline strategies for creating a winning proposal. This could be led by past BE participants.

Beyond BE participants wanted to share their experience more broadly, and felt BE could be a conduit for engaging youth in high performance computing (3 participants, 3 instances). In addition, two participants felt HPC would be very enticing to those who might be losing their interest in computer science as it shows the future of technology. Recruiting those students losing interest would be difficult, as the application process requires student initiative, but recommending this strategy to professors could help promote computing persistence. In addition, greater job fair recruitment was recommended by one student. He felt the large companies were missing from the job fair at SC12—that greater recruitment efforts could ensure the “big names” staffed the job fair as well.

Conclusion

In this study, we explored the notion of “leadership development” from a broad perspective. The report highlights multiple ways the Beyond Broader Engagement participants build leadership skill and capability through participation in Broader Engagement at SC and the SC12 conference itself. While few Beyond BE participants had opportunities to extend their leadership into the conference structure itself, they did gain knowledge, develop networks and networking ability, learn from current leaders in the field, and aspired to greater and more full participation in future SC conferences. The lessons learned through the Broader Engagement program could support leadership and diversity efforts in other professional conferences as well. The findings of this study indicate that conference

participation, when deeply structured to support networking, content knowledge development, and personal and professional goal setting and achievement, can develop students' and professionals' leadership abilities.