

How to Make the Magic Happen: Management Models for Sustained, Agile, and Open Collaboration in an Interdisciplinary Earthquake Research Center

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in response to the NSF 20-036 Dear Colleague Letter

We write this from our perspective of over a decade in several leadership positions within the Southern California Earthquake Center, including positions on the Board of Directors, Planning Committee, Chair/Vice Chair of the Planning Committee, Deputy Director/Co-Director, and importantly, also scientific participants within the SCEC Collaboratory. Based on this experience, we offer some observations and recommendations that we think are important to the success we have had. Although our comments are specific to SCEC, they apply to other contemplated earthquake research centers, and beyond.

DCL 20-036 states:

Earthquake science is inherently interdisciplinary, involving scientists from geophysics, geology, tectonics, geomorphology, engineering, computer science and other allied fields. Further progress in understanding fault behavior and earthquake processes will require convergent approaches and greater collaboration to enable systems-level insights on fault behavior and seismic hazards. Thus, NSF seeks to support research center(s) to enable transformative research in earthquake science. The center(s) will meaningfully improve the national welfare through bold and creative activities to expand the impact of earthquake research to a wide range of stakeholders and broaden participation of underrepresented groups in STEM.

We wholeheartedly agree with this statement. The question any multi-disciplinary center will be faced with is: given the multi-disciplinary character of our science, how do we carry out research that enables diverse disciplines to interact both broadly and deeply enough to develop and take full advantage of possible synergies such that the whole is greater than the sum of the parts?

There are several modes of funding used by NSF for research collaborations. The STC model for research centers was the mode in which SCEC initiated. That is far enough in the past that we do not have direct experience with it; however, we have heard that the top-down structure of the center did not effectively encourage research collaboration across disciplines, with perhaps a few important exceptions.

The NSF collaborative proposal mechanism is another alternative mode for funding multidisciplinary research. This mechanism preconfigures levels of support to a set of institutions and investigators. That has the virtue of clarity, with the distinct administrative advantage of clearly articulated tasks and responsibilities for each of the PIs/Co-PIs involved in the effort.

This administrative clarity comes at a cost; however, and because of that, SCEC has evolved to operate in a different mode. We have done this to meet our goals of sustaining a collaboration that is: **agile** and therefore able to pursue unanticipated research opportunities on short notice, and **open** and therefore able to recruit the talents of investigators that bring new perspectives, new capabilities, and greater diversity to the SCEC enterprise. Here is how the research collaboration has been organized in SCEC 2-5:

Planning Committee. *The Science Planning Committee (PC) is comprised of members who represent both disciplines and multidisciplinary focus groups. The PC meets annually to develop a collaboration plan that is open to all interested investigators, whether or not they are at a core SCEC institution. The primary criterion for funding an investigator or investigator team is that the proposed project is judged by the PC to have potential to make a useful contribution to SCEC goals. The PC remains active throughout the year to keep the Center on track scientifically, which is critical to management of a multi-disciplinary center. The organizational structure and membership of the PC has repeatedly evolved to provide fresh perspectives and meet the changing needs of SCEC.*

Technical Activity Groups. *(TAGs) and Special Fault Study Areas are designed to be of finite-duration, within a single 5-year SCEC collaboration, and to bring intense multi-disciplinary focus on pressing issues and key research targets to address key seismic hazard questions.*

Special Projects. *(additional proposals beyond the base program) allow us to emphasize and to pursue particular opportunities as they arise. Because these are more focused in scope and limited in duration than the SCEC core program, the NSF collaborative proposal mechanism has worked well.*

Through these mechanisms SCEC has retained the flexibility to adapt to new opportunities and new ideas and to keep the collaboration both open and agile.

The Planning Committee has disciplinary breadth and the open nature of the collaboration allows grassroots planning, and action, to meet SCEC research goals. Despite the extremely modest and year-by-year nature of funding for SCEC research projects, there is broad and deep enthusiasm in the research community to participate, which is expressed in the ~150-180 project proposals we receive for consideration every year.

Our management model is different than usual, but its success has attracted international attention. We have had international visitors attend the annual meeting and invite us to their home countries to understand, “how we make the magic happen.” The SCEC model has now been emulated in earthquake research centers in New Zealand, Taiwan, and China; it is being held forth as a model for a potential volcano modeling collaboratory in the US, and we were asked to talk about the SCEC research model at the workshop that led to the formulation of the SZ4D initiative.

We recognize that because the SCEC center management is novel, it presents a challenge to justify within NSF. From the outside, it might appear that SCEC leadership is acting as a *de facto* funding agency. What that misses is the fact that we forge our collaboration in a way that is consistent with the overall SCEC goals, which have been fully vetted by NSF, and that NSF retains final budgetary authority on projects that the PC recommends for funding. We are open to alternative management models, but are mindful that the current SCEC model of research administration has a long and successful history.