The thesis of Creso M. Sá has been reviewed and approved* by the following:

Roger L. Geiger
Distinguished Professor of Education
In Charge of Graduate Programs in Higher Education
Thesis Advisor
Chair of Committee

Lisa R. Lattuca
Assistant Professor of Education

David P. Baker
Professor of Education and Sociology

Michael J. Dooris
Affiliate Assistant Professor of Education
Director, Planning, Research and Assessment

*Signatures are on file in the Graduate School.
ABSTRACT

Fostering interdisciplinarity has become a laudable goal for federal agencies and research-intensive universities alike. The National Science Foundation has supported interdisciplinarity for a number of years, through center programs and other initiatives. In the early 2000s, the National Institutes of Health made an explicit commitment to interdisciplinarity in the “NIH Roadmap.” At about the same time, strategic plans of research universities have increasingly emphasized interdisciplinary scholarship. Universities, however, ground their basic organizational frameworks in the nexus between disciplines and academic departments. Both external sponsorship and university leadership commitment to fostering interdisciplinarity therefore suggest the need to induce change in the way scientists work. These calls for change are not new, and some are skeptical regarding the likelihood that they might cause substantial change.

This dissertation explores the organizational reactions of universities to current interdisciplinary thrusts in science. Through document analysis, the organizational approaches utilized by research-intensive universities to implement interdisciplinary agendas were examined. These patterns include a move towards strategic university-wide initiatives, the creation of specialized scientific facilities to host interdisciplinary teams, a continuing interest in centrally-supported centers and institutes, and concerted administrative efforts to nurture collaborative research programs, including competitive seed grant programs. A minority of institutions have engendered changes in core university policies and functions, such as faculty hiring, and evaluation and tenure policies. Five case studies provide an in-depth examination of how and why universities implement organizational strategies to foster interdisciplinary research. The cases include institutions whose practices have gained visibility among peers and in the policy community. Going beyond normative arguments, this dissertation advances understanding of interdisciplinary science as an organizational phenomenon in higher education through the empirical investigation of emerging university models.
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CHAPTER 1
INTRODUCTION

He who rejects change is the architect of decay. The only human institution which rejects progress is the cemetery.


STATEMENT OF THE PROBLEM

Interdisciplinarity is, once again, high on the discourse of federal agencies, scientific associations, industry, and academic leaders. Many contend that academic institutions risk impairing scientific advancement and diminishing the contributions of science to society by retaining traditional organizational forms and modes of work associated with disciplinary specialization. Shifts in the production of knowledge through the blurring of boundaries among traditional disciplines, particularly apparent in the Life Sciences and hybrid fields like Materials Science and Neuroscience, accentuate that perception. A sense that the ‘needed’ science does not follow from the ways of organizing research in academia underlies actions ranging from academic and policy advocacy of interdisciplinarity to federal and philanthropic funding of interdisciplinary centers. Universities are called upon to reshape themselves to break the structural barriers that prevent researchers from engaging in interdisciplinary modes of investigation. The reformed university would purportedly allow for leaps in scientific progress and greater economic and social benefits to society.
Recent studies indicate that university actors participate actively in the debate and advance interdisciplinary initiatives on their campuses. University leaders seek to exploit the opportunities that interdisciplinarity afford, and have incorporated such concern in strategic planning efforts. Scholars have suggested that this emphasis may bring organizational change, and that those institutions more apt at effectively adapting to interdisciplinary thrusts may gain an edge in the research market if current trends persist. There is also skepticism about the rhetoric of interdisciplinarity in academia and universities’ ability to implement strategic plans. A particularly skeptical view is that if interdisciplinarity were to significantly affect the disciplinary arrangements of academia, this would have happened already.

Interdisciplinarity as an Organizational Phenomenon

In his essay *Interdisciplinarity: the Paradoxical Discourse*, Peter Weingart analyzes the apparent contradiction between interdisciplinary and disciplinary. By examining the common valuations attributed to each in light of the philosophy and sociology of science, Weingart argues that the discourse on interdisciplinarity is in reality a discourse on innovation in knowledge production. He raises the question of why interdisciplinarity and disciplinarity are viewed as contradictory and kept independent from one another, both in terms of public discourse and in the gaps between individuals’ endorsements and actions. To answer that question he refers to Robert Merton’s analysis of the ambivalence of scientists, which dealt with their seemingly paradoxical behavior of upholding values of modesty and disinterestedness while disputing priority in research findings. Researchers will publicly pronounce openness to interdisciplinarity, Weingart
contends, as it denotes interest in originality and innovation. But that will not necessarily translate into interdisciplinary work, and may even reflect a staunch preference for disciplinary rigidity. Weingart asserts that if this is true, we cannot take scientists affirmations of the need for interdisciplinarity at face value nor expect that the normative advocacy for more interdisciplinary work will change their attitudes. Rather, he suggests that interdisciplinarity be viewed as an organizational principle, whereby interested parties seek to shape the conditions that may influence scientists’ behavior. 

A relevant trend in the academic research environment is the rise in funding for collaborative research. There is a long-term rise in the number and dollar amounts the National Science Foundation allocates to multi-investigator awards, relative to the traditional single-investigator counterparts. Although multi-investigator awards still amounted to less than half of single-investigator awards in 2001, the former received $1.13 billion and the latter $1.11 in that year. Agencies not only fund collaborative work but also explicitly require specific organizational arrangements through some of their programs. The NSF defines its center programs as ‘investments that enable organizations to integrate people, ideas, and tools on scales that are large enough to significantly impact important S&E fields and cross-disciplinary areas.’ Likewise, the National Institutes of Health explains the recent addition to its extensive portfolio of center programs, the Exploratory Centers for Interdisciplinary Research, as a function of organizational needs: ‘the scale and complexity of today’s biomedical research problems demand that scientists move beyond the confines of their individual disciplines and
explore new organizational models of team science. The NSF invested approximately $365 million in centers during 2002-2003, while the NIH has spent a five-fold amount.

The centers programs mentioned above are a relatively recent phenomenon dating from the mid-1980s. Other federal agencies and private donors have long committed resources for university research units, and universities themselves have established centers and institutes to augment their scientific productivity. In general, universities have traditionally used organized research units (ORUs), more frequently called research centers or institutes, to cope with increasing and diversifying knowledge needs of society. ORUs defy simple characterizations, given their huge variety in sources of support, missions, organizational structure, size, and longevity. Essentially, they are conduits for academic research that external agents are willing to sponsor for their own purposes. While academic units also establish a gamut of relationships with patrons of science, ORUs are typically established to focus primarily on sponsored research, deriving their subsistence and legitimacy from the ability to secure resources.

No comprehensive study or data collection effort exists on ORUs or interdisciplinary programs. Moreover, although funding agencies widely promote it, interdisciplinary research is not systematically codified for accounting purposes. That situation creates a void of data for purposes of inter-institutional comparisons and analysis of variance. The organizational consequences of a university’s commitment to interdisciplinarity cannot be grasped from nationally representative listings, ratings, and rankings, such as those of academic departments. Studies of interdisciplinarity contribute only to a certain extent, as detailed reports of campus contexts are not a meaningful part of this literature, and discussions of organizational arrangements are often normative or
speculative. This pattern was recently punctuated by a comprehensive National Academies report entitled *Facilitating Interdisciplinary Research*. The report presents survey and interview data, andcatalogues practices from universities, scientific organizations, funding agencies, and industry. It makes specific suggestions to the various groups involved with academic research to reduce general and specific barriers to interdisciplinary work. While the report sheds light on various kinds of university initiatives with that purpose, it lacks a theoretical basis and empirical depth to substantiate the purported promises that the different organizational models hold, and to buttress their designation as ‘best practices.’ Despite its weaknesses, the report offers a useful compilation of ideas and initiatives across a range of institutions and sectors.

This study is about the constitution of university strategies to foster interdisciplinary science and their organizational consequences. The political and financial support to, and the proclaimed interest of academic leaders in interdisciplinarity suggest the potential for a creative tension between institutional aspirations and traditional structures. While it is known that many universities have incorporated interdisciplinarity in their strategic plans since the late 1990s, the specific organizational approaches employed on campuses are poorly understood. The purpose of this study is to identify and characterize deliberate efforts to spur collaborative research across traditional departmental and disciplinary boundaries, including the creation, reorganization, or adaptation of university policies, practices, and structures. To achieve its aims, this study pursues the following research questions.
Research Questions

1. What organizational strategies have research universities employed to implement the interdisciplinary thrusts of their planning efforts?
   - How can those be characterized in relation to existing knowledge of the departmental structure and the organization of ORUs?
   - What changes, if any, might they cause in traditional university structures?
   - Are there patterns in the ways universities seek to promote interdisciplinary research?

2. How have selected universities implemented interdisciplinary strategies, and why?
   - What were the impetuses and actors driving their adoption?
   - What were the internal and external factors shaping these strategies?
   - Do these strategies create new policies, practices, and structures?
   - What happens to the traditional centrality of departments in key aspects such as faculty hiring and evaluation?
   - Under these strategies, is there a research drift to ORUs or do academic units remain central to interdisciplinary science?
   - What are their likely implications?

Organization of the Study

The sets of research questions listed above correlate to the two phases of this study. The first phase entailed the examination of strategic plans and other institutional
documents of 99 research universities to address the first set of questions. This initial stage of the project aimed, in addition to answering those questions, to identify universities with deliberate organizational strategies that change traditional academic structures, policies, and practices. The second phase entailed a closer examination of five universities with such strategies, resulting in case studies that describe and analyze their evolution, design, and implementation, under the overall guidance of the second set of questions. The study design and the conceptual basis for this study are described in Chapter 2.

Chapter 2 starts by characterizing the contemporary wave of interest in interdisciplinary research, and the efforts to promote change in academic institutions, which have been briefly foreshadowed in this introduction. To understand the need for change it is necessary to appreciate what is to be changed and why. Historical and sociological studies of higher education are reviewed to paint a careful picture of the research university, including the strong nexus between disciplines and departments, and why it matters. Subsequently, recent studies by economist Irwin Feller and sociologist Steven Brint that unveiled the rise of interdisciplinarity in the strategic planning efforts of research universities are discussed. The knowledge on the calls for interdisciplinarity, the organization of the university, and studies melding these two issues gives way to a theoretical discussion of the key concepts articulated in this dissertation, and a theory-based interpretation of the reasons for continuity and change in the disciplinary-departmental structure.

The Feller and Brint studies indicated the ubiquity of interdisciplinarity in recent academic plans. Chapter 3 extends their findings by examining the specific approaches
employed to promote interdisciplinary research. Salient regularities include (1) the adoption of interdisciplinary initiatives, (2) the creation of certain types of ORUs, (3) the construction and planning of modern facilities designated as interdisciplinary spaces, and (4) the adoption of formal university seed-grant programs and support services to enhance inter-departmental research collaborations. Although there is some variability in the specific models adopted under each of these rubrics, the general patterns are noticeable. The landscape view provided in Chapter 3 highlights repeated occurrences derived from document analysis and describes practices that have been formalized and reported.

The case studies make a different contribution. Their purpose was to examine selective institutions that have adopted deliberate and identifiable organizational strategies to foster interdisciplinary research. In choosing the cases, maximum variation among the types of strategies employed was sought to uncover a range of emergent models. The case studies examine more closely the experiences of five campuses, each presenting a distinctive approach. The strategies of the five cases were reported in *Facilitating Interdisciplinary Research* as innovative models. Duke was the only among them not nominally cited, but several of its practices were promoted in the report.

In all cases interdisciplinary strategies are associated to the fundamental pursuit of academic quality, institutional prestige, and the resources that bring those. However, the differences in resource endowments and competitive conditions among the public and private universities offer a broad way to divide the cases. The strategies of the public universities tended to arise in contexts of greater resource scarcity and the perceived need to carefully target investments to enhance academic quality, even if at the margins. At the
elite private universities studied, interdisciplinary strategies are closely associated to the quest for academic leadership.

Chapter 4 reports on the Pennsylvania State University, the University of Wisconsin-Madison, and Arizona State University. The Penn State case reports on the four ORUs created through internal reallocations, following the ‘institute model,’ to spur collaborative research in priority areas across colleges and departments. In addition to the usual coordinating and catalyst roles such units fulfill, they also co-fund faculty positions designed by departments to advance interdisciplinary collaborations. The Penn State institutes are viewed as a strategic effort to develop the research enterprise and influence the recruitment priorities of part of the faculty body. UW-Madison’s case discusses the Cluster Hiring Initiative (CHI), which was implemented to recruit faculty into interdisciplinary clusters rather than traditional departmental lines. Clusters are faculty-proposed, competitively reviewed, and earn centrally funded faculty lines, which may be assigned to multiple departments and colleges. The fundamental driver of the CHI was the precarious fiscal conditions the university faced in the 1990s that led to real losses in the tenure-laden faculty body. It was made possible by an initiative, designed around the idea of economic competitiveness, which obtained additional revenues from the state that were leveraged with private fundraising. The case of Arizona State analyzes the one of the most explicit leadership efforts to reengineer the university under interdisciplinary directives, in order to redress weaknesses and exploit research niches in the pursuit of national recognition. State funding from recent legislation has been applied to boost the university research program through new ORUs, and a new school of the Life Sciences was recently established as a novel model of interdisciplinary organization.
Chapter 5 presents the cases of Stanford University and Duke University. Stanford’s case reports on the university’s major ‘multidisciplinary initiatives,’ spearheaded by new interdisciplinary institutes. These initiatives emerged mostly from the bottom-up, eventually gaining administrative support that scaled up their scope and resource aspirations. Most prominent among them is the Bio-X program and the Clark Center, one of the emerging spaces for interdisciplinary science. The traditional disciplinary-departmental structure is not questioned at Stanford, and the new initiatives are accommodate through their appeal to excellence and innovation. In what can be viewed as a contrast, the Duke case presents the concerted upper-administrative effort to make interdisciplinarity a true comparative advantage for the university, after several years of self-styled identification with it. The Duke senior leadership believes in the need to induce long-term cultural change on campus, in addition to providing incentives and removing structural obstacles to interdisciplinarity. It has acted on several fronts to move the university towards the explicitly espoused vision of a matrix organization, where fluid and reconfigurable interdisciplinary forms emerge to stimulate creativity and innovation to reinvigorate the academic units. Substantial institutional investments in new initiatives were augmented by private gifts in the past five years, and new structures, evaluation systems, and policy reforms have taken place to facilitate interdisciplinarity.

The case studies show that interdisciplinary strategies take shape as means tailored to achieve multiple context-specific ends. While at an aggregate level one sees general constraints to interdisciplinary interactions in academia, the variability of institutional contexts and cultures with their different shared values, taken-for-granted assumptions, patterned behaviors, and collective experiences creates a rich diversity of
specific challenges and related organizational responses. This diversity suggests that caution is needed when organizational models are described as replicable commodities, with little consideration for the contexts from which they emerged. Nevertheless, strategies universities have employed to facilitate interdisciplinary research can be analyzed at a higher level of abstraction. Chapter 6 advances a theoretical discussion on interdisciplinary strategies, linking the findings of this investigation to relevant higher education and organizational theories. The conclusion in Chapter 7 highlights general findings, discusses implications, and provides directions for further research.

Justification

At the most general level, this dissertation is motivated by the analysis of dynamics of continuity and change in higher education. The last twenty five years have been widely characterized as an era of transition, which has created pressures on higher education institutions to adapt and sustain organizational change. American research universities present a fertile site for such inquiry, and the problem of organizational adaptation to interdisciplinary thrusts touches upon their core features. Academic professionals undergo intensive socialization during their graduate training and remain connected to national and international disciplinary communities, to which their research work is directed and from which they derive recognition. They are hired, evaluated, and promoted in disciplinary departments. Calls for interdisciplinary research include the charge that upper-administrative leadership is needed to overcome the disincentives embedded in academic structures. Particularly when viewed in international and
comparative perspective, American universities are entrepreneurially managed and historically responsive to external needs. But they also retain the characteristic of shared governance with decentralized power structures, and deference to the professional authority of academics. Change tends to occur slowly and incrementally in the university through iterative processes, and comprehensive reform is hard to achieve exclusively through top-down enforcement. Unveiling rising patterns and organizational models as they take shape can contribute to the theoretical and practical discussion of whether, how, and why to adapt the university to demands for interdisciplinary research. Such discussion can be enhanced by the appreciation of findings through the lenses of higher education and organizational theories that describe and explain university structure, administrative action, and faculty behaviors.
ENDNOTES


3 For the most recent statement along these lines, see National Academies' Committee on Science, Engineering, and Public Policy, Facilitating Interdisciplinary Research, (Washington, D.C.: The National Academies Press, 2005). Chapter 2 fleshes out these arguments more thoroughly.


5 Ibid.; Irwin Feller, Whither Interdisciplinarity (In an Era of Strategic Planning)? Presented at the Annual Meeting of the American Association for the Advancement of Science, (February 12-16, 2004), Seattle, WA, 36-38.


9 National Academies, op. cit. note 3, 118.


12 Brint, op. cit. note 4, 31.


14 See the dated, but illustrative surveys: Robert Friedman and Renee C. Friedman, The Role of University Organized Research Units in Academic Science (University Park, PA: The Pennsylvania State University, Center for the Study of Higher Education, Center for the Study of Science Policy, Institute for Policy Research and Evaluation, 1982); Robert Friedman and Renee Friedman, Sponsorship, Organization and Program Change at 100 Universities (University Park, PA: Pennsylvania State University Institute for Policy Research and Evaluation Center for the Study of Science Policy, 1986).

15 As observed over 30 years ago in Stanley Ikenberry and Renee Friedman, Beyond Academic Departments: The Story of Institutes and Centers (1st ed) (San Francisco: Jossey-Bass, 1972), 103.

16 A directory of non-profit institutes has been published, but it is too inclusive and provides limited contact information on the units. See Paul Dresser, Research Centers Directory, 13th Edition, (Detroit, MI: Gale Research, 1989).


23 Rhoten, *op. cit.* note 2, 9-10.3

CHAPTER 2
BACKGROUND AND STUDY DESIGN

REVIEW OF THE LITERATURE & CONCEPTUAL FRAMEWORK

Discussions of and calls for interdisciplinary research in academia have long been with us. Depending on how broadly one defines interdisciplinarity, the lineage of advocates and counter-advocates, as well as the collection of arguments pro and against it, can be greatly augmented. Julie Klein, for instance, finds roots of interdisciplinary thinking in Greek philosophy. This study takes a more specific approach, focusing on the organization of science in research universities. It is grounded on recent writings that view interdisciplinary research as a strategic alternative, part of a rising ethos in the university sector. The focus of the present dissertation is on the deliberate actions of universities to stimulate interdisciplinary research, circumventing or changing the traditional disciplinary-departmental mode of knowledge production. The section below establishes the conceptual basis for this investigation, by reviewing the relevant literatures related to university organization and interdisciplinary science and presenting constructs guiding the study. It is divided into five parts. The first discusses the current calls for interdisciplinary research; the second explains why such calls directly target the organization of research universities; the third reviews recent studies on the rise of interdisciplinary approaches in the strategic planning efforts of these institutions; the fourth considers the traditional recourse to organized research units to pursue interdisciplinary investigation outside the departmental structure; and the fifth defines
key concepts and provides a theoretical foundation. The final section explains the research methods employed.

Current Support for Interdisciplinary Research.

Reviews of the literature suggest intrinsic and extrinsic drivers to interdisciplinary research.\(^2\) *Intrinsic* factors derive from the very advancement of science. Disciplinary communities push the frontiers of knowledge farther and farther in a specialized fashion. Communities bring to this exploration their own tools: intellectual orientations, analytical approaches and paradigms. Sometimes they reach unexplored alleys where their tools are still too rudimentary to carve out new understanding of the phenomenon under study. But it so happens that members of other, sometimes related disciplinary communities, are exploring the same alleys with a different set of tools. By jointly pursuing the exploration of that unknown knowledge domain, investigators can employ complementary toolsets to gain greater insight into the research problems at hand. As evidenced by the emergence of fields like biochemistry and materials science, those pioneering collaborations may evolve into a field of their own.\(^3\) *Extrinsic* factors involve societal problems or interests that motivate the organization of the interdisciplinary programs. Research agencies and foundations, scientific associations and industry may advocate for and/or fund interdisciplinary research.\(^4\) This separation is of course stylized, and not meant to suggest inexorable boundaries between intrinsic and extrinsic factors. There is a rather dynamic interplay between scientists and those who fund science, as they form networks in the university research system.
The single-investigator project on disciplinary problems is traditionally the main mode of sponsored research. Nevertheless, interdisciplinary research has become a laudable goal for federal agencies, scientific associations and universities. Exhortations for interdisciplinarity are neither original nor a recent phenomenon, as the current wave of interest in interdisciplinarity goes back at least to the 1970s and other bursts of support have been verified since the modern disciplines took shape in the 19th century. The interesting aspect of current support for interdisciplinary research is the convergence in the discourse among major agents in the university research system.

The National Science Foundation (NSF) has long supported interdisciplinary research and education, notably through center grants and but also through other programs. In the early 2000s, the National Institutes of Health (NIH) explicitly endorsed interdisciplinary approaches in biomedical sciences as a key to knowledge advancement. In the first decade of the twenty-first century, the major funding agencies emit a clear message: interdisciplinarity is wanted in academic research and education. Again, these recent efforts at the federal level are not unprecedented. For example, the Department of Defense already funded interdisciplinary science through the Advanced Research Projects Agency’s programs of materials research laboratories in the 1950s. But still, they characterize the presently favorable environment for research that spans the boundaries of disciplines.

Most recently, the National Academies released a report that sought to understand the state of interdisciplinarity at academic institutions and made recommendations to facilitate it. Commissioned by the W.M. Keck Foundation as part of the Future Initiatives, which sponsors interdisciplinary science through grants and conferences,
"Facilitating Interdisciplinary Research" offers a compendium of practices and organizational models from universities, research institutes, national laboratories, and industry. The report reiterates the resilience of disciplinary traditions in academia, but highlights several cases of innovative practices, policies and structures to facilitate interdisciplinary research within and outside of higher education. The cases profiled offer alternative approaches for the organization of academic and research units, the administration of research programs, the evaluation of faculty and research projects, and the training of scientists. They are explicitly endorsed as ‘best practices.’ The report’s and other contemporary exhortations for interdisciplinary work evoke its presumable inevitability for solving complex scientific puzzles and address ‘real world’ problems. Academic structures are often characterized as rigid and inflexible, ‘roadblocks’ to knowledge advancement.

The Organization of the Research University

The National Academies report suggests that universities should adopt matrix models to overcome the ‘silos’ that arise in the departmental structure, and even go beyond these models:

In considering how institutional characteristics might be changed to facilitate interdisciplinary research, it is useful to think of how such changes might affect peoples’ abilities to reach their goals. A more dramatic or ‘revolutionary’ vision of interdisciplinarity might be seen as a transformed matrix in which institutions strive for a more complete integration of disciplines, institutions ‘without walls,’ a high degree of flexibility and mobility for students and faculty, and research efforts that are organized around problems rather than disciplines.
The idea that of matrix structures in academia is not new. Among illustrious contributors, one will find Christopher Jencks and David Riesman, who nearly 40 years ago argued for ‘the need for more mobility and anarchy’ among disciplines and sub-disciplines. They argued that the former are eminently administrative units, while the latter are the true intellectual units of the university. So, they called for a continuing process of assembling and reassembling faculty, whose interests intersect on the basis of research problems, to offer new kinds of PhD programs. Far from generating a static, problem-driven organizational alternative to academic departments, Jencks and Riesman contended that universities should engage in a continuous state of creative destruction, akin to ‘Jefferson’s revolution every twenty years.’ Burton Clark has more recently noted the pragmatic usefulness of matrix structures in the enhancement of university entrepreneurial activities, as project teams (centers) have greater flexibility to accommodate external needs, learn from environmental agents, and generate new sources of income. Clark has also used the matrix metaphor to discuss academics’ multiple allegiances, an idea recurrently exploited in the higher education literature. Whether for fulfilling the educational function, as in Jencks and Riesman’s argument, or employing academic expertise to boundary-spanning activities, as in Clark’s discussion, matrix conceptualizations call for more flexibility and fluidity in the discipline-department organization.

The modern university, however, finds in the nexus between disciplines and academic departments its basic organizational framework. Lawrence Veysey locates the origins of clear departmental structures at leading universities in the 1890s, and argues that the systematic pursuit of academic research in the period was propitious for the
institutionalization of the departmental organization. Roger Geiger argues that disciplines and departments ‘had powerful reciprocal effects upon one another’ as both institutions developed, with the growing authority of one reflecting upon the other. Ever since, the departmental organization has sustained academic work, despite cyclical interest in interdisciplinary modes of scholarship. Through the control over faculty appointments and evaluations, departments shape the intellectual capital of the campus. They do so in tune with the cultures, norms and intellectual orientations of academic disciplines. Moreover, the evolving dynamics of disciplinary fissure, partition and recombination are reflected in the organization of departments. ‘The steady decomposing of disciplines into specialties, and then of specialties into more specialties, operates across universities as an uncontrollable, self-amplifying phenomenon. Disciplinary subdivision is a powerful pressure for departmental substructuring.’

Tellingly, the National Academies report’s sole example of a research institution within the discussion of a ‘transformed matrix’ is the Rockefeller University. Studied for its proclivity for generating scientific breakthroughs, Rockefeller was founded at the 20th century as a research institute with a mandate to establish a new standard of excellence in the biomedical sciences. To do so, it has avoided replicating the departmental model, even when it became a graduate university in the mid-20th century. Originally, Rockefeller grouped scientists from various backgrounds into an integrated organization, composed of two departments: the Department of Laboratories and the Department of the Hospital. Since the 1950s, the institute has expanded the number of laboratories and diminished internal integration, but ‘it is still much less differentiated internally than any American University.’ Hollingsworth and associates have provided a detailed account
of the organizational and cultural features of the Rockefeller University they claim are conducive to scientific excellence. Among those are organizational flexibility: labs were closed when senior scientists departed, and Rockefeller was able to move into new areas through hiring, as there has been traditionally little incentive for self-replication of the faculty; scientific diversity and integration: Rockefeller had a moderately high degree of scientific diversity coupled with intense and frequent interactions among scientists with different expertise, which was structured through mechanisms such as journal clubs, open lectures, shared lunch and tea breaks, and retreats; and leadership: Rockefeller presidents have provided both scientific and administrative direction since the appointment of Simon Flexner in 1901, and they have typically been recruited for high scientific standards, leadership skills, and a background and commitment to interdisciplinary approaches.\textsuperscript{22}

As abundantly clear from its history, the Rockefeller University is rather unique, hardly representing a comparable model for the mainstream research university. First, despite the expansion it experienced, it remains small as compared to the average university, with a faculty of around 130 tenure-line members.\textsuperscript{23} Second, its focus on the biological sciences, an area that has experienced an intense convergence and cross-fertilization among sub-fields with the rise of molecular biology, sets more contained limits within which to stimulate interactions. This is hardly comparable to the typical university setting, comprehending myriad academic disciplines. Not leaving the realm of the biosciences, the University of Wisconsin-Madison offers and illustrative example: it has dozens of departments in subspecialties like botany, plant pathology, physiology and zoology; biochemistry and genetics each have two departments.\textsuperscript{24}
The example above is a good reminder that the abstract division of labor in the landscape of scientific research should not be viewed as perfectly symmetric to geography of departmental organization. Academic departments are administrative units, sometimes clustered together or set apart in slow evolutionary processes for reasons other than intellectual distance. ‘The various subdisciplines within biology or history or psychology, for example, have only limited intellectual relationship to one another, and the same is true in every other field.’\textsuperscript{25} Jencks and Riesman argued long ago that subspecialties within departments and faculty working on similar problems are the true intellectual units of the university. Beyond the university, Diana Crane referred to the supra-institutional networks of scholars in the same research area as ‘invisible colleges.’\textsuperscript{26} Departments provide the administrative framework for the instructional activities and the allocation of university resources; peer networks, research groups, co-investigators, and coherent specialties provide the ‘carrying vehicles’ for knowledge creation.\textsuperscript{27}

Interdisciplinarity as a University Strategy

In recent years, higher education experts have noted a favorable trend among universities regarding interdisciplinary research. Irwin Feller places this tendency in the competitive framework of the university research system and universities’ strategic planning efforts. He discusses the intense advocacy for interdisciplinary research among sponsors of science, which, accompanied by financial commitments, creates incentives for universities to increase their relative emphasis on interdisciplinary programs.\textsuperscript{28} Steven Brint argues, more generally, that a rising ethos of ‘interdisciplinary creativity’ co-exists
with the traditional academic orientation towards disciplinary specialization. He situates the origins of this trend in the context of inter-institutional competition, stimulated by the ascending university roles of supporting economic competitiveness and the democratization of the liberal arts. Despite the different analytical contexts, these authors agree that strategies to promote interdisciplinary research have become usual in university plans since the late 1990s, and that universities seek such strategies to augment their competitiveness and institutional prestige.

This poses an interesting contrast to an examination of the preferences of research administrators in earlier periods. A study found that central administrators generally favored a laissez-faire approach in the early 1980s, not offering much direct support for interdisciplinary inquiry. Back then, only a minority believed in ‘interventions’ through incentives for faculty collaborations or in fulfilling an active role in trying to shape the university research portfolio. Such findings led the authors to conclude that there was a general lack of policies to spur interdisciplinarity in the university sector. Feller contends that between the late 1980s and the mid-1990s, the emphasis of university planning relied on management by objectives, continuous quality improvement, and goals of upward mobility in the Carnegie Classification system and National Research Council rankings of doctorate degree programs.

Drawing on the analysis of 69 strategic plans and interviews with administrators of 89 institutions, Brint finds that while many universities follow rigid disciplinary metrics to track their progress, others pursue ‘new directions’ that emphasize ‘interdisciplinary creativity.’ Such directions give rise to new university models, presented in the table below in contrast with the established models of traditional
research universities. Brint’s survey of academic leaders indicates a widespread adoption of strategies to spur interdisciplinary creativity; Feller equally finds that ‘promotion of interdisciplinarity appears as a central thrust in the strategic plans of many major research universities,’ as indicated by an analysis of the documents of ‘40 leading research universities.’

Table 1. Brint’s Characteristics of Established Research Universities and New University Models.

<table>
<thead>
<tr>
<th></th>
<th>Established research universities</th>
<th>New university models</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agents</strong></td>
<td>Individual and small teams</td>
<td>Large multidisciplinary groups</td>
</tr>
<tr>
<td><strong>Means</strong></td>
<td>Agency and Foundation grants, fellowships</td>
<td>Concentration of large-scale economic resources and/or political support networks</td>
</tr>
<tr>
<td><strong>Orientation of agents</strong></td>
<td>Disciplinary, sub-disciplinary</td>
<td>Interdisciplinary</td>
</tr>
<tr>
<td><strong>Underlying dynamics</strong></td>
<td>Cumulative progress in fields of formal knowledge</td>
<td>Constant innovation in economy and society</td>
</tr>
<tr>
<td><strong>Criterion of success</strong></td>
<td>Rank in national ratings</td>
<td>Contribution to economic and social progress</td>
</tr>
<tr>
<td><strong>Legal frame</strong></td>
<td>Tenure and promotion; faculty privileges</td>
<td>Technology transfer laws; diversity guidelines</td>
</tr>
<tr>
<td><strong>Dominant ideology</strong></td>
<td>Advancement of knowledge</td>
<td>Creating the future</td>
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These authors’ diagnostics of what lies beyond stated strategies differ, however. Brint suggests that many substantive commitments have accompanied the rhetoric of university plans (e.g. cross-campus initiatives, new curricula, interdisciplinary centers). On the other hand, Feller claims that ‘something is amiss between rhetoric and reality,’ as implementation issues seriously affect the ability of interdisciplinary strategies to come to fruition. Those issues relate to the reward structure (e.g. disciplinary promotion and tenure criteria), administration (e.g. budget control, indirect cost recovery distribution, and space allocations), and threats to traditional modes of work in universities (e.g. new reporting relationships, and restrictions on faculty autonomy). Feller judges that despite
recent trends, ‘disciplines continue to be seen as the most effective and efficient manner for generating scientific and technological advances, training the next generation of scientists, and transferring received knowledge.’33

Feller finds much enthusiasm with interdisciplinarity but also much variation in the willingness and preparedness of campuses to implement concrete strategies.34 Shedding some light on that variation, Brint suggests that the ideology of ‘creating the future’ is strongest among private research universities, whereas public institutions were more likely to view themselves in (disciplinary) specialist terms. These differences can be interpreted, Brint argues, as a consequence of the private sector’s emphasis on leadership, and the public sector’s connectedness to the immediate realities of their states. Furthermore, he claims that the ‘new directions’ may be most attractive for lower-ranked universities in either sector aspiring to upward mobility, since such institutions lack the resources to build disciplinary strengths at a comparatively high level.35 Feller indirectly supports these argument, by indicating (1) that interdisciplinarity appears as a strategy for aspiring universities that participate in NSF’s EPSCoR program, and (2) that elite private universities have had greater success than their public counterparts in obtaining foundation support for interdisciplinary institutes and programs recently.36 Hence, at the high end of the prestige hierarchy, privates would be better positioned to exploit interdisciplinarity than publics, for the resources they have and the aspirations they cultivate; at the low end, interdisciplinary approaches become an alternative competitive strategy to bypass traditional criteria of excellence.

These apparent differences between sectors and prestige levels regarding institutional strategies can be better understood in the competitive context of the
university sector. In the past thirty years there has been a steady rise in institutional funds
to support scientific investigation, now second only to federal funds. Universities are
compelled to seed promising research initiatives and invest on faculty quality and
infrastructure, which are increasingly expensive in the sciences. Over the past decades,
strong private universities have built an advantage over their public counterparts in terms
of faculty salaries and start up packages. In general, public universities have faced
difficulties in the competition for faculty talent, partly due to faltering state support.
Public institutions have employed cautious hiring tactics, by retaining or attracting
tenure-line faculty selectively, and pooling resources from open faculty positions. In the
race to ‘get ahead’ or at least avoid ‘falling behind,’ state universities are generally
constrained in their ability to promote growth at the academic core. This situation
underlies hypotheses that public universities may be at a disadvantage to promote
interdisciplinary research. Interdisciplinary initiatives require discretionary resources and
are at least initially disconnected from instructional revenues. Decisions to invest in
interdisciplinary science have multiple stimuli as discussed above, but institutions have to
bear with the additional resource requirements, as Charles Vest notes:

New intellectual trends, especially the growing importance of organizing to
conduct highly interdisciplinary research and education, tend to bring new
organizational overhead with them. The formation of new laboratories, centers,
and institutes is sometimes encouraged by research sponsors and is often believed
to be necessary, in order to conduct many interdisciplinary activities. These new
organizational often require new space, as well as additional staff and services.

Finally, Brint and Feller mention institutions which are supposedly more
associated or successful with interdisciplinary strategies, but evidence from
organizational contexts is thin. Facilitating Interdisciplinary Research partially
addresses this gap by providing a number of examples of ‘innovative models.’

Nevertheless, the breadth of the report comes at the expense of more detailed description and thorough analysis of individual initiatives. Interdisciplinary research teams have long assembled outside of the departmental structure in research centers and institutes. Also known as ‘organized research units’ (ORUs), they became a conspicuous component in the ecology of organizational forms of the research university with the ascendancy of academic science in the mid-20th century.

Organized Interdisciplinary Research in the University

The small body of literature that emerged to analyze the spread of ORUs after World War II suggests that they are the usual organizational response to demands for interdepartmental collaborations. This literature indicates that interdisciplinary ORUs may be created for various reasons. First, research sponsors may need and/or explicitly require interdisciplinary organizational models. Second, faculty may pursue interdisciplinary collaborations voluntarily, and succeed through grantsmanship in spawning separate units. Third, and intertwined with the others, university administrators may induce the formation of interdisciplinary ORUs for a number of purposes, including the expansion of research activity in a field, the resolution of internal administrative problems, and to attend to specific external demands for interdisciplinary work.

The history of an early interdisciplinary research center on a distinguished campus illustrates the issues universities still face with the administration of ORUs. In the post-war period, the Carnegie Corporation funded the Russian Research Center at
Harvard University. The center had the mission to advance knowledge of the Soviet Union, with a mandate to bridge expertise from several disciplines research and education. Faculty joined from multiple Harvard departments to help the center fulfill its objectives, which also included the dissemination of knowledge to a wider audience, and the training of new scholars in the field. Nevertheless, the disciplinary preferences of faculty and the departmental reward structure shaped the activities of the center overtime. Research was pursued with disciplinary orientations and was directed at specialized academic communities. Junior faculty participating in the center experienced the grip of the disciplinary ‘invisible hand’ in tenure reviews, and behaved accordingly. Graduate students and post-doctoral fellows were primarily linked with departments and their disciplinary degree program requirements. ‘As a result, interdisciplinary remained as an elusive ideal.’

Other problems are characteristic of larger ORUs, which develop autonomously on a stable financial basis. For such units, the challenges are to avoid the ossification of its structures, competition with departments, and self-perpetuation beyond their original purposes. It has been the case that universities have severed ties with research institutes who grew too large, too autonomous and with missions too alien to the academic environment. Some universities have ‘tolerated’ other institutes that seem to deviate from the campus culture and standards of scientific excellence, but have conspicuously segregated them organizationally and physically from the academic core. Unfortunately, recent writings on ORUS have missed the longevity of such tensions, providing particularistic narratives with redundant findings.
Evidence that ORUs are catalysts of interdisciplinary work is scant and inconclusive. In the 1980s, survey studies suggested a prevalence of disciplinary work in large samples of ORUs. A recent investigation of six interdisciplinary centers suggests a higher propensity among faculty to share information about projects than to engage in joint knowledge creation. The author argues that without tangible objectives around which to coalesce researchers from different disciplines, centers are likely to become outlets for attracting new funding for old research. The conclusion is that, being interdisciplinary centers embedded in a disciplinary structure, chances of success in building a strong faculty and sustaining quality research in the long run are slim – as they were in the case of the mid-century Harvard Russian Research Center.

The literature suggests that the administration of ORUs in the research university can be described as a series of dilemmas. Usual source of tensions are the allocation of resources, credit, and recognition. Apportioning overhead on research grants to ORUs may upset colleges and departments, for the participation of their faculty in generating external awards. Not doing so limits the ability of centers to support themselves, creating a financial burden on the campus. On the other hand, requiring ORUs to be entirely self-sustainable is a recipe for harnessing (implicit or explicit) competitive behaviors, and also leaves them vulnerable to vagaries in the sponsored research market. Another common issue regards the hiring of faculty—ORUs normally lack the prerogative of making tenure-line appointments. This limits the ability of centers to build a faculty with specific expertise. Allowing centers to hire their own faculty, in turn, creates a permanent commitment to an area that may lose relevance both intellectually and financially. When the aim is to spur interdisciplinary interactions, neither scheme promises ideal solutions.
The participation of departmental faculty in interdisciplinary centers is usually
accompanied by concerns over the value attributed to center activities in evaluation,
particularly at the junior level. In contrast, a cadre of full-time faculty with a permanent
full-time appointment in centers may develop the kind of specialization and convergence
associated with the departmental structure, possibly inhibiting more fluid interactions
with a wider range of experts.**52**

Interdisciplinary Strategies: Key Definitions and Theoretical Perspectives

Disciplines are variously defined through sociological, economic and cultural
theoretical perspectives.**53** One popular view describes them as an outcome of the division
of academic labor.**54** Specialism is an efficient way to focus scientific discovery, the
argument goes, allowing for a deeper understanding of increasingly specific areas of
inquiry. As discussed above, such is the process of specialization in academia that sub-
areas sometimes gain critical mass and evolve into new fields, with its own associations,
journals, degree programs and university departments.**55** Among the existing
conceptualizations of disciplines, Stephen Turner’s contribution is particularly relevant to
this study. Turner defines disciplines as partially protected internal markets, whose
competitive dynamics generates similarities in their products, that is, the experts they
train, certify and employ. Such competition causes university departments to be only
marginally differentiated:

The rigours of internal markets contribute to a kind of standardization of training
in which the demands of the market become demands placed on students. The
students, willingly or not, internalize these demands, at least in the minimal sense
of having gone through the experience of studying for a particular exam or
performing a particular kind of procedure or research act. The fact that a lot of people are trained in fundamentally the same way makes it possible for them to effectively make judgments about the quality of the work done by other people and for regimes of training to themselves be evaluated for their rigour.\textsuperscript{56}

Turner considers claims that disciplines reunite common intellectual cores open to debate; he characterizes popular distinctions between interdisciplinary and disciplinary forms of knowledge as ‘the product of the historical accidents that created disciplines in the first place’.\textsuperscript{57} Therefore, interdisciplinarity is a consequence of ‘novel divisions of labor in response to novel ends,’ Turner argues.\textsuperscript{58}

Drawing on Turner’s conceptualizations and the studies reviewed above, this dissertation defines interdisciplinary strategies as \textit{deliberate organizational arrangements to foster research including faculty from at least two disciplines}, including new organizational structures, policies, and administrative practices.

These conceptualizations and definitions call for a theoretical basis to explain the dynamics of continuity and change of the disciplinary-departmental organization. As an institution, the university is described as both a stern preserver of fundamental traditions and an apt adaptor to changing circumstances.\textsuperscript{59} On one hand, it is a cliché to evoke the university as one of the oldest institutions in the world; on the other, scholarship grows on aspects of change in higher education: commercialism, managerialism, and entrepreneurialism, to mention but a few.\textsuperscript{60} While there are those who will speak of an unchanging, stubbornly solipsistic university on one hand, and a corporate university driven by the ‘bottom-line’ on the other, a full observation of universities as organizations (versus partial accounts of discrete aspects of its operation) make a moderate position more palatable.\textsuperscript{61}
The field of organizational studies offers multiple theoretical perspectives to inform the understanding of change and continuity. These perspectives variously emphasize strategic action or organizational conformity to environmental influence, macro-structural or organizational-level analysis, adaptation or selection processes. Thus, they provide complementary theoretical lenses that can be applied to different organizational phenomena (although some would claim they are competing paradigms). This section reviews them instrumentally, to analyze the aspects of the problem under investigation that they best apply to.

Above, disciplines were described through the division of academic labor argument as internal markets. This argument has much descriptive power; in fact, at the infancy of the research university, William Rainey Harper deliberately organized the nascent University of Chicago with departmental units in order to delegate and decentralize responsibility. But with the rise and consolidation of the university, the division of labor argument seems insufficient to account for continuity of the disciplinary-departmental structure. Succeeding universities did not find a *tabula rasa* of organizational forms, but rather institutionalized departmental models and recognized disciplines with their respective associations, journals, and conferences. Credit for the similarities among universities in the academic fields they cover recurrently goes to competition. Nevertheless, such competition takes place within a stable institutional prestige hierarchy, whereby Matthew effect dynamics reward those at the top and reinforce the status quo.

Andrew Abbott proposes that the resilience of disciplines results from a ‘dual institutionalization,’ formed by the macrostructure of disciplinary labor markets and the
microstructure of individual universities, each containing similar departments. Ronald Jepperson’s conceptualization of institutions is particularly relevant:

Institutions are those social patterns that, when chronically reproduced, owe their survival to relatively self-activating social processes…. routine reproductive procedures support and sustain the pattern, furthering its reproduction – unless collective action blocks, or environmental shocks disrupts, the reproductive process.  

Abbott observes disincentives for universities to deviate from the established forms, since it threatens the academic career prospects of its Ph.D. graduates. He notes that Carnegie Mellon University is successful as ‘perhaps the only major university in the United States organized in nontraditional departments,’ but unique. Veysey argued that the departmental-disciplinary structure of the university was institutionalized between 1890s and 1910s, when the modern university was already recognizable. After that, ‘[t]o succeed in building a major university, one [now] had to conform to the standard structural pattern in all basic respects – no matter how one would trumpet one’s few peculiar embellishments.’ To the extent that his statement relates to the disciplinary-departmental organization, it seems to corroborate Paul DiMaggio and Walter Powell’s proposition that there may be high structural heterogeneity as an organizational field emerges, but homogenization tends to prevail as the field becomes well established.

Moreover, an additive pattern followed the institutionalization of the departmental structure. Universities have historically responded to new demands and opportunities through the addition of units, but elimination has been rare. Abbot contends that when departments are merged or terminated, such decisions are more likely to result from resource constraints than from a drive to reengineer traditional academic structures. Then, in Abbott’s view, with the perpetuation of the traditional hiring mechanism that feeds
departments with faculty from the dedicated disciplinary markets they partake of, ‘the current social structure of disciplines will endlessly re-create itself.’

Neo-institutional scholarship stresses that organizations seek ‘social fit’ within organizational fields (organizations in a similar industry, their suppliers, customers, and regulatory agencies). Under this perspective, disciplines and departments can be viewed as powerfully ‘rationalized myths,’ which are adopted as taken-for-granted ways of organizing, regardless of whether they truly generate technical efficiencies. Academic instruction and research are poorly understood technologies, whose outputs are hard to define, agree upon, and verify. In the presence of such uncertainty, procedural conformity and the adoption of generally accepted organizational forms, legitimated by elites and institutions perceived as successful, mitigates disagreements and ambivalence over goals and technology. The departmental organization could be viewed as providing a passport to social acceptance and legitimacy, since they help satisfy societal expectations of what ‘a true university’ is. Under a neo-institutional perspective, competition is not the sole or even the main mechanism generating institutional isomorphism. Rather, institutional patterns shape the notions of how universities should organize, as rationalizing forces in society confers legitimacy to the disciplinary-departmental mode. Such patterns would influence organizational action by framing cognitive and normative boundaries within which university behavior is acceptable and its structures are legitimate.

Empirical studies of higher education institutions have challenged the emphasis on conformity of the original formulations of new institutional theory, and suggested a need to consider older arguments on the role of interests, power, and strategic choice. One salient tendency of theoretical refinements has been on explaining mechanisms of
institutional change, and how institutional patterns are both constraints and generators of action.\textsuperscript{76}

Traditional accounts of university behavior are implicitly based upon rational adaptation theories. Martin Trow highlights that organizational survival has always depended on external judgments in the various markets universities participate in and the backing of multiple constituencies, as American higher education has historically been characterized by comparatively low centralized government regulation and high community support. Hence, the activities universities engage in have had to bear relevance to those who directly or indirectly supported their survival. In such a system of open competition, the success of the elite private universities shaped the aspirations and behavior of others.\textsuperscript{77} Institutional prestige became a crucial asset as it translates into resources, and many argue universities are prestige-maximizers.\textsuperscript{78} Universities participate in certain activities and markets in a manner that satisfies the requirements of the disciplinary rewards systems, the main source of information on the relative standing of higher education institutions, and the departmental structure would be the vehicle through which to pursue academic distinction.\textsuperscript{79} Such view is consistent with the works of contingency theorists and resource dependence theorists, who believe that organizations rationally manipulate strategy and structure to adapt to environmental threats and opportunities.\textsuperscript{80}

The strategic management literature follows the assumptions and extends the contingency and resource dependence arguments. Strategy is commonly defined as a plan, a consciously intended course of action, following Alfred Chandler’s influential work in the 1960s.\textsuperscript{81} Influential models of organizational strategy place the analytic
emphasis on the firm’s behavior to cope successfully with competitors, consumers, suppliers, and salient environmental conditions.⁸² These models emphasize coherence among goals, means to pursue them, organizational structure, and outcomes, as well as coordinated action and systematic implementation. Henry Mintzberg and colleagues have expanded the views on intentionality and purposefulness through the investigation of strategy formation processes, by arguing that intended strategies may or may not realize, as well as emerge from unintended consistencies in organizational action. They have offered different typologies to describe strategies according to intentionality and content.⁸³ Mintzberg has also thoroughly criticized the practice of strategic planning in firms by exposing unwarranted assumptions and ‘fundamental fallacies’ of the technique, such as the capacity of planners to analyze relevant elements in environmental scans, and their ability to meaningfully predict future conditions.⁸⁴

Strategic planning has disseminated in higher education, as observed above, and related documents give partial basis to the observation of interdisciplinary strategies. The ‘strategy as plan’ view has found its way in the higher education literature, but well-articulated models of academic strategy are lacking.⁸⁵ More commonly, scholars import metaphors and heuristic devices for situating an organization in its industry from business studies.⁸⁶ Scholars disagree on how well strategic plans reflect university goals and strategies. A famous critique came from Robert Birnbaum, who argued that strategic planning is one of the management fads in higher education, which was adopted following a pattern of emulation of managerial techniques from industry and government.⁸⁷ Birnbaum’s echoes the criticism that academic strategic planning is merely ceremonial, producing formal documents that do not result in concrete developments.
Such criticism finds theoretical roots in the characteristic ‘loosely-coupled’ organization of universities, which Michael Cohen and James March argued led to an ‘organized anarchy’ style of decision-making.\textsuperscript{88} Scott explains that in loosely-coupled organizations, ‘[r]ules do not always govern action: a rule may change without affecting behavior, and vice versa.’\textsuperscript{89} On the other hand, there are those who argue that ‘there is a new and powerful emphasis on moving from formulation to implementation, from plan to practice.’\textsuperscript{90} These opposing views are likely to persist, given the difficulties to produce generalizable studies on the effectiveness of strategic planning, both in higher education and beyond.\textsuperscript{91} Empirical studies on strategy-setting in universities, particularly as it pertains to the research enterprise, are conspicuously missing.\textsuperscript{92}

Unlike the theoretical perspectives discussed above, the population ecology scholarship originally stressed the inability of organizations to adapt to the environment. Based upon Darwinian biological theories of natural selection, this line of work proposes that the main form of structural change consists of processes of organizational selection, including replacement by birth of new forms and mortality of older ones.\textsuperscript{93} Michael Hannan and John Freeman articulated the idea of structural inertial to argue that organizations respond relatively slowly to environmental changes. They emphasize relative paces of change, as reflected in the comment that ‘the worst of all possible worlds is to change structure continually only to find each time upon reorganization that the environment has already shifted to some new configuration that demands yet a new structure.’\textsuperscript{94} Selection processes are implicit in historical analyses of organizational models in higher education that did not survive, such as ‘multipurpose colleges’ and early women’s colleges, which are judged to have succumbed to changing circumstances that
made them inadequate or irrelevant. The population ecology scholarship shares with institutional theory the idea that the perpetuity of a particular organizational form or an organizational population may be unrelated to effectiveness and efficiency, and may result from political, social, cultural and institutional factors.

Summary

The preponderance of fragmentary and mixed evidence paints a blurred picture of the state of interdisciplinary research across universities. Scattered findings on institutions that support interdisciplinarity allow neither for an appreciation of general patterns nor for greater understanding of specific organizational contexts. The studies reviewed above have noted that interdisciplinarity became widely present in the strategic efforts of universities, but did not approach the organizational developments of particular campuses. The National Academies report approaches that gap, but lacks empirical depth on the constitution and organization of the ‘best practices’ it describes. New organizational models have apparently emerged, but their exact consequences for the disciplinary-departmental structure are unclear in the absence of detailed description and analysis.
STUDY DESIGN

A general question guided this dissertation: what organizational strategies have universities employed to foster interdisciplinary research? To answer this question, this study pursued both general patterns and specific developments. This was a two-phase investigation consisting of an initial exploratory phase mainly based upon document analysis and literature review, followed by case studies (see Figure 1). These methods were found to be the most appropriate given the availability of data and the relatively incipient state of research on the topic.

Figure 1. Study Design.

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
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<tr>
<td><strong>Goal:</strong> Identify organizational approaches associated with interdisciplinarity</td>
<td><strong>Goal:</strong> Describe and analyze emergent interdisciplinary strategies</td>
</tr>
<tr>
<td><strong>Motive:</strong> Reduce the lack of information on potential organizational implications of interdisciplinary trends</td>
<td><strong>Motive:</strong> Understand the causes and consequences of interdisciplinary models</td>
</tr>
<tr>
<td><strong>Research strategy:</strong> Exploratory</td>
<td><strong>Research strategy:</strong> Case-based, descriptive</td>
</tr>
<tr>
<td><strong>Sources of data:</strong> Strategic plans and equivalents</td>
<td><strong>Sources of data:</strong> Interviews, campus records, documents, etc</td>
</tr>
<tr>
<td><strong>Analytical approach:</strong> Inductive</td>
<td><strong>Analytical approach:</strong> Inductive</td>
</tr>
<tr>
<td><strong>Validity threat:</strong> Data may not reflect accurately the developments on campuses</td>
<td><strong>Validity threat:</strong> Data may reflect partial views on organizational strategies</td>
</tr>
<tr>
<td><strong>Asserting validity:</strong> Triangulation</td>
<td><strong>Asserting validity:</strong> Triangulation; preference for administrative perspective is deliberate</td>
</tr>
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The first phase aimed to unveil regularities in university approaches to facilitate interdisciplinary research. The sample and data sources were derived from the higher education literature. The former comprehended 99 universities, which have been identified as distinguished research performers (see Appendix A). The latter followed recent studies reviewed above that used strategic plans to capture formal goals and...
intended strategies of higher education institutions. The choice of this data source arises from the ubiquity of planning among universities, the wealth of information plans make available, and the lack of other efficient alternatives to gather qualitative institutional data. This study collected and analyzed the planning documents of all universities in the sample. Sixty-nine universities had a document identified as an institution-wide strategic plan. To assure the accuracy of strategic plan content, multiple sources were checked against them for verification. Those included progress reports or updates on strategic plans whenever available, as well as myriad other sources including presidential annual addresses, self-study reports, news releases, articles in the news media, and institutional websites, among others. These voluminous data were employed to answer the following sub-questions: what approaches have universities employed in their strategic planning efforts to foster interdisciplinary research? Are there recognizable patterns in the approaches utilized? Have the announcements of university plans been of any practical consequence (or did intended strategies become realized)? Do they cause significant change in the disciplinary-departmental structure of the university? Do they deviate from traditional practices (e.g. establishment of ORUs, seed funding etc)?

As part of this exploratory phase, data from a sample of NSF programs described as interdisciplinary was also collected and analyzed. This set of programs was selected following a review of the literature, and an analysis of the program announcements in the cross-cutting/interdisciplinary category (more detailed information on those programs is described in Chapter 3). The initial motivation for examining these data was to attempt to capture whether there were relationships among the professed interdisciplinary goals of universities and performance in that sub-set of NSF grants. A more complex
interpretation emerged from the extensive analysis of institutional document and interview data. Obtaining large federal grants (including the identified sub-set of NSF grants) has appeared as formal goal in the plans of several universities, but other patterns of commitment to interdisciplinarity discussed in Chapter 3 relate only indirectly, if at all, to the pursuit of such awards. Campus interviews provided further evidence that the targeted competition for these awards is a very specialized activity that concerns research administrators and potential principal investigators, but seems to be generally decoupled from the more general thinking about promoting and facilitating interdisciplinary research on campuses. Therefore, the analysis of NSF grants is reported as one additional piece of the puzzle tackled in Chapter 3 regarding the relative commitments of universities to interdisciplinarity, providing an admittedly broad indicator. The exploratory quantitative analysis examined relationships suggested in the literature and academic plans: Do large research universities do better than small ones? Are there differences among public and private universities?

In the second phase, the aim was to extend the overarching question of what organizational strategies universities have employed to foster interdisciplinary research into an in-depth examination of five disparate cases that represent emerging models. How did interdisciplinary strategies emerge, and why? Do they change traditional academic structures, such as the centrality of departments in faculty hiring and evaluation? Do they shift power and resources to ORUs? In approaching university interdisciplinary strategies, a socio-constructivist stance seems more pertinent than a prescriptive one. Classifying research types or modes is more complex than the more normative contributions to the literature suggest. Social constructivist approaches often demonstrate
that characterizations of scientific work may vary depending on context, viewpoint and purpose of the actors. Therefore, this is not an evaluation study of the effectiveness of particular arrangements in inducing interdisciplinary work according to some a priori definition. Whether an organizational arrangement produces inter- or multi- or trans-disciplinarity, whatever distinctions one might draws among those, is beyond the scope of the present inquiry. Rather, interest lies on the nature of the organizational arrangements produced in the name of interdisciplinary science and described as such.

The case study methodology was chosen because it affords the opportunity to ‘investigate a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.’ Still, cases (units of analysis) are bounded systems. Merriam describes the outcome of case study research as a holistic description and analysis of individuals, programs, policies or institutions of interest. These analytical descriptions subsidize researchers in ‘building concepts, hypotheses, or theories rather than deductively deriving postulates and hypotheses to be tested (as in positivist research)’.

In this dissertation, cases are formal interdisciplinary strategies of research-intensive universities. Universities may have one or multiple interrelated organizational arrangements composing its strategy. The sampling strategy was criterion-based, privileging relatively deviant cases according to conceptual considerations. As the logic of the study lies on the tension between the traditional disciplinary-departmental structure and interdisciplinary models of organization, universities had to satisfy the following criteria: (1) have an identifiable, formal, and deliberate organizational strategy to foster interdisciplinary research (dubbed ‘interdisciplinary strategy’ for simplification);
(2) that this strategy involves intended change in the disciplinary-departmental organization (e.g. the way universities hire, organize, evaluate, and reward faculty); (3) that chosen institutions be generally representative of the comprehensive research university in overall structure, so as not to be characterized as a special cases regardless of the interdisciplinary strategy (e.g. niche institutions such as Rockefeller University, Carnegie-Mellon University); (4) that the overall sample balanced public and private universities, based upon the differential competitive challenges affecting each sector, as discussed in the literature and (5) that each of the selected cases illustrates a different approach so as to better grasp a range emergent organizational models.

Penn State University, the University of Wisconsin-Madison, Arizona State University, Stanford University and Duke University were identified as satisfying the criteria. They all have implemented, between the mid-1990s and today, an identifiable organizational strategy to stimulate interdisciplinary research. Their organizational strategies comprise tangibles such as new or modified institutional policies, programs and organizational structures, but are also permeated with intangibles such as administrative priorities, strategic directions and leadership vision. The practices of these universities have earned the recognition of peer institutions, scholars, and interdisciplinary advocates, and have been highlighted in the National Academies report.108

The choice of multiple campuses with distinctive strategies follows one of the research designs proposed by Janet Schofield to increase the generalizability of qualitative studies. Schofield views generalizability in the sense of what Egon Guba and Yvonna Lincoln termed ‘fittingness’ - the degree to which an investigated situation
matches other situations of interest. Heterogeneity among sites informs the alternative directions that a relevant trend may take in educational institutions.\textsuperscript{109}

The case studies drew on multiple sources of data, including official planning documents, published materials, annual reports, organizational histories, institutional records and interviews with university representatives. Multiple sources allowed for the triangulation of data, which strengthens the internal validity of case studies.\textsuperscript{110} Within each case, the selection of interviewees was equally purposeful, since it sought to obtain information from key informants uniquely positioned to explain the development of interdisciplinary strategies from an administrative perspective. The main contact point was either the office of the provost or the office of research, depending upon the division of roles at each institution. Acquiescence and collaboration from those offices, judged fundamental for reasons of access to relevant sources and institutional data, was sought and obtained in all cases. The procedure known as ‘chain’ sampling was employed: a tentative list of informants was suggested by the investigator to the senior academic offices contacted, who would be solicited to make further suggestions of individuals who have a direct involvement in the specific programs, policies or systems supporting the university’s interdisciplinary strategy.\textsuperscript{111} Pilot study at Penn State was carried out in fall 2004, and the other four site visits took place in spring 2005.

The aim of the case studies was to answer the questions: how and why were they implemented? How did they evolve? How do they change and fail to change academic structures? The approach was essentially descriptive, to gain insight into the research problem and understand the complex organizational processes at play. The analytical approach was inductive, focusing on making sense of observed patterns as they connect
to previous studies of university organization, and on what can be learned from the
formation and implementation of five different strategies.

Table 2. Specific Sub-Questions Informing the Investigation of Interdisciplinary Strategies.

<table>
<thead>
<tr>
<th>a) Scope and structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the organizational strategy to promote interdisciplinary research? Are structural forms added /existing structures modified? What is the role of academic departments? Does interdisciplinary research drift apart or is embedded in academic departments? What specific policies and incentives shape the structural drive for interdisciplinarity?</td>
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<table>
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<tr>
<th>b) Impetus for creation</th>
</tr>
</thead>
<tbody>
<tr>
<td>What were the origins of the institutional commitment to an interdisciplinary strategy? What is the competitive position of the university? How did faculty and administrators participate?</td>
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<tr>
<th>c) Governance/Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a separate decision-making structure for interdisciplinary initiatives? Who/what unit oversees implementation efforts? Is governance centralized in the senior administration? What is the role of deans and department heads?</td>
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</table>

<table>
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<tr>
<th>d) Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the mechanisms to stimulate interdisciplinary work? What are the inducements for faculty to do interdisciplinary research? Are there provisions to hire new faculty members under the interdisciplinary strategic thrust? If so, what are the hiring and evaluation processes like?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>e) Education and Instructional Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the strategy address the educational function? Is there change in curricula or in degree programs? Are students integrated in interdisciplinary research efforts?</td>
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<table>
<thead>
<tr>
<th>f) Policy and Administrative Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the administrative/policy framework for the organizational strategy? Are new administrative systems implemented, or existing ones modified?</td>
</tr>
</tbody>
</table>

The case studies portray the interdisciplinary strategies in evolutionary and
dynamic terms, rather than adopting a ‘best practices’ stance. Each case attempts to
identify the sources of interdisciplinary drives in the university, salient organizational and
environmental conditions shaping the implementation of specific initiatives, the key
actors bringing them about, and the scope and amount of change they involve. It is thus
possible to analyze and understand the structures, the tensions they generate and the
solutions they offer, and to raise useful questions regarding their duplicability and
adaptability to other settings. For the reader, the outcomes of these cases should
hopefully be a deeper understanding of how the five universities have engendered
organizational change, employing the broadly defined concept of interdisciplinarity to
overcome constraints, exploit opportunities, steer institutional advancement, and respond
to faculty thrusts.
ENDNOTES


4 See Rhoten, *op. cit.* note 2, 8.


7 Edward J. Hackett, ‘Interdisciplinary Research Initiatives at the U.S. National Science Foundation,’ in Peter Weingart and Nico Stehr (Eds.), *Practising Interdisciplinarity* (pp. 248-259) (Toronto; Buffalo: University of Toronto Press, 2000), 249-251.


21 J. Rogers Hollingsworth and Ellen Jane Hollingsworth, ‘Major Discoveries in Biomedical Research Organizations: Perspectives on Interdisciplinarity, Nurturing Leadership, and Integrated Structures and Cultures’ in Peter Weingart and Nico Stehr (Eds.) *Practising Interdisciplinarity* (pp. 215-244), (Toronto: University of Toronto Press, 2000), 231.


23 Ibid., 61.


27 Clark, *op. cit.* note 20, 234-236.


31 Feller *op. cit.* note 5, 12.

33 Feller, Ibid., 112; and Feller, op. cit. note 5, 14.

34 Feller, op. cit. note 5, 36.

35 Brint, op. cit. note 29, 45-46.

36 For (1), see Feller, op. cit. note 28, 112; for (2), see Irwin Feller, Who Races with Whom; Who is Likely to Win (or Survive); Why, Paper delivered at the symposium ‘The Future of the American Public Research University,’ (February 25-26, 2005), The Pennsylvania State University, University Park, PA, 15-16.


40 Feller, op. cit. note 36, 10-12.


42 Brint singles out Arizona State University, Carnegie Mellon University, Duke University, Rensselaer Polytechnic Institute (RPI), the University of Illinois, and the University of Southern California (USC) as the clearest examples of institutions whose strategic plans follow ‘new directions.’ Feller’s praises go to Carnegie Mellon, the Georgia Institute of Technology and the Massachusetts Institute of Technology and the University of Michigan, among others, as universities that are organizationally receptive to interdisciplinarity. See Brint, op. cit. note 29, 29; Feller, op. cit. note 28, 111; and Feller, op. cit. note 5, 26-27.


Geiger, *op. cit.* note 39, 141.

See, for instance, papers composing the special issue on public policy centers of *Metropolitan Universities, 10*(1), (1999).


See Clark, *op. cit.* note 20, 154; see also Stahler and Tash, *op. cit.* note 44, 543-546.

See Rhoten, *op. cit.* note 50, 8-10.

See Lattuca, *op. cit.* note 6, 27-42.


For the formative period of disciplinary organizations, see Geiger, *op. cit.* note 17, 20-39. *Facilitating Interdisciplinary Research* presents data on the number of departments at selected universities and on the number of professional societies over the 20th century. The data indicate steady increases, illustrating an incessant pace of disciplinary specialization. National Academies, *op. cit.* note 10, 19 and 138.

Stephen Turner, ‘What Are Disciplines? And How is Interdisciplinarity Different?’ in Peter Weingart and Nico Stehr (Eds.), *Practising Interdisciplinarity* (pp. 46-65), (Toronto; Buffalo: University of Toronto Press, 2000), 52.


Turner, *op. cit.* note 56, 56. Experts on interdisciplinarity describe several ways the novel ends interdisciplinary arrangements respond to may come about. Some see in interdisciplinary research a way to promote knowledge integration, understanding the disciplinary mode of science to result in fragmented knowledge. Others emphasize interdisciplinarity as a means to restructure disciplines, through the absorption of theories from other fields. Yet others believe in the ever-popular view that complex societal problems require interdisciplinary research approaches. See Klein, *op. cit.* note 1, 40-47.


63 See Geiger, *op. cit.* note 17, 36-37.


67 See Abbott, *op. cit.* note 18, 126-127. Questions regarding the relative employability of interdisciplinary scholars are on-going. See Lattuca, *op. cit.* note 6, 44.


78 See Clark, op. cit. note 61, 169; see also Geiger, op. cit. note 37, 14-15.


81 Chandler defined strategy as ‘the determination of the basic long-range goals and objectives of an enterprise, and the adoption of courses of action and the allocations of resources necessary for carrying out these goals.’ Alfred Chandler, Strategy and Structure: Chapters in the History of the American Industrial Enterprise, (Cambridge, MA: MIT Press, 1962), 13.


85 For recent usage of such definition, see Michael Dooris, John Kelley and James Trainer, ‘Strategic Planning in Higher Education,’ New Directions for Higher Education, 116(123), (2004): 5-11.


Dooris, Kelley and Trainer, *op. cit.* note 85, 8.


Strategic plans, academic plans, strategic analysis reports are some of the ways these official documents are called. In the absence of institution-wide plans, other documents were used as proxies, such as presidential statements of goals and strategies, budget plans, and self-study reports, following Brint’s approach.

Data was collected from the NSF electronic database. NSF data on total research expenditures of higher education institutions was used to gauge the relative importance of interdisciplinarity for each university. Naturally, NSF-sponsored research is a share of total university research, be it disciplinary or interdisciplinary. Nevertheless, the agency funds research across a wide spectrum of disciplines and multiple combinations among them in crosscutting programs.

In this regard, Jane Calvert’s work on the concept of ‘basic’ research is instructive. She dissects scientists and policy makers’ definitions of the term, finding variability in the way they define ‘basic’ along six different dimensions. Her analysis indicates that multiple competing definitions can co-exist, framing
the same research activity as basic, applied or otherwise depending on context and interpretation. Calvert argues that the idea of basic research interests policy makers and funding agencies for pragmatic reasons, since they have systematically adopted the concept for several decades as an accounting/statistical category. Jane Calvert, ‘The Idea of ‘Basic Research’ in Language and Practice,’ Minerva, 42(3), (2004): 251-268.

102 As a reviewer of the proposal for this study poignantly observed, this project could be described as a study of universities’ structural arrangements to ‘increase the amount of inter/cross/multi/trans—and who knows what else—disciplinary research.’ Such is a prescriptive stance, and scholars who discuss what scientists should do to achieve what they think inter- or other hyphenated disciplinary modes of research are implicitly and explicitly create hierarchies among these types. See Julie T. Klein, Walter Grossenbacher-Mansuy, Rudolf Haberli, Alain Bill, Roland W. Sholz and Mirta Welti (eds.) Transdisciplinarity: Joint Problem Solving among Science, Technology, and Society: An Effective Way for Managing Complexity, (Boston: Birkhauser, 2001), 220.


105 Sharan B. Merriam, Qualitative Research and Case Study Applications in Education, (2nd ed.), (San Francisco: Jossey-Bass, 1998), 34.

106 Sharan B. Merriam, Qualitative Research in Practice: Examples for Discussion and Analysis, (San Francisco: Jossey-Bass, 2002), 9.


110 Yin, op. cit note 103, 97-99.

CHAPTER 3
RESEARCH UNIVERSITIES: PLANNING FOR INTERDISCIPLINARITY

As discussed in Chapter 2, promoting interdisciplinarity has become a standard feature in the planning efforts of higher education institutions. While the extensive use of the term suggests a faddish adoption, some would argue that universities effectively implementing interdisciplinary strategies may be better positioning themselves for a likely future.¹ This chapter seeks not to confirm but to extend recent analyses by addressing their silences: what approaches are universities employing in their strategic planning efforts to foster interdisciplinary research? Are there recognizable patterns in the approaches utilized? Have the announcements of university plans been of any practical consequence (or did intended strategies become realized)? Do they seem to deviate from traditional practices (e.g. establishment of ORUs, seed funding etc)? The analysis is based upon planning documents gathered from 99 research-intensive universities in fall 2004.² In most cases, multiple documents were examined, as when older strategic plans were updated, progress reports were released, or when there was more than one of these efforts in place. Most of the planning processes were initiated after 2000; the earliest was released in 1997 and the most recent in 2004. Data on NSF grants and relevant interview data from fieldwork supplement the analysis.
Observers of organizational change among research universities are interested in how identifiable strategies to promote interdisciplinarity alter the way academics are hired, organized, evaluated and rewarded. While university leaders have gone a long way in endorsing inter-, multi-, cross- and trans-disciplinary approaches, radical transformation in those respects is far from view. Those who have examined the current interdisciplinary trend in higher education caution that, by and large, departments still control academic life through hiring and tenure decisions. Such a conclusion, however, deemphasizes concerted effort of selected institutions to promote change in the core activities mentioned above. Precursors of these changes are Rockefeller University and Carnegie-Mellon University, which have historically been organized along interdisciplinary lines. However, these are focused universities that cater for selected niches in research and graduate education. Other institutions offer examples of recent change occurring within the mainstream research university sector.

The word reform perhaps best describes the actions of Duke University and the University of Southern California. These universities’ interests in interdisciplinarity matured over long periods of time, over which multiple self-assessment exercises and planning cycles took place. Duke’s trajectory started in 1988 and USC’s in 1994. Therefore, recent developments are neither circumstantial nor an attempt to jump on the bandwagon. Among other initiatives, their leaderships have spearheaded adaptations in faculty promotion, evaluation and recognition policies to account for interdisciplinary interests. Such changes are permanent and come with ringing endorsement of the
respective provosts. At USC, the award of ‘university professor’ recognizes faculty whose work contributed to multiple disciplines. As an outcome of its latest strategic plan, the university has altered promotion and tenure guidelines to explicitly require colleges and schools to accommodate the interdisciplinary work of the faculty. The Duke case study describes similar changes, and an incipient innovation in the hiring of senior faculty to enrich scholarship at the crossroads of the disciplines. Not so far along in reforming traditional policies are the Pennsylvania State University and the University of Wisconsin-Madison, which introduced other approaches for hiring faculty with interdisciplinary interests. These universities counter-balance the traditional centrality of departments with new decision-making processes or bodies, as they experiment with alternative models of faculty hiring and evaluation.

Universities have also reflected on the perceived need to accommodate changing patterns of knowledge production within the departmental-disciplinary organization. For internal consumption or for institutional reaccreditation, some universities have in recent years examined their ability to nurture and induce interdisciplinarity, such as the University of Michigan, Northwestern University, and UW-Madison. These self-investigations coincide in their accounts of the purported uniqueness of their respective campuses in the openness for and interest in interdisciplinary collaborations, constrained by administrative rigidities and departmental mentalities that pose extra burdens on faculty that reach out of disciplinary confines. The issues of resource allocations, credit and recognition, and tenure and promotion decisions are usually diagnosed, but solutions are rarely conclusive. The difficulty lies in the uneasy balance between the institutional
impulses for interdisciplinarity and the established ways of ascertaining academic quality.

A report from the University of Wisconsin-Madison states:

Interdisciplinary scholarship presents two paradoxes for an academic institution. First, to maintain high quality standards for interdisciplinary research, the institution must have strong disciplinary structures. But the strength of those structures may inhibit the development of effective interdisciplinary programs. Second, much interdisciplinary work has an applied or policy focus and is therefore subject to greater public scrutiny than is work within a traditional disciplinary framework. The need for the protection of tenure may be greater for interdisciplinary researchers, while the nature of interdisciplinary work makes it more difficult to obtain tenure.9

Such a position is markedly different from that of Duke and USC, as it assumes substitutability between interdisciplinary and disciplinary work and does not consider the possibility of reform in evaluation procedures. It is indeed the default position, especially popular among universities that are, or reasonably aspire to be, at the highest echelons of academic prestige. Endorsements of interdisciplinarity on these campuses are often tightly coupled to reminders of the need for disciplinary ‘depth’ and ‘rigor’ to give a solid foundation to the ‘interdisciplinary innovation.’ An illustrative example comes from Cornell:

One of Cornell’s distinguishing features is our established culture of interdisciplinary work built on a disciplinary base, which is evident in both our instruction and research activities. This culture has been instrumental in our academic strategic planning decision to emphasize several target areas to which major shares of our resources would be directed.10

This is hardly surprising, since these ideas have historically shaped the discourse on interdisciplinarity, as discussed by Peter Weingart.11 Nor is it unanticipated that strategies based upon incentives for interdisciplinary work have been the most common. What follows is a snapshot of these essentially evolving programs and initiatives to harness interdisciplinary scholarship. Confirming the expectations, most universities
analyzed here discuss interdisciplinarity in their planning documents. To be exact, only fifteen institutions in the sample do not state goals or describe means to pursue interdisciplinarity. Naturally, that the word interdisciplinarity appears in a strategic plan is no real assurance of practical commitments. It has been suggested that in many cases universities simply adopt interdisciplinary labels without promoting significant change. Some plans state lofty goals unconnected to tangible actions, while others mention interdisciplinarity *en passant*, grouping it with other desirable thrusts such as community outreach, multiculturalism, internationalism and diversity. Although these instances may be interesting evidence for a study on the diffusion of ideas (or fads), those are not the focus of this chapter. Weingart’s argument that interdisciplinary discourse is a discourse of innovation in research helps understand this trend. Both scientists and universities seek the ‘excellence’ ideal, and espousing innovative science is consistent with it. However, universities also use the idea of interdisciplinarity in conjunction with and as a means to achieve other goals, which include but are not limited to reforming academic structures.

The remainder of this chapter is divided into six sections. The first five describe approaches universities exhibit in their plans, punctuated by descriptions of examples that were actually implemented, from the most inclusive to the most specific. The sixth section presents data on a selection of National Science Foundation interdisciplinary grants.
Strategizing Advancement in Research: Interdisciplinary Initiatives

Half a century ago, Frederick Terman became provost of Stanford University, determined to help the institution become the distinguished private university of the West Coast. He believed Stanford should excel in few and important areas, creating what he dubbed ‘steeples of excellence.’ Such approach has clearly become a standard strategy (or aspiration) among research universities, reinforced by the discourse of strategic management adopted in the past few decades in higher education (‘we can’t be all things for all people’). But back in the 1950s, Terman aimed at, and exerted heavy-handed influence on, building strong departments and schools. The analysis of current strategic plans of research universities indicates a distinctive pattern that resembles Terman’s ‘steeples’ approach but shifts the locus of change. A number of universities have adopted initiatives in selected interdisciplinary areas. Twenty-one planning documents present various ‘crosscutting initiatives,’ ‘interdisciplinary priority areas,’ ‘strategic areas,’ ‘super cluster areas,’ among other labels. Universities typically explain or justify these initiatives with the rational argument of investing scarce resources to leverage institutional strengths in order to exploit relevant new fields. This chapter highlights the general patterns, while three of the case studies (Duke, Penn State, and Stanford) provide a closer examination of the evolution of such initiatives within their institutional contexts.

As previously suggested, these initiatives are predictably created in areas designated as priorities at the federal level. Interestingly, the very idea of electing priority areas that cut across the departmental structure mirrors the planning approaches of major federal agencies. This analysis found biotechnology, computer and
information science, computational biology, environmental studies, genomics, materials science, and nanoscience and engineering to be popular, but other thrusts exist in children, youth and family studies, ethnic and regional studies, gerontology, and urban studies, to cite a few examples. Underlying this pattern are common assumptions of strategic planning and management, such as that organizational strengths can be advantageously matched with environmental opportunities. The following excerpts are illustrative:

An essential component of our strategy to increase prominence in research will lie in identifying areas of existing distinction that represent future growth and broad impact in key research areas. These core strengths represent opportunities for the Institute’s continuing leadership in fields that promise increased significance, new intellectual challenges, and relevance to broad societal and technological needs. In addition, these core strengths link our existing enterprise to new and exciting research arenas.²⁰

By promoting broad-ranging programs, we will position ourselves in the center of the most dynamic academic areas while assuring that our investments in faculty and facilities have maximum impact.²¹

These initiatives come in different numbers, shapes and sizes; one university may develop two, as the Rensselaer Polytechnic Institute (RPI), and another thirteen, as Harvard University. Naturally, there is great variability in the organizational approaches used and in the scope of the programs. Initiatives may involve creating organized research units, hiring new faculty, allocating some discretionary resources for decentralized investment, and sometimes starting an interdisciplinary educational program. Some entail major financial commitments fueled by philanthropy and governmental support, while others recycle internal resources for comparatively modest undertakings. The processes through which universities choose their priorities range from extensive bottom-up deliberation to the appearance of such deliberation. Shared
governance is nourished forcefully at the strongest institutions, as the case studies in the following chapters and the present analysis suggests. The most prestigious state institution, the University of California at Berkeley, provides an example of extensive faculty input in a process of electing priorities for investments – the ‘new ideas initiative’.  

In 2001, UC-Berkeley’s administration released a request for ideas for new research programs to the faculty, receiving 120 pre-proposals as a result. A review committee decided that the most promising could be clustered under 10 interdisciplinary themes. Representing the presumption indicated above, ‘the Committee felt the interdisciplinary synergy resulting from combining these ideas into more comprehensive ‘themes’ made them both stronger and more comprehensive.’ In the following year, another call was made for full proposals detailing specific programs within the identified themes. After a six-month process of internal and external reviews and committee deliberation, four out of the 10 original areas were contemplated with 21 full-time equivalent faculty positions. The areas chosen were computational biology, regional and metropolitan studies, nanosciences, and new media. Between the strategic plan’s outline of the thematic areas and the review of the full proposals, coordinators of the initiative organized 10 meetings to obtain faculty input. UC-Berkeley envisioned replicating this experience ‘two or three’ times during the decade, to generate ‘perhaps five to eight new programs’ with 40 new FTE faculty.

The University of California at Davis and Duke have implemented interdisciplinary initiatives through similar approaches. Harvard University has recently identified 13 new interdisciplinary initiatives, and created a new endowment to fund
them. Much organizational effort and coordination are required in processes like these, but the commonsensical benefit is that they generate more agreement (or less disagreement) around the decisions. Elsewhere, signs of extensive consultation for crafting strategic initiatives are less apparent, and strategic plans are exhibited as the administrative agenda of the senior leadership, as in the cases of RPI and the University of California at Los Angeles. The University of Minnesota started a ‘strategic positioning’ process, under a new president, assembling task-forces to develop recommendations for eight interdisciplinary initiative areas – established in advance of the planning exercise. Minnesota’s approach resembles Penn State’s efforts during the 1990s that led to the creation of its research consortia (see Chapter 4). A stronger upper-administrative influence is apparent in the selection of priorities at these universities.

Regardless of the relative weights of bottom-up and top-down impetuses in decisions to promote interdisciplinarity, the most ambitious initiatives seem to thrive where serious faculty buy-in combines with senior administrative backing. Although somewhat platitudinous, the importance of such matching of interests is evident in major investments. This is particularly crucial when new organizational structures are created that cut across colleges and departments. Such units need dedicated financial support, since they lack the traditional revenue streams of instruction and, sometimes, overhead on research grants. At the same time they usually depend on the interest of departmental faculty to join in and carry on interdisciplinary activities. Marshalling central university resources and raising additional revenues amongst competing priorities demands administrative will and energy, and a critical mass of organized faculty support signals the worthiness of the commitment.
The evolution of the Cornell Genomics Initiative is a case in point. In the late 1990s, Cornell identified three ‘strategic enabling research areas:’ computer and information science, genomics and advanced materials science (later, nanoscience boomed and grew out of advanced materials to become a fourth area for Cornell). Initially devised to study possible strategies to react to the rise of genomics in the life sciences, the Genomics Initiative task force succeeded in making the case that Cornell should change the way it made faculty appointments in the division of biological sciences to encourage interdisciplinary collaborations. To do so, the task force proposed new cross-departmental hires that would further Cornell’s genomics expertise in five focus areas. Search committees were set up with representatives of the Genomics task force and experts of the focus areas, and they recruited 18 new faculty members with joint-appointments. The task force also recommended investments in space and infrastructure. These actions were pursued between 1998 and 2001 at a cost of $20 million. The Genomics task force became a permanent body, to which new faculty become affiliated, aimed at overseeing the development of the Genomics Initiative. In 2002, the latter became the New Life Sciences Initiative (NLSI) and raised its stakes. NLSI is scrupulously presented as ‘a comprehensive and ambitious plan to reinvent the life sciences at the university based on a fusion of the traditional biological disciplines with the physical/engineering sciences and computer/mathematical sciences.’ The expanded initiative comprises a hiring plan for 100 additional faculty, a major $140 million building, and a presidential fellowship program to attract top graduate students.

Cornell’s experience illustrates how an organized faculty thrust gained institutional backing, harnessing sizeable investments and long term commitments.
NLSI’s bottom-up trajectory and lofty aspiration to reinvent the life sciences resemble the development and aims of Stanford’s Bio-X program (see Chapter 5). These initiatives relate to the present effervescence in the life sciences, where scientists see great potential for breakthroughs through interdisciplinary interactions. One provost interviewed for this study gives a telling testimonial:

A dean in the medical school told me: you know, half the time when I get a file in my office for a hire, I don’t actually know what department is hiring him. It could be cell biology, biochemistry, genetics, genomics… that’s what’s happening in the sciences. The area where it is slowest is the social sciences… I think the social sciences are starting to pick up, but they’re still behind, I would say.

This sense of scientific dynamism, coupled to its relatively comfortable position in the research funding arena, makes the biosciences a natural candidate for being the focal point of interdisciplinary ventures.

In addition to the universities mentioned above, others to have formally chosen priority areas for new initiatives are Carnegie Mellon University, Colorado State University, Ohio State University, Rutgers University, Syracuse University, Texas A&M University, Tulane University, the University of Colorado at Boulder, the University of Connecticut, University of Florida, the University of Pennsylvania, Vanderbilt University and the Virginia Polytechnic Institute.

Creating Interdisciplinary Spaces

NLSI and Bio-X also exemplify a trend of university investments in modern, upscale interdisciplinary facilities. For the real and imaginary promises that scientific interactions across disciplines hold, many universities have built or are planning to build
innovative buildings to house scientists from multiple disciplines and departmental affiliations. Although separate research laboratories have long existed, these modern facilities differ in the aspiration to establish interdisciplinary organizational paradigms.\(^\text{34}\) They purportedly favor scientific considerations in the allocation of space and grouping of faculty laboratories over administrative norms and departmental traditions, as the California Institute for the Telecommunications and Information Technology [Cal-(IT)\(^2\)] explains:

As architects have known for a long time, the structure of a building is tied intimately to the social interactions that occur inside them. With that understanding coupled to our commitment to interdisciplinary research, Cal-(IT)\(^2\) faculty and staff have spent considerable time working with two architectural firms to design our new facilities. We’ve come to understand our various disciplines' requirements, designed specialized laboratories and studios, and considered appropriate ‘adjacencies’ within each building.\(^\text{35}\)

These interdisciplinary spaces share the contemporary fetishism for crossing boundaries of disciplines, departments, colleges and even universities in a few cases.\(^\text{36}\) Their design includes open, modular and flexible laboratory areas, so as to facilitate the work of cross-disciplinary teams of investigators, which may assemble and disassemble as needed. As they announce and describe these units, universities claim they are creating the infrastructures for the research of the future. More proximally, these facilities are reportedly powerful magnets when recruiting the faculty and students of the present.\(^\text{37}\) A few examples illustrate the magnitude of recent investments in this kind of infrastructure:

- Stanford built in 2003 the James H. Clark Center, a 245,000-square-foot facility designed to foster interdisciplinary collaborations among scientists and engineers from several schools and medical scientists. The Clark Center is home to the Bio-
X program, and has the capacity to house around 40 faculty and a total of 600 people, at a construction cost of nearly $150 million (see Chapter 5).

- The University of Michigan started its multi-pronged Life Sciences Initiative in 1999, at about the same time the state of Michigan committed tobacco settlement funding to the creation of a Life Sciences Corridor. The pinnacle of the initiative is the Life Sciences Institute (LSI), a 230,000 square feet facility completed in 2003 at a cost of $100 million. LSI was designed with open laboratory spaces and core infrastructure to foster research collaborations. Faculty have dual-appointments at the institute and at numerous departments. At full operation, this building will house between 25-30 scientists and a total of 350 people. The institute already hosts 17 faculty members, 6 of whom newly recruited at junior and senior ranks.³⁸

- Of similar scope is the Center for Biotechnology and Interdisciplinary Studies at RPI. Announced as a central priority in the 1999 strategic plan, the center came to fruition in 2004. Its size, capacity and cost are roughly comparable to Michigan’s LSI (218,000-square-foot, 400 people and $80 million). Like LSI, it will house departmental faculty and provide core facilities for scientists throughout the institute.³⁹

- UC-San Diego and UC-Irvine are each opening in early 2005 a branch of Cal-(IT)², funded through $150 million of leveraged state support. The 215,000 and 120,000 square feet buildings will provide core facilities, such as clean rooms, several types of labs, and spaces for clusters of faculty. Other UC campuses are also building interdisciplinary facilities for the other state-supported California
Institutes for Science and Innovation, such as the California NanoSystems Institute building at UCLA.\(^{40}\)

- The University of Chicago should open in summer 2005 the Interdivisional Research Building, a massive 400,000 square feet edifice designed to bridge the biological and physical sciences at the university. The building’s cost may reach $200 million. Several existing research institutes and departments will relocate to the IRB, which will house about 100 faculty.\(^{41}\)

- Duke plans to inaugurate in 2006 the $115 million French Sciences Center, a 285,000 square feet science facility announced as a space to breed interdisciplinary collaborations among life and physical scientists. Part of the investment comes from a donation from Duke Trustee Melinda French Gates.\(^{42}\)

- Cornell has followed suit, breaking ground for the Life Sciences Technology Building this year, which is schedule to become the hub for the NLSI by 2007. Its cost is estimated at $140 million. Like Stanford’s Clark Center, it is announced as the most ambitious building project ever undertaken at Cornell.\(^{43}\)

- So too has the UW-Madison, which counts on gubernatorial support in its bid to erect the Wisconsin Institute for Discoveries over the decade, whose cost is projected at a hefty $375 million. The institute is part of a series of state investments in biomedical science.

The ‘returns on investment’ of these large interdisciplinary facilities are hard to evaluate. One eminent scientist who has directed a large research center cautions that universities ‘need better business plans’ when undertaking such commitments, because of the long-term financial burdens accruing from expenses in facilities, equipment, and
professional staff. Another distinguished scientist, also experienced in directing an ORU, expressed some skepticism over the long term viability of these large interdisciplinary buildings. Her concern is whether they can sustain momentum, after initial enthusiasm wanes, to justify their costs in terms of scientific outputs. An alternative viewpoint is offered by two institute directors, who support recently opened buildings on their campuses and plans for additional ones with the need to catch up with the leaders in the field. Indeed, competitive considerations and the pursuit of prestige seem to influence the decisions to make these investments to a great extent. At a minimum, faculty gain new research space and shared equipment, and campuses display upscale constructions that denote scientific prowess.44

Fighting hard battles for state appropriations lately, public universities like UW-Madison have found receptivity for new investments in states’ eagerness to nurture knowledge-based industries. The current zeitgeist encourages states to sponsor knowledge creation, which has translated into support for professorships, research ‘centers of excellence,’ and funds for R&D, in addition to new scientific facilities.45 Universities, in turn, have justified large-scale interdisciplinary programs in economic development terms.46 Private universities, besides cultivating philanthropy, have also benefited from such state programs (RPI and Cornell received funding from New York state for their facilities). While there are concerns that state commitments may not be sustainable in the long run, the current climate seems highly receptive for proposals that tie cutting-edge science to the promise of technology-based economic growth.47 Arizona State University is one example of a second-tier public institution aptly exploiting this
Coordinating Interdisciplinary Research

Nearly a third of the strategic plans examined describe existing or developing interdisciplinary centers or institutes. Some are embedded in larger initiatives, while others stand alone. Research centers and institutes are hard to typify, given the huge diversity in goals, characteristics and structures. Presently, there is a tendency for universities to establish interdisciplinary ORUs that share central features, and this section synthesizes the models being adopted.

The Interdisciplinary Institute. These units are created to serve as umbrella organizations in a particular interdisciplinary area and steer its development. Typically bearing a lean administrative structure, such institutes fulfill coordinating and catalyst roles. The coordinating role is administrative; they are structurally positioned in relation to a number of research centers and programs in a roughly correlate position of colleges in relation to departments. In addition, institute directors may coordinate resources such as research facilities and instrumentation. The catalyst role is their actual mission. As they will typically not have an exclusive faculty nor grant degrees, institutes provide inducements for department-based faculty to do interdisciplinary work.

Institute directors, normally senior professors recognized in the field, report to the vice president for research or provost. Their role is to champion their interdisciplinary area within and outside the university. Internally, they allocate resources to seed
collaborative projects, help departments hire faculty, develop programs for faculty to cross college and departmental boundaries, and disseminate information on external funding opportunities. They may in some cases have a role in establishing interdisciplinary educational programs. Externally, they are ambassadors of the university’s portfolio in the interdisciplinary area. The institutes are often established to provide a single and visible face for broadly-based, decentralized scientific expertise.

Institutes may have their own facilities, which gives their directors an important and scarce resource to attract faculty. But they may also be virtual units, co-habiting research laboratories or other facilities over which they only have partial control. Institutes may also have a core group of faculty housed within their premises. Nevertheless, these units are intended to have porous boundaries; affiliation for a large number of faculty is either automatic or obtained easily if faculty are interested.

An example is Northwestern University’s recently created Institute for Nanotechnology.\(^{50}\) The Institute’s role is to ‘support meaningful efforts in nanotechnology, house state-of-the-art nanomaterials characterization facilities, and nucleate individual and group efforts aimed at addressing and solving key problems in nanotechnology.’\(^{51}\) The Institute coordinates four research centers, seven research facilities, and operates an industrial affiliates program. Its physical home is the Center for Nanofabrication and Molecular Self-Assembly, a laboratory opened in 2002. Other good examples of interdisciplinary institutes are discussed in the institutional case studies: the Stanford Institute for the Environment, the Duke Institute for Genome Sciences and Policy, and the Penn State’s institutes in materials research, environment, social sciences and life sciences.
Institutes may be established to mold the development of a new scientific field on campus. The comment of one senior administrator is illustrative:

I find the word interdisciplinary very interesting… in the sense that some of it I think is legit… some of it, it is the vehicle by which we create units that represent modern fields and scholarship when we don’t know structurally how to do it because we don’t know how to sunset a department.

The California Institute of Technology and Cornell provide interesting examples in the same evolving field; both have started campus-wide initiatives in information science. When Information Science and Technology (IST) was launched in 2004, Caltech president David Baltimore was quoted as stating that information science will be the unifying discipline of the century, hence the ambition to make this initiative span the boundaries of the six Caltech divisions. IST serves as an umbrella organization for six research centers, four of which newly created, and draws faculty from several departments. It hires faculty in association with other divisions, and already employs 22 post-doctoral fellows. A fundraising campaign is in place to secure $100 million until 2007, which will support the construction of a new building and the establishment of an endowment for professorships, fellowships and research funds. Reports suggest that there is a proposal for IST to become another Caltech division.

Cornell’s Faculty of Computer and Information Science (CIS) was created to become a focal point for scholarship in the field (another ‘strategic enabling research area’), spanning existing colleges, research centers and institutes. The original idea for CIS was of a flexible organizational structure that would breed research and academic programs across departments. Curiously, the intended flexibility of Cornell’s CIS seemed contingent to the direction of the field and the strategies of peer institutions:
If necessary, the unit could be given degree granting authority to move it closer to a college structure in the event that many other universities adopt the college model for computing and information. That is the model adopted by CMU, Georgia Tech, and Penn State. In the unlikely event that student interest wanes and research funds become scarce, new departments would not form and exploratory programs would disappear.\textsuperscript{56}

As anticipated, Cornell has implemented a new Ph.D. program in Information Science, starting in 2005/2006.\textsuperscript{57} CIS has moved closer to a traditional academic structure by having a dean and offering undergraduate and graduate programs. However, it shares with IST a vision of information science as a field that should interact with several disciplines, hence their campus-wide programmatic orientation. Both recruit faculty for joint-appointments with other departments, and serve as a hub for research centers and programs.

Finding the right fit for CIS within Cornell was not automatic. At its creation, it was recommended that CIS incorporated the existing Computer Science department of the College of Engineering.\textsuperscript{58} This advice caused discussion on campus, and the ultimate decision was to accommodate CIS under the administrative home of the College of Engineering. Computer science faculty have joint-appointments at CIS, but promotion and tenure decisions fall under the auspices of the college.\textsuperscript{59}

These examples demonstrate how institutes may be used as transitional structures for fields whose future seems uncertain. At early stages in the institutionalization of academic fields and in moments of disciplinary reconfigurations, it is hard to predict which specific branches and disciplinary blends will become the mainstream.\textsuperscript{60} Universities take cues from the research and education markets and the moves of peer institutions, as evidenced in Cornell’s case, and adopt malleable organizations. These have the advantage of serving as test beds, avoiding a premature commitment to a
potentially irrelevant configuration. New colleges, schools or departments require tenure-lines and degree programs, while institutes may deploy those resources without committing to them permanently. Hence, interdisciplinary institutes have the advantages of (1) being easier to create than academic units, since they have lower resource requirements and entail less permanent commitments; (2) giving internal and external visibility to the institution’s research in an area, which would otherwise lack a unified outpost; (3) endorsing ‘champions’ for the interdisciplinary area, who spur the creation of new research and education programs (the catalyst role); (4) providing a framework for the coordination of related units, programs and networks. On the other hand, they lack the power to make tenure-line appointments, and their ability to perpetrate change are related to the use of resources as incentives.

**The Interdisciplinary Center.** A fine line separates the institute from the interdisciplinary center. The center fulfills primarily research roles, as opposed to those of coordinating and catalyzing research across a gamut of units. Even when institutes develop a core faculty, housed in a laboratory, their primary mission is to spur collaborations beyond core participants. Centers, on the other hand, are first and foremost research units bearing first-hand responsibility for a more circumscribed research area. Their interdisciplinary missions attracts faculty from multiple departments because of the scientific requirements on one hand, and faculty interest and resource needs on the other. Centers may be also depicted at a ‘lower’ positional level in the university organization as compared to institutes. As indicated above, a number of centers may co-exist within an institute, but they may also be stand-alone units reporting to the central administration or
to an academic unit. Centers may take diverse forms, the most common of which are characterized below.

1. *The Interdisciplinary Network*. These centers have a research mission of interest to a number of faculty from different departments/colleges, who interact to perform research, or attend formal and informal meetings. With minimal infrastructure, these are usually ‘virtual’ units, boosted with some discretionary funds for a part-time director to buy-out faculty teaching time, award small planning grants and promote interdisciplinary seminars and workshops. By and large, faculty bring their own research agenda to these centers. The Fitzpatrick Photonics Center at Duke is one example – it was among the ‘new initiatives’ created in the last planning effort. Media-X, at Stanford University, is a case of a network that emerged from the bottom-up and gained institutional recognition.61

2. *The Interdisciplinary Laboratory*. More systematically organized, the interdisciplinary lab offers a physical structure under which to cluster faculty from across the university. Particularly important in the laboratory sciences, these centers offer space for faculty to conduct interdisciplinary research and access to instrumentation, along with the professional staff to operate it. Such units are often described as a way to rationalize the use of scarce university resources. That is seen in the widespread adoption of such organizational forms, which have been dubbed ‘multidisciplinary facilities.’62 Interdisciplinary labs will typically have a director and a management staff to run the operations. Harvard University’s Bauer Center for Genomics Research is one example. It was built in 2002 as one of a series of investments announced in the late 1990s to address Harvard’s lack of
competitiveness in important scientific fields. Others addressed in the following chapters are the BioDesign Institute at Arizona State University and the Geballe Materials Laboratory at Stanford.

3. The Interdisciplinary Center Grant. Established when federal research grants require a center organization. This model has become more popular since the mid-1980s with the NSF Engineering Research Centers, although similar contracts with federal agencies for extra-departmental research have existed for much longer. The federal agency typically outlines desired characteristics for the constitution, organization and administration of these research centers in the requests for proposals. Center grants sometimes strengthen an on-going university research center or institute. A recent example is the NIH-funded Center for Quantitative Biology established in 2004 at Rice University, which is hosted within the Lewis-Sigler Institute for Integrative Genomics. Others start from the ground-up, particularly in pioneering fields. Such is the case of the first NSF-funded Mathematical Biosciences Institute, in 2002, at Ohio State University.

4. Large-scale Research Infrastructure. Complex and sophisticated instrumentation has historically been housed in separate units on campuses. Synchrotron laboratories and particle accelerators are earlier examples, and nanofabrication facilities a more recent one. They are ‘interdisciplinary facilities’ to the extent that a range of scientists from different fields may utilize them, sometimes in multidisciplinary teams. These are service units with a specialized full-time staff. These types of units are acknowledged vaguely in the specialized literature on ORUs, but not systematically differentiated. Previous descriptions of individual research
centers often fail to identify broader patterns across universities, while attempts to categorize organizational frameworks for interdisciplinary work have lacked specificity in identifying and describing the structures for organized research. Some have used size or stability as key variables to categorize ORUs, while others have proposed broad classifications relating to their missions. None of these prior formulations captures the distinctions above. The table below summarizes key features for each type, including the primary roles of the unit and participant faculty, organizational form and scope, composition of staff and likely longevity.

Table 3. Types of Interdisciplinary Organized Research Units.

<table>
<thead>
<tr>
<th>Type</th>
<th>Role</th>
<th>Faculty Roles</th>
<th>Form and Scope</th>
<th>Staff</th>
<th>Longevity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institute</td>
<td>Catalyze research</td>
<td>A ‘core’ full-time faculty may develop, others are clients of services and programs</td>
<td>Virtual, university-wide, sometimes with a dedicated facility as a hub</td>
<td>Minimal full-time at core, professional staff in sub-units</td>
<td>Long-term, adaptive due to the broad scope and mission</td>
</tr>
<tr>
<td>Center-Network</td>
<td>Research</td>
<td>Members of a network</td>
<td>Virtual, cross-departmental, bounded by a specialized problem set.</td>
<td>Minimal, part-time</td>
<td>Medium-term, easily adaptive but not resilient to loss of key faculty or funding</td>
</tr>
<tr>
<td>Center-Grant</td>
<td>Research</td>
<td>Participants in a grant project</td>
<td>Virtual, cross-departmental, multi-institutional,</td>
<td>Minimal, full-time at core</td>
<td>Medium- to long-term, may or may not reach self-sustainability</td>
</tr>
<tr>
<td>Center-Lab</td>
<td>Research</td>
<td>Tenants of facilities, clients of research services</td>
<td>Centered at a facility, bounded by a specialized problem set.</td>
<td>Full-time core and professional staff</td>
<td>Long term, stable units</td>
</tr>
<tr>
<td>Center-Infrastructure</td>
<td>Research</td>
<td>Clients of research services</td>
<td>Centered at a facility that attracts specialized users</td>
<td>Full-time core and professional staff</td>
<td>Permanent, stable units</td>
</tr>
</tbody>
</table>

Increasing the number of interdisciplinary centers to boost external research funding is a formal goal for some institutions, like Purdue University. Brown University
has started a number of centers since 2002 through its Academic Enrichment Initiative, and continues planning for more.\textsuperscript{70} The University of Cincinnati recently proclaimed its ambition to create ‘high profile’ interdisciplinary ORUs, to help raise its stature.\textsuperscript{71}

Following the preferences of federal agencies, the University of Iowa plans to track progress in obtaining interdisciplinary center grants, and the University of Kentucky aims at stimulating interdisciplinary multi-investigator research teams.\textsuperscript{72} At a more specific level, documents from North Carolina State, Penn State, and the Virginia Tech name particular interdisciplinary ‘center grants’ the university should compete for.\textsuperscript{73} The quest for such federal funding is the cause of yet another trend among research-intensive universities, that of making special provisions to enable faculty to compete successfully for center or large, multi-investigator grants.

Seeding Interdisciplinary Research

The plans of seventeen institutions evidence a pattern of centralized seeding of interdisciplinary projects. These universities have announced and/or implemented formalized programs at the central administration to competitively fund interdisciplinary teams to perform collaborative research.\textsuperscript{74} These programs have been called Academic Excellence Fund, Academic Venture Fund, Centers of Excellence Program, Commitment to Excellence Fund, Fund for Excellence in Science and Engineering, Peaks of Excellence Program and Targeted Excellence Program, among others. As the labels denote, these funding schemes aim at identifying and nurturing high quality research groups. While some of these programs may fund disciplinary projects as well, it is
curious to notice a convergence across universities in the value attributed to collaborative research and boundary crossing to achieve ‘excellence.’ Obtaining major external grants and achieving self-sustainability is usually an expected outcome of these projects. Once they succeed, they may evolve into more permanent structures.

Seed funding is a longstanding feature of the research university. Nevertheless, their justification and purported aims are curiously intertwined with the calls for interdisciplinarity. The University of Nebraska’s ‘Programs of Excellence’ exemplifies the typical level of funding in these programs. The university has seeded 20 projects since academic year 2002/2003, with investments ranging from $25,000 planning grants to awards of $100,000 and beyond. 75 Ohio State University has the straightforwardly labeled Large Interdisciplinary Grants Development Program. The office of research competitively awards up to $250,000 for research groups to prepare a proposal for NSF and NIH grants that fulfill the program’s requirements. Interdisciplinary teams must submit a proposal within 2 years or return the money; successful proposals also pay back the initial investment through indirect cost recoveries. 76 Smaller programs suggest more proximate goals. Washington State University’s Office of Research has a program named Initiation of Collaboration. It disburses small sums (up to $5,000, which colleges and departments should match) to support meetings or retreats for faculty to interact and develop ideas for interdisciplinary projects. 77 This is similar in scope to the Provost’s Fund for Interfaculty Collaborations at Harvard. 78 The University of Michigan’s Rackham Graduate School has also run a variety of grant competitions across the range of investments described above. 79
The University of Southern California’s Center for Interdisciplinary Research represents a different model. Operating under the Vice Provost for Research, the center has competitively awarded annual fellowships to 6-7 faculty members per academic year since 2002. Up to $50,000 may be requested for research expenditures, and the appointment frees faculty from teaching and service duties to concentrate on the proposed interdisciplinary project. Fellows meet biweekly to discuss their research and also general issues concerning interdisciplinarity. The expected end result of the appointment is a proposal for a large grant or a book.$^{80}$

In such initiatives, modest investments are sometimes expected to result in large grants. Tracking the exact returns on these investments can be an elusive task though. While this can be made by following immediate success in securing external funding, the question remains of whether similar grants could be obtained at a lower cost or through other means. An alternative argument is equally reasonable – that support for groups who fail to get funded cannot simply be dismissed as a loss, since the work initiated may mature and result in later rewards. There are also potential externalities involved, since reasons for proposal rejection may not relate to scientific merit of the funded work (e.g. agency budget cuts, failure to address non-scientific requirements of proposals).

Administrators interviewed for this study often justify these investments with anecdotes of a recent success in obtaining a major federal grant, whose value far outweighs the annual costs of the seed funding program.

Some institutions have recognized the need to improve their administrative support to faculty in the quest for interdisciplinary grants. As multi-investigator, cross-college and inter-institutional research grants become popular, universities start to
employ specialists to successfully compete for and manage them. At North Carolina State University, an Office of Publications and Proposal Development was created to improve the quality and quantity of interdisciplinary work.\textsuperscript{81} NC State follows Virginia Tech, which established the Office of Interdisciplinary Programs in 1995 with a similar mandate.\textsuperscript{82} Duke, Penn State, UC-Davis and SUNY Stony Brook also have similar units, which fall under the offices of the provost or the vice president of research.

Other institutions recognize these trends in their planning exercises. The University of Cincinnati established a task-force to examine the need to follow suit and create a central fund to nurture IDR.\textsuperscript{83} At Washington State, a working group (interestingly formed by department heads) proposed the establishment of an office to coordinate interdisciplinary activities, in response to a charge from the strategic plan.\textsuperscript{84} Case Western University recently raised many of the same questions. A recent report of a commission on research and graduate education attempts to determine Case Western’s preparedness for the current research funding environment. The report suggests the hiring of proposal development staff to help faculty with interdisciplinary grant-writing, and the development of interdisciplinary core facilities. It also recommends the establishment of a $150 million fund to, among other things, stimulate interdisciplinary research and nurture centers.\textsuperscript{85}

**Interdisciplinary Grants**

The widespread interest in obtaining major federal awards that involve interdisciplinary collaborations suggests the saliency of this type of research grant in
shaping university structures. Despite growing interest among universities, as depicted above, and the substantial investments of funding agencies, we currently lack an appreciation of universities’ relative performance in obtaining such grants. While this section cannot fully address this problem, it allows for a glimpse of their success in obtaining a cross-section of NSF grants identified as ‘crosscutting-interdisciplinary’ (hereafter called NSF-IDR grants).

Although the NSF does not use a consistent and uniform definition for interdisciplinarity, the program solicitations of NSF-IDR grants provide relevant cues on what they seek to promote. These program solicitations typically exhort scientists to forge new interdisciplinary research collaborations, developing projects that span disciplinary and organizational boundaries. Such exhortations appear in the sections describing the program and its goals, stating guidelines for proposal preparation, and providing criteria for evaluation. In many cases, solicitations explicitly encourage or require the formation of interdisciplinary teams and include additional review criteria (see Table 4). Sometimes they indicate the expected profile of research teams, or specify desired organizational arrangements for the project, as in the following examples:

Such interdisciplinary collaborations are a requirement for this program and must be demonstrated in the proposal; for example, by naming a co-principal investigator with academic credentials and appointment in an area different from that of the principal investigator, or by other means. A typical research collaboration might include a computer scientist and a neurobiologist. Proposals should describe interdisciplinary work to be done.

A MRSEC may encompass one or more interdisciplinary research groups (IRGs). Each IRG involves several faculty members and associated researchers, addressing a major topic or area, which may range from fundamental to applied research, in which sustained support for interactive effort by several participants with complementary backgrounds, skills, and knowledge is critical to progress.
Taken together, this collection of grant programs covers a range of research areas, provides different levels of funding, and represents several NSF directorates. A few of these are ‘center grants,’ which have been also labeled ‘multipurpose, multidiscipline university research center.’ These are usually expected to achieve self-sufficiency and outlive NSF sponsorship. Other programs entail setting up large research groups but not necessarily the long-term commitments of a center. IGERT is somewhat unique in this selection, since its overarching aim is to create new models of interdisciplinary graduate education allied to research; the other programs emphasize research and influence graduate education indirectly. All active grants in the programs listed above were included, except in the case of the ITR program.

Table 4. Analysis of Program Solicitations of NSF-IDR grants.

<table>
<thead>
<tr>
<th>Program</th>
<th>ID Goals</th>
<th>Encourages ID teams</th>
<th>ID Review Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biocomplexity in the Environment</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Collaborative Research in Computational Neurosciences</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Engineering Research Centers</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Human and Social Dynamics</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Information Technology Research</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integrative Graduate Education and Research Traineeship</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Materials Research Science and Engineering Centers</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Mathematical Sciences: Innovations at the Interface</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nanoscale Interdisciplinary Research Teams</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Nanoscale Science and Engineering Centers</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Science and Technology Centers</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science of Learning Centers</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Collectively, all programs had 888 active grants at the time of data gathering. Some programs award grants to multiple institutions. In such cases, a choice had to be made between capturing overall university involvement with NSF-IDR grants or their...
‘leadership’ in obtaining such grants (hosting the principal investigator). The latter alternative was chosen, as the data available from the NSF abstract database does not allow for reasonably estimating each institution’s relative participation in multi-university grants without incurring major assumptions.

**Distribution and Overall Patterns.** Not surprisingly, leadership in NSF-IDR grants is heavily concentrated among those universities that are heavy performers of research. Using the 2000 Carnegie Classification, doctoral-research extensive universities dominate, with over 90 percent of all grants; doctoral-research intensive universities have a modest participation, and that of master’s colleges and universities and liberal arts colleges is negligible (see Table 5).^{92}

<table>
<thead>
<tr>
<th>Carnegie Classification</th>
<th>N</th>
<th>Percent</th>
<th>Grants</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research-extensive</td>
<td>120</td>
<td>80.0%</td>
<td>826</td>
<td>93.0%</td>
</tr>
<tr>
<td>Research-intensive</td>
<td>22</td>
<td>14.7%</td>
<td>52</td>
<td>5.9%</td>
</tr>
<tr>
<td>Master’s Institution</td>
<td>6</td>
<td>4.0%</td>
<td>8</td>
<td>0.9%</td>
</tr>
<tr>
<td>Liberal Arts College</td>
<td>2</td>
<td>1.3%</td>
<td>2</td>
<td>0.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>150</td>
<td>100%</td>
<td>888</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 5. NSF-IDR grants awarded, by Carnegie Classification.

The distribution of grants among institutions is also highly skewed. Overall, 150 higher education institutions were awarded NSF-IDR grants (see Appendix B), but more than a third of those received up to 2 grants only, and roughly two thirds received less than 6 grants, as shown in the figure below. The remaining third that concentrates most of the grants are listed in Table 6. This group is composed almost exclusively of research-extensive institutions; among the 52 universities listed, only 2 conduct less than $100 million in R&D: RPI and Drexel University. Within this group, the representation of the
private and public sectors is about the same as in the 99 research universities whose strategic plans were examined for this study (1/3 private).\textsuperscript{93}

Figure 2. Distribution of NSF-IDR Grants Among 150 Higher Education Institutions.


<table>
<thead>
<tr>
<th>Rank</th>
<th>Institution (Bold= public)</th>
<th># Grants</th>
<th>Total R&amp;D</th>
<th>Total NSF R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Carnegie Mellon University</td>
<td>27</td>
<td>$188,191</td>
<td>$38,511</td>
</tr>
<tr>
<td>2</td>
<td>University of California-San Diego</td>
<td>23</td>
<td>$585,008</td>
<td>$88,532</td>
</tr>
<tr>
<td>2</td>
<td>Cornell University</td>
<td>23</td>
<td>$496,123</td>
<td>$79,910</td>
</tr>
<tr>
<td>2</td>
<td>Massachusetts Institute of Technology</td>
<td>23</td>
<td>$455,491</td>
<td>$55,215</td>
</tr>
<tr>
<td>3</td>
<td>University of California-Berkeley</td>
<td>21</td>
<td>$474,746</td>
<td>$58,174</td>
</tr>
<tr>
<td>4</td>
<td>Georgia Institute of Technology</td>
<td>19</td>
<td>$340,347</td>
<td>$38,821</td>
</tr>
<tr>
<td>5</td>
<td>University of Washington - Seattle</td>
<td>18</td>
<td>$627,273</td>
<td>$60,919</td>
</tr>
<tr>
<td>5</td>
<td>Northwestern University</td>
<td>18</td>
<td>$282,154</td>
<td>$25,956</td>
</tr>
<tr>
<td>6</td>
<td>University of California-Los Angeles</td>
<td>16</td>
<td>$787,598</td>
<td>$36,415</td>
</tr>
<tr>
<td>6</td>
<td>University of Minnesota</td>
<td>16</td>
<td>$494,265</td>
<td>$37,348</td>
</tr>
<tr>
<td>7</td>
<td>University of Michigan</td>
<td>15</td>
<td>$673,724</td>
<td>$51,794</td>
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<td>Stanford University</td>
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<td>$42,128</td>
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<td>7</td>
<td>University of Colorado</td>
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<td>University of Illinois at Urbana-Champaign</td>
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<td>$97,995</td>
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<td>Harvard University</td>
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<tr>
<td>9</td>
<td>Pennsylvania State University</td>
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<td>$41,955</td>
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<td>University of California-Santa Barbara</td>
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<tr>
<td>10</td>
<td>Johns Hopkins University</td>
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<td>$580,235</td>
<td>$28,760</td>
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</tbody>
</table>
Interestingly, Carnegie Mellon is a conspicuous leader with over 3 percent share of the distribution, exceeding universities whose overall excellence makes them strong candidates for topping the charts in most research-related measures. Leadership in this metric corroborates recent prognostications of the university’s successful record in securing major interdisciplinary awards. Carnegie Mellon views interdisciplinarity as core competitive advantage, as its latest strategic plan makes explicit.
faculty of about 500, the university is also physically compact. Many like institutions believe that such features create an intimate environment that facilitates interactions across colleges. Indeed, other small universities appear in the table above, such as Caltech and Brown. Naturally, scale is important for universities to make an impact in certain areas, and an alternative hypothesis also has its proponents, who believe that large institutions can amass faculty from various fields and sub-fields more easily. Carnegie Mellon, despite having achieved a respectable position among research universities, acknowledges the tradeoffs between its size and recognition in disciplinary venues. Nevertheless, the university seems imbued with an interdisciplinary vision and strategy:

   Carnegie Mellon has compensated for the limitations of its size through strategic positioning and leveraging its limited resource base through interdisciplinary collaboration in both research and educational initiatives. Every department in the university nurtures and engages in collaborations that cross traditional disciplinary boundaries, both to address issues of size and more effectively to pursue important research problems.

   Caltech is another exceptional institution. A small campus with a faculty of less than 300, it has more graduate students than undergraduates. Like Rockefeller University, its scientific distinction is credited to a collegial and interdisciplinary culture and high degrees of internal integration. Caltech deviates from the departmental model of comprehensive universities and is organized into 6 divisions. It is also home to one of the Beckman Institutes, whose mission to bridge the fields of chemistry and biology seems to find much support among the Caltech divisions. Given its history and organization, Caltech is closer to Rockefeller and Carnegie-Mellon than to the traditional comprehensive university.

   Whether or not size is a meaningful variable in explaining universities’ advantage in the interdisciplinary research market is a question open to empirical investigation.
Starting to delve into this uncharted terrain, this study conducted exploratory statistical analyses within the sample of 150 universities to lead NSF-IDR grants, which yields suggestive results. As expected, total R&D expenditures are a good predictor of interdisciplinary grants universities obtained, reflecting the distribution patterns described above that favor research-extensive institutions. The association among NSF total R&D funding and the number of NSF-IDR grants a university receives is even stronger, and the figure below portrays the relationship between these variables. The general patterns of this association remain when Carnegie Mellon, a salient outlier, is excluded from the analysis.

Figure 3. NSF-IDR Grants and Total NSF R&D Funding.
In the figure above, lines demarcate one and two standard deviations from the mean. We see most universities falling within the one standard deviation range, and a few ‘overachievers’ and ‘underachievers.’ Among the overachievers, one sees a mix of usual suspects and less obvious ones. The MIT, Georgia Tech, the University of Texas-Austin, and Harvard are within the two standard deviations range, and Northwestern follows Carnegie-Mellon in the three standard deviation range. Caltech and the University of Illinois at Urbana fall below the mean due to their relatively large NSF total funding. Others highlighted are the universities analyzed in the case studies.

The MIT has historically succeeded in boosting its research enterprise via multidisciplinary research laboratories, as it reached out to industrial and military research funding. More recently, the institute has established crosscutting units like the Engineering Systems Division (1998) and the Computational and Systems Biology Initiative (2003) to advance institute-wide interdisciplinary agendas. Both are bold enterprises seeking to define new knowledge domains through research and graduate education, also pursuing the external collaborations that are a trademark of the MIT. Another technological university, Georgia Tech has also long employed interdisciplinary approaches in its ascendancy as a research institution. It pioneered developments discussed above by establishing an Office of Interdisciplinary programs in 1973 to encourage and coordinate interdisciplinary ORUs; by the mid-1980s it had over twenty such units. Historically, Georgia Tech’s emphases on engineering, applied work, and economic development have apparently been conducive to entrepreneurial and collaborative approaches. Today, the institute professes a deliberate interdisciplinary orientation and indicates that as a cause for its growth in the areas of biotechnology,
entrepreneurship, microelectronics, nanotechnology and telecommunications. It backs those claims with investments in new centers and multidisciplinary facilities.  

Northwestern not only has recently examined its ability to support interdisciplinarity (p. 3), but has also placed interdisciplinary research at center stage in its present strategic plan. This is indeed an interesting example of the current mood among universities. Northwestern’s previous strategic plan (1997) relied heavily on disciplinary metrics of success and progress in those was the overarching goal, although some ideas to support interdisciplinarity appeared at the margins. The 2004 document, in contrast, makes interdisciplinarity its central feature and a potential point of distinction for the university. It states at the outset:

Described in the pages that follow are broad, flexible ideas aimed at moving the University toward an overarching interdisciplinary vision. We value a continuing spirit of collaborative, pioneering creative work and learning at the overlapping edges of academic disciplines. We appreciate the creative tension between strong disciplinary and interdisciplinary pursuits; and we intend to maintain a sound balance between interdisciplinary programs and seasoned disciplinary ones. At the same time, we expect the boundaries of academic disciplines to change over time as they are influenced by what was once interdisciplinary. We aspire that Northwestern will be the university of choice for the most talented faculty and students sharing this vision.

Competitive seed funds to launch new initiatives, recently created and proposals for ORUs (along with new mechanisms to review them), and plans for hiring interdisciplinary clusters of faculty and increasing administrative support for collaborative research have all been announced.

Harvard recently disclosed an ambitious plan to bolster science and technology in the Allston campus through 13 new ‘multidisciplinary initiatives.’ The guiding principles of this effort include ‘flexibility’ to deal with ‘advances in technology,
changing disciplinary boundaries, and emerging fields;’ and ‘multidisciplinarity and collaboration,’ informing the organization of the Allston campus and the design of its buildings, because ‘some of the most exciting areas of inquiry in the sciences require multidisciplinary and collaborative approaches.’ \textsuperscript{112} Twelve of the initiatives are in popular fields such as Biomedical Sciences, Computing, Engineering, Environment and Stem Cells. The other initiative entails the construction of a center for collaborative science, which would be a ‘resource dedicated to interactive and collaborative scientific research that can be shared across the sciences.’ \textsuperscript{113} The premise is that research is being increasingly conducted by geographically dispersed teams who lack facilities for periodic face-to-face interactions and work meetings. To address the demand generated by this trend, Harvard plans to build the center with workspaces for temporary usage, equipped with computing resources and data analysis instrumentation. In addition, gathering spaces would allow for more informal interactions. In the process of devising this plan, the task force on science and technology did external benchmarking of several new research institutes and facilities, including the Cornell New Life Sciences Initiative, some of the new multi-campus science and innovation institutes in California (discussed above), Stanford’s Bio-X program, and the Duke Institute for Genomic Sciences and Policy (discussed in Chapter 5). \textsuperscript{114}

For all the limitations embedded in attempts to measure poorly-defined concept as interdisciplinary research, the NSF-IDR grants seem to provide a reasonable first step. The appearance of some ‘usual suspects’ at the top can be viewed optimistically. Naturally, the preponderance of certain knowledge domains in this dataset favors those
institutions whose strengths lie on those areas. This situation, however, mirrors the prevalence of research programs recognized as interdisciplinary in certain science and technology areas instead of others. In the absence of rigorous, large-scale evaluations of the nature of collaborations in such research projects, identifying programs that grantors and grantees define as such remains the best possible alternative.

Healthy skepticism regarding this social construction of interdisciplinary programs should be kept. Political and policy considerations influence the adoption of interdisciplinary initiatives at the NSF. Externally, these initiatives resonate with federal mandates for accountability, since they ‘show that the agency’s research effort is focused on achieving identifiable ends and that those ends are congruent with larger themes established by the administration.’ Internally, they allow for inconspicuous reallocations of resources among scientific fields, without upsetting specific communities. Still, policy and political motivations do not necessarily preclude effective implementation. The process leading to the elaboration of a program announcement for these initiatives is long and involves multiple stakeholders. Since the success of a program relates to the interest of the scientific community, their input and feedback is gathered through workshops and consultations.

The notion that the federal agencies are influential drivers, particularly if stated under the assumption that they equate with ‘the environment’ – external to academe – tells only part of the story. The design of interdisciplinary program announcements is better understood as resulting from information flows within networks of actors. Recognized scientists play a key role in these networks, and their preferences help shape these programs.
Similar logic applies to interdisciplinary initiatives within university planning efforts. On one hand, ‘interdisciplinarity has become the darling of the research community, synonymous with all things modern and creative and progressive about science.’ Universities espouse it as they have done with diversity, internationalism, and economic development. On the other, interdisciplinary initiatives are a more palatable reason for internal resource reallocations than transfers among traditional units. Careful wording may include most fields of knowledge as possibly connected to elected interdisciplinary thrusts. Initiatives funded competitively carry the intrinsic legitimacy of peer-review. Few (if any) institutions would explain as bluntly as Cornell the positive and negative consequences of electing priority areas for investments:

In return for this targeted support, we anticipate being able to make major advances in those areas, thereby increasing the general state of knowledge, as well as public recognition of Cornell’s considerable strengths. In the short term, at least, this strategy means that there will be relative winners and losers among the disciplines at Cornell.

The organizational approaches discussed above suggest that most universities target the facilitation of interdisciplinary research, while a dedicated few engage in substantive academic reform. While some suggest that lower-ranked institutions have the most incentive to adopt interdisciplinarity in order to sidestep the disciplinary hierarchy, they are likely to face some ceilings. Attracting academic talent and capturing the attention of donors and sponsors are crucial in the boldest interdisciplinary ventures. The wealth and social capital of elite universities gives them an insurmountable advantage, but institutional cultures and leadership priorities seem decisive in the establishment of new organizational strategies. In the case studies that follow, such institutional contexts are investigated more closely, rendering a detailed portray of selected interdisciplinary
strategies. The five cases depict what lies beneath the glossy rhetoric of institutional plans, and how interdisciplinarity has been used to fulfill a diversity of purposes.

The Penn State case study reports on how the university uses four interdisciplinary institutes to spur collaborations across colleges and departments. UW-Madison’s case discusses the Cluster Hiring Initiative (CHI), which was implemented to recruit faculty into interdisciplinary clusters rather than traditional departmental lines. The case of Arizona State analyzes the administrative effort to reengineer the university under interdisciplinary directives, in order to redress weaknesses and exploit niches in the pursuit of national recognition. Stanford’s case reports on rising inter-school initiatives, most prominently on the Bio-X program and the Clark Center, one of the emerging spaces for interdisciplinary science. Finally, the Duke case analyzes multiple strategic efforts to make interdisciplinarity a true comparative advantage for one of the distinguished private universities in the country.
ENDNOTES

1 See Irwin Feller, *Whither Interdisciplinarity (In an Era of Strategic Planning)*? Presented at the Annual Meeting of the American Association for the Advancement of Science, (February 12-16, 2004), Seattle, WA, 36-38.

2 See description of research methods in Chapter 2, and Appendix A for a list of the institutions.

3 See ‘Interdisciplinarity as a University Strategy,’ Chapter 2.

4 For Carnegie-Mellon, see Feller, *op. cit.* note 1, 27. For Rockefeller University, see Rogers Hollingsworth and Ellen Jane Hollingsworth, ‘Major Discoveries in Biomedical Research Organizations: Perspectives on Interdisciplinarity, Nurturing Leadership, and Integrated Structures and Cultures’ in Peter Weingart and Nico Stehr (Eds.) *Practising Interdisciplinarity* (pp. 215-244), (Toronto: University of Toronto Press, 2000), 222-231.

5 See Duke University, *Crossing Boundaries: Interdisciplinary Planning for the Nineties, Self-Study Report to the Southern Association of Colleges and Schools* (Durham, NC: Duke University, Office of the Provost, 1988); and University of Southern California, *Strategic Plan of the University of Southern California, (Los Angeles, CA: University of Southern California, Office of the Provost, 1994).*


7 See University of Southern California, *Guidelines of the University Committee on Appointments, Promotions and Tenure,* (Los Angeles, CA: University of Southern California, Office of the Provost, 2005), 4, 8. See also University of Southern California, *USC’s Plan for Increasing Academic Excellence: Building Strategic Capabilities for the University of the 21st Century,* (Los Angeles, CA: University of Southern California, Office of the Provost, 2004), 1, 5-7, 12-13.

8 See Northwestern University, *Inter-disciplinary Teaching and Research at Northwestern University, Self-Study Report to the North Central Association of Colleges and Schools,* (Evanston, IL: Northwestern University, Office of the Provost, 2004); University of Michigan, *New Openings for the Research University: Advancing Collaborative, Integrative, and Interdisciplinary Research and Learning,* (Ann Arbor, MI: University of Michigan, Office of the Provost, 2000); and the University of Wisconsin, *Report from the Provost’s Ad Hoc Committee for Faculty in Interdisciplinary Programs,* (Madison, WI: University of Wisconsin, Office of the Provost, 2003).

9 See University of Wisconsin-Madison, *Report of the Provost’s Ad Hoc Committee on Faculty in Interdisciplinary Programs,* (Madison, WI: University of Wisconsin-Madison, Office of the Provost, 2003), 7.


11 For a critical discussion of these popular associations, see Peter Weingart, ‘Interdisciplinarity: The Paradoxical Discourse,’ in Peter Weingart and Nico Stehr (eds.) *Practising Interdisciplinarity* (pp. 25-41) (Toronto: University of Toronto Press, 2000).

12 Previous studies used different samples. See ‘Interdisciplinarity as a University Strategy,’ Chapter 2.

Utah State University’s strategic plan provides a typical example. It states a goal of ‘fostering new partnerships, both internally, through interdisciplinary, inter-departmental/college, and inter-divisional collaboration, and externally, through connections with government and the private economy, in keeping with the new role of the engaged land grant university.’ None of the implementation actions associated with this goal is even remotely related to promoting interdisciplinary research or education. See Utah State University, *Compact Plan*, (Logan: Utah State University, Office of the Vice President for Research, 2004), 24-25.


27 For RPI, see http://www.rpi.edu/president/profile.html, and for UCLA, see http://www.ucla.edu/chancellor/university/university_2.html.

28 For Minnesota’s Interdisciplinary Academic Initiatives, see http://www1.umn.edu/pres/01_initiatives.html.

29 On that note, Robert Friedman and Renee Friedman stated in the early 1980s: ‘Administrators and sponsors frequently enunciate broad institutional or national policy goals as a justification for the establishment of ORUs. However, in supporting the establishment of such units or conducting their research in an ORU environment, most researchers are primarily concerned with their own personal career goals.’ Robert Friedman and Renee Friedman, The Role of University Organized Research Units in Academic Science, (University Park, PA: The Pennsylvania State University, Center for the Study of Higher Education, Center for the Study of Science Policy, Institute for Policy Research and Evaluation, 1982), 112. See also discussion on ORUs in Chapter 2.

30 Cornell is the lead institution in three major nanosciences and engineering federal center grants. For the strategic areas, see Cornell, op. cit. note 10, 8-13.


33 As reported at the University of Michigan: ‘Indeed, it is in the biomedical sciences where the collapse of disciplinary boundaries is most strongly felt and where faculty recognize the urgent need to reorganize the way in which research and teaching take place.’ See University of Michigan, ‘Introduction to the Self-Study Report for Institutional Reaccreditation,’ New Openings for the Research University: Advancing Collaborative, Integrative, and Interdisciplinary Research and Learning (Ann Arbor, MI: University of Michigan, Office of the Provost, 2000), 6.

34 The University of Illinois at Urbana-Champaign is said to have pioneered this trend, with the establishment of the Beckman Institute in 1989. See National Academies’ Committee on Science, Engineering, and Public Policy, Facilitating Interdisciplinary Research, (Washington, D.C.: The National Academies Press, 2005), 104-105.


36 ‘One of the more durable characteristics of the knowledge society has been the concern with spanning boundaries of all types,’ see Tomas Hellström and Merle Jacob, ‘Boundary Organisations in Science: From Discourse to Construction,’ Science and Public Policy, 30(4), (2003), 235. The four California Institutes for Science and Innovation are each based in multiple University of California campuses. For federally-funded multi-institution research centers, see Barry Bozeman and P. Craig Boardman, Managing the New Multipurpose, Multidiscipline University Research Centers: Institutional Innovation in the Academic Community, (Washington, D.C., IBM Endowment for the Business of Government, 2003), 15-17.


Larry Klaes, ‘Students Create Earthy Happening to Launch Life Sciences Building,’ *Cornell Chronicle*, 36(26), (March 17, 2005): 1, 4. For the Clark Center, see chapter 5.

See Ehrenberg, *op. cit.* note 22.

See Geiger and Sá, *op. cit.* note 40.

Brint suggests that the economic development rationale is more prevalent among public universities, while private institutions would be more likely to emphasize the scientific excitement of interdisciplinary programs. This is consistent with the findings of the case studies in the following chapters. See Brint, *op. cit.* note 18, 29.

Reductions in pre-established financial commitments in California, for the California Institutes for Science and Innovation, and Michigan, for the Life Sciences Corridor, suggest that changing political climates and local priorities may be disruptive for long-term plans of universities. For California, see Feller, *op. cit.* note 1, 29; for Michigan, see Geiger and Sá, *op. cit.* note 40, 11-12.

See discussion on ORUs in Chapter 2. For a survey, see Friedman and Friedman, *op. cit.* note 29.

One should note that nomenclatures are awfully inconsistent across campuses, and the terms used below are based on the most common findings and their power to convey the models described.


Information Science is ‘a field that cuts across, or is orthogonal to, the conventional academic disciplines.’ See Marcia J. Bates, ‘The Invisible Substrate of Information Science,’ *Journal of the American Society for Information Science*, 50(12), (1999): 1044.


56 Cornell, Ibid., 15.


58 See Cornell University, op. cit. note 55, 3, 9-27.


61 For the Fitzpatrick Center, see Duke University, op. cit. note 21, 113-115. See also Chapter 5.


64 See Friedman and Friedman, op. cit. note 29, 170-173.

65 For Rice University, see ‘Finance; U.S. government funds center for quantitative biology,’ Science Letter, September 21, 2004, 536. For Ohio State, see Rita Colwell, Braiding Mathematics and Statistics with Life Sciences: Weaving Future Tapestry, Speech delivered at the Ohio State University, Friday, (October 11, 2002).

66 For atheoretical descriptions of ORUs, see the papers comprising a special issue of the journal metropolitan universities on public policy institutes: Metropolitan Universities, 10(1), (1999). For a review on the organization of interdisciplinary work, see Julie T. Klein, Interdisciplinarity: History, Theory and Practice. (Detroit, MI: Wayne State University Press, 1990), 123-137.


68 Alpert proposed two classes of units: the multidisciplinary facility (MF), exemplified in the library, and the interdisciplinary mission organization (IMO), to comprehend a most other forms. See Alpert, op. cit.
Geiger has characterized ‘centers’ and ‘institutes’ differently. In a nutshell, he suggests that the first help faculty fulfill their own research agendas, while the second serve the needs of sponsors. Roger L. Geiger, ‘Organized Research Units – Their Role in the Development of University Research’ Journal of Higher Education, 61(1), (1990): 1-19.

69 See Purdue University, The Next Level: Preeminence – Strategic Plan for 2001-2006 (West Lafayette, IN: Purdue University, Office of the President, 2001), 9-10.


71 See University of Cincinnati, UC21: Defining the Urban Research University: A Technical Report from the Comprehensive Academic Planning Process (Cincinnati, OH: University of Cincinnati, Office of the President, 2004), 54-58;

72 See The University of Iowa, Implementing the Strategic Plan – the 2002-03 Report (Iowa City, IA: University of Iowa, Office of the Provost, 2003), 8; and University of Kentucky, The Dream and the Challenge, (Lexington, KY: The University of Kentucky, Office of Planning, Budget, and Policy Analysis, 2003), 6-7.


74 They are Auburn University, Case Western University, George Washington University, Indiana University, Kansas State University, North Carolina State University, Ohio State University, Rutgers University, SUNY Stony Brook, University of Connecticut, University of Illinois at Urbana-Champaign, University of Iowa, University of Nebraska, University of Virginia, Vanderbilt University, Virginia Tech, Washington State University.

75 See University of Nebraska, First Year Report on Programs Supported by Programs of Excellence Fund, (Lincoln, NE: University of Nebraska, Office of Academic Affairs, 2003), 1-8; see also ‘5 Areas Added to Programs of Excellence’, The Scarlet, March 11, 2004, http://ucommxsrv1.unl.edu/scarlet/public/FMPro?-db=scarletstory-&-format=storydetail.htm-&-lay=public-&-op=eq&-storyid=731651S33003X&-max=1&-find=.

76 Grants aimed for must award between $2.5 and $10 million over 5 years if from the NSF or between $5 and $15 million/5 years if from the NIH. The program defines an ‘interdisciplinary team’ as ‘a group of faculty from departments with different scholarly missions.’ See http://research.osu.edu/programs/lg-interdisc.cfm.


78 See http://www.provost.harvard.edu/funding_opportunities/interfaculty_collaboration.php.

79 http://www.rackham.umich.edu/Events/interdis.html
See http://www.usc.edu/programs/cirfellows/. USC’s Center for Interdisciplinary Research partially resembles the nearly 24-year-old practice of Bridging Fellowships at the University of Rochester. Rochester fellows, however, spend one semester in a different department. To pursue the fellowship, faculty should obtain approval from his or her department chair, college dean and the endorsement of the provost. Currently, the provost discourages junior faculty from applying. See University of Rochester, Decentralization and the Curricula at the University of Rochester, Self-Study Report to the Middle States Association Commission on Higher Education, (Rochester, NY: University of Rochester, 2004), 77.

NC State, op. cit. note 71, 3-4.

To judge from reports released as part of its current strategic plan, Virginia Tech’s office attempts to measure interdisciplinary activity at the university and monitor progress, in addition to performing the usual support services of offices of sponsored research. See Interdisciplinary Programs: Report on Faculty Productivity, http://www.unirel.vt.edu/stratplan/InterdFacProd.html.

See University of Cincinnati, op. cit. note 73, 58.

The working group also recommends changes in promotion and tenure procedures, indirect cost recoveries allocations, and interdisciplinary center reviews. See White Paper Recommendations, Working group # 3, 7 (May, 2003), http://provost.wsu.edu/department_chairs_whitepapers/workgroup3.html.

See Case Western University, Case as a Research University: Opportunities and Challenges – Recommendation of the Commission on Research and Graduate Education, (Cleveland, OH: Case Western University, Office of the President and Provost, 2004), 4-6, 8, 11-12.


National Science Foundation, Collaborative Research in Computational Neuroscience (CRCNS) – Program Solicitation 04-514, 6.


See Bozeman and Boardman, op. cit. note 36. The authors discuss their research on ERCs and STCs, but seem to generalize the definition to similar programs at the NSF.

The NSF reports that ITR started emphasizing interdisciplinarity in its 2002 solicitation, and that orientation continued in the 2003 and 2004. In addition, the 2002 and 2003 competitions awarded small, medium and large grants. Given the sheer number of ITR grants in general and of small and medium awards in particular, these two categories were removed from the analysis as they would inflate the dataset (ITR awarded over 800 small and medium grants, as compared to a remaining 888 grants in all other categories). Criteria for the large projects were more stringent regarding specific plans for interdisciplinary research and collaboration. For the shifting emphasis of ITR overtime, see http://www.nsf.gov/home/crssprgm/itr/start.htm. For description of requirements for small, medium and large project, see National Science Foundation, Information Technology Research (ITR) – Program Solicitation 02-168, 11-13. For details on 2004, see NSF, ITR – Program Solicitation 04-012.

The data was gathered from the NSF abstract database in October-November 2004, when multiple reiterations of the data collection procedures were carried out to assure consistency in the dataset.

Only four out of the 99 did not obtain any NSF-IDR grant: New Mexico State University, SUNY-Albany, Tulane University and the University of Connecticut.

See Feller, *op. cit.* note 1, 27.

Its vision is to ‘lead educational institutions by building on its tradition of innovation and of transcending disciplinary boundaries to meet the changing needs of society.’ See Carnegie Mellon University, *Carnegie Mellon Self Study Report to the Middle States Association Commission of Colleges and Schools* (Pittsburgh, PA: Carnegie Mellon University, Office of the Vice President, 1998), 2.

Brown University, Dartmouth College, Duke University, Northwestern University and the University of Pennsylvania are some institutions to note that a small faculty or a compact campus favor interdisciplinarity. For Brown, see http://www.brown.edu/web/pae/plan.html#multidisciplinary; see also Duke University, *op. cit.* note 21, 16; Dartmouth College, *Dartmouth College: Forever New*, (Hanover, NH: Dartmouth College, Office of the President, 2002), 17; Northwestern University, *op. cit.* note 50, 2, 5; The University of Pennsylvania, *Building on Excellence: The Leadership Agenda* (Philadelphia, PA: The University of Pennsylvania, Office of the Provost, 2003), 3.

Cornell defends the alternative view: ‘Size and disciplinary diversity are fundamental advantages for a research university in attracting top scholars, because major research initiatives commonly require large groups and participatory support from experts in neighboring fields or subfields.’ Cornell, *op. cit.* note 10, 8. Similar statements have been made by administrators at UW-Madison, in Steven Brint, *Can Public Research Universities Compete?* Delivered at the Symposium ‘The Future of the American Public Research University,’ (February 25-26, 2005), The Pennsylvania State University, University Park, PA, 29-30.


See Hollingsworth and Hollingsworth, *op. cit.* note 4, 231-239.

For more details on the Beckman Institute, see Eric Scerri, Interdisciplinary Research at the Caltech Beckman Institute, in Peter Weingart and Nico Stehr (Eds.) *Practising Interdisciplinarity* (pp. 194-214) (Toronto: University of Toronto Press, 2000).

Drawing on the stated assumptions of strategic plans both favoring smallness and largesse, as well as on related scholarly work indicating particular advantages of the public or private sectors, three variables were constructed as holding potential influence on universities’ performance in NSF-IDR grant leadership: (1) total research and development (R&D) expenditures, (2) size of the faculty (full-time tenured and tenure-track faculty, excluding medical school) and (3) institutional control (public or private). Data on faculty size and R&D were gathered from IPEDS and the NSF, respectively.

Faculty size is mildly correlated with NSF-IDR grants ($r=.417$, $p < .001$), but this relationship is not significant when adjusting for total R&D. For the final model, excluding the non-significant variables of faculty size and institutional control, total R&D alone accounted for over 50 percent of the variance in the number of grants ($R^2 = .511$, $Beta=.715$, $p < .001$). Total R&D remains a significant predictor among the 99 research universities as well, albeit explaining less of the variance ($R^2 = .362$, $Beta=.602$, $p < .001$).

$R^2 = .718$, $Beta=.847$, $p < .001$. 

104 The former aims at ‘defining and evolving engineering systems as a new field of study and transforming engineering education and practice’; the latter’s mission is ‘to advance research and education in the emerging field of systems biology and to pursue high-impact collaborations with companies engaged in biomedical and pharmaceutical research.’ See Massachusetts Institute of Technology, Reports to the President 2003-2004 – Dean, School of Engineering (Cambridge, MA: Massachusetts Institute of Technology, MIT Reference Publications Office, 2004), 59-118; and Massachusetts Institute of Technology, Reports to the President 2003-2004 – Vice President for Research and Associate Provost (Cambridge, MA: Massachusetts Institute of Technology, MIT Reference Publications Office, 2004), 50-52.

105 Geiger, op. cit. note 15, 289-293.


107 Interdisciplinary initiatives of the earlier plan included five new ORUs, seed funding for faculty networking (domain dinners), and incentives for cross-school faculty appointments. See Northwestern University, Implementation of the Highest Order of Excellence – 1998-2002: Final Report to the Community, (Evanston, IL: Northwestern University, Office of the Provost, 2003), 1-4.

108 See Northwestern, op. cit. note 50, 2-4, 6-8.

109 Harvard, op. cit. note 26, 7-8.

110 Ibid., 5.

111 Ibid., 50.

112 Ibid., 59.


114 Denis Caruso and Diana Rhoten, Lead, Follow, Get Out of the Way: Sidestepping the Barriers to Effective Practice of Interdisciplinarity, (San Francisco, CA: Hybrid Vigor Institute, 2001), 2.

115 The University of New Mexico combines two popular thrusts: promoting interdisciplinary interactions is a specific objective to promote the larger goal of valuing and benefiting from the ‘many dimensions of
diversity.’ University of New Mexico, *The University of New Mexico Strategic Plan*, (Albuquerque, NM: The University of New Mexico, Office of the Provost, 2001), 8.

120 See Cornell, *op. cit.* note 10, 8.
CHAPTER 4
INTERDISCIPLINARY STRATEGIES AT PUBLIC UNIVERSITIES

Public universities have formidable challenges in the inter-institutional competition for research resources and prestige. For Penn State and UW-Madison, interdisciplinary strategies emerged as reactions to an adverse competitive environment of increasingly strong private universities and faltering state appropriations. Faced with dubious capacity to successfully maintain or increase their standards by doing business as usual, the administration of these land-grant institutions reallocated resources and power away from the disciplinary-departmental structure to make selective investments in what they perceive to be university-wide priorities. Arizona State represents a more extreme approach in the shift of resources and power. Its central administration, that displays more latitude than their counterparts in the other universities discussed here, has set an ambitious course of action for institutional advancement. On that campus, leadership in research seems to be inexorably drifting towards ORUs, through which the university seeks to establish new sources of recognition.

THE PENNSYLVANIA STATE UNIVERSITY

Penn State has a long history of involvement with interdisciplinary research. Its current flagship scientific strength, materials science, was pioneered at the university in the 1950s through interdisciplinary research and graduate education programs. In the 1960s, Penn State reportedly drew attention of peer institutions with its organization of
administrative units outside of the college and departmental structure, the Intercollege
Research Programs (IRPs). The IRPs remained the organizational framework for
interdisciplinary units until recently, when the university reorganized the structure of its
major interdisciplinary programs. Four interdisciplinary institutes took shape to advance
the ‘academic initiatives of strategic importance’ outlined in planning documents: the
Materials Research Institute (MRI), the Penn State Institutes of the Environment (PSIE),
the Huck Institute of the Life Sciences, and the Social Science Research Institute (SSRI). Together, the institutes comprise an organizational strategy to strengthen Penn State’s research enterprise through interdisciplinary, collaborative research.

The Penn State Interdisciplinary Institutes

Despite the existence of other centrally-administered ORUs at Penn State, the
analysis is limited to the four institutes for two main reasons: their emphasis on
stimulating behavioral change among faculty in the colleges, and the priority status
accorded to them. The first reason excludes ORUs operating at the margins of Penn
State’s academic core, such as the Applied Research Laboratory and the Marine Corps
research program, whose emphases lie on applied work, mostly for the defense sector.
Both reasons exclude the Institute for the Arts and the Humanities (IAH), also linked to
the Office of the Vice President for Research, from the analysis. Given the smaller scale
of external funding for research in the arts and the humanities, IAH focuses on more
proximate goals. It appears to be a valuable resource for Penn State faculty, with its
residential fellowship schemes, office and meeting space in its exclusive cottage on
campus, and seed money for the design of interdisciplinary courses. But its different scope in the sponsored research enterprise apparently contributes to the characterization of IAH by one informant as an ‘odd duck’ among the other institutes. Demonstrations abound of the priority Penn State gives to the other four institutes, both in official rhetoric and in budgetary terms (see Figure 4).³

Although varying in scope and specific tactics, the four institutes share a recognizable organizational model: they are exemplars of the interdisciplinary institute discussed in Chapter 3. Basically, the Penn State institutes deploy resources to promote collaborative scholarship across colleges and schools. Salient resources institutes administer include co-funded faculty, whereby the institute supports half of the cost of a faculty position proposed by a department; core facilities and instrumentation; and seed funding. The role of institute directors is viewed as ‘using these resources strategically,’ which can be translated in various ways. More generally, such ‘strategic use’ refers to the consideration of perceived university-wide priorities rather than the particular interests of academic sub-units. At the tactical level, it regards pragmatic investment choices, such as building shared facilities for general use (and thus avoiding redundancies) and awarding seed grants for proposals with both scientific merit and clear external funding potential.

There is an unequivocal interest among the institutes in helping faculty attract large, or as some described, ‘important’ and ‘significant’ grants from federal agencies. Such preference is attuned to the funding patterns at the federal level, which show a steady increased in multi-investigator awards and a continuing investment in center grants and multidisciplinary and multi-institutional programs.⁴ Indeed, the formal functions of the Associate Vice President for Research/Director of Strategic and
Interdisciplinary Initiatives revolve around enhancing the research competitiveness of the university, which includes ‘providing leadership for the development of major research activities at the University,’ and ‘working with the faculty and administration to organize large-scale, multi-investigator, interdisciplinary research teams.’

However, institutes are not expected to be revenue-generating units. Grants are administered through the colleges, to avoid internal competition such as those experienced with the old IRPs. Hence, the present model results from deliberate attempts to address past issues concerning the relations among IRPs and academic units:

While there is fundamental recognition for the value of interdisciplinary research and collaboration, units have historically competed for credit and the resources that credit yield, and for real or perceived reputation. Penn State’s prior organization of interdisciplinary activities and distribution of resources, including research incentive funds (formally known as indirect cost returns), produced impediments to successful collaboration.

The impediments generated by the assignment of credit to academic units on research grants are indeed a traditional obstacle to interdisciplinary collaborations. Typically, the return of indirect cost recoveries exclusively to the unit hosting the principal investigator in collaborative research grants leads creates disincentives for inter-college collaborations and the participation of departmental faculty in ORUs. These issues and variants were experienced at Penn State in the past. Recognizing the problem, the university implemented a new research accounting system that assigns proportional credit to both colleges and ORUs in grants, as a measure to assure that all relevant units are recognized for their relative contributions to research awards. The system allows the university to track the evolution of the interdisciplinary initiatives, in terms of their
contribution to the overall performance of the university, and the evolution of collaborative work among units.\textsuperscript{9}

All institutes report to the Vice President for Research. This relationship is viewed as providing an essential link among the units and ‘institutional continuity.’\textsuperscript{10} With slight variations in the names and functions, there are two governance structures for each institute. Executive committees comprising institute directors and Deans of participating colleges oversee general performance and define broad goals. Another body, composed of faculty of participating colleges, helps institute directors with academic policy and decisions on investments. By and large, institute directors exercise discretion in the design and management of their programs. Senior administrators compare the relative position of institute directors in the university to that of college deans.\textsuperscript{11} Institute directors derive their authority from the resources they control.

Administratively, the institutes are umbrella organizations for different types of interdisciplinary centers (see Table 7). As the four institutes incorporated older IRPs and bring together large fractions of the Penn State faculty, the number of such research centers is large. New centers have also been established within the institutes to explore specific fields of strategic interest for the university, like the recently created Neuroscience Institute within the Huck Institute for the Life Sciences.\textsuperscript{12} The institutes also coordinate core facilities, such as the Huck Institute’s DNA Microarray Facility and MRI’s Materials Characterization Laboratory, and SSRI’s Survey Research Center.
Table 7. Selected ORUs within the Penn State Institutes.

<table>
<thead>
<tr>
<th>Institutes</th>
<th>Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penn State Institute for the Environment</td>
<td>• Hydrogen Energy Center</td>
</tr>
<tr>
<td></td>
<td>• Center for Molecular Toxicology and Carcinogenesis</td>
</tr>
<tr>
<td></td>
<td>• Center for Infectious Disease Dynamics</td>
</tr>
<tr>
<td>Huck Institute for the Life Sciences</td>
<td>• The Institute for Genomics, Proteomics, and Bioinformatics</td>
</tr>
<tr>
<td></td>
<td>• The Biotechnology Institute</td>
</tr>
<tr>
<td></td>
<td>• The Neuroscience Institute</td>
</tr>
<tr>
<td>Materials Research Institute</td>
<td>• Center for Nanoscale Science</td>
</tr>
<tr>
<td></td>
<td>• Center for Innovative Sintered Products</td>
</tr>
<tr>
<td></td>
<td>• Carbon Research Centers</td>
</tr>
<tr>
<td>Social Sciences Research Institute</td>
<td>• Populations Research Institute</td>
</tr>
<tr>
<td></td>
<td>• Children, Youth and Families Consortium</td>
</tr>
<tr>
<td></td>
<td>• Survey Research Center</td>
</tr>
</tbody>
</table>

All institutes seed collaborative research, albeit in different ways. The Huck Institute and SSRI have formal competitions, PSIE disburses funds more informally, and MRI uses both formal and informal approaches. The first two units exemplify opposite ends in the scale of investments, which can be explained by the cost differentials of research in the life sciences and the social sciences and the magnitude of expected returns. At the high-end lies the Huck Institute, whose peer-reviewed planning grant program awards up to $375,000 over three years to help investigators obtain federally supported centers. Tobacco Settlement funds have also been allocated in a similar fashion for collaborative health research. In the lower-end, SSRI has a two-tiered seed funding scheme. Level 1 funding ($500 - $4,000) aims at stimulating faculty to initiate an interdisciplinary team. The idea behind these small grants is to ‘get faculty out of their labs’ and ‘give them a reason’ to craft promising interdisciplinary research questions. Level 2 funding ($4,000 - $15,000) targets teams that need support to consolidate a research project into a competitive grant proposal.
The Evolution of the Institutes

Although some of the research thrusts embodied in present institutes have existed for a long time, the four units as they exist today were established from the mid-1990s to the early 2000s. The work of the University Futures Committee (UFC) in the early 1990s planted the initial seeds that led to those developments. The committee was convened to examine and plan for the challenges the university would face in the years to come. UFC released its reports in 1993, including recommendations to re-organize the life sciences. The Life Sciences Study Group was formed to analyze alternatives and propose a new way of organizing the field at Penn State. The group considered alternative models, but ultimately proposed the creation of a new college.\textsuperscript{14} Strong reaction to this proposal surfaced, and the administration shifted the focus to a unit that could serve as an umbrella organization. As these ideas developed, Graham Spanier succeeded Joab Thomas as president of Penn State. Implementation of the new unit to coordinate the life sciences would fall under Spanier’s tenure.

The intellectual origins of the Penn State institute model can be credited to the process leading to the creation of the Life Sciences Consortium in 1996, during which extensive benchmarking and external consultation took place. Two interviewees involved in this process claim not to have emulated any particular model, but to have selectively borrowed desirable elements of other universities’ programs. A scientist who participated in the formation of the consortium recalls that the basic idea was to pool resources to make equipment and facilities available to the whole campus and to disburse research money solely on a competitive basis. Underpinning this formulation was a perception of
inefficiency and redundancy in college and departmental behaviors of seeking control over resources for the status that they bring. These fundamental building blocks of the Life Sciences Consortium have remained in place and were later incorporated in the other consortia.

The University Planning Council (UPC) in charge of the 1997-2002 strategic plan continued the discussion on interdisciplinary initiatives, bringing two new fields to the agenda: children, youth and families; and information sciences and technology.\(^{15}\) The first, a presidential favorite, was constituted as a consortium in 1998, and the second became a new school in 1999.\(^ {16}\) The other institutes took their current form in the early 2000s. This was achieved through the re-allocation of internal resources, after years of compulsory cost reductions in the colleges generated discretionary funds for strategic investments.\(^ {17}\)

The life sciences have been an Achilles heel to Penn State, which is well-ranked in sponsored research in many areas but lags behind in this important field.\(^ {18}\) Re-christened the Huck Institute of the Life Sciences, this unit has left the most conspicuous imprint on the Penn State campus in the past few years. By far, the Huck Institute has the largest number of co-funded faculty (60); its new 152,000 square feet building is centrally located on campus, providing core facilities to the faculty of participating colleges; and it offers nine options (with a 10th proposed) of the Integrated Biosciences Graduate Degree Program (IBIOS), which enrolled a class of 37 graduate students in academic year 2004/2005.\(^ {19}\) IBIOS degree options are designed to address research areas that link faculty from multiple departments, and would not translate into training opportunities for graduate students in the regular departmental programs. The relatively
sizable investment in the operation of the Huck Institute, depicted in Figure 4, reflects Penn State’s acknowledged need to catch up with leading institutions. Plans for future development include a Life Sciences Corridor on campus, with one additional building planned and others envisioned.

Figure 4. Shares of Total Operating Budget for Six Penn State Budget Units for 2003/2004 and 2004/2005 (Including IAH and the Children, Youth and Families Consortium - CYFC).

The Materials Research Institute is today the unit giving a unified face to the Penn State materials research portfolio. The UFC diagnosed the materials community to be fractured. The once pioneer Materials Research Laboratory had established itself apart from the academic departments, while a large faculty body scattered throughout the university conducted materials research in isolation. That situation, it was perceived, did not contribute to presenting the strength of Penn State materials science externally. A first institute was created to coordinate the materials research community in the early 1990s,
but it co-existed with MRL for several years. Naturally, this duality did not address the fundamental issues diagnosed earlier. In 2001, the university merged the two units into the present MRI, following the proposal of a senior faculty member. MRI’s operation involves five colleges. Differently from the others institutes, MRI provides 1/3 of the cost of the 35 co-funded faculty it supports. MRI also manages core facilities in multiple locations, and disseminates information (internally) on research opportunities and (externally) on Penn State expertise. Plans for a major new building are underway with state support, which will provide a physical hub for material scientists on campus and substantially upgrade the provision of core facilities and space.\textsuperscript{20} The case of materials also exemplifies the barriers to the creation of new academic units; such proposals were made in the past but succumbed under high capital needs and the unwillingness of existing departments and colleges to share resources.

The Penn State Institutes of the Environment also stems from the work of the UFC, and exemplifies the sometimes tortuous evolution of organizational structures on campuses. Penn State had an IRP called the Environmental Resources Research Institute. After UFC, the Environmental Research Consortium was created. The consortium eventually absorbed the old IRP in 2001 forming a new Environmental Consortium, later renamed PSIE. Besides the changes in names, PSIE moved away from the earlier focus on engineering, embracing connections with more disciplines. Today it involves eight colleges, and participating departments host around 31 co-funded faculty members.

Like PSIE, SSRI has a multi-chapter history of mergers and restructuring. In 2000, a task-force examined the situation of the social science at Penn State and found fragmentation and overlap among existing units. Following the task force
recommendations, SSRI was established in 2001 consolidating two older IRPs and establishing the Survey Research Center as a resource to Penn State social scientists. In mid-2004, SSRI merged with the Children, Youth and Family Consortium (CYFC). SSRI involves four colleges and, through CYFC, co-funds around 14 faculty positions.\textsuperscript{21}

In addition to promoting interdisciplinary interactions within the broad areas the institutes represent, Penn State has a formal objective of harnessing collaborations across institutes.\textsuperscript{22} The underlying expectation is to leverage existing strengths to exploit niches in the sponsored research market.

The Institutes and Organizational Change

Interdisciplinary research is loosely defined among Penn State administrators; the most tangible criterion is organizational. All institutes stress the inducement of cross-college collaborations as their core business. When asked to explain how they identify interdisciplinary research, administrators indicate that there are multiple context-specific considerations influencing such judgment. Multiple administrators exemplified that a project from two investigators with similar disciplinary training could be considered interdisciplinary if the faculty were based in different colleges, and brought different intellectual approaches, scientific methodologies, or basic-applied orientations to the research problem. One institute director also mentioned that he has supported a project of a single-investigator because he viewed the project as strategic to enable subsequent interdisciplinary research. But multi-investigator projects among faculty in different academic units are the norm. Overall, Penn State administrators seemed skeptical of the
power and usefulness of a priori definitions of interdisciplinarity for judging proposals or evaluating faculty work, and preferred to rely on case-by-case assessments.

The institutes’ approaches to promote interdisciplinarity are not alien to the university. The scheme of co-funding faculty positions is the most original in format, since they differ from the usual arrangements for dual-appointments including cost-sharing. The novelty lies in the way the positions are created and in the expectation that co-funded faculty will behave as ‘boundary-spanning’ individuals, contributing to instill a collaborative research culture. Specifically, co-funded faculty positions result from a process where departments develop proposals in agreement with their colleges, responding or not to a ‘call for proposals’ from the institutes. Departments and their respective colleges are supposed to specify why a particular unit is an adequate home for the faculty member, and how the faculty’s teaching and research will strengthen both the unit and enhance collaborations beyond it. In addition, they need to back the proposals not only financially, but also through a formalized commitment to support the faculty’s interdisciplinary activities. Once there is consensus between the department and the college, a proposal is submitted to the related institute. There is a limit in the number of proposal submissions per year, varying from two to four depending on the institute. The institutes decide which faculty positions to fund through deliberation within their committee governance structure. The expectations for those positions are that the new faculty members will contribute to the interdisciplinary research mission of the institute, participating in collaborative activities that bridge disciplines. The fact that these proposals for co-funding run through institute committees, built to be representative of participating colleges, has been structured to dilute territoriality. Organizationally, this
hiring model adds a layer of oversight and decision-making that displaces exclusive departmental and college control over faculty recruitment.

As such, this hiring scheme differs from joint-appointments in which the new faculty member receives two academic homes. Those appointments challenge the faculty to demonstrate commitment and excellence for two distinct disciplinary communities, as well as balance the service to each unit. Northwestern University, for example, recently surveyed the experience of its faculty with interdisciplinary joint-appointments. Faculty funded by two or more departments faced more intense pressures due to heavier workloads and strictly disciplinary promotion criteria.24 This duality is avoided with the Penn State co-funded faculty, which for all purposes belong in their home department. That is where evaluation, promotion and tenure decisions take place. As interviewees strongly emphasize, faculty are expected to be first and foremost a good match for their home departments. Institute leaders characterize co-funding as ‘an investment in’ or ‘a partnership with’ departments. Penn State’s model also deliberately avoids the usual issues involving faculty participation in interdisciplinary ORUs, such as tensions with departments regarding credit allocation and disadvantages for junior faculty in tenure decisions.25

After five years of co-funding, institute directors evaluate the performance of the faculty against the criteria of furthering the institute mission and the plans outlined for the position. This evaluation determines whether the institute renews its financial support for another five-year period. Such decision is not meant to influence promotion, tenure, or the continuation of the faculty member at Penn State. Directors highlight that faculty may
turn out to be an excellent match for departments but fail to meet institute goals for a
number of reasons, in which case co-funding would be withdrawn.

The strategic importance of the co-funded faculty positions can be better
appreciated in relation to the overall competitive environment Penn State and other public
universities face.\textsuperscript{26} Penn State illustrates the long-term pattern of relative decline in the
state appropriations and higher dependence of public institutions on student tuition
revenues. From 1970 to 2005, state appropriations’ share of the operational budget
dropped from 62 percent to 22 percent, while tuition’s share increased from 32 to 71
percent.\textsuperscript{27} Indeed, Penn State’s senior administration claims to have deliberately
implemented this interdisciplinary hiring approach as a way to steer investments on
faculty to important areas, as they foresaw limited resources available to promote growth
at the academic core.\textsuperscript{28} These conditions heighten the relative impact of strategic hiring
programs, and may reasonably influence departmental interest, or necessity, to pursue co-
funding agreements.\textsuperscript{29}

Penn State data indicate modest increases in the number of tenure and tenure-
track faculty since 1995 (see Table 8). Since then, demand for expansion of instruction
has been met through the use of temporary personnel. If in 1995 year tenure-track faculty
were over 70 percent of the faculty body, by 2004 the proportion had slipped to around
64 percent. The absolute number of tenure-line positions in the colleges and schools
increased by less than 5 percent in the period, which is equivalent to 78 added faculty. In
the last five years, full and associate professor appointments have increased marginally,
while assistant professor positions slipped (see Figure 5). The last available figures
indicate that the four institutes co-funded 140 positions. Therefore, the latter accounted for the net growth in tenure-line faculty in academic units.

Table 8. Penn State Faculty by Tenure Status and Unit Type, 1995-2004.

<table>
<thead>
<tr>
<th>Year</th>
<th>Home Unit</th>
<th>Tenure</th>
<th>Tenure Track</th>
<th>Subtotal</th>
<th>Other Standing</th>
<th>Fixed Term</th>
<th>Total</th>
<th>Tenure line Share</th>
<th>Non-College Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>Colleges/Schools</td>
<td>1,197</td>
<td>389</td>
<td>1,586</td>
<td>66</td>
<td>534</td>
<td>2,186</td>
<td>72.55%</td>
<td>20.54%</td>
</tr>
<tr>
<td></td>
<td>Support Units</td>
<td>39</td>
<td>25</td>
<td>64</td>
<td>218</td>
<td>167</td>
<td>449</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>Colleges/Schools</td>
<td>1,189</td>
<td>381</td>
<td>1,570</td>
<td>65</td>
<td>511</td>
<td>2,146</td>
<td>73.16%</td>
<td>20.41%</td>
</tr>
<tr>
<td></td>
<td>Support Units</td>
<td>40</td>
<td>22</td>
<td>62</td>
<td>205</td>
<td>171</td>
<td>438</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>Colleges/Schools</td>
<td>1,195</td>
<td>392</td>
<td>1,587</td>
<td>62</td>
<td>554</td>
<td>2,203</td>
<td>72.04%</td>
<td>19.70%</td>
</tr>
<tr>
<td></td>
<td>Support Units</td>
<td>43</td>
<td>18</td>
<td>61</td>
<td>193</td>
<td>180</td>
<td>434</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>Colleges/Schools</td>
<td>1,206</td>
<td>406</td>
<td>1,612</td>
<td>55</td>
<td>609</td>
<td>2,276</td>
<td>70.83%</td>
<td>18.89%</td>
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<tr>
<td></td>
<td>Support Units</td>
<td>44</td>
<td>12</td>
<td>56</td>
<td>193</td>
<td>181</td>
<td>430</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>Colleges/Schools</td>
<td>1,194</td>
<td>431</td>
<td>1,625</td>
<td>57</td>
<td>628</td>
<td>2,310</td>
<td>70.35%</td>
<td>17.79%</td>
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<td></td>
<td>Support Units</td>
<td>37</td>
<td>10</td>
<td>47</td>
<td>195</td>
<td>169</td>
<td>411</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>Colleges/Schools</td>
<td>1,193</td>
<td>457</td>
<td>1,650</td>
<td>63</td>
<td>673</td>
<td>2,386</td>
<td>69.15%</td>
<td>16.97%</td>
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<td></td>
<td>Support Units</td>
<td>36</td>
<td>18</td>
<td>54</td>
<td>202</td>
<td>149</td>
<td>405</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>Colleges/Schools</td>
<td>1,199</td>
<td>458</td>
<td>1,657</td>
<td>65</td>
<td>751</td>
<td>2,473</td>
<td>67.00%</td>
<td>16.13%</td>
</tr>
<tr>
<td></td>
<td>Support Units</td>
<td>38</td>
<td>21</td>
<td>59</td>
<td>193</td>
<td>147</td>
<td>399</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>Colleges/Schools</td>
<td>1,182</td>
<td>492</td>
<td>1,674</td>
<td>57</td>
<td>799</td>
<td>2,530</td>
<td>66.17%</td>
<td>15.06%</td>
</tr>
<tr>
<td></td>
<td>Support Units</td>
<td>36</td>
<td>22</td>
<td>58</td>
<td>186</td>
<td>137</td>
<td>381</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>Colleges/Schools</td>
<td>1,212</td>
<td>471</td>
<td>1,683</td>
<td>56</td>
<td>831</td>
<td>2,570</td>
<td>65.49%</td>
<td>15.02%</td>
</tr>
<tr>
<td></td>
<td>Support Units</td>
<td>36</td>
<td>23</td>
<td>59</td>
<td>185</td>
<td>142</td>
<td>386</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>Colleges/Schools</td>
<td>1,241</td>
<td>423</td>
<td>1,664</td>
<td>54</td>
<td>890</td>
<td>2,608</td>
<td>63.80%</td>
<td>14.11%</td>
</tr>
<tr>
<td></td>
<td>Support Units</td>
<td>35</td>
<td>20</td>
<td>55</td>
<td>189</td>
<td>124</td>
<td>368</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: The Pennsylvania State University.

Another issue worthy of notice in the Penn State make up of its scientific workforce is the decrease in non-college appointments (see above). Over the last 10 years, there has been a downwards trend in the hiring of tenure and non-tenure track full time faculty outside of colleges and departments. In 1995, other units had around 20 percent of those appointments, but in 2004 only about 14 percent. In absolute numbers, there was also a decline of 18 percent. This is consistent with the declared emphasis of the university on integrating colleges and ORUs.\(^{30}\) Appointing faculty without an
academic home is a traditional source of issues, including ‘second-class citizenship’ at the university, compensation differentials, and career ceilings.\textsuperscript{31}

Figure 5. Penn State Full-time Faculty by Rank (2000-2004).

Note: * Includes lecturers, research faculty and librarians. Source: The Pennsylvania State University.

Penn State acknowledges the difficulty in assessing the success the co-funded faculty positions.\textsuperscript{32} Indicators recently used to examine these positions were data on externally funded research grants.\textsuperscript{33} Although certainly important, these data tell a very rudimentary story, particularly in the absence of information about the nature of the research and reasonable comparison groups. Good performance in these metrics, obviously, does not imply interdisciplinarity. The reverse side of the coin is that faculty might experience delays in external funding because of the time and effort involved in engendering inter-departmental collaborations. The attention to indicators of sponsored research productivity is consistent, however, with the administrative goals of expanding the volume of external awards and the emphasis on obtaining large agency grants.
The institutes have the opportunity to exercise a more precise judgment of co-funded faculty’s performance, and thus verify whether their goals are being met, during the five-year reviews. Assuming that rigorous consideration is given to each case and that institute directors are willing to enforce the terms of the agreement, the review process works as a corrective mechanism to cases where the goals of the position are not met. These cases can result from failure to recruit adequate candidates, lack of departmental support the faculty’s interdisciplinary activities, and faculty ‘shirking,’ for example. However, that the institutes have the means to enforce their goals does not mean they will necessary do it in cases of poor compliance. They may lack adequate information and not be willing to bear possible political costs of decisions to withdraw co-funding. The effectiveness of Penn State’s model in creating actual interdisciplinary behaviors is thus contingent on the commitment of the institutes to pursue and enforce their goals of catalyzing inter-college work, and continuing central administrative backing of their mandate.

Overall, the Penn State institutes represent a clear and replicable organizational model, added to the repertoire that includes traditional structures such as programs, departments, school, and colleges. For each of those structures a certain set of resources, inputs, and outputs is assumed. Establishing a new department usually implies gathering a tenure-line faculty body hired from and for a definable academic field, who are going to administer course offerings and degree programs in that field. Establishing an interdisciplinary institute at Penn State implies committing resources to building research capacity across the boundaries of traditional disciplines and academic units, through co-funded faculty, shared facilities, and seeding funding. There are signs of the continuing
replication of the model originally established with the Life Sciences Consortium almost 10 years ago. Some units nested into the present institutes may emerge to become new university-wide priorities, most notably in the case of the already announced Energy Institute. Perceiving the opportunity in terms of societal needs and research funding in this critical area, Penn State is planning to develop this new initiative initially within PSIE with 8 co-funded positions. The Huck Institute’s Neuroscience Institute may also be scaled up, as it will occupy the second life sciences building and there are plans to hire 30-40 new faculty in the field over the next decade.

Two main impetuses seemed to have shaped the emergence of the Penn State interdisciplinary institutes. The first was addressing problems of coordination among units in the research fields of materials, environment, life sciences and social sciences. There were particularities in the organizational issues faced in each of those areas, but fundamentally the university has attempted to leverage existing strengths through cross-college interactions. The second impetus regarded facing the competitive challenges in the faculty market. The approach to faculty recruitment entailed a redistribution of internal resources that shifted the presumable trajectory of departmental self-replication towards institution-wide developmental priorities.

Reallocation strategies are symptomatic of the ‘economics of scarcity’ that public universities have experienced contemporarily, but Penn State is not among the cases of acute resource starvation. Nevertheless, limited capacity to create new revenue streams and a long-term pattern of decreasing reliance on state appropriations were turned into a motivation for generating operational efficiencies and pooling funds for strategically
changing the makeup of the faculty, even if at the margins. In light of the data presented above, it is doubtful whether the university would have been able to expand the size of its life sciences faculty as it did, for example, without the co-funding model. Overall, the 140 co-funded positions contributed to the modest increase in the tenure-line professoriate over the past decade.

While co-funded faculty are still subject to the same barriers to interdisciplinary work in general, the system in place clearly assigns incentives and authority in order to facilitate the effectiveness of the arrangement. Departments opt in or out of co-funded agreements with institutes as they wish; undertaking the financial burdens of each of these decisions is a powerful incentive for cooperation. Furthermore, control over promotion and tenure decisions avoids double allegiances and mixed-messages both for the faculty and the department. On the other hand, institutes can enforce their goals through their own periodical evaluations of the co-funded agreements. The institutes operate as extended arms of the university leadership as they advance the campus-wide goals and priorities in the recruitment of faculty and the seed funding of inter-departmental research collaborations.

THE UNIVERSITY OF WINSCONSIN-MADISON

Early in the 20th century, the University of Wisconsin aptly captured the land-grant spirit in the ‘Wisconsin Idea,’ extending the orbit of institutional influence to the borders of the state. Since then, the notion of a university deeply engaged with its region became characteristic of American higher education. In recent years, UW-Madison produced yet another idea that has incipiently started to disseminate among other
universities. This time, the Wisconsin innovation was devised to span internal boundaries of the university; it involves a magnified role for the university administration in the recruitment of faculty, and a break with the tradition of departmental control over hiring.  

The Cluster Hiring Initiative (CHI)

The CHI entailed the creation of a number of faculty lines for the university as a whole, and the competitive allocation of those faculty lines to faculty-proposed clusters. The latter are supposed to develop an interdisciplinary area of inquiry, spanning the boundaries of the traditional academic units. Essentially, the Provost’s Office runs the operation and ‘owns’ the faculty lines. It fully funds the cluster faculty salaries while they are at the university. There is no commitment, however, to replace departing faculty and the position may return to the Provost’s Office for reallocation. These positions are viewed as fulfilling functions that may exhaust themselves and cease to exist. Clusters are hugely variable, and not formally defined. The formal objectives of the CHI blend broad statements about its aims and glossy statements typical of university goals:

1. enable the campus to devote a critical mass of faculty to an area of knowledge that would not be addressed through existing departmental structures;
2. provide for new research tracks and collaborative opportunities;
3. address complex social issues;
4. advance the Wisconsin Idea by serving society’s needs through interdisciplinary research, teaching and service;
5. encourage and foster cooperation with an already strong faculty and staff;
6. create new curricular offerings on the undergraduate and graduate levels;
7. assist in the fulfillment of other missions of the University, in particular increasing campus diversity.
The hiring process as it was last conducted starts with a call for cluster pre-proposals from the Provost’s Office. Those are evaluated by a broadly-representative faculty advisory committee headed by the Associate Vice Chancellor for Faculty and Staff Programs. Full-proposals are then submitted by invitation. The formal criteria for the evaluation of cluster pre- and full proposals involve five aspects, as specified in the table below. Successful proposals are assigned a number of faculty positions and a Lead Dean, who appoints a search committee to conduct the recruitment process. The committee is supposed to represent the areas of relevance to the cluster and not particular departments or schools, and operates like a departmental search committee. It has the task of identifying promising candidates that can fulfill the requirements set for the cluster, and also of their potential departmental tenure home. There is no a priori commitment to link academic units participating in the search process with a faculty position. Indeed, departments not represented in search committees have been chosen as homes for cluster faculty hires. Once a potential match is found, agreement of both the search committee and the possible home department must occur for a job offer to be made. Start-up packages are also negotiated among the Graduate School, the college and department hiring the faculty. After the faculty member is hired, she becomes for all academic purposes incorporated in the department with full salary support from the Provost’s Office.

Table 9. Criteria for Evaluating Cluster Proposals.41

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<thead>
<tr>
<th>Criteria</th>
<th>Questions Asked</th>
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<tr>
<td>Quality</td>
<td>Why should this project be undertaken? What unique challenges and opportunities does it involve?</td>
</tr>
<tr>
<td>Relevance to Mission and Vision of UW</td>
<td>How does your proposed project further the objectives of the Cluster Hire Program?</td>
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How effectively do your proposed search strategies address campus diversity needs? Will the pool of candidates sought for this cluster include persons with diverse personal and professional backgrounds and experience?

What linkages with existing programs and units on campus will assist in bringing the hiring to a successful conclusion? What are the infrastructure needs?

Are there emerging needs and scholarly developments that create a unique window of opportunity for the proposed cluster of hires?

As administrative units, clusters are completely autonomous; they do not report to anyone on campus. A cluster coordinator is chosen among the participating faculty, but the role is very informal and implies few, if any, duties. The clusters function as informal groupings, whose specific activities are contingent upon the faculty involved, the nature of their work, their connections with other on-going interdisciplinary programs, among other contextual factors.

The Evolution of the Cluster Hiring Initiative

In the mid- to late-1990s, UW-Madison faced a situation of declining state appropriations that compromised its capacity to keep up core investments in faculty and infrastructure. Increases in appropriations were only experienced in the early 2000s, followed by a steady decline back to the levels of the triennium 1995-1997 in 2004. These patterns have resulted in a relative decrease of state funding as a share of the university’s budget – a national phenomenon – and a relative increase of state moneys allocated for specific purposes (see Figure 6). One of the most deleterious consequences was the erosion of the faculty body. Even when one considers that the university had experienced substantial growth in the late 1980s, the decrease in the number of faculty...
was significant (see Figure 7). Measured by a headcount (which includes faculty occupying administrative posts), UW-Madison had in 1999 a gap of nearly 150 faculty relative to the level of academic year 1982/1983. The figures for full-time equivalent faculty show a decrease of 288 FTE between the start and the end of the 1990s.

Figure 6. State Appropriations for General and Specific Purposes, and the Total State Funding as a Share of UW-Madison's Total Budget.\textsuperscript{42}
These trends were anticipated in the strategic planning process leading to the 1995 document *A Vision for the Future*, which highlighted the need for the university to ‘make hard choices’ in the pursuit of priorities. The plan, issued by the former Chancellor David Ward after campus-wide consultations, also called for a reflection on the university’s organizational structure and for the encouragement of inter-departmental collaborations:

Our current academic structure, including academic departments, degree programs, and their locations within schools and colleges, should be subjected to a fresh analysis and changed to meet the needs of the future…. Our current organization is based not on comprehensive planning, but rather is the product of incremental change, ad hoc decisions, and gradual accretion. To be prepared for the demands of a world in which knowledge is being quickly transformed, our organizational structure needs flexibility to keep pace…. We will need to change the policies and practices that inhibit interdepartmental collaboration, no matter how the campus is formally structured…. We have to recreate a sense that the university encourages faculty, staff, and students to communicate across
departmental boundaries and to deal with challenges that are located in the spaces between the disciplines.\textsuperscript{43}

In the following years, the university was faced with the challenge of implementation as the predicted scenario of stagnant appropriations materialized. UW-Madison’s strategy to overcome the financial constraints was the ‘Madison Initiative,’ a four-year investment plan crafted to leverage state funds with private support. Chancellor Ward sought to obtain $57 million from the state between 1999 and 2003, with a promise to match it with $40 million in philanthropic fundraising. The initiative had four thrusts: hire and retain faculty, enhance student learning through technology, improve financial assistance to needy students, and renovate buildings. The faculty recruitment element would be pursued selectively, emphasizing campus-wide priorities.

The origins of the faculty recruitment approach preceded the formalization of the Madison Initiative. In 1997 UW-Madison exploited gubernatorial interest in supporting biotechnology for economic development to propose that new faculty lines were funded in the life sciences. Twenty faculty positions were then created as a result, in what would later be characterized as the first round of cluster hires. The idea of hiring faculty for interdisciplinary areas took shape, and was sold as part of the Madison Initiative to the state governor and legislature in anticipation of the 1999-2001 budget request. With matching funds from the Wisconsin Alumni Research Foundation (WARF) and the University of Wisconsin Foundation, the university obtained $5 million from the state towards a total $15 million for the CHI. One upper administrator recalls:

So, that was 15 million, if you figure roughly 100,000 per faculty member, you got 150. Now, what do you do with those? Needless to say, every dean and every department chair was clamoring to have back the positions they lost when the cuts came… So, the idea actually came from the associate vice chancellor in the
provost’s office. He said, well, let’s not just clone this people back where they were. Let’s try to do something to tie the interface among various disciplines together.

The fundamentals of the CHI fell into place. The 150 new faculty positions would help the university recover from the retrenchment experienced in the 1990s, and still position UW-Madison at the forefront in interdisciplinary niches. Underlying principles motivating the willingness to ‘do something to tie the interface among the disciplines together’ in hiring were later articulated (or perhaps rationalized) consistently with the earlier predicaments of a *Vision to the Future*:

By establishing the Cluster Hiring Initiative, the campus acknowledged that existing curricula demands, departmental traditions, and faculty governance may limit departmental opportunities to pursue new directions in faculty hiring. The challenge is that departments may be unable to hire faculty who pursue important new, more experimental, less established areas of research, or interdisciplinary initiatives that are by definition more distant from the core of a single discipline. The prevailing academic cultures and structures tend to replicate existing areas of expertise, reward individual effort rather than collaborative work, limit hiring input to a single department within a single school/college, and limit incentives and rewards for interdisciplinary and collaborative work. In addition, existing interdisciplinary teaching or research programs often have no avenue to ensure replacement hiring as faculty resign or retire.

Five rounds of competitions took place between 1997 and 2001, whereby 143 faculty positions were allocated to 49 clusters, with some hires still pending. The initial focus of the first two rounds in the biosciences was followed by an emphasis on the humanities and social sciences in the 1999 round, and in various fields in 2000 and 2001. In numerical terms, cluster faculty are neither negligible nor a solution to faculty attrition at UW-Madison. The CHI became a noticeable component of overall faculty recruitment, accounting for between 14 and 20 percent of newly appointed academics between 1999 and 2004 (see ).
Figure 8). Individual clusters have been allowed to hire between 1 and 5 new faculty (see Figure 9). In addition, the Provost’s Office instituted in 2002 annual competitions for ‘Enhancement Grants,’ to provide clusters with modest funds for partial support of programmatic expenses.45

Figure 8. Number of Faculty Hires per Academic Year and Share of Faculty Recruited Through CHI, 1999-2004 (Source: University of Wisconsin-Madison).
The organization of the CHI has undergone adaptations overtime, shaped by centrifugal forces on the Madison campus. Interviewees seemed convinced that UW-Madison stands out among its peers in administrative decentralization, as one administrator best summarizes:

Wisconsin is absolutely (the most) cumbersome in terms of the institutional bureaucratic structure…. When you look at how Wisconsin builds faculty governance into places where other institutions are more able to operate on a top-down level, and also when you look at how the budget works here and the amount of power that the deans have, as compared to other campuses [where] the provost distributes the deans’ budgets, and here it’s not the way it looks. So this campus is much more decentralized than other campuses that are trying to do similar things often modeled after ours.

Over the 5 rounds of cluster competitions, roles initially belonging to the central administration were shifted to the faculty. The clearest case is the selection of cluster proposals, initially under the provost and chancellor and then mediated through a faculty committee. By round 4, norms and guidelines were substantially more formalized than
initially; roles for lead deans, committees and administrative units involved in the cluster hiring process were delineated in detail.\textsuperscript{46} The Madison Initiative succeeded in obtaining additional revenue for UW-Madison’s core activities by appealing to the economic competitiveness rationales \textit{in vogue}. Nevertheless, turbulence in the flow of state appropriations ultimately affected the Madison Initiative. After the first parcel of state funds was obtained in 1999-2001, the second phase of investment suffered from budget cuts in 2001-2003. UW-Madison only received $11.8 million then, as compared to the expected $28-29 million, and most of the money came from student tuition. This reduction directly affected the CHI, particularly in the composition of the last round of clusters. A total of 11 clusters had been approved, consisting of 34 new faculty lines. Of those, only 16 faculty positions were authorized to fill in 6 of the proposed clusters. There is a commitment among UW-Madison administrators to replenishing the CHI, pending success in securing additional resources for faculty hiring and retention. Those have been included in the budget request for 2005-2007, as the 2003-2005 biennial budget was also unfavorable to the university.\textsuperscript{47} UW-Madison will not, in the foreseeable future, engage in further rounds of cluster competitions. The short-term goals are to fill the promised faculty lines, and learn more about the experience of existing clusters.

\textbf{Interdisciplinary Hiring, Disciplinary Structures}

The processes established for and the amount of organizational effort put into the five rounds of cluster competitions, followed by a formal evaluation of the initiative, suggest an institutional interest in making the CHI achieve its goals.\textsuperscript{48} In addition, it is a
role of the Office of the Vice Chancellor for Faculty and Staff Programs to monitor the progress and help the development of the initiative. Somewhat predictably, however, perceptions of CHI’s value are variable. The very condition of troubled finances that motivated the establishment of the program has generated resistance to it, due to the associated loss of college and departmental autonomy. Two upper administrators explain:

The timing of the cluster program… there was a cut from the state to the university budget. Many departments had the experience for the first time, perhaps in years, perhaps ever, when they were not going to get to replace something that they’d always had, one of X, and one of Y and one of Z… and now they’re going to have to pick between X, Y and Z for the next hire. And at the same time they got this cut, the cluster program got created. From the central administration, how would that be described? As, there was going to be a budget cut anyway, and the university came up with an incredibly creative way to go to the state and get positions that we wouldn’t have had… But at the department and faculty level, that was not the experience at all. The experience was, you took away that, and you gave us this instead. You took away something that we needed, that was core, that helped fund our core mission, to teach undergraduates, to fulfill major requirements, and you gave us back something that was completely marginal. That doesn’t help us get anything done that needs to get done, and you expected us to do what we were always doing. That last piece is probably not true, nobody expected them to do what they were always doing except themselves. But institutions are so slow to change…

There are people who are still unhappy with it. I truly think it’s a minority, a very small minority. The complaints you hear ‘oh these are just faddish areas, they are not the core disciplines, you need to be investing the in the core disciplines’, ‘oh, the quality of the people who are being hired in the clusters is not as high, because’ and they will come up with a lot of reasons why this is true. Our analysis indicates that’s not correct at all… It’s people that saw that the department of X lost some number of positions, and they feel the quality of their discipline is being undermined, and the faddish cluster thing comes in, and we’re not rebuilding our strengths.

In addition to shaping the reaction of some departmental faculty and college administrators, the conditions of retrenchment also influenced the format of the program.
It was necessary to cope with the real and perceived needs of colleges and departments to replenish their faculty bodies, which directly influenced the size of clusters:

Had they [the cluster faculty positions] gone into four our five big clumps, big clusters, many people would have felt that they really got robbed. This way, everybody really had a crack at it… but you would have to make the case…. It was a way to enhance interdisciplinarity, while still building across a wide range of disciplines…. The danger of course is that you spread it so thin that you don’t accomplish anything.

The threat of dilution of efforts is not discussed in the internal evaluation of the clusters, conducted in 2003. The report’s evaluative efforts are important and warrant discussion, but suffer from at least two problems that should be noted. These seem to arise from an uncertainty on how to judge the success of the clusters, which was apparent in interviews with administrators, and the reactions on campus to the CHI. In regard to the first, a clear preference for quantitative measures became a liability in the lack of appropriate data, and the evaluation committee failed to circumvent this limitation with a systematic qualitative approach. The report ascertains the effectiveness of the CHI by the selective description of obvious cases where clusters forged interdepartmental connections and developed active interdisciplinary research programs. When quantitative data were available it fell short of portraying the workings of the clusters, such as external research award data that for the most part show no performance differences among cluster and non-cluster faculty. Second, much of the evaluative effort concentrates on assuaging perceptions among some faculty that ‘cluster faculty are a privileged class given preferential treatment resulting in better start-up packages, higher salaries and easier teaching loads,’ by displaying comparisons along such measures. Therefore, despite the attempt to monitor progress, there remains a lack of fundamental
understanding of the common experiences of cluster faculty, and of potentially relevant features of successful clusters that could be instructive to others. An internal conference is planned for 2005 for cluster faculty with the goal of promoting an exchange of such information.

The report notes institutional ‘enthusiasm for’ and ‘euphoria over’ the CHI, despite some shortcomings and the short life of the program. Some of the problems perceived are the complexity and length of the hiring process, the proper attribution of credit and recognition for cluster activities in faculty evaluations, and the long-term maintenance of the clusters given funding uncertainties and the potential loss of faculty lines due to departures. From the viewpoint of cluster faculty, a central concern is of course the weight of their cluster-related work in tenure evaluations. This is particularly relevant to the program since 67% of the faculty were hired at the assistant-professor rank. The first cohort of probationary cluster faculty is still to come up for tenure in 2005/2006, and they will face an evaluation system that has arguably not been adjusted for the advent of clusters. In the university policy for faculty evaluation, there is a suggestion for departmental review committees to, in some instances, consider including outside members to aid in the guidance of faculty, but that is not specifically required in the case of faculty whose work is interdisciplinary. Tenure cases move from the departmental to the divisional committees, and the latter are perceived as powerful units in tenure evaluations. One administrator reports hesitancy of the latter committees in considering adapting evaluation procedures for the inclusion of information on cluster activities in the tenure cases of assistant professors.

Recently, [an administrator] went to the each of the four divisional committees to talk to them about how they were treating the clusters in the [evaluation] process
and found a great deal of hesitation and resistance to treat the cluster hires in any way different than they treat anybody else. And all [the administrator] was really asking them to do was actually make sure they got information about what was going on in the cluster in the dossier that they request… This really is where I’m seeing structural obstacles emerge, it is in the procedures for evaluation. Assistant professors I interact with are worried about whether what they do in the cluster have any merit at all. It is already the case that the service work that clusters entail… is a time consuming activity. It’s not the work of departments, it’s not the conventional service.

Concerns over the receptivity to interdisciplinary work at UW-Madison have indeed generated another report, which was produced to ‘to identify potential disparities in responsibilities and rewards between faculty with interdisciplinary responsibilities and those without.’ 53 Focusing on comparisons between faculty with formal joint-appointments and those with affiliations to a single department, the report finds no disadvantage in obtaining promotion and tenure for the former. However, such finding offers little insight into the experience of cluster faculty, as only 7 percent of them have appointments in more than one department. 54

Interviews with cluster coordinators suggest a fundamental issue not discussed in the CHI evaluation report. 55 Although any small number of clusters would not be representative of the myriad experiences of cluster faculty, site interviews suggest that clusters may easily not come to fruition. The lack of oversight and the loose constitution of clusters as campus units place most of the responsibility and the burden of making them work on the shoulders of the faculty. This issue surfaced both with faculty whose clusters are obviously active and with those in which tangible activities were hard to identify. Central administrators view the lack of structure as needed, to embrace the significant differences in the cultures and work modes of the different disciplines, and to
allow for the diversity of goals clusters display. One senior administrator captures the overall thinking:

If people are going to be successful you have to respect how they operate in their own cultures. You can’t force a one size fits all structure on how clusters ought to be organized, and how they ought to be administered. We sort of let them do their own thing, and then try to get some handle on whether this is working or a disaster, a waste of $15 million. I don’t think even in the worst circumstances this would be a waste, I think what would happen is that people would spring back into the standard faculty model, and we’d end up with 150 new faculty looking like the other faculty.

On the other hand, this arguably leaves much of the success of clusters to chance.

A cluster coordinator most explicitly addressed this issue:

There are some things about the clusters which are both – as is so often the case about structures – both a strength and a weakness (sic). And that is, that the cluster reports to nobody. The strength of that is obviously the freedom that’s involved in there. The weaknesses are that there is very little in the way of resources which are directed to clusters. There’s a little tiny grant program…. and there’s also no one there to protect cluster members…. to provide them with a structure in which they can do their job. For people who have been tugged in more than one direction at once, there isn’t for most clusters someone you can go to say, ‘no, you can’t pull them apart like that.’

Little beyond the personal commitment of individual faculty is at play to induce clusters to pursue collaborative agendas. The role of ‘cluster coordinator’ was downplayed by all faculty interviewed, as a mere formality with no formal roles. Given the concerns regarding the consideration of cluster activities in tenure reviews, it is reasonable to expect that some faculty may feel compelled to focus on work that resonates within their departments during their probationary years, or be advised to do so by mentors, as one administrator suggests (and further notes that ‘the job of the assistant professor is to get tenure’). The level of detachment of clusters from their academic bases and the pursuit of interdisciplinary activities are apparently highly variable. Three faculty
members emphasized the hiring aspect as the decisive characteristic of the CHI, as illustrated in following excerpt:

What we tell them [cluster faculty] is that if they’re getting hired into for example the [X] department, they can just consider themselves to be a member of that department if they want to, who happened to be hired by a different means. They should seek out, proceed in whatever way they think is best for their careers. Of course they also know the vision that we have for the cluster, and we have opportunities that we put before them to collaborate with people that are here.

These opportunities for interdisciplinary collaborations seem to occur more easily when they are intertwined with the interests of academic units. For example, one cluster coordinator describes the research expertise of his cluster and the facility they operate as magnets to faculty in many disciplines. In this case, the expertise that made the faculty attractive to the host department also causes interdisciplinary interactions. Another faculty coordinator credits much of what he perceives as a good performance of his cluster to the development of an educational program that had been in the agenda of his school for many years. Other clusters were reportedly hired into and strengthened ongoing interdisciplinary ORUs. But it is certainly too soon for sound judgments on the prospects of UW-Madison’s clusters. Finding ways to meaningfully assess their contributions will remain the challenge for the coming years.

Decidedly promulgated from the top-down, the CHI resonates with strategic directives outlined in the mid-nineties. It addressed the state of ‘incremental change, ad hoc decisions, and gradual accretion’ critiqued in the 1995 strategic plan in regard to faculty recruitment, and advanced the goal of promoting ‘inter-departmental collaborations’ cutting across the traditional organizational structure. The initiative’s origin was shaped by opportunistic moves and the engineering of the Madison Initiative.
Faced with the opportunity to generate public-private support, the administration centralized control over faculty lines in what is perceived to be an atypical behavior at UW-Madison. The recourse to interdisciplinarity displaced the departmental emphasis on refilling lost positions, and also enabled the dispersion of the new faculty positions across a range of academic units.

The laissez-faire approach for the constitution and operation of clusters was apparently adopted in the name of faculty autonomy. However, it appears to decentralize too much and specify too little. Clusters have been scattered around the university but their faculty belong in the departmental structure. Funding for cluster faculty continues regardless of what they do, provided they remain at the university, and no mechanism exists for verifying the performance of individual clusters. This is somewhat idiosyncratic, given the significant upfront investment of time and effort by those writing cluster proposals and those participating in review and search committees. For the lack of formal interlocutors on campus, and associated lack of accountability and administrative support, clusters can be depicted as lying somewhere between voluntary faculty collaborations and loose interdisciplinary networks. While the interest in unleashing faculty creativity and the respect for disciplinary differences are certainly worthwhile, the lack of structure leaves faculty vulnerable to institutional obstacles to interdisciplinarity and the clusters unaccountable. Administrators recognize and are concerned with the obstacles to the success of cluster faculty, such as evaluation procedures for promotion and tenure. However, no signs of concerted efforts to influence or change those are apparent. What can be inferred from this is that there is hope that clusters succeed, but
they ought to do so by overcoming the traditional institutional and disciplinary barriers to interdisciplinary work.

ARIZONA STATE UNIVERSITY

Arizona State University president Michael Crow has made the most explicit defense of an interdisciplinary strategy for institutional advancement in recent times, as he took office in 2002. Crow articulated that ASU should aspire to excel under a new standard for excellence that emphasizes responsiveness to societal needs, engagement with regional development, and scholarship spanning disciplinary boundaries. Perhaps the best example of what Steven Brint termed ‘interdisciplinary creativity,’ Crow’s ‘design imperatives’ for ASU exhort the university to privilege connectedness and integration over compartmentalized disciplinary specialization. His advocacy of ‘intellectual fusion’ directly addresses the departmental organization:

I encourage teaching and research that is interdisciplinary, multidisciplinary, and transdisciplinary. I encourage the convergence of disciplines, where appropriate, a practice that might more accurately be described as intellectual fusion… Programs that involve multiple departments and schools, that bring together scholars from different disciplines, have unique strengths. In order to overcome the limitations inherent in traditional scholarship, I would like to see ASU undertake strategic recombinations of complementary academic units to create programs that both maximize core strengths and facilitate the creation of new knowledge. The motivation in creating interdisciplinary programs is not to eliminate disciplines as we know them, or to transform core fields, but rather to advance knowledge in the face of its rapidly changing nature… It is no longer adequate to neatly equate disciplines with departments. Rather we must think in terms of programs comprised of disciplines construed across departments and schools.
Recently created units such as the New School of the Life Sciences (SOLS), the BioDesign Institute, and the Institute for Computer and Information Science and Engineering (InCISE) have characterized ASU’s strategy for advancement based upon the principles laid out above. These, as well as the overarching central administrative orientation towards interdisciplinarity, are the focus of this case.

Organizational Restructuring and the Developmental Periphery

The main impetus for interdisciplinarity at ASU emanates from the central administration. Under the current president, the university has aggressively shifted control over discretionary resources, and the power that accompanies them, from the colleges to the office of research and economic affairs. Central investments have targeted multi-school programs and interdisciplinary research units in priority areas. The comments of a senior administrator characterize the context of ASU:

At least in this phase of our development, we have a very, very strong president who has a vision and a very strong will… whereas in a lot of places things evolve more organically, in the sense faculty sort of go along and say, ‘hey, let’s have a center.’ There’s a lot more strategic thinking going on around here. The School of Life Sciences would never have happened, in a million years, from the life sciences faculty themselves…. There is a lot of things done in both investing in the kind of people we hire these days as well as the money that we put back in the system to support projects and programs and centers that, if there isn’t some aspect of interdisciplinarity to it, usually it isn’t going to be supported higher up at the university. The faculty have gotten the message, and fortunately a lot of them enjoy the work.

Two crucial features of the ASU strategy, reverberating Crow’s exhortations, are the selective investment in ORUs and the restructuring of academic units:

Definitely, I think, the historical model of strong, silo departments was the traditional way. At the upper level of the university, people feel that – except in a
few cases – we would not compete well in that game. And so, why replicate what somebody else has done… why don’t we build really strong centers and be good with them?

The BioDesign Institute perhaps best exemplifies this approach of, as Burton Clark would say, ‘enhancing the developmental periphery’ through entrepreneurial ORUs. Other units have been created, such as the Center for the Study of Religion and Conflict, the Consortium for the Study of Rapidly Urbanizing Regions, and the Stardust Center for Affordable Homes and the Family. The older Center for Environmental Studies has been turned into the International Institute for Sustainability, with plans to become a degree-granting school in the near future. However, the BioDesign Institute and InCISE are more developed and represent ASU’s priority areas in terms of sponsored research. The exemplify well the university’s approach of investing in areas where funding is more readily available and institutional investments can provide relatively fast returns in terms of national recognition.

The BioDesign institute fulfills not only Crow’s intellectual fusion imperative, but also the entrepreneurial one. Its mission is ‘to advance innovations improving human health and quality of life through use-inspired, biosystems research and effective, multidisciplinary partnerships.’ Blending biology, computing and engineering, the BioDesign Institute aims at quickly magnifying ASU’s research enterprise by tapping on the huge life sciences research market. Its goals include 25 percent annual increases in research funding, 20 percent annual increases in industrial partnerships, a doubling its research capacity in five years. Organizationally, the institute clusters faculty into 10 research centers, distributed in contiguous laboratory spaces to facilitate interdisciplinary
interactions. The centers explore various interfaces among the three main areas fields, fulfilling a number of niches:

- Center for Applied NanoBioscience
- Center for Bioelectronics and Biosensors
- Center for BioOptical Nanotechnology
- Center for Environmental Biotechnology
- Center for Evolutionary Functional Genomics
- Center for Infectious Diseases and Vaccinology
- Center for Neural Interface Design
- Center for Protein and Peptide Therapeutics
- Center for Rehabilitation Neuroscience and Rehabilitation Engineering
- Center for Single Molecule Biophysics

A newly inaugurated 170,000 square feet facility is the first of a projected four-building complex totaling over 800,000 square feet of research space. The entrepreneurial flavor of the institute is well demonstrated by its space allocation policy. Faculty must commit to attract external funding in proportion to the laboratory space requested, following a formula that calculates the adequate ‘return on the investment’ per square foot of used space. A non-academic administrative cadre manages the complex operations of the institute, and its director has extensive experience and a distinguished career in industrial R&D.63

InCISE is another outcome of ASU’s centralized investments in the developmental periphery. Emerging from the School of Engineering and connected to the office of research and economic development, this unit’s goal summarizes the essential traits of the interdisciplinary institute model: ‘to leverage selective investments in collaborative, interdisciplinary projects to build partnerships between researchers, improve visibility with funding agencies, and produce successful large collaborative proposals that would not be possible using traditional approaches emphasizing individual
InCISE is an umbrella organization for five core research units and another three affiliated research groups. Its emphases lie on the interaction of computer and information science with other academic fields and on applications. Maximizing the research productivity, as in the case of the BioDesign Institute, is a formal goal to be assessed by metrics such as the ‘return on investments.’

ASU, like Penn State, has implemented an accounting system that allows for both academic units and ORUs to be recognized for faculty’s sponsored research activities. In regard to the financial assignment of credit, a quarter of the indirect cost recoveries are channeled through the office of research back to the colleges, departments and the research units as a proportion of their participation in the grant. The university is still coping with issues in this system; for example, questions arise regarding the right mechanism to account for and compensate units when equipment will be purchased or space allocated for interdisciplinary groups.

The second administrative strategy, aimed at addressing academic weaknesses, has been to reengineer departments in such a way as to exploit untapped subspecialties within, between and across disciplines. A senior administrator describes the reach of this approach within the university:

You have departments looking to reorganize, grow, and a lot of different organic processes that now result in about a dozen new schools popping up around the university, most of them in the College of Liberal Arts and Sciences. So, the School of Global Studies, School of Human Diversity and Social Change, which is basically the anthropology department, School of Earth and Space Exploration, which is geology, plus astronomy, plus engineering. The Dean is using this to take weak departments and break them up into pieces that might have a better chance at becoming something good and eliminating pieces… for instance, the sociology department is going away… it will break up into three pieces. It’s sort of like redistricting.
The structural reengineering leading to the SOLS is one example of that. ASU consolidated the old departments of biology, microbiology and plant biology into a new school within the College of Arts and Sciences. Its professoriate is clustered into six faculties with no fixed budgetary lines. SOLS has been described as taking ‘a directed approach to changing the culture’ to support ‘both disciplinary and interdisciplinary approaches to research.’ The school also provides seed grants to stimulate collaborative work.

The Evolution of ASU’s Interdisciplinary Strategies

Enthusiasts of narratives centered on leaders and their ability to change organizations would readily embrace the start of Crow’s presidency as origin of the current interdisciplinary strategies at ASU. Although his aggressive promotion of interdisciplinarity has certainly had an impact in the administration of the university and in the priority afforded to ORUs, the current president seems to be an enabler of latent thrusts that had existed for longer. After Crow took office in 2002, the senior administrative team went through changes to assure buy-in of the interdisciplinary and research agendas, as explained by an interviewee in the upper administration.

Over the seven and a half years that I’ve been in [the administration] some deans got it and some deans didn’t get it. And I would say that our previous president didn’t have a strong feel for research… Not that much really moved. But when president Crow came in, who studied science policy as his area of expertise and was a senior research officer at Columbia, a top ten research university in the country, he was willing to back up the things that [the office of research] was doing with administrative clout. And he also was willing to work with the Provost to replace some of the deans or encourage them to move on. What we have now is, pretty much across the board, the senior administration leadership of the university understands the goal.
ASU is a relatively new contender in the research market and secondary to the University of Arizona in the state. A historical comparison of its performance in sponsored research against ‘peer’ institutions illustrates ASU’s incremental pace of advancement in research over the past 15 years. In the figure below, the trajectory of ASU’s total R&D expenditures was plotted against those of universities that were at a comparable level in 1995, a decade ago. Such comparison, although reducing complex organizational realities to a single indicator, evidences the constant evolution of ASU and like-universities, which makes the quest for relative progress a competitive ‘race.’ Utah State, whose ascendant performance in the early 1990s appeared to have detached the university from this peer group, oscillated and remained close to ASU and others by the early 2000s. The University of South Carolina started from a lower point in the late 1980s but has caught up and remained at comparable levels to ASU since the early 1990s. On the other hand, Kansas State and Oklahoma State, other ‘second state universities,’ have fallen behind since the late 1990s. UC-Santa Barbara leads the pack by a small margin.
In its quest for a larger role in sponsored research, ASU still finds the legacy of its prior orientation towards undergraduate education influences the receptivity of the new thrusts. One upper administrator explains:

I’d almost want to say that we have two generations of faculty because of the evolution of the university… until twenty years ago this wasn’t a serious research institution; it was more an undergraduate education university. Sometime twenty or twenty-five years ago people started to get hired for their research strengths and the vision was that this was going to be a stronger research university. So you have a generation that was brought in to be researchers and a generation that was brought it to be teachers with some research. I think what you would find among the faculty hired in the last ten years is that the majority of them would embrace interdisciplinary research.

ASU’s top-down approach was enabled by the generation of discretionary resources for the central administration to fund its priorities. Part of that was achieved through state technology-based economic development policies, following a national trend. A state referendum in 2000 passed Proposition 301, which raised sales taxes in
0.6 percent to fund education. As part of the proposition, each of the state universities receives Technology and Research Initiative funds. The universities have to justify these allocations through plans to invest in certain areas, and ASU elected the fields of (1) biosciences and technology, (2) information science and technology, (3) materials research, and (4) manufacturing, in addition to programs in (5) technology transfer and (6) workforce development. TRIF moneys have supported research, with the first two areas receiving the lion’s share of the allocations. In 2002, ASU received almost $5 million of such funding, and the figure rose to $26.5 in the following year. The availability of these resources created the conditions for the establishment of the initiatives in bioscience and technology and computer and information science before Crow’s tenure.

Since then, the BioDesign Institute has clearly taken the lead as the most conspicuous move to bolster organized research on the Tempe campus. This unit alone has received over a third of TRIF allocations. Not having a medical school, ASU’s alternative to get into the life sciences was to couple the biosciences with the existing strengths in engineering and informatics. The institute has helped hire 20-25 tenure-line faculty members by providing start-up funding and salaries for 3-5 years, after which their home departments pick up the faculty’s costs. It proudly boasts early successes in helping attract distinguished scientists. Non-tenure research faculty are also hired for projects on a need basis. The university invested $69 million in the first BioDesign building, which is regarded as a ‘world-class facility’ and described as a hub for interdisciplinary collaborations. The building was erected between late 2002, when BioDesign was conceptualized as the central focus of the biosciences and biotechnology initiative receiving state funds, and late 2004.
The origins of InCISE lie in a proposal from the chair of the department of computer science and engineering to better exploit TRIF funding to information sciences and technology. The overall idea was ‘to shake the departmental structure of silos’ making computer and information sciences ubiquitous on campus and, in the process, elevate the department to the top-25 nationally. The office of research and economic development backed up the proposal, and the unit was created in 2003 with central funding of $2 million a year. InCISE employs the mechanisms of seed funding and center nurturing to foster interdisciplinary collaborations, and also provides faculty with research support services, workshops and space for neophyte collaborators. It also seeks to establish connection to other units, in general, and to BioDesign, in particular.

The New School of the Life Sciences came about after a decade of studies on how to organize the biological departments at ASU failed to reach consensus. A new dean was appointed to the College of Arts and Sciences in 2001, and he pursued the merger of the departments in 2003. According to one administrator, ‘he had this vision of having a college that was full of schools. Instead of having the old departmental… disciplines, they [would] have schools that brought in a mix of disciplines together.’ For the school directorship, ASU hired a department chair from the University of California-Davis with extensive interdisciplinary experience. The move towards SOLS is consistent with the College’s ‘redistricting’ approach mentioned above.

Institutional Advancement and Interdisciplinary Organizations

ASU’s strategies of institutional advancement lead to many questions: whether colleges can thrive based on schools, what the proper balance between ORUs and
departments is, and whether the resources will be continually available to sustain an interdisciplinary emphasis. By partially deviating from the institutionalized disciplinary-departmental model, the university is forced to confront these issues as it attempts to build a strong faculty. Faculty hiring has been both department and center-initiated, but a departmental tenure home is still the norm. In regard to resources, one research administrator explains that philanthropy may not be a feasible alternative for ASU to start and support interdisciplinary programs because alumni’s allegiances are tightly associated with particular colleges. Conciliating the interests of colleges and interdisciplinary programs is a source of tensions not only internally, but also with such constituencies. Asked if the focal point of university development has shifted from the academic core to the ‘periphery,’ one senior administrator reasons:

I think where there’s more confusion around here is… who really takes the lead in deciding what kind of people we hire? Are department chairs taking the lead in the hiring to build strong departments? That’s what they’re interested in. Or is the center trying to build a strong center and recruiting people that they think would fit well in the center and then they have to find a home for them in a department? We have both of those things going on… I would say there’s not agreement among our faculty as to whether we should build strong departments or strong centers… or whether you can build a strong college without building strong departments. If I had to generally say what I thought the deans - in hiring - would say is that they’re interested in getting good people and we need to make the new initiatives work. Departments become the leaders for the academic programs, but they’re becoming probably less of the leaders for the research programs.

The leadership of the interdisciplinary centers and institutes on campus is perceived by some as antithetical to the transient and reconfigurable character that they believe interdisciplinary programs should have, as expressed in Crow’s ‘design imperatives.’ For example, the institutional clout of the BioDesign Institute and the resources it controls suggests a research drift to strong ORUs. The descriptions of the
institute’s new facility as a space to facilitate multidisciplinary collaborations need to be contextualized; its encapsulated design, location on the edge of the campus, and restricted access that requires eye-scans for entry demarcate clear boundaries from other units. The need to realize the ambitious expected returns on the investment translate into a more focused and top-down operation. Reverberation of the confusion regarding the roles of academic units and ORUs in general and the place of BioDesign in particular, are captured in the opinion of an academic administrator from one of the colleges:

The jury is still out in BioDesign, in my opinion. I suspect that if you would come back three years from now, you are going to find out that it has become an independent institute, it’s going to be tenuring its own faculty, and having its own graduate programs. It’s too big, too organized, too independently structured. They’re already appointing a graduate programs’ coordinator... and they’re not a degree-granting unit.

Indeed, in 2005 the institute announced training opportunities for graduate students in an interdisciplinary program including lab rotations, still under development.\(^{73}\)

Whether the strategy of reengineering departments into new units will help the university raise its stature is a question to be answered in the long run. However, that SOLS merger has led to an interdisciplinary organization seems difficult to sustain, despite SOLS’ being presented as an ‘important example of intellectual fusion.’\(^{74}\) The repeated failures to unify the departments were symptomatic of longstanding territoriality and fragmented loyalties. The top-down integration may have been a needed shock treatment administratively, but evidence of culture change is still faint. One interviewee assesses the recent evolution of the school:

This place was almost dysfunctional in my view. [There was] a faculty meeting, a senate meeting, and faculty yelled at each other and stomped out of the room. When I read over the bylaws, it was just this restrictive set of things that basically means nothing can change anymore because everybody was just sort of protecting
themselves. It’s a very protectionist document, that we are changing now. Complete distrust in each other. Even the staff here, were drawn together from three departments, and they were fighting… that’s how [department X] did it, but we did it better in [department Y]… the curriculum is a combination of the old departments.

Asking about the effectiveness of the arrangement of the ‘faculty’ organizational model to promote new clusters of people along interdisciplinary lines, the interviewee above responds:

Faculties were supposed to be these changeable units. Where, it kind of changes with times and needs, you can change your membership… I would call it an affinity group. [Faculty members] immediately organized back into things that looked like the old departments, and they all joined their own groups and now they’ve got their own peers. Because that’s the people they feel comfortable with, and merits and promotions, and all those issues are dealt with personnel committees within each of these faculties. Even within the old departments there were factions. The people who used to hang out together still hang out together. Now we have this problem that they haven’t really integrated.

SOLS presents a good case for the investigation of the academic equivalent to corporate mergers or firm reengineering. While the new unit is still in its infancy, the challenges to be addressed in the near future are more proximally related to making the integration come to fruition. Substituting labels, such as ‘faculties’ for ‘departments,’ is a far cry from the cultural change needed to realize the stated vision of building an interdisciplinary organization. Part of that may be attributable to the subsisting evaluation structures, which provide incentives for the like-minded to remain together. On a more subjective level, lack of faculty ownership for the new school, which essentially resulted from a top-down decision, and mutual distrust, seem to be serious obstacles to integration.
ASU exemplifies essentially top-down strategies to promote interdisciplinary research. Those strategies arise from the perceived need to bypass the mainstream system of disciplinary evaluation to obtain recognition and resources. Along the way of such transformation towards a more entrepreneurial, regionally-embedded, and responsive university, ASU seeks to overcome its academic weaknesses. To the extent that the interdisciplinary approaches adopted translate into success in sponsored research, the university may be able to capitalize upon its crosscutting initiatives to raise the stature of the faculty. A sustained impetus to back up such initiatives with sizable funding is indispensable, and the willingness of the state to maintain funding for academic research in the long run may be crucial for that.

Questions remain on how far the university will go in shifting the power structures further to the interdisciplinary centers and institutes. If viewed from the perspective of the relative investments made so far, the latter have obviously been privileged. The ‘redistricting’ approach to consolidate departments or form schools may lead to recognition in niches, but success will ultimately depend upon the viability of these fields emphasized in the research and education markets, as well as academic quality. To judge from the example of SOLS, top-down implementation may be a quicker and surer way of pursuing such strategy, but it is not enough. Longer processes involving changes in organizational culture and identity are needed if such units are to develop new ways of producing and disseminating knowledge.
ENDNOTES


2 They are the life sciences; materials; environmental sciences; children, youth and families; and social sciences research. See the Pennsylvania State University, Progress Amidst Challenge – The Penn State Strategic Plan, (University Park, PA: Office of Planning and Institutional Assessment, 2002), 6. See also The Pennsylvania State University, Office of the Vice President for Research Strategic Plan 2002 – 2005, (University Park, PA: Office of the Vice President for Research, 2002), 24-35.

3 For IAH programs, see http://php.scripts.psu.edu/dept/iah/grants.php. Note that IAH is listed in the website of the OVPR alongside the other units (see http://www.research.psu.edu/ir/). Both the website and the most recent annual report on research also list the Applied Research Laboratory and ‘defense’, among the other four units and strategic priorities, respectively. See the Pennsylvania State University, Annual Report of Research Activity FY 2004, (University Park, PA: Office of the Vice President for Research, 2005), 3. However, the centrality of the other four institutes was re-affirmed in 2005 - see The Pennsylvania State University, Office of the Vice President for Research Strategic Plan 2005-2008, (University Park, PA: Office of the Vice President for Research, 2005), 33.


6 Penn State, OVPR Strategic Plan, op. cit. note 2, 35.

7 See discussion on ORUs in Chapter 2. Universities that use variants of responsibility center management seem particularly prone to facing such issues. The University of Michigan has found the implementation of RCM to affect the predisposition of units to support interdisciplinary work. See University of Michigan, New Openings for the Research University: Advancing Collaborative, Integrative, and Interdisciplinary Research and Learning, (Ann Arbor, MI: University of Michigan, Office of the Provost, 2000).

8 Eva Pell, The Challenges of Public Research Universities, Presented at the Research Universities Colloquium, Department of Education Policy Studies, Penn State University, (March 2, 2004).

9 See Penn State, OVPR Strategic Plan, op. cit. note 2, 35-36.

10 Ibid., 35.

11 This is yet another factor setting IAH aside – its director reports to the Deans of two colleges, and not directly to the Vice President for Research.

12 For the plans to strengthen expertise in the neurosciences, see Penn State, OVPR Strategic Plan, op. cit note 2, 25.

13 See the RFP at http://hils.psu.edu/grantguide.html.


Pell, *op. cit.* note 8; Robert McGrath, *The Organization of Interdisciplinary Research at the Pennsylvania State University*, Presented at the Research Universities Colloquium, Department of Education Policy Studies, Penn State University, April 6, 2004.

For data on sponsored research, see Penn State, *OVPR Strategic Plan, op. cit.* note 2, 3-17. For an earlier diagnostic of the weakness in the life sciences, see Brown, *op. cit.* note 14.

The number of 60 co-funded positions depended on success in recruitment taking place during spring 2005. This figure was corroborated in the latest presidential state of the university address. See Graham Spanier, *State of the University*, (September 9, 2005), http://president.psu.edu/sou/articles/176.html.


The IRPs were the Institute for Policy Research and Evaluation and the Populations Research Institute. See Eva J. Pell, *Penn State Research: Update on Activities – A report to the Board of Trustees* (May 10, 2002), 3. Co-funded faculty positions were originally allocated to CYFC and not to SSRI.

Penn State seeks to explore niches that link these two areas, such as nanobio research. There are also collaborations involving the PSIE and Huck. See Penn State, *op. cit.* note 3, 26, 39.

Pell, *op. cit.* note 8.


See ‘Organized Interdisciplinary Research in the University,’ Chapter 2.

See ‘Interdisciplinarity as a University Strategy,’ Chapter 2.

These figures exclude the College of Medicine-Hershey, Dickinson School of Law, and the Pennsylvania College of Technology (Source: Penn State Budget Office, http://www.budget.psu.edu/BOTJuly/default.asp).

Pell, *op. cit.* note 8.

Feller suggests that institutions like Penn State are more likely to compete against other up-and-coming public universities than to be able to catch up with leading private institutions. Irwin Feller, *Who Races with Whom; Who is Likely to Win (or Survive); Why*, Paper delivered at the Symposium ‘The Future of the American Public Research University,’ (February 25-26, 2005), The Pennsylvania State University, University Park, PA.


32 See Penn State, *OVPR Strategic Plan*, op. cit. note 3, 33.

33 Ibid, 34-37.

34 The co-funding agreement can be viewed through the theoretical lens of principal-agent theory, which deals with relationship of delegation whereby actors seek their own interests by exchanging resources. Principal-agent theory has been used in research policy since the early 1990s. See Dietmar Braun and David Guston, ‘Principal-agent Theory and Research Policy: An Introduction,’ *Science and Public Policy*, 30(5), (2003): 302-308.

35 For the possibility of faculty 'shirking,' Norma Morris offers the rationale of scientists for not abiding to research patron’s guidelines: ‘Though scientists do respect the principal’s priorities in orienting their work and framing their proposals, they feel they can confidently ignore those terms of their contract that might get in the way of their scientific work’ (p. 361), Norma Morris, “Academic Researchers as ‘Agents’ of Science Policy,” *Science and Public Policy*, 30(5), (2003): 359-370.

36 Penn State, *OVPR Strategic Plan*, op. cit. note 3, 55-57.

37 Ibid., 39. For the projected number of new faculty, see Huck Institute for the Life Sciences Newsletter, (Spring 2005), 8. http://www.huck.psu.edu/Spring2005Newsletter.pdf.


40 See http://wiscinfo.doit.wisc.edu/cluster/progrmdesc.html.

41 http://wiscinfo.doit.wisc.edu/cluster/overviewr5.html#Criteria.


45 The provost’s office invests 200,000 per year on the program, and awards up to 20,000/year over three years to successful proposals. These grants have supported academic events and graduate students, for example.

46 See http://wiscinfo.doit.wisc.edu/cluster/overviewr5.html.

47 See State of Wisconsin, Department of Administration, Division of Executive Budget and Finance, *Budget in Brief*, (February 2005), 5.
48 UW-Madison, op. cit. note 44.

49 Ibid., 2.

50 Ibid., 22-23.

51 Ibid., 16.


53 University of Wisconsin-Madison, *Report of the Ad Hoc Committee on Faculty in Interdisciplinary Programs*, (March, 2003), 1.

54 The report presents some evidence that faculty with joint-appointments have not suffered in tenure and evaluations, and offers recommendations on how to improve the climate for interdisciplinarity at UW-Madison. The approaches discussed are by and large those discussed in Chapter 3: seeding interdisciplinary programs, adapting evaluation and reward structures to account for interdisciplinary work, creating spaces for inter-departmental groups of researchers. The report also suggested changes in the allocation of credit to reward departments that support the interdisciplinary work of their faculty.

55 Invitations to concede an interview were sent out to the coordinators of clusters having 3 or more faculty. Five cluster coordinators were available and willing to participate, four of which were in the natural sciences, and one crossing the natural and social sciences.


58 See discussion on Chapter 2.

59 Ibid., 26.


61 ‘We have invested discretionary resources in initiatives and projects that we felt had the best chance of meeting aggressive financial return on investment targets, and which also had the greatest likelihood of bringing national recognition to ASU.’ See Arizona State University Alumni Association, *Building ASU’s Future – ASU Vision Special Edition*, 7(1), (Fall 2003), 6.

62 Presented to my by an administrator of the institute.


64 http://incise.asu.edu/about/index.html.

65 National Academies, op. cit. note 4, 67.

66 Feller, op. cit. note 29.

67 See Chapter 3.


See Skip Derra, ‘Biodesign Institute brings world-class labs to ASU,’ *ASU Insight*, (December 10, 2004), B1.

For the conceptualization, see Crow, *op. cit.* note 57, 18.

http://www.biodesign.asu.edu/graduates/


CHAPTER 5

INTERDISCIPLINARY STRATEGIES AT PRIVATE UNIVERSITIES

The elite private sector in higher education enjoys a comfortable competitive position. Private institutions best represent the self-reliance of American universities, setting their own standards through the continuous search for academic leadership. Stanford and Duke are both at the higher echelons of prestige, and illustrate distinct patterns of commitment to interdisciplinary approaches. Stanford’s case reports on a campus where inter-school initiatives have emerged amid an otherwise traditional university structure. Most prominent are the Bio-X program and the Clark Center, one of the emerging spaces for interdisciplinary science reported in Chapter 3. The Duke case analyzes comprehensive efforts to make interdisciplinarity a true comparative advantage for one of the most distinguished universities in the country. Duke seems poised to capture the best of traditional and emerging university directions, by combining disciplinary strengths with a unique predisposition towards interdisciplinary creativity.

STANFORD UNIVERSITY

Stanford has historically promoted interdisciplinary research beyond its schools through a number of independent research laboratories, centers and institutes (hereafter called independent labs). Currently, there are thirteen independent labs under the Dean of Research – the earliest was founded during World War II and the most recent in 2003. Most of them can be described as *interdisciplinary centers*, as discussed in Chapter 3.
However, three initiatives emerged in recent years at Stanford which are broader in scope: the Stanford Program for Bioengineering, Biomedicine, and Biosciences (Bio-X), the Stanford Institute for the Environment (SIE), and the Stanford International Initiative. Given the incipiency of the latter, the focus of the discussion is on the reportedly major ones, Bio-X and SIE. \(^2\) Centered on independent labs, they resemble more closely the interdisciplinary institute pattern.

**Independent Labs and Multidisciplinary Initiatives**

In the Stanford vocabulary of organizational forms, independent labs are the formal structures for organized interdisciplinary research. The ORUs carrying the label ‘independent’ are more formally organized, report to the Dean of Research, and draw on faculty from more than one school. As they require additional resources, the university seems to control the creation and continuation of these units closely. To establish one, proponents must satisfy several requirements, including clear sources of sustainability and evidence of the need for a multidisciplinary organization. Periodical evaluations including sunset provisions may result in termination or restructuring. \(^3\) To understand these units within their context, one must note that Stanford is highly decentralized. The remarks of the head of an interdisciplinary unit help set this context.

All things at Stanford are bottom-up… very few programs are top-down. [Vice Provost and Dean of Research] Arthur Bienenstock does not sit in his office and say ‘would it be interesting to have a program, something like [name of unit], why don’t we get some guys to do it’. It’s absolutely the other direction. So, I think, the faculty here are increasingly aware in their research that doing good basic science depends on collaboration with people outside of their department as much as inside their department, that’s just more and more true… and also application of ideas in the real world requires collaboration outside of the departments. So
those are really motivations for doing this. (...) So [name of unit] is… all of these programs are trying to help individual faculty, they are not really heavy, top-down, highly organized programs, that can count on an annual budget from the university… this is unlike a lot of other places.

Two of the most recently created independent labs illustrate Stanford’s top-down and bottom-up efforts. The Geballe Laboratory for Advanced Materials (G-LAM) is the latest step in the evolution of materials research organizations at the university, which started with a federally-funded Materials Research Laboratory established in the 1960s. Leading to the construction of G-LAM was the perception that a common facility could harness collaborations more effectively by placing scientists under one roof, instead of disbursing research funds to faculty within their departments, as in the old MRL model. G-LAM was created in 1999 to provide core facilities and research services for faculty from seven schools. It works as an umbrella organization, administering pre-existing centers and new units like the Stanford Nanocharacterization Laboratory. Basically, this interdisciplinary laboratory enhances the infrastructure for materials research. A different role is fulfilled by Media-X, the new industrial affiliates program connected to the longstanding Center for the Study of Language and Information. Media-X emerged from bottom-up academic entrepreneurialism, and subsists in meeting the needs of external research sponsors. Its expertise is presented as ‘interactive technology’ – a shortcut comprising topics related to people’s use, learning and design of electronic technology. Entirely self-supporting, Media-X exemplifies Stanford’s culture of enlisting corporate partners, whose membership fees fund primarily basic science, to provide them with access to cutting edge research. This interdisciplinary network exploits the interest of the
private sector and governmental agencies in generic research, creating synergies between faculty agendas and external opportunities.

Differently from these and other independent labs, the Stanford multidisciplinary initiatives are conceptualized as far-reaching institutional commitments to relevant fields, involving multidisciplinary units and potentially all schools. The current president expresses a commitment to sustaining those initiatives and making them an intrinsic part of the university rather than peripheral appendages.

Of course, a comprehensive effort to increase the resources we devote to multidisciplinary research and teaching creates several challenges and pitfalls. Some of the most significant challenges arise from a disconnect between interdisciplinary initiatives and the existing structure of schools and departments, which relies on a disciplinary model to organize teaching, research, and the allocation of resources. Engaging in cross-departmental, and cross-school, research and teaching will require that we are flexible and adaptive so that the very structure of the institution does not become a stumbling block. Stanford's faculty members are known for their ability to collaborate across such boundaries. All of us -- the Provost, the Deans, and I -- are determined that institutional barriers will not become stumbling blocks to these initiatives.

Organizationally, the central nodes of these initiatives have taken the form of new independent labs, and owe much to the way Stanford structures them. They display the common approaches of seeding collaborative research, promoting interdisciplinary seminars and degree options, and managing core infrastructure for the faculty at large. Faculty participating in Bio-X and SIE retain a departmental home, where promotion and tenure decisions take place. Departments also administer external research grants and contracts obtained under the umbrella of Bio-X and SIE. Bio-X awards a limited number of graduate and post-doctoral fellowships, funded by private gifts. All students are affiliated with departmental graduate programs.
In 2000, a needs assessment exercise formalized the current emphasis on the
development of Bio-X, SIE and the International Initiative. This process could be
viewed as a moment of reflection on the development and significance of these
initiatives, but not as their origin. By that year, foundations were in place for both Bio-X
and SIE. Bio-X’s exegesis entailed bottom-up entrepreneurialism, leadership
engagement, institutional ambition, and timely philanthropic support. SIE similarly
emerged from the bottom-up and gained serious administrative backing afterwards.

Asked about the role of planning on the definition of priorities for investments, a senior
administrator responds:

I am skeptical of strategic planning. Every one of us in this building and the deans
recognize that creativity of the faculty is much greater than our collective
wisdom… and if you want to have an institution where that creativity flourishes…
so, if I have to say what is item number one in our strategic plan? It is get the best
faculty you can get.

Indeed, cross-departmental collaborations are seen as typical of the culture of the
university. All those interviewed for this study seemed convinced of a certain uniqueness
of Stanford in having such a culture. One distinguished scientist and academic leader,
with vast experience at the university, provides a candid explanation for his assessment of
the university’s context as conducive to collaborative work:

This whole area is characterized by that. For instance, there is an analysis of this
area compared to route 128. Companies [here] work together… usually
competitors will help each other. It is really nice, people like each other. Another
thing is… faculty live on campus, a large fraction of the faculty live on campus.
You meet your neighbors in all sorts of different departments. I for a long time
had a collaboration with two successive faculty in Earth Sciences that started
because the daughter of one of them was babysitting for us. He and I got to
speaking and we realized that we were interested in complementary aspects of the
same problem and we started working together. I co-supervised his students and
then his successor’s students. We have a faculty swimming pool, where you meet your colleagues from all different departments and we talk together. And, for some reason that I don’t understand, there is just a lot of mutual respect… you know, you have a history here of deans of engineering supporting the humanities strongly, and things of that sort, that I just didn’t see before at other institutions. But it’s part of the nature of this place, people like each other.

Reflecting the essence of the commentary above, the roots of Bio-X lie in the longtime collaboration between two Stanford faculty members, James Spudich (a developmental biologist) and Steven Chu (a physicist). During the 1990s, they garnered support from other scientists interested in conducting research that involved interactions among the biosciences and engineering, physics, medicine, chemistry, computer science, among other fields. This group of faculty nurtured a vision of infusing the biosciences with scientific approaches from these various disciplines and vice-versa. In 1998, they started an initiative informally labeled Bio-X, and engaged in discussions with the central administration. As a result of those discussions, former provost Condoleezza Rice and former vice provost Charles Krueger (now Bio-X deputy chair) established a multi-school planning committee with the charge of recommending an organizational model for the initiative. One of the fundamental issues faced at the time was a noticeable lack of linkages between the medical school and relevant units in the physical and life sciences.

The idea that emerged was of a broad-based initiative that encompassed medical, physical and biological scientists and engineers at large, but also provided a focal point to nurture interdisciplinary interactions. Part of the plan was to establish the infrastructure to enable the initiative to thrive. That started to materialize when then provost and current president John Hennessy approached Silicon Valley entrepreneur and former Stanford professor Jim Clark for a gift. In 1999, Clark announced a $150 million donation to
Stanford, mainly to build a new facility,\textsuperscript{9} which was supplemented by a $60 million anonymous gift in 2000. The James H. Clark Center was conceived as a multidisciplinary hub, and has enabled the more specific agenda of Bio-X: the creation of a critical mass of scientists with a commitment to think differently about research. The Clark Center’s conceptualization and role in the advancement of Bio-X are discussed in the section below. The broader agenda of Bio-X has been pursued by enlisting faculty affiliates from 58 departments, who are interested in at least one of the eight scientific themes of the program. It has also been promoted through the Bio-X Interdisciplinary Initiatives, a seed grant program that funded forty projects with a total $6 million in 2000 and 2002. Seminar series, lectures, short courses and other events complement the mix of activities.

The origins of the environmental initiative can be traced back to the creation of the Earth Systems Undergraduate Program and the Environmental Faculty Forum in the 1993 academic year. The forum gave faculty doing research on the environment a means to convene, and the idea of constituting an overarching structure in the field gradually matured. The faculty approached the Provost, and a succession of studies followed during the 1990s. The alternative of creating a new school surfaced during deliberations of a Provost-appointed committee. Nevertheless, it was felt that the interdisciplinary mission intended for this endeavor would better be met through an institute model. An institute would allow for the inclusion and leveraging of existing strengths in departments and schools, despite the obvious resource advantages of schools. The committee conceived a broad Environmental Initiative, with a new independent lab as its centerpiece. SIE was created to help articulate academic units and ORUs, undergraduate and graduate degree options, and provide incentives to nurture collaborative research programs.\textsuperscript{10}
During its formative years, SIE built a web portal to communicate internally and externally resources available at Stanford in environmental research. Achieving higher visibility to environmental research and education at the university has been a goal ever since. With presidential-funds, the Environmental Interdisciplinary Initiatives Program was started in 2003 to promote research collaborations among faculty in different schools. A senior faculty position was allocated to SIE for a cross-school search, also on the President’s budget. Eventually, SIE will have 6-8 full-time equivalent faculty positions that may be leveraged with joint-appointments with departments. Its new building will host environment-related research centers and house a core group of faculty.  

Even as these initiatives are identified as major commitments at the university, the university is careful in the relative priority given to them. As one interviewee indicates, the fact that the senior administration is not critical of academic departments helps in the acceptance of the multidisciplinary initiatives. Traditional tensions accruing from the centrality of schools and departments and the autonomy of independent labs exist, but in the words of a lab director, Stanford ‘would rather live and deal with them’ than to displace the power of the academic units. Allocation of resources, such as space, and recognition for research conducted in multidisciplinary arrangements are some of the usual problems also faced at Stanford. From the perspective of the independent labs, working with faculty from different schools presents challenges, because of the different policies, administrative norms and expectations of their home units.

Bio-X has certainly gone farther in its development, and commanded more attention and praise recently.  

Within Stanford, the experience accumulated in the
evolution of Bio-X seems to have influenced the plans for SIE’s development.\textsuperscript{13} The former has a close symbiosis with a major new facility, which is one of the emerging spaces for interdisciplinary science discussed in the previous chapter. For the recent endorsements that it received and for representing an emerging trend among research universities, the conceptualization and implementation of this facility are discussed below.

Building Interdisciplinarity

The idea of breaking down the barriers – physical, cultural and bureaucratic – between disciplines was taken seriously in the planning of Stanford’s showcase interdisciplinary building. The sophistication of the Clark Center’s design conveys careful planning to fulfill an interdisciplinary mandate in the smallest details. Its glass-walled laboratory spaces are open and ample, housing multiple faculty and student teams seamlessly and shaking the notion of ‘Professor X’s Lab’ followed by and separated from ‘Professor Y’s Lab.’ Break areas, meeting places and some equipment are shared. Furniture, benches and utility hookups were devised in such a way as to facilitate quick and cheap rearrangements of lay-out. One’s architectural instincts are challenged by the curvy design of the building’s three wings, which reveal more than conceal the scientific work going on inside of them. The voyeurism of passer-bys is stimulated by the ubiquitous use of glass, making the center an attractive site for anthropologists and sociologists of science.

The Clark Center houses Bio-X and, temporarily, the new Department of Bioengineering. There are 35 Bio-X faculty residents at the center and about a half-dozen
faculty of the department, along with students and post-docs.\textsuperscript{14} How and with whom to occupy the building were the subject of long discussions. The alternative that prevailed was for Bio-X to form clusters of faculty whose research agendas indicated potential synergism along novel lines of inquiry, avoiding the reproduction of familiar webs of departmental relations as well as traditional topical affinities. The difficulties in creating consensus around this alternative should not be underestimated, but were ultimately overcome. A process involving faculty volunteerism and deliberation by Deans and the council spearheading Bio-X eventually resulted in nominations for faculty residents. Around 25 percent of the vacancies were reserved for new hires.

One explicit assumption in the concept of the Clark Center is that interdisciplinarity is best achieved through spontaneous faculty collaborations, but that those can be bred. Workspace sharing is perhaps the most direct example of the attempt to orchestrate associations among faculty and students with different backgrounds. In general, participation in centers seems to increase the likelihood of inter- and multi-disciplinary collaborations as one would expect, and moderately-sized groupings within centers play an important role in that.\textsuperscript{15} Bio-X is organized to advance more intimate connections among four to five faculty labs in the shared work areas, and programmatically foster other interactions through academic events. One such activity is dubbed ‘Talks in English,’ a lecture series for faculty to discuss their research in accessible language for colleagues from other disciplines.

More subtly, there is also a belief in the power of the Center to induce happenstance. This belief permeates the idea that the Center’s location, precisely between the medical facilities and the main science and engineering buildings, and amenities
facilitate casual encounters and social gatherings among faculty and students.\textsuperscript{16} Indeed, anecdotal accounts emerged of innovative research enabled by conversations among colleagues who would hardly meet had they not been working at the Clark Center, and of the social interactions at the restaurant and coffee shop that reveal opportunities for scientific cooperation.\textsuperscript{17} Whether such social affairs lead to fruitful collaborations seems to be an open empirical question, despite its intuitive appeal.\textsuperscript{18} Propinquity has been a central element in the design of regional clusters involving academia, fueled in large part by the legend of the Silicon Valley.\textsuperscript{19} Brought down to the university sphere, the idea of promoting physical proximity among faculty from different disciplines has long justified the creation of research centers in general. The question that should be asked, to increase understanding of the organization of scientific work, is to what degree these expected planned and spontaneous outcomes in terms of interdisciplinary collaborations actually contributes to behavioral change. Recent work on interdisciplinary research centers suggests that propinquity alone may be important but not sufficient to stimulate such change. Common projects and purposes seem to be needed for faculty to go beyond social interactions and engage in joint knowledge production.\textsuperscript{20} Nevertheless, extensive evidence from studies of distance and work groups suggest that the assumptions driving the Clark Center’s design are valid. Individuals in contiguous spaces tend to interact and like one another, and informal encounters and spontaneous communication increase the chances of people developing strong ties which facilitate work interactions and collaborations.\textsuperscript{21}

The design of so-called ‘hotel spaces’ at the Clark Center is meant to enable Stanford scientists and visitors to collaborate for short periods of time. The hotel spaces
consist of 65 benches, which can be requested by faculty affiliates for use over 6-12 months. Indeed, the idea of dedicated space for short-term occupancy, allowing scientists to work in proximity to initiate projects or analyze data has attracted external attention and endorsements. Nonetheless, while admittedly experimental, the use of hotel spaces at the Clark Center has ‘not yet come to fruition,’ in the judgment of a senior academic leader. Such assessment does not convey a premature frustration with the overall idea, but rather an on-going search for an adequate model. At any rate, the current tentativeness of the arrangement has not precluded outsiders from making ringing endorsements of the hotel space concept.

Exactly what to expect from Bio-X is far from obvious. Clearly, aspirations go beyond establishing a successful record in obtaining large interdisciplinary grants, although those are important. When asked about the relative importance of those in assessing the success of the multidisciplinary initiatives, one senior administrator claimed that:

We haven’t thought a lot about that but it does appear to be happening. I mean, what I’m seeing is… we’ve got two junior faculty who got big center grants… untenured faculty, recently. We’re seeing more of that, but we haven’t planned it that way. The faculty will have to take the lead on what they go after.

The Bio-X Chair Matthew Scott describes the program as a ‘social experiment.’ One senior administrator articulates the ultimate aim boldly: ‘to change the way people do and view science.’ Conducting such experiment and promoting such change are naturally long-term processes. Evaluation, as another senior administrator explains, requires a ‘qualitative look’ into their contribution to science in the long run. Trust is posited on the faculty to make use of the opportunities the program affords them in
productive and original ways. As Scott has been quoted in explaining his vision of the success of Bio-X:

A few years from now, we’ll be looking and saying, did projects take off that would not have taken off had we not put this together? We’ll be looking for cases where the juxtaposition of people from different fields, both inside the Clark Center and in events of the Bio-X program, led to new projects. I hope that the people in Bio-X will come out of their shells and their comfortable little groups of familiar co-workers and really look hard for chances to do something unique and new.  

Despite the occupation of and publicity around the Clark Center, the long-term vitality of Bio-X is not taken for granted at Stanford. There is attention among academic leaders to the potential for a lack of common ground among resident faculty to develop, eroding the creative mission of the program. Administrators highlight that Bio-X seeks to be more than a collection of faculty co-habiting a new building, and discussions take place on how to nurture a coherent intellectual culture. The eight scientific themes are broad areas (e.g. biodesign, genomics, imaging), and not seen as providing uniting base to the program. The challenge seems to lie on creating a shared sense of purpose that ties faculty together, making the Bio-X occupancy of the Clark Center a substantive academic enterprise, and yet maintaining the inherently open and non-departmental nature of the program.

Stanford’s multidisciplinary initiatives are subtly evolutionary and viewed as a resource to the faculty, instead of deliberative administrative mechanisms to instill policy or structural changes in discipline-oriented departments. Departments remain central in administrative and academic matters, particularly the usual tension-provoking issues of sponsored research management and faculty evaluation. Genuinely responsive to the
interests of the faculty, the initiatives have arisen from grassroots thrusts that earned institutional recognition and support. Such support was instrumental in the utilization of the university’s relational networks for fundraising that enabled further development. Although central funds have been allocated to these initiatives, their overall visions have not been constrained by resource deprivation. Instead, ambitious visions have set financial targets to be pursued. Despite the boldness of Bio-X and the Clark Center, in particular, departments remain fundamentally central to the operation of the research enterprise. Hiring, promotion and evaluation procedures have not been altered. Owing its eminence to the strength of its schools and departments, Stanford has apparently little incentive to reform them. These multidisciplinary initiatives are the newest jewels in the crown of the university; an affirmation of excellence, instead of pathways to pursue it.

DUKE UNIVERSITY

Duke University presents perhaps the least visible, but most comprehensive set of strategies to foster interdisciplinary research. These strategies arise from a peculiar combination of strong leadership and the traditional decentralization of elite private universities. Distinguished as one of the institutions that define quality in higher education, Duke also boldly embraces interdisciplinarity and has taken action to pursue it. Today, the university capitalizes on a longstanding interest in encouraging interactions across schools and departments, and on a perceived shared culture that favors them.

This case focuses on five distinguishable organizational strategies that Duke implemented in recent years to promote interdisciplinary research: (1) the constitution of an upper-administrative, vice-provost level office to improve the management of
interdisciplinary ORUs, (2) changes in promotion and tenure policies to include special provisions for faculty whose work is interdisciplinary (3), selective investments in inter-school interdisciplinary initiatives, and (4) the creation of special professorial appointments of an interdisciplinary nature, and (5) adaptations in resource allocation procedures to diminish disincentives for inter-departmental collaboration. Upper-administrative incentives for faculty to teach courses in different schools, although important, are not part of this analysis.\textsuperscript{26}

Planning, Culture Change, and Academic Reform

These five strategies are expressions of the overall philosophy at Duke to promote enduring culture change to include interdisciplinarity in the core operation of the university. Duke’s administration’s organizational image for the integration of interdisciplinary and disciplinary units is “an interconnected matrix structure of intellectual life, both in research and teaching, with the traditional schools and departments as ‘rows’ and the interdisciplinary units as ‘columns.’”\textsuperscript{27} The remarks of two senior administrators express that philosophy:

Interdisciplinarity is kind of useless if it doesn’t come back and revitalize the departments…. And unless there’s that revitalization that’s going on, then you’re going to have a lot of animosity and jealousies, instead of people feeling that they all profiting, there’s going to be a lot of people just resisting.

So much of success in interdisciplinarity is a cultural issue, and an incentives issue, and it’s both. The incentives by themselves will not succeed.

The office of the Vice Provost for Interdisciplinary Studies has a central role in the organization of interdisciplinary ORUs at Duke: it coordinates the creation and
review processes of all centers and institutes; organizes the Interdisciplinary Administrators Working Group (IAWG), which meets periodically to create a collective intelligence on the administration of interdisciplinary units; and consults with faculty directors on center management issues. The review process for interdisciplinary centers and institutes is a recent development. In its latest strategic plan, Duke determined that it would seek a proactive stance to improve the management of centers to assure their usefulness and impede the indiscriminate proliferation of units that could, directly or indirectly, drain scarce university resources. The creation of new ORUs must be carefully justified, and sunsetting is the default outcome of the five-year reviews. Centers and institutes have to produce an extended annual report in the year of the review, encompassing their intellectual contributions, degree of faculty participation and insertion in internal and external networks, contributions to scholarship in the departments, sources and levels of internal and external funding, and plans for securing future sustainability. Under these new policies, Duke ‘treats interdisciplinary units almost like small businesses,’ whose bottom-line is the value added in terms of scholarship, and also external support for their programs. The Vice Provost for Interdisciplinary Studies also operates seed funding schemes, promotes events, and maintains a website that is a portal to interdisciplinary resources at Duke, with information for both faculty and students.

Duke’s new interdisciplinary initiatives also arose from the latest planning effort, and are representative of a larger trend among research universities (see Chapter 3). The 13 initiatives are mostly interdisciplinary research centers. They are all expected to achieve self-sustainability over the five-year period that is granted to all interdisciplinary ORUs between reviews, or some measure of self-sustainability with support from the
schools. Fields represented range from Genomics Science and Policy to Child Family and Policy, and have variable relative focuses on research and training, with an obviously stronger emphasis on the former. The initiatives are:

- Center for Child and Family Policy
- Center for Environmental Solutions
- John Hope Franklin Institute for Interdisciplinary Studies
- Institute for Genome Sciences and Policy
- Center on Global Change
- Computer-Based Support for Science and Engineering
- Integration of the Arts
- Center for Biologically Inspired Materials and Materials Systems
- MicroIncentives Research Center
- Program in Neural Analysis
- Fitzpatrick Center for Photonics and Communications Systems
- Nanoscience Initiative
- Information Sciences and Information Studies

The Office of the Provost understands that seeding programs and improving the management of centers helps promote interdisciplinarity only to a certain extent. Beyond incentives and managerial support, the institutionalization of interdisciplinary activities requires the removal of structural obstacles and change in the campus culture. A decisive step in that direction was the introduction of an explicit policy to accommodate for faculty’s interdisciplinary interests in promotion and tenure reviews. Faculty are allowed to have two members of a five person committee, plus a co-chair, to represent their interdisciplinary interests. The final report to the appointment, promotion and tenure (AP&T) committee includes input from both the departmental and interdisciplinary area representatives, and both co-chairs represent the faculty’s case. Duke’s policy change preceded the University of Southern California’s, addressed in Chapter 3. These changes not only are favorable to faculty members whose work would be interdisciplinary
regardless of institutional policy, but are also symbolic endorsements of the value attributed to such scholarship: interdisciplinarity is treated as an inner part of evaluation and not as a substitute for disciplinary research or as a marginal activity with meager recognition. In this regard, an interesting feature of Duke’s policy is that it requires deans and department chairs to appoint the reviewers whose expertise matches faculty interdisciplinary interests, not placing the burden of the faculty member.

In the same path towards the institutionalization of interdisciplinarity, Duke has created a limited number of ‘university professor’ positions. While this rank can be accorded to continuing faculty earning tenure simultaneously across two Duke schools, the recent disposition is to use 10 endowed chairs to recruit new, eminent academics, for a tailored appointment that best suit their needs. The first two appointments are in ‘new technologies in society’ and in genomics. The recipient of the former was hired (out of Stanford) in late 2004 with tenure to the entire College of Arts and Sciences, reporting directly to the dean of that unit. The hiring of that faculty member was conducted by a university-wide committee with representatives from 13 departments and 4 schools, and co-chaired by the vice provost and the dean of the college. The Genomics university professor designated tenure home is the School of Medicine. Duke is in the process of building the endowments and planning the future hires. This hiring strategy is clearly a recruitment tool to help the university attract distinguished faculty by maximizing on the perceived flexibility and interdisciplinary strength of the university.

That is similar to the planned use of ‘Provost faculty lines’ anticipated in the strategic plan, which is yet to take place.\textsuperscript{31} That essentially will involve hiring based on ‘problems and ideas, and not on departments,’ according to an upper-level administrator.
Faculty lines that become vacant are centrally re-allocated to priority areas, and the hiring is pursued by a university-wide committee, after which departments will competitively bid for hosting the new faculty members. In general, tenure lines remain essentially departmental, but the Duke administration actively studies alternatives due to the needs of the interdisciplinary institutes. The new Institute for Genome Science and Policy has been allowed to recruit non-tenure track research professors, a mechanism that may be also adopted by other major research institutes.

Evolution of Duke’s Strategies

These significant actions have been taken since the late 1990s, and result from strong central administrative support to Duke’s interdisciplinary agenda. They mix carefully planned and opportunistic moves, as well as top-down and bottom-up drives. They flourished in a context that its key actors perceive as a forerunner in relation to other research universities and administratively supportive of interdisciplinary work:

We’ve come to see ourselves as an institution where we foster interdisciplinarity, even if it isn’t always easy to do and we don’t always know what that means. Certainly, we’ve been carrying that banner before that banner became a buzzword among all institutions.

All in all, I think Duke does truly values the interdisciplinary aspects of the resources on campus. Generally speaking, when you ask them [the central administration] to help you accomplish something interdisciplinary they’ll try to find a way to indulge you.

Part of the Duke legend is the belief that its culture, age, and physical characteristics of the main campus are all favorable to inter-school linkages. In the words of three center directors, the campus culture is regarded as contributing to attract faculty
with an interdisciplinary penchant through ‘self-selection.’ Duke’s proclivity for inter-
school collaborations was highlighted in the latest strategic plan. The general message of
the excerpt below was a recurrent theme during fieldwork interviews.

Each of our schools has substantial interactions with virtually all the others, and
our faculty members have close colleagues and collaborators not only in their own
disciplines but in many others as well…. Because of its relative youth,
comparatively smaller and more integrated campus, and less deeply entrenched
departmental cultures, Duke has particular opportunities to build on its culture of
fostering interdisciplinary collaboration, while retaining the positive qualities of
disciplinary teaching, training, and research.³³

The year 1987 is often cited as a landmark in the systematic attention given to
interdisciplinarity at Duke, with the self assessment efforts that took place leading to the
institutional reaccreditation. The university chose to pursue a special-concentration
option for the self-assessment study, focusing on the issue of interdisciplinarity. One
upper-administrator argues that the intellectual origins of the changes brought about in
recent years can be traced back to the 1988 self-study report *Crossing Boundaries.*³⁴ The
university leadership at the time is credited with having considered that a distinctive
strength that Duke could capitalize upon. A senior administrator recalls:

Under Phil Griffiths, who was the provost in the mid- to late 1980s and early
nineties, that there was an attempt to not only have interdisciplinarity but to say
this is the place where Duke is different from our peer institutions… we are going
to make this our trademark, the ability to do everything we can so that the faculty
can operate with as few intellectual, infrastructure, organizational, and
credentialing boundaries as possible across the departments and schools.

Since the late 1990s, this earlier vision to cultivate interdisciplinarity as a
comparative advantage started to take a stronger hold organizationally. The university
faced two seemingly unrelated events, the outcomes of which were senior appointments
that brought to office key actors in the subsequent development of the interdisciplinary
strategies discussed here. The first event was an enticing outside offer from a major university to an eminent humanities professor at Duke. The university’s approach to retain this scholar was far from conventional. Former president Nannerl Keohane made a counteroffer that entailed creating a new administrative position specifically to help make interdisciplinarity ‘institutionally strong.’ Professor Cathy Davidson accepted the undertaking, and was appointed the Vice Provost for Interdisciplinary Studies in 1998. A year of exploratory work followed, involving benchmarking with peer institutions, to design the new administrative post. Initially, the position absorbed related roles that were part of the duties of the Dean of Graduate Studies. An upper-administrator describes the process:

At that time, I don’t know if it’s still the case, we called many different universities and there was no equivalent to vice provost for interdisciplinary studies at this level up, that allows you to make programs across the entire university. There were dean positions, a couple of more sub-dean or sub-provost positions, but this was the first one that really gave someone the entire portfolio across the university… We as a university thought of what we could do with such a position. We all felt that this gave us a new way of thinking programmatically into the research and teaching across the schools.

As this new position was being developed, the second event unfolding in parallel was the search for a new provost. The university seemed to have reached a critical juncture in terms of the aspirations cultivated for further institutional advancement. A central administrator who participated directly in the process recalls:

I think the institution was looking, at that particular moment… Duke had never strategically planned. There were some earlier documents, [the 1994 strategic plan] Shaping the Future, but there’d never been an exercise, a big exercise… I think there was just tremendous pent-up energy of asking, gee, we’ve arrived on the national scene, we’re not a regional university, what the hell do we do? And I think they were looking for somebody who could be respected and could stand up and say I know what we can do. He was there, right time, right place, and he did it.
Duke appointed professor and department chair Peter Lange, who had served in the mid-1990s as Vice Provost for Academic and International Affairs, as provost in 1999. A senior administrator assesses that Provost Lange focused on the planning and implementation of specific strategies to materialize the vision cultivated back in the late 1980s:

I would say with this Provost, Peter Lange, for the first time we really looked at the microscopic, how does a center run, what can we do to make a center run, how do we give incentives even to the level of the non-faculty staff who run so many faculty, so many centers in the university. That’s been a hallmark of this administration, as well as the big planning, strategic planning.

Provost Lange has come to be a pivotal advocate for interdisciplinarity, which was an important aspect of the planning exercise that culminated in the strategic plan Building on Excellence. Implementation of the total plan required $160 million in programmatic investments and over $515 million to build and renovate facilities over 4 years. This planning exercise was the formal genesis of the strategy to improve the management of centers and institutes, the policy changes in promotion and tenure evaluations, and the 13 centrally-supported interdisciplinary initiatives. The latter required over $90 million in programmatic costs alone.\textsuperscript{35}

An outgrowth of this strategic planning effort was a financial mechanism for Duke to continuously invest on inter-school programs. During the planning, a pool of strategic funds was created to be available to the academic units. The upper administration yearly taxes that pool, and requires the collected funds to be employed in inter-school programs. Deans have to agree on jointly committing to a new interdisciplinary initiative, which qualifies them for a 1:1 matching from the provost’s
office. This matched funding can be applied to the core costs of the programs, such as staff, space, and equipment.

In the aftermath of the strategic plan, the assignment of indirect cost recoveries (ICR) was identified as an administrative hurdle to research collaborations among academic units. ICR in multi-investigator grants returned to unit of the principal investigator, and those of the centrally funded initiatives/centers returned to the office of the provost. The predictable reaction among the academic units followed, and in 2002 Duke shifted the overhead back to the schools in the proportion of their participation in the interdisciplinary grants. The central funds disbursed to support those initiatives are viewed as start-up money, which should be cyclically reallocated to new ventures. The review procedures for interdisciplinary units called for in the strategic plan dictate these cycles. Since 2001, the office of the Vice President for Interdisciplinary Studies has implemented the new procedures, which has caused a reduction in the number of ORUs from 89 to 58 in 2004. Many units had long lost their original purpose, relevance, or were not actually functioning.

The adoption of the centrally-funded interdisciplinary initiatives was a large financial commitment, but more modest investments have also been rationalized. Previously, the Provost’s Common Fund had been established in 1991/1992 to seed interdisciplinary scholarship. It has competitively supported 47 projects since the first awards in 1993, as many other universities have come to do more recently (see Chapter 3). For 2005/2006, the university has requested proposals with potential to be scaled up and considered for becoming the interdisciplinary initiatives of the next strategic plan.36
In doing this, Duke shapes the Common Fund as early-stage seed programs for start-up interdisciplinary programs.

Organizational and Cultural Change

The set of initiatives discussed here not only provides usual incentives for faculty to reach out of their departments, but also has aimed at reforming traditional academic norms. Upper-administrative leadership has evidently been crucial in the evolution of those initiatives. Asked about the origins of the salient role of the Provost’s office in shaping the university’s academic strategy, a senior administrator replies ‘that’s the person. I would not say that about the last provost, when I would say the schools ran the institution…. He [the provost] also has a vision, and he doesn’t want to waste his time.’

Strong leadership has been carefully tempered with an orientation towards the involvement of the faculty and mid-level academic administrators in the crafting and implementation of the interdisciplinary strategies. Such blend of central steering with deliberative approaches has been seemingly important in the perpetrating critical changes in traditional academic norms. The clearest case is the modifications in AP&T guidelines. Discussions over about a year preceded the new policy, in an apparently deliberate move to garner as much support as possible for implementation through consensus over the desirability, scope and direction of change. This approach was adopted not only for the obvious purpose of obtaining buy-in, but also to instill cultural change, as explained by a key participant in the process:

We wanted it public. So we vetted it at meetings of all the department chairs of the interested schools, we brought it to the dean’s cabinet, we brought it to the advisory council of the academic council, we brought it to the full academic
council, and took it to the board of trustee. I don’t know that it needed to take that long, but it felt like it was so significant that we wanted everyone to hear about it and everyone to feel like they had had participation in doing it. In other words, part of the process of taking it around all those committees was changing the culture. If we had simply made a change, it might have been done in a cursory way. But by getting people’s excitement up about this and really thinking through and having many discussions about what the implications would be, it really got it, and they were excited about it and so far it has worked very, very well. At the time that the vote came, it was a unanimous vote, as opposed to something divisive. We gave everybody a chance to talk and a chance to contribute to what this would look like and how it would be shaped.

In the lengthy workings towards the approval of the new AP&T guidelines, advocates did not shy away from addressing the usual concerns over interdisciplinarity weakening the quality of scholarship. The argumentative logic employed avoided the messianic statements of a rosy future where all important work is interdisciplinary or of the purported superiority of collaborative research approaches. Instead, there was a reiteration of the importance of the peer-review principle, through the notion that experts should evaluate both departmental and interdisciplinary work. By accommodating for people from other disciplines in the review process, Duke could avoid not only undervaluing interdisciplinary work but also overvaluing it. This seems to have helped assuage fears of diminished evaluative rigor leading to lowered academic standards. This recent change has already demonstrated its usefulness:

We had two cases last year of colleagues who would probably not have gotten tenure if they had been under the old dispensation. But they have had such an incredible impact at Duke and beyond Duke with their interdisciplinary work that having that rigorous representation of their interdisciplinarity made all the difference. They both have tenure, and they are doing very, very well… they’re prominent.

When it comes to institutional resistance to faculty crossing the boundaries of traditional academic units, college deans are, like butlers in British detective stories,
among the primary suspects. At Duke, upper administrators interviewed for this study were rather positive about decanal receptivity. One top administrator, for instance, sees ‘less resistance from the deans, and more resistance from certain faculty groups, not all.’

The employment of the strategic initiatives fund seems to have been instrumental in forging ties among the schools, contributing to promoting a collaborative culture.

Another upper administrator assesses that arrangement as a powerful incentive:

> It’s a good deal for them, and it also forces them out – in the best possible way, of course – it pushes them outside their comfort zone of just working within the school. There’s no incentive for deans otherwise to work beyond their schools. This is actual financial and intellectual incentive to work collaborative with the other deans.

Most of the centers created under the strategic initiatives model have been in place for the past five years and are due to undergo review in 2005. Expectations for the units, while in large part shaped by their individual goals and purposes, also have the pragmatic bent accompanying targeted investments. The response from the faculty-director of one center to the question of what Duke expects from them is suggestive:

> What the university wants… what’s in it for the university is: the view this [strategic initiative funds] as seed money, and they’ll view how the [X] center succeeds in the review format by how much grant money we bring back in. That would be one of the metrics… if a working group produces a Science or Nature paper, that matters too… but they’re looking for more than just a peer-reviewed article that’s interdisciplinary. They want something more substantive than that…. I think the expectation also is that they want us to go out and try for bigger grants in different fields, you know, million-dollar plus grants… they’re not going through all this so that someone can write a 250,000 dollar grant. I can do that on my own, I don’t need a center’s help. They want to change the makeup of research on campus. So they produce 10 or 20 of these centers and some of them will be cut off and some of them will continue, depending on their success, which I think is fair.
The implementation of each of the interdisciplinary initiatives could be reported as a series of occurrences, depicting the particulars shaping their histories. Alternatively, the initiatives can be viewed as part of the larger start-up funding and review systems that Duke has implemented. Each initiative’s development is likely shaped by factors such as initial start-up support, the quality and commitment of the faculty involved, the leadership skills of the faculty-director, among other internal and external contingencies. But the evaluation system constrains the developmental pathways of the various interdisciplinary units created, regardless of their specific characteristics, into a series of predictable outcomes.37

The figure below comprehends possible outcomes (Oₙ) of the central start-up funding for interdisciplinary centers over the five-year review periods (Tₙ), under the influence of the various factors suggested above. Three major outcomes are considered: (O₀) termination of the unit after a five-year review, (O₁) renewal, and the expected level of organizational development, and (O₂) renewal, at a higher level of organizational development than initially planned. Organizational development is conceptualized in light of the review criteria for the interdisciplinary units (e.g., achievement of pre-established goals, degree of self-sustainability, the extent of integration with schools and departments etc). A myriad of intermediary outcomes can be conceived of, but for the four trajectories below suffice for expository purposes.
The first two alternatives entail the purported ‘default’ outcome of the review process for interdisciplinary ORUs: centers may fail to reach a critical mass or exhaust its contribution in the first five years, which would result in termination after the first review (1); centers may succeed in the first renewal, but subsequently fail to become self-sustainable or cease to create ‘value added,’ undergoing decline to the point of termination in the second review (2). A more promising scenario is that centers develop as planned over the initial period, obtaining internal and external support to ensure their renewal and likely survival over a longer time frame (3). Interdisciplinary initiatives may also develop into units of a greater scope than originally planned (4).

The first two trajectories await for examples in this and forthcoming years, as reviews take place. The third trajectory is exemplified by the Institute for Genome Sciences and Policy (IGSP), originally envisioned as a university-wide initiative and clearly one of the largest commitments. A faculty director was hired in 2002 with carte
blanche to shape the organization, which is described as a ‘school without walls.’ IGSP
deemphasized the relative autonomy of previously existing research centers that fell
under its umbrella, and turn them into highly permeable and interrelated units. About 25
faculty work directly in the institute and 10 others will be hired; they are recruited and
funded by IGSP, but hold a tenure-home in a department. Other 25-50 faculty are
indirectly involved through collaborations with them. Another example is the Fitzpatrick
Center for Photonics and Communications Systems. With a secured endowment, linkages
with eight departments and a close association with the School of Engineering, the center
reached its fifth year in relative stability.\(^{38}\) During the 2004/2005 academic year, Duke
conducted a search for a new director, which raises the question of whether the Center
will maintain the current profile (3) or attempt to enlarge its scope (4).

One clear example of an ascendant trajectory (4) is Duke’s initiative in
environmental solutions. With initial funding of $2.1 million, the Center for
Environmental Solutions was devised as an interdisciplinary network, to serve as a
resource for faculty and students with seminars and seed monies. The center is viewed as
‘very productive’ by an upper administrator, who attributed to its success the $70 million
gift for Duke to expand its presence in the field. In 2005, the university created the
Nicholas Institute for Environmental Policy Solutions, with the ambition of making it
influential in ‘setting the national environmental agenda,’ and having a ‘global reach.’\(^{39}\)
The new institute vastly transcends the initial operation, based mostly in the law school,
with faculty participating on a part-time basis. A new full-time director has been recruited
and the institute will count on resident faculty. The evolution of the environmental
program clearly demonstrates the benefits that can accrue from Duke’s strategic funding of interdisciplinary initiatives.

Collectively, these and future initiatives may contribute to Duke’s distinctive approach of pursuing interdisciplinarity as a comparative advantage, to build upon the excellence it has achieved according to traditional standards. The success of this approach may be conditioned by the ability of the university to sustain and deepen a culture conducive to interdisciplinarity:

You have a better faculty at Stanford than you have at Duke, in the Arts and Sciences, anyone could argue that. That, in some ways, having an incredibly strong faculty considerably hinders some of the interdisciplinarity as well… you’ve got a lot of fiefdom builders, and stuff like that. So, I view Duke’s challenge as very tricky, because we would kill to have that faculty reputation that Stanford has, all the Academy members, you’ve got to realize that on one avenue that is the goal, to keep raising that aspirational level for faculty excellence. With that, comes an interesting price if you don’t create the right culture…. To me that’s the biggest challenge.

This perceived challenged involves the notion of substitutability among disciplinary and interdisciplinary work. If those are instead complementary, as many seem to believe, how close is Duke from operating as an ‘interconnected matrix structure of intellectual life’? The vision of a matrix structure, cultivated at Duke and elsewhere, entails fluid dynamics of allocation and re-allocation of resources to interdisciplinary areas, as old missions are accomplished and new priorities emerge. But as faculty are the crucial input into interdisciplinary initiatives, hiring patterns shape the potential for those flows of expertise. One senior administrator argues that departmental-disciplinary traditions are particularly relevant in the composition of faculty lines, posing certain obstacles to reallocation:
We haven’t got to the point where we can have a cross-departmental matrix, although we talk about it a lot right now. At some point, the more you diffuse this, the easier it would be for the faculty to group around, hire, in what are the emerging areas of scholarship rather than sustaining [self-replicating logics of departments]…. The goal is to build star faculty in every school, not every department…. Medicine has moved in this way a lot. The centers in the School of Medicine have much more power now than department chairs…. It’s easier in that side of the fence. It’s a little more coherent, and there’s a bottom line there, to deliver health care. It’s harder on our side of the fence where you have this steward of the discipline line… we wouldn’t be an institutions if we didn’t have classics. I don’t argue that, but every existing unit can make that argument. Who has guts to prioritize? You decide you’re going to close a department, you’d better be prepared for Tuesday’s New York Times.

The explicit policies discussed above attempt to induce a slow but steady organizational evolution towards more flexible academic structures. Duke’s approach is systematic and oriented to building lasting mechanisms to support, evaluate, and reward interdisciplinary research. Differently from most universities, Duke has been confronting fundamental issues known to impede interdisciplinarity, most obviously the case of tenure and promotion guidelines. Commonly, administrators and faculty everywhere acknowledge such problems and lament their consequences, but seem unwilling to address them. In Duke’s tackling of those issues, the importance of senior leadership is abundantly clear. Top-down leadership has been exercised to confer visibility and to send a clear signal of the desirability and importance attributed to interdisciplinarity, but extensive campus consultation and faculty involvement have also been part of significant changes. This blend of leadership strategy and bottom-up interdisciplinary entrepreneurialism, expressed in the new initiatives, suggest an open avenue for institutional and cultural change.
Duke’s strategic investment in interdisciplinary initiatives has followed the logic of pursuing academic leadership and distinction, through potentially transient but relevant programs. Such investment has not arisen from or translated into financial deprivation for the academic units. Rather, it resulted from an aggressive use of university resources and fundraising to finance new inter-school linkages. At Duke, ORUs are not viewed as a parallel structure designed to overcome or compensate for university failures, but as an experimental ground for innovative research and scholarship that adds and reinvigorates the academic core. Duke’s success in obtaining philanthropic support to maintain or expand some of the new initiatives suggests an admirable competitive advantage that reinforces its logic of strategic investments.
**ENDNOTES**


4 For handsome annual fees, partners may join the executive council, have a visiting researcher at Media-X facilities and access research findings, but sponsored research agreements and rights for licensing are negotiated separately. The lure of Stanford scientists has attracted major American, European and Japanese corporations. See http://mediax.stanford.edu/partners/.

5 A draft of visual representation of this conceptualization was shared with me, but I was asked not to replicate it since it was a work-in-progress.


7 For a description of the grants and fellowships, see http://cmgm.stanford.edu/biochem/biox/grant/index.html.

8 President Hennessy singled out the three initiatives in his 2002 State of the University address to the Academic Council. See Hennessy, *op. cit.* note 6.


10 An Interdisciplinary PhD program in Environment and Resources began admitting students in 2003.


13 President Hennessy explicitly connected the plans for SIE to the experience with Bio-X in his presentation/announcement of the former to the Faculty Senate. See Edward D. Harris Jr., *Faculty Senate Minutes – To the Members of the Academic Council Thirty-Sixth Senate*, Report No. 1, (October 9, 2003), 11, 13-14.
The department will remain co-located there until a new building is erected. The new science and engineering quadrangle will include buildings for the Department of Bioengineering and for the Stanford Institute for the Environment. There are synergies between the department’s mission and Bio-X’s, as the former focuses on the intersection between engineering and biomedicine. Bioengineering is singular among academic departments at Stanford for being jointly administered by the schools of Medicine and Engineering. Inherently interdisciplinary (a mechanical engineer and a cardiologist co-chair the department), the department has started graduate programs in 2004 and plans to eventually offer an undergraduate degree. See Dawn Levy, ‘Intel Inside: SEQ 2 Gives Scientists and Engineers a 21st Century Research Home,’ Stanford Report, (February 9, 2005).

Based on an empirical study of interdisciplinary research centers, Rhoten suggests that faculty groupings size within centers is more important than total organizational size in stimulating research collaborations. She recommends centers to allow for small close collaborations of 10-15 researchers, and more informal interactions among a total of 40-50 scientists. See Diana Rhoten, A Multi-Method Analysis of the Social and Technical Conditions for Interdisciplinary Collaboration, Final Report – National Science Foundation BCS-0129573, (September 2003), 43, 45.

It is believed that not only the Center is a convenient passageway, but also a social ‘magnet.’ To that effect, the chief architect of the building claims that the 240-seat ground floor restaurant was envisioned as a center piece of the Clark Center’s design. In ‘Creating the Clark Center – A New Shape for Science at Stanford University’, video documentary, 20 min, Stanford University, 2003.

Rhoten examined interactions of faculty in interdisciplinary centers, categorized as ‘close’ (knowledge creation) and collegial (information-sharing), but these kinds of interaction were treated as substitutes. See Rhoten, op. cit. note 15, 24-25.


See ‘Organized Interdisciplinary Research in the University,’ Chapter 2.

Sara Kiesler and Jonathon Cummings, ‘What Do We Know About Proximity and Distance in Work Groups? A Legacy of Research,’ in Pamela Hinds and Sara Kiesler (Eds.) Distributed Work (pp.57-80), (Cambridge, MA: The MIT Press, 2002), 65-66.

See National Academies, op. cit. note 12, 183.

Harvard’s task force on science and technology suggested the need for a building devoted to such use at Allston. 50. The National Academies report recommends that universities ‘create laboratory facilities with reassignable spaces and equipment for people performing IDR’, Ibid., 196.


In academic year 2003/2004, Duke implemented an experimental policy to provide extra compensation for faculty participating in inter-school exchanges involving cross-school teaching of full-semester courses. This policy is scheduled to undergo evaluation in 2005/2006. See Cross-School Teaching Policy,
http://www.provost.duke.edu/directory2.htm. The Smith Fellowship has, since 1999, funded two or three faculty per year to pursue one semester of full-time study in a different areas of scholarship that their own.


29 See a full description of the criteria at http://www.interdisciplinary.duke.edu/overview/review.php.


32 The university recently surveyed other universities to learn about their hiring models. Lange, *op. cit.* note 27.

33 Duke, *op. cit.* note 28, 9, 16.


37 See Feller’s conceptualization of implementation trajectories. Irwin Feller, *Whither Interdisciplinarity (In an Era of Strategic Planning)?* Presented at the Annual Meeting of the American Association for the Advancement of Science, (February 12-16, 2004), Seattle, WA, 7-9.

38 For the $25 million dollar gift to the center, see Duke University and Stanford University, *$50 Million Gift To Launch Centers For Advanced Photonics and Communications Systems at Stanford and Duke*, Press release, (December 13, 2000), http://www.dukeneWS.duke.edu/FundRaising/Fitzpat5.htm.

How one views the university structure and the need for change influences one’s appreciation of current university efforts. For example, Diana Rhoten claims that there is no lack of external support or intrinsic motivation from the faculty to engage in interdisciplinary research, but of systematic implementation:

The fact is, universities have tended to approach interdisciplinarity as a trend rather than a real transition and to thus undertake their interdisciplinary efforts in a piecemeal, incoherent, catch-as-catch-can fashion, rather than approaching them as comprehensive, root-and-branch reforms. As a result, the ample moneys devoted to the cause of interdisciplinarity, and the ample energies of scientists directed towards that goal, have accomplished far less than they could, or should, have.1

On the other hand, skeptics such as Andrew Abbot claim that if interdisciplinarity were to have any impact at all in the organization of academia, it would have already done so.2

This study suggests that the problem of organizational adaptation to interdisciplinary thrusts cannot simply be viewed as one of faulty implementation by recalcitrant universities; nor can interdisciplinarity be viewed as innocuous to the way universities organize. A theory-informed depiction of the university, how it is organized, how it resists and embraces change, and why it employs interdisciplinary strategies is needed to inform the debate. As most work on interdisciplinarity tends to overemphasize the academic structure as a source of constraint,3 some would like to see greater investments in autonomous interdisciplinary ORUs;4 others propose an overhaul of the disciplinary-departmental organization, with more free-flows of faculty and students
grouping around research problems. Nevertheless, these solutions are hardly ever proposed within a framework that considers the complexity of the university as an organization. ‘Comprehensive, root-and-branch reforms’ are not usual, and perhaps constitute an unrealistic notion of change for higher education institutions, as noted in the relevant literature. One also needs to take into account that the unspecified but frequent levels of interdisciplinary research in academia show that the university structure is also an enabler. Lisa Lattuca has argued this point, suggesting several questions regarding the influence of organizational contexts on faculty interdisciplinary behavior that remain largely unexplored.

THEORETICAL PERSPECTIVES ON INTERDISCIPLINARY STRATEGIES

The previous chapters show that universities have experimented with varied organizational strategies to facilitate interdisciplinary research. Taking a landscape view, research universities converge in the approaches utilized to foster boundary-crossing investigation. Many institutions have established campus-wide initiatives, interdisciplinary facilities, centers and institutes, formal seed grant programs and administrative support for inter-departmental activity. Few universities have engaged in reform of traditional policies and structures, touching upon the crucial mechanisms of faculty recruitment, evaluation, promotion and tenure.

A closer examination of selected campuses in the case studies provided a more comprehensive and detailed perspective on the reasons why universities employed such strategies, how they evolved, and how they operate. The case studies exploited the most
salient aspects of each university’s interdisciplinary strategies, those facets that are defined as and thought to be changing their campuses and even the university sector. The scope, degree, and area of change of the interdisciplinary strategies analyzed varied across cases. Both at Duke and Arizona State, the upper leadership seeks to exploit interdisciplinarity as a source of institutional differentiation. This similar strategic orientation bifurcates into disparate approaches and structures on each campus. At Penn State and Stanford, major interdisciplinary ORUs advance university-wide initiatives. These units are the conduits for innovative means of stimulating and organizing interdepartmental research. At UW-Madison, the Cluster Hiring Initiative is a more contained and specific strategy, but with significant organizational repercussions.

Multiple conceptual lenses can enhance understanding of the dynamics at play, as demonstrated by the evidence presented in the previous chapters. Three themes emerged from the data analysis as particularly relevant to analyzing university efforts to foster interdisciplinary research, even if they are not exhaustive. The first refers to the staying power of institutionalized structures in universities and the viability of entrepreneurial action to perpetrate change. The second deals with strategic organizational behavior, whereby loosely-coupled universities with ambiguous goals employ interdisciplinary strategies to exploit opportunities and cope with contingencies. The third relates to the different organizational roles of university administrators and faculty and their relationships to interdisciplinary strategies. These three themes are represented in the conceptual model below as three layers of analysis: institutional arrangements, organizational contexts, and individual action. It lies on the theoretical notion of bounded-rationality – intendedly rational and opportunistic actors face cognitive
constraints and information gaps that prevent optimal choices. The following five sections discuss the findings through these conceptual lenses.

**Figure 12. Three Levels for the Analysis of Interdisciplinary Strategies.**

| Institutions and Institutional arrangements: Norms, 'Rules of the Game', Disciplines, Peer-review, Scientific associations, etc |
| Organizational characteristics: Policies, organizational structures, culture, climate, tradition, identity, location factors, etc. |

<table>
<thead>
<tr>
<th>Individual characteristics</th>
<th>Perceived risks and uncertainties</th>
<th>Perceived costs and benefits</th>
<th>Perceived contingencies and opportunities</th>
</tr>
</thead>
</table>

**Institutional Arrangements and University Agency**

Institutional theories emphasize the pursuit of legitimacy as a primal means of organizational survival and the stability of institutionalized arrangements. Within organizations, institutional elements (actions, roles, structures) are resistant to change, are maintained without justification for long periods of time, and are easily transmittable to new organizational members. Organizational structure becomes what John Meyer and Bryan Rowan called a ‘rationalized myth.’ View through this perspective, the benefits of prevailing arrangements in academic structure (e.g. the quality control afforded by the dual-institutionalization of disciplines and departments) have a normative, indisputable status for academic actors. Hence, institutional environments limit the options that university agents envision as possible alternatives for organizational change, and institutionalized structures tend to be assumed as natural.
Universities more commonly adopt the language and rhetoric of interdisciplinarity than reform academic structures, as seen in Chapter 3. It is relatively easy and cheap to display lofty goals in strategic plans, or craft documents that analyze current trends and call for more interdisciplinarity in the university. Viewed from an institutional perspective, these actions function as symbolic acts that indicate university’s responsiveness to the knowledge needs of society and the evolution of science. Such artifacts may or may not result from a deliberate administrative attempt to chart a vision for organizational change, or to implement proximate measures to spur interdisciplinarity. Universities are indeed known to display inconsistencies between stated goals and action.

Policy changes are more difficult to effect, particularly those that go against institutionalized and thus unquestioned practices. Administrators and faculty may not conceive such change as an option in the first place, and if they do, they have to overcome the inertia caused by the taken-for-granted assumptions, ‘sunk costs,’ and disciplinary-departmental identities that sustain the status quo. That internalized beliefs and ‘rationalized myths’ influence administrators and faculty to a great extent does not mean that it is impossible for entrepreneurial actors to perpetrate change in the university structure. University administrators have advanced such change, whether they were seeking to behave strategically, advancing personal and organizational agendas, or reacting to precipitating events. But apprehending the taken-for-granted, normative nature of central features of university organization seems necessary to fully understand current efforts.
The way universities have handled the crucial function of evaluating and promoting faculty gives a powerful example of these dynamics. Although widely recognized as a major obstacle for faculty to pursue interdisciplinary research especially at the tenure-seeking stage, most universities preserve the traditional policies and procedures that structure the process along disciplinary preferences and expertise. The reports of committees created on some campuses to assess the situation of faculty pursuing interdisciplinary work always includes the concern with evaluation and tenure, but tend to treat the related policies and procedures as immutable. Proposed solutions are often preventive, such as improving faculty mentoring and facilitating communication among different units when researchers hold dual-appointments.\textsuperscript{15}

UW-Madison offers a specific example of both change and conformity. UW-Madison administrators counteracted the centrality of departments in faculty recruitment with the Cluster Hiring Initiative. Reduced state appropriations created inhospitable conditions that justified an unconventional administrative solution to secure additional funding. The CHI effectively generated and seized control of a sizeable number of new academic positions, which are described as belonging to the ‘campus,’ not to colleges and departments. Should cluster faculty leave the university, the administration decides how to reallocate it. This is a real change from the usual allotment of tenure-line slots to academic units that determine when and how to use and replace them. Academic units reportedly felt usurped of resources that they traditionally controlled, despite the logical argument from the perspective of administrators that the cluster faculty positions would not exist if it were not for the CHI. According to informants, a key factor in the reaction of colleges in departments (beyond the natural role of interests and power) was the
internalized expectation regarding the proper composition of the faculty and the related academic activities that should be performed.

The fact that the CHI brought in a contingent of faculty members, most of whom at the assistant professor rank, to fulfill an interdisciplinary agenda did not imply modifications in traditional policies that could affect their performance. UW-Madison administrators recognize the negative effect that the evaluation, promotion, and tenure procedures can have on the interdisciplinary activities of cluster faculty, but formally reforming those procedures was not considered an option as far as this study could determine.16

One way of reading these events is to judge that the CHI is an inconsistent effort to promote interdisciplinarity, because it poses the burden of success on the shoulders of the cluster faculty, many of whom are at a vulnerable point in their careers. This interpretation can be extended; despite the concerted effort to promote and sustain the CHI, the EPT procedures are an institutionalized arrangement whose properties remain unquestioned on the Madison campus. They are a central element of what defines academic excellence in the cognitive repertoire of faculty and administrators. In addition to interview data, evidence to sustain this interpretation comes from the campus committee that investigated the performance of faculty in interdisciplinary programs (defined as faculty with formal joint-appointments). The committee’s report celebrates similar rates of success of those faculty as compared to the regular faculty in obtaining tenure, but noted that that may happen at a higher cost for the former. The report interprets this adverse effect as a needed vaccine to prevent potential weaknesses in scholarly activity, and uses the conventional rhetorical separation between disciplinarity
and interdisciplinarity as distinct research processes to support this view. The report states, ‘the need for protection of tenure may be greater for interdisciplinary researchers, while the nature of interdisciplinary work makes it more difficult to obtain tenure.’ An apparently uncontested status leaves the current form of the EPT procedures shielded from all the suggestions in the report to stimulate and recognize interdisciplinary activity.

Similarly, Penn State separates the processes of evaluation for promotion and tenure decisions and the five-year assessment of interdisciplinary contributions of co-funded faculty for the renewal of institute salary support. Those two processes have different purposes, run through separate organizational channels, and aim at informing distinct decisions. Formally, at least, this separation suggests that departmental-disciplinary and institute-interdisciplinary activities belong in two distinct cognitive spheres. In the first, academic units enforce quality standards through disciplinary peers and determine faculty merit and ‘belongness’ in the department. In the second, institutes transact support for their interdisciplinary mission by exchanging partial funding for the faculty position for inter-college collaborations. The separation of evaluation processes preserves integrity of departmental autonomy, a widely cherished value in research universities. Interviewees expressed the view that co-funded faculty ‘belong to’ the departments, and sustained that this view assails fears that institutes are in competition with departments.

Duke provides a counterexample on this contentious issue of faculty evaluation. Its academic leadership, who explicitly views and advocates interdisciplinarity as a differentiation strategy for the university, drove the reform of evaluation, promotion, and tenure policies. To advance the reform, the administration used the argument that
scholarship, be it disciplinary or interdisciplinary, should be held against the highest academic standards of quality and rigor, enforced by adequate peer-review. By not seeking to produce ‘true’ peers to judge the interdisciplinary research, the argument goes, it would be as easy to undervalue it as to overvalue it. The concern with rigor is both one of the elements in the discourse that raises suspicions against interdisciplinarity, and part of the attitudes and values imparted to academics socialized in the disciplines. This argumentation not only was effective in practice, but is also theoretically plausible as an approach to introduce change in a delicate area. It builds upon the existing knowledge structures or schema of the faculty and creates a cognitive dissonance – if proper peers are employed to assure the integrity and legitimacy of disciplinary work, why would not the same approach be used with interdisciplinary scholarship? Administrators considered this line of reasoning to have positively impacted the acceptance of the need for change and the resulting policy guidelines, which explicitly require academic units to include proper ‘interdisciplinary peers’ to evaluate the case of faculty that performs boundary-crossing research, and to have a representative of the interdisciplinary area co-chair the faculty’s review committee.

Changes in central features of academic structure are possible, but they require actors to question the assumptions of traditional practices that have a normative character and rule-like status, and to counteract ingrained habits and thought patterns through organized action. At UW-Madison, the assumption that departments could and should refill lost faculty positions was undermined by fiscal constraints. The administration pursued the resources and later the new organizational structures and practices through which the CHI was implemented. At Duke, the assumption that evaluation by
disciplinary-departmental peers was an assurance of rigor and due process for all faculty members was challenged through the concept of ‘true’ peers. Comprehensive deliberations in various university forums aimed at building a shared consensus on the need for and direction of change.

University Contexts and Goal Ambiguity

Ideas abound for university administrators, faculty, and students to cope with specific disincentives to interdisciplinary work. More specifically, there is a considerable volume of prescriptive work focusing on how universities can best organize interdisciplinary programs. Nonetheless, the case studies suggest that the design and implementation of interdisciplinary strategies is highly contingent upon the local context, history, culture, leadership, and other relevant institutional characteristics that make each university somewhat unique. Indeed, the relevance of context for organizational change in higher education cannot be overstated. Pursuing similar missions (produce and disseminate knowledge), functions (teaching, research, and service), and ideals (excellence, equity), universities differentiate themselves significantly in the ability to effect and sustain change, as well as in the specific solutions they find to general challenges. Burton Clark asserts that ‘facing the same external forces, some universities change extensively, some change moderately, and some hardly change at all.’

The cases provide evidence that universities adopt interdisciplinary strategies for multiple context-specific reasons to fulfill ambiguous goals. Goal ambiguity is indeed a distinctive feature of the university, which may facilitate or hinder organizational
Those defining characteristics of higher education institutions help appreciate the diffuse and multi-purpose nature of interdisciplinary strategies. Such strategies emerge from campus-specific circumstances as much as they may relate to broader trends in science and the research economy. Therefore, caution is needed with the rhetorical veneer applied to campus plans and policy reports that simplify particular university initiatives and structures as unambiguous solutions to the problem of facilitating interdisciplinary research.

At Arizona State, interdisciplinarity provided a rationale for the creation of a new academic unit. The School of the Life Sciences on the Tempe campus has been described as ‘important example of intellectual fusion,’ which one of the presidential design imperatives to shape Arizona State as an exemplar of the ‘new American University.’ The recent National Academies report *Facilitating Interdisciplinary Research* included the unit among its ‘innovative practices,’ describing the unique organizational features of permeable boundaries among the school’s faculties, and the inclusion of social scientists and humanists that allow for a ‘truly interdisciplinary educational experience.’ At closer inspection, the school is attempting to build a culture and identity that are conducive to the realizing the unit’s interdisciplinary agenda. Old informal structures, thought and behavioral patterns, and group allegiances were not simply erased by decree. This reflects the difficulties of merged academic units reported in the literature, and not necessarily a localized problem (and the reorganization of the life sciences units at UC-Berkeley started in the 1980s provides an interesting contrast in the scope, length, and approach of the change process). An interdisciplinary rationale justified a long overdue departmental merger, which was seemingly logical from both an administrative and
scientific perspective. Moreover, the school’s creation solved an on-going organizational problem in a manner that is consistent with leadership priorities. So, the intention to create an interdisciplinary culture to implement the university’s strategic vision, as asserted in presidential and policy reports, is intertwined with the rationalization of a fragmented structure. The point is not to make an exposé of the Arizona State’s initiative, but rather, to highlight the essential goal ambiguity of university organizational strategies.

Stanford’s Bio-X program/Clark Center embraces the view that biological research is moving towards interdisciplinarity, which calls for different arrangements that depart substantially from the traditional departmental organization. The Clark Center embodies the bold vision of shaping the future of bioscience, by organizing scientists in new and experimental ways. It ‘is uniquely designed and constructed to foster collaborations among people with diverse scientific background and interests.’ The overarching aim of this venture is to produce long-term change. However, more proximate motivations and pragmatic choices relating to the Stanford context were also at play in the evolution of this enterprise, starting from its bottom-up origins. The lack of interactions between medical scientists and other scientists and engineers, a liability in an era of ‘Big Biology,’ influenced the implementation of the initiative. Indeed, the very location of the Clark Center is emblematic of the interest in linking the colleges and the medical school, as highlighted by campus officials. Moreover, the new facility, built expeditiously in two years, not only houses the Bio-X program and facilitates its mission but also provides a home for faculty of the new department of bioengineering. The reasons for hosting the latter are not epistemological though – space is a scarce resource
on most campuses, including Stanford’s. Indeed, who would populate the facility was the subject of much deliberation. As it groups scientists from different disciplines in contiguous areas creating the potential for novel collaborative projects, the Clark Center also lends its modern and forward-looking outlook to the enticement of new faculty and students. Examined in detail, the evolution of interdisciplinary initiatives such as Bio-X/Clark Center involves an interaction of various localized interests and choices at the micro-level, where deals are struck and compromises are reached. The broad goal to change the way science is done remains valid at a general level; on campus, the program and facility fulfill multiple roles and objectives.

The Clark Center offers one clear example of the sometimes tenuous relation between localized experiences and the derivation of ‘general’ solutions to the problem of fostering interdisciplinary research. One specific feature of the Clark Center is the provision of workspace for temporary use, dubbed ‘hotel space,’ to facilitate the formation of new interdisciplinary collaborations.29 The availability of such space in the center emerged from the process through which the concept for the Clark Center was developed. This novelty has attracted external attention,30 including from Harvard University, whose recent task force on science and technology recommended the construction of a facility to fulfill this role on the planned Allston campus.31 The Harvard report justifies it with the rising importance of collaborative projects involving researchers located at disparate sites. Interestingly, hotel space is still a tentative, experimental arrangement at the Clark Center whose potential benefits have not yet become clear. It may take some time before universities’ experiments in this area indicate
more clearly the real demand for and the tangible benefits that can be expected from such infrastructure.

At UW-Madison and Penn State, interdisciplinarity served as a rationale for reassigning the distribution of scarce faculty lines. For UW-Madison, the impossibility of replacing all lost faculty positions was the impetus for a new logic governing the justification for new hires, and the creation of interdisciplinary clusters fit the bill. The idea of building innovative scholarship through interdisciplinarity interacted with the politically desirable aim of spreading the cluster faculty across the university, as those were times of resource deprivation and academic units felt aggrieved. For Penn State, leadership priorities for the development of the faculty in the fields of life sciences, materials sciences, environmental sciences, and children, youth, and family studies shaped the implementation of the co-funding scheme. The ambitions are to raise the profile of the faculty and the research productivity in those areas. Designing co-funded faculty positions to increase the likelihood of inter-departmental research collaborations in a means, following from those aspirations. Indeed, in recent institutional documents the university boasts its success in enlarging the faculty in the life sciences (the recipient of most new positions), and indicates the productivity in terms of external awards of co-funded faculty. Hence, interdisciplinarity is one among many thrusts causing the advent of cluster faculty and co-funded faculty. The relative achievements of each of these models are conditioned by their multiple goals and purposes.

The Penn State case also shows how interdisciplinary institutes evolved from previous forms, and how the issues that afflicted them shaped the new organizational model. The institutes, conduits for the investment in the co-funded positions, evolved
from ORUs that had existed for decades as Intercollege Research Programs. University leaders (administrators and faculty) altered their aims and functions to address problems that had been experienced in the past. Such problems with the management of centers and institutes were not unique to Penn State, of course, but the local conditions and experience influenced how the structures evolved. Specifically, competition among departments and ORUs for credit and resources influenced markedly the new governance and organizational structure of the institutes, and also the way the university accounts for credit on external awards.

University leaders have also used interdisciplinarity at a more general level, as a higher-order institutional value or strategic orientation. This phenomenon has been described as the rise of institutional policies to encourage ‘interdisciplinary creativity,’ generated by efforts to configure the university as an engine of economic and social change.\(^{33}\) Bringing this perspective to the analysis of specific campuses, one sees that the translations of upper-administrative orientations into organizational strategies are locally construed and denote variations in aims and visions of the ideal university structure.

The leadership both at Arizona State and Duke uses interdisciplinarity as an idée-force to drive organizational change and differentiate the universities from competitors. Arizona State aspires to achieve greater research performance and national recognition. Its significant investments in interdisciplinary centers and institutes are part of a growth strategy for the research enterprise. These research units link the leadership principles of seeking intellectual fusion and ‘use-oriented basic research,’ that is, fundamental science that bears obvious social and economic implications (as popularized by Donald Stokes in the book *The Pasteur’s Quadrant*).\(^{34}\) Therefore, major Arizona State ORUs respond to
the intertwined aims of (1) building academic quality (attracting respected researchers and the outputs associated with them, such as prestigious federal grants), and (2) delivering useful scientific discoveries to justify state investments in the university and please current and new research sponsors. Arizona State’s envisioned ‘new American university’ connects academic research more closely to regional agendas and economic development missions through dedicated research units.

The BioDesign Institute is one of Arizona State leadership’s bets for the realization of its aspirations. The new facility, to be joined by other three new laboratories, stands as a monolith on the perimeter of the Tempe campus. BioDesign concentrates university investments in a field with high prospects for the production of economically-relevant research. The high expectations of returns on such investment are reflected in the institute’s entrepreneurial management style, under the aegis of a scientific director with extensive experience in industrial R&D and a professional management staff. BioDesign has aggressive goals for increasing sponsored research, tightly managed infrastructure, and a focus on areas leading to industrial and clinical applications. Faculty working in the BioDesign Institute are expected to maintain an active sponsored research program contributing to the unit’s goals, and fluctuations in their performance and shifting external funding priorities are likely to reshape the make up of scientific body. In such context, problem choices and modes of work need to consider market forces. Spontaneous collaborations are expected, but among those already working at the institute and following the unit’s overarching goals. The BioDesign laboratory is presented as a ‘world class facility,’ a resource for the university to attract and retain scientists. It shows signs of early success in that area, and has
extended its arm into the educational function by starting to offer opportunities for graduate training in an ‘interdisciplinary program’ that will prepare students ‘equally well for research roles in an academic environment or in private industry.’ \(^{36}\) BioDesign and other new ORUs have been established to strengthen the research enterprise at Arizona State and help build the institutional reputation that academic departments have not earned.

In contrast, Duke’s pursuit of interdisciplinarity as a distinctive ‘signature’ entails reciprocal linkages between inter-school initiatives and the academic core, for the mutual reinforcement of traditional and emergent scholarship. The Duke leadership seeks to promote a unique balance of disciplinary and interdisciplinary strengths, building upon a local culture that is perceived as conducive to this blend. The university’s efforts to facilitate interdisciplinarity include reforming policies and funding structures to bolster inter-school research. Duke’s centrally funded interdisciplinary initiatives are generally treated as a temporary investment, contingent upon their ability to produce academic ‘value-added’ and reach self-sustainability. The systematic approach adopted since the last strategic plan for the selection, funding, and evaluation of new initiatives operationalizes the conceptualization of the university as a dynamic matrix organization, whose faculty move between the more permanent academic core and a more fluid and evolving developmental periphery. This approach is one way to respond to the challenge that Burton Clark articulated for the organization of the research university:

The growth of campus research institutes and interdisciplinary programs intensifies the problem of how to provide them with constructive, funded autonomy and at the same time integrate them with departmental control of faculty appointments, student selection, and program requirements. Too little autonomy hobbles the effectiveness of these nondepartment units; too much
strength on their part means a drift of the campus’s intellectual center of gravity from departments to, for example, research institutes.\footnote{37}

Duke addresses this tension with the expected transience of ORUs, although in some cases a durable institutional presence is certain (e.g. the genomics and environmental initiatives). Moreover, the university stresses the need for threads linking the activities of centers and institutes to those of departments in the policies governing the establishment, evaluation, and renewal of interdisciplinary units. The intellectual center remains in the academic core, and ORUs serve the function of stimulating them. While at Duke the vision is to infuse the academic core with interdisciplinary creativity, at Arizona State the research drift to ORUs is the clearest consequence of recent investments.

Universities do benchmark others when planning new ventures, especially those institutions that they define as their reference group. But while they face similar problems and external forces, specific solutions and organizational arrangements are often tailor-made. They build upon the institutional history, culture, local resource endowments, and regional circumstances.

Academic Leaders: The Different Organizational Roles of Administrators and Faculty

Creating adequate environments for the practice of interdisciplinary research is often viewed as a managerial problem that requires academic leadership. For example, Irwin Feller asserts ‘where an interdisciplinary culture does not already permeate the institution, or where such culture in threatened, central administration action is needed to
nurture heads who pursue collaborative research relationships that cross boundaries. Reports on interdisciplinary programs on particular campuses also illustrate the salient role of faculty initiative, driven by intellectual motivations to seek new collaborations across organizational boundaries. Indeed, individual choice arguments have been used implicitly and explicitly to analyze the growth of interdisciplinary ORUs. Previous studies note that university actors create centers and institutes instrumentally to access resources, enhance individual and institutional prestige, attract and retain prolific scientists, and boost research productivity both at the faculty and the institutional level. Recently, individual choice theory from the field of urban planning and economic development has been used as a theoretical lens to analyze the sprawl of biomedical centers on university campuses. At the individual level, interdisciplinary strategies result from choices and actions of academic leaders, both from the administration and the faculty.

Administrators and faculty face distinct sets of choices regarding the adoption of interdisciplinary strategies. While the gap between the values of faculty and administrators is the subject of higher education inquiry, studies on interdisciplinary research in the university do not approach these differences explicitly. Some assume that faculty have a natural interest in interdisciplinarity because of its intrinsic power and the development of science, and infer that administrators fail at the organizational level. Others view as the role of senior administrators to induce change amidst risk-averse faculty, susceptible to hostile policies and academic administrators that might prevent them from pursuing inter-departmental collaborations. This section employs the
perspective of the different organizational roles of faculty and administrators as a
heuristic device to understanding the adoption of interdisciplinary strategies.

Faculty and administrators share a similar professional origin but operate under
distinct value systems. University professors value collegiate governance and
professional autonomy, while administrators emphasize bureaucratic norms and
hierarchical control. Such differences can be expressed through Howard Aldrich’s
models of organizational coherence: the social systemic model and the associative model.
These are two ways to conceive of organizations and their participants, which Aldrich
asserts synthesize social science research on the subject. In the social systemic model,
organizations are social systems that distribute roles and incentives to participants,
shaping their behavior towards supporting organizational goals. Authorities distribute
activities and enforce compliance of norms, and the power of members is assigned
hierarchically. In the associative model, self-interested actors coalesce in organizations
for the resources they need to pursue their own goals. Authorities mediate exchanges of
incentives and rewards among participants, and negotiate norms. Individuals derive their
power from their position in the opportunity structure of the organization and their
relationships with other participants. Organizational members in these two models are
seen as holding supporter and user orientations, respectively (see Table 10).

Table 10. Aldrich’s Two Models of Organizational Coherence.

<table>
<thead>
<tr>
<th>Member's relation to the organization</th>
<th>Associative</th>
<th>Social Systemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users</td>
<td>Mediate incentive exchanges</td>
<td>Allocate incentives</td>
</tr>
<tr>
<td>Supporters</td>
<td>Negotiated</td>
<td>Enforced</td>
</tr>
</tbody>
</table>
University administrators are commonly depicted as primarily fulfilling supporter behaviors, related to the advancement of the university and maximizing its prestige (or seeking to increase administrative control). Conversely, university faculty are usually viewed as primarily operating on a user mode, particularly those academics conventionally called ‘cosmopolitans.’ Such faculty are deeply committed to knowledge production and strongly connected to their disciplinary communities, which is usually described as holding ‘divided loyalties.’ Universities provide the resources with which they can participate in the international scientific networks. It should be noted that Aldrich refers to user and supporter orientations as co-existing behaviors, not psychological or ideological attitudes regarding the organization and its functions.

**Administrators and Interdisciplinary Strategies.** The narratives of planning documents and university officials describe the central administration as concerned with harnessing the decentralized scientific expertise of their universities and focusing it on relevant areas through strategic action. When justifying interdisciplinary approaches, administrators often refer to the goals and needs of ‘the campus,’ speaking as arbiters of the competing aspirations and self-centered demands of colleges and departments. In this sense, the implementation of interdisciplinary strategies resonates with internalized assumptions regarding the role of academic administrators. Gary Rhoades called them the ‘myths of management:’ (1) no change occurs without managerial initiative, (2) managers focus fragmented academic units and loyalties, and (3) managers rationalize planning and budget. University-wide initiatives, as described in Chapter 3, are a good representation
of how these ‘myths’ may underlie central administrative attempts to foster interdisciplinary research.

Interdisciplinary strategies have also been rhetorically associated to three accepted principles for university administration, often used in conjunction. First and foremost, interdisciplinarity is conflated with the search for academic excellence. This justifies and legitimizes administrative action through the appeal to one of the most widely shared academic values. Universities promote their interdisciplinary initiatives, ORUs, and other approaches through the interest in being at the forefront. As we have seen, Stanford’s Bio-X-Clark Center’s aim is to ‘create the science of the 21st century;’ Arizona State’s BioDesign Institute is about performing ‘world class research;’ the UW-Madison clusters were established to assure new faculty recruits would be in ‘cutting-edge, innovative’ fields. Even if interdisciplinary initiatives are defended as based upon ‘solid’ disciplinary expertise, as is usual, interdisciplinary interactions are the step ahead to greater quality, funding opportunities, and prestige.

Second, interdisciplinarity has been linked to a leveraging principle, of maximizing the use of scarce resources and seeking efficiencies. This principle is at play when universities hire faculty that may contribute to more than one academic unit (as Penn State co-funded and UW-Madison cluster faculty), or when managerial support and financial incentives are given to collaborative projects through which the university aims to increase external funding. Interdisciplinary threads and interactions are presented as a rational way ‘to do more with less’ – multiple departments can benefit from a faculty appointment rather than just one, and the university as a whole can perform more (and some would say better) research by linking researchers across campus. Few would argue
against the search for such efficiencies and maximization of existing resources, although actors may do so if they perceive power shifts as a function of new organizational arrangements.

Third, interdisciplinarity is often attached to an organizational flexibility principle of making the university more agile and responsive to changing knowledge needs. This principle is at work when administrators encourage inter-departmental programs and university-wide initiatives to enhance creative responses to new challenges, envisioning the so-called matrix organization. Organizational flexibility to create new linkages among colleges and have faculty move between fluid structures and academic units is viewed as a strategic advantage. When pursuing this way of organizing, universities seek to adapt more rapidly to changing demands and opportunities than it is expected from the traditional academic structures. This can hardly be opposed, especially when colleges and departments are assured their integrity, and faculty their autonomy in choosing whether or not to join boundary-spanning programs. Indeed, taking an adversarial stance to university flexibility and responsiveness is antithetical to the widely shared values in American higher education, expressed in the historical Land-Grant mission and the contemporary economic development roles. These three principles are explicitly espoused in the narratives of strategic plans and campus officials, as described in the previous chapters.

Hence, the idea of interdisciplinarity becomes (intentionally or unintentionally) a useful tool, resembling what Susan Star and James Griesemer called a ‘boundary object.’ A boundary object is a concept that brings actors together for a common purpose, while allowing them to retain disparate social identities and different interpretations of what
they are achieving. These objects can be deliberately manipulated to bring stability to boundary-spanning relationships and exchanges. ‘They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation.’ These translations are needed to accommodate goal ambiguity, especially as universities pursue initiatives that link multiple disciplinary and departmental communities, as well as external publics. For example, for campus officials interdisciplinary programs may represent investments in research quality and distinction, a strategic way to focus institutional energies and resources. For the faculty involved, they may be means to access funding, infrastructure, and collaborators that allow them to pursue their research agendas. For external audiences, they may symbolize university commitments to relevant research that might impact social policy, human welfare, or technological development.

For the reasons discussed above, supporting interdisciplinary research becomes an attractive option among the strategic choices that university administrators might make. Given the existence of external rewards for it, promoting interdisciplinary research is a natural focus for managerial attention. It conforms to prevailing ideas about the role of managers in rationalizing planning, focusing fragmented loyalties of sub-unit, and promoting change. Universities’ structural lack of dedicated senior leadership and traditional revenue streams to support interdisciplinary initiatives open much opportunity for managerial action. Moreover, interdisciplinary thrusts are often associated to the widely held value of seeking excellence, and are compatible with administrative notions of leveraging resources and enhancing organizational flexibility. Such linkages make the choice of supporting interdisciplinarity an attractive option for administrators. It denotes
a commitment to innovativeness while advancing rational managerial principles. As a ‘boundary object,’ interdisciplinarity can be used as an idea that allows for multiple interpretations among different interest groups, while permitting mutual understanding at a broad level. But supporting interdisciplinary research beyond rhetoric and occasional incentives to produce federal awards entails leadership to investigate and propose dialogue on general and local assumptions regarding the organization of research. Such action may be welcomed in propitious campuses, but may also be an uphill battle in others. In the cases of Arizona State and Duke, senior leaders have had a major role furthering interdisciplinary agendas, extending previous efforts and expectations.

Not surprisingly, interdisciplinary strategies often displace power and discretion from academic units to the central administration and its delegates. As indicated in the previous chapters, offices and formal administrative positions whose duties entail coordinating, monitoring and stimulating interdisciplinary work have been created. Among the case studies, Duke and Penn State have specialized offices to oversee interdisciplinary activity, albeit with very difference functions. Such administrators and directors of interdisciplinary ORUs control resources that they use to create incentives for departmental faculty to engage in inter-college work. Steven Brint suggests that the managerial impetus driving interdisciplinary thrusts involves political motives in addition to strategic reasons, as it shifts some of the power and authority from disciplinary leaders to those who can gather resources and plan large research programs.54

The relative roles of academic managers and faculty seem to vary across campuses in fundamental ways. But the choice of interdisciplinary areas for investments typically involves faculty input, especially at stronger research institutions. The cases of
Stanford and Duke suggest that the senior leadership on those campuses nourishes trust on faculty judgments regarding programs likely to increase academic quality and institutional prestige. Faculty scientific preferences are viewed favorably as consistent with institutional goals, and their input is crucial in the development of major initiatives. This reflects existing scholarship on the elite private sector. Conversely, top-down approaches seem more salient in less prestigious campuses, where self-preservation motives and risk-aversion are perceived by administrators in faculty and departmental choices. The Arizona State case exemplifies this cleavage, but also suggests that lower-tier universities with shifting administrative agendas regarding research also create opportunities for entrepreneurial scientists committed to academic excellence.

In general, the case studies suggest that when administrators choose to support interdisciplinary strategies they open opportunity windows for faculty with boundary-spanning interests and skills. For such faculty, traditional structures can be a constraint to the quest for new knowledge, resources, and career options. Particularly in the natural sciences, staying at the frontier requires the ability to access increasingly expensive facilities and instrumentation, which may require a varied set of relationships to different audiences. The present emphasis on university-wide initiatives and interdisciplinary institutes enlarge the set of opportunities available for entrepreneurial academics seeking alternative pathways of research and scientific leadership. Senior university scientists were key figures in proposing the establishment of major initiatives and ORUs such as Bio-X and the Stanford Institute for the Environment, the Penn State Huck Institute for the Life Sciences and Materials Research Institute, and the Arizona State Institute for Computing and Information Science and Engineering. Leadership in such ventures entails
distinctive challenges, particularly the constant engagement in boundary-spanning activities and the mediation between traditional and emergent values in scientific activity.

**Faculty and Interdisciplinary Strategies.** The success of interdisciplinary strategies depends in large part on captivating the minds of the faculty. Faculty adhesion to university priorities depends on persuasion and negotiation, rather than hierarchical enforcement. Well-conceived processes to solicit and fund new interdisciplinary initiatives depend on their interest and involvement. New research centers and institutes rely on the willingness of faculty to participate both as users, utilizing the resources they make available, and supporters, helping the university achieve its objectives. While the literature places considerable weight on the role of administrators in steering universities towards interdisciplinary approaches, faculty make the ultimate decision regarding the modes of research to be pursued. This general argument was overwhelmingly used by interviewees in their narratives of interdisciplinary strategies on their campuses. That is to be expected due to the professional status of the faculty and the tradition of collegiate governance.

Aldrich’s associative model (that describes user behaviors here associated to faculty’s organizational roles regarding research) shares economic behavioral assumptions that have long been a source of analogies for the world of science. Michael Polanyi compared science to a democratic market system, whereby social coordination is achieved through interrelated processes of mutual adjustment. In his ‘republic of science,’ academics use professional standards instead of prices to assert the value of scientific contributions. Furthermore, Polanyi viewed scientists as utility maximizers,
selecting problems that allow them to obtain the highest results given the intellectual and material resources available. They do not (or should not, in Polanyi’s view) follow blindly the appeal of resources, although those play a role in conditioning his or her choices of research problems. Rather, scientists choose problems on the basis of ego-involvement – exciting problems that are both challenging and feasible would be preferred. So far, the general argument on the primacy of faculty interests over external rewards seems to have survived the test of time. Reviews of studies on faculty work suggest that ‘individual predilections, preferences, and perceptions appear to be more powerful than reward systems in influencing faculty behavior.’ Consequently, the various disincentives to interdisciplinarity abundantly discussed in the related literature can be seen as exogenous variables that affect but not determine scientists’ research behaviors.

Theoretical and empirical studies suggest distinct motives for university researchers to engage in interdisciplinary research. Peter Weingart argues that interdisciplinarity and disciplinary specialization are parallel, mutually reinforcing research strategies, which provide complementary descriptions to the process of scientific advancement. He views interdisciplinarity as ‘the result of opportunism in knowledge production…. Scientists seize opportunities to acquire knowledge and resources as a means to produce new knowledge; users of knowledge (policy makers, industrialists, etc.) seize opportunities to acquire knowledge by providing resources.’ Examining the work patterns of faculty experienced with interdisciplinarity, Lattuca makes the case that faculty think about interdisciplinary investigation as they think about research design, with different questions and problems leading to distinct approaches. These arguments
complement Turner’s definition of interdisciplinarity as ‘novel divisions of labor for novel ends’ with individual-level motives of opportunism and intellectually-driven decisions for the pursuit of knowledge. It follows that if faculty utilize their campuses’ interdisciplinary strategies to further boundary-crossing agendas, there is a convergence among their user and supporter behaviors. That is, in seeking to satisfy their interests they support the interdisciplinary goals of university strategies. Conversely, if faculty are moved simply by opportunistic resource acquisition motives to perform disciplinary scholarship, user and supporter behaviors diverge. Therefore, university strategies are more likely to achieve interdisciplinary goals if and when ‘intellectually-driven opportunism’ takes place.

The specialized literature discusses several disincentives, institutional barriers, and ‘costs’ (broadly understood) to interdisciplinary investigation that are believed to influence researchers’ motivation to pursue it. The economics concept of ‘transaction costs’ provides a useful metaphor. Economist Steven Cheung suggests that transaction costs could be more precisely labeled ‘institution costs,’ since they are all the costs ‘which do not exist in a Robinson Crusoé economy…. An economy of more than one individual would necessarily contain institutions, but the costs that arise as a result may entail no transactions at all.’ The institutionalized structures of disciplines and departments generate certain transactions costs for interdisciplinary scholarly exchanges. University scientists make additional investments to perform interdisciplinary research relative to disciplinary inquiry, because of both the research process and organizational factors.
Regarding the research process, scientists who pursue interdisciplinary work face the challenge of dispensing time and effort to competently grasp distinct bodies of knowledge, which may be an unattractive option after years of reaping benefits from specialization. Also, research collaborators from different fields need to learn how to communicative effectively, by establishing a common ground and a ‘common language.’ Researchers often hold preconceived notions about other disciplines, which may hamper effective communication and fruitful interactions. Hence, the process of conducting boundary-crossing research ‘taxes’ the researcher, particularly if she is a novice in interdisciplinary affairs, with additional burdens in terms of time and effort. Such differential is naturally reduced as researchers specialize in interdisciplinary topics and establish solid collaborations.

The university context also creates costs for faculty to pursue interdisciplinary research through formal and informal structures. Formal norms, policies, and administrative practices are widely noted to inhibit interdisciplinarity. For example, establishing inter-departmental and inter-college programs may require university actors to broker new arrangements and arrange new rules at each occurrence. Likewise, faculty participation in ORUs and multi-investigator grants may call for reiterated adjustments in the overhead allocation agreements, and evaluation routines, and the attribution of credit and recognition. A potential lack of known procedures to secure seed funding and workspace may inhibit faculty to form interdisciplinary projects due to perceived high information search costs and opportunity costs. In addition to these formal constraints, studies of interdisciplinarity typically argue that traditional disciplinary-departmental cultures may be a hindrance to boundary-crossing activities. Boundary-crossing activity
may raise suspicions about the researcher’s commitment to her home unit and high academic standards. Deans and chairs may discourage, implicitly or explicitly, the establishment of such inter-school linkages, and departmental colleagues may look down upon faculty with substantial participation in interdisciplinary activities. The relevance of these informal constraints to faculty behaviors has been observed in studies of faculty involvement with technology transfer, which suggest that local behavioral norms have a significant influence on scientists’ activities.\textsuperscript{70}

Interdisciplinary research also entails particular risks for university researchers, similarly related to the research process and organizational structures. Regarding the research process, interdisciplinary projects may lead to longer start-up periods, time to publication, and extensive co-authorship (viewed and rewarded differently across fields),\textsuperscript{71} increasing the risk of those activities in terms of their returns in professional recognition. Moreover, faculty have reasons to perceive higher uncertainty over the prospects of interdisciplinary research. Interdisciplinary work is reportedly harder to evaluate, fund, and publish, since funding agencies and academic journals normally employ disciplinary experts to evaluate the quality of research articles and grant proposals.\textsuperscript{72} Organizationally, the dual-institutionalization of disciplines and departments generally makes it difficult for researchers to gain entrance into mostly disciplinary academic labor markets after pursuing interdisciplinary training, although the changing landscape in some natural sciences may have changed that.\textsuperscript{73} Despite the perceived change of attitude regarding interdisciplinarity in the past decades, this is still regarded as a major barrier to the institutionalization of interdisciplinary graduate degree-granting programs.\textsuperscript{74} Perhaps the most salient risk at the university level relates to faculty
evaluation for tenure, which normally relies on the judgments of disciplinary peers. Scientists with interdisciplinary interests are subject to being inadequately evaluated or yet experiencing very high costs by having to do ‘double-duty’ – produce enough disciplinary scholarship to compensate for the lower weight of interdisciplinary work (e.g. publications in interdisciplinary journals or journals in other disciplines may be unfavorably perceived). As observed in one campus, this situation creates ‘fewer rewards per unit of effort’ for scientists, consistently with the notion of transaction costs.

The discussion above considers faculty motivations in research (ego-involvement), choices of interdisciplinarity as a function of ‘intellectual opportunism,’ and the concepts of costs and risks as heuristics to examine interdisciplinary strategies from the viewpoint of the university researcher. While devout interdisciplinarians overcome obstacles and disincentives to pursue their interests, other researchers stay within disciplinary knowledge domains for their entire careers. If the intrinsic motivation of scientists is a key determinant of their propensity to engage in boundary-spanning collaborations, universities interested in augmenting interdisciplinary activity can reap benefits from carefully selecting and retaining individuals with the desired profile. Those are likely to pursue their interests in the presence of the costs and risks discussed above. More frequent and experienced interdisciplinarians may no longer perceive higher costs and risks in reaching out to colleagues in other disciplines. In general, universities may attempt to reduce the perceived costs and risks associated to boundary-crossing activity on their campuses, benefiting all faculty who have or might engender interdisciplinary collaborations depending upon the circumstances. The
following two and final sections of this discussion flesh out these two generic approaches and draw connections to relevant organizational studies.

Interventions on Faculty Recruitment

The first managerial alternative is rather straightforward: universities may deliberately attract researchers with interdisciplinary predilections, expertise and experience. Given the importance of faculty motivations, academic administrators could reasonably expect that a higher contingent of such scientists translate into higher levels of interdisciplinarity. In a sense, interdisciplinary-oriented faculty resemble entrepreneurs: they are more likely to take the risks to pursue their interests, and to have developed or be willing to develop needed skills (e.g. communication and team management skills, multidisciplinary knowledge). They may also have a multiplier effect, by enlisting faculty partners in their projects and imparting their attitudes to graduate students. Such faculty may also be uniquely positioned to undertake supporter organizational behaviors such as proposing and administering interdisciplinary programs, mentoring younger faculty, and participating in advisory and review committees related to interdisciplinarity.

Interventions in this area have followed the ‘management myths’ logic, justified by the notion that the departmental self-replication locks the university into potentially undesirable trajectories in the development of the faculty and consequently of the research enterprise. The most likely solution for university administrators is to gather resources to alter recruitment processes and re-allocate tenure lines or create new ones, since changing the overall recruitment process by decree seems an unlikely option. The cases studies offer detailed examples of particular strategies: Penn State allocated
recycled dollars to its institutes for the competitive co-funding of department-initiated interdisciplinary hires; UW-Madison sought new funding for cluster faculty lines owned by the campus and awarded competitively through a committee structure; Duke has started to establish a few endowed professorships to attract distinguished faculty with tailor-made interdisciplinary appointments, via university-wide committees as well. Despite variation on the circumstances, goals, and specific approaches, all these instances show new decision-making structures being used to consider university-wide priorities in hiring. They differ from the incremental, additive pattern of departmental faculty and departments themselves, and exemplify pathways for administrative action in faculty recruitment.

These initiatives extend the more traditional approach of allowing ORUs to jointly recruit and support faculty with departments at their discretion and through centralized, ad-hoc decision processes. Those are represented in the Arizona State and Stanford cases. Arizona State allows the BioDesign Institute and other interdisciplinary ORUs to help hire and provide temporary support for new faculty with a departmental tenure home, and Stanford continues its established practice of having independent labs, including the new multidisciplinary initiatives, collaborate with departments in the recruitment of scientists with jointly-paid appointments. Efforts of this kind have been in place for a long time. Differently from the emergent models above, they do not present systematic processes involving a relatively broad representation of university actors and interests in hiring decisions and structures. Alternatively, granting tenure-lines to ORUs for their own specialized purposes replicates the logic of assigning faculty positions to academic units. Universities have sporadically granted control of faculty lines to
interdisciplinary centers, but that is far less common than intermediary arrangements whereby ORUs have the resources but not the evaluative authority over tenure-track scientists.  

Table 11. Three Models of Interdisciplinary Hiring: UW-Madison, Penn State, Duke.  

<table>
<thead>
<tr>
<th>University</th>
<th>Funding</th>
<th>Control of Faculty Lines</th>
<th>Origination of the Positions</th>
<th>Faculty Recruitment</th>
</tr>
</thead>
<tbody>
<tr>
<td>UW-Madison</td>
<td>UW foundations matched by state</td>
<td>Central Administration</td>
<td>Faculty propose clusters</td>
<td>Inter-departmental search committees</td>
</tr>
<tr>
<td>Penn State</td>
<td>Internal reallocations</td>
<td>Institutes/Departments</td>
<td>Departments propose positions</td>
<td>Department search committees</td>
</tr>
<tr>
<td>Duke</td>
<td>Philanthropy</td>
<td>Central Administration</td>
<td>University committees identify professors and tailor positions</td>
<td>University committees</td>
</tr>
</tbody>
</table>

The new models (Table 11) are not radical departures but incremental changes, except in the case of UW-Madison. There, the central administration seized the opportunity afforded by the state’s willingness to support technology-based economic development programs to partially recoup from faculty attrition with the Cluster Hiring Initiative. The top-down nature of the CHI is delimited to the ownership of the tenure lines; clusters are proposed, evaluated and implemented largely by faculty committees. By competitively allocating the new positions to interdisciplinary ‘clusters’ through peer-review processes, UW-Madison spread new faculty across the schools and departments and avoided the perception of an arbitrary handpicking of winners and losers by the upper-administration. The concept of interdisciplinarity also lent proponents of the CHI its usual positive valuations (e.g. innovative, cutting-edge), which turned a partial recovery of faculty positions into a bold administrative strategy to tap into emerging fields of research. In doing so, the initiative’s innovative motive is juxtaposed to departments’ disciplinary self-interest, justifying the clusters not only in terms of resource scarcity but also on intellectual grounds.
The CHI relies primarily on the motivations and interests of the cluster faculty, who by and large face the same costs and risks of interdisciplinary research as other faculty on campus – there is only limited administrative support and very modest funds for cluster activities. Furthermore, the cluster is not a formal structure that helps organize behaviors and reduce ambiguities. The evidence presented in the case study indicates that its effectiveness depends on many factors, including the ability of search committees to attract good candidates relative to the cluster goals, a favorable match among faculty hired into the same cluster, and positive conditions in and among the faculty tenure homes. For all purposes, cluster faculty belong in their home departments. Allegiance to the goals of the clusters they were hired into is largely voluntary, described as more of a moral commitment than contractual agreement. This is particularly relevant since most of the cluster faculty were hired at the assistant professor level. Tenure-seeking researchers are likely to be perceptive of the formal and informal behaviors of colleagues and academic administrators, since they are subject to their judgments in evaluation, promotion and tenure decisions. As existing policies and regulations have not been explicitly adapted to account for the CHI one may find that tenure-seeking faculty are bearing high costs for cluster activities or simply avoiding them. The former outcome is more likely if cluster faculty actually hold interdisciplinary preferences and motivations, but that is an empirical question.

At Penn State, the co-funded faculty positions are an incremental innovation on the practice of jointly-funded faculty recruitment by departments and ORUs. At the origin of this model, the university did not face as serious a situation as UW-Madison, but there were concerns in the administration over the capacity to improve the faculty
under the prevailing competitive conditions. The Penn State approach represents the managerial rationalization of planning and budget *par excellence* – compulsory costs reductions on the academic units created the discretionary funds eventually allocated to the institutes in general and the co-funding scheme in particular.

Penn State’s institutes provide a strong financial incentive for departments to voluntarily recruit faculty with an interdisciplinary profile, and hold both the academic unit and the co-funded individual accountable for fulfilling a ‘contract.’ The goals stated for the position when it is proposed are negotiated among the department, college and institute, and provide a formal framework for evaluating the performance of the faculty. Those are supposed to shape the search process and the terms of the job offer to the chosen candidate. Theoretically, faculty are hired into an organizational environment that has agreed on the specific requirements of interdisciplinary activities, which might reduce costs and risks of crossing departmental and college boundaries. Nonetheless, formal assessment of the faculty performance remains in the hands of the departments, through the usual procedures of evaluation, promotion, and tenure.

Despite the absence of reforms in the evaluation, promotion, and tenure policies, Penn State’s co-funding model provides a structure for all parties involved in the process to exercise their interests and enforce accountability. Departments and colleges are cognizant of the costs to be borne by the hired co-funded scientists, and choose the kind of researcher they want to recruit. The institutes have the ability to enforce their interests, since they can withdraw funding if they judge that the faculty has not met the expectations at the five-year reviews. Faculty themselves may defend their performance against the criteria of the co-funding agreement. The frailties of the arrangement relate to
the difficulties involved in contractual relationships in general: information asymmetries, the costs of information gathering, and the potential that actors pursue their self-interest at the expense of the accorded goals. Much of the success of co-funded faculty model depends on the ability and willingness of the Penn State institutes to enforce the terms of agreement.

The CHI initiative was an opportunistic response to an exogenous shock. At Penn State, the co-funding model evolved endogenously as part of a strategy to bolster particular areas (however broadly defined), emphasizing collaborative research and the pursuit of large external awards. Despite the differences in goals, formats, and organizational circumstances, UW-Madison and Penn State share some similarities in the way they assess their efforts. Both administrations have used quantitative comparisons of performance in sponsored research awards between faculty hired through their interdisciplinary models and the regular faculty. A systematic qualitative examination of the activities and achievements of faculty hired under the expectation of advancing an interdisciplinary agenda would be warranted by the formal goals of the hiring models, and Penn State has the means to do so through the periodical reviews of co-funding agreements.

Duke has started an incremental innovation on the common practice of creating endowed professorships to recruit and retain outstanding faculty. The goal is to hire star faculty with an established interdisciplinary agenda. Despite its incipiency, Duke’s chaired interdisciplinary appointments represent an alternative model with very different goals and scope from those described above. UW-Madison and Penn State programs have both recruited approximately 140-150 faculty, whereas Duke aims at reaching and
maintaining 10 such positions at any given time, having filled two at present. The deliberate recruitment of these highly visible academics will certainly strengthen the belief articulated by interviewees on campus that Duke tends to attract and retain faculty with an interdisciplinary profile.

The endowed professorship model is viewed as a means to offer unequaled freedom for Duke to attract high-caliber researchers, who otherwise would be difficult to lure away from other universities, through a tailor-made appointment that best suits their interests. When fully implemented, these faculty will form an elite academic cadre of boundary-spanning individuals whose credentials have long been established, and for whom interdisciplinarity is no longer a source of risks and uncertainties but a mode of specialization. In summary, this is a high-cost, high-prestige, low-volume and low-risk model. It is evidently more likely at elite private universities with extensive fundraising potential among donors who are sympathetic to investments in scientific assets that enhance institutional distinction.

In summary, administrative interventions in recruitment procedures to attract candidates with interdisciplinary interests can be substantiated on two arguments. The first arises from the imprint that early socialization during academic training leaves on faculty predilections and assumptions regarding research. Related scholarship suggests that researchers ‘learn to think’ in certain ways and identify themselves with particular disciplinary cultures, problem sets, and modes of work during their graduate studies. Scientists whose PhD and post-doc experiences were interdisciplinary, influenced by interdisciplinary mentors, or took place in organizations friendly to interdisciplinarity, may be likely to have boundary-spanning orientations. The second argument concerns
specialization: experienced researchers whose careers evolved in interdisciplinary trajectories are likely to reap greater benefits from such work. This does not imply that these are the only people who can contribute to interdisciplinary programs or that theirs is a superior contribution. But such interdisciplinarians can be arguably expected to be consistently involved in and champion such programs, which can be an asset for universities developing initiatives.

Interventions on the Environment for Interdisciplinary Research

The second and broadest area for administrative intervention is to engender change to reduce the perceived costs and risks of interdisciplinary research for faculty. Plenty of evidence comes from the survey of institutional documents that universities display formal interest in creating incentives for and reducing the barriers to interdepartmental collaborations. There is a vast array of specific actions to achieve those purposes. Such actions can be classified into three basic approaches: (1) changing formal and informal norms; (2) creating or adapting organizational structures; and (3) aligning incentives to interdisciplinary goals. These three approaches may be embedded in similar organizational strategies, but they relate to different mechanisms to stimulate faculty to engage in interdisciplinary research, as described in the table below.

Table 12. Approaches for Reducing the Costs and Risks of Interdisciplinary Research.

<table>
<thead>
<tr>
<th>Approaches</th>
<th>Mechanism</th>
<th>Implementation</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norms</td>
<td>Endorses and legitimizes interdisciplinary research</td>
<td>Institutionalization of formal and informal norms</td>
<td>Policies, practices, routines, cultures</td>
</tr>
<tr>
<td>Organizational Structures</td>
<td>Subsidizes information search, coordination, management</td>
<td>Continuous interventions</td>
<td>Adm. Units, ORUs</td>
</tr>
<tr>
<td>Financial incentives</td>
<td>Stimulates faculty opportunism</td>
<td>Continuous interventions</td>
<td>Grants through central adm. or ORUs</td>
</tr>
</tbody>
</table>
A normative framework that increases the energy needed for inter-departmental interactions, pursuing such activities can be viewed as too costly and/or too risky. Formal and informal norms may reinforce disciplinary-departmental compartmentalization, treat interdisciplinary research as an exception (perhaps of a lesser kind), or a cumbersome practice in organizational terms. Those norms can be formal, such as administrative policies and practices, and informal, such as campus and departmental cultures. Formal norms embedded in policies and administrative routines are more tangible and within the reach of administrative action than campus cultures, tacit understandings, and implicit expectations. Promoting change in deeply ingrained administrative and behavioral norms that are viewed as natural may be difficult, as argued in the discussion on institutionalized structures. Taken to its maximum consequence, systematic normative change institutionalizes interdisciplinary research in the university’s formal and informal structures. Such institutionalization grants organizational legitimacy to interdisciplinary research, thus reducing psycho-sociological burdens for faculty.

The case studies describe some changes in formal norms, such as policies for awarding credit, whether financial or recognition, to all units whose faculty obtain interdisciplinary grants, as opposed to the academic home of the principal investigator (Penn State, Duke, Arizona State); creating governance structures to stimulate cooperation among colleges, departments, and ORUs (Penn State, Duke); changing evaluation, promotion, and tenure procedures to accommodate interdisciplinary research (Duke, and also the University of Southern California as discussed in Chapter 3). Leadership efforts to make interdisciplinarity a component of the campus identity have also taken place, as shown in the cases of Arizona State and Duke. In such instances,
faculty may feel that interdisciplinary work is appreciated and contributes to defining or changing the campus culture, which might interact favorably with their intrinsic motivations.\textsuperscript{85}

Although the need to create favorable cultures to nourish interdisciplinary research is widely acknowledged, the constitutive aspects of campus cultures that enable or coerce interdisciplinarity have not been systematically explored and remain poorly understood.\textsuperscript{86} Duke’s culture is described in terms of the university’s relative youth, physical characteristics of the campus, and a belief that the institution has tended to attract researchers with interdisciplinary interests, causing a process of self-selection in faculty recruitment and retention. At Stanford, a perception that mutual respect among the faculty across fields is favorable to interdisciplinary collaborations is cited, along with the campus identification with the regional culture of inter-organizational collaboration. Further investigation across a number of universities could indicate regularities in the cultural elements associated with interdisciplinarity.

Another cultural aspect deserving further exploration is whether interdisciplinarity is perceived to be an element of the campus identity. Unlike organizational culture, within which it is embedded, organizational identity stems from interactions among the perceptions of internal and external constituencies.\textsuperscript{87} Identity and image are interrelated, and some contend that university actors may deliberately translate institutional aspirations into one or the other.\textsuperscript{88} As Dennis Gioia and James Thomas put it, ‘barring drastic contradictions or unmanageable discontinuities between present and projected identity, top managers can induce identity changes by working towards the desired future image.’\textsuperscript{89} A changed organizational identity, through the adoption of new values, goals,
and organizational attributes, may overtime result in different external perceptions of the organization’s image. Conversely, the deliberately projection of a desirable external image may compel substantive organizational change in the aspired direction.

The case of Arizona State is illustrative. The university leadership strongly endorses interdisciplinarity in its vision, goals and aspirations for the university – a stated institutional ambition is to make Arizona State ‘a leading center for interdisciplinary science and technology discovery and development.’\textsuperscript{90} Administrative impetuses to change the campus culture are likely to find obstacles among those faculty and administrators whose preferences and achievements are not as valued in the new regime. Sub-cultures that were once part of the mainstream of campus life are displaced with the heightened emphasis on research and on the tenets of the leadership vision.\textsuperscript{91} Such displacement may generate informal constraints to the implementation of the interdisciplinary agenda. But overtime, successes in acquiring resources and improving academic quality can bolster institutional image, with self-reinforcing effects on the new campus identity.

The route that Arizona State is starting to take is familiar to Duke. Duke has had formal discussions on and self-styled identification with interdisciplinarity for almost two decades, which some would argue result from an even longer tradition. The most recent developments signal to a coming of age of this institutional aspiration, through decisive action to improve the environment for interdisciplinarity. A set of changes have been implemented in the past few years to reduce actual and perceived costs and risks of interdisciplinarity for faculty and administrators. To assail fears that ORUs create additional financial burdens that may not result in academic gains, clear expectations
have been set for interdisciplinary centers and institutes, which are assumed to be temporary and required to undergo periodical reviews with sunsetting as the default outcome. To lower disincentives for academic units to support the centrally-funded interdisciplinary initiatives, Duke has shifted the allocation of overhead on external grants from the office of the provost back to participating colleges, departments, and ORUs. To handle the real and perceived problems of lack of recognition and lower rewards for interdisciplinary activities at the individual level, the administration requested faculty, department chairs, and deans to include those activities in their annual self-assessment forms, and interdisciplinarity is supposed to be recognized in the decisions over merit pay raises. To oversee interdisciplinary ORUs, central seed-funding programs, the recruitment of professors with interdisciplinary appointments, and work on reducing structural barriers to interdisciplinarity, the office of the Vice Provost for Interdisciplinary Studies was constituted. Duke is acting on multiple fronts to create a favorable organizational environment to interdisciplinarity. Duke’s experience seems consistent with the view that a projected institutional image can motivate organizational change.

As exemplified by the Duke office for interdisciplinary studies, organizational structures are also employed to foster interdisciplinarity. Such structures are at the central administration and also decentralized in the form of interdisciplinary ORUs. As described in the previous chapters, these units fulfill crucial functions to enhance inter-departmental connections. Their activities are justifiable by different but intertwined reasons, since they relate to compensating for the cognitive and skill limitations of the faculty. First, the comprehensive university is a ‘city of intellect,’ with an array of resources and
capabilities spread over the campus. Knowing about and coordinating them would be a heavy burden for individual researchers with multiple and competing demands on their efforts. Second, some claim that the increasing complexity of the research enterprise in general has caused a ‘revolution in the university research administration’ in the past 20 years. That has implications for how university scientists pursue external awards, as there is an overload of information requirements and procedural exigencies involved in sponsored research, especially in large interdisciplinary projects. For example, the process of competing for interdisciplinary center grants demands much coordination among multiple university actors, sometimes across campuses. Third, managing large-scale interdisciplinary programs and ORUs is a complex task, which requires administrative and leadership skills in addition to scientific expertise. Faculty directors may see themselves in administrative roles with little prior experience and training related to those roles. Therefore, organizational structures can reduce the costs associated to information search, the coordination of university resources and capabilities, and the managerial aspects of interdisciplinary projects. Faculty may perceive those costs to be too high to get involved with interdisciplinary activity, or be frustrated by them during the lifespan of research programs and centers, depressing the quantity and quality of interdisciplinary research on campus.

Chapters 3, 4, and 5 offer several examples of campuses that created upper-administrative offices and interdisciplinary institutes with a mandate to coordinate and catalyze interdisciplinary research. Such units employ specialized personnel and implement systems to facilitate information flows regarding external opportunities and contingencies (e.g. information on external funding, shifting agency priorities) as well as
coordinating internal capabilities (e.g. available faculty expertise and instrumentation). Research administration staff and directors of interdisciplinary institutes and centers fulfill boundary spanning roles, bridging various academic units and external agents, and brokering agreements. Naturally, such personnel are also constrained in their ability to gather and process information, which justifies specialization in terms of activities (e.g. develop inter-departmental collaborations) and knowledge domains (e.g. environment, biotechnology). Organizational decentralization of these functions through ORUs is to be expected due to the complexity of the organizational technology, the multiple environments the university participates in, and the high resource requirements of each field.  

ORUs following an institute model fulfill the various roles described above, such as the Penn State institutes, Stanford’s multidisciplinary initiatives, the Duke Institute for Genome Science and Policy and the new Nicholas Institute for Environmental Policy Solutions. All these units invariably organize systems to collect and disseminate information on the resources available at the university. Institutes in particular serve as a hub of dispersed expertise and infrastructure, reducing the information search costs for faculty. Interdisciplinary laboratories allow scientist to operate in proximity, reducing the spatial burdens of collaborations spanning academic units. As discussed above, a growing interest on providing flexible facilities for ‘incubating’ interdisciplinary programs arises, to overcome the challenges of assigning spaces for such activities.

Stanford’s Bio-X/Clark Center illustrates recent investments on perennial structures that create a space for interdisciplinary interactions. From the perspective of the costs and risks of interdisciplinary activity, such spaces function as ‘free trade’ zones
that subsidize scholarly exchanges that would otherwise be ‘taxed’ by geographical
distance. Although the program and the facility evolved separately and are distinct, the
interdisciplinary thrust of Bio-X shaped the concept of the Clark Center to a great extent,
which in turn has given the program a space to thrive. Lattuca has argued that ‘the
interdisciplinary space of the future would provide interdisciplinary faculty, or faculty
with interdisciplinary research and teaching interests, with a place to grow.’ By building
a body of permanent residents, Bio-X/Clark Center attempts to form a research
community where continuous and lasting interdisciplinary collaborations thrive. The
physical features of the Clark Center, including location, design, and the provision of
work areas for temporary usage, are intended to stimulate the spontaneous emergence of
a protean web of interdisciplinary interactions. Ultimately, it is in faculty’s hands how to
exploit the opportunities the new facility and program open.

Finally, universities have used appreciable amounts of their own capital to
provide financial incentives for interdisciplinary programs. From modest planning grants
to major awards to support new inter-college initiatives, universities offset the costs and
risks for faculty to establish interdisciplinary interactions and form boundary-crossing
linkages. Seed funding helps faculty allocate time, arrange meetings, and staff assistance
to otherwise unsupported activities. More substantial investments fund faculty hiring,
infrastructure, and programmatic activities. This range of targeted funding approaches
can be appreciated in Chapter 3 in the creation of interdisciplinary initiatives and formal
seed grant competitions. Strategic investment logics have explicitly justified university
efforts (e.g. exploit niches, move ahead in cutting-edge fields, augment prestige etc).
These investments vary in their short-term or long-term focus and relative emphasis on generating lasting behavioral change. Many formal seed grant competitions are one clear example of expectations on short-term returns, especially those explicitly designed to attract major federal grants. Whether the university obtains such grants is an unambiguous measure to verify the return on the investment. Investments in broader interdisciplinary programs are often viewed as yielding more complex and diffuse benefits, such as establishing leadership in important areas, following a long-term perspective. Multiple factors affect their developmental trajectories, such as the availability of continuing flows of resources (e.g. research funding, students) and the ability and interest of scientists to secure them. The mixed results of the Engineering Research Centers (whose goals included a focus on interdisciplinary research) to take hold and become self-sufficient on campuses after initial NSF funding is ceased is illustrative. In some campuses, ERCs have matured into stable organizations, whereas in others they have disintegrated.

In summary, changing university formal and informal norms, creating and altering organizational structures, and providing financial incentives all reduce the costs and risks of boundary-crossing for faculty, but they do so through different mechanisms and to different degrees. Normative changes help ‘leveling the playing field’ for faculty pursuing inter-departmental collaborations by reducing administrative and social constraints; they may still lack the ability to gather and process relevant information on opportunities, and manage process of building a research team. Organizational structures facilitate information flows and managerial aspects relevant to interdisciplinary research,
but faculty might still perceive high costs and risks in inter-departmental research activities because of prevailing campus expectations, routines, and other factors. Financial incentives stimulate faculty opportunism by offsetting some of the risk of interdisciplinary programs; but faculty may still face the same constraints, information gaps and management issues that affect boundary-crossing work. Hence, these various mechanisms are likely be self-reinforcing when used in conjunction. Entrepreneurial agents committed to interdisciplinary agendas are key inputs to create and sustain the organizational strategies enabling these mechanisms.
ENDNOTES


3 See ‘The Organization of the Research University,’ Chapter 2.

4 Rhoten, *op. cit.* note 1, 10. See also James Roberts, ‘Interdisciplinary Research Centers to Interdisciplinary Graduate Programs,’ in Mabel Rice, *Riding the Momentum of Research: Leadership Challenges in Public Research Universities*, MASC Report No 108 (pp. 73-82), (Lawrence, KS: University of Kansas Merrill Advanced Studies Center, 2004), 73, 78-81.

5 See ‘The Organization of the Research University,’ Chapter 2.


7 See Lisa Lattuca, *Creating Interdisciplinarity: Interdisciplinary Research and Teaching among College and University Faculty* (Nashville: Vanderbilt University Press, 2001), 41-42.


11 See ‘Interdisciplinary Strategies: Key Definitions and Theoretical Perspectives,’ Chapter 2.


13 For a review, see Kezar, *op. cit.* note 6, 75.

14 See Interdisciplinary Strategies: Key Definitions and Theoretical Perspectives,’ Chapter 2.

15 See ‘Planning for Interdisciplinarity: Patterns and Approaches,’ Chapter 3.

16 The university policy does include a suggestion that departments may include outside members in the guidance of tenure-seeking faculty when they have interests not represented in the home department. But the fundamental processes of evaluating and defending the case of the faculty member to the departmental and divisional committees remain unaltered.


18 See discussion of Peter Weingart’s work in Chapter 1.
19 Kezar, *op. cit.* note 6, 45.


21 As reviewed in Lattuca, *op. cit* note 7, 43-50.


23 Kezar, *op. cit.* note 6, 75.

24 See ‘Institutional Advancement and Interdisciplinary Organizations,’ Chapter 4.


29 *Ibid*.


31 See discussion on the committee’s recommendations in ‘Distribution and Overall Patterns,’ Chapter 3.


33 See ‘Interdisciplinarity as a University Strategy,’ Chapter 2.


35 The Vice President for Research and Economic Affairs defends the recent large research grants and gifts to the university in the following terms: ‘ASU is trying to become not only larger, but also more responsive to the needs of its community. This attention to work that makes a difference to society is reflected in The Biodesign Institute. The new hub for ASU’s biomedical and biotechnology portfolio emphasizes discoveries that cut across disciplines in order to directly improve the human condition. The Biodesign Institute combines expertise in life sciences, materials research, computer science, and manufacturing to try to emulate the elegant ways that nature solves problems. These can range from repairing broken spinal cords to improving the survival rate of coronary bypass patients to helping blind people negotiate their environment. Rather than being an isolated ivory tower, The Biodesign Institute is intended to catalyze research across the institution and across metropolitan Phoenix.’ See, http://ovprea.asu.edu/research/.

36 http://www.biodesign.asu.edu/graduates/


40 For a review, see Creso Sá, *Centers and Institutes as Boundary Organizations in the University Matrix*, draft manuscript, (May 6, 2004), Center for the Study of Higher Education, The Pennsylvania State University.


42 Kezar, *op. cit.* note 6, 72-73.

43 Rhoten, *op. cit.* note 1, 8-9.

44 Irwin Feller, *Whither Interdisciplinarity (In an Era of Strategic Planning)?* Presented at the Annual Meeting of the American Association for the Advancement of Science, Seattle, WA (February 12-16, 2004), 17-20.


49 Aldrich, *op. cit.* note 46, 117.


53 Ibid., 393.


56 At Arizona State, for instance, the new Institute for Computing and Information Sciences and Engineering was created following a proposal of a senior professor and department chair of the department of computer science and engineering.

57 For the ‘processes of mutual adjustment’ market metaphor, see Michael Polanyi, ‘The Republic of Science,’ Minerva, 1, (1962): 54-73.

58 Lattuca, op. cit. note 7, 49.

59 Peter Weingart, ‘Interdisciplinarity: The Paradoxical Discourse,’ in Peter Weingart and Nico Stehr (Eds.), Practising Interdisciplinarity (pp. 25-42) (Toronto; Buffalo: University of Toronto Press, 2000), 39.

60 Lattuca, op. cit. note 7, 262-266.

61 See ‘Interdisciplinary Strategies: Key Definitions and Theoretical Perspectives,’ Chapter 2.


63 Transaction costs economics, grounded on the early contributions of Nobel Prize laureate Ronald Coeze and popularized by Oliver Williamson, has influenced organizational studies as one of the strands of the ‘new institutionalism.’ See Richard Scott, Organizations: Rational, Natural, and Open Systems (5th edition), (Upper Saddle River, NJ: Prentice Hall, 2003), 113-114.


66 See Rainer Bromme, ‘Beyond One’s Own Perspective: The Psychology of Cognitive Interdisciplinarity’ in Peter Weingart and Nico Stehr (Eds.), Practising Interdisciplinarity (pp. 115-133) (Toronto; Buffalo: University of Toronto Press, 2000), 118-131.

67 For example, see a recent report of a social scientist that works with environmental conservation research. Lisa Campbell, ‘Overcoming Obstacles to Interdisciplinary Research,’ Conservation Biology, 19(2), (2005): 574-577.

68 See ‘The Organization of the Research University,’ Chapter 2.

69 Those are more commonly discussed than specific campus cultures. See Lattuca, op. cit. note 7, 35-37, 44-45.

University Technology Transfer,’ presented at the Knowledge Clusters and Entrepreneurship in Regional Economic Development Conference, (September 13-14, 2004), University of Minnesota.

71 ‘For example, in mathematics, single-author papers are the norm and are an important step towards tenure, whereas in chemistry coauthorship is the norm.’ National Academies’ Committee on Science, Engineering, and Public Policy, Facilitating Interdisciplinary Research, (Washington, D.C.: The National Academies Press, 2005), 75.

72 The alternative to disciplinary peer-review has been to form interdisciplinary review panels. But reviewers may delimit their assessment to the disciplinary aspects they are familiar with, they may lack specific criteria to judge interdisciplinarity, and the communication problems described above may affect evaluation. Of course, higher risks in research are not exclusive to interdisciplinarity. Certain kinds of disciplinary investigation can be viewed through the same lens, such as exploratory studies of poorly understood or controversial problems, and research that employs heterodox methods for any given field. See Facilitating Interdisciplinary Research (pp. 116, 130-134, 149-150, 152-153).


74 National Academies, op. cit. note 71, 97-99.

75 See a recent survey on faculty and administrators, which points to promotion criteria as one the most highly ranked obstacles to interdisciplinarity by both groups: Ibid., 76. See also related discussion in ‘Interdisciplinary Strategies: Key Definitions and Theoretical Perspectives,’ Chapter 2.

76 On this note, a recent economic study of scientists’ research behaviors in a French university empirically sustains the widely held idea that probationary faculty produce less interdisciplinary research. See Nicolas Carayol and Thuc Uyen Nguyen Thi, Why do Academic Scientists Engage in Interdisciplinary Research? BETA Working Paper, (Strasbourg, France: Bureau d'Economie Théorique et Appliquée, Université Louis Pasteur, 2004), 11-12.

77 University of Wisconsin-Madison, Report of the Ad Hoc Committee on Faculty in Interdisciplinary Programs, (March, 2003), 5.

78 For discussion of individual characteristics associated with interdisciplinarity, see Julie Klein, Interdisciplinarity: History, Theory and Practice, (Detroit: Wayne State University Press, 1990), 182-188.

79 Beyond universities, homogeneity among organizational members through hiring, retention and attrition is indeed an observed phenomenon in organization theory. See Aldrich, op. cit. note 46, 124-127.

80 See ‘Organized Interdisciplinary Research in the University,’ Chapter 2.

81 UW-Madison’s faculty handbook suggests that accommodations be made in the evaluation of certain promotion and tenure cases, and uses interdisciplinary work as an example of those. However, it does not establish a formal procedure to be followed. Interviewees indicated concern over the appreciation given to interdisciplinarity especially by the divisional committees, as reported in the case study.


83 For a statement on disciplinary cultures, see Becher, op. cit. note 65, 185-194.

84 Bercovitz and Feldman have found training effects to influence faculty propensity to engage in technology transfer activities. Bercovitz and Feldman, op. cit. note 70, 16-17.
See the discussion on leadership and peer effects in faculty decisions to engage in technology transfer. Bercovitz and Feldman, *op. cit.* note 70, 10-11.

See note 69.


Lattuca, *op. cit.* note 7, 260.

INTERDISCIPLINARY STRATEGIES: TYPES, CHANGES, AND IMPLICATIONS

Universities have created new faculty recruitment models, altered traditional procedures for allocating resources, erected innovative facilities to aggregate faculty from multiple disciplines, introduced new policies to properly evaluate and reward interdisciplinary research, and formed new administrative structures dedicated to the coordination of interdisciplinary programs. While on most campuses no deep changes have taken place, new models are emerging that modify the department-centered university, even if at the margins. These models supply university leaders nation-wide a repertoire of organizational forms that includes faculty clusters, interdisciplinary facilities, incubating space for interdisciplinary collaborations, university-wide initiatives, strategic interdisciplinary funds, and offices for interdisciplinary research, among others. They also offer precedents and benchmarks for the adoption of new financial, administrative, and evaluation routines designed to facilitate inter-college collaborations.

Changes: Academic Core and Entrepreneurial Periphery

Knowledgeable observers have suggested that despite the rhetoric of change, departments retain control over the fundamental functions of faculty hiring and
evaluation, and there are gaps between stated aspirations and the implementation of interdisciplinary strategies. This study suggests a more nuanced picture. Research universities continue their long story of incremental change, but emergent approaches are visible that alter the centrality of departments in key functions.

The experiments at UW-Madison, Penn State, and Duke with hiring models to attract faculty with interdisciplinary interests extend in visible ways the usual recruitment practices. Signs of dissemination are apparent, with RPI’s hiring of faculty ‘constellations’ and Northwestern’s stated interest in following suit. Administrators might find it easier to implement such programs by generating new dedicated funding streams, so that strategic hiring with interdisciplinary goals is not perceived as competing with the aims of academic units. Future research can examine more specifically the trajectories and contributions of faculty hired through these recruitment models. Do they effectively contribute to interdisciplinary research? Do the benefits accruing from such hiring models outweigh their organizational costs? What are their strengths and weaknesses? How can universities improve these models? The multiple, intertwined goals of the UW-Madison and Penn State hiring schemes suggest difficulties for determining ‘success.’ Their relative effectiveness may depend upon the viewpoint, interests, and organizational position of the observer. Is overall success to be understood as a function of shifting the allocation of faculty lines across fields? To what extent is the effectiveness of faculty members related to the quantity and quality of boundary-crossing collaborations, the attraction of external research awards, and the fulfillment of departmental duties?

Duke’s changes in faculty evaluation procedures shows how core academic policies can be altered to accommodate interdisciplinary work. In years to come, the
effects of these changes will become amenable to empirical investigation, not only at Duke but also at USC, where similar procedures were adopted recently. More proximally, the Duke’s policy reform, which was reportedly agreeable, provides insight for administrators interested in such change processes. Future investigation of USC could shed further light on the issue. As this was not a systematic study of whether university faculty evaluation policies include explicit provisions for interdisciplinary work, it is possible that other higher education institutions have important lessons to teach in this area.

Universities continue to establish ORUs to further research programs across academic units as they have done for a long time. This is consistent with a long term trend in higher education in the last half-century; ORUs have been a significant element in the rise of several prominent research universities, and more broadly, the ascendancy of the research mission in the university sector. While most universities have 3-digit lists of centers and institutes that operate at various organizational levels, this study focused on the more select number of major interdisciplinary units connected to the central administration. Research administrators view these ORUs as strategic and necessary to compensate for the structural limitations of colleges and departments in the research arena.

However, there are signs of a conceptual cleavage across institutions regarding the relative roles of ORUs in the university structure. Traditionally, ORUs are viewed as complementary to the academic core and part of an increasingly enlarged entrepreneurial periphery. Today, some go as far as proposing that centers should be the focus of university investments, and should get actively involved in offering degree programs.
Arizona State is an example of campuses where major investments are taking place in centers and institutes, which seem to be taking the leadership in the research enterprise. History shows that entrepreneurial ORUs that are expected to generate substantial revenues and control significant resources may become silos and compete with academic units. The reorganization leading to the current Penn State institutes shows precisely a reaction to the past experience with these adverse effects. Nonetheless, universities starting from disadvantageous positions in the competitive race for research distinction may feel compelled to shift investments to units that are more amenable to managerial control.

While the positive expectations regarding decisions to shift the focus to ORUs are clear – greater flexibility, financial returns etc. – the uncertainties reported at Arizona State regarding the proper balance between centers and academic units suggest that university actors still lack understanding of how to handle this transition. Can institutions like Arizona State follow a similar trajectory of many of today’s distinguished universities, which boosted research capabilities through research centers and raised the stature of the academic core in the process? The positive answer is the explicit working hypothesis of Arizona State president. Or, is a new ‘core’ emerging around entrepreneurial ORUs, laying the foundations of a truly new university model?

In contrast, Duke established a comprehensive system for creating and regulating the continuity of centrally-funded ORUs. This system is composed of the separate but articulated processes of funding new interdisciplinary initiatives as part of the strategic plan, and the coordination and evaluation of centers conducted by the office for interdisciplinary studies. While most universities have policies regulating ORUs, Duke
has moved ahead by taking a formal and systematic approach for monitoring and reviewing them, including the default expectation of termination after each five years.

From an organizational perspective, the interest in pursuing horizontal linkages spanning departmental boundaries parallels certain developments in industry, where scholars and professionals have discussed for some time the simultaneous use of functional departments and product teams in matrix-like arrangements, and the organization of the firm around business processes. The image of a matrix organization, where academic units occupy one axis (as functional departments) and ORUs another (as project teams), is usually employed to describe how universities arrange these two sets of structures. The fundamental premise of matrix management is that professionals can participate both in functional units and project teams. The axis of the university matrix that comprehends ORUs is viewed as the agile, entrepreneurial force bringing fluidity to the otherwise conservative and discipline-oriented colleges and departments. Both in industry and academia, these models arise from the perception of increasingly complex environments, where competitive pressures and consumer demands challenge the traditional organizational paradigms. In the higher education scholarship, the matrix organization has been used as a descriptive metaphor for some time, but not yet operationalized systematically in studies of interdisciplinary research. Future inquiry might explore the relationships among different types of matrix structures identifiable in universities and outcomes in terms of generating and sustaining interdisciplinary research collaborations.
General Patterns in the Research University Landscape

A distinctive approach has emerged in planning efforts of research universities. It related to the centrally-coordinated investment in strategic initiatives that span organizational boundaries. This is corollary of older premises in academic planning, such as ‘we can’t be all things to all people,’ but with a preference for boundary-spanning efforts. The aim of such initiatives is not to strengthen one particular department as a staple of excellence, but rather to focus resources on research areas that may ramify into various academic units. Such investments are expected to heighten the visibility and distinction of the university’s research enterprise in areas of inquiry that are believed to yield certain payoffs in terms of scientific prestige and external awards. While the adoption of such initiatives had been captured in recent scholarship, this study extended previous findings by describing the various means through which universities implement them. By comparing the stories of the initiatives reported in this study, it is possible to appreciate a range of routes universities have taken and draw elements that may be applicable elsewhere.\(^9\) Initiatives are usually spearheaded by an interdisciplinary ORU that may control new facilities, funding for programmatic activities, research support services, and even faculty lines.

This study makes a typological distinction among interdisciplinary research units, grounded on the analysis of the dozens of ORUs described in institutional documents. When universities seek an organization with broad coverage of academic fields and subfields, to spur collaborations spanning a range of departments and even colleges, they establish units following the ‘institute model.’ Institutes fulfill the roles of coordinators of university resources and catalysts of interdisciplinary collaborations in a given area of
research. Institutes may administer a number of other units and facilities, operating as a holding companies or umbrella organizations. When the goal is to mobilize a research effort in a more specifically defined field, universities establish units following the ‘center model,’ either within the organizational framework of an institute or in isolation. Centers may take several forms: they may be networks of faculty from different departments, with little dedicated infrastructure and staff support; they may operate out of a dedicated laboratory, which provides a common roof for scientists from across the university to develop team-based projects; they may arise from federal grants that require the establishment of a center organization; and they may also revolve around facilities housing sophisticated instrumentation that serves scientists from multiple disciplines and may be sites for interdisciplinary collaborations.

These multiples forms have been scantily described and differentiated, and conceptual confusion is a usual reaction to the variety of sizes, shapes, functions, and purposes of ORUs. However, the distinctions made above extends previous classifications, as they seem to capture the logics campus leaders use when establishing such units, and facilitate understanding of this diverse array of structures.

Universities have also invested in new spaces for interdisciplinary research, particularly in the natural and physical sciences. Such trend has been characterized by major investments in innovative facilities at some leading institutions, such as the Clark Center at Stanford University and the Life Sciences Institutes at the University of Michigan. While universities constantly invest in building and renovating research laboratories, these and other facilities have been designed to stimulate interdisciplinary collaborations and have been promoted as such. It is rather suggestive that in most cases
these interdisciplinary spaces are dedicated to collaborative research involving the Life Sciences, where scientific advancements have made traditional departmental divisions meaningless.

The Clark Center is an exemplar of interdisciplinary spaces. Its organizational arrangements are still highly experimental and expectations are set on inducing long term cultural changes. It is too soon to anticipate the opportunities and constraints generated by its new way of organizing scientists, although it is easy to get enthusiastic about the *avant-garde* character of the Bio-X/Clark Center enterprise. These emerging structures raise new questions in regard to the effectiveness of ORUs to foster interdisciplinarity and their roles on campus. Future studies could specifically investigate whether and to what extent large shared workspaces facilitate meaningful knowledge exchanges, informal interactions, and structured short-term and long-term collaborations. These questions can be pursued through various methodological approaches, ranging from social network analysis to ethnographic techniques. Theoretical support for such inquiry can be found on scholarship on propinquity and collaborative work and the formation of scientific collaborations, in addition to interdisciplinarity.\textsuperscript{13} Incorporating theories and insight from the field of architecture would seem pertinent in the investigation of the effects of such facilities on the social behavior of scientists. Studying the dynamics in place in units such as the Clark Center systematically and longitudinally would seem of great practical implications, especially for academic administrators directing comparable facilities or contemplating similar undertakings. New buildings are due to open in the near future, and investigation of their actual purposes and uses may elucidate whether
they represent a definite trend towards a new model of research facilities or simply modern edifices that house old structures and practices.

Finally, universities have taken action to stimulate collaborative research projects across disciplines, by establishing central seed funding programs and enhancing support services to faculty. These mechanisms relate to the sometimes formal goal to obtain and increase the number of large interdisciplinary research awards. The selection of NSF grants examined here, while admittedly a crude measure, shows an overall concentration in the distribution of these awards among very large research performers. Nevertheless, some interesting exceptions stand out, most notably Carnegie Mellon University. Some universities seem relatively better prepared to attract large grants that require collaborative efforts than others,\textsuperscript{14} justifying the administrative efforts on many campuses to enhance their competitiveness in that regard.

This is one symptom of the growth, professional specialization, and strategic roles of university offices of research. Offices and professional roles associated with fostering and coordinating interdisciplinary activities have also been created, and may represent a new line of sub-specialization in the research administration ‘profession.’ Although previous research suggests these are not entirely new,\textsuperscript{15} there remains much novelty associated with central structures to promote interdisciplinarity as evidenced in Duke’s case, where administrators did not find comparable units among peer institutions in the late 1990s. Clearer understanding on associated professional roles and structures is clouded because vice presidents for research and the activities of their offices remain poorly investigated. As noted elsewhere, such gap is puzzling given the extensive study
of academic leadership, and also the growing body of research on technology transfer, one of the sub-components of the research enterprise.

Considerations for the Analysis of Interdisciplinary Strategies

Some analytical tradeoffs are evident in the study of university efforts spur interdisciplinary science. On one hand, one may impose external criteria of success to the context-specific, multipurpose university strategies and miss the local construction of meaning by the very actors advancing them. On the other, one may focus on actors’ viewpoints and take their intentions to promote boundary-crossing research at face value, risking the ability to make informed judgments on the strategies they use. The challenge is to balance the local representations of reality with conceptual frameworks that allow for critical analysis.

The cross-analysis of the case studies indicate the need for a more comprehensive understanding of the nature of research universities as organizations to inform the debate on interdisciplinary research in academia. Such understanding entails a consideration of distinctive characteristics that influence universities’ ability to and ways of promoting organizational change. This includes appreciating the influence of institutionalized elements on academic actors, how university ambiguities might influence particular organizational strategies, and the latter’s roots on specific campus contexts. A perspective focusing on identifying and disseminating ‘best practices’ might prove elusive at higher levels of aggregation. The sets of norms governing organizational behaviors in each campus cannot simply be transplanted elsewhere, nor understood as separate from the
constitution of specific interdisciplinary strategies. To effect significant change in traditional academic structures, academic leaders have to recognize the need and possibility of change in the first place, going beyond taken-for-granted assumptions regarding proper ways of organizing.

University strategies associated with interdisciplinarity emerge amid administrative agendas, general and situated contingencies, local resource endowments, and the interacting interests of various stakeholders. These factors shape the solutions found to campus-specific problems, which may or may not reflect sector-wide ones. Such dynamics give a local character to the design and implementation of interdisciplinary strategies that can be easily understated. Ultimately, universities adopt interdisciplinary strategies for multiple reasons, and some advocates may be frustrated by the lack of structure at the micro-level to promote ‘true interdisciplinarity’ according to normative definitions. From the perspective of administrators interviewed for this study, not letting organizational boundaries impede faculty to join in collaborative efforts to produce high-quality research is a serious motivation for administrative action, regardless of the exact processes through which knowledge is produced.

Academic administrators and faculty face distinctive choices when supporting and engaging in interdisciplinary strategies. Those choices take place in the context of prevailing institutional arrangements, campus characteristics, and their different relationships with the university. Administrators are concerned with institutional advancement, and the idea of interdisciplinarity is consistent with widely shared values and organizational principles. That may help explain its popularization in academic planning, in addition to the potential for changing scientific paradigms and meeting
external needs. For faculty, participating in interdisciplinary arrangements relates to their choice of research problems and strategies. Future investigation could explore the usefulness of an individual choice framework in predicting faculty engagement in interdisciplinary research programs.

It has been empirically observed that faculty think about interdisciplinarity as they think about research design. A parallel seems to hold for academic leaders at the organizational level. They devise strategies which incorporate the idea of interdisciplinarity as they consider the organizational problems that they seek to address. From the viewpoint of upper-administrators, interdisciplinarity provides a counter-argument to the traditional accretive pattern of university growth, and the structural obstacles for leveraging dispersed expertise when such flexibility is needed. Accretion and silo mentalities are the antithesis of the contemporary effort of university leaders to behave strategically, which has been formalized in extensive planning processes and sometimes elaborate documents charting future directions. Across campuses, interdisciplinary strategies have taken several shapes and represent different degrees of commitment to academic reform. In common, universities use the idea of interdisciplinarity as a means to achieve diverse ends such as stimulating high quality scholarship, increasing sponsored research, shifting the makeup of the faculty, enhancing institutional reputation, and emphasizing investigation that is perceived as more relevant to society, whether for its economic or policy implications. Whether or not organizational strategies achieve those ends seems to be the central concern of the academic leaders that bring them about.
ENDNOTES

1 See ‘The Organization of the Research University,’ Chapter 2.


3 See ‘The Organization of the Research University,’ Chapter 2.

4 An opinion echoed by James Roberts, ‘Interdisciplinary Research Centers to Interdisciplinary Graduate Programs,’ in Mabel Rice, Riding the Momentum of Research: Leadership Challenges in Public Research Universities, MASC Report N° 108 (pp. 73-82), (Lawrence, KS: University of Kansas Merrill Advanced Studies Center, 2004), 73, 78-81.


9 For a recent account of the creation of one initiative reported elsewhere, see Robert Brown, ‘The Bioeconomy: Building a Campus-Wide Initiative From a National Priority,’ in Mabel Rice, Riding the Momentum of Research: Leadership Challenges in Public Research Universities, MASC Report N° 108 (pp. 35-40), (Lawrence, KS: University of Kansas Merrill Advanced Studies Center, 2004).


12 For recent description of recently established units resembling the ‘institute model’ and the ‘center model’ see, respectively, Roberts, op. cit. note 4, 37; and Susan Sheridan, ‘Building on Strengths: The Development of an Interdisciplinary Research Center,’ in Mabel Rice, Riding the Momentum of Research: Leadership Challenges in Public Research Universities, MASC Report N° 108 (pp. 107-114), (Lawrence, KS: University of Kansas Merrill Advanced Studies Center, 2004).

As suggested by Irwin Feller, *Whither Interdisciplinarity (In an Era of Strategic Planning)*? Presented at the Annual Meeting of the American Association for the Advancement of Science, (February 12-16, 2004), Seattle, WA, 17-18.

See discussion on Georgia Tech in ‘Distribution and Overall Patterns,’ Chapter 3.


This is one weakness of the recent National Academies Report *Facilitating Interdisciplinary Research*, which catalogues myriad university initiatives as ‘best practices’ but lacks a stronger empirical basis. See note 7.

APPENDIX A:

99 RESEARCH UNIVERSITIES

Arizona State University, main campus
Auburn University, all campuses
Boston University
Brandeis University
Brown University
Cal Tech
Carnegie-Mellon University
Case Western Reserve University
Clemson University
Colorado State University
Columbia University
Cornell University, all campuses
Dartmouth C
Duke University
Emory University
Florida State University
George Washington University
Georgia Tech, all campuses
Harvard University
Indiana University, Bloomington
Iowa State University
Johns Hopkins University
Kansas State University
Louisiana State University, all campuses
Michigan State University
MIT
New Mexico State University, all campuses
North Carolina State University
Northwestern University
NYU
Ohio State, all campuses
Oregon State University
Penn State, University Park
Princeton University
Purdue University, main campus
Rensselaer Polytechnic Institute
University of Miami
University of Michigan, Ann Arbor
Rice University
Rutgers University, NJ
Stanford University
SUNY Albany
SUNY Buffalo, all campuses
SUNY Stony Brook all campuses
Syracuse University, all campuses
Texas A&M, all campuses
Tufts University
Tulane University
University Alabama, Birmingham
University Delaware
University of Arizona
University of California, Berkeley
University of California, Davis
University of California, Irvine
University of California, Los Angeles
University of California, Riverside
University of California, San Diego
University of California, Santa Barbara
University of California, Santa Cruz
University of Chicago
University of Cincinnati, all campuses
University of Colorado, Boulder
University of Connecticut, all campuses
University of Florida
University of Georgia
University of Hawaii, Manoa
University of Illinois, Chicago
University of Illinois, University ofrbana-Champaign
University of Iowa
University of Kansas, all campuses
University of Kentucky, all campuses
University of Maryland, College Park
University of Mass, Amherst
University of Minnnesota, Twin Cities
University of Missouri, Columbia
University of Nebraska, Lincoln
University of New Mexico, all campuses
University of North Carolina, Chapel Hill
University of Oklahoma, Norman
University of Penn
University of Pittsburgh
University of Rochester
University of South Carolina, Columbia
University of South Florida
University of Southern California
University of Tennessee, Knoxville
University of Texas, Austin
University of Utah
University of Virginia, all campuses
University of Washington
University of Wisconsin, Madison
Utah State University
Vanderbilt University
Virginia Polytechnic Institute
Wake Forest University
Washington State University
Washington University, St. Louis
Wayne State University
Yale University
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VITA

Creso M. Sá

EDUCATION


Master in Marketing, Escola Superior de Propaganda e Marketing (Brazil), 1999.

Baccalaureate, Communications, Universidade Católica do Salvador (Brazil), 1997.

PUBLICATIONS AND PRESENTATIONS


HONORS AND AWARDS

National Science Foundation Dissertation Improvement Grant, 2005.


Penn State Department of Education Policy Studies Travel Grant Award, 2003.


