2.8 Other Collaborations and Outreach

2.8.1 Purposes and Mechanisms

In order for the U.S. to operate from a position of strength in research, innovation, translation, education, and economic impact, the mindset of the next-generation workforce is critical. To help address this need, a major goal of the ERC program is focused on producing graduates who will be creative U.S. innovators in a globally competitive economy. To that end, the ERC engineering workforce development program needs to include not only university-level education strategies but also strategies that attract precollege and non-traditional students to engineering careers, as well as strategies to involve a broad array of collaborations with government labs and innovation centers and foreign institutions. These involvements should include assessment to monitor progress and impacts over time and to improve the program as needed.

The role of Gen-3 ERCs is to strategize and impact the above through appropriate partnerships. Collaborations with and outreach to other institutions for research and education enable Gen-3 ERCs to disseminate more rapidly and widely the "ERC culture." This can be accomplished through a variety of mechanisms, including joint proposals, exchange of faculty and/or students, direct funding for specific research tasks, consulting activities, and other means. The goal is worthy, and in fact the results of these interactions have largely been worthwhile. This section of the chapter outlines generally followed operating principles, with some examples and lessons learned.

Experience has suggested that best practices for engineering workforce development partnerships include the following:

- This collaboration should be driven by a passion for engineering education and by strong leadership. Partnerships are successful and the results and impacts are profound when both parties are on the same wavelength, moving toward a common (and lofty) goal.
- Successful alliances can be established only when both parties benefit from the collaboration.
- It is necessary to identify those institutions that have capabilities and facilities that are complementary to the goals and mission of Gen-3 ERCs. In this way the interaction becomes a win-win collaboration that benefits both sides.
- For research collaboration, discussion among the ERC thrust area leaders should identify the appropriate individual(s) to contact at the other institution. The approach is then made and, if there is an interest, joint discussions are held to ensure that the outreach institution participant(s) have the same goals and are willing to follow the procedures used in the ERC. It is important to ensure that there is a strong intellectual match-up. Experience demonstrates that financial support alone is not a sufficient basis for a strong partnership.
- It must be realized that failures can occur. Therefore, it should be made clear at the outset that, if the interaction is not successful, the alliance will be terminated.

2.8.2 Academic Institutions

2.8.2.1 Non-partner Affiliated Universities and Colleges

NSF encourages the ERC, as it makes sense, to include as affiliated (non-partner) organizations one or more institutions participating in research and/or education programs, such as universities or colleges that are contributing affiliated faculty groups. To increase the impact of the ERC on the technical workforce, the ERC may partner with community colleges and or technical colleges.While the core configuration of an ERC allows up to four domestic partner universities in addition to the lead university, non-partner affiliated universities and colleges must be selected based on the value they add to the overall mission of the center. Often the success of the ERC does not depend on the number of partners so much as on the quality of the partnership, as far as the mission at hand is concerned. For example, the ERC-RMB, led by North Carolina Agricultural and Technical State University, includes only two domestic partner universities, the University of Pittsburgh (UP) and the University of Cincinnati (UC). The partnerships were initiated based only on inherent synergies and past track record. This gave the time and

resources for judicious selection of non-partner colleges and universities, community colleges, and other institutions. In RMBÃ¢â‚¬â„¢s case the non-partner affiliated 4-year institution is California State UniversityÃ¢â‚¬â€œLos Angeles (CSULA) This approach is having a positive impact on many fronts, from multiple research proposals to graduates entering professional programs in medicine, to the studentsÃ¢â‚¬â„¢ winning of national-level recognition based on team research across the institutions.

Another type of ERC collaboration and outreach with non-partner universities and colleges is the Research Experiences for Undergraduates Program (REU), which is described in more detail in Section 2.3.2.4 of this chapter and in Best Practices Chapter 4, Education Programs. The REU program, for which supplemental NSF funding is available, allows leading undergraduates from other universities and colleges to experience hands-on ERC research opportunities that hopefully will encourage them to pursue graduate education in science and technology.

2.8.2.2 Precollege Partners and Community Colleges

The ERCÃ¢â‚¬â„¢s partnerships with community colleges and or technical colleges serve to increase the impact of the ERC on the technical workforce. Precollege educational institutions are included in order to bring engineering concepts to the classroom and stimulate student interest in enrolling in college-level engineering degree programs and in engineering careers. The partnerships also serve to strengthen the technical workforce and stimulate interest in careers in engineering.

The precollege education programs stimulate student interest in engineering careers and increase the diversity of domestic students studying engineering at the college level. This would include school districts and/or individual schools. A strong relationship with the above will create: (1) STEM teachersÃ¢â‚¬â„¢ involvement in ERC research and education programs, creation of educational modules for their school teaching activities, and integration into their curricula; (2) a strong impact on diversity and broadening participation of underrepresented groups, both teachers and students, into these engineering experiences; and (3) an infusing of creativity, innovation, and STEM leadership motivation among talented high school students through the Young Scholars program.

For example, some ERCs have formed partnerships with county school systems, middle schools, community colleges, and technical community colleges to provide outreach to secondary school teachers and K-12 and associate-degree level students. Some centers have also become involved in local science fairs, both as mentors or judges. This approach is creating a positive impact on many fronts: teachers and young scholars engaging in ERC research and pursuing national competitions, community graduates entering 4-year educational programs through a 2+2 articulation agreement, and organization of national education workshops.

2.8.2.3 Foreign Partners and Collaborators

Gen-3 ERC Programs aim to provide an opportunity for domestic students and faculty to collaborate in a globally connected university research and education environment. The collaborations established with researchers in foreign institutes should lead to the advancement of pre-competitive research. The judicious selection of foreign partners is just as crucial to the ERCÃ¢â‚¬â„¢s success as that of domestic partner and non-partner institutions. It should be based on the institutionÃ¢â‚¬â„¢s position of global strength and leadership in the ERC research area; the passion and motivation of the global partnership coordinator in working with the ERCÃ¢â‚¬â„¢s leadership to advance common goals, leading to accomplishments such as the joint organization of workshops, conferences, and knowledge exchangeÃ¢â‚¬â€•technical as well as cultural; and the opportunities for faculty-student exchanges. The foreign collaboration should add significant value to the research and also offer the ERC students the opportunity to work in a foreign laboratory for a mutually agreed period of time. Sufficient time in the foreign partnerÃ¢â‚¬â„¢s laboratories enables the ERC student to have a meaningful international research experience that is relevant to the student's research in the ERC.

The foreign partner collaboration could be formalized through a Memorandum of Understanding (MOU) among the institutions, or less formal ERC-faculty-to-foreign faculty collaboration. The MOU approach is strongly recommended for future sustainability of the partnership. In both cases, there should be mutually protective Intellectual Property (IP) policies that could evolve over time to meet the requirements of the individual institutions. As an example, one of the current ERCs (ERC-RMB) had a global research partnership with Hannover Medical School (MHH) in Hannover, Germany, while the Indian Institute of TechnologyÃ¢â‚¬â€œMadras (IITM) provided additional global entrepreneurship and cultural knowledge. Passionate leadership from the coordinators involved has resulted, in addition to an exchange of students for research, the organization of international workshops in the

biomedical field, including at the FDA, helping the ERC to become one of the trailblazers in this area of technology.

2.8.3 Federally Funded Research and Development Centers

As outlined in Section 2.5, there are a large number of competitive solicitations that are released by many other federal agencies throughout the year, and many ERCs apply often for supplemental funding and collaborative research through this mechanism. The ERC Program is generally viewed positively by other funding agencies and is seen as a stable, well-supported platform for related R&D programs.

There are also a small number of NSF supplemental funding opportunities restricted to ERCs and other existing Program participants, and centers which actively seek out these special solicitations can readily enhance their finances and opportunities for collaboration with other groups (see Section 2.5).

Among the different collaborators an ERC may develop, Federally Funded Research and Development Centers (FFRDCs), commonly known as National Laboratories, present some great opportunities while at the same time creating a number of difficult challenges. First, it is important to recognize that a National Lab is not a funding source, but rather a partner in building up the ERCÃ¢â‚¬â„¢s research programs. The ability to align research activities that meet a common vision and mission is critical for a strong collaboration. This is not necessarily a trivial matter, due to the nature of NSF and the National Labs. NSF has historically depended primarily on university-led efforts, which rely on graduate students at a relatively modest cost, and the research proceeds in an open-ended fashion. National Labs, on the other hand, depend primarily on career researchers and the research is driven programmatically by the funding agency requiring clear deliverables. Even if these deliverables cover long-term research goals, they usually address a very specific national need, such as cybersecurity for infrastructure. This has a myriad of implications in practice. For example, the National Labs tend to be very strong at creating new experimental infrastructure and building research capacity in a particular field. Still in recent years, they have put greater emphasis on involving students, including post-docs, and working more closely with universities as well as industry. NSF has moved more towards targeted research and innovation with research. So the two research models are moving closer together, reducing some of the barriers.

The natural division of labor between an ERC and a National Lab is for the ERC to focus on long-term research goals, while the National Lab leads experimental setups and provides firm deliverables that match programmatic needs. One way to enable this division is through post-doc assignments at the National Lab where the former student more fully explores ideas from their dissertation. This is not to say National Labs have no long-term research objectives. In fact, they may have on staff many mathematicians and physicists, and so on, who are accustomed to longer-term research goals than in engineering. Still, even in the pure science fields they are focused on clear program goals and demonstrations. ERCs will collaborate best if they understand those goals. It is worth noting the contrast of the multi-year budget cycle at NSF relative to the typically yearly funding decisions for the Labs. This research has to be managed so deliverable deadlines can be met.

As with most collaboration, long-term sustainability stems from developing personal relationships and actively working together on research problems. For some centers, this arises naturally from past collaborations and proximity. For example at the CURENT ERC at the University of TennesseeÃ¢â‚¬â€œKnoxville, many faculty and even some staff have joint appointments at Oak Ridge National Laboratory (ORNL), which is located within a short driving distance of the university. This is an obvious advantage in understanding the different environments. Even without proximity, many of the National Labs maintain strong relationships with several universities. It is important to have faculty on the ERC team who have fostered these relationships and understand the programmatic approach of the National Laboratories.

2.8.4 University, State/Local Government Organizations Devoted to Entrepreneurship and Innovation

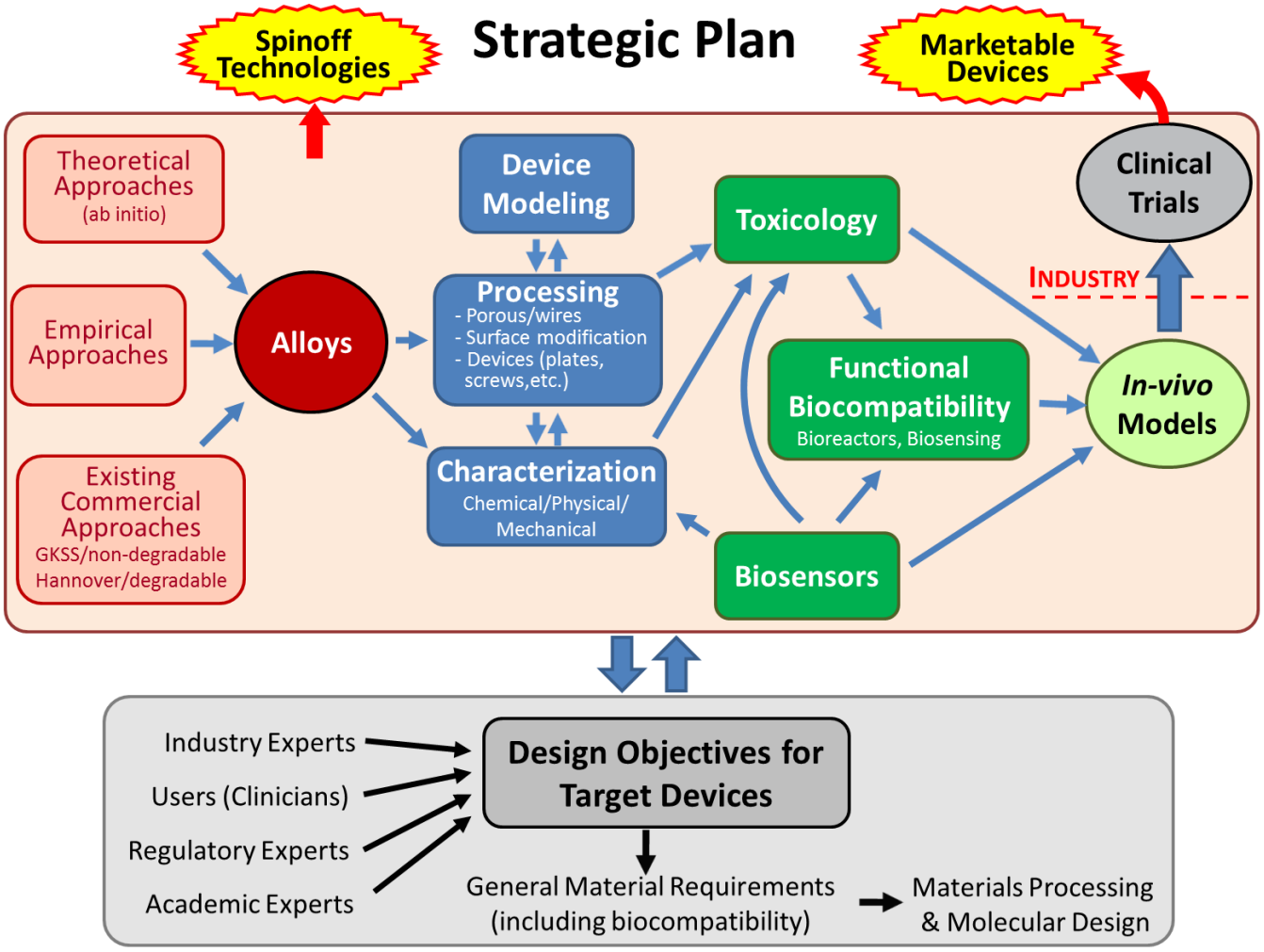
Partnerships with state and local government and/or academic organizations devoted to entrepreneurship and innovation is an important aspect of Gen-3 ERCs. With needs for job creation serving as a driver, state and local governments are increasingly looking to find ways to support entrepreneurs, and are partnering with universities in this effort. Government agencies look to universities to provide technical support to entrepreneurial efforts, provide training in business basics, and train and develop the workforce required for new ventures to thrive. They also look to universities as the source for innovation from which entrepreneurial jobs may grow, and may have programs to provide some financial support for innovation in business areas targeted by the state for economic development. As such, it is important to engage representatives from these organizations in the ERC, preferably as innovation partners and advisors to the ERC leadership. The relationships built in this fashion will not only help to cement the

centerÃ¢â‚¬â„¢s role in driving regional economic development, but help extent the center's contacts, as theseGovernment organizations are routinely sought out by entrepreneurs and are accordingly extremely well connected. While the exact nature of these organizations will vary from state to state, the State Department of Commerce is a good starting point for developing these relationships.

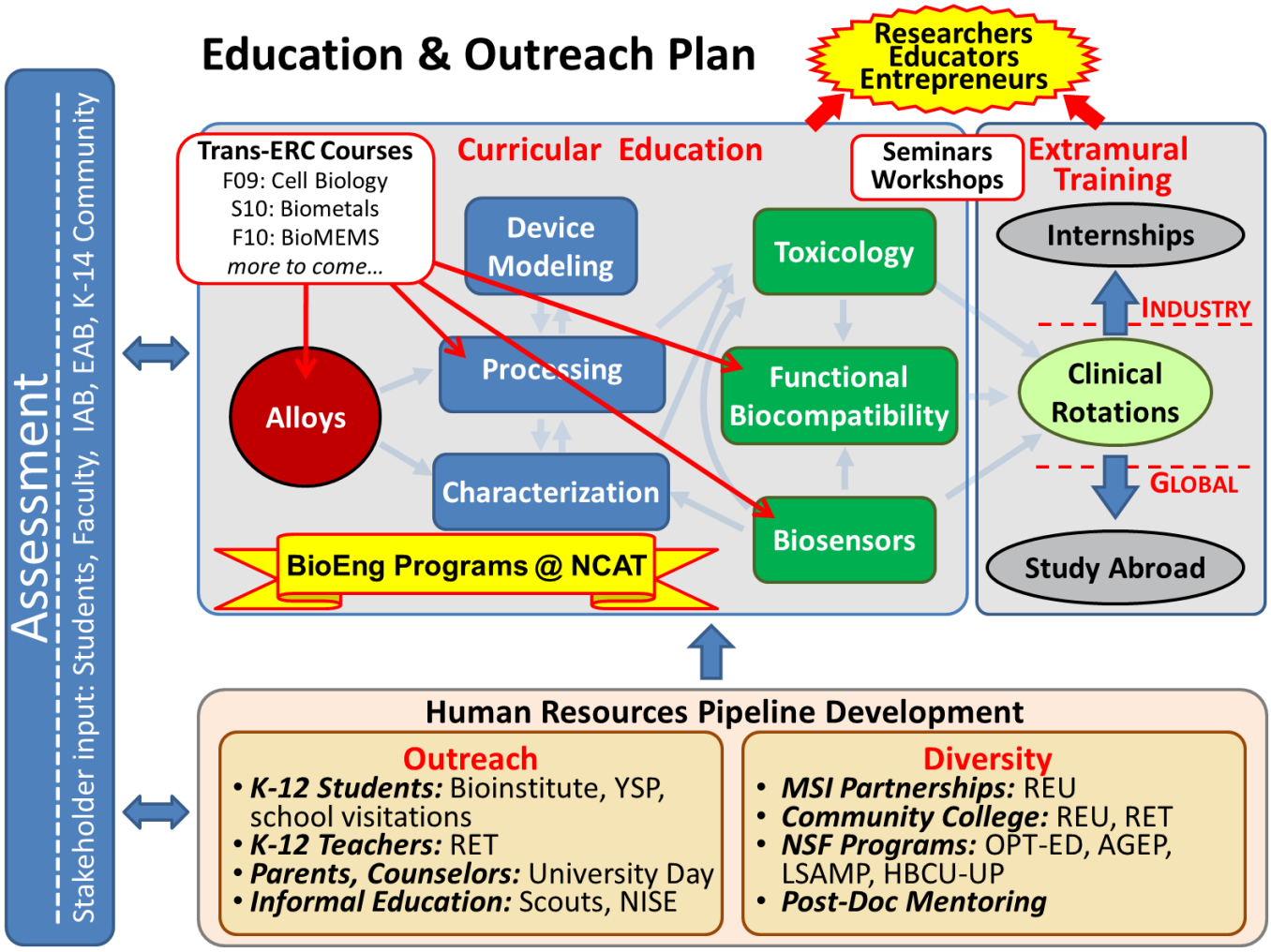
In addition to developing partnering opportunities, these organizations can help provide the ERC with resources needed to enhance entrepreneurship training for students. Many universities have established Centers for Entrepreneurship, and these groups should be formally engaged in the ERCÃ¢â‚¬â„¢s education and industrial affiliates programs. Similarly, staff and entrepreneurs at local business incubators can provide educational opportunities through seminars, workshops, and mentoring of students.

CASE STUDY:

The integrated research strategic planning and education and outreach strategic planning of the ERC for Revolutionizing Metallic Biomaterials at NC A&T State University (RMB) is one example of an ERC's approach to developing effective collaboration and outreach efforts. Both strategic plans have been carefully developed to be in support of each other, and both plans employ a uniform color-coding scheme to demarcate thrusts and pathways and to track the impact of the vision and mission of Gen-3 ERCs from research to education to outreach. All partner (as well as non-partner) universities, colleges, community colleges, and other precollege partners, along with foreign partners/collaborators, federal labs, and academic/state/local government organizations devoted to entrepreneurship and innovation, are embedded seamlessly through these strategic plans, resulting in maximum impact.



ERC-RMB Research Strategic Plan



ERC-RMB Education and Outreach Strategic Plan

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