

## A Super Department Model for Multi-University Collaboration

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## **A Super Department Model for Multi-University Collaboration**

**Abstract:** Since 2013, a partnership of Electrical and Computer Engineering programs from nearly 20 Minority Serving Institutions (MSIs) have been collaborating to produce more and better-prepared graduates by leveraging connections between partner institutions and outside organizations from academia, government and industry. Key to the success of this collaboration has been the development of a virtual working community of practice through regular online and in-person meetings, resource and idea sharing, collaborative assessment and publication/dissemination of results, advocacy and mentoring for one another, and mutual trust. The lessons learned have led the partners to form a non-profit organization to provide the infrastructure to support joint activities and programs. This new organization has enabled the group to expand the collaboration scope to address the full learning and working experience of students and faculty and include other MSIs. Its vision is to be a collaboration of Minority Serving Institutions Working as One organized as a virtual super department with broadly based strengths in education, scholarship and service. In time, the organization will grow and the model being developed replicated and implemented for other disciplines.

### **Introduction**

Since 2013, 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 (NSF Award #1255441). 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 include other minority serving institutions (MSIs). Recently, the group has added 2 additional HBCUs and 3 Hispanic Serving Institutions (HSIs) and received funding for a Mega REU/RET site with a team led by Morgan State University (NSF Award # 1849454). Key to the success of this collaboration has been a solid virtual working community of practice sustained through regular meetings including weekly video conferencing and in-person workshops; online resource sharing, and highly collaborative publication/dissemination of results at ASEE conferences.

While the original 13 partners worked to solidify and sustain the impact of ECP on improving the learning experiences of their students and the augmented group developed new technical research collaborations, a leadership working group explored how to realize the most effective working infrastructure for the evolving consortium. By identifying the primary barriers to future success, it became clear that a new support organization was 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 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.

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 through access to resources and opportunities not available individually. IEC works 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, IEC will grow and the model being developed can be replicated and implemented for other disciplines.

**Experimental Centric Based Engineering Curriculum for HBCUs:** The ECP project created an *HBCU Engineering Network* which 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 EE topics. 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. As the ECP project wound down, the group has been reflecting on what lessons there are to be learned from this experience. First and foremost, the project succeeded because many schools worked together as one to collectively improve the learning experiences of their students.

What enabled the group to succeed? 1) Experienced faculty trained faculty at schools new to personal instrumentation at both in-person workshops and regular online meetings. The experienced faculty from within the project had worked together previously 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. 2) Participants engaged in effective, regular, nearly weekly communication through online meetings. 3) Common assessment tools were developed and implemented with guidance from an experienced team from UAlbany. 4) Activities and accomplishments were collectively documented at ASEE meetings. 5) The project actively involved both department heads and teaching faculty. 6) Overall, the project 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.

The group also encountered some significant barriers that impeded its ability to achieve its goals as quickly and effectively as it had hoped. 1) The support infrastructure at participating schools was often not adequate to support collaborations. A great deal of personal intervention was usually required. 2) It was not possible to create and maintain an effective external web presence. Content was productively shared, but also required a lot of personal intervention. 2) 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. 3) 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. 4) 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. 5) The ECE programs that make up the collaboration are generally under-resourced.

**The Inclusive Engineering Consortium:** A series of hypotheses were developed that led to the creation of the IEC to handle funding, program support and general infrastructure. The collective group of schools can function as, in effect, a super department, so it is possible to collaborate with outside schools and other institutions as equals rather than as an afterthought. Two changes help address leadership. First, by using an external organization to handle funding and general infrastructure, all partners operate on an equal footing (no prime). The new organization does not compete with the departments, but rather magnifies their capabilities. Second, infrastructure includes leadership and teamwork training through workshops and mentoring, especially for writing proposals and doing collaborative research. Sustainability requires that the external entity be a formal, legal entity.

Based largely on the experience of the original 13 IEC members in the ECP project, the driving hypotheses being explored by the organization are: (1) many activities historically undertaken by traditional departments can achieve either higher levels of success and/or success in new areas when developed and implemented by multi-institutional teams; (2) resources and support programs can be effectively shared across many institutions; (3) improvement science, specifically professional development addressing key topics such as teaching, advising, team science, communication, leadership and program management can build capabilities at all partner institutions and breakdown historical barriers to collaboration; (4) the combination of collective experiences and resources with diverse student populations can enable students to achieve greater success and to build personal networks; and (5) alliances built with outside entities can be established and nurtured on a level playing field with external entities by working collectively with other organization partners rather than as individual departments.

### **Collaborative IEC Activities**

The Inclusive Engineering Consortium was established as a non-profit early in 2019. Prior to that time, the group of collaborators received multi-year funding for the Experiment Centric Pedagogy project and the SCR<sup>2</sup> Mega REU/RET site. Howard was the lead school for the former and Morgan State is the lead for the latter. Both projects involved nearly all IEC partner institutions and cover the time period from 2013 to 2021. These two projects have produced over 20 publications. [1-24] A proposal to extend SCR<sup>2</sup> funding is being prepared. An additional grant was obtained by Morgan State to expand the application of ECP beyond ECE, which is supported, in part, by IEC. (A paper on this project has been submitted to this conference.) About a year was required before IEC obtained basic approval to submit proposals to NSF. At that time, what remained were the final steps in the process that are only taken once an organization has a grant proposal that is approved for funding. This did not occur until February of 2021. Prior to receiving full approval, all NSF proposals were submitted through partner organizations, as they were before IEC was founded. In the summer of 2019, NSF partially funded a workshop held at

Intel headquarters in Oregon. [25] This grant was funded through North Carolina A&T. A second workshop grant was also funded by NSF through Tuskegee for a workshop to be held at the annual ECEDHA meeting in Florida in March 2020. This workshop was cancelled due to COVID and was replaced by a series of mini-workshops offered online between May 2020 and February 2021. (A paper on this workshop series has been submitted to this conference.) In addition to these funded workshops, IEC also received NSF RAPID Grant funding to study the impact of COVID-19 on the Minority Serving Institutions it serves. (A paper on this grant has been submitted to this conference.) This grant was funded through IEC's partner organization ECEDHA. The activities funded through these three grants have actively involved faculty and students from nearly all IEC partner departments. In addition, IEC supports multi-university teams that have received NASA INCLUDES planning grant funding through North Carolina A&T and Texas El Paso. The combination of the mini-workshops and NASA INCLUDES planning grant workshops resulted in over 15 total IEC workshop sessions, with durations between one and two hours, addressing topics including team science, autonomous systems, minority faculty working with and at predominantly white institutions, multi-institutional alliances and initiatives, engaging with industry, women in STEM, and anti-racism practice in engineering. All of the five hypotheses listed above were addressed in these workshops.

In addition to the grants listed above, several proposals have been submitted, some involving only IEC members and some involving equal collaborations with faculty from R1 schools. In all cases, IEC members were involved in the proposal process from the beginning. Each submission has resulted in improved proposal quality. IEC is also developing partnerships with other organizations and universities. It has recently signed an MOU with a southeastern university to collaborate in its AI initiative and re-established its participation in the 50k Coalition now that the latter has obtained long term funding from the Clark Foundation. IEC has five corporate partners and is working to expand that number and also actively pursuing foundation support.

## **The Future**

IEC membership will soon be expanded generally to better accommodate organizations, companies and universities looking to build collaborations with IEC faculty and students. The scope of collaborations between its member departments will also continue to grow to achieve goals that no single partner has the time, personnel, facilities or other resources to address alone. It will also continue to support the professional development of its member faculty, staff and students to realize its goal of more and better prepared ECE grads.

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