Report from CEOSE *Ad Hoc* Subcommittee on Institutional Transformation

Introduction. CEOSE's 2004 report, *Broadening Participation in America's Science and Engineering Workforce* (CEOSE 04-01, December 2004), concludes that progress since 1980 in broadening participation in STEM has been measurable, but disappointingly modest. This situation impoverishes our STEM enterprise, which lacks the ideas and energy bright people from a different background can bring. Spurred by a fervent desire that long before 25 years from now, no groups will be so drastically underrepresented as is currently the case for African Americans, Hispanic Americans, Native Americans, Alaskan and Hawaiian natives, persons with disabilities, and women (the one group for which participation gains have been substantial), the 2004 Report identifies institutional transformation as an essential strategy and recommends CEOSE action:

> *CEOSE should seek to understand the elements necessary to transform institutions into entities that are supportive of a diverse population of students and faculty, engage leaders of NSF grantee institutions in the goal of broadening STEM participation, and thereby recommend to NSF means by which it can generate ~~propel~~ institutional transformation through its policies and programs.*[1]

CEOSE hosted a mini-Symposium to gather specific ideas and direction to promote and catalyze institutional change. Since diversifying the population of STEM students and broadening the demographics of STEM faculty are two different challenges, they are likely to require and respond to different policy levers and institutional change strategies. The Mini-Symposium explored both. The stated goals of the Mini-Symposium were:

1. To identify best practices in and persistent barriers to institutional transformation that broadens participation in STEM—both among students and among faculty.
2. To share the ideas and experiences of leaders in the STEM academic community.
3. To make recommendations to CEOSE on what actions it could take that would best propel the institutional-transformation agenda forward.
4. To make recommendations to CEOSE and to funding agencies (including NSF) on ideas for policies and programs that will cause institutions to choose to make changes, which taken together will transform the STEM enterprise to become much more welcoming, supportive, inclusive, enabling, and advancing of persons from groups traditionally underrepresented in STEM (and obtain the data to demonstrate this progress).

The Mini-Symposium. Held at the National Science Foundation on October 16, 2006, the mini-symposium brought together NSF program managers, CEOSE members, and individuals with experience driving and implementing institutional transformation to broaden participation in STEM.[2] Three round-table-style, moderated panels, featured respectively: specific NSF programs that influence institutional transformation, challenges and strategies for broadening participation in the STEM faculty, and ways to improve the climate in STEM for our nation's rich demographic pool of students. Seeded

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[1] CEOSE, *Broadening Participation in America's Science and Engineering Workforce*, CEOSE 04-01, p. 103, 2004. Available at http://www.nsf.gov/od/oia/activities/ceose/reports/ceose2004report.pdf

[2] The agenda and list of participants are appendices to this Report.

by brief presentations from the invited panelists, the ensuing discussion involved all attendees and was extremely helpful to CEOSE. The major insights and ideas are summarized below.

What is Institutional Transformation (IT)? The mini-symposium did not attempt to reach consensus on this important question, but found a few perspectives to be useful.

- From ACE: IT alters the culture of the institution by changing underlying assumptions and overt institutional behaviors, processes and structures; is deep and pervasive, affecting the whole institution; is intentional; and occurs over time.[3]
- Four dimensions: IT has four interacting dimensions that each must transform: students, faculty, curriculum, structure and climate.
- A lesson from engineering: conceive, design, implement, and operate.
- An analogy from chemistry and physics: IT as an institutional "phase transition" and recrystallization into a different stable state.

Insights. Different types of institutions face different transformational challenges to broaden participation in STEM. Primarily undergraduate institutions and traditional minority-serving institutions have inclusive and supportive STEM programs and demographically diverse faculty. Their transformational challenge is to become sufficiently research-intensive that their students and faculty routinely engage in discovery science and engineering and obtain STEM preparation on a par with the best in the country. On the other hand, the key transformational challenge for our leading, primarily majority institutions is to become more inviting to, supportive of, and enabling of students and faculty from under-represented groups both academically and socially. However, it is possible that some strategies for transforming institutions could be applicable to all institutions of higher education, from community colleges to the elite research universities.

Some potential "best practices" emerged through the panelists' presentations and the discussion. These "best practices" could be viewed as attributes which are helpful or desirable, and some were recognized as key to specific institutions, programs, and situations.

- Someone who is dedicated to the transformation initiative and responsible and accountable for achieving results.
- Administrative infrastructure in the form of an office or person to whom underrepresented students and faculty can go for assistance of many types.
- Interest and encouragement or pressure from "the top," for example the President or key board member(s).
- Strategic planning to guide the effort, and implementation of the strategic plan.
- Faculty who are supportive and actively engaged in the effort. Without considerable faculty "buy-in" it would be challenging for any initiative to succeed~~There was doubt whether any initiative could be successful without considerable faculty "buy-in."~~

[3] ACE 2001, "On Change V"

- Alignment of the institution's reward structures for faculty, staff, and students with the goals of broadening participation.
- External pressure from important constituencies (*e.g.* funding agencies, major donors, employers of many STEM graduates).
- Effective and multifaceted mentoring, both formal and informal, where the mentor is focused on helping the mentee to succeed through the next career milestone to the point of becoming established in the following career phase. For example, a faculty mentor for an undergraduate student would guide the student through graduation and into a well-matched graduate program. A Ph.D. mentor would make sure the mentee obtained the research, publication, presentation, teaching, and grant-writing experience needed to be competitively selected for a post-doctoral, industrial, or tenure-track faculty position, and would continue to mentor the newly minted Ph.D. until well established in the next position.
- Linkages and partnerships between STEM education and research programs and diverse communities outside of academe, to engage students and faculty in actively applying their STEM expertise to issues that are important to the communities that under-represented students come from.

Issues. Three issues emerged as ~~ones needing over-riding attention in institutional~~ being particularly important to increasing minority participation in higher education. ~~transformation to broaden participation.~~ First, the high K-12 drop-out rate for under-represented minority students, especially in poor urban and rural areas, means that below half of this population is prepared for higher education of any type, much less in STEM fields, which require significant background in mathematics. Clearly attention must be paid, starting in elementary school, to keeping these children in school, challenged, motivated, and learning, and to providing alternative pathways for them to develop and cultivate their STEM talent. Second, the STEM potential of persons with disabilities is often ignored entirely. Rarely are data disaggregated to reveal the overlap and intersections among disability, gender, race, ethnicity and socio-economic status *vis a vis* inclusion in STEM. Moreover, given the range of types and magnitudes of disabilities, there is no simple fix that will invite and allow access for all. Transformed institutions will need fail safe mechanisms that unobtrusively and gracefully help students and faculty succeed in STEM, regardless of their disability. Third, since both mentors and leaders can be "made," institutional transformation initiatives should include training to help willing individuals develop the skills needed to become leaders in the effort. In addition, training can help people become effective mentors for under-represented individuals, whose background, experiences, and perspectives are markedly different from their own and from their traditional STEM colleagues.

Action Items and Recommendations for CEOSE and NSF.

1. CEOSE should seek to develop an operationally useful definition of institutional transformation aimed at broadening participation. What attributes would a transformed institution have? What measures or metrics would be useful to drive and assess transformation?
2. Working with NSF, CEOSE should organize a meeting focused on institutional transformation to be attended by the presidents, provosts, and board members from

several of the top universities in terms of NSF funding. Inform them of the overall performance of their campus, with respect to inclusion and advancement of persons from under-represented groups at the undergraduate, graduate, post-doctoral, and faculty levels, and challenge them to do better.

3. CEOSE should invite each NSF directorate to understand and describe for CEOSE at an upcoming meeting the specific barriers its community faces to broadening participation, and then to design and implement programs that drive or incentivize progress.
4. CEOSE should encourage each NSF research directorate to make start-up research funding available to new investigators who bring a commitment to broaden participation, modeled on the Research Initiation Grants and Career Advancement Awards (RIG/CAA) program in BIO.
5. NSF should prepare an update of its plan for broadening participation among its STEM staff, rotators, reviewers, review panels, advisory committees, and committees of visitors.
6. NSF should ensure that its Cyber Infrastructure (CI) initiative is "born" inclusive at all levels, enabling participation in its development and access to its transformational resources by persons traditionally under-represented in STEM, institutions that serve these populations, and persons with disabilities.
7. NSF should strengthen accountability for broadening participation by requiring annual and final reports to specifically address this topic ~~include input specifically on this impact;~~, separate from other broader impacts. The charges to panels reviewing cooperative agreements and MREFC Projects should include a specific question to assess progress toward broadening participation. COV's should be asked specifically to assess the extent to which the programs they are reviewing are proactive about broadening participation.
8. NSF should consider how to configure programs so that it becomes possible for undergraduate institutions, EPSCoR states, and minority-serving institutions to "graduate" from targeted programs (like EPSCoR, CREST, and HBCU-UP) to become successful competing for mainstream programs, such as Alliances for Graduate Education and the Professoriate (AGEPs), Science and Technology Centers (STCs), or Materials Research Science and Engineering Centers (MRSECs).
9. NSF should target an evaluation of the AGEP and ADVANCE programs to determine the extent to which ~~whether~~ they are changing the culture of the institutions which have received grants.
10. NSF should fund research to understand institutional transformation aimed at broadening participation in STEM. Among other things, this research should determine if there is a common framework, set of practices, or sequence for successful transformations.
11. 11. NSF should strongly encourage Presidents, Provosts and Boards of Trustees from institutions receiving NSF support to work with faculty to develop a fund raising plan that is directed at endowing faculty chairs/professorships and student fellowships that are integral to actually providing long-term continuity to institutional transformation.

Summary. The mini-symposium helped CEOSE identify a number of ~~the~~ issues and barriers to institutional transformation. The issues and recommendations provide a

framework for CEOSE action in the coming biennium and for policy advice to NSF. As one panelist noted, you use carrots to lead a horse; it takes a stick to get the horse to change directions. Working together, we must convince institutional leaders, faculty members, donors, and the scientific community that broadening participation in STEM is an essential strategy for continuing U.S. leadership and prosperity in the global economy.