Indiana University
School of Informatics
Strategic Plan for Research

The School of Informatics Strategic Planning Research Committee submits its resulting recommendations to the Leadership Council of the School of Informatics on this day 19 November 2007. This document addresses the strategic research areas, proposes priorities for assisting faculty be more effective in research, and recommended strategic alliances. It includes a summary of the faculty responses to the survey that the committee conducted.

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1. Introduction

In response to an August 2007 charge set forth by Dean Schnabel, the Research Committee of the Strategic Planning process was convened and charged with responding to several high-level questions having to do with the research health and opportunity of the School. The committee undertook a thorough and considered discussion over the course of several months of meetings and e-mail discussions that covered the effectiveness of the school in supporting research, the current state and federal climate and opportunities they presented for long-term research, the school's research breadth, and the unique research climates of the different units (Info-B, CS-B, and IUPUI). The committee solicited feedback from the entire faculty through a carefully prepared faculty survey that sought faculty opinion on research opportunities, the funding climate, and individual research practices.

The committee strongly feels that it has discharged its duties with utmost care and respect for the breadth and diversity of research being undertaken in the school. It sees value in the furthest reaches of research, from music informatics to quantum computing.

2.0. Strategic Research Areas

A goal of the committee's work is to identify the areas in which the school is best positioned to achieve and/or sustain national and international prominence/leadership. The committee felt the timeline for achieving prominence should be on the scale of five years rather than a decade or more. Obtaining prominence within this timeframe requires a relative uniqueness of the vision (not everyone is doing it), existing strength in the School in terms of expertise and critical mass, and a favorable national funding climate. Specifically, the *criteria by which the recommended strategic areas are chosen are* ***1) Sustainability:*** *the future prospects of an area - part of a growth trend at the national level or ability to create one,* ***2) Expertise within school and capacity****: record of scholarly achievement, reputation. Critical mass of faculty within the school, and* ***3) Existing or anticipated collaborations/funding opportunities****: uniqueness of the area amongst competing schools, or uniquely positioned (due to university or state initiatives)*. For a research area to be considered strategic, it generally must satisfy all three criteria. A research group may be well regarded and prominent in an area (#2), but if the area does not appear to have strong prospects for new funding programs and opportunities on the national stage (#1), the area will not likely achieve a step function in visibility within 5 years.

The committee recommends seven research foci as the School of Informatics' key strategic research areas:

- *Complex Systems*
- *Data, Information, and Search*
- *HCI Design*
- *High Performance Computing/e-Science*
- *Life Sciences*
- *Technology for Values*
- *Trust and Privacy in Cybersecurity*

These seven foci span from broad initiatives, such as Technology for Values and Life Sciences, to cross disciplinary engagements such as Data, Information, and Search and Trust and Privacy in Cybersecurity, to the more focused areas: HCI design, complex systems, and HPC/e-Science.

The committee acknowledges an eighth area of importance to the School of Informatics and that is *Cognitive Science*. While the committee is not identifying Cognitive Science as a "strategic research area" because its core intellectual identity is housed outside the School, the committee acknowledges that Cognitive Science is an internationally prominent area in which the school plays a major role. The committee strongly recommends that the school leverage and sustain this area.

Each of the seven Strategic Research Areas is discussed in the following subsections.

2.1 Complex Systems

Computing complexity derives fundamental patterns and structures in massive datasets; exploits computation as a means of achieving understanding and predictive power in the natural and social sciences and engineering; simulates and predict systems comprising multiple interacting elements; systems biology and adaptive search.

Rationale for choice: Interdisciplinary research, strong relations across campus (SLIS, Cog-Sci, biology, physics, statistics), reputation, critical mass. Collaboration within the school (HCI, life sciences, cybersecurity). Opportunities: Interdisciplinary funding, consistent federal funding, University Life Science Initiative, opportunities in health and public policies.

2.2 Data, Information and Search

Data, information, and Search is a research focus around the burgeoning volume of scientific, scholarly, and Internet data. It includes data preservation; information modeling, discovery, analysis; visualization, data mining, information representation, search, and metadata and provenance. It extends to human interface issues, and social and policy issues related to data.

Rationale for choice: Cross and inter-disciplinary research, reflects unique breadth of school; strong relationships on campus with Digital Libraries Program, UITS, SLIS, and HPC/e-Science. Unique nationally. Has an established industry program. Positive funding history. According to one faculty member who responded to the survey, "The School, by its nature, needs to provide national and international leadership in this area." Opportunities: this highly cross-disciplinary area has the potential to garner significant federal funding through large grants, and the potential to substantially participate in and lead University-level initiatives. Large-scale private foundation opportunities.

2.3 HCI/D

Human Computer Interaction Design (HCI/d), properly contained in HCI, is oftentimes referred to as *interaction design.* HCI/d applies methods and theory from design disciplines in general to the now mainstream confluence of design and HCI. The trend of integration of HCI with design is now common to leading institutions, such as Stanford's

d-school, CMU's HCI Institute and School of Design, and UC Irvine.

Rationale for choice: The School of Informatics has critical mass in the subarea of design, and is unique nationally in the strength and recognition of the group. The area is strategic to the success of several of the interdisciplinary strategic research areas (data, info and search; tech for values). This strategic area has an opportunity to strengthen research ties between IUB and IUPUI. Opportunities: HCI is a critical component to current interdisciplinary funding initiatives, and the focused area has a record of interdisciplinary effort. Possibilities for funding at NSF appear to be increasing with programs such as Human Centered Computing, Design as Science.

2.4 HPC/e-Science

HPC/e-Science is a narrowed focus of the broader parallel and distributed computing areas into a focus on high performance computing, and web services architectures in service of science and engineering.

Rationale for choice: Strong funding record; international recognition. Large grants. Cross-campus working relationships. Strong inter-school collaboration. Opportunities: the expertise in this focused area is being leveraged into stable infrastructure and interdisciplinary projects that contribute to the strength of broader research initiatives.

2.5 Life Sciences

Life Sciences is a unifying theme around which the diverse life sciences informatics work in the school can coalesce. This includes computational modeling of life processes, systems biology, bioinformatics (genomics), chemical informatics, translational research consisting of health information technology and from bench-side to bedside and large-scale drug screening and design.

Rationale for choice: The University and state-wide initiatives can best be taken advantage through the encompassing response of a strategic priority. The life sciences work in Informatics has established synergy with local industry and Medical school and has critical mass. It has existing relationships with Biology department and the Regenstrief Institute of the Medical school. A major subarea, bioinformatics, has a strong funding history.

Opportunities: This broad initiative positions the school to have a strong respose to State and University initiatives. It has significant federal and private funding opportunities, and as a unifying may facilitate research investigation of end-to-end systems (i.e., from genes to behavior). It can encompass farther-reaching activity such as the development of media applications in health education and assistive technologies for the health related work.

2.6 Technology for Values

Technology for Values is a broad new initiative that explores how values such as privacy, access, freedom, ethical behavior, security, participation, and efficiency, operate in the algorithms, interfaces, and tools that make up our digital universe. It recognizes that information technologies are the product of human choices and social objectives

and that our use of information technology can change our ability to act and interact in the world around us. These changes may support or undermine the values that we cherish. Or they may require us to articulate more complex understandings of these values that reflect the presence of technological innovations. Work in this area brings together methodologies from science, mathematics, social science, the humanities, and design and asks how and in what capacity the technologies we build change our social world.

Rationale for choice: This new initiative makes use of the diverse expertise found within the School of Informatics in both technical and social science areas and seeks to integrate these competencies around common questions. Technology for Values could encompass research in security, robotics, natural and life sciences, complex systems, social studies of technology, and human computer interaction.

Opportunity: Technology for Values has the potential to define a new scholarly area nationally, to shape new funding opportunities, and promote interdisciplinary collaboration. Members of the Bloomington faculty have an existing strength in this area and have received grants from the National Science Foundation for work in Design for Values and from the program in Ethics and Values of Science, Engineering, and Technology. Research in this area has the potential to make research proposals in other areas stronger by providing a mechanism for faculty to consider the social aspects of information technology in a rigorous, cross-disciplinary environment. It may leverage other nationally recognized campus resources, such as the Poynter Center for the Study of Ethics and American Institutions.

2.7 Trust and Privacy in Cybersecurity

Trust and Privacy in Cybersecurity is a narrowing and focusing of the broader topic of security onto issues related to how people trust the security and privacy of the technology that surrounds them. Can we build electronic voting systems that are trustworthy? Should people believe their email is secure when it is not? People misplace their trust in 'secure' systems when they are phished. People are going to have trust that a medical device data collection is private and that data records are not abused/mined. This is an area rich in research opportunities that draws upon many of the strengths of the school and its broader university connections. Developing secure, trusted and private systems requires that we consider not only the traditional technical issues of security, but also how those technologies should be designed to interface with the complex human system that is influenced by its own history, psychology and society.

Rationale for choice: critical mass of faculty, relationships across campus (with law school, HPER), positive funding history. Opportunities: Trust and Privacy in Cybersecurity has the potential to shape new funding opportunities as it leverages the unique focus. There is a likelihood for sizeable funding opportunities, separately and in collaboration with other strategic areas.

3.0 Recommendations for assisting faculty in research

The committee was charged with examining and identifying key strategies that the School should use to be more successful in assisting its faculty. The following are the key, priority recommendations that emerged:

Sustain and promote research: The committee strongly recommends open and transparent policies for sustaining and promoting research, external funding, and junior faculty development. This may include differential teaching loads, buyouts, and indirect cost return. The school is fortunate to have faculty with considerable research activity; these faculty also carry normal teaching loads and are often tasked with service loads that when taken in total limit his/her ability to further develop the research strength.

Support collaborative research: The committee believes that a key strength of the school is its interdisciplinary nature. As such, the School should give faculty appropriate credit for participating as a co-PI and should ensure that co-PI participation is reflected in tenure decisions.

Grants Editor: The committee endorses the School's decision to hire a Grants Editor. Faculty survey results were strongly favorable to this kind of role in the school.

Graduate Student Admissions and Funding: The committee identified current policies for graduate student admissions and graduate student funding policies as areas that currently impede research. Junior faculty have difficulty attracting PhD students, and tenured faculty have difficulty with a shortage of available and qualified PhD students. Graduate student stipends are low, and it has been suggested that this reduces the quality of the applicant pool.

Other Recommendations: The committee suggests a research day to facilitate cross-unit interaction and stimulate future collaboration. The committee also suggests that faculty would benefit from a repository of examples of successful grants.

4.0 Recommended Key Strategic Alignments

The committee examined opportunities for collaboration either within or outside the school that are of key strategic importance and recommends the following key strategic alignments:

The Indiana University Life Sciences Initiative is a key strategic importance for the school. The committee recommends that stronger connections be built at top levels in the school.

The School should be responsive, such as through seed funding, to emerging efforts on campus or elsewhere that could lead to significant interdisciplinary activities.

The Medical school and the Regenstrief Institute could be a primary focal point for the interdisciplinary efforts at IUPUI, while also serving as a valuable resource for members of the Bloomington faculty.

5.0 Items for consideration in Implementation

While the strategic planning research committee was not specifically charged with developing an implementation plan for the priorities put forth in this document, it felt the

need to convey issues that surfaced during discussion that may be useful as implementation plans are developed.

The cross-disciplinary strategic research areas suffer from limited physical encounters with each other due to the school's multiple buildings. As a short-term solution to bridging the physical distance, the school could consider technology to reduce the appearance of distance. Over the long run, a single building is needed. The success of the cross-disciplinary strategic areas will also depend upon how well the inherent risk of collaborative effort across very different disciplines can be minimized.

There are gaps in faculty expertise in the Data, Information, and Search strategic area that could be addressed through retirements. Threats to success of the HCI-D strategic research area are its relatively weak funding record, and a faculty critical mass that may be at a low point. The HPC/e-Science area contains a larger percentage of senior faculty than is desirable.

Many of the faculty in the Cybersecurity are untenured, and have expressed concerns about resulting visibility. In the Life Sciences area steps should be taken to strengthen the connection between life sciences research at IUB and at IUPUI. Additionally, the lack of leadership at IUB if not resolved relatively soon could be damaging. Untenured faculty in this area feel pressure from teaching loads and a curriculum they feel is not attracting the best students.

Technology for Values: As this is a new initiative, steps should be taken to refine this heading and identify specific projects in this area. Identifying a senior faculty member to lead this initiative is of vital importance. This faculty member should have the ability to communicate across disciplines and have expertise studying the human dimensions of information technology.

The strategic research areas should make strong effort to align with national leaders to exploit funding opportunities and acquire prominence. Issues of diversity should be addressed within each strategic research area.

Appendix

School of Informatics
Strategic Planning Research Committee
Summary of Faculty Survey Report
October 26, 2007

Background. At its first meeting, the strategic planning research committee indicated a survey of faculty would be useful for their work. The Director of Planning assumed responsibility of the development of the survey and subsequent data collection, data analysis and writing of this report. The survey was developed with considerable input from committee members. The survey focuses on a variety of issues, including the processes for securing grant funding as well as questions posed by Bobby Schnabel and the Leadership Committee in the strategic planning document of 8/31/07.

Concurrent with the survey initiative, the committee has also embarked on an effort to examine faculty summary reports so committee members can get more detailed information about the specific nature of faculty research.

Both of these research committee efforts have sparked considerable debate, sometimes heated, which underscores the difficulty in getting consensus around the issues. This in and of itself is a noteworthy finding.

Method and Sample. The survey was distributed via the committee co-chairs to the three departments: Bloomington Computer Science, Bloomington Informatics, and IUPU-I Informatics. Forty surveys were returned.

The table below shows the numbers and percentages of the sample from the three departments.

Department	Number Returned	% of total sample
Bloomington CS	10	25%
Bloomington Informatics	17	43%
Bloomington CS/Informatics	2	5%
IUPUI-Informatics	11	27%

Appendix A lists the names of faculty who returned surveys, although the comments included in this summary report are simply listed by department and not by name as some faculty requested confidentiality.

Respondents also indicated their research focus. Eighteen choices were provided which underscores the amazing breadth of the School.

Importance of External Funding. External funding was deemed "crucial" (43%) or "important" (43%) to faculty's ability to conduct their research by the vast majority of respondents. Some interesting differences by department emerged and are reported in the table below.

How important is external funding to your ability to conduct your research?	Bl-CS	Bl-Info	Bl-CS/ Info	IUPU-I Info	Overall

Crucial	3 (30%)	5 (29%)	2 (100%)	7 (64%)	17 (43%)
Important	5 (50%)	9 (53%)	--	3 (27%)	17 (43%)
Not that Important	2 (20%)	1 (6%)	--	1 (9%)	4 (10%)
Not at all Important	--	2(12%)	--	--	2 (5%)

These differences were not statistically significant, which is no surprise for such a small sample, but are nonetheless interesting and may reflect the nature of research conduced in the various departments and by individual faculty within those departments. As the detailed comments reinforce, some research demands external funding while other research is not as dependent on it.

Priority of Funding. Given the importance of funding to conducting their research, it's no surprise that the vast majority of faculty considered securing external funding an "absolute top priority" (40%) or "high priority" (40%). Some interesting differences emerged by department as reflected in the table below.

What priority do you give to securing external research funding?	**Bl-CS**	**Bl-Info**	**Bl-CS/ Info**	**IUPU-I Info**	**Overall**
Absolute top priority	2 (20%)	5 (31%)	1 (50%)	8 (73%)	16 (40%)
High priority	6 (60%)	7 (44%)	1 (50%)	2 (18%)	16 (40%)
Medium priority	1 (10%)	2 (13%)	--	1 (9%)	5 (13%)
Low priority	1 (10%)	2(13%)	--	--	3 (8%)

Again, these differences were not statistically significant but they do seem noteworthy.

Challenges in Getting Funding. Given its relative importance and priority for the majority of faculty it's important to understand the factors within the school that present challenges to securing external funding. Faculty were given a list and could pick as many as applied. Those factors and percent checked were:

What do you see as the biggest challenge (s) to getting funding for your research?	**% indicating**
Lack of funding streams	46%
Lack of graduate student availability for generating preliminary data	39%
Heavy teaching loads	44%
Lack of mentoring	33%
Lack of execution/support from the School in writing, editing, or formatting proposals	18%
Constructing the budget within the School or within the IU system	8%
Other	29%

Comments on this item included:

"Lack of overhead return for successful grant completion; arbitrary and unreasonable buy-out policies for courses." (Bl-Informatics)

"Could really do with help in formulating proposals for different agencies (e.g. tips for writing and R01…) (Bl-Informatics)

"Time needed to write grant proposals." (IUPUI-Informatics)

Specific Help. An open-ended item asked what things the School can do to help increase the likelihood that research proposals will be funded. The more common items included:

Better mentoring by senior faculty of junior faculty.
Reduce teaching loads.
Need more student support.
More help in writing/editing proposals.
More coordination of partnerships/collaborations.
More systematic way of providing information about funding opportunities.

In general, these comments reinforce the findings from the previous item, which provided options to check.

Lessons Learned. The majority of faculty indicated they explicitly consider lessons learned from a proposal process, particularly ones that were not funded (74%). A few indicated they did not understand the question.

Notice of Funding Opportunities. Item 8 of the survey asks how faculty find out about funding opportunities. There are a variety of ways listed, perhaps the most troubling is by "accident." In combing the responses it's not a stretch to conclude that the process is somewhat haphazard and the school probably should get more systematic in notifying faculty of funding opportunities.

Other Funding Opportunities. Item 9 asked if faculty were aware of other funding opportunities beyond NSF and HIH. Most (80%) indicated they were. Among those listed were:

The Department of Energy (DOE)
The Department of Defense (DOD)
American Chemical Society (ACS)
Several foundations including Hewlett-Packard, Microsoft, Nina Mason Pulliam, Sloan, and Mellon

Consistent with the conclusion of Item #8, it seems the School might want to implement a systematic process to discover and notify faculty of funding opportunities beyond "the usuals."

3-5 Areas in Which School is Best Positioned to Achieve and/or Sustain National and International Prominence/leadership in Research.

This is clearly the hot-button question for the survey and committee. The item was open-ended and indicated the following suggestions:

Artificial Intelligence/Machine Learning

Bio/Health/Life/Chem Informatics. These are clearly distinct areas but might best be captured under the heading of Health/Life Sciences Informatics

Complex Systems

Data and Search

HCI/d

High Performance Computing

Music

Pervasive Technology

Programming Languages

Security

Social

One respondent suggested the School focus on "cross-cutting areas" such as technology for values, data and search, cybersecurity, and science informatics.

Finally, one respondent had a philosophical difference with the question and approach implied by it: "I personally think this is the 'wrong approach.'" Unless there is a pressing need to focus our resources in specific strategic areas, I believe the School should support 'excellent' research in whatever area it may be…"

Concluding Items. The last three items addressed strategies to be more successful in attracting research funding, opportunities for collaboration within or outside the School, and a last open-ended suggestion item. These are too numerous to summarize.

Conclusions. First, the Research Committee is grateful to faculty who took time to provide thoughtful feedback to the survey.

There is much to consider in this report and in the detailed comments of faculty. In a School full of researchers, it seems prudent to point out that the survey is not necessarily a research effort, but rather a tool to the committee considers very valuable in its deliberations of some very difficult issues and attempts to build consensus around those issues.

Towards that end, this effort has provided much for the committee to consider as they continue with its task of providing a final report on November 15. The full survey results, which are not included here because of the sensitive nature of the comments, reveal much about colleague's work within their departments and across the three very diverse departments of the School. In realizing the breadth of the school, one realizes its potential for an amazing array of collaborative work.

Respectfully submitted,

Dirk Van Gucht, Beth Plale, Alex Vespignani, Yaoqi Zhou, Steve Myers, Eden Medina, Anna McDaniel, Polly Baker, Edgar Huang, Pedja Radivojac, Eli Blevis, Dennis Gannon, and Jim Shea.

Appendix A
Faculty Submitting Surveys

Aspray	**Groth**	**Paolillo**
Baik	**Guha**	**Radivojac**
Blevis	**Gupta**	**Raphael**
Brown	**Hahn**	**Rocha**
Camp	**Huang**	**Romero**
Chauhan	**Jones**	**Sabry**
Connelly	**Leake**	**Shankar**
Dalkilic	**Lumsdaine**	**Stolterman**
Defazio	**Mahoui**	**Van Gucht**
Dunker	**Mannheimer**	**Walker**
Fox	**Menczer**	**Wild**
Friedman	**Merchant**	**Wise**
Gannon	**Myers**	**Wu**
		Zhou