Research & Collaboration Committee (RCC)
Final Report

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Executive Summary

Under the assumption that the research profile of the new school should be defined with a clean-slate, think-big, long-term, risk-aversion, and interdisciplinary approach, the Research and Collaboration Committee (RCC) proposes *Contextually-Situated Computing (CSC)* as the emerging brand of the new school. The concept of "computing" is defined broadly to include all aspects of computer science, information science, library science and associated domains where computing plays a pivotal role in education and research.

Through discussion with numerous units at Pitt, it is clear that computer and information science (CIS) research is related to everything that we do as a society, whether in science, business, government or individual lives. CIS is no longer about creating faster or more energy-efficient computing systems in isolation, but to entwine computing within the context of solving complex problems of significant societal benefits and physical world benefits. Both CIS and other domains participating will participate collaboratively in solving these problems, accelerating the research impact and significance of all parties.

The CSC brand embraces several emerging themes at which the University of Pittsburgh is uniquely positioned to further achieve national and international stature, including connected life, health and medicine; modeling and computational tools for scientific discovery and societal good; computing at extremes; data stewardship and scientific replicability; education for/by computing; and social dynamics and computing.

For these themes, numerous strategies can be employed, with CIS as the "center of gravity", to bring together researchers both across campus and externally, particularly within the Pittsburgh region. Two types of Collaboratories can be created, namely Research Collaboratories around the themes to serve as rallying points to involve Pitt researchers and Industry Collaboratories to attract industry to Pitt for collaboration and innovation. The collaboratories will be designed to be agile sub-units that can address research themes that emerge throughout the new School's history. A new Associate Dean of Research and a Research Council will be formed to identify, select, and nurture themes to become self-sustaining Research Collaboratories. Individual faculty can be engaged and incentivised through course reductions, semester buyouts, immersive workshops, and student/faculty exchanges and visits (with other Pitt units and/or with industry).

Co-location is essential for all participants in the activities of the new school, including current faculty, new faculty hires in strategic themes, researchers from other units

and from industry, and (obviously) students.

1 Assumptions and Definitions

1.1 Assumptions and Core Values

During the work of the RCC, several assumptions and core values have taken hold and have framed the thinking of the committee, i.e., the approaches and outcomes from our efforts.

- **Clean slate:** As suggested by the Provost, we do not limit the RCC work by existing structures, methods of operating today, or current/past concerns. The new unit should be rooted on its future, aligned with University priorities and initiatives, based on our expertise and the expertise of other units.
- **Think big:** Address issues with significant end impact on University of Pittsburgh (in short, Pitt) and beyond. Uncover the collaborations that will make a leap towards new disciplines or new research.
- **Medium- and Long-term thinking:** Focus on the long-term directions of the new entity, i.e., what will be important and where can we have an impact in the next 10+ years. Must also consider the medium term of 5-10 years to establish a solid foundation. Avoid thinking too near-term; identify what is new/emerging rather than what is already known today, without ignoring current expertise.
- **Interdisciplinary Research:** Rather than focusing on strictly CIS formative disciplines, the new School will lead to culture change to foster interdisciplinary research through collaborations among CIS researchers and outside collaborators.
- **Risk Taking and tie-in to Upper Administration:** The Plan for Pitt calls for partnerships and collaborations, risk taking, impact through pioneering research, expanding our computational capacity, and personalized education. Embrace these and other values while forming a new school from the perspective of research and collaboration.
- **New School:** Although the Structure Committee has not reached a resolution and the faculties have not voted, we're working under the assumption that the new "entity" will be a new school that brings together multiple collaborators for research and education. Some departments/programs may decide to join the new school, while others may not join but will be key collaborators. There will be associated research organizational units (e.g., *Research Collaboratory*, see report from Structure Committee) to carry out the different themes of research defined below.

1.2 Definitions

The RCC has been using some terms throughout our discussions. To ensure clarity in this document and continued discussion, we define a few terms below.

- **Computing** is defined broadly to be as inclusive as possible incorporating all aspects of computer science, information science, library science, and other collaborators associated with computing, such as statistics and DBMI.

- **Computer and Information Science** (**CIS**) is defined as a working term to identify the new unit by a name. It is not intended as the actual name.
- **Research Brands**, or *Research Identity*, refers to the CIS research directions that will create a name for Pitt; involves CIS and also other disciplines/units.

2 Committee Charge

The RCC is charged with examining the potential research areas and collaborations where a new CIS unit can multiply the research outcomes campus wide. The committee is to analyze and understanding how computing and informatics are being applied today, what are the future opportunities, and what are the potential areas where expertise can be most profitably built. To this end, the committee has a two-fold charge:

1. Collaboration
   (a) Identify existing and potential collaboration relationships
   (b) Classify the nature, level and scale of existing and potential collaboration relationships
2. Research Branding
   (a) Develop and prioritize a few candidate research brands at which the new unit could excel and contribute to Pitt becoming a leader worldwide
   (b) Develop evidence to support the candidate brands, make a recommendation on the branding areas and potential opportunities for collaborations within the brand

The process followed by the RCC to identify brands and collaborations can be found in the Appendix.

3 Emerging Brand

During the course of the conversations with faculty, potential collaborators, RCC members, and visitors, we have identified a brand for CIS, namely *Contextually-Situated Computing*, or CSC. This brand is an overarching direction for CIS, with several underlying themes (a.k.a., ”focus areas”).

In developing the brand and themes, the intent is to determine areas and specific topics that CIS can have significant impact on campus and in the region. The long-term goal is twofold: (a) for individual faculty in CIS to *align* their research agendas to the brand and themes, and (b) to attract external collaborations and funding sources that will contribute to the brand.

In the spirit of collegiality, respect for tenure, and diversification, we note that the intent is *not* to force faculty members to change research agendas, but it is important to recognize that individual faculty research programs can contribute to the research brand (in some situations with minor adjustments). Faculty should be fully able and respected to pursue agendas that are separate from the brand and themes, if they choose to. It is also important to consider the challenges with establishing collaborations for junior faculty prior to promotion and tenure.

We describe branding in two parts: the emerging brand (this section) and the emerging themes (the next section).

3.1 Contextually-Situated Computing

CIS research and reach are largely about the "everything" that we do as a society, whether in science, business, government or individual lives, with some science of technology (programming languages, databases, information systems, algorithms, computer processors, operating systems, networks and the like).

It is a cliché, perhaps, to say that "computing is everywhere", but this statement has never been more resoundingly true than today. The entwinement of computing in society and our physical world is having a profound effect on the disciplines. Interdisciplinary CIS research is no longer "computing to create faster computing systems" nor "computing in support of an application domain;" it is about allowing the domain to influence CS/SIS and vice versa. This substantial transformation currently underway will transcend this simplistic notion of interdisciplinary. The change is that CIS will focus on contextually-situated computing: the disciplines are no longer on their own, nor just standing along the side of a domain in interdisciplinary study.

The disciplines are directly embedding, trusting, and deriving intelligence (through computing) within the context of the problems they are trying to solve, for example: understanding and analyzing data; managing a situation for safety, privacy and security; discovering new insights from unstructured data; automating tasks in the smart home, streets, cities, and highways; reducing intrusiveness and improving responsiveness and quality of health care and medical treatment; and, creating interactions of device and data as one. One way to think about this notion is swimming in a sea of data, trying to make sense of it all and getting more out of it for the betterment of society (e.g., education, health, social aspects) and deeper understanding of the world (e.g., ecology, city planning, agricultural, water, energy, and built environment needs). As disciplines, we must remove technological silos and insular research and education to lead the placement of **computing within the context**. Furthermore, to have the most relevant and significant impact, CIS must work on real world situations to include the full range and scale of a problem's complexity. This real-world focus should include transitioning research ideas from the laboratory into successful innovations.

An emerging example of **contextually-situated computing** (CSC) is tetherless augmented reality (as embodied in Google Glass and Apple iWatch), which encompasses so much of CIS to enable something new. These devices put the user directly "in the data", sorting through it to understand and learn to assist the individual (comfort, safety, entertainment, etc.) and to benefit society (e.g., coordinating and guiding disaster response). Of course, a device like Google Glass is not just a "consumer device", but also an enabler to create novel opportunities, such as recording and analyzing images, geopositional data and past behavior to discover something new and improve situational awareness. Tetherless augmented reality brings together most of CIS in one place, including machine learning, data management, security and privacy, human-computer interaction (HCI), embedded systems, high-performance computing, networking, software engineering, and on and on. It also involves other domains such as psychology, social networks, industrial design, social work, among others, and even seemingly unrelated, though vital domains, such as neuroscience and consumer fashion. Numerous similar examples arise in medical devices, robotics, autonomous vehicles, and others.

CIS will become more attuned to context in addition to development of individual science. This requires rethinking how to approach research and education. In research, we need to consider the relationship of innovations to the end capabilities required by CSC. For instance, in computer systems architecture, there is a trend of specialization, where a computing system is tailored to a domain. In big data analytics, deep learning is emerging as an important new trend. New algorithms and computer architectures can be built to more efficiently and synergistically apply deep learning within any domain, thus allowing more data to be analyzed for improved scientific understanding and discovery from the analyzed data. These examples illustrate connection between machine learning, computer systems architecture, and data analytics. By itself, one individual area could not develop as fast and as deep knowledge as the collaboration of different areas, given the synergistic relationship among all parts.

The CIS undergraduate and graduate curricula need to incorporate concepts behind contextual situation. Students need to be educated to become contextually-situated computing thinkers, creating new technologies by incorporating contexts and the end goals of computing, rather than being only a technologist. This touches again on all CIS areas, e.g., databases, security and privacy, algorithms, operating systems, compilers, software engineering, and also technology in society. New curricula must embrace relevant emerging research areas, such as data analytics. New contexts and how they influence the way we create new computing systems, design and use them should be an integral part of the new curriculum. An emphasis should be given to innovation and the means by which ideas are turned into real-world outcomes.

Students formed by the new CIS will be a different breed of professionals: they will have learned how to cross boundaries, interact with people outside their discipline, understand domain problems, carry ideas from initial formation into practice in innovations, and synthesize concepts and knowledge. Like many topics, learning to span boundaries involves both concepts and skills that can be taught, including entrepreneurship, computing ethics, governmental policy, and societal effect.

In summary, **Contextually-Situated Computing is:**

1. The symbiotic entwinement of computing and other areas to address new crosscutting research opportunities and to accelerate research in all participating areas far beyond what can be done in isolation.

2. Solving complex research challenges with an orientation on the end impact to advancing scientific discovery, creating new knowledge and understanding, and bettering society and the physical world.

3. The translation of research outcomes into practice through innovation.

4 Emerging Themes under the Brand

Several themes fitting under the umbrella of Contextually-Situated Computing have started to appear. Below we list some initial themes; the list is not exhaustive, nor is it final. We anticipate changes and clarifications to these themes, as well as entirely new themes may be identified. Indeed, the CSC brand is intended to evolve and capture new themes over time as research progress is made and new challenges appear.

We focus in this report on the potential crosscutting collaborative themes where Pitt has unique expertise and an opportunity exists to be national and international leaders in areas of growing importance. To this end, there are several critical areas that will contribute directly to the development of the themes and brand, including cybersecurity, data mining, artificial intelligence, energy savings, and human-computer interaction, among others, too many to list. We also note that we will directly interact with the Pitt Centers that will contribute to the research mission of the CIS, including the proposed Center for CyberSecurity, the Learning Research and Development Center, the Center for Simulation and Modeling, the Pittsburgh Supercomputing Center, the Mascaro Center for Sustainable Innovation, the Center for Energy, among others. In essence, the CIS-specific areas are sub-disciplines that will make vital contributions to each crosscutting theme.

We also do not include some "hot" topics such as Smart Cities, Elderly Care, and Internet of Things, although urban computing, connection to devices, and the like will be quite important as world population is now concentrated more on urban areas and new challenges emerge, especially in developed countries where the population is aging rapidly. This aspect can be included in several of the themes below.

4.1 Connected Life, Health and Medicine

Description: Today we live in a fully connected world. This opens many new possibilities for gathering, analyzing and synthesizing data from many sources to drive improvements in individuals and communities. For example, sensor data may be gathered from multiple sensor sources, e.g., FitBit, automobile information system, and even a smart home to help a health care provider to monitor, understand/diagnose issues and make recommendations to improve an individual's well being. Social and behavioral sciences can complement a technologist's expertise and a health provider's knowledge by contributing well-developed frameworks and empirical evidence; for example, what information can the FitBit or Smart Home provide that would make the largest difference?

Areas: Cyberphysical, CyberSecurity and Privacy, Data Management, Machine Learning, Natural Language Processing, Human-Computer Interaction, Internet of Things

Potential Collaborators: School of Medicine, School of Arts and Sciences, School of Public Health, School of Engineering, School of Health and Rehabilitation Sciences,...

4.2 Modeling and Computational Tools for Scientific Discovery and Societal Good

Description: Both scientific communities and general societies have accumulated great amount of data. With the help of current and new generation of computing and informatics technologies, scientific discoveries and societal decisions can be informed by data and simulated behaviors rather than intuition. For example, computing and healthcare experts can, with the help of data-analytic, modeling, and other tools, build and verify new models (at different scales) of diseases, their risk to society, their treatment, and/or identify factors influencing its outcomes. Another example is new simulation models at different scales that can be used to analyze the spread of the disease in geographical areas, without having to wait for the physical events to happen. Another example is how Social Sciences can be both a consumer and a provider of insights about how to bring together multiple, hard to combine, data sets at different units of aggregation, using sophisticated simulation techniques. Another example is that government policies affecting certain regions and areas can be examined through data simulation and visualization without having to wait for ten or twenty years for them to take effect.

Areas: Modeling, Programming Languages, Machine Learning, High-performance Computing, Statistics, Information Extraction and Retrieval, Data Mining and Management, Human Computer Interaction,

Potential Collaborators: DBMI, School of Public Health, School of Health and Rehabilitation Sciences, GSPIA and other units in Social Science, units in Biology, School of Education, SAM, Pittsburgh Super-Computer Center (PSC)

4.3 Computing at the Extremes

Description: The next generation high-performance computing (extreme computing) is evolving to be aligned with the philosophy that is prevailing in the RCC, that is, solving problems in context. Examples include: (a) deep specialization of the entire hardware/software stack to specific contexts (e.g., combining existing and emerging devices to solve specific classes of problems medical and/or biomedical issues of search and sequencing); (b) quantum and approximate computing, emerging as new structures to make computations orders of magnitude faster and to enable solutions do not need high accuracy (e.g., social networks, graph computations, searches, etc) and (c) energy reduction and power management at the extremes, including energy scavenging, nonvolatile memories for many different applications at different scales (e.g., the new DOE proposed supercomputer is limited to 20MW).

Areas: Nonvolatile Computing, Energy Harvesting, Algorithms, Systems, Networking, Computer Architecture, Data Storage and Management, Information Retrieval, Machine Learning,

Potential Collaborators: Department of Electrical and Computer Engineering, Department of Industrial Engineering, Department of Physics, PSC, units in Biological Sciences, DBMI, units working on social computing , Combustions and Explosions, etc.

4.4 Data Stewardship and Scientific Replicability

Description: Governments, corporations, health care professionals, scientists, and individual citizens all rely on data to make scientific, strategic, or sensible decisions. Therefore, there is a critical need for supporting the entire data and computation lifecycles, from creation, to preservation, to utilization, to provenance. In addition to management of data (e.g., experiment results), curation of software and experimentation infrastructures are needed for data reusability, data sharing with the appropriate privacy, result replicability, data provenance, and research transparency. Furthermore, data are increasingly stored and managed in a distributed fashion within and across many communities and individual in them. Therefore how to engage communities, how to aggregate data from different eras and in different media/formats is a challenge.

Areas: Cybersecurity and privacy, Data Curation and Stewardship, Library Sciences, Storage, Scientific Transparency, Reproducibility, Data Retrieval

Potential Collaborators: PSC, University Library System, units in Health-related Sciences, DBMI, units in Humanities, various departments in Social and Natural Sciences

4.5 Education for/by Computing

Description: The Education and Computing fields are becoming very intertwined. Recently, MOOCs and online resources (e.g., Khan Academy) have caused a flux in the field, and are now being more properly studied. Enhancing education about computing has been hailed as a fundamental issue in many redesigned freshman curricula, given the role that computing plays in most disciplines. Moreover, training more teachers and creating better teachers will involve many disciplines to create pedagogies for how to integrate technology in K-12 classrooms for different subjects, how to teach effective teach very large lectures, and how to teach online courses on mobile/desktop platforms. Other examples include invoking multidisciplinary teams to develop different curricula that uses intelligent tutoring systems to guide students while understanding their language as well as a good teacher would, create new education platforms for special training (e.g., responsive robotic devices for nurse training or simulations/visualizations for chemists), and globalize/internationalize education and research (leveraging machine translation and lesser-known languages).

Areas: Intelligence in Education, Machine Learning, Computing Education, Pedagogy, Distance Learning.

Potential Collaborators: LRDC, CSSD, School of Education, units in Health-related Disciplines, Psychology, NeuroScience, units in Language-related Disciplines, School of Engineering.

4.6 Social Dynamics and Computing

Description: Computing and informatics both aim to support people in their various tasks, which are often influenced by their communities and social environments. Computing within context therefore needs to consider the social dynamics of people. Research in how pervasive and how intrusive computing is, from the perspective of privacy, controlled access to information, legal issues, social and cultural issues, and the effects of social antecedents and social networks on predicting individual behavioral outcomes or societal trends.

For example, given that Social Scientists established that humans overweigh small probabilities of negative events, what information should be displayed on a device and how would such information influence user interaction with the device or the environment? Given what experimental social science know about reputation concerns, social incentives, and its potential perverse outcomes, are the controls one should exercise on a personal basis with the advent of new networking capabilities?

Areas: Social Computing, Personalization, Network Analysis, Graph Computing, Computing at Scale, Cybersecurity, Specialized Computing, Computational Social Science, Internet of Things.

Potential Collaborators: DBMI, School of Public Health, School of Education, School of Health and Rehabilitation Sciences, GSPIA, Psychology, units in Social Sciences

5 Strategies for Collaboration

The new school and associated research centers have a focus on fostering and rewarding collaborative initiatives in both research and education. Investment in specific mechanisms suggested below will enable the collaborations and research suggested herein to flourish (larger in scope, deeper in subject area, and faster in growth). The collaborations with researchers outside CIS include industry partners to be fostered, which will have consequences on IP development and IP policies within Pitt. Similarly, innovation policies will have to be updated, given that new spin-off companies may be started out of Pitt collaborations, and from the research centers developing futuristic research.

The primary means to seed, nurture and sustain research themes in CIS will be through **Collaboratories**, which can be of two types, namely Research Collaboratories and Industry Collaboratories.

As outlined in the Structure Committee's report, a Research Collaboratory is an entity that brings together researchers from many disciplines at Pitt and externally into teams to address crosscutting complex challenges. A Research Collaboratory is focused on solving specific grand challenges that have the potential for significant impact on society and the physical world. A collaboratory will pool and combine research talent into a virtual organization, i.e., a laboratory without walls. We envision that a Research Collaboratory will be similar in spirit and scope to a National Science Foundation Expedition[1] effort. A Research Collaboratory will provide the Pitt community, as the NSF's description of Expeditions states, "with the opportunity to pursue ambitious, fundamental research agendas" in ways that "combine creative talents in the identification of compelling, transformative research agendas that promise disruptive innovations in computing and information for many years to come." Research Collaboratories will come and go as research problems mature and new challenges emerge, making CIS a vibrant and renewing intellectual environment.

A Research Collaboratory will be an agile entity that can be quickly founded, efficiently conduct research, and transition ideas into innovations. Collaboratories will be intended to have lifespans of 5-7 years, possibly up to 10 years in some cases. A collaboratory may pave entirely new directions and become deeply rooted and fully self-sustaining that it may be appropriate to be transitioned into a more permanent organization, i.e., a *program* with associated curriculum. It is important that a collaboratory have a well-defined agenda and metrics to continuously assess success and effort completion. A designated leadership team would direct each collaboratory. We expect that each Research Collaboratory will be an externally-funded \$15M to \$20M endeavor during its lifetime (or \$2M-\$3M per year). There will be a new Collaboratory every 1-2 years, with 4-5 Collaboratories in the steady state, significantly raising the research profile of Pitt in the area of Computing.

An Industry Collaboratory will enable collaborations with industry, attracting the major players in Contextually-Situated Computing and its themes. For example, if Westinghouse decides to build the next MRI machine, Westinghouse would choose to colocate with CIS given the different expertise in medical, computing, physics, and other expertise. This is akin to what happened at CMU with Google and Apple, but a much broader collaboratory, that does not focus exclusively on Computer Science. CIS and Pitt are uniquely positioned to attract such joint ventures, although it will require new thinking and a new culture with respect to innovation, commercialization, IP, and other such issues. Industry Collaboratories lifetimes will be shorter than Research Collaboratories, and will likely be less frequently started, given the heavy dependence on the economy

[1] See http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503169

and on industry.

We anticipate that an **Associate Dean of Research** position and a faculty **Research Council** would be created in CIS to help set the school's broader research vision and strategy. The Research Council, under the guidance of the Associate Dean of Research (who coordinates activities with the Vice-Provost of Research, similar to the SSOE equivalent position), would catalyze, select and seed the most promising directions that could turn into a collaboratory. They would also be responsible for orchestrating the Research Collaboratories toward the research vision and strategy of the school while meeting the goals of the University. New faculty positions, aligned to the research vision and strategy, may also be sought to found and sustain the collaboratories. The Structure Committee's report gives more details about the implementation of the collaboratories and their leadership.

In addition to these overarching mechanisms, we identified, in concert with the other CIS proposal committees, several focused mechanisms:

- Seeding projects to create new collaborations within CIS and also with outside collaborators. The high research productivity of the CIS will be supported by the recruitment of high-quality graduate students through fellowships and/or research assistantships, and of other NTS (non tenure stream) positions, such as postdoctoral fellows, research scientists, research faculty, lecturers.

- Course reductions and semester buyouts for faculty in residence in different units: faculty from CIS to other units, faculty from other units to CIS, and faculty starting new large projects within CIS). This would require collaboration and funding from other units on campus, given that CIS is being built to create a collaboration culture at Pitt. We suggest 1-2 course reductions and 0.5 - 1 GSR per large project to be developed.

- Visiting Industry Researchers, who would visit or receive courtesy appointments in CIS in order to develop research under Industry Collaboratories, or temporarily under Research Collaboratories. Recently, hiring such personnel under the rubric of Professor of Practice has proven successful.

- Immersive workshops or retreats to bring together colleagues from different units in intensive, short periods to develop directions around challenges in some selected research themes. Funding would encompass inviting 1-2 speakers-turn-collaborators, a professional facilitator, and providing a venue for such encounters.

- Carefully selected visiting faculty from other institutions to bootstrap and to enhance collaborations.

- Student exchanges, jointly advised, and jointly supported between units or from other institutions. Short-term research programs for students, in order to attract them to CIS.

- Joint appointments for a tangible purpose (e.g., PhD student advising)

- Funding for summer schools that offer teaching (CS/SIS) modules to a domain (the summer schools might be relatively short and intensive, say one or two weeks with activities for the full day); these can be taught by internal or external faculty.

- Translational Efforts must also be carried out, as a second example of culture change. This is similar to the Clinical and Translational Science Institute (CTSI) and Coulter Translational Research Partners II Program, where promising projects undertaken by CIS researchers and collaborators will be either licensed or created start-up ventures.

Implementation The proposed themes in this document could be the basis for establishing the initial round of Research Collaboratories for the next 5-7 years of CIS. To this end, we suggest undertaking a short period of rapid investigation to form teams to further explore and develop the themes. This period could involve incentives to fund a small number of graduate student fellows, post-doctoral researchers and course releases for faculty to assist in exploring and establishing the themes.

Once initial themes are selected, fully defined and coalesced into longer-term agendas, funding will be required to establish the first-round of 2 to 3 Research Collaboratories for CIS. This funding will be an important part of the "boot strapping" process for the new school to create a culture around agile, crosscutting, risk-taking research for end impact. It creates a foundation on which to base the school, implement a new culture, and compete for the external funding necessary to the school's long-term research success. It will create a culture of sustainability and of support among collaborators.

The Research Council, Associate Dean of Research and the Dean of CIS will need to catalyze initial efforts to create collaboratories, including the first round at the founding of the new school. They will need to develop ways to identify themes, including some of the ones above, incentivize students and faculty both within CIS and outside CIS at Pitt, and make awards of funding for both initial explorations of the themes and the first round of collaboratories. In addition, there will need to be some means of assessment and accountability for following through on the proposed efforts. The Associate Dean of Research will take the lead in assessment and evaluation on an on-going basis.

In hiring new faculty for CIS, the profile of candidates should be chosen with a two-prong approach: filling existing gaps of research and teaching needs within CIS, or to emphasize research and interests that align with the theme in focus at that particular time. Careful consideration must be given to balancing collaborations and development for tenure and promotion since collaborations can be time consuming to get started, particularly at the early career stage.

6 Open Issues

In developing this report, the RCC identified several open issues that require both diligence from faculty in the new unit and strong commitment from the university.

- Contextually-situated computing emphasizes interdisciplinary collaboration, and will be engaged in service to other parts of the university. But engagement of CIS with other disciplines need to contribute to the research excellence in the disciplines or collaborations therein, creating new research that would be infeasible to achieve separately.

- Our discussions with various collaborators often demonstrate the importance of having all relevant parties to be located within short distance or co-located. In particular, as many participants of the new unit as possible should be co-located in the same building; short of that, spaces should be designated for collaborative spaces, where faculty and students from other units are able to spend significant amount of time when working on a project.

- Contextually-situated computing enables engagement of various departments/schools in many areas related to computing/informatics and the specific domains. Although expertise in many of these areas already exist, the RCC has not assessed whether there are gaps in the faculty/research programs to fulfill all themes within the brand.

Appendix: Process to Identifying Brands and Collaborations

The committee undertook a systematic process toward understanding the existing and potential collaborations and to develop the brands. Below we briefly sketch the process:

1. Identify existing and potential collaborators (SIS, CS, University)
2. Discussion with collaborators
   - Assessment of current state of computing with respect to the collaborators
   - Forward-looking vision – where is computing going in 5-10+ years in the collaborators' domains?
   - Enablers: identify mechanisms that enable successful research collaborations
3. Distill information
   - Nature of collaborations (scale, impact and limitations)
   - Existing and required expertise and strengths
   - Emerging trends (brand and themes falling under brand)
   - New processes, mechanisms and incentives for cross-cutting initiatives
4. Analyze the landscape of other efforts in the brand area and develop support behind the brand (e.g., quantitative, funding, programs, etc)
5. Continually process, iterative, and develop
6. Write report.

Several meetings have been held with potential collaborators:

1. Medical and health: DBMI, Public Health, Pharmacy
2. Education: LRDC and School of Education
3. Office of the Vice-Provost for Research: Don Shields and Mark Redfern
4. Engineering: ECE, Industrial Engineering (CEE, Mascaro, and CMI invited but didn't make the meeting)
5. CoE program (undergraduate and graduate directors, chair of ad hoc ECE committee on the CoE program)
6. Humanities: Slavic Languages, Studio Arts, Linguistics,
7. Natural Sciences: Biological Sciences, Neuroscience, Pittsburgh Supercomputing Center
8. Social Sciences: Social Work, GSPIA, Economics, Political Science
9. Business and Law: