RESEARCH CENTERS AND INSTITUTES:

A SURVEY OF OUR SCHIZOPHRENIA

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Adieu to the Lone Ranger Researcher

In September 2003, National Institutes of Health (NIH) Director Elias A. Zerhouni laid out a series of far-reaching initiatives known collectively as the NIH Roadmap for Medical Research. The NIH Roadmap represents an attempt to transform the nation's medical research capabilities and to accelerate both the discovery and the application of new knowledge. The Roadmap provides a framework of the priorities the NIH must address in order to optimize the organization's entire research portfolio. Significant opportunities are identified in three main areas: new pathways to discovery, research teams of the future, and re-engineering the clinical research enterprise.

The concept that the twenty-first century research workforce will consist of collaborative teams rather than individual investigators is fundamental to all three foci of the NIH Roadmap, as is the recognition that the traditional divisions within the biomedical research community can impede the pace of scientific discovery. To discourage artificial barriers and promote collaboration, a series of new awards have been established to support: the training of scientists in interdisciplinary strategies, the creation of specialized centers to help scientists forge new disciplines from existing ones, and the initiation of conferences designed to catalyze collaboration among the life and physical sciences. In addition, the NIH plans to create and support National Centers staffed by highly multi-disciplinary scientific teams to stimulate technological progress in proteomics, imaging, membrane protein production, and biomedical computing. The NIH also will promote new partnerships among organized patient communities, community-based physicians and academic researchers, in an effort to transform and reenergize the clinical research workforce.

Recent initiatives at the National Science Foundation (NSF) and the United States Department of Agriculture (USDA) mirror the NIH imperative for increased collaboration and "bigger science". The nation's leading research universities, medical schools and teaching hospitals have also acknowledged these challenges. In response to a question about the most important trends in biomedical research, the Association of American Universities, the National Association of State Universities and Land Grant Colleges and the Association of American Medical Colleges cited: increasing complexity and reliance on

shared resources, growth in multi- and cross-disciplinary research, and accelerating translation of basic science to clinical applications, public health and underserved communities.

Clearly, the cartoon equivalent of the successful academic researcher is no longer the Lone Ranger, but instead, a member of the Justice League.[1] How will principal investigators and public research universities respond to this challenge?

An Abundance of Centers and Institutes

The Roadmap builds on a 45 year old tradition of NIH-directed funding to research centers for the purposes of facilitating interdisciplinary collaboration and fostering the translation of basic science to patient care. Recently, a committee assembled by the Institute of Medicine evaluated the approximately 1200 centers currently supported by NIH. They found not only that the portfolio is diverse, but also that the procedures for defining, establishing and evaluating research centers are inconsistent and highly variable. The committee report endorsed the use of centers to promote collaborative research by multi-disciplinary teams, while at the same time finding that it is difficult to assess and/or compare the efficacy and productivity of the currently funded research centers. To this end, the committee put forward specific recommendations that would make the processes for classifying, establishing, and evaluating centers more explicit and systematic.

Research universities have also embraced the notion that the establishment of research centers and institutes is an effective means for promoting multidisciplinary collaboration and stimulating new research directions. Like the NIH, universities have been inconsistent in establishing uniform definitions, policies, and expectations for research centers and institutes. A web-based survey of public research universities confirmed that academic planning and policy-making have not kept pace with the proliferation of research centers/institutes.

Standard sampling procedures were used to select randomly 20 of the 102 public institutions classified by the Carnegie Foundation for the Advancement of Teaching as Doctoral/Research Universities-Extensive[2] (Table 1). Eleven of the selected institutions were among the Top 50 American Research Universities, as determined by *TheCenter*[3] in 2003. All 20 institutions provided a web-accessible list of centers and institutes. The number of research centers and institutes per institution ranged from 8 to 153 (median = 51); the top 50 research universities featured a significantly higher number of centers and institutes than their counterparts (Figure 1).

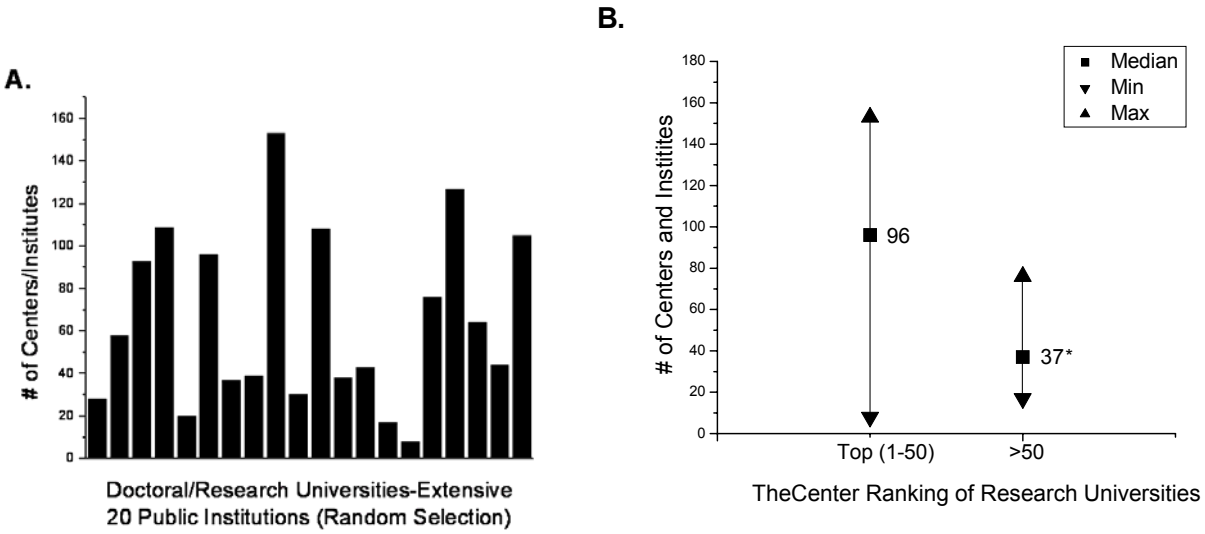

Figure 1. Frequency of centers and institutes at 20 randomly selected public research universities (see Table 1) for all sampled institutions (panel A) and for the eleven universities in the Top 50 compared to the nine others (panel B).

Table 1

Random Sample Public Universities (20 of 102 Doctoral/Research- Extensive)	
Auburn University	State University of NY at Stony Brook*
University of California-Berkeley*	University of North Carolina at Chapel Hill*
University of California-San Diego*	Ohio University main campus
University of Georgia*	University of Oklahoma, Norman campus
University of Maryland Baltimore County	Pennsylvania State University, University Park*
University of Massachusetts*	University of Pittsburgh, Pittsburgh Campus*
Western Michigan University	University of Texas at Arlington
University of New Hampshire	University of Utah*
Rutgers, The State University of NJ*	University of Vermont
City University of NY Graduate Center	Virginia Polytechnic Institute and State University*

*Top 50 TheCenter Ranking

One center or institute was randomly selected for each of the 20 universities sampled (Table 2). Interestingly, a majority of these centers were thematically consistent with the foci of the NIH roadmap. Content analysis of the mission statements and web sites for all 20 centers/institutes revealed a strong orientation toward promoting multidisciplinary research, public-private partnerships, and economic development (Table 3). Centers/institutes involving more than one department were more common than centers/institutes involving more than one college or university.

Table 2

Selected Centers and Institutes
Pulp and Paper Research and Education Center (Auburn)
QB3: Quantitative Biomedical Research (UC Berkeley)
Center for Comparative Immigration Studies (UCSD)
Complex Carbohydrate Research Center (U Georgia)
Center for Women and Information Technology (UMBC)
Center for Neuroendocrine Studies (U Mass)
Nanotechnology Research and Computation Center (W Michigan U)
Biomolecular Interaction Technologies Center (UNH)
Center for Communication and Health Issues (Rutgers)
CUNY Institute for Software Development and Design
Center of Excellence in Wireless and Information Technology (Stony Brook)
Institute of Marine Sciences (UNC)
Nanoscale and Quantum Phenomena Institute (Ohio U)
Institute for Applied Surfactant Research (Oklahoma)
Materials Research Institute (Penn State)
Automation and Robotics Research Institute (UT Arlington)
Thomas E Starzl Transplantation Institute (Pittsburgh)
Nora Eccles Harrison Cardiovascular Research and Training Institute (Utah)
Center for Sustainable Agriculture (Vermont)
Virginia Bioinformatics Institute (VT)

Table 3

Content of Mission Statements and Web Sites of Selected Institutes	
Item	**Frequency**
Strengthen Multidisciplinary Research	100% (20/20)
Outreach/Extension	95% (19/20)
Public-Private Partnerships	75% (15/20)
Economic Development	70% (14/20)
Graduate Education	80% (16/20)
Undergraduate Education	60% (12/20)
Multi-Departmental	90% (18/20)
Multi-College	65% (13/20)
Multi-University	60% (12/20)
Defined Criteria for Success	20% (4/20)
List of Accomplishments	85% (17/20)

If Centers and Institutes are the Solution, What are the Problems?

The websites of 17 of the 20 randomly selected centers and institutes summarized major accomplishments. In contrast, only 4 specified any criteria for measurement of success. This disparity may reflect the broad and varied goals, structures and activities of centers/institutes, as well as the difficulties inherent to assessing their value added, outcomes and impacts.

University policies regarding the establishment of new centers/institutes were freely accessible from two of the 20 institutions examined, the University of Maryland Baltimore County and the University of Oklahoma. Similar policies were referenced on websites of two additional institutions, the University of Georgia and Virginia Polytechnic Institute and State University, and these were made available to the author upon request. All four of the polices 1) provided for subclassification of multi-disciplinary units based on the complexity of interactions (ex: group, lab, center, institute); 2) required that forming centers/institutes specify a purpose and plans, including statements regarding the vision, mission, objectives, participants and clients, bylaws, governance, reporting structure, funding plan, and resource implications; 3) required periodic formal review with the potential for recommending reorganization or dissolution.

Major differences in the policies were noted with respect to autonomy, accountability, and incentives. Specifically, centers/institutes at the four universities differed regarding: the ability to offer credit courses and degree programs, the role in appointment/evaluation of tenure-track faculty, the expectation for generation of operating expenses, the position in the organizational chart, the extent of the annual reporting requirements, and the

interval for formal periodic review. Only one of the four university polices provided an obvious financial incentive to participants in interdisciplinary centers/institutes, by allocating additional sponsored research overhead to the center in an amount equal to that assigned to the collaborating colleges and departments.[4]

Although all four policies mandated justification for establishment and maintenance of centers/institutes, only one framed the associated questions explicitly in terms of value added: "what can it [the center or institute] do programmatically that cannot be done at least as well without it?[5] Again, this may reflect the difficulties inherent to assessing the contributions of centers and institutes. Centers may have complex missions. The desired outcomes such as enhancing translation of basic science to clinical application may take a long time. It is difficult to partition credit for grants, publications and other accomplishments between centers/institutes and their affiliates. Overall, the value added by centers and institutes may be intangible. In any case, evaluation of centers and institutes will require new tools.

A set of questions has been developed by the NSF specifically for evaluating the outcomes of research center programs designed to address long-term complex problems, to advance a team-based, cross-disciplinary research and education culture, and to develop public-private partnerships that foster innovation; these are shown in Table 4. The organizational elements model (OEM) framework developed by Roger Kaufman could also be applied to research centers and institutes in order to determine the value added.

In Kaufman's model (Figure 2A), there are three levels of performance improvement planning and impact: mega, macro, and micro. There are also related results, primary clients and beneficiaries, processes, and inputs. The framework is used to link planning and results, to ensure that everything an organization uses, does, and delivers will add value to external clients and society. In addition, the inclusion of expectations and criteria for measuring success at the mega level provides a "proactive framework for improvement" that encourages thought about "what could be" as well as "what is." Again, a major challenge is determining the cost-efficiency gains associated with centers/institutes compared to traditional investigator-oriented research units.

Table 4

Questions for Evaluating Programs of Research Centers
Research
Do centers develop new perspectives that reflect the organized character and collaborations they encourage? (Are they actually studying distinctively different kinds of problems that are more complex, broader or long term?)
Are problems formulated in novel ways; does research move in directions that it otherwise could not have? (Do the centers fill a special niche in their research field?)
Education
Do the "learners," be they students, faculty, or industrial partners, acquire the insights and competencies necessary to perpetuate the scientific field?
To what degree are learners bringing practical benefits to the university or industry they work in or to the intellectual environment of the center itself?
Knowledge/Technology Transfer
How is the program designed to make an impact, and who is the customer?
What is industry getting from the centers that it could not get from individual investigators?
What is the evidence that the centralized, multidisciplinary structure of centers makes university/industry collaboration more efficient?
Institutional Impact
What organizational or policy changes occurred in the parent institutions as a result of creating centers?
What broader changes (e.g. in the culture of research) can be attributed to a program of centers or to the funding of center programs generally?

from McCullough J. 1992. Draft Report of the NSF Program Evaluation Staff Workshop on Methods for Evaluating Programs of Research Centers.

Alternatives to Centers and Institutes?

The attention concentrated currently on the evaluation of centers and institutes is important for the reasons cited previously. However, this emphasis also distracts from serious consideration of alternative means to minimize institutional barriers to multi-disciplinary collaborations, and to encourage translational research and public-private partnerships.

A.

Level of Planning	Level of Result	Primary Client and Beneficiary	Processes	Inputs
Mega	Outcome	Society and External Clients	Activities, programs and interventions designed to meet needs at all three results levels	Human, physical, and financial resources that an organization can use to meet needs and deliver useful results.
Macro	Outputs	The Organization Itself		
Micro	Products	Individuals or Small Groups with the Organization		

B.

Level of Planning	Level of Result	Primary Client and Beneficiary	Processes	Inputs
Society	Basic knowledge; Advances in medicine and public health; Educated workforce; Technology transfer; Economic development; Social renewal	Civil society; Legislators; Employers; Workforce; Patients	Research efforts; Incentive schemes; Business incubators; IP commercialization; Public-Private partnerships; Training programs; Promotion & tenure	Faculty; Trainees; Laboratory space; Equipment; IT; Venture capital; Start-up funds; Grants; Gifts/Endowments Tuition
Center University	Multidisciplinary collaboration; Grants; Patents; Partnerships; Graduates; Certifications; Recognitions	Center/ Institute University		
Partners Faculty Trainees	Manuscripts; Individual awards; Course offerings; Satisfied participants	PI's Postdoc's Students		

Figure 2: The three level organizational elements model (OEM) framework is based on five equally important elements that must be addressed by all organizations and their related projects and programs. Panel A shows the general model, while panel B features elements specific to the university research centers/institutes. The framework provides a basis for aligning what is used, done, produced and delivered with external value added in both planning and impact assessment processes.

At the present time, the formation of multi-disciplinary research teams at public research universities is limited by mind-set, and by misalignment of goals, strategies and rewards. Institutional culture inspires conceptual limitations: the attitude that communication with colleagues outside the department or college is difficult and unrewarding; and the belief that the cost (broadly defined) of collaboration exceeds the value. The physical and organizational infrastructure at public research universities does not support multi-disciplinary interactions. Meaningful rewards for multi-disciplinary interactions are rare; in fact, issues related to credit and resource allocation often serve as disincentives to investigators, department heads and deans. These problems can be addressed either by additions to the existing organizational structure or by large-scale reorganization. The former include not only research centers/institutes, but also information clearinghouses, interdisciplinary administrative units, interdisciplinary training programs, and targeted funds for new collaboration. Their efficacy is uncertain.

One successful example of large scale reorganization has been well-documented: the restructuring of biology at the University of California-Berkeley. In the early 1980's, Berkeley recognized that "the study of living things has matured into a quantitative science with a substructure of overlapping component disciplines which no longer have the precise disciplinary lines familiar in the past".[6] The institutional response to the revolution in biology was not to create new centers/institutes or training programs, but rather to undertake a campus-wide planning process aimed at transforming and revitalizing the life sciences. This process included an inventory of biologists and their activities, an evaluation of existing strengths and weaknesses, and the development of strategies for both radical reform of the intellectual program and construction of new facilities.

Major changes resulted from the deliberate, extensive and expensive planning and implementation processes. The departmental structure of biological sciences was altered to reduce the number of departments, loosen departmental boundaries, and increase departmental permeability to change. The procedures for faculty appointment and promotion were altered to increase the emphasis on scientific merit over departmental loyalty. Substantial investments and improvements were made in facilities as well as in faculty recruitment and retention. These reforms made it easier for biologists of various kinds working on related problems to find each other and work together. The institutional culture at Berkeley was permanently changed to make departmental lines irrelevant to doing science.

The transformation of biology at Berkeley reflected strong academic leadership and institutional will to tackle a major problem in a systematic and coherent fashion. Replicating this manner of operation, while riding the momentum of research, represents a significant challenge to public research universities.

Conclusions

Over the past few years there has been a growing national trend, strongly fostered by federal funding agencies, for scientists and institutions to collaborate on multidisciplinary research teams. One outcome of this trend has been the establishment of multidisciplinary and multi-institutional centers and consortia devoted to specific scientific problems and research areas. It is generally assumed that these arrangements enhance research capability by providing significant financial and human resource support that would not be available through traditional mechanisms. However, there are limited data to support this assertion. Furthermore, there are unresolved and ambiguous issues related to university centers and institutes that pose significant challenges for the associated trainees, faculty and administrators. These include organizational structure, reporting requirements, educational mission, appointments, accountability, credit, and incentives.

Although, the definition and collection of useful data may be difficult and controversial, there can be no excuse for not attempting to ask and answer questions about what centers/institutes contribute: to the society, to the university and to its faculty and students. It will be critical to develop criteria for determining the value added of research centers/institutes. At the same time, it will be important to determine if there are effective means other than centers/institutes for encouraging multidisciplinary collaborations and translational research.

"To solve the problems of today, we must focus on tomorrow."
~ Erik Nupponen

End Notes

1. The Justice League is a core group of comic book superheroes (Superman, Batman, Wonder Woman, Green Lantern, Flash, Hawkgirl, and J'onn J'onzz (also known as the Martian Manhunter) who work together to fight evil and injustice. Frequently, these seven principals are joined in their never-ending battle by other notable avengers – a group ranging from classic icons like Green Arrow, Aquaman and Captain Atom to more obscure heroes such as Aztek, B'wana Beast, and Vigilante.

2. http://www.carnegiefoundation.org/Classification/CIHE2000/PartIfiles/DRU-EXT.htm

3. http://thecenter.ufl.edu/index.html

4. University of Oklahoma, http://research.ou.edu/policy/Institutes_Centers_Policy.htm

5. University of Georgia, Academic Affairs Policy Statement No. 7, http://www.uga.edu/ovpi/curriculum_systems/academic_policy.htm

6. University of California, 1983

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