Student Based Research Networks (SBRN) to Foster Career Pathways

Preliminary Concept Proposal

The proposed full-scale development for student-based research networks (SBRN) seeks to construct informal learning networks between students positioned at different points in the technology educational continuum and across institutional boundaries. The SBRN concept views that an informal, self-directed network of diverse students can articulate research problems relevant to (but still outside) conventional two-year college technology curricula in a fashion more expedient than normal college curricula development processes.

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Executive Summary

The proposed ***full-scale development*** for student-based research networks (SBRN) seeks to construct informal learning networks between students positioned at different points in the technology educational continuum and across institutional boundaries. The SBRN concept views that an informal, self-directed network of diverse students can articulate research problems relevant to (but still outside) conventional two-year college technology curricula in a fashion more expedient than normal college curricula development processes. Specifically, research activity at the University/Institute level that can influence career pathways diffuses slowly to the two-year college level, and even slower to secondary education curriculum development forums. The SBRN is an ISE framework that enables STEM students from different settings to engage in a facilitated team environment as a "community of learners," adept at indentifying, shaping, and solving research questions that can be addressed at the 2-year college technology level.

There are four specific aims of this ISE project:

1. To adapt a disciplined practice-based research network (PBRN) process to a student-based research network (SBRN) framework and facilitate four to six funded teams through a complete project cycle.
2. To create a partnership among LCCC (including its Institutes), ReachHigher (secondary school development initiative) and CWRU to foster the translation of research issues into a 2-year college setting.
3. To identify critical path items in the full-scale version of the SBRN framework that might limit its impact in the translational of research to technology curricula.
4. To evaluate SBRN among LCCC and its constituencies, specifically as it pertains to effectiveness in fostering secondary student awareness of advanced technology career pathways.

The **intellectual merits** reside, in part, in the unique links and resulting synergies of students with different technology literacy but complementary skill-sets working in an informal network, facilitated by experienced educators. It links the discovery process of universities to advanced curricula development of community colleges through a SBRN "spin in" framework.

Among the **broader impacts** it seeks to align two-year college student career pathways with regional economic needs so the latter are more nationally and internationally competitive, especially a regional economy in the throes of change. The focus is on advanced technology (initially sensors and sensor systems) discovery because the industry is of regional consequence. LCCC is experienced in a variety of pathways (it has 14 University Partnerships), and can attend to the processes required to engage the broader academic community.

SBRN teams will be integrally involved in identifying Technology Projects that derive ideas from research Universities and Institutes. Institutional interactions fostered by this ISE will initially be between (and within) LCCC, ReachHigher, and CWRU, serving as a test-bed for LCCC's relationships to other institutions in the region and technology institutes, although each will have to be attuned and managed according to the distinct properties of future SBRN frameworks.

Project Overview

The proposed ***full-scale development*** for student-based research networks (SBRN) seeks to construct informal learning networks between students positioned at different points in the technology educational continuum and across institutional boundaries. The SBRN concept views that an informal, self-directed network of diverse students can articulate research problems relevant to (but still outside) conventional two-year college technology curricula in a fashion more expedient than normal college curricula development processes.

Lorain County Community College has recently launched the Center for Advanced Systems Applications (CASA) and the Electronic Materials Reliability Institute (EMRI) to address product development and advanced manufacturing issues related to sensor systems technology. Several aspects of these initiatives draw heavily on the "practical application of scientific knowledge" as it pertains to manufacturability, life, reliability, and forensic domains related to CASA and EMRI technologies. One of several roles of these Institutes is to move students along the path of advanced degrees and support skills required in jobs of tomorrow. The Institutes are centered around advanced technologies not currently a part of the 2-year college curricula.

A. Project Rationale

Students may be uncertain about moving from a 2-year to 4-year degree program, or unable to envision their role in research Institute activities. In such cases then CASA and EMRI will take longer to impact student education than required by our dynamic economy. One pathway forward is an informal science education (ISE) framework that enables students to gather with like-minded peers and explore the research world in an intellectually safe environment. Using the framework of Practice Based Research Networks (PBRN), the proposed Student-Based Research Networks (SBRN) is an adaptation of the PBRN concept as for bridging University research and field practice that has been in place for several decades. Our concept for an SBRN is derived from PBRN and is based on three principles:

1. The experience and training of technologists is appropriate and adequate enough to frame research questions applicable to the Institutes.
2. Networks of like-minded students are an intellectually safe (effective) environment that promotes a "climate of inquiry."
3. CASA and EMRI research topics can be cast (cascaded from the University) in a manner amenable to study at the 2-year student level; resulting in outcomes relevant to the research community.

The SBRN is an ISE framework that enables STEM students from different settings to engage in a facilitated team environment as a "community of learners," adept at indentifying, shaping, and solving research questions that can be addressed at the 2-year college technology level. Student members of the SBRN can down-select the pool of research questions they have identified and then embark on how the solution to the question can be answered within the 2-year college setting.

A.1 Specific Objectives and Significance

Recent shifts in the industrial structure of the northeast Ohio regional economy have recently resulted in significant state and federal investments in research and advanced technology, around several themes (materials, health, and energy). These investments are intended to foster new products and services to (ultimately) create new jobs within our community, but an unmet need is the development and dissemination of educational frameworks and content

suited to these technologies. In many cases, conventional technology instructors have yet to make the shift from a didactic ("sage on the stage") to dialectic (a facilitator of critical thinking skills) curricula frameworks, and the lag in this paradigm shift has impeded, for instance, 2-year college curricula offerings in advanced sensor system technology. The general goals of the SBRN informal science framework is to introduce a new mechanism for student learning and for students to have the opportunity to experience research at a developmentally appropriate level, contribute to the research community, and build personal momentum to explore an advanced degree.

Our specific objectives are to develop and encourage:

- *A network triad*: Abet and pilot a unique student network among a community college (LCCC), a research university (CWRU), and a gateway to secondary school students (ReachHigher) to expedite the translation of research ideas into a 2-year college framework.
- *Infrastructure development:* Catalyze a new informal science education infrastructure to foster and sustain a culture of inquiry engaging learners from different educational settings. The informal setting for the students is facilitated by a faculty (a dialectic approach) mentor foster new career pathways students.
- *Sustainability and Expansion***:** Establish SBRNs as an accepted mechanism for bridging student interest in research when existing curricula lags the technology advances. Over time the SBRNs become curricula components themselves.

The approach we are proposing to meet these objectives is achievable, rooted in the theoretical underpinning of PBRNs, and has the potential to transform the way research Institutes are integrated into conventional 2-yer colleges.

A.2 Intellectual merit and broader impact

The **intellectual merits** reside, in part, in the unique links and resulting synergies of students with different technology literacy but complementary skill-sets working in an informal network, facilitated by experienced educators. It links the discovery process of universities to advanced curricula development of community colleges through a SBRN "spin in" framework. Among the **broader impacts** it seeks to align two-year college student career pathways with regional economic needs so the latter are more nationally and internationally competitive, especially a regional economy in the throes of change. The focus is on advanced technology (initially sensors and sensor systems) discovery because the industry is of regional consequence. LCCC is experienced in a variety of pathways (it has 14 University Partnerships), and can attend to the processes required to engage the broader academic community.

A.3 Theoretical framework: Student-Based Research Networks

Using the framework of Practice Based Research Networks (PBRN), the proposed Student-Based Research Networks (SBRN) is an adaptation of the PBRN concept for bridging University research and field practice that has been in place for several decades. A number of papers have been published on the PBRN framework - the works of Nutting[1] and Nutting and Stange[2] are good examples. It might initially be viewed that an SBRN is "yet another" program in an already crowded space of initiatives, centers, programs, workshops, etc., etc., to serve students; further, that what is really needed is a way to integrate existing activities, not create new ones. However, as shown in Figure A, an SBRN is intended primarily as a mechanism for *informal engagement*, that is, a mechanism designed and operated as an interface between existing activities. Thus, SBRNs actually leverage and integrate (not complicate!).

A.4 Proposed Program

In the same way that CASA and EMI are gateways to research inquiry at the College requiring a slight shift in the engineering technology delivery model, the model for student engagement must also evolve. The challenge is that both require slight paradigm shifts in the way educational content is delivered and student learning occurs. The SBRN conceptual framework has the following attributes:

1. Students are primarily self-directed in the nature (lab, theoretical, experiential) and scope of research questions, with a facilitator guiding discussions and enabling access to resources. Networks of students can eventually self-assemble into smaller SBRNs.
2. University research subject areas are adapted, interpreted or transformed (through the CASA and EMRI gateway) into a developmentally-appropriate engineering technology framework.
3. Core concepts, subjects, and resources from, say, the Engineering Technology or Allied Health divisions pertaining to the research issue are managed through the facilitator or another liaison.
4. Inclusion of, say, community high schools, provides team diversity and leadership opportunities for LCCC SBRN members as mentors and teachers themselves.

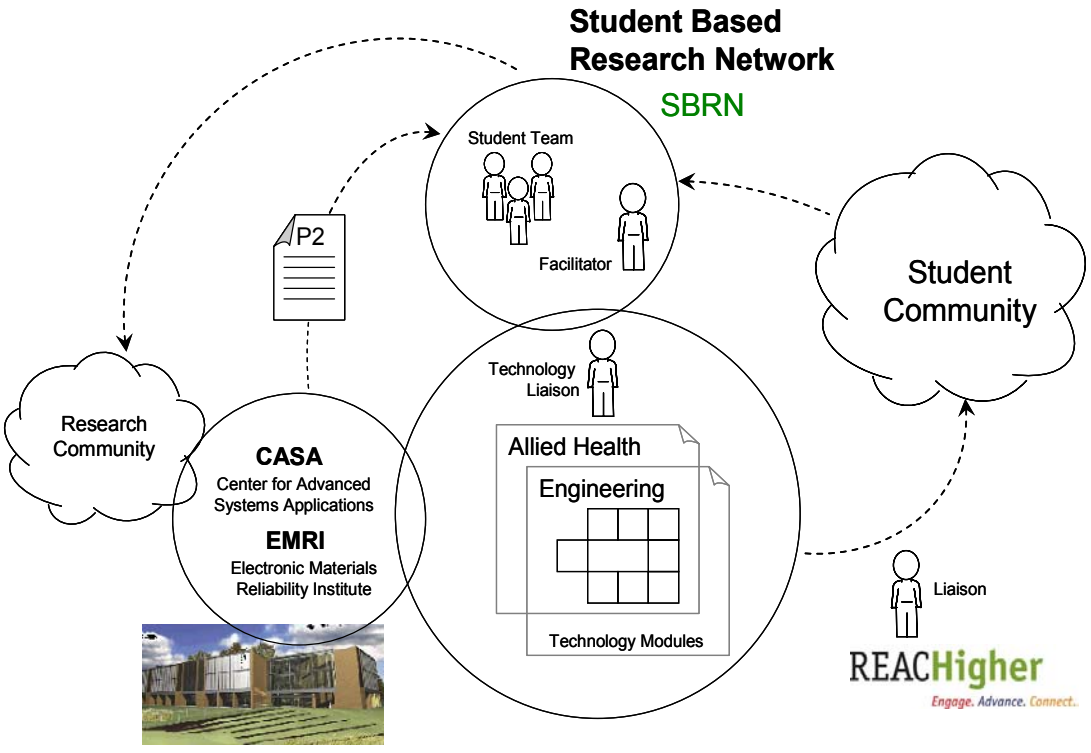

Fig. A – SBRN as a mechanism for integrating current educational components

Research universities are complex and often opaque, especially to those outside and that can intimidate students considering the move to a 4-year degree. This ISE framework helps overcome that educational barrier.

B. Project Design

The LCCC concept is very simple: through informal student networks, it is possible to mainstream advanced technology research into a student's manufacturing education experience through a pedagogical program within the "comfort zone" of student activity that spans technician and technologist training. The project's proximity to LCCC's recent launched CASA and EMRI research institutes and research companies will test and facilitate a series of SBRN teams – facilitated by faculty -- that provide students with access to noteworthy research concepts and ideas. LCCC's mix of student entrepreneurial energy and access to research activity provides unique opportunities to students -- particularly so in an urban setting – and explores the boundaries of "an instructor as a facilitator" in the realm of curriculum design.

LCCC has designed a project that directly addresses the four major objectives outlined in the previous section. At the conclusion of a successful program, LCCC will have assessed the ability to:

- Adapt components of EMRI/CASA research programs to the engineering technology program; a typical case study might be the sensor manufacturability process definition given only a desired form factor and user needs analysis.
- Accelerate the learning process through the development of SBRNs that bridge the University and College learning environments
- Vertically integrate with Secondary Schools for the identification and development of career pathways.
- Develop a student-lead SBRN Council, fostering leadership development through "apprentice mentor" programs involving, for instance, ReachHigher.
- Horizontally integrate controls components through interdisciplinary projects with, for instance, LCCC Allied Health Division

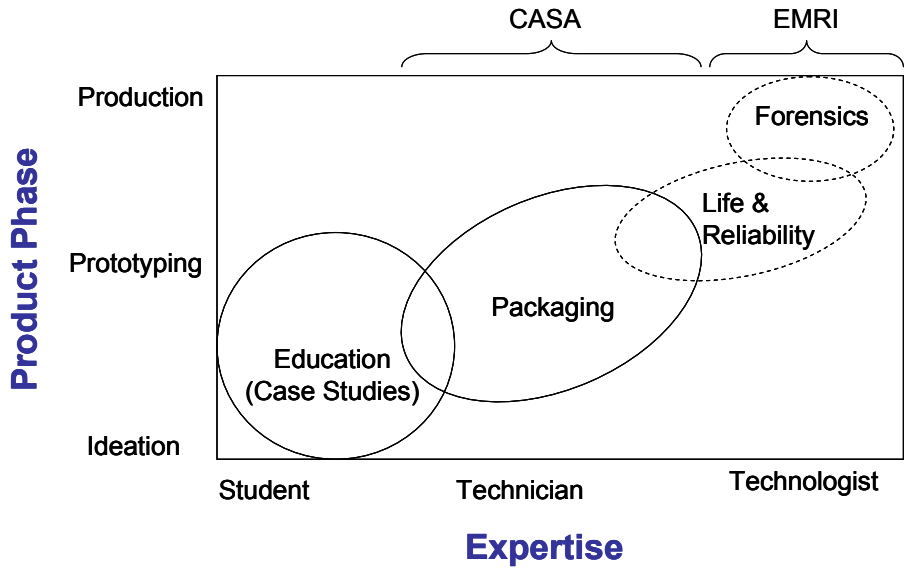

Fig. B – Technological domains associated with recent LCCC institute launches

To adequately evaluate the success of the project, the PI and Co-PIs will measure the progress of each goal and objective both during the project and at its end. The evaluation plan will follow the criteria established and guidelines set for planning, formative, and summative evaluation in the NSF "User-Friendly Handbook for Project Evaluation: Science, Mathematics, Engineering and Technology Education". Professional services will be contracted out to carry out each of the evaluation components.

C. Project Management

There are three major components to the SBRN management plan for the full proposal:

The Organizational Hierarchy, describes the ISE project organization, defining the role each strategic partner has to the lead organization (LCCC).

At the Strategic Development level, specific roles of each PI, their relationship to the organizational structure, and the composition of the membership is established. Also defined are other participant (contractor, and subaward PI) roles in setting strategic direction for the center and oversight responsibilities related to the ongoing management and operations of the project.

The Organizational Development (OD) component outlines how organizational success will be measured and how progress toward SBRN project goals will be quantified, and who will be responsible for monitoring and evaluating progress. The OD function is also responsible for identifying potential changes in strategic direction and how these changes will be accomplished, along with the budget allocation process and its relation to changes in strategic direction.

Partners in this plan are as follows:

	Partner	Role
1.	LCCC Division of Engineering Technology	Lead Academic Organization
2.	University Partnership at LCCC	Liaison with Research Universities
3.	LCCC Heath Sciences Division	Liaison with systems biology organizations and institutions
4.	Case Western Reserve University	Liaison with research organizations
5.	ReachHigher	Gateway to secondary school students

The proposed program creates a partnership based on mutual or overlapping objectives in technology and research, and in developing a workforce along a continuum to serve those needs. Our management plan is structured to allow and enhance SBRN partners' ability to reach those objectives and be alert to what serves as a barrier or disrupts them.

C.1 Institutional Partner Roles and Responsibilities

While the institutional partners' histories, missions, organizational technologies and competencies, constituencies, and objectives differ, the institutions do have intersecting interests in regional partnerships for workforce development and the translation of research from the University to the 2-year college setting.

Lorain County Community College: Unlike a research university, a community college is regionally focused. One of its primary roles is to attract and train students for vocations in the local economy. A successful community college like Lorain County Community College (LCCC) has a track record of responsiveness to local community and industrial needs, and is recognized as an innovator in educational technologies and training. LCCC is Ohio's top-ranked community college and has received the state of Ohio's highest quality rating for educational institutions by

achieving the Tier 3 Achievement of Excellence. LCCC offers a combination of programs and services unique in the state, is skilled at managing partnerships with other higher education institutions (though its unique University Partnership program) and with businesses, and serves a highly diverse student body. The region and workforce it serves, strongly African American, Latino and Eastern European in ethnic origins, have been heavily affected by the closure of various automotive plants and the downturn in related operations; LCCC is key to helping redirect and re-equip the current and emerging workforce. The proposed ISE program will leverage various strengths at LCCC:

ReachHigher: REACHigher is an educational resource for Lorain County and surrounding communities. The organization provides links to resources that can improve secondary school students' success and provide a transition for the next level of education. REACHigher also works with businesses and community organizations to ensure that students learn the skills they need for a changing job market. The organization includes educational professionals from pre-school through college. The goal of the group is to identify barriers within the educational process, and to work with educational institutions and community leaders to improve educational attainment and success throughout all education levels.

- **Engage**: REACHigher enables everyone in the community to become involved with the educational success of our students. Educators, parents, students and community organizations create partnerships to remove educational barriers for students at all levels.
- **Advance**: When students are successful in their current educational endeavors, they are better prepared to advance to the next level of education. REACHigher works with all educational levels, from pre-kindergarten to college
- **Connect**: REACHigher connects community members with educational resources throughout the area. These connections are vital to establishing common goals and working together on effective solutions.

Case Western Reserve University: Case Western Reserve University (CWRU), with about 3500 undergraduate and 6500 graduate students, is a nationally ranked research university, part of the larger system that recruits students and faculty, distributes information on research and discoveries, places its graduates for advanced study or in employment, and attracts over $400 million in funding from national and international sources.

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