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Title: **Coastal Adaptation Research and Innovation Center**

Goals: Broadening participation
Identifying research opportunities and gaps
Organization of CoPe hub

Overview:

The National Science Foundation has asked the scientific community to explore ideas that address all of the goals listed for the scoping sessions, and many teams have done so, to varying degrees of success. The type of research that is of primary value to the NSF is basic or fundamental research; applied research, development, demonstration, and deployment are of less importance, and are generally not able to receive support. As a result, an effective NSF hub must show how basic research can be complemented by applied research and technology development in such a way as to enable NSF to receive continuing support from Congress and interested stakeholders, as well as the active support of other federal mission agencies that carry out coastal research, such as NOAA, the EPA, USGS, and the Department of Interior.

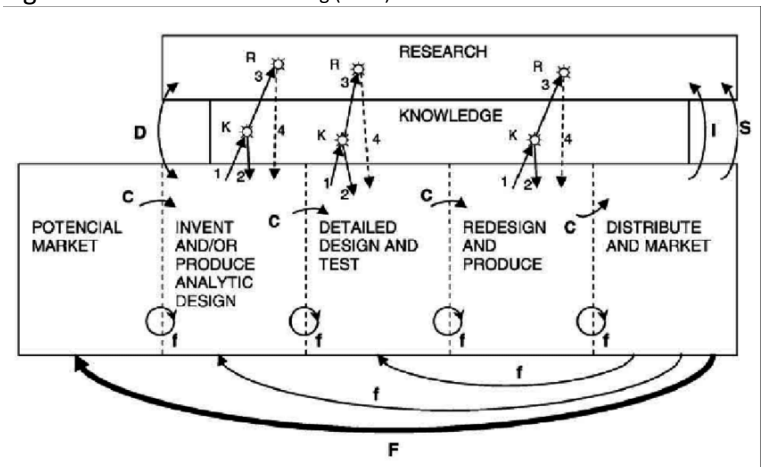
In addition, the NSF prefers that the proposed hubs be interdisciplinary and adopt a systems perspective on selected topics that are investigated. These preferences (posted during the scoping sessions) suggest that each project would have a team leader able to recruit researchers across multiple disciplines and involve a broad range of stakeholders in the project who would also serve as beneficiaries of the research results. These are key requirements as they will enable the hub to identify research opportunities and gaps in a fairly straight-forward manner, and enable the hub, with the appropriate organizational structure, to expand its scope of activities and influence.

Proposed Hub Structure and Function:

Our understanding of how basic and applied research are utilized by the private sector was advanced by Kline and Rosenberg (1986) who argued that scientific and technical information does not move along a linear path from basic research through applied research to new technology, but is more accurately characterized as moving through an interactive chain-linked framework in which *technology push* and *market pull* draw upon scientific and technical knowledge from a variety of pathways and in an explicitly interactive manner (see Figure 1 below).

More recently, Jay and Gerard (2015) diagrammed the key features of a sustainability-oriented innovation center that would be located at a research university (see Figure 2 below).

Figure 1 from Kline and Rosenberg (1986)



Chain-linked model showing flow paths of information and cooperation.
Symbols on arrows: **C** = central-chain-of-innovation; **f** = feedback loops; **F** = particularly important feedback.

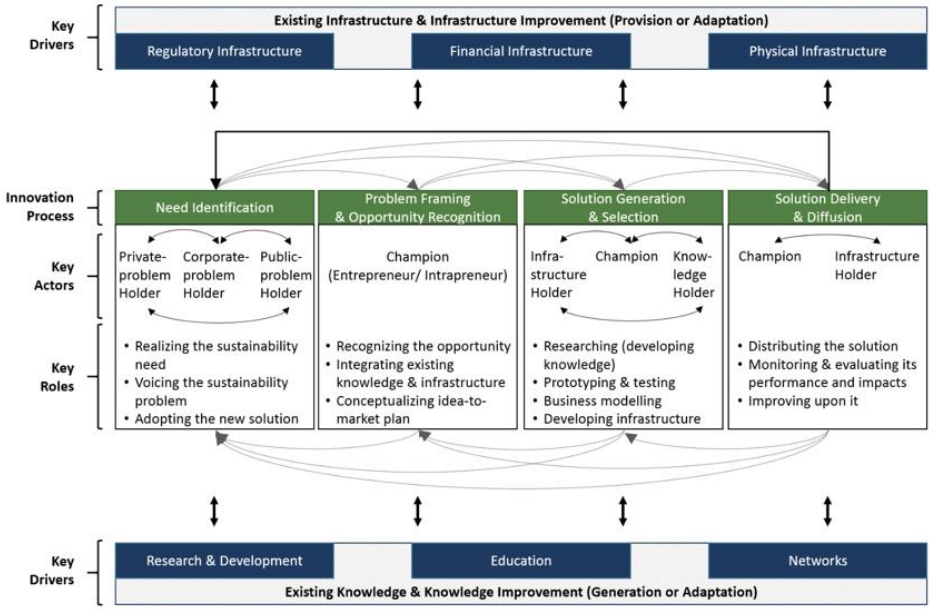
K-R: Links through knowledge to research and return paths. If problems solved at node K, link 3 to R not activated. Return from research (link 4) is problematic - therefore dashed line.

D: Direct link to and from research from problems in invention and design.

I: Support of scientific research by instruments, machines, tools, and procedures of technology.

S: Support of research in sciences underlying product area to gain information directly and by monitoring outside work. The information obtained may apply anywhere along the chain.

Figure 2 from Jay and Gerard (2015)



There are several reasons why these models are important to the structure and functions of a possible NSF hub. First, innovation is inherently interdisciplinary and requires a variety of disciplines to be carried out properly. Second, though the above figures illustrate private sector innovation pathways, many of their themes can be applied to NSF-funded research. For example, the importance of selected coastal

research issues can be characterized as *market pull* by stakeholder and/or agency requests. Topics such as deploying coastal sensors, planning for and mitigating natural disasters, building community resilience, and similar research opportunities can be readily identified with stakeholder assistance and evaluated in terms of the needed research and technology development that would enhance knowledge utilization and dissemination. Third, the expectation of interdisciplinary research favors hub location at a research university that has demonstrated a commitment to interdisciplinary research and rewards technology development. The example of the University of California, Berkeley campus and its management of the Lawrence Berkeley National Laboratory reflects the potential for research teams from a variety of disciplines to be developed and address new research challenges in a systematic manner through the possible development of new technology. This latter aspect of technology development can generate needed revenue to maintain the center and support less technology-oriented projects. Fourth, the hub has a strong educational and outreach component that can expand its scope of impact to a wider audience. Lastly, the engagement of federal, state, and local agencies and corporations interested in problem-focused research and application together with possible technology development will attract new research sponsors and user groups, thus building trust and confidence in the hub. An example of this can be seen in the *Changing Course* competition (http://changingcourse.us/) in which design teams recruited scientists with coastal expertise to envision future prospects of the degrading Louisiana coastline. In addition, valuable insights from designers have been sought by the U.S. Army Corps of Engineers following the coastal destruction of Hurricane Sandy (Seavitt Nordenson et al. 2018).

Conclusions:

While the number and location of the coastal research hubs is not known at this time, the proposed structure enables interdisciplinary research teams to address local and nonlocal topics in a systematic manner with stakeholder groups that may need NSF-sponsored basic research to develop new technologies and applications. The hub leadership will need to maintain a flexible organizational structure that will enable new ideas to take hold with the possibility of new stakeholders to be recruited. The hub meets the expressed goals of the proposed NSF hub concept and helps to foster additional support for hub research, education, and technology development activities.

Literature Cited:

Changing course: navigating the future of the Lower Mississippi River Delta
http://changingcourse.us/

Jay, Jason and Gerard, Marine, *Accelerating the Theory and Practice of Sustainability-Oriented Innovation* (July 10, 2015). MIT Sloan Research Paper No. 5148-15. Available at SSRN: https://ssrn.com/abstract=2629683 or http://dx.doi.org/10.2139/ssrn.2629683

Kline, S., Rosenberg, N. “An Overview of innovation”, in Landau R, Rosenberg N, editors. *The Positive Sum Strategy: Harnessing Technology for Economic Growth*. National Academy of Sciences, Washington, DC. 275-306. 1986.

Seavitt Nordenson, Catherine, Guy Nordenson and Julia Chapman 2018. *Structures of Coastal Resilience*, Island Press, Washington, Covelo, London.