The Inclusive Engineering Consortium Stakeholders’ Workshop  
July 14-15, 2019 Tigard, Oregon Intel Campus

PROJECT SUMMARY

Over the last 6 years, a collaboration of 13 HBCU Electrical and Computer Engineering (ECE) programs has been working together to implement Experiment Centric Pedagogy (ECP) to improve the student learning experience at all partner institutions. The lessons learned and best practices of this effort have encouraged the 13 partners to expand the scope of their collaboration to address the full learning and working experience of students, faculty and staff and to expand the group to include other minority serving institutions (MSIs) with ECE and similar programs. Recently, the group has expanded to include 2 additional HBCUs and 2 Hispanic Serving Institutions (HSIs) and received funding for a Mega REU/RET site. Key to the success of this collaboration has been the development of a solid virtual working community of practice through regular meetings including weekly video conferencing and workshops usually held at one of the partner institutions; online resource sharing, and highly collaborative publication/dissemination of results, notably at ASEE conferences. The last workshop of the original ECP grant was held at the 2018 ECEDHA Annual Meeting to identify logical next steps and introduce the group to the broad ECE community. With additional funding from NSF, a second 2018 workshop, engaging the expanded group, was held in Alexandria, VA in June with a focus on promising ideas for technical research collaboration, including the Mega REU/RET site.

While the original 13 partners have been working to solidify and sustain the impact of ECP on improving the learning experiences of their students and the newly augmented group has been developing new technical research collaborations, a leadership working group has been exploring how to realize the most effective working infrastructure for the evolving consortium. By identifying the primary barriers to future success, it has become clear that a new support organization is necessary if MSI collaborations (like ECP) are to work together as one. With the assistance of the Electrical and Computer Engineering Department Heads Association (ECEDHA), the group has created a new organization, the Inclusive Engineering Consortium (IEC), consisting of a core group of collaborators and a second, much larger group of affiliated members from other universities, industry and professional societies. We propose to have the first face-to-face meeting of the IEC in July 2019 in coordination with the Intel (IEC’s first founding partner) HBCU Consortium Meeting. Planned sessions include Broad Appeal Programs; Investment in Leaders/Future Leaders; Strategic Connections; Infrastructure; and Building IEC.

Intellectual Merit: The overall IEC vision is to be a collaboration of Minority Serving Institutions Working as One to Advance the ECE Enterprise. It is organized as a virtual super department with broadly based strengths in education, scholarship and service. Collectively, IEC can function as the equal of any ECE program, accomplish more and have a greater impact on its students, faculty and staff through access to resources and opportunities not available individually. It is the earliest of days for IEC and essential that all stakeholders fully participate in creating the organizational support structure and initial activities necessary to realize IEC’s grand vision.

Broader Impacts: This workshop will begin IEC’s efforts to more fully engage MSIs in the US education and research enterprise; graduate more and better prepared minority engineers; increase efficiency and productivity at MSIs; and develop a sustainable and effective infrastructure to support minority students, faculty and staff at all universities. In time, the IEC group will grow and the model being developed can be replicated and implemented for other disciplines.
Project Description

1.0 Motivation and Objectives

We propose a one and one-half day strategic planning workshop focused on the creation and initial focus of the Inclusive Engineering Consortium, IEC. IEC is a novel collaboration among the 15 ABET accredited Electrical and Computer Engineering programs at the nation’s Historically Black Colleges and Universities and 2 Hispanic Serving Institutions. The 15 HBCUs are the 13 departments who participated in the National Science Foundation-funded Experimental Centric Pedagogy project (Award #1255441) plus the University of the District of Columbia and Virginia State University. These two programs were accredited after the formation of the original group of 13. The 2 HSIs are the University of Texas at El Paso and Turabo University, with the latter serving as a surrogate for the engineering schools in Puerto Rico.

Experimental Centric Based Engineering Curriculum for HBCUs

In Fall 2013, Howard University, in collaboration with Alabama A&M University, Florida A&M University, Hampton University, Jackson State University, Morgan State University, Norfolk State University, North Carolina A&T State University, Prairie View A&M University, Southern University, Tennessee State University, Tuskegee University, and University of Maryland Eastern Shore, received funding for a National Science Foundation grant entitled, “Experimental Centric Based Engineering Curriculum for HBCUs”. The project had the significant outcome to create an “HBCU Engineering Network” that is focused on the development, implementation, and expansion of an Experimental Centric-based instructional Pedagogy in engineering curricula used in these HBCUs.

The project started during the 2013-2014 academic year by implementing a hands-on approach that introduced concepts related to circuit analysis and experiment design to selected introductory classes in electrical and computer engineering (ECE). By the end of the first year of the project, all the 13 institutions implemented hands-on activities in their Introductory to Electrical Engineering (EE) and Circuits classes as well as on advanced EE content. By the end of 2016 over 100 curriculum modules were developed and used in the class setting to teach topics in linear circuits, including mesh and nodal analysis, Thevenin and Norton equivalent circuits, transient in RL, RC, RLC circuits, frequency-dependent circuits, and operational amplifiers. The hands-on activities were based on using personal instrumentation like the Analog Discovery Board (ADB) and standardized parts kits, which were generally provided to the students at the beginning of the semester so the students could use them throughout the entire course, in class and at home. Institutions involved in the project also developed separate modules on electronics, energy storage, and magnetics and were using personal instrumentation in teaching higher-level courses in electrical engineering and in undergraduate research projects such as REU and RET programs.

The project successfully demonstrated that an experimental centric pedagogy combined with hands-on educational technology stimulates student interest in the STEM area, promotes content acquisition, and problem solving, and retention. Hands-on activities were shown to be
successful across a variety of instructional settings and introductory EE topics. The momentum that the project has is remarkable. By the end of the project practically all the minority students at the 13 institutions (which represent over 35% of the entire population of the African-Americans in engineering in the United States) were exposed to multiple experiences with mobile boards. In most of the 13 institutions, personal instrumentation completely replaced the traditional laboratory experiments which were usually based on heavy and stationary equipment. The hands-on activities at all the institutions were evaluated by an external assessment group and the results were presented at multiple American Society for Engineering Education Conferences [1-3].

The success of the HBCU ECP project led the group to consider whether or not the scope of the collaboration could be expanded to include a broader range of topics and participants. For the last two years, the group has been reflecting on what lessons there are to be learned from this experience. Both formal processes (e.g., SWOT analysis) and informal processes (e.g., brainstorming and random discussions), in person and online, have been utilized. What follows is a brief summary of what has been learned so far.

First and foremost, the project succeeded because many schools worked together as one to collectively implement ECP using personal instrumentation at all 13 schools.

- Experienced faculty (both within and from outside the group) trained faculty at schools new to personal instrumentation at both face-to-face workshops and regular online meetings. The experienced faculty from within the project had worked together previously on personal instrumentation in the Mobile Studio Project (which also involved Rose-Hulman), the Mobile Hands-On STEM Project (which also involved Georgia Tech and Virginia Tech), and the LESA ERC
- Participants engaged in effective, regular, nearly weekly communication through online meetings alternating between leadership one week and everyone the next.
- Common assessment tools were developed and implemented with guidance from an experienced team from UAlbany.
- Activities and accomplishments were collectively documented through regular participation in annual ASEE meetings and focused ASEE meetings (e.g., on the first-year experience).
- The project actively involved both department heads and faculty teaching Circuits and Electronics courses (mostly analog but also digital) at all levels including first year.
- New connections were developed with outside schools and industry (e.g. industrial participation in workshops and providing workshops for schools in Puerto Rico)
- Branched out into collaborations based on technical research (e.g., the Mega REU/RET site was funded, with others under review)
- Began adding other schools including HBCUs (UDC and VSU) and HSIs
- Overall, developed a very productive network of participants based on mutual respect, trust and confidence in the group’s ability to collectively produce high quality work. Participants had a lot of fun making a difference for the students at these great schools and have demonstrated an exceptional commitment to helping one another. They also don’t waste much time trying to address issues on their own when they know there is someone in the group who has the experience to help out.
Next, the group encountered some significant issues (speed bumps, barriers …) that impeded its ability to achieve its goals as quickly and effectively as it had hoped.

- The support infrastructure at participating schools is not presently adequate to support collaborations. Even with the active participation of department heads, contracts and grants offices generally could not respond quickly and reliably. A great deal of personal intervention was required to maintain basic functionality. It was also not possible to create and maintain an effective external web presence. Internally, content was quite productively shared, but, again, required a lot of personal intervention using email, phone calls and face-to-face communication.
- Experience doing collaborative research is limited. The number of such experiences is small and the participant schools are almost always brought into collaborations late in the game after the project is nearly fully developed. Several schools have experience in ERCs, but only one has ever been the lead. Research capabilities in particular areas are not significant at most institutions but, collectively, a critical size can be realized by combining faculty/labs/students/staff from several schools.
- Faculty at participating institutions have very large teaching and advising responsibilities and are given inadequate opportunities to learn how to be leaders and how to build research programs. The ECP collaboration was hindered at times by the inability to get enough participants to step up and assume leadership positions.
- The ECE programs that make up the collaboration are generally under resourced and it remains a challenge to find a way to sustain its activities.

Based on what has been learned from this reflection, a series of hypotheses are being developed on what the group should do if it hopes to expand the limited set of goals of the ECP project to address all aspects of the ECE enterprise at MSIs and elsewhere.

- An outside partner should be found and/or a new organization created to handle funding and general infrastructure.
- If the collective group of schools can function as, in effect, a super department, it will be possible to collaborate with outside schools and other institutions as equals rather than as an afterthought. It is assumed that such collaborative research must be, at least to some extent, distributed and not depend on the existence of a particular set of facilities, which rarely exist at the partner schools. There are exceptions at the larger partners (e.g., NCAT, FAMU/FSU). The broad focus of the Mega REU/RET project is built around the very distributed area of Smart Cities & IoT to begin to address this issue.
- Two changes will help address leadership. First, by finding an outside partner to handle funding and general infrastructure, all partners will operate on an equal footing (no prime). Second, infrastructure will include leadership training through workshops and mentoring, especially for writing proposals and doing collaborative research. For example, some kind of proposal red team structure should be implemented, which will take some time to find the right people and process.
- Sustainability requires the existence of a formal entity. To this end, the IEC was created, which, being a new organization, requires continuous development. This organization can
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provide all of the above through effective fund-raising, especially with industry and foundations.

Inclusive Engineering Consortium

In March of 2017, conversations began regarding the future of the ECP. An organization separate from any one university was needed to sustain the gains experienced during the ECP period and support the future growth of the group. There needed to be an entity that behaves like a large virtual department composed of the faculty, staff, and students of the member departments. This virtual department has access to opportunities unavailable to any one department. This distinction is important. The new organization does not compete with the departments, but rather magnifies the departments.

The ECP leadership looked at existing organizations that supported either minority serving institutions or electrical and computer engineering departments. There were several possibilities. We agreed to explore a relationship with the national Electrical and Computer Engineering Department Heads Association, (ECEDHA). With the guidance and support of ECEDHA leadership, we were able to create a 501 c3 corporation called the Inclusive Engineering Consortium. This proposed meeting is an important first gathering of the IEC.

Workshop Objectives

The IEC has developed a broad and very challenging vision of enabling MSIs and their students, staff and faculty to more fully become part of and contribute to the ECE enterprise. To realize this vision, this workshop is proposed to bring together IEC’s stakeholders to determine the first strategic steps of the new organization and to begin to create an overall long-term strategic plan. Specifically, the workshop will address the following four topics: Broad Appeal Programs that, like ECP, can be addressed collectively; Leadership and Professional Development to create the cadre of future leaders for the partner institutions and to facilitate successful careers for their faculty, staff and students; Strategic Connections to develop partnerships within the group, with other universities, industry, government, foundations, professional societies, etc.; and building the Infrastructure to support and sustain the group.

Deliverables The organizers for each of the sessions will produce a list of immediate short-term goals with proposed strategies, necessary resources, etc. identified. That is, what are the immediate next steps for IEC? The core group of participants who will work on the immediate next steps should also be formed and a timeline specified. In addition, a similar list of long-term goals will be produced, again with any necessary resources/infrastructure identified.

Facilitators It is too often the case that organizations can operate in a bubble in which communication relies too heavily on jargon and too many assumptions are made about people’s background knowledge and experience. To address this issue, we will have a team of facilitators led by Pamela Mack (Virginia State University) and Miguel Velez-Reyes (UTEP). It will also include any attendee who is new to the collaboration (i.e., not attended previous workshops). The team is responsible for the following:

- Session introductions and timing
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- Assuring that presentations, discussions and, especially, any session outcomes can be understood by the general ECE community by asking questions, raising points of clarification, and providing feedback at the end of each session and the end of the overall workshop.

A.  Broad Appeal Programs

It is currently a challenge for consortium institutions to individually conduct large-scale research. More and more institutions are competing for rapidly diminishing funding opportunities. A single consortium institution is not as competitive as a collaborative effort among multiple institutions, where the strengths of each institution can be combined to address a meaningful outcome. Over the past 5 years, this consortium has developed a culture of collaboration, with associated methods, which can be leveraged to provide capacity building across each institution, especially since each institution serves a similar population. In addition, most collaborations with strong R1 universities have involved only one or two MSIs playing a peripheral role and rarely engaged at the start of the effort. This session will cover building a strong foundation for collaborative research within the consortium. Presenters will discuss lessons learned from successful prior research collaborations as well as highlight best practices.

Organizers:
Mohamed Chouikha IEC Secretary/Treasurer, Professor, Prairie View A&M University
Corey Graves Associate Professor, North Carolina A&T State University
Kofi Nyarko Associate Professor, Morgan State University

B.  Leadership and Professional Development

The future of any organization depends on the quality of its leadership and clear pathways to professional success. This workshop session will explore ideas for how best to help students, staff, faculty and leaders at all levels prepare for successful careers by learning to take control of one’s personal destiny and to effectively utilize support resources. Presenters will discuss topics such as mentoring, team building, collaboration, communication, networking and training opportunities. Discussions will identify areas where help from an organization like IEC will increase chances for success.

Organizers:
Craig Scott IEC President, Professor and Dean, Morgan State University
Demetris Geddis Assistant Dean and Department Chair, Hampton University
Michel Reece Associate Professor and Chair, Morgan State University

C.  Strategic Connections

It is challenging for small to mid-sized programs, especially those at minority serving institutions, to establish mutually beneficial relationships with programs at larger research-intensive universities. In a similar way, interactions with government and industry are often focused only on hiring students in those programs. The goal for this session is to develop an understanding of the elements of ideal, mutually beneficial strategic partnerships in
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which the super department of MSI ECE programs functions as the equal of strong R1 departments. Presentations and discussions will identify best practices that lead to win-win relationships.

Organizers:
John Kelly IEC Vice President, Associate Professor, North Carolina A&T State University  
Petru Andrei Professor, FAMU-FSU  
Mandoye Ndoye Assistant Professor, Tuskegee University

D. Infrastructure

The goal for this session is to answer a critical question: What infrastructure is necessary to position IEC for future success? Short presentations will review what has been learned from the ongoing collaboration described at the beginning of this section, primarily in the discussion of the HBCU ECP program, and from the first three sessions. Topics such as professional development, the IEC website and web-based support structure, meeting organization support, etc., will be addressed in breakouts and full group discussions.

Organizers:
Ken Connor, IEC Board Member, Professor Emeritus, Rensselaer Polytechnic Institute  
Shiny Abraham, Assistant Professor, Seattle University  
Miguel Velez-Reyes, Professor and Chair, University of Texas at El Paso

E. Strategic Planning

This session will be an open discussion, led by IEC leadership, focused largely on the long-term goals and strategies identified in the four sessions above. In addition, value propositions for stakeholders and potential partners (universities, industry, government, professional societies …) will also be addressed.

Organizers:
Craig Scott IEC President, Professor and Dean, Morgan State University  
John Kelly IEC Vice President, Associate Dean, North Carolina A&T State University  
Mohamed Chouikha IEC Secretary/Treasurer, Professor, Prairie View A&M University  
Ken Connor IEC Board Member, Professor Emeritus, Rensselaer Polytechnic Institute  
John Janowiak Executive Director, ECEDHA and IEC

2.0 Expected Outcomes and Assessment

The overall schedule for the workshop and related activities incorporates pre- and post-workshop online meetings, as described in Section 6. There are deliverables from the organizers of each activity and from workshop participants. While the deliverables are generally described, at least in part, in other sections, they are summarized here for clarity.

Workshop Organizers: Final report

Participants: 2-3 specific items from personal SWOT (pre- and post-workshop)
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Facilitators: Assuring all documents are appropriate for general ECE community

Session Organizers: Short-term and long-term plans, including personnel and timeline

All Organizers and Participants: Actively contribute to one or more of the session reports, the final report, survey analysis, etc.

All Organizers and Participants: Evaluation surveys

The primary purpose of the evaluation surveys is to determine whether or not the workshop met the needs of the participants. More specifically, do the short- and long-term goals identified in each session address issues of value? Did the top issues identified by each participant get addressed? Did each participant’s list of top issues change and, if so, how? Is the IEC coming together as an organization that will have a positive impact on the professional development of and opportunities for faculty, staff and students at member schools?

2.1 Intellectual Merit

The overall IEC vision is to be a collaboration of Minority Serving Institutions Working as One to Advance the ECE Enterprise. It is organized as a virtual super department with broadly based strengths in education, scholarship and service. Collectively, IEC can function as the equal of any ECE program, accomplish more and have a greater impact on its students, faculty and staff through access to resources and opportunities not available individually. It is the earliest of days for IEC and essential that all stakeholders fully participate in creating the organizational support structure and initial activities necessary to realize IEC’s grand vision.

2.2 Broader Impact

This workshop will begin IEC’s efforts to more fully engage MSIs in the US education and research enterprise; graduate more and better prepared minority engineers; increase efficiency and productivity at MSIs; and develop a sustainable and effective infrastructure to support minority students, faculty and staff at all universities. In time, the IEC group will grow and the model being developed can be replicated and implemented for other disciplines.

3.0 Recent Meetings on the Same Subject

No other meeting of this type for this audience exists.

4.0 Workshop Organizing Team
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The workshop organizing team consists of three groups; IEC leadership, ECEDHA management, and the Intel HBCU initiative team. This team works well together and conducted a successful meeting in March of this year. The IEC leadership core consists of the following who were also central to the management of the HBCU ECP project: Craig Scott, John Kelly, Mohammad Chouikha, and Kenneth Connor. These four were responsible for the content of the workshop. The ECEDHA management team has expertly supported the national electrical and computer engineering department chairs association, ECEDHA. ECEDHA management leads the communications and logistics efforts. In part as a result of their own similarly focused effort, Intel’s HBCU initiative team has partnered with IEC as a way to both facilitate our efforts and amplify their own.

5.0 Venue, Date, and Communication to Invitees

The IEC Stakeholders’ Workshop is planned for July 14th and 15th in Hillsboro, Oregon, on the Tigard Intel Campus. The choice of venue and date was influenced by a strong, supportive relationship with Intel. In 2017, Intel launched a $4.5 million initiative to broaden the technology industry’s workforce pipeline. The six participating HBCUs include Florida A&M University, Morgan State University, Howard University, Prairie View A&M University, North Carolina A&T State University and Tuskegee University. A meeting of this group of six HBCUs, all of whom are IEC member universities, is planned for the two days immediately following our workshop. Intel calls their meeting, “The Intel HBCU Consortium 2.0” and it will be held on July 16th and 17th. As a result, we will use the same hotel for our accommodations and Intel is providing meeting space on their campus at no charge.

We are using a variety of means to communicate with our invitees. An electronic mail message has been drafted by the IEC president and will be sent by May 10th. We also plan to distribute pre-workshop briefing packages and hold a web-based meeting just prior to July 14th. We will monitor registrations and contact anyone directly who has not responded to ensure our invitation was not overlooked. The schedule and process we plan to use is also described in Section 6.

The planning committee also intends to host two, post-workshop web-meetings to conclude any planning begun during the workshop, organize working groups, or communicate information valuable to the continued evolution of our consortium.

6.0 Proposed Activities, Agenda, Collecting and Disseminating Results, Impact

7 May 2018: Save the Date Announcement (email)

When Funding is Available: Formal Announcement of Workshop Details (email)

17 June 2019: IEC Leadership Meeting at ASEE Conference
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19 June 2019: Update on Workshop (email)

26 June 2019: Online Meeting
• Summary of work to date, based on paper presented at ASEE
• Overview of Workshop
• Pre-workshop tasks assigned, including personal SWOT (due 14 July 2019)
• Discussion

14 July 2019 Workshop (Tigard, OR)
IEC Board Meeting 3-5 PM
Registration 4 – 6 PM
Opening Session (Working Dinner) 5 – 7 PM
• Status update on collaborative activities
• Status update on IEC and approve charter
• Status update on pre-workshop activities
• Review tasks for workshop

15 July 2019: Workshop (Tigard, OR)
7:00 am – 8:00 am  Breakfast
8:00 am – 8:30 am  Travel to Intel
8:30 am – 10:00 am  Broad Appeal Programs
10:00 am – 10:30 am  Break
10:30 am – 12:00 pm  Leadership and Professional Development
Noon – 1 pm  Lunch presentations
1:00 pm – 2:30 pm  Strategic Connections
2:30 pm – 3:00 am  Break
3:00 pm – 4:30 pm  Infrastructure
4:30 pm – 5:00 pm  Break
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5:00 pm – 7:00 pm  Strategic Planning (working dinner)

21 August 2019: Preliminary Assessment Report (email)

17 September 2019: Online Meeting 1:00 – 2:00 PM EDT
  • IEC Organizational Status
  • Status Updates on Each Session Topic
    o Progress on immediate next steps
    o Updates to long-term goals
  • Discussion

18 September 2019: Post Survey (email) – 17 September 2019

16 October 2019: Preliminary Workshop Report (email)
15 January 2020: Final Workshop Report

7.0  Results from Prior NSF Support

Prior NSF support for this collaboration (i.e., the HBCU ECP project and the Alexandria Workshop) is addressed in Section 1. The HBCU ECP project grew out a series of collaborations between Rensselaer Polytechnic Institute (RPI), Howard University and Morgan State University built around RPI’s Mobile Studio Project (see mobilestudioproject.com) whose vision has been to develop and deploy affordable technology and learning materials to enhance Science, Technology, Engineering & Mathematics (STEM) education. The strategy of the Mobile Studio Project is to empower ECE students by providing them each with a full mobile electronics laboratory (personal instrumentation) that is smaller and cheaper than a textbook. This approach permits full implementation of hands-on activities in any classrooms (lab, lecture, etc.) and for homework, also anywhere and anytime. The Mobile Studio Project collaboration was expanded to include successful activities also built around personal instrumentation, including Rose-Hulman, Georgia Tech and Virginia Tech, to form the Center of Mobile Hands-On STEM (MOHS). The latter group has been particularly successful in expanding the use of personal instrumentation in ECE education through in-person and online workshops.

Based on the successes of the Mobile Studio Project and MOHS, a new group was formed to engage all 13 HBCUs with substantive ECE programs. This latter group received funding from NSF to fully implement what became known as Experiment Centric Pedagogy (the evolution of Mobile Studio) which resulted in successful application of ECP throughout their undergraduate programs. Starting in 2013, this effort produced fundamental changes in how ECE education is offered and provides a model for how minority serving schools can work together productively. Funding for this effort ended September, 2018. The following month, the group received funding for a Mega REU/RET site that engages faculty and students from all partner schools in research on Smart and Connected Cities. The first cohort of REU and RET participants will be having research experiences at Morgan State, Norfolk State and Prairie View A&M this summer.
8.0 Conclusion

To enhance our degree programs and to improve the overall learning and working experience for students, staff and faculty, we are advancing the creation of a virtual department. This department consists of the entire IEC membership’s faculty. We believe that this will result in enhanced efficiency and effectiveness, allowing us to both serve our students better and achieve greater research results. A persistent challenge for smaller departments is the creation, collection and analysis of assessment data as part of continuous program improvement. We believe that this virtual department will also help us to create more effective assessment systems as part of our continuous improvement efforts. We further believe that this consortium will allow us to be competitive in larger, multi-campus research funding opportunities. IEC will enhance technical research in ways our individual departments cannot. For example, we have plans for shared research infrastructure that can be the nexus for even greater research productivity.