ERC KEY FEATURES: DESIGNING THE NEXT-GENERATION ERC
Report from the 2007 Annual Meeting

All attendees at the 2007 annual meeting of the NSF Engineering Research Centers (ERC) program—ERC faculty, staff, and students—participated in a systematic, detailed analysis and assessment of the key features of the Generation-2 and upcoming Generation-3 ERCs[1]. Appendix A outlines the defining features for these generations of ERCs. The work was conducted in breakout groups, with a carefully selected "Synthesis Group" compiling and integrating the findings of the various groups. Appendix B outlines the analysis process and workflow; Appendix C presents the results of the Synthesis Group's work along with the findings of five later breakout sessions that examined "special issues" Identified by the Synthesis Group The aim of this effort was to provide ERC program management with feedback on those key features and recommendations for the design of next-generation ERCs, for which a solicitation will be issued in 2008 for FY 2010 awards.

OVERALL FINDINGS

The overarching finding emerging from this effort is that the existing set of ERC key features is generally excellent and should be retained, with some modifications to the characteristics of a few features. With the exception of "Partnerships for Innovation," an extension of the traditional ERC industry partnerships to include research collaborations with small firms in translational research, the substantial majority recommendation of all the breakout groups was to retain all the existing key features, as shown in Figure 1. (Subsequent discussion revealed that concerns about the new Gen-3 Partnerships for Innovation feature seem to reflect confusion about the objectives and characteristics of this Gen-3 key feature itself rather than fundamental or practical concerns with the feature.) Figure 1 shows the number of the 11 breakout groups[2] recommending that a feature be retained or deleted. For example, for the first feature, 8 (73%) of the 11 breakout groups recommended retention. No new key features were recommended for addition to the existing set.

Participants in the breakout groups were given an opportunity to cast votes reflecting their individual perceptions as to the single most significant strength and weakness of the overall program. In total, 92 such votes were cast, with results shown in Figure 2. As the figure shows, the "Single Most Significant Strengths" (blue bars) and "Single Most Significant Weaknesses" (red bars) identified by meeting participants revealed that they strongly resonate with the cross-disciplinary, systems oriented, industrially relevant orientation of the ERC program and with the benefits of these foci on university-level education. Weaknesses were revealed in aspects of the pre-college key feature and in the annual reporting process under "Infrastructure–Management"; these issues are addressed in subsequent sections of this report.

In general, the participants believe that ERC program goals and desired outputs need to be as clear as possible, but at the same time, that NSF should provide flexibility for individual centers to meet those goals (i.e., one size doesn't fit all). The identified Single Most Significant Weaknesses reflect a concern that NSF is asking the ERCs to do too many things relative to the funding levels of the program. The identified Strengths and Weaknesses together reflect an appreciation for flexibility, since there may be many ways of meeting program goals, and a desire for "best practices" that could

[1] Gen-3 ERCs will be funded in the summer of 2008 through the ERC Program solicitation NSF 07-521.
[2] Two of the original 12 breakout groups were merged to ensure a large enough number of participants in the breakout, resulting in a total of 11 breakouts.

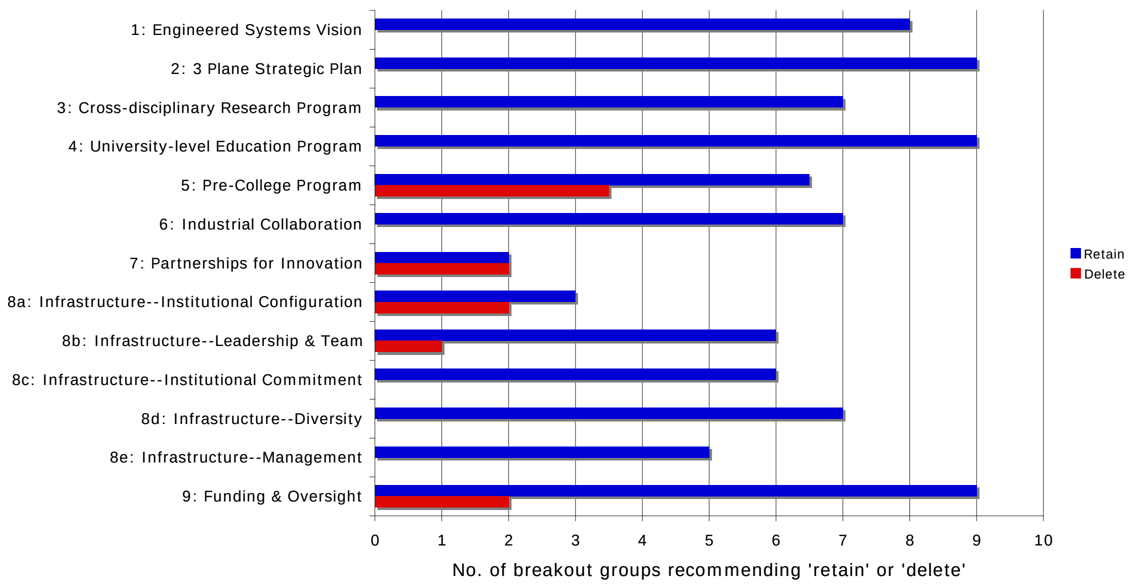

Figure 1. Results of the analysis regarding recommendations to <u>retain</u> or <u>delete</u> current ERC key features in future-generation ERCs.

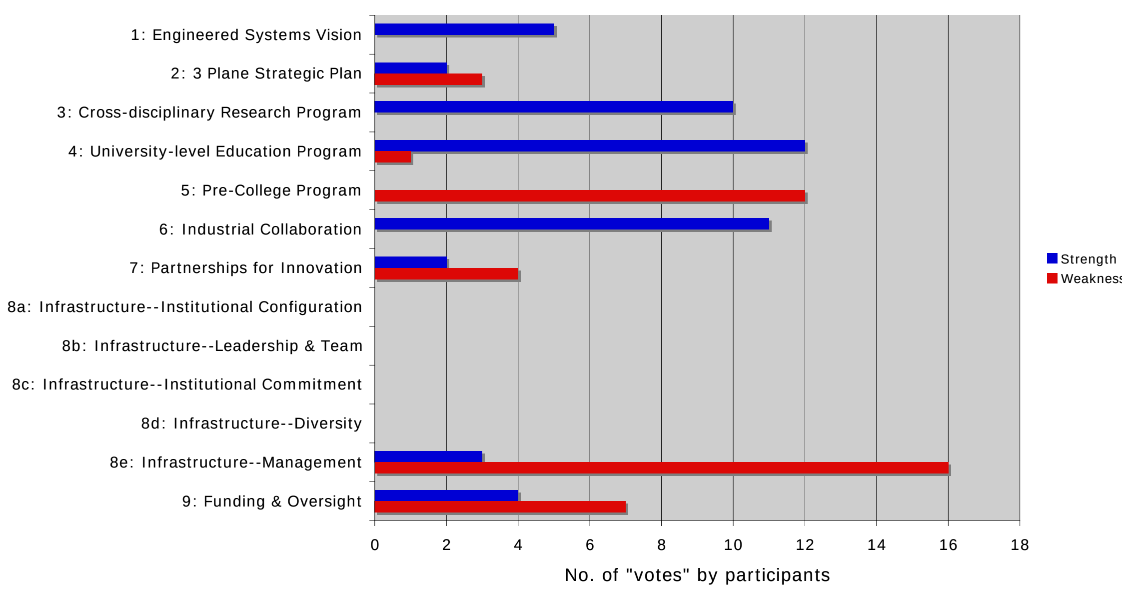

Figure 2. Each participant was asked to identify the Single Most Significant Strength and Weakness among all the Gen-2/Gen-3 ERC Key Features. The results are displayed in the figure, with the number of participants indicated.

help the centers achieve the ERC program goals. The Single Most Significant Weakness indicated in the Infrastructure–Management key feature also reflects the fact that the annual reporting burden for an ERC is substantial. Participants were interested in establishing more of a feedback loop in the annual reporting process so as to insure that report data are being used systematically and are driving future ERC program decision making.

SPECIFIC KEY FEATURES: DISCUSSION

Key Feature 1: Transformational Engineered Systems Vision

Breakout groups unanimously agreed that this feature should be retained in future Engineering Research Centers. Participants agree that the systems approach is the essence and driving force of ERC's and that the engineered systems vision focuses the activities of a center and defines its long-term goals. Several participants consider it the single greatest strength among all ERC key features.

Key Feature 2: 3-Plane Systems Motivated Strategic Research Plan

Breakout groups unanimously agreed that this feature or some version of it should be retained in future ERCs. The scope of intellectual inquiry of all ERCs spans from fundamental research, to enabling technologies, to engineered systems-level work; centers are clearly systems-motivated; and the research programs are strategically planned. A graphical representation that captures and expresses this complex, multi-level scope of operations is very useful as an organizational, communication, planning, and management tool.

However, participants expressed some concern about the three-plane graphical construct now in use by ERCs—i.e., whether it is appropriate for all ERCs and whether there might be other approaches to the graphical representation of strategic planning that might better serve particular centers. For example, the current chart does not adequately depict the connectivity among various research activities, nor does it account for the temporal dimension. Consequently, centers might want to include a "roadmap" component along with the three-plane chart when conducting strategic planning. There is concern that site visit teams (SVTs)/reviewers tend to give undue weight to the three-plane chart and thus can be too conservative in their interpretation of it and in their reactions to changes over time. Additionally, there is some non-uniformity and perhaps a degree of uncertainty among the ERCs in how the chart is used; for example, testbeds appear in different planes in different centers.

<u>Recommendation:</u> Participants recommended better orientation for SVTs/reviewers and more explicit guidelines for proposers in how the chart is to be developed and used. For example, perhaps proposers should be given the flexibility to use, at their own risk, an alternative depiction of their strategic plan (which must in any case include fundamental research, enabling technologies, and engineered systems). Evolution of the chart over time at an ERC is necessary and to be expected and even encouraged; and center leadership as well as NSF should emphasize this to SVTs/reviewers.

Key Feature 3: Cross-disciplinary Research Program

The breakout groups unanimously agreed that this feature should be retained in future Engineering Research Centers. Moreover, a significant number of participants identified this key feature as the single most significant strength of the ERC program (see Fig. 2). Cross-disciplinary research provides unique opportunities to innovate, to tackle complex problems, and to meet future engineering workforce needs. A perennial concern across the life of the ERC program, reflected again in this analysis, is that some students—especially those joining academic faculties, depending on the hiring and promotion policies at particular institutions—might be disadvantaged unless they also have an in-depth specialization in their field.

Key Feature 4: University-level Education Program

Breakout groups again agreed unanimously that this feature should be retained in future-generation Engineering Research Centers. Moreover, a significant number of participants—more than for any other key feature—identified the education of university-level students as the single most significant strength of the ERC program (see Fig. 2). The consensus viewpoint was that cross-disciplinarity is key to the unique value of an ERC-style education, and that all characteristics of this key feature, such as the interaction with industry and the leadership experience gained through involvement in Student Leadership Councils (see Appendix A) are important and valuable. Every ERC should promote undergraduate research, but some participants expressed the viewpoint that the Research Experiences for Undergraduates (REU) program should not be mandated. Participants felt that ERCs should have flexibility in designing their education programs to suit their particular circumstances.

In discussion following the meeting by members of the Synthesis Group and Special Issues breakout session moderators, the question of how to sustain ERC education programs post-graduation was addressed. The following points were made. First, ERCs build considerable momentum in their education programs (both precollege and university) after six years. They provide an educational environment for students that is unmatched on campus. And ERCs build an integrated cross-disciplinary culture in partnership with industry, where knowledge is transformed into real-world systems technology. The involvement with industry and the ability to see real-world results are strong motivators for undergraduates and even pre-college students. But past experience has shown that, post-graduation, the education and outreach programs are usually terminated for lack of funding.

Recommendation: Participants recommended that NSF should consider partially relaxing the 10-year limit on the duration of funding for ERCs and joining in a matched partnership to continue support for education and outreach programs post-graduation. This support would encompass all ERC education and outreach programs, including pre-college (see Key Feature 5). NSF and the university/-ies) would share the costs of a $200,000 per year program for five years. Continued annual funding of these programs by NSF and the university partners would depend upon their performance and impact during those five years. The next ERC solicitation should include such a post-graduation education partnership between NSF and the universities involved. For ongoing ERCs, NSF also should require this commitment from the university partners in the sixth-year renewal proposal and should revise the cooperative agreements at renewal.

Key Feature 5: Pre-college Education Program

Participants agreed that there is significant value for engineering and for the nation in K-12 outreach and the majority viewpoint is that this key feature should be retained (see Fig. 1). However, a number of participants identified aspects of this key feature as the single most significant weakness of the ERC program, and more breakout groups recommended deleting it than was the case for any other ERC key feature. Participants questioned whether all ERCs have sufficient expertise to design and deliver effective K-12 outreach programs. Moreover, they felt that mandating educational outreach without providing significant resources to carry out these programs, as is the current situation, is not a workable approach.

These issues were explored in more detail in a follow-up breakout session and subsequent open discussion, which generated the following questions, findings, and recommendations:

Is an ERC the best place to address the pre-college pipeline problem? ERCs may or may not be appropriate vehicles for addressing this issue. They certainly can have a role to play; but the question is, what? Participants feel that to be effective requires the involvement of people with engineering-education or a general pre-college education/teaching background. Recommendation: ERCs should collaborate with successful, established non-ERC K-12 programs and/or with technical education specialists with K-12 expertise. ERCs can serve as a resource for positive experiences (e.g., via the RET program). The involvement of these personnel would require increases in the current level of ERC support from NSF.

What is the goal(s) of K-12 programs? NSF's goal for ERC pre-college programs is not clear, making it hard for ERCs to know how much effort to devote to them. Is it to transform K-12 technical education or just to provide an enrichment component? Centers can't allocate the right resources without knowing the goal or goals. Recommendation: Effort needs to be put into answering this question. Development of a realistic strategy for scaling up the K-12 impact of ERCs should be an important ERC program goal. Data should be collected, reported, and fed back to inform future program development. NSF should provide templates, expectations, etc., to the ERC faculty.

Should pre-college education and outreach be mandated? Many participants have reservations about NSF requiring these activities. However, they feel they should be strongly encouraged, with clear expectations provided. There is strong majority support in general for providing experiences in engineering for pre-college students, but ERCs should have the flexibility to design their own programs, which could include RET, long-term partnerships with K-12 institutions or program providers, Young Scholars, faculty/student mentors, etc.

Are the resources (financial and staff) adequate? Is funding within the ERC program commensurate with the expected level of commitment to K-12 programs? Universally, the response was, "No!" As was noted above, a much clearer definition of program/center goals in this area is needed. Whether the available resources are adequate depends on the goals. Participants are concerned about specifying K-12 outreach budget amounts for the centers under the current climate of reduced funding and unclear expectations. Recommendation: If these activities are mandated, funding for them has to match the goals (or vice versa). The idea was proposed of partnerships for K-12, like the Gen-3 Partnerships for Innovation. How to manage such an activity should be left to each ERC, however. Additionally, see the recommendation under Key Feature 4 regarding post-graduation NSF/university matching grant funding of ERC education and outreach programs.

Is the achievable impact commensurate with the effort (opportunity cost)? Many participants felt that, given the lack of clear goals and limited funding available for these activities, the impact is small and tends to dilute the other activities and resources of the ERCs. In any case the impact is difficult to measure.

How would industry measure the success of K-12 programs? ERCs could data gather on this from their Industrial Advisory Boards, especially the existing industry education partnerships at some centers.

Recommendation: NSF should convene a meeting with the appropriate people to discuss the K-12 issues outlined here.

Key Feature 6: Industrial Collaboration

Breakout groups unanimously agreed that this feature should be retained in future-generation Engineering Research Centers. Moreover, a substantial number of participants identified this key feature as the single most significant strength of the ERC program. Industrial collaboration provides industrial/practitioner relevance, generates best practices, prepares students, supports company hiring and innovation… all things that are extremely important for a successful ERC. Requiring cash fees is difficult, but it is an important aspect of commitment. One common point is that the handling of IP issues is complicated; for example, it is difficult to establish a center-wide IP policy for multi-university ERCs.

Key Feature 7: Partnerships for Innovation

This key feature is all-new for Gen-3 ERCs. Being unfamiliar with the program, participants had more questions than answers. Perhaps most significantly, they were unsure about the goal(s) of Partnerships for Innovation (PFI) and how it differs from the goals of Key Feature 6, Industrial Collaboration. Concern was expressed about the timing of the partnership requirement—i.e., whether the partnerships should be a criterion for renewal rather than startup. Participants saw important strengths in this program related to: enhanced competitiveness for the nation; the opportunity to broaden faculty perspectives; increased student enthusiasm, experience, and opportunities; and support for spin-offs and employment. Weaknesses cited included a concern that the Partnerships for Innovation could compromise industrial commitment. There was also concern that there might be a geographical disadvantage for some universities and that some universities cannot create an incubator program.

These issues were explored in more detail in a follow-up breakout session and subsequent open discussion, which generated the following questions, findings, and recommendations:

What is the goal(s) of Partnerships for Innovation? Participants felt that the goal is unclear. Is it: (1) to benefit students through expanded career options and educational experiences; (2) to accelerate technology transfer/commercialization; (3) to enlarge the faculty's scope of thinking (e.g., that there are other professional options for students besides academia); (4) to help focus the ERC on its purpose; (5) to provide more flexibility in industrial partnerships; (6) to stimulate entrepreneurship; (7) to help bridge the 'valley of death' in the life of an ERC…or is it some combination of these, or something else entirely? <u>Recommendation:</u> NSF should clearly state what the goals are for PFI and then ERCs should generate ideas for achieving these goals through the Partnerships.

Is there flexibility to meet the goal(s)? Once goals are set, there must be flexibility, both overall and in setting metrics; having a good plan for the center is what counts the most. Flexibility enables customization to each ERC's needs and available resources. The point of this flexibility is to allow the individual ERCs to develop innovative models to achieve the goals of the PFI program, giving them freedom along with the responsibility. This approach also provides the ERC with leverage to push the institution for support. <u>Recommendation:</u> NSF should provide a mechanism (including a timeline) and venue by which models can be shared in order to meet the goals of the PFI.

Should the PFI be part of the industrial program? Does it conflict with the industry consortium program? The breakout group discussed whether these partnerships should be part of each center's overall industrial program. Participants recognize that there is a danger in spinoffs; for one, they can create adversarial relationships between faculty. Royalty issues present difficulties. There are also questions such as, How to keep small businesses from feeling 'second class' or 'special class'? and Can large companies share in start-ups (e.g., as stockholders)? <u>Recommendation:</u> These partnerships should be incorporated within each center's overall industrial program, in a way that complements the program rather than detracts from it. Further, the key to avoiding problems is the flexibility to adjust the PFI according to each center's field. Each ERC should be allowed to find a way to embrace the objectives of innovation that works best for their situation.

Are medium and large companies excluded from the PFI? NSF's intent was not to exclude medium or large companies necessarily from the PFI, but it seems to have been interpreted in that way. ERC Program Leader Lynn Preston said that NSF will provide funds for seeding small startups through the base support levels of Gen-3 ERCs. The partnerships will include large companies, but NSF will not fund the ERCs for those particular partnerships. However, in discussion it was pointed out that some big companies tend to sit on the sidelines and watch how technologies develop through startups, then buy them out or duplicate their advances. Some participants are concerned that this program is likely to give them another incentive to do that. Regardless, NSF's intention with PFI is to give the Gen-3 centers a "kick-start catalyst" for small businesses, and then "see how it goes." The question was raised as to how funding for incubator projects will be arranged. Ms. Preston said that the centers will determine that on their own.

Key Feature 8a: Infrastructure—Institutional Configuration

With the exception of one issue, foreign collaboration, this key feature was not especially controversial. Participants felt that the number of institutions in an ERC should not be mandated by NSF; instead, it should be whatever makes sense in a given proposal. Also, they expressed the view that inclusion of a female- or minority-serving institution should be encouraged but not required.

The foreign collaboration question derives from the stipulation, new to Gen-3 ERCs, that: "One or more partners may be a foreign university, but foreign governments must pay the cost." This issue was explored in more detail in a follow-up breakout session and subsequent open discussion, which generated the following questions, findings, and recommendations:

How does this aid American competitiveness? The twin aims are to allow U.S. universities to continue competing successfully in foreign markets for the best students and faculty; and to prepare the American engineering workforce to compete in global markets

How can ERCs best capitalize on foreign collaboration? The rationale for involving foreign universities is to leverage foreign resources, both intellectual and capital (facilities and funds). An important question is how best to manage shared leadership of centers involving foreign partners. This issue is complicated, even more so than for U.S.-based multi-university ERCs; it is not a matter of simple participation. <u>Recommendation:</u> NSF should form a task group or hold a workshop to compile Best Practices on "shared center management across multi-national centers."

Should NSF mandate collaboration with foreign partners? The foreign partner for Gen-3 ERCs is not a requirement; the question is, should it be made a requirement in future Gen-4 ERCs? Participants noted that the logistics of such partnerships—even small things such as travel and attendant costs—can become very complicated and make it difficult to easily collaborate. <u>Recommendation:</u> NSF should not require (mandate) a formal collaboration, but should take steps to remove barriers and difficulties that ERCs face in working with foreign institutions. The NSF foreign office can help with foreign collaborations.

How should we handle the IP & ITAR (export control) issues? <u>Recommendation:</u> NSF should set up a special office to advise ERCs (and other interested NSF-funded research units) on foreign policies regarding IP and related issues that are complex and subject to rapid change. NSF PD Deborah Jackson was designated as the ITAR point person on the NSF staff for ITAR and EARs regulations and how they affect international collaborations.

What are some appropriate technology focus areas for foreign-collaborative ERCs? <u>Recommendation:</u> NSF should consider establishing multinational ERCS on global issues such as disaster preparedness and management, water issues, and energy sources. Global participation in such areas makes more inherent sense than it does in many competitive high-tech areas.

Should NSF allocate some resources for foreign partners? The question arose, "Why can't ERCs subcontract to a foreign entity?" In reality, an NSF awardee <u>can</u> subcontract with a foreign entity. The decision was made by NSF not to directly fund a foreign partner in a Gen-3 ERC because of the high visibility of the ERC program. In any case, participants made the following <u>recommendation:</u> NSF should not directly fund foreign partners; instead, perhaps a small pool of funds should be made available for test beds and other areas where collaboration is easier. Lynn Preston said that ERCs can pay for this through subawards, or else use industry funds.

Key Feature 8b: Infrastructure—Leadership and Team

The strong preference of participants was to retain the ERC leadership/team structure currently in place in Gen-2 ERCs. Some comments were that the leadership team should be flexible, with its structure tailored to center programs and specific needs. There were some questions about eligibility requirements for key personnel. For example, at many ERCs the Education Director must have a PhD and be a faculty member; yet in many cases an individual without these credentials might have the most relevant experience and strongest professional interest and motivation to carry out these duties well. Salary restrictions imposed on staff positions are another issue needing attention.

Key Feature 8c: Infrastructure—Diversity

The overwhelming preference of participants was to retain the strong focus on improving diversity among ERC faculty, staff, and students. The participants recognize that engineering problems require a diversity of perspectives and a workforce that reflects the diversity of the nation. They are proud of their success to date and do not want to risk losing ground. Beyond the ERC program's diversity policy, ERCs recognize that they need a diversity strategic plan. They want goals, flexibility, and accountability. For example, should NSF require ERCs to participate in LSAMP and AGEP programs? The "artificiality" of competing for minority students was noted; competing in a limited pool of candidates does not necessarily increase the size of the pool. <u>Recommendation:</u> More appropriate measures of effectiveness and success in this area, based on a diversity strategic plan, need to be developed.

Key Feature 8d: Infrastructure—Management Systems

The strength of this key feature is in the information and management systems. The greatest weakness—and it is one that is frequently identified as such by participants (see Fig. 2)—is the complexity and cost of reporting to NSF. This issue was explored in more detail in parts of two follow-up breakout sessions and subsequent open discussion, which generated the following questions, findings, and recommendations:

Are the frequency and structure of site visits optimal? In general, recommendations here focus on less frequent site visits and more frequent formal contact with the center's PD. <u>Recommendations:</u> The first site visit now occurs too soon after initial funding; it should take place no earlier than nine months after center startup. Year 1-3 site visits should be retained, augmented with frequent communication with the PD. Post-Year 3, there should be site visits in Year 5 and Year 6, but in Year 7 only if special issues to be addressed. The Year 8 site visit should focus on sustainability, with NSF pushing the university administration to buy in. Post-Year 8 site visits should occur only if necessary. Additionally, NSF should re-evaluate the ERC review criteria. The format for site visit needs to be revisited; the need for site visits changes as a center ages, and the site visit format should reflect these changes.

How can the annual report process be improved? The current annual report process is too burdensome and too costly, taking center resources from research, education, and outreach activities. It can cost $100,000 to produce a full-scale annual report. But the report itself is an ineffective communication tool read, at best, only in part by the site visit team. In addition, NSF needs to be certain that the right questions are being asked in the reporting.

Recommendation: Volume I should be shortened to 50 pages; this will help focus the center's message. Page limits should be strictly enforced. The reporting guidelines should be completely revised so as to make a 50-page Volume I report possible. The revision effort should start with a clean slate, avoiding redundancies and duplication (e.g., text and tables).Volume II should have a simplified format that includes two-page (strictly enforced) project summaries, statistics, publications, and biosketches for the leadership team.

Recommendation: NSF should determine if some of the annual reporting tasks can be handled by a central contractor, in the way that QRC prepares the ERC's reporting tables. This would require the ERC to input basic textual information, raw nuggets, etc., and a professional writer could turn the document into something more readable and useful to NSF and its reviewers as well as to the ERCs themselves.

NSF PD Barbara Kenny will form a study committee to look into these possible revisions.

Key Feature 8e: Infrastructure—Institutional Commitment

There was a unanimous finding that institutional cost-sharing should be reinstated and required, as it: (1) provides needed money; and (2) commits the institution to the center. Participants recognize that there may need to be special consideration for institutions that cannot afford cost-sharing

Key Feature 9: NSF Funding/Oversight

There is a concern that ERC funding levels might not be keeping up with inflation. Participants believe that future ERCs should be well funded, not pared-down. In addition, they are concerned about the recently declining total number of ERCs.

Recommendation: NSF should support 20-25 ERCs per year at appropriate levels of support to encourage augmented support through partnerships with the involved universities, industry, and other sources of funding. Cost sharing by universities and industry should be reinstated for centers, since the investment is a three-way partnership to which all partners should contribute financially.

Some ERCs gain administrative support from their universities post-graduation, but this is not typical. Administrative support is vital to maintaining the center post-graduation.

Recommendation: NSF should require a commitment for post-graduation administrative support from the universities in the sixth-year renewal proposal and should revise the cooperative agreements at renewal. The next (Gen-4) ERC solicitation also should require post-graduation administrative support from the universities.

Experience with funded ERCs indicates that it takes at least eight years for most ERCs to reach the stage where they can fully explore the development of transformational systems and their realization. However, at the time when they become most productive in this level of work, funding is phasing down and graduation looms. After graduation, the systems culture begins to fade, as it is not funded by other sources and explorations of the transformation of knowledge into technology are also curtailed. The traditional academic culture takes over unless the ERC can gain support from mission agencies.

Recommendation: NSF should alter the renewal cycle so that an ERC in its eighth year may compete for an extended period of support after Year 10 for up to five more years, to enable the realization of systems work and transformational research with industry. This support must be in partnership with industry and/or mission agencies and the preponderance of support would be from these sources.

NSF would have to explore how mission agencies can partner at this stage, given their funding restrictions and requirements. This will enable NSF and the country to contribute to the advancement of innovations resulting from the original ERC investment.

<u>Recommendation:</u> The length of an ERC's life span need not necessarily be uniform across the program; it should be sensitive to the particular technology area. In many cases there should be some baseline NSF support beyond 10 years to help maintain the "ERC-ness" of a center after graduation. See also the recommendation for extended funding of education and outreach programs under Key Feature 4.

Oversight issues are discussed under Key Feature 8d above.

APPENDIX A

GEN-2 & GEN-3 ERC CURRENT KEY FEATURES

1. **Transformational Engineered Systems Vision**
   Gen-2 & Gen-3

2. **3-Plane Systems Motivated Strategic Research Plan**
   Gen-2 & Gen-3

3. **Cross-Disciplinary Research Program**
   Gen-2 & Gen-3:
   - Engineered-systems motivated
   - Research at the fundamental, enabling technology and systems levels
   - Proof-of-concept test beds

   Gen-3 Only:
   - Develop a culture that links discovery to innovation by engaging small firms in a research program to carry out transformational research to speed the innovation process and by forming partnerships with organizations devoted to entrepreneurship and innovation

4. **University-level Education Program**
   Gen 2 & Gen 3:
   - Cross-disciplinary team culture for undergraduate and graduate students
   - Integrate research into the curriculum and, in some cases, new degree programs
   - Prepare graduates for success in industry through collaboration with industrial members and internships
   - Prepare students for management and leadership through ERC Student Leadership Councils
   - Provide formal Research Experiences for Undergraduates

   Gen-3 Only:
   - Education program designed to develop creative, adaptive, and innovative engineers capable of success in a global economy; includes formative and summative assessment

5. **Pre-college Education Program**
   Gen-2 & Gen-3:
   - Provide formal Research Experiences for Teachers
   - Provide experiences with engineering for pre-college students

   Gen-3 Only:
   - Form long-term partnerships with a few middle and high schools to infuse engineering concepts into the classroom and increase the enrollment of pre-college students in college-level engineering degree programs
   - Assessment of the impact of the partnerships
   - Offer a Young Scholars Research program to enable talented high school students to carry out research

- Faculty and students participate in pre-college efforts as mentors and their efforts are recognized and rewarded by their administrations

6. Industrial Collaboration

Gen-2 & Gen-3

- Form partnerships with industry in research and education to speed technology transfer and develop new generations of engineers with knowledge of industrial practice
- Governed by a center-wide membership agreement, IP policy, and Industrial Advisory Board
- Industry required to provide cash and/or in-kind support

7. Partnerships for Innovation

New for Gen-3

- Strategically designed to optimize innovation and speed commercialization/utilization of the ERC's research findings/technology
- Partnership with an organization devoted to speeding innovation & entrepreneurship (state or local government, university or other organization)
- Include small innovative domestic firms in research programs to translate ERC research into innovation through collaboration with ERC's students
- NSF does not require or expect industry cost sharing

8. **Infrastructure**

Gen-2 & Gen-3:

- Lead and partner universities total less than 5—Gen-3 total=manageable few
- One must be female or minority serving
- Leadership team as defined for Gen-2
- Diversity strategic plan as defined for Gen-2 but in Gen-3 no requirement for partnerships with AGEPs or LSAMPs
- Management systems, advisory committees, financial management systems, reporting systems, facilities, headquarters, and university commitment to ERC
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Gen-3 Only:

- No outreach universities required
- One or more partner may be a foreign university but foreign governments pay the cost
- Small firms engaged in research program fore translational research
- Innovation/entrepreneurship partner
- No university cost sharing required
- Recognition of faculty mentoring by university administration in tenure and promotion

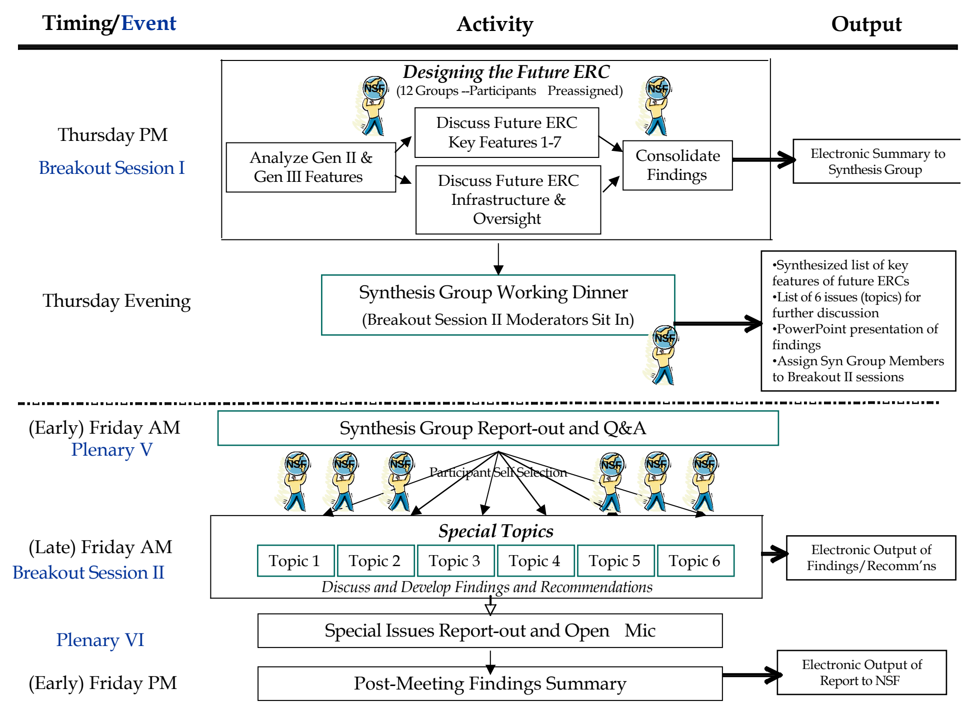
9. **NSF Funding/Oversight**

Gen-2 & Gen-3:

- Ten-year life span; base funding grows through time from start-up of \$3.25M to \$4.0M at year 4; phase-down funding in years 9 and 10
- Administered through a cooperative agreement
- Start-up review, annual reviews, renewal reviews in years 3 and 6
- ERC PD responsible for the oversight and funding recommendation
- Leader of the ERC Program responsible for approval of funding recommendation

APPENDIX B

Process Guidelines and Session Timing
2007 Annual ERC Meeting



Overall Meeting Purpose

- To design the future ERC

Overall Meeting Objectives

- Hear lessons from recently graduated centers and perspectives of a recent NSF-sponsored survey of foreign centers programs;
- Offer constructive input from leadership, faculty and student teams of current ERCs regarding strengths and weaknesses of current ERC features;
- Develop recommendations about the characteristics of the future ERC
- Meet and network with colleagues across the ERCs and also with NSF program staff.

THURSDAY

o **Breakout Session I: Laying groundwork for designing the future ERC (1:45-4:30 p.m.)**

Session Overview: For approximately the first hour of the nearly 3 hour session, participants in all 12 main breakouts will discuss and identify the strengths and

weaknesses of Gen-2 and Gen-3 ERC key features. For the remainder of Session I, participants will make recommendations for the future ERC, including rationales for retaining, adding, or deleting key features.

Getting Started (1:45- 2:00 p.m.)

- Welcome
- Self-introductions
- Review session purpose and agenda/process/desired outcomes

Strengths and weaknesses of Gen 2 and Gen 3 key features (2:00-3:00 p.m.)

Notes: (1) "Strengths and weaknesses" will be identified based on the experiences of individual centers but will be defined and expressed from the standpoint of the ERC program as a whole.

- Participants silently brainstorm and note on 4" x 6" Post-it notes (1 idea per note) the strengths (orange) and weaknesses (yellow) of ERC key features (as listed in the handout, "Background on ERC Key Features"); participants post their notes in the appropriate places on the flip chart pages affixed to walls around the room (the heading of each flip chart will be a key feature) (8-12 minutes)
- All participants then get up to review comments on all charts; they may add more Post-it notes if someone else's ideas sparks more of their own thinking; no discussion as this is happening (5-8 minutes)
- General discussion (appx. 30 minutes):
  - Review collected findings feature by feature for clarification; eliminate duplicates (moderator may be moving, consolidating, eliminating certain Post-it notes during this time);
  - Discussion of various viewpoints
  - Template 1: "Current KF Strengths and Weaknesses." One slide per feature (9 slides). Scriber enters the strengths and weaknesses as the group agrees upon them throughout the discussion.
- Each individual will identify the single most important strength and single most significant weakness across all the key features (5 minutes)
  - Each participant gets two dots (1 blue for strength, 1 yellow for weakness) and puts their dots on pages next to one chosen strength and one chosen weakness. DON'T OVERLAP DOTS!
- Close discussion by reflecting briefly on items that have the largest number of dots (5-10 minutes). Scribe records on Template 1 the number of dots received by any given Key Feature strength or weakness.

Focus on the Future: Recommendations for Future ERCs (3:00- 4:30 p.m.)

- Two sub-groups within each of the 12 Breakouts work simultaneously (3:00-4:00 p.m.) on the rationale for retaining, adding, or deleting key features.

  - Sub-group A: Key Features 1-7. Sub-group A gets the dotted sheets for Key Features 1-7 and the session laptop. See Template 2 – "Directives for Sub-groups" and Template 2 – "Current KF 1-7 Analysis and Rationale."

    If *Retaining*–
    - Defining characteristics (define the feature, its characteristics, and suggested modifications, if any, related to the strengths and weaknesses noted)
    - Specific suggestions for improvements

  - Suggestions for qualitative and/or quantitative performance indices (review criteria, metrics)

  If *Deleting*–
  - Cite the key feature as currently defined
  - Explain rationale for dropping it
  - Note any reservations or concerns about losing it.

  If *Adding* a new Key Feature –
  - Define the new key feature and its recommended characteristics
  - Include rationale for adding
  - Suggestions for qualitative and/or quantitative performance indices (review criteria, metrics)

- Sub-group B: Key Features 8-9. Sub-group B gets the dotted sheets for Key Features 8-9, and uses the laptop of someone in the Sub-group with Template 3 – "Current KF 8-9 Analysis and Rationale."

  Infrastructure Key Feature (#8)
  Use the guidance for the analysis of key features 1-7 (retaining, adding, and deleting) to now analyze each of the sub-features under the Infrastructure Key Feature, including performance review criteria for each.
    - Institutional Configuration
    - Leadership and Team
    - Diversity
    - Management and Oversight Systems
    - Institutional Commitment

  NSF Funding/Oversight Systems Key Feature (#9)
  Use the guidance for the analysis of key features 1-7 (retaining, adding, and deleting) to now analyze the NSF Funding and Oversight Systems, but **do not include performance review criteria.**
    - Funding Levels
    - Life Span and Annual/ Renewal Review Configuration
    - Oversight Process (Reporting, Interaction with lead PD and Program Leader)

- In each of the 12 breakout groups, the two subgroups reconvene to share and discuss their findings (4:00-4:30 p.m.) Scribes from these two Sub-groups append their findings into one file and save it on the jump drive.
- Jump drives are brought to the meeting Registration Desk immediately upon the conclusion of this breakout
- ABA prints the consolidated file from each of the 12 breakouts and makes 18 copies for the Synthesis Group by 6:00pm

Synthesis Group Working Evening with Dinner

- Purpose: Integrate findings from 12 working groups and identify priority issues and questions for discussion on Friday

  Outputs (Template 4 – "Findings of the Synthesis Group"

- Synthesized list and brief description of each of the key features and characteristics of the future ERC (with rationale)
- List of six issues that require additional discussion/clarification, with identification of two to three questions per issue to be discussed in Breakout Session II
- A PowerPoint presentation of the above for plenary presentation on Friday morning
- Assign Synthesis Group members to Breakout II sessions (2 per breakout)

Give Dave's jump drive with completed Template 4 to an ABA staff member, who will have copies made for the morning. The six "Special Issues" slides will be preloaded on jump drives for Breakout Session 2.

FRIDAY

Plenary Session V - Reporting Out and Q&A (8:10- 9:05 a.m.)

- Dave McLaughlin presents synthesis and special issues (8:10-8:30) (Completed Template 4)
- Questions, discussion from the floor; focus initial comments and questions on the synthesis (8:30-9:00)
- Lynn gives charge and process for breakout sessions to discuss special issues (9:00-9:05)

Transition Break (9:05-9:30) – Self-assignment of participants to Breakout II sessions; meeting planning team will "direct traffic"

Breakout Session II: Special Issues (two members of Synthesis Group in each session) (9:30-10:45)

Session Overview: For approximately the first 20 minutes of this 75 minute session, participants in the six breakouts will share additional thoughts and reactions to the synthesis report on the design of the future ERC. For the remaining roughly 55 minutes of this session, participants will discuss and make recommendations regarding the two to three questions posed for the special issue assigned to their group.

- Questions, comments, concerns relating to Synthesis Group findings of future ERC design characteristics (9:30-9:50**)**
- Discussion, findings, and recommendations regarding the designated special issue in terms of the questions posed for it (9:50-10:45)

Template 5 – "Special Issues" (one template for each issue) Scribe will save the document on a jump drive and give the drive to an ABA staff member PRONTO. We will preload each Special Issue document for Plenary 6 and make hard copies for the Findings Summary Group.

Break (10:45-11:00)

Plenary Session VI: Reporting Out and Wrapping Up (11:00- 12:15)

- Special Issue Session Report-outs (5 minutes apiece) (11:00-11:30)
- Open mike for comments from the floor (11:30-12:00)
- Recap, next steps, thank-you's, and adjournment from LP and CL (12:00-12:15)

Post-meeting: Prepare Findings Summary (12:30- ~3:30)

- Six Breakout II moderators and Synthesis Group chair & co-chair revise draft synthesis report in light of Breakout II findings (Dave McLaughlin to act as chair)
- Final report prepared in PowerPoint or Word as appropriate
- Lynn and Barb will be available nearby to answer any questions and to receive the final output
- Possible visit to NSF by Dave McLaughlin and Jay Keasling following this meeting to clarify, expand on report findings—if needed

Template 4 as completed by the Synergy Group will be pre-loaded, so Findings Summary Group members can make changes directly to it. Original Synergy Group report will not be lost.

APPENDIX C

SYNTHESIS OF BREAKOUT FINDINGS/RECOMMENDATIONS

C-1: SYNTHESIS GROUP REPORT

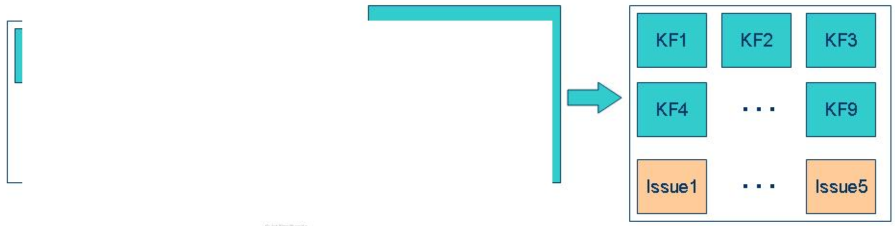
Charge to the Synthesis Group

Inputs

Reports from 11 Breakout I groups (~ 200 pages)

Outputs

Key Features for next gen ERC and Issues for Breakout II groups



A few common themes

- ERC Key Features are generally excellent :
  - Mostly retentions; few deletions; no additional/new features
- ERC goals/desired outputs need to be as clear as possible but NSF should provide flexibility for individual centers to meet those goals (one size doesn't fit all)
  - Are we trying to do too many things?
  - Mandates need to be consistent with funding levels
  - Flexibility: there may be multiple ways of meeting program goals
  - Additional best practices could help us achieve these goals
- Feedback loop needed for annual reporting
  - Reporting burden is substantial.
  - Are the data being used systematically?
  - How is it driving future decision making?

1. Transformational Engineered Systems Vision

5S, 0W

Retain (8R, 0D)

- Systems Approach is the essence and driving force of ERC's
- Defines long-term goals, focuses activities

about the dots:

Single most significant strength of the ERC program:

Single most significant weakness of the ERC program:

A small number of dots:

A large number of dots:

Total dots: 104

2. 3-Plane Systems Motivated Strategic Research Plan

2S, 3W

Retain (9R/0D)

- Rationale: ERC's span fundamental -> systems level research.
- 3-plane construct
  - Is this appropriate for all ERC's? (Issue for Breakout II)
  - What are other appropriate approaches to strategic planning?

3. Cross-disciplinary Research Program

Retain (7R/0D)

10S, 0W

Rationale: Cross-disciplinary research provides unique opportunities to innovate, to tackle complex problems, and to meet future workforce needs.

- Some students could be disadvantaged without having a specialization

Template 4

4. University-level Education Program

Retain (9R, 0D)

12S, 1W

- Consensus is that all KF characteristics are important & valuable
  - Every ERC should promote undergraduate research, but REU should not be mandated
- Cross-disciplinarity is a key
- ERC's should have flexibility in designing their programs.

Template 4

5. Pre-college Education Program

Retain ? (6.5R 3.5D)

0S, 12W

- Significant value in K-12 outreach, but do ERC's have the expertise to design and deliver effective educational outreach programs?
- Mandating educational outreach without significant resources is not recommended.
- This is an issue for Breakout II.

6. Industrial Collaboration

Retain (7R/0D)

11S, 0W

Rationale: provides industrial relevance, best practices, prepares students, supports company hiring and innovation … extremely important

- Requiring cash is difficult, but it is an important aspect of commitment
- Handling of IP issues is complicated

7. Partnerships for Innovation

Retain ? (2R, 2D, 1 unsure,1 for merge with KF6)

2S, 4W

- What is the goal for partnerships for innovation?
  - Should this be merged feature 6?
- Timing of partnership requirement may be important
  - Should this be a criterion for renewal rather than startup?
- Strengths
  - Enhances competitiveness for America
  - Opportunity to broaden faculty perspectives
  - Increases student enthusiasm, experience, opportunities
  - Supports spin-offs and employment
- Weaknesses
  - Could compromise industrial commitment
  - Geographical disadvantage for some universities
  - Some universities cannot create an incubator program
- **This is an issue for Breakout Session II.**

8a. Infrastructure: Institutional config.

Retention ? (3R, 2D)

- Number of institutions should not be mandated (should be what makes sense to a proposal).
- The inclusion of a female- or minority-serving institution should be encouraged but not required

8b. Infrastructure and leadership

Retain structure of Gen 2 (6R, 1D)

- Leadership team should be flexible
- Structure should be flexible and tailored to center programs
- Some questions about eligibility requirements for key personnel and salary restrictions

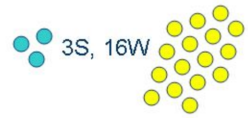
8c. Infrastructure: Diversity

Retain (7R, 0D)

- Rationale: Engineering problems require a diversity of perspectives and a workforce that reflects the diversity of the nation.
- ERCs need a diversity strategic plan
  - We're proud of our success. We want goals, we want flexibility and accountability.
  - We don't want to slip back: should we require LSAMP and AGEP programs?
- Develop more appropriate measures of effectiveness

8d. Infrastructure:Management

Retain (5R, 0D)



- Strength is information and management systems
- Weakness is reporting complexity -- this is a Breakout II issue.

8e. Infrastructure: Institutional Commitment

Retain (6R, 0D)

- Unanimous: institutional cost-sharing should be required
  - Provides needed money
  - Commits the institution to the center
  - We recognize that there may be a special consideration for schools that cannot afford cost-sharing

9. NSF Funding/Oversight

Retain (9R, 2D)

4S, 7W

- Funding/Lifetime
  - Concern about funding levels.
  - Does the funding keep up with inflation?
  - Life span should be sensitive to the particular area
  - We want more ERC's that are well funded.
  - Should have some baseline NSF support beyond 10 years.
- Oversight --- Breakout II Issue on this.
  - Numerous concerns over reporting and site visits
  - Are we asking the right questions in the reporting?
  - Concern about frequency and structure of site visits
  - Annual report is very labor intensive
  - Changing reporting requirements

Special Issues

1. Three-plane structure (Weiland, McLaughlin, Velez)
2. Pre-college education program (Duggan, Muzzio, Menoni)
3. Partnership for innovation (Lee, Sander, Johnson)
4. Foreign collaboration (Dasgupta, Chandra, Jahns)
5. Reporting and oversight (Nerem, Keasling, Tranter, Rocca)

Issue 1: Three-plane structure/organization

- Are three planes the right partitioning of the fundamental -> systems continuum for all ERC's?
- What are the alternatives?

Weiland, McLaughlin, Velez

Issue 2: Pre-college education program

- Is the ERC the best place to address the pre-college problem?
- Should pre-college education and outreach be mandated?
- Are the resources adequate?
- Is the achievable impact commensurate with the effort (opportunity cost)?

Duggan, Muzzio, Menoni

Issue 3: Partnership for innovation

- What is the goal for partnerships for innovation?
- Is there flexibility to meet the goal?
- Should this be part of the industrial program?
  - Does it conflict with the industry consortium program?
- Why only small companies?

Lee, Sander, Johnson

Issue 4: Foreign Collaboration

- How can ERC's best capitalize on foreign collaboration?
- How does this aid American competitiveness?
- How do we handle the IP issues?
- How do we handle the ITAR (International Traffic in Arms Regulations), and EARs (Export Administration Regulations) issues?

Dasgupta, Chandra, Jahns

Issue 5: Reporting and oversight

- Are the frequency and structure of site visits optimal?
- What are the right questions in the reporting?
- How do we improve the annual report process?

Nerem, Keasling, Tranter, Rocca

Questions/Comments?

Mike Gust
Erik Sander
Bob Nerem
Siddharth Dasgupta
Tom Jahns
Carmen Menoni
Fernando Muzzio
Miguel Velez-Reyes
Jorge Rocca
Anthony Johnson
Beth Tranter
Jim Weiland
V. Chandrasakar
Claire Duggan
Fred Lee
Ann Becker
Jay Keasling
Dave McLaughlin

Special Issue #1:
3-Plane Structure

Three-plane structure/organization

- Are three planes the right partitioning of the fundamental->systems continuum for all ERC's?
- What are the alternatives?

Discussion

- Important for ERC's to have
  - Fundamental research, enabling technology, and engineered systems
  - Engineered systems drives/integrates the activity in other areas
- Useful to have common graphical representation, but it can be given undue weight

Problems with 3Plane Structure

- Doesn't account for temporal dimension
- Concern that changing elements could evoke harsh critique by SVT
- Forces center and reviewers into hierarchical thinking (not all activities need all three planes at all times)
- Can't adequately represent connectivity

Recommendations

- Better training for SVT/reviewers on how the 3 plane chart is to be used
- Better guidelines for proposers
- Allow flexibility for proposers, at their own risk, to use alternative depiction of strategic plan
  - Must include fundamental research, enabling technology, and engineered systems
  - This may result in a better tool (BMES tornado)

Thoughts

- Uniformity is good
  - Esp. in sense of required key features of the center
- Use of diagram isn't uniform
  - E.g, testbeds appear in different planes
- One size doesn't fit all
  - Need flexibility in visualizing foundational through applied/systems level research
- Visualization / diagrams are useful
- Serves as useful 'acid test' for where individual projects fit into systems level
- Thrust-testbed integration can be contrived/not well represented in three planes
- The three-plane chart (or any diagram) does not a successful center make

More thoughts

- Light bulb, Segway don't fit three-plane diagram
  - Knowledge doesn't always flow perfectly vertically through all planes
- Do we agree that all three levels apply to all ERCs? (are they required by NSF?)
  - Fundamental technologies
  - Enabling technologies
  - Engineered systems
  - If so, then just need to decide on best depiction
- Are we taking the planes too literally?
  - Or is the NSF being too literal?
  - Research activities can belong to two or more planes
- Is fundamental research being constrained by the three-plane diagram?

More thoughts

- SVT may punish ERCs for changing three-plane plan as a result of unexpected research results
  - E.g., testbeds may develop non-linearly
  - Suggests artificial gaps/causality relationships in research plan when components change
- Three-planes may help focus long-term research goals, grand vision
- Three-plane diagram works better as a systems vision than as a research plan

Alternatives

- Should incorporate key features of ERC
  - Working group?
- How represented should be left to center, PI
  - Graphical representation of how research spans fundamental discovery to engineered systems, testbeds, etc.
  - E.g., ‘twister’ – tornado-like depiction that removes artificial partitions among research activities
    - Continuum of planes
  - Matrix
  - Technology maps

Special Issue #2: Pre-college education program

- Is the ERC the best place to address the pre-college problem?
- Should pre-college education and outreach be mandated?
- Are the resources adequate?
- Is the achievable impact commensurate with the effort (opportunity cost)?
- What is goal(s) of K-12 program?
- How would industry measure success of K-12 program?

Duggan, Muzzio, Menoni

Pre-college education program

- Is the ERC the best place to address the pre-college problem?
  - Yes or no but…..
  - Need people with engineering educ or genl educ background
  - Should have collaboration with educ specialists with K-12 expertise
  - ERC's can act as positive resource (e.g., RET)

Duggan, Muzzio, Menoni

Pre-college education program

- Should pre-college education and outreach be mandated?
  - Many yes but with reservations
  - Many No, but strongly encouraged with clear expectations

Pre-college education program

- Are the resources (financial / staff) adequate?
  - Is funding within the ERC program indicative of the level of commitment to K-12?
  - Universally “No!”
  - Need more clear definition, adequacy of resources depends on goals

Pre-college education program

- Is the achievable impact commensurate with the effort (opportunity cost)?
  - Hard to measure w/o goals
  - Many comments “No”

Pre-college education program

- What is goal(s) of K-12 program?
  - Provide templates, expectations, etc to faculty
  - Effort needs to be put into answering this question
  - Some specific suggestions for goals
  - Strategy for scaling up the impact should be a major goal
  - Data reported should be fed back and inform future program development

Pre-college education program

- How would industry measure success of K-12 program?
  - ERC could data gather from IAB
  - Hold another meeting with right people to discuss

Special Issue #3: Partnerships for Innovation

- What is the goal for partnerships for innovation?
- Is there flexibility to meet the goal?
- Should this be part of the industrial program?
  - Does it conflict with the industry consortium program?
- Why only small companies?

Partnership for innovation

- What is the goal for partnerships for innovation?

Is it?

- To benefit students – more options, experiences
- Acceleration of tech transfer/commercialization
- Enlarges faculty's scope of thinking
  - E.g. there are other professional options for students besides academia
- Helps focus ERC on its purpose
- Provides more flexibility in industrial partnerships
- Stimulates entrepreneurship
- Provides another aspect for student training
- To help bridge the 'valley of death' in the life of an ERC
- Or is it something else?

Partnership for innovation

- Is there flexibility to meet the goal?
  - There **must** be flexibility
    - Overall
    - In setting metrics – having a good plan is what counts more
  - Flexibility enables customization to needs and available resources
  - Point of flexibility

    – allow the individual ERC to determine innovative models to achieve goals of PFI program (both freedom and responsibility)
  - Provides ERC leverage to push the institution

Template 5

Partnership for innovation

- Should this be part of the industrial program?
  - Does it conflict with the industry consortium program?
  - Yes – it must be a part of the industrial program and must complement the program rather than detract from it.
    - There is a danger in spinoffs – can create adversarial relationships between faculty
    - Royalty issues present difficulties
    - Can large companies share in start-ups (e.g. as stockholders)?
    - Key – flexibility to adjust according to your field
    - To keep small businesses from feeling 'second class' or 'special class'
    - The ERC should find a way to embrace the objectives of innovation that works best

Template 5

Partnership for innovation

- Why only small companies?
  - We've already addressed this – on flexibility slide

Partnership for innovation

- Other Comments
  - NSF should provide a mechanism (including a timeline) and venue by which models can be shared in order to meet the goals

Special Issue #4: Foreign Collaboration

- How can ERC's best capitalize on foreign collaboration?
- Rationale:
  - Leveraging foreign resources

Dasgupta, Chandra, Jahns

- Do we want to mandate collaboration of foreign partners?
- Recommendation:
  - Don't require (mandate) a formal collaboration, but take steps to remove barriers on the difficulties ERCs face in working with foreign institutions. Small things can get very complicated (e.g. travel costs) and make it difficult to easily collaborate.
  - NSF foreign officers can help with foreign collaborations.

- How does this aid American competitiveness?
- Rationale
  - Compete in foreign markets
  - Preparing American workforce to compete in global markets

- How do we handle the IP issues?
- Recommendation:
  - Have NSF center of expertise to help advise ERCs on specifics of policies/issues, etc….

- How do we handle the ITAR (International Traffic in Arms Regulations), and EARs (Export Administration Regulations) issues?
- Recommendation:
  – Again, NSF Center of expertise to advise

Additional Issues

- How to manage shared leadership of centers? Not simple participation.
- Recommendation:
  – This issue is very complicated. May want to collect best practices on it.

- Should there be ERCs based on global issues – like Disaster Preparedness, Water, Renewable Energy?
- Recommendation:
  - NSF should consider ERCs on global topics.

- Should NSF allocate some resources for foreign partners?
- Recommendation:
  - No, but ….. (hiring, test beds, etc.….)

Special Issue #5: Reporting and oversight

- Are the frequency and structure of site visits optimal?
- What are the right questions in the reporting?
- How do we improve the annual report process?

Nerem, Keasling, Tranter, Rocca

Recommendations: Are the frequency and structure of site visits optimal?

- Less frequent site visits; more frequent formal contact with PD
- First site visit occurs too soon after initial funding – no earlier than 9 months after beginning of center
- Need Y1-3 site visits with frequent communication with PD
- Post-Y3, site visits in Y5 and Y6
- Y7 - only if special issues to be addressed
- Y8 - focus on sustainability-NSF push university administration buy in
- Post Y8 only if necessary
- Re-evaluate review criteria
- Format for site visit needs to be revisited: need for site visit changes as center ages and site visit format needs to reflect these changes

Recommendations: How do we improve the annual report process?

Current annual report process is too burdensome, too costly, taking resources from research, education and outreach activities!!

- Report is an ineffective communication tool
- Annual report is at best read only in part by site visit team
- Shorten Volume I to 50 pages – help focus Center's message
- Page limits should be strictly enforced
- Guidelines need to be completely re-vamped so as to make a 50 page Volume I report possible
- Start with a clean slate avoiding redundancies and duplication – text AND tables!!
- Volume II – simplify format: include 2 page (strictly enforced) project summaries, statistics, publications and biosketches for leadership team