Strategic Planning

Synergies between Science/Engineering and Liberal Arts/Social Sciences

“Bridging Disciplines: Solving Complex Problems”

College of Agricultural
College of Education
College of Consumer & Family Sciences
The Graduate School
School of Management
College of Pharmacy, Nursing & Health Sciences
College of Science
College of Liberal Arts
College of Engineering
School of Technology
School of Veterinary Medicine
Executive Summary
Synergies between Science/Engineering and Liberal Arts/Social Sciences
“Bridging Disciplines; Solving Complex Problems”

In the recent past, reports from such groups as the Kellogg Commission and the American Association of Colleges and Universities have called upon institutions of higher learning to examine the way they carry out their learning engagement, and discovery missions in an era of globalization and increasingly complex challenges facing humanity in the twenty-first century. The need for cutting-edge knowledge is clear as is the need for a concerted effort to bring this knowledge to bear on a variety of local, national, and global challenges.

Solutions to complex problems require technical and scientific expertise as well as understanding the impact on societies and cultural barriers to significant change. Researchers from all areas must join forces across the disciplines to meet these challenges and to prepare the next generation of researchers, educators, leaders, and world citizens for the problems they will confront.

Creating a synergistic learning and research environment will position Purdue University to take part in these important tasks. It promises to enhance the talent of faculty and students and to demonstrate the value and necessity of diverse people and disciplines working collaboratively. Synergistic work will position Purdue as a global university.

Of paramount importance to the cultivation of synergies is a faculty, student, and staff collective empowered to facilitate such endeavors. We propose the creation of a Synergies Advancement Council whose task would be to clear the way for innovative synergistic curricula, programs of study, and discovery and engagement activities.

We propose a core curricular experience as essential to the preparation of graduates who will appreciate the need for multiple approaches to complex problems. A core curricular experience would expose all students, regardless of their programs of study, to courses above the 100-level that demonstrate the interplay between diverse disciplinary perspectives on the same problem.

In order to encourage synergistic, interdisciplinary research, the university must reward faculty researchers who undertake such work in its tenure and promotion policies and practices. A review of tenure and promotion represents the articulation of the requirements for citizenship in the twenty-first-century university.

We propose the establishment of an institute for public policy as one promising site of synergy between sciences/engineering and liberal arts/social sciences. We envision the institute combining research on energy, environment/climate change, regional development, and women, children, and families with policy recommendations and the analysis of the social impact of policy on societies and communities at home and abroad.

Funding for the Synergies Advancement Council, the core curricula, and the review of promotion and tenure will come largely from internal sources and from targeted fundraising. The public policy institute will require support from sponsored research and fundraising for activities and facilities.
Introduction

In the recent past, reports from such groups as the Kellogg Commission and the American Association of Colleges and Universities have called upon institutions of higher learning to examine the way they carry out their research, teaching, and engagement missions in an era of globalization and increasingly complex challenges facing humanity in the twenty-first century. The need for cutting-edge knowledge from colleges and universities is clear as is the need for a concerted effort to bring this knowledge to bear on a variety of local, national, and global challenges.

These groups and various funding agencies also note the need to integrate the arts, humanities, and social sciences as well as engineering and the physical and biological sciences into multi- and interdisciplinary research teams as they address large-scale problems. Solutions to complex problems require technical and scientific expertise as well as understanding of the impact on societies and the cultural barriers to significant change. Researchers from all areas must join forces and work together across the disciplines to meet the challenge posed by the Kellogg Commission “to advance the common good” in a “New Era and a Different World.” At the same time, the university must rise to the challenge of preparing the next generation of researchers, educators, leaders, and world citizens for the problems they will confront.

Creating a synergistic learning and research environment will position Purdue University to take part in this important task. Some sites of synergy already exist on our campus; we propose taking purposeful steps to integrate faculty and students in all colleges into more collaborative endeavors.

Taking on global as well as domestic challenges requires respectful collaboration with men and women from different cultures. Individuals from different cultural backgrounds bring particular perspectives and knowledge to bear on the challenges that face humanity. Diverse communities like Purdue University bring multiple approaches to problem-solving together; the challenge is to maximize this advantage by creating opportunities for people with different backgrounds and approaches to work synergistically toward common goals.

All public universities to some extent grapple with the charge of conducting research and teaching in this “New Era.” Among our peer institutions, we find efforts to develop and encourage synergies between Science/Engineering and Liberal Arts/Social Sciences, and in some areas they appear to have made more progress than Purdue University. Nevertheless, we are in a position to take a leadership role in defining the administrative structures and institutional culture for an effective twenty-first-century university. Because of Purdue’s traditional strength in agriculture, engineering, and science, the university must make dramatic changes in order to integrate the liberal arts and social sciences into the fabric of undergraduate and graduate learning and institutional research. As we strive for the goal of creating synergies between Science/Engineering and Liberal Arts/Social Sciences we have an opportunity to become a model for the engaged synergistic university.
Current Synergies

The university has begun to encourage and enable synergistic work. The most important examples of synergy can be found in various research centers and Discovery Park; joint-appointed faculty members; joint graduate programs that span two or more colleges; the Study in a Second Discipline program; public policy projects in Agricultural Economics, and collaborative research projects. The Energy Center, the Center for Research on Climate Change, the Cancer Center, and the Regenstrief Center, for example, have incorporated faculty from the College of Liberal Arts in ongoing research that is largely science-centered. About 200 faculty members hold joint appointments; the vast majority, however, are within a college rather than across colleges, and of those that do cross college boundaries, an overwhelming number span science, engineering, and agriculture. Only seventeen cross a scientific/technical field with liberal arts and social sciences. Graduate programs in Neuroscience and Gerontology involve faculty and students in the sciences and the social sciences. Faculty members who are selected to study in a second discipline typically do so to enhance their individual research agendas.

There have been numerous collaborative research projects—between linguists and specialists in computer graphics, artists and engineers, historians and engineers, but there is no central clearinghouse where a database of such interdisciplinary collaborations are tracked. In many departments, interdisciplinary work is discouraged—in mentoring of young colleagues, at merit deliberations, and at the time of tenure or promotion. Students also encounter barriers to working across colleges—degree requirements that leave little room for electives; combined majors and minors that preclude completing a bachelor’s degree in four years; the inability to substitute courses from one college for requirements in another; and the absence of an option to create an individualized plan of study.

Disciplines continue to be the core strength of the university; therefore our goal is not to undermine disciplines and departments. Instead, our goal is to facilitate the work of a subset of our faculty who are committed to interdisciplinary, collaborative, and problem-solving approaches in their research and classrooms. By encouraging synergistic work, the university will also promote the ideal of collaborations among diverse people. The initiatives outlined below are designed not only to remove barriers to such work, but also to take steps that will encourage and reward synergistic efforts.
I. Synergies Advancement Council

Of paramount importance to the cultivation of synergistic learning, discovery, and engagement is a faculty, student, and staff collective empowered to facilitate such endeavors. A Synergies Advancement Council would clear the way for innovative synergistic curricula, programs of study, and discovery and engagement activities.

To compete in a complex world that requires new ways to solve difficult problems, the University needs to create a climate that supports cross-disciplinary thinking and the creation of pathways between colleges. To jumpstart a synergistic environment, it is necessary to establish a group of passionate, like-minded individuals on the faculty, staff and in the student body who will enable synergistic activities by reducing the internal obstacles to cross-disciplinary work.

The absence of a “home” for synergistic endeavors results in frustration—for students wishing to develop their own plans of study, for faculty eager to work with others outside their home discipline, for research teams seeking partners outside their home college, and for faculty committed to organizing classroom ventures that would introduce students to complex problems from a variety of perspectives. The size of Purdue University’s faculty and student body inhibits familiarity with research specialists outside one’s college. At present there are a limited number of ways potential collaborators can become aware of one another. Not all faculty members and students will be attracted to synergistic research and learning; those who are should be able to find one another and to take an active part in fostering new initiatives.

One model that could be used as a basis for this initiative is the Service Engagement Advisory Board. We propose that our Synergies Advancement Council be comprised of individuals (faculty, graduate and undergraduate students, and staff) who currently are engaged in synergistic cross college/department endeavors and are committed to furthering such activities. These individuals are aware of the existing barriers to synergy and would be charged with developing new processes that would encourage rather than impede synergistic activities.

Faculty members appointed to the Synergies Advancement Council should be currently involved in interdisciplinary activities and passionate about collaborative activities. Faculty should be released from departmental obligations during their Council tenure so that this appointment will be seen by the university community as a career-enhancing position. All members should be visionary, team-oriented, engaging individuals who have the networking abilities to champion such work. The Council must be empowered to recommend processes that make synergies happen—in learning, discovery, and engagement.

The Synergies Advancement Council would have a direct link to the Provost to recommend projects and processes designed to promote synergies. The council would serve as a clearinghouse to provide information on current synergistic endeavors and to facilitate collaborations that fall outside officially established centers. The Synergies Advancement Council would clear the administrative path for those seeking innovative,
interdisciplinary learning, discovery, and engagement opportunities and to facilitate the following: 1) create-an-undergraduate-major option for students who want to blend requirements from two or more majors to create a unique program of study, and individualized programs of graduate study that involve more than one college; 2) symposia and lecture series for bringing potential collaborators into productive interactions; 3) the incubation of synergistic curricula; 4) a support system for collaborative projects that do not meet the standards of a “Center” but that promote innovative work across the liberal arts and the sciences (e.g. undergraduate minors that blend elements of the sciences/engineering and liberal arts/social sciences and that appeal to students from more than one college); and 5) the dissemination of publicity for synergistic work being done by faculty and students. The last charge would help position Purdue as a university committed to synergistic activities.

The objective is not to create a new fiefdom but to create a site for facilitating synergies in learning, discovery, and engagement. Providing an intellectual home for interdisciplinary scholars promises to make the best and fullest use of the talents of faculty members and students seeking to bridge disciplines and integrate knowledge from diverse fields.

Funding from the Provost’s office to provide incentives for curriculum development and implementation is essential. The Synergies Advancement Council will oversee the distribution of such funds. Once developed, courses would become part of a regular teaching assignment for faculty and would be sustained through regular allocations for teaching needs distributed to each of the colleges. In addition, at least two fellowships to Study in a Second Discipline, evaluated and ranked by the Council, will be earmarked for proposals that link science/engineering with liberal arts/social sciences. Other strategies for supporting this initiative include targeted fundraising among corporate donors, whose businesses would benefit from integrated research expertise by faculty and Purdue graduates, and launching a mini-campaign among alumni interested in both arts and sciences to sponsor named lecture series or annual symposia. Finally, two of the Bilsland Strategic Initiative Fellowships could be focused specifically on synergies (under the Graduate School’s rubric of “fostering interdisciplinary graduate education”), giving the fellows support for their graduate education and high, university-wide visibility for their special initiatives.

We will know this initiative has succeeded when synergistic courses have been introduced, when students propose innovative programs of study across colleges, and when teams of faculty researchers form new collaborations.

Metrics
1. Quantitative and Qualitative measures of cross-college plans of study.
2. The number of students enrolling in integrative courses.
3. The number of new discovery, learning, and engagement projects that position themselves as synergistic.
II. A Core Curricular Experience

The preparation of graduates with an appreciation of the need for multi-pronged approaches to complex problems requires a curriculum that includes a significant number of courses that integrate the theories and practices of two or more disciplines. This core curricular experience would expose all students, regardless of their programs of study, to courses above the 100-level that demonstrate the interplay between diverse disciplinary perspectives on the same problem. Ideally, 10% to 15% of all plans of study would be devoted to such courses.

Currently, Purdue University has neither a unified core curriculum nor a common curricular experience that is unique to Purdue. Most individual colleges have identified a list of core courses or core competencies to be completed in addition to the requirements of majors in the college. This means that when students from different colleges interact with students outside their colleges, it is most often at the introductory level and it is not likely to be in courses that require collaboration, teamwork, or the necessity of appreciating the sophisticated analytical work performed by professionals in the field.

We propose developing a core curricular experience that will ensure all graduates will have had courses focused on problem solving, effective communication, and critical thinking. As one of the contributors to the Synergies blog site puts it: “Is Purdue out to create brilliant researchers or brilliant citizens of the world community who happen to be researchers?” The latter certainly are in high demand, and a core curricular experience would empower Purdue University graduates to think and act collaboratively, to integrate the technical and scientific know how with the social and cultural analysis provided by liberal arts education, and to be prepared to offer their services to those seeking solutions to complex problems.

Some of our peer institutions have a core curriculum or general education requirements that can be met by taking so many hours from a menu of courses in the humanities, natural sciences, mathematics, and communications. A handful of them also make options available to their students such as a freshman experience, problem-based seminars, and the like, but they do not insist that all students pursue these options. We have an opportunity to develop a curriculum that integrates multiple disciplines and that gives all students the challenge of learning how to work in teams, address complex problems, communicate their findings in effective ways, and think critically about the social and cultural issues that affect scientific and technological approaches to problem solving.

To accommodate the scale required to involve all undergraduates in the common curriculum, we would draw from a select menu of courses that share common learning outcomes and attributes that cut across disciplinary boundaries. The common learning outcomes would address relevant issues of the day and draw from perspectives from multiple disciplines. The courses would be taught with significant components in small class sizes for students to have the opportunity to exchange ideas in discussion formats. The courses that would fulfill the requirement would not simply be courses from another discipline, but they would address issues from multidisciplinary perspectives and have multidisciplinary input from the instructional material or the instruction itself. The intent would be for the classes to involve students from multiple disciplines in the same courses.
Examples of these courses would include great issues courses where students study and discuss relevant issues that are presented from multiple perspectives. There are a significant number of courses in Liberal Arts, for example, that address topics in the science and technology arenas. Courses that address local or global issues through service-learning, such as the EPICS courses, are other examples of courses that could meet the common requirements.

The intent of the common curriculum would not be to add to the required number of credits to graduate but rather to integrate courses that meet the common curriculum attributes into the curricula of the respective colleges and departments. To facilitate this, it is envisioned that the courses that would comprise the common curricular experience would be drawn from two classifications, one from within their own college and one from outside. This would give flexibility for colleges to integrate the common curriculum into both their own disciplinary elective courses and their general education requirements.

The proposed initiative is very timely given initiatives within the colleges of engineering and science creating college-wide outcomes that are designed to broaden students' experiences. These outcomes include abilities to work with multidisciplinary teams and to understand their fields within the larger global and societal contexts and are consistent with the synergistic approach to the common curriculum. These college efforts could be leveraged to help create the common curriculum.

New courses or modifications of existing courses would be needed to put a set of courses in place to achieve the common curriculum. Seed funding for these initiatives would be needed from the office of the Provost as the curriculum is put in place. We recommend that the model used to obtain external sponsors for EPICS courses be followed. Additionally, resources available from a reallocation of regular teaching resources would be assigned to support the new curriculum. Finally, in order to inspire support for this initiative, funding to support teaching needs will be dependent upon the extent to which individual colleges participate in the development of new, synergistic courses. Once developed, courses would become part of regular teaching assignments for faculty and would be largely sustained through regular allocations for teaching needs distributed to each of the colleges to encourage the continued offering of the multidisciplinary courses.

We will track the success of this initiative by the integration of core curricular requirements into the colleges' curricula, by the number of faculty engaged in offering synergistic courses, by the quality of student performance in these classes, and by the extent to which courses attract students from multiple colleges.

**Metrics**

1. Quantitative and Qualitative measures of plans of study integrating common curricular experience.
2. The composition of classes by colleges.
3. Quantitative and Qualitative measures of the student experience in the common curriculum.
4. The number of faculty involved in the core curriculum courses.
II. A University-wide Review of Tenure and Promotion Practices

In order to encourage synergistic, interdisciplinary research, the university must reward faculty researchers who undertake such work in its tenure and promotion policies and practices.

Interdisciplinary and multidisciplinary research projects have captured the imagination of scholars in most universities across the United States. Research centers bring together teams of researchers from a variety of disciplines to work on a focused problem; like most of its peer institutions, Purdue University supports numerous such centers. At the same time, most universities maintain discipline-based and department-centered standards for promotion and tenure. Interdisciplinary scholars, by definition, work at the intersection of disciplines, and their work is not always legible to colleagues determined to maintain standards of the profession. Primary committees typically demand that candidates for tenure or promotion show what percentage of a collaborative project they have contributed. The contribution itself may not be path breaking in the discipline, but the project as a whole result in new ways of knowing and doing.

We applaud the effort to establish policies and procedures for evaluating faculty with joint appointments (a draft proposal entitled “Issues Related to Policy Regarding Process for Review and Promotion of Junior Faculty with Joint Appointments” is currently under discussion among university leaders), but we believe it is necessary to take the next step toward re-evaluating institutional culture. The review of tenure and promotion practices we envision is more than a statement about interdisciplinary research or about procedures for evaluating joint appointments. It is nothing less than an articulation of the requirements for citizenship in the twenty-first-century university. We start from the assumption that university practices should reflect what we say we value; if synergistic research, teaching, and engagement is a requirement in the New Era, then tenure and promotion standards, guidelines, and practices should reflect that commitment. If universities are to be engaged in research that addresses significant and complex problems, then they must find a way to encourage and reward discipline-based as well as interdisciplinary scholars. At the moment Purdue University and all of its peer institutions live with a disconnect between the drive for synergistic research and learning and tenure and promotion policy that privileges discipline-based knowledge over interdisciplinary problem solving.

Leading the way on tenure and promotion practices will not only create an environment conducive to and supportive of synergistic collaborations across colleges, but will also take full advantage of the energy and talent of faculty members and students with innovative approaches to problem-solving and research. It will also contribute to a climate in which diversity is valued for its transformative possibilities. At present, women, racial/ethnic minorities, and international students are distributed unevenly in the colleges at Purdue University. By placing a palpable value on cross-college collaboration in discovery, learning, and engagement activities, students and faculty members in all parts of the campus can begin to appreciate the contributions made by all community members—women and men from all backgrounds and with a variety of expertise—to the production of knowledge and the practices that address our greatest collective challenges. Indeed, diversity will come to be a necessity and one of the university’s greatest assets.
Responsibility for a review of tenure policy lies with the faculty under the leadership of the Provost. This initiative would address concerns expressed in the November 2003 report entitled “Building a Foundation for Career Long Faculty Development at Purdue University.” As one focus group participant put it: “[I]f interdisciplinary research is a summum bonum, then there must be university-wide support of that goal, including and especially local Department support.” Another argued, “Again speaking to the call to step up interdisciplinary and externally supported research activity, when such activity is undertaken we must find a way to recognize the contributions of the entire team instead of the more common practice of giving credit primarily or sometimes even exclusively to the primary investigator.” Most institutions of higher learning respond to issues like these with special guidelines for joint-appointed faculty or interdisciplinary scholarship. A faculty-driven initiative to create tenure and promotion policy for the twenty-first-century university would be truly path breaking.

If given visibility in university publications, this initiative promises to make Purdue a model for institutions interested in establishing high academic standards for interdisciplinary work that at the same time endorse the intrinsic value of such work. It would also make the university an attractive destination for scholars, teachers, and students with creative, interdisciplinary investments. This initiative would not only enhance the talent of those already on campus but also bring diverse scholars and students to a community that has positioned itself as a welcoming institution. Ideally such a review would preserve the high standards for promotion and tenure within disciplines even as it established rigorous standards for evaluating work between and across disciplines.

The costs associated with this initiative are minimal; facilities, fundraising from internal and external sources, and seed-grant funds are not needed. What we do need are visionary leadership and a collective will to craft a culture supportive of collaboration.

Metrics
1. Rising number of successful candidates for tenure and/or promotion whose promotion documents show significant collaborative, synergistic scholarship in discovery, learning, and engagement.
2. Qualitative, anecdotal evidence of satisfaction with institutional support for interdisciplinary endeavors.
IV. An Institute of Public and Global Affairs

Synergies between Science/Engineering and Liberal Arts/Social Sciences should not be encouraged as ends in themselves; they should be developed in order to have an impact. As scholars begin to find answers to the great global challenges, they can have the desired results only if they inform policies that endorse and implement them. At the same time, the analysis of current policies that demonstrates and explains their impacts, both positive and negative, on societies and communities at home and abroad must be supported.

We propose creating an Institute of Public and Global Affairs in order to harness the talents of specialists in social and cultural analysis, political processes, and effective communication to those of scientists and engineers in collaborative problem-solving. This initiative focuses on a specific field in which collaboration between the sciences/engineering and the liberal arts/social sciences promises synergy and impact. It is meant to serve as an example of the potential power of synergistic collaboration among diverse disciplines. The institute is designed to evaluate various public policies, to inform the public through both scholarly publications and engagement activities of the effects of public policies and technological change on society and subgroups therein, and to provide policymakers current research findings to better inform the decisions they make.

Currently, research related to public policy is being undertaken by faculty and students in such areas as Agricultural Economics, the College of Liberal Arts, the College of Consumer and Family Sciences, and Centers for Energy, the Environment, Regional Development, and Research on Climate Change. A new initiative in Women’s Studies is in the advanced planning stages by its Director whose ties to UNESCO will position students and faculty in that field to play a research consulting role at the international level as well as locally and nationally on policies related to women, children, and families.

Some ties among these groups already exist, but more could be encouraged. The institute is intended to coordinate the ongoing activities in the area of public policy, to attract new collaborators to this field, and to bring into productive interaction diverse faculty and students interested in policy analysis, social and cultural analysis of current policies, and discoveries that can inform future policies.

Many of our peer institutions house public policy institutes. Notable among them are the UC Berkeley Institute of Governmental Studies, the UC Davis Institute of Governmental Affairs, the UT-Austin Lyndon B. Johnson School of Public Affairs, the UIUC Technology and Public Policy, the University of Michigan, Gerald R. Ford School of Public Policy, and the University of Wisconsin Robert M. La Follette School of Public Affairs. Each focuses on a limited number of policy areas, and the interplay between policy analysts and research scientists varies from institute to institute.

The initiative will be communicated as Purdue’s attempt to lead the way toward a better understanding of the consequences of governmental policies on the lives of individuals here and around the world as well as providing cutting-edge research to inform new policies in the areas of energy, environment, regional development, and women and families. Building on our current strengths and areas of scientific and policy expertise, we
believe that Purdue can develop an important signature strength by encouraging synergistic collaborations on these focused areas.

The institute will enhance talent by bringing together researchers from a number of academic areas within Purdue and increasing the reach and impact of their work. Undergraduate and graduate students with interests in specific issues may well develop individualized programs of study to take advantage of the scientific and liberal arts expertise available in the field of public policy and thus prepare themselves to understand multiple aspects of a particular issue. Other possible outcomes include multidisciplinary conferences, jointly taught undergraduate and graduate seminars, visiting faculty and post-doctoral appointments, and distinguished speakers’ visits, all of which would showcase Purdue’s commitment to synergies between the liberal arts/social sciences and the sciences/engineering that lead to effective and informed public policy making.

The institute will enhance the diversity initiatives of the university by bringing together scholars studying the impact of policies on underrepresented groups and disempowered populations with those interested in seeking scientific solutions to complex problems in such areas as energy, the environment, national and international security, and health care. Moreover, the institute will also tackle global issues, and in doing so, expand faculty, student, and public awareness of the effects of governmental policies on problems of world-wide significance. This should enhance Purdue’s position as a global university.

Initially, synergistic discovery and learning activities related to public policy should be cultivated with funding from the Provost’s Office to provide seed money and staff support for making innovative proposals to external funding agencies. But the charge of faculty engaged in the institute will be to attract external sponsors for their research. Eventually, facilities for conferences, seminars, and interaction among the diverse faculty involved in public research may be needed. We propose that planning and fundraising begin in the next five years with the expectation that the groundwork for collaboration will be laid and the facilities needs will be more clearly defined. In the intervening years, seed grants, the quest for external funding, and other incentives for policy-related initiatives will be facilitated by the Synergies Advancement Council.

**Metrics**

1. Number of recommendations considered and/or adopted by policy makers.
2. Number of students seeking undergraduate or graduate degrees in the field of public policy.
3. Number of research proposals submitted jointly by faculty across the disciplines in the area of public policy.