Report to the Provost

Fourth Strategic Initiative Summit:

"Harnessing Information, Multiplying Knowledge"

February 24, 2012

Co-Chairs:
- Perry Alexander, Electrical Engineering and Computer Science/Information and Telecommunication Technology Center
- Nancy Baym, Communication Studies
- Leonard Krishtalka, Ecology and Evolutionary Biology/Biodiversity Institute

Planning Committee:
- Arienne Dwyer, Anthropology/Institute for Digital Research in the Humanities
- Saralyn Reece Hardy, Spencer Museum of Art
- Steve Hawley, Physics and Astronomy
- Deborah Ludwig, KU Libraries
- Susan Lunte, Chemistry/Pharmaceutical Chemistry
- Mary Morningstar, Special Education
- Prakash Shenoy, Business

1. INFRASTRUCTURE INVESTMENTS

Three areas require infrastructure investment to support interdisciplinary research in the strategic initiative Harnessing Information, Multiplying Knowledge. These are: (A) information technology resources; (B) physical resources; and (C) human resources.

A. Information technology resources. KU's IT infrastructure currently lacks clearly defined and implemented core support for research computing resulting in frustration among researchers and the staff who try to serve them. Researchers do not know what to expect and IT professionals do not know what they should provide. Generally, we assert that all researchers should have access to computing resources necessary for their research.

> *Recommendations:* KU should commit itself to a research computing infrastructure that minimally provides:
> - access to high-performance computing and data storage
> - dedicated research data storage and archiving
> - facilities for hosting physical and virtual computing platforms
> - reliable, high-speed connectivity to computing resources
> - staff dedicated specifically to research computing support

We have no illusions that such resources will be provided at no cost to KU researchers. However, costs should be clearly defined and shared by the university.

The good news is that although our IT infrastructure is not where it needs to be, we are making progress. The new Academic Computing Facility is starting to engage constituents to define what our research computing infrastructure should be. The next year will see a new, NIH funded state-of-the-art cold room in Nichols Hall; the construction of a 'community cluster' to support HPC needs; dedicated research data storage; and a new Director of Research Computing. Most importantly, the ACF will provide expertise to support new equipment and software as well as the development of large proposals.

However, even when these new ACF capabilities come to fruition, other computing needs must be addressed.

> *Recommendations:*
> - Implement reliable 10G network links among all researchers on the KU Campus as well as 10G connections to KUMC and Edwards Campus. Without such connectivity, utilizing new computing capabilities such as community clusters and research storage is impossible, and will result in continued balkanization of computing resources. Our bandwidth leaving

campus must be improved to support collaborations with other universities and with local industry.

- Update or replace our telecommunications infrastructure. We must have modern capabilities that support mobile devices, effective teleconferencing, electronic classrooms, presentation facilities, and a single identity for each member of the KU community. In addition, our telecommunication infrastructure should eliminate physical relocation for meetings, teaching, and advising. It bears repeating that our connectivity to KUMC and Edwards Campus must be seamless—we will never be physically co-located, but we can and should be virtually co-located.
- Negotiate site licenses for common research packages such as R, Matlab, SPSS, Lisrel, NVivo and the ESRI software suite that have become ubiquitous among researchers. Provide a clearinghouse where researchers can discover mutual needs and negotiate preferred pricing with vendors.
- Develop a common facilities description that defines available computing support for any grant proposal. Simplify the identification of IT resources and provide IT expertise to PIs while working on proposals and grants.

B. Physical resources: Physical space for interdisciplinary research is a known problem for KU generally, and is likely to be mentioned in all strategic initiative reports.

Recommendations:
- We need physical spaces for faculty to gather outside departments and schools that "belong" to no one specific entity (see **Mechanisms**, below). Our research centers should have spaces for collaboration aside from presentation rooms and meeting facilities. The Commons is a wonderful start to university-level facilities that promote interdisciplinarity and collaboration, but such facilities should pervade the campus.
- Both research centers and KU as a whole need facilities to support visiting faculty – be they visitors from outside KU or visitors from our own campus exploring collaborative research opportunities.
- Aside from traditional physical space, we must think boldly about virtual collaboration spaces. We need a "digital commons" where faculty across the KU can gather and share ideas.
- Support for our libraries as they focus more on finding and sharing knowledge than warehousing printed material.
- Our gathering places must provide means for hosting virtual participants. A first step is addressing the aforementioned connectivity and telecommunications issues, but physical infrastructure is simply an enabler for the kinds of virtual collaborations that we should engage in.

C. Human resources: Hardware and physical infrastructure are, comparatively, the easy problems for KU to address. Developing a support infrastructure for research

computing is far more difficult. Although the Advanced Computing Facility will serve projects that require high-performance computing support, the larger needs of research computing are more pervasive.

Recommendations:

- Identify more personnel in IT who deeply understand and distinguish the needs of research faculty from the tasks of enterprise or academic computing. Service-level agreements should be established to define what researchers can expect from IT services.
- Provide a better support infrastructure for software distribution and licensing (See **IT Resources** above). KU has made great strides recently in this area, but numerous license agreements are still cobbled together by informal alliances of departments and research centers.
- Develop an education network for teaching faculty and students about available hardware and software. Develop courses that provide instruction on the use of computing resources, targeting individuals outside the computing disciplines to support their research computing needs.
- Eliminate the regulatory environment and monolithic philosophy surrounding IT. Acknowledge: (1) that researchers and research centers use IT resources differently than those involved in the IT enterprise or academic computing; (2) that researchers and research centers often require IT resources and use that are tailored to a discipline's unique data and methodologies. For a research organization like KU, IT management must be responsive to the community it serves, i.e., look outward, not inward, and be committed to a mission and philosophy of enabling, not regulating.
- As addressed below (see **Mechanisms**), KU needs people and institutional mechanisms that foster research leadership, integration and collaboration across interdisciplinary initiatives involving IT.

2. PEOPLE AND HIRING: GAPS IN RESEARCH EXPERTISE AND LEADERSHIP

Principle: Additional hires in the Information Domain—as well as across the other three Strategic Initiatives—will not have the desired impact of synergizing KU grand challenge research if these hires are merely dropped into department silos, as is the current, default practice in the College and schools.

This principle was a theme repeated in all four summits. It is critical for Harnessing Information, Multiplying Knowledge, because the information domain (informatics, computation, technology, communication, etc.) is simultaneously (1) the platform for interdisciplinary synthesis across the sciences, humanities, arts, engineering and other fields integral to Strategic Initiatives 1, 2, and 3; and (2) its own education and research enterprise with ontologies common to many applications.

Currently, if faculty are not in the same department, very few are aware of others doing relevant work, even if they are in the same building,. Essentially, the humorous, yet deadly serious theme that emerged during SI-4 was: like the planet's biodiversity, 96% of KU faculty and research scientists remain "undiscovered"— they don't know of one another (see **Mechanisms**, below).

Across all fields at KU, there are many individual faculty members and students doing excellent work within or involving information technologies, whether it takes those tools as an object of study or uses them to conduct and present research in their individual areas.

Recommendations:
- Hiring decisions in any unit or combination of units should be based first on a comprehensive assessment of who is already here and what related/combined strengths already exist in these units.
- Hires should strategically synergize to fill gaps that create interdisciplinary clusters out of what is already here, including units outside the College.
- An effective cluster, synergistic mechanism is to jointly-appoint new hires across appropriate departments and/or research centers.

Concerning the SI-4 and its computing disciplines, the biggest gaps in expertise lie in high-performance and scientific computing; handling and processing massive data; and scientific visualization. Although we are making great strides in improving our cluster computing and data handling infrastructure, this must be accompanied by strategic hires of researchers who will enable broad use of these resources.

- *Recommendation:* Each of the following personnel needs was mentioned repeatedly in our interactions inside and outside our committee. Furthermore, they were identified far more frequently than any hardware or software need.
  - *Security, Social, and Stewardship:* Research is burgeoning in the areas of information privacy, security, social media and ethics. KU has existing expertise in these areas, but it tends to be fragmented among centers and departments. We should take advantage of our status as a designated NSA/DHS Center for Information Assurance Education to unify and expand our capabilities. Exciting opportunities exist in this area that span computer science and engineering, social sciences and humanities, and public policy.
  - *Massive Data:* Research expertise in handling massive data is similarly critical and similarly multidisciplinary. Significant opportunities for collaboration exist in the natural and social sciences, humanities, education and journalism among others. Although KU does have expertise in data mining and learning, other challenges exist in areas such as access control, database systems, archiving and access, mobility and metadata, all of which require additional expertise. Furthermore, given the demands we foresee,

KU's existing expertise in data mining and learning will be quickly overwhelmed as we increase our interdisciplinary research activities.

- *Data visualization:* The third area identified most frequently by KU researchers is data visualization. Like data mining and learning, KU has some specific existing resources in this area. However, it requires expansion to include human-computer interaction, scientific visualization, and ubiquitous and mobile device computing. The interdisciplinary nature of this area will quickly overwhelm existing resources, but presents numerous opportunities for joint hires. With the emergence of computing appliances such as smart phones and tablets, the nature of how we consume computing and interact with computing is rapidly changing.

- *High Performance Computing (HPC):* Recruit researchers whose primary area is high-performance computing architectures and software, and their innovative, novel applications. Such research is inherently interdisciplinary and will enable collaborative research across the Lawrence campus and at KUMC. This is not to say that KU has no one using HPC, simply that we have no one actively researching applications of HPC to new problems, innovative HPC architectures, or basic HPC software systems. With the emergence of new computing resources through the ACF, KU will be in a strong position to recruit and retain top researchers in this area. This area should be a priority target for a future foundational position.

More generally, harnessing information and multiplying knowledge bear directly on fostering interdisciplinary research across all four strategic initiatives, and, indeed, encompasses the sciences, humanities, arts, engineering and other disciplines. Critical here is the recognition of the role of *informatics*, namely, the integration of data, models, and analytics across vastly different domains for forecasting phenomena across human and natural systems. Such informatics capability is fundamental to all grand challenge questions posed by each of the four strategic initiatives and, indeed, the integration of challenges that overlap the initiatives. Whatever the discipline, the structure of research and thought involves the common "workflow" of data–model–analytics–narrative (or result), which, in turn, feeds back to each of the workflow components. Informatics creates the language connections among disparate workflows, i.e., it mediates and links the interoperability of these workflows among disciplines.

Recommendation:

- Recruit *informaticists,* whose expertise encompass the suite of information technologies, from software engineers to computational thinkers and designers, to information cartographers. The latter, for example at MIT, involve collaborations between visual artists and computational scientists. Typically employed by business, such system-level thinkers for conceiving and mapping information architectures across domains are now essential for research and education in academia.

- Recruit *social informaticists*. The cross-domain application of *informatics* requires the companion *social informatics* expertise to create the necessary collaborative research/learning structure and environment among faculty and students in disparate, individual disciplines. This expertise lacks a simple descriptor, precisely because it is interdisciplinary. For reference, we use the term, *social informaticist*. Such individuals are typically trained in the information and computer sciences and in technology-mediated collaboration and collaborative learning. They create co-emergent innovation by enabling conceptual and technological mediation and integration among faculty in disparate disciplines, i.e., they enable researchers to map relationships and commonalities across their disciplinary boundaries. Such expertise is typically absent in academia, but it is essential in the R&D and applications arenas for enabling people to conduct IT-mediated research that requires integration and modeling of phenomena across domains.

3. MECHANISMS/PROCEDURES FOR RESEARCH LEADERSHIP AND COORDINATION

KU has excellent researchers and leaders in information technology, many of them logically in EECS, ITTC, BI, Communications, Libraries and other units. However, no matter KU's expertise in this or any other of the three strategic initiative areas, the greatest hurdle voiced by faculty and students to conducting interdisciplinary research is that we are, for the most part, unknown to one another. To use a biological metaphor, faculty live on islands, geographically and reproductively isolated, unable to mate intellectually. Should they spot a mate on an adjacent island and attempt to swim over, they are turned back by strong, hidebound currents of antiquated departmental and university cultures. There are exceptions, but not enough to make this section of our report redundant.

A number of no or low cost mechanisms can help reverse these currents and encourage faculty research and research coordination across the information sciences, arts and humanities and other disciplines.

Recommendations
- Appoint new faculty jointly across departments and/or across departments and research centers; reward collaborating units for doing so (i.e., reverse the current disincentives).
- Enable the quick self-assembly of research clusters and groups to answer interdisciplinary RFPs in the information technology and other disciplines. From its purview, KUCR learns of federal agency RFPs and quickly assembles a team of "likely suspects" as the draft nucleus of the research team. Members of the nucleus, using their knowledge of colleagues in relevant areas of expertise, draft additional team members both from within and without KU in academia, business, etc.

- Recruit KU faculty who have served as federal agency program officers to be initial leaders of institutional grants/teams. Pair them with junior, high-achieving faculty to train future research leaders.
- Have each KU unit designate a knowledgeable representative (typically the chair or director) that KUCR or team members can consult to help build interdisciplinary research teams.
- Institute a regular "PechaKucha" with food and libation for faculty and other researchers to present quick, 5-minute idea cafés of their research, expertise and avenues for broader engagement. The Commons would be an ideal venue. The PechaKucha would help foster networks of researchers with braided disciplinary interests (http://www.pecha-kucha.org/what).
- Use The Commons to establish a standing, interdisciplinary, strategic think tank akin to The Santa Fe Institute to foster larger scale, bold, risky research ideas and innovations. Participation across sciences, arts, humanities, etc. is essential. One focal area would be the conceiving and mapping of current and future information architectures across disciplines. Another would be the social informatics for enabling technology-mediated integration of information. See http://www.thedailybeast.com/newsweek/2012/02/12/cormac-mccarthy-on-the-sante-fe-institute-s-brainy-halls.html
- Build a hyperbolic database of KU researchers and their expertise/interests for quick reference for team building.

4. IMPLICATIONS FOR CURRICULUM DEVELOPMENT AND ENGAGED SCHOLARSHIP

The theme of Harnessing Information, Multiplying Knowledge raises implications about what needs to be taught, how curricula should be organized, and the resources such curricula require. We mentioned a need for instruction in the application of computing to students and faculty outside of the traditional computing degrees. However, we must go farther than that when looking at KU's curriculum as a whole.

Recommendation: What we must teach broadly across the university must be expanded to include:
- *Information literacy*: Locating appropriate data, tools and information; assessing the value of information, understanding how technologies work, how to use them effectively
- *Analytic abilities*: How to analyze new kinds of data, how to make decisions about data to keep vs. discard, how to code data (even if only in most basic ways)
- *Technological integrative abilities*: How to design informatics to integrate data/models among disciplinary domains; how to do system-level thinking and information mapping.

- *Technology-mediated collaboration*: How to enable individuals to collaborate on integrating their informatics among disciplinary domains
- *New presentational abilities*: How to visualize data to ask new questions; how to create digital work using visual media for artistic, scientific and design purposes; how to deploy and visualize data to communicate with broader public, how to design for instruction and other practices
- *New applications*: how to use and create technology to meet the demands of contemporary society and industry
- *Broader perspectives*: How to understand technology in ways that go beyond the tools of the moment
- *Ethics*: What are the ethical implications of the contemporary data explosion? Of technological engagement? Of social media? Of policy and governance of technologies? Of defaulting personal freedom to silicon and algorithms?

Achieving these ends requires a new, more flexible curricular organization that:

- Values breadth so that students learn from areas across the university. For instance, computer scientists might learn about ethics of information through courses in the humanities and about the meaning and representation of information through studying the arts
- Values interdisciplinarity so that students have organized paths of coordinated courses through curricula across campus; this could be accomplished through team teaching between very different units, or through the development of new, interdisciplinary degrees.
- Is flexible so that people can nimbly adapt as new opportunities arise
- Integrates external organizations into the curriculum through service learning, internships, real-world research opportunities, and so on.

Recommendation: Resources must be dedicated to supporting new learning objectives and techniques identified above.
- Staff to help support the teaching mission. This must include technical support for hardware and software, but should go much farther providing production assistance for distance learning, copyright assistance for classroom demands, instructional capabilities for faculty education.
- Online space for pooling pedagogical resources and connecting with others. This goes back to the 'digital commons' concept mentioned previously. There must be a place for KU educators to collaborate, sharing and developing new ideas for education.
- Better software licensing so students as well as teachers have access to the tools they need. This includes software for producing traditional papers and presentations, but also for producing eBooks, audio and video resources, and online learning capabilities.

This theme also raises implications about the importance of engaged scholarship. Organizations outside the university are both struggling to understand the technologies we are all bombarded by and inventing the technologies we will soon be studying. The university's researchers have important roles to play on both fronts in understanding the problems people have and developing tools to solve them.

5. RECOMMENDATIONS FOR FUNDING OPPORTUNITIES

Air Force Office of Scientific Research
The focus of AFOSR is on research areas that offer significant and comprehensive benefits to our national warfighting and peacekeeping capabilities. These areas are organized and managed in three scientific directorates: Aerospace, Chemical and Material Sciences; Mathematics, Information and Life Sciences; and Physics and Electronics.
http://www.wpafb.af.mil/library/factsheets/factsheet.asp?id=8981

Alfred P. Sloan Foundation
The Foundation is unique in its focus on science, technology, and economic institutions. It believes the scholars and practitioners who work in these fields are chief drivers of the nation's health and prosperity.
http://www.sloan.org/apply

Apple Corporation
http://www.apple.com/contact/

Bill & Melinda Gates Foundation
Our belief that every life has equal value is at the core of our work at the foundation. We follow 15 guiding principles, which help define our approach to our philanthropic work, and employ an outstanding leadership team to direct our strategies and grantmaking.
http://www.gatesfoundation.org/grantseeker/Pages/information-for-grant-seekers.aspx

Canadian Institute for Advanced Research
Early Career Training is accomplished through the CIARs Junior Fellow Academy program:

- Cosmology and Gravity
- Earth System Evolution
- Experience-based Brain and Biological Development
- Genetic Networks
- Institutions, Organizations and Growth
- Integrated Microbial Biodiversity
- Nanoelectronics

- Neural Computation and Adaptive Perception
- Quantum Information Processing
- Quantum Materials
- Social Interactions, Identity and Well-Being

http://www.cifar.ca/early-career-training

Defense Advanced Research Projects Agency
Defense Sciences
Information Innovation Office
Microsystems Technology Office
Strategic Technology
Tactical Technology Office
http://www.darpa.mil/Opportunities/Solicitations/DARPA_Solicitations.aspx#TTO

Department of Education
- Institute of Educational Science

  Our mission is to provide rigorous and relevant evidence on which to ground education practice and policy and share this information broadly. By identifying what works, what doesn't, and why, we aim to improve educational outcomes for all students, particularly those at risk of failure. We are the research arm of the U.S. Department of Education, and by law our activities must be free of partisan political influence.
  http://ies.ed.gov/funding/
- Office of Special Education and Rehabilitative Services
    - Rehabilitation Services Administration

      The mission of the Rehabilitation Services Administration (RSA) is **"to provide leadership and resources to assist state and other agencies in providing vocational rehabilitation (VR), independent living (IL) and other services to individuals with disabilities to maximize their employment, independence and integration into the community and the competitive labor market."**
      http://rsa.ed.gov/grants.cfm
    - National Institute on Disability & Rehabilitation Research

      The National Institute on Disability and Rehabilitation Research (NIDRR) provides leadership and support for a comprehensive program of research related to the rehabilitation of individuals with disabilities. All of our programmatic efforts are aimed at improving the lives of individuals with disabilities from birth through adulthood.
      http://www2.ed.gov/fund/grant/apply/nidrr/index.html

Department of Homeland Security
The mission of DHS is to prevent and deter terrorist attacks, protect against and respond to threats and hazards to the Nation, and secure our national borders

while welcoming lawful immigrants, visitors, and trade. The strategies S&T will use to support this mission and make the Nation safer are:

Explosives Division
Chemical/Biological Division
Command, Control, and Interoperability Division
Borders and Maritime Security Division
Human Factors/Behavioral Sciences Division
Infrastructure/Geophysical Division

https://baa2.st.dhs.gov/portal/public/Menu.action?page=baa_current_solicitations

Google Inc.

The purpose of this program is to facilitate more interaction between Google and academia and also nurture stronger relations and partnerships with universities. The intent of the awards program is to support academic research aimed at improving information access (defined broadly). Google funds Research Awards unrestricted and retains no intellectual property from the research. We prefer if the results from the research are open sourced and widely published. Awards through this program are for one year in the range from $10K-$150K. Areas that are of particular interest include (but are not limited to):

- Economics and market algorithms
- Education innovation
- Geo/maps
- Health
- Human-computer interaction
- Information retrieval, extraction, and organization
- Machine learning and data mining
- Machine translation
- Mobile
- Multi-media search and audio/video processing
- Natural language processing
- Policy and standards
- Security and privacy
- Social systems
- Software Engineering
- Software and hardware systems infrastructure
- Speech
- Structured data and database management

http://research.google.com/university/relations/research_awards.html

Hartwell Foundation

The Primary Mission of The Hartwell Foundation is to grant awards to individuals for innovative and cutting-edge biomedical applied research that potentially benefit children. The individuals and children should be citizens of the United States. The general aim is to provide funds for early stage research projects that have not yet qualified for funding from traditional sources.

- Individual Biomedical Research Awards
- Biomedical Research Collaboration Awards
- Biomedical Research Fellowships

http://www.thehartwellfoundation.org/Individual_Biomedical_Research_Awards.shtml

John Templeton Foundation
The John Templeton Foundation serves as a philanthropic catalyst for discoveries relating to the Big Questions of human purpose and ultimate reality. We support research on subjects ranging from complexity, evolution, and infinity to creativity, forgiveness, love, and free will

http://www.templeton.org/what-we-fund/funding-priorities

Kauffman Foundation
Ewing Kauffman advised his associates to invest in people and be willing to take risks as we look for opportunities to promote positive education and accelerate entrepreneurship in America. We consider our grants to be investments, and we look for a return on the grant investments we make.

http://www.kauffman.org/about-foundation/funding-guidelines.aspx

Kellogg Foundation
The W.K. Kellogg Foundation supports children, families, and communities as they strengthen and create conditions that propel vulnerable children to achieve success as individuals and as contributors to the larger community and society.

http://www.wkkf.org/grants/for-grantseekers.aspx

MacArthur Foundation (Digital Media and Learning)
The John D. and Catherine T. MacArthur Foundation is a private, independent grantmaking institution dedicated to helping groups and individuals foster lasting improvement in the human condition.
The digital media and learning initiative is exploring the hypothesis that digital media tools now enable new forms of knowledge production, social networking, communication, and play.

http://www.macfound.org/site/c.lkLXJ8MQKrH/b.913959/k.E1BE/Applying_for_Grants.htm

Missile Defense Agency Science and Technology Advanced Research (MSTAR) BAA
The Missile Defense Agency (MDA) is charged with developing and fielding a Ballistic Missile Defense System (BMDS) to protect the United States (US), as well as US allies and friends from a ballistic missile attack.

https://www.fbo.gov/index?s=opportunity&mode=form&id=c164a22fc06328822d935d6b3396739d&tab=core&_cview=0

National Aeronautics and Space Administration
http://nspires.nasaprs.com/external/solicitations/solicitations.do;jsessionid=6d6YTP
Rc7bPJDd6Chvt37CHhQIGX7jhX66QQvFs89tH5hWW2prQy!-1495209655!-
1407319093!7006!9008!NONE?method=init&stack=push

National Institutes of Health
- Center for Information Technology
  Mission: To provide, coordinate, and manage information technology, and
  to advance computational science.
  Vision: To be a vital partner in the discovery of biomedical knowledge.
  http://cit.nih.gov/
- National Institute on Aging
  Since 1974, the NIA -- one of the 27 Institutes and Centers of the NIH -- has
  been at the forefront of the Nation's research activities dedicated to
  understanding the nature of aging, supporting the health and well-being of
  older adults, and extending healthy, active years of life for more people.
  http://www.nia.nih.gov/research/dea/grants-process
- Eunice Kennedy Shriver National Institute of Child Health & Human
  Development
  The NICHD, established by congress in 1962, conducts and supports
  research on topics related to the health of children, adults, families, and
  populations.
  http://www.nichd.nih.gov/funding/
- National Institute on Deafness and Other Communication Disorders
  Established in 1988, NIDCD is mandated to conduct and support
  biomedical and behavioral research and research training in the normal and
  disordered processes of hearing, balance, smell, taste, voice, speech, and
  language. The Institute also conducts and supports research and research
  training related to disease prevention and health promotion; addresses
  special biomedical and behavioral problems associated with people who
  have communication impairments or disorders; and supports efforts to
  create devices which substitute for lost and impaired sensory and
  communication function.
  http://www.nidcd.nih.gov/funding/pages/what.aspx
- National Institute on Mental Health
  The mission of NIMH is to transform the understanding and treatment of
  mental illnesses through basic and clinical research, paving the way for
  prevention, recovery, and cure.
  http://www.nimh.nih.gov/research-funding/grants/research-grants-r.shtml
- National Cancer Institute
  Supports and coordinates research projects conducted by universities,
  hospitals, research foundations, and businesses throughout this country and
  abroad through research grants and cooperative agreements.

http://www.cancer.gov/researchandfunding
- **National Institute of Biomedical Imaging and Bioengineering**
  http://www.nibib.nih.gov/
- National Institute of General Medical Sciences

  The mission of the National Institute of General Medical Sciences (NIGMS) is to support research that increases understanding of life processes and lays the foundation for advances in disease diagnosis, treatment and prevention. http://www.nigms.nih.gov/
- **National Human Genome Research Institute** (NIH)
  http://www.genome.gov/

National Science Foundation

Directorate of Computer & Information Science & Engineering
http://www.nsf.gov/dir/index.jsp?org=cise

Office of Cyberinfrastructure
http://www.nsf.gov/dir/index.jsp?org=OCI

Directorate of Engineering
http://www.nsf.gov/dir/index.jsp?org=eng

Office of International Science and Engineering
http://www.nsf.gov/div/index.jsp?div=OISE

Education and Human Resources
http://www.nsf.gov/dir/index.jsp?org=ehr

Office of Integrative Activities
http://www.nsf.gov/dir/index.jsp?org=OIA

National Security Agency
Our vital research program focuses on four critical goals:
- We develop the means to dominate the global computing and communications network.
- We cope with the overload of information in our environment and turn that overload to our strategic advantage.
- We provide the means for ubiquitous, secure collaboration both within our government and through its interactions with various partners.
- We create the means for penetrating into the "hard" targets that threaten our nation wherever, whenever, or whomever they may be.
  http://www.nsa.gov/research/index.shtml

Office of the Director of National Intelligence
Program offices & Goals:
- Smart Collection

The goal of the programs in this office is to dramatically improve the **value** of collected data from all sources.
- Incisive Analysis

The goal of the programs in this office is to maximize **insight** from the information we collect, in a **timely** fashion.
- Safe & Secure Operations

The goal of the programs in this office is to be able to counter new capabilities implemented by our adversaries that would threaten our ability to operate freely and effectively in a **networked** world.
http://www.iarpa.gov/

Office of Naval Research
http://www.onr.navy.mil/Contracts-Grants.aspx

Robert Wood Johnson Foundation
The mission of the Robert Wood Johnson Foundation is to improve the health and health care of all Americans. Our goal is clear: To help our society transform itself for the better.
Through our investments in our grantees, we seek to improve the health and health care of all Americans. In 2010, we awarded approximately $300 million in grants that fell within seven program areas.
http://www.rwjf.org/grants/

Simons Foundation
The application of quantitative methods to biology has been progressively more productive over the past several decades. The use of statistical methods and large scale data analyses, for example, is in the process of revolutionizing modern genetics. The applications of both math and physics have been critical to neurobiology. Bringing together mathematicians and biologists, the Simons Foundation supports a Biology Colloquium at the Mathematical Sciences Research Institute (MSRI), a systems biology program at the Institute for Advanced Study (IAS), and a newly established biology program at the Institut des Hautes Études Scientifiques (IHÉS). Through these interdisciplinary programs, the foundation hopes to stimulate collaborations that will further advance research in the life sciences.
https://simonsfoundation.org/grants

United Stated Food and Drug Administration
http://www.fda.gov/ForFederalStateandLocalOfficials/CooperativeAgreementsCRADAsGrants/ucm234305.htm

United States - Israel Binational Science Foundation (BSF)
Regular research grants
Open to all scientists from Israel and the USA. Please verify your eligibility before submitting.
Start-up research grants
Open to American and Israeli scientists who are in the initial stages of their independent careers. Find more details here.
Workshop grants
Open to all American and Israeli scientists, and addressing specific topics that will change from one year to the next and will be announced in the annual Call for Proposals. You can see the current call here.
Prof. Rahamimoff Travel grants
Open to American and Israeli PhD students and post-doctoral researchers for research related trips to the other country. Find more details here.
BSF Energy Research grants
Supported by funds from the Israeli Ministry of National Infrastructures, and the U.S. Department of Energy. It will support joint research programs in alternative and renewable energy, and in energy efficiency. You can read more about the program here. **Please note that the submission to this program is irregular and is dependent on the availability of funds.
Transformative Science Research grants
A new program in 'Transformative Science' was launched in 2010. This is a small program of up to 2 awards annually that will receive larger grants than in our regular program. To be awarded a grant, the program must be 'transformative'. The BSF has adopted the NSF definition for 'Transformative Science', which is:
Research driven by ideas that have the potential to radically change our understanding of an important scientific concept, or lead to the creation of a new paradigm, or a new field of science. Such research is characterized by its challenge to current understanding or by its pathways to new frontiers.
http://www.bsf.org.il/BSFPublic/DefaultPage1.aspx?PageId=223&innerTextID=223

United States Department of Defense (DOD)
Aerospace, Chemical and Material Sciences Directorate
http://www.wpafb.af.mil/library/factsheets/factsheet.asp?id=9196

Physics and electronics Directorate
http://www.wpafb.af.mil/library/factsheets/factsheet.asp?id=9205

Waitt Foundation

Funding partnerships and projects in conjunction with its grantees and two operating foundations—the Waitt Institute and the Waitt Institute for Violence Prevention, the foundation supports a variety of scientific and environmental programs with an emphasis on ocean conservation.

> Exploration & Discovery
> Scientific Innovation
> Community Building

http://waittfoundation.org/grant-guidelines

Additional Funding Opportunity Identified at Summit

United States Department of Energy (DOE)
http://www.er.doe.gov/grants/

6. APPENDIX: SWOT ANALYSIS

Strengths

- World class researchers are using informatics and "big data" in systematic programs of scholarly inquiry across the sciences, arts, and humanities and are bringing in significant federal funding to the university
- New KU leadership not only values research, they also understand it and have demonstrated excellence
- Excellence among existing academic programs and centers with bridges already built
  - The Commons@KU
  - Museums and Libraries
  - New Bachelor of Science degree in Interdisciplinary Computing represents an important collaboration between EECS and Physics and Astronomy
  - Bioinformatics
  - Journalism (Social Media)
  - Computational Physics and Astronomy
  - Institute for Digital Research in the Humanities
  - Center for Research Methods and Data Analysis
  - Biodiversity Institute
  - Communication Studies
  - Psychology
  - ITTC
  - Public Administration
- Existing relationships with corporations and external organizations such as:
  - Cerner
  - Sprint

- o Stowers Institute
- Willingness and capacity to partner with commercial entities and government agencies
- Commitment and experience in international arenas
- New Advanced Computing Facility (ACF) funded by NIH grant
- Use of ScholarWorks and taking the lead on open access policy
- Our museums, archives, and libraries are "hidden gems" that support and advance research and creativity
- Online museum and library collections
  - o KU was one of the very first university art museums to have collections online and continues to develop the museum plus databases now being used across the country
- Collegial campus
- Special Education has taken the lead on assistive technology and the ways that technology and learning can interface both for students in classrooms and also for teacher education
- Pockets of excellent individual faculty in many departments
- KU Information and Telecommunication Technology Center (ITTC) is a National Security Agency (NSA)/Department of Homeland Security (DHS) Center of Excellence in Information Assurance
- People working on KU strategic initiatives are excited and more interested in success than who gets credit
- Islands of existing domain specific expertise
  - o Particle physicists have experience extracting information from the extremely large amount of experimental data produced by facilities such as the Large Hadron Collider (LHC)
  - o Astronomers are beginning to develop that same experience from extracting information from large survey databases
  - o KU Astrobiology has experience extracting information from large amounts of data on mass extinctions
- Expertise in visualization and more subjective uses of data which offers many possibilities between humanist artists and scientists
- People with metadata experience which can be applied to the practical problems of managing enormous amounts of data

Additional Strengths Identified at Summit
- Workshops from Institute for Digital Research in the Humanities
- Developing expertise in curation of digital artifacts
- Libraries transforming spaces for collaboration

Weaknesses

- KU lacks Washington presence with federal funding agencies
  - KU must establish a Washington presence to be competitive beyond National Science Foundation (NSF) and National Institutes of Health (NIH) style agencies
- No mechanism for sustaining a large research proposal effort until it comes to fruition; we talk about opportunities, get excited, write a proposal, and if we don't hit the first time the effort ends
- Computing infrastructure is at least 10 years behind
- KU's world class researchers cannot compete with other institutions with regard to computing power on campus. They either design their own (haphazardly) or rely on other institutions
- Small computing faculty relative to peers
  - Insufficient numbers of computing faculty to support collaboration across all academic disciplines, particularly engineering and sciences
- Lack of incentives or models for innovation
- Graduate recruiting and funding
- Statistical knowledge/education at KU is lagging behind our peers
- Statistical knowledge/education at KU is spread out in Business, Mathematics, Economics, Education, Engineering, Psychology, etc., with little collaboration and coordination in course offerings, etc.
- Scarcity mindset that inhibits unexpected discoveries and expansive projects
- Lack of programmatic approach to life cycle management of information
- Lack of critical mass in social media research
- Lack of support for researchers who need help accessing and mining "big data"
  - Senior faculty may be poorly-equipped to take maximum advantage of the availability of new, huge data sets; new tools and training may be required
- Lack of forums for identifying research partners and collaborators
  - Inconsistent opportunities for faculty to come together around ideas and indulge the imagination
  - Pockets of faculty excellence remain isolated and have no way of connecting to others with similar interests
  - Lack of KU Lawrence-KUMC collaborations
- New skills and courses necessary to make the computational astronomy degree relevant to new astronomical databases
- Insufficient infrastructure that supports the organization, validation, visibility, and dissemination of scholarly communication in diverse and longitudinal forms along a continuum of research and creativity
- Tendency to work in information silos and not necessarily seek (or be willing and able to wait for) campus-wide solutions. Small solutions and small steps are easier than scaled solutions and big steps. We are very early still in formulating standards in some areas that can cross disciplines.

- Lack of bridge building and engagement of people across disciplines from the outset of a research project
- Legacies … things we keep doing because we must, or feel we must, even as new opportunities are not embraced

Additional Weaknesses Identified at Summit
- Lack of expertise in theoretical computer science and applied math
- Lack of IT policy experts for data management plans
- Lack of knowledge about what expertise we do have
- Lack of understanding of what is happening in other units
- Materials science expertise needed to capitalize on nanoscience initiative
- Courses with interdisciplinary value are not open to interdisciplinary enrollment
- Lack of training and support of experts in high performance computing to serve as a bridge between the engineers and the users
- Need a central place for support, knowledge, expertise
- Barriers and lack of structure to reward faculty for their cross-disciplinary work
  o Promotion/Tenure
  o Physical and virtual space for collaboration
  o Curriculum requirements
  o Remove impediments between schools, not just departments
- Discipline specific terminology hinders communication between disciplines
- Lack of access to super computing hinders recruitment and training of graduate students
- Lack of campus-wide database to identify potential collaborators/track and discover expertise
- Need to establish protocols to decide what data should be discarded

Opportunities
- Major NSF Requests for Proposal (RFPs) that deal with interdisciplinary data and computing
- Computing in Humanities and Social Sciences is growing exponentially
  o With the growth of computing in Humanities and Social Sciences, KU's position as one of the top liberal arts universities in the Midwest will serve us well
- Proximity to Ft. Leavenworth, the Army's cyber infrastructure center, and McConnell AFB, headquarters for the Air Force Information Aggressor Squadron
- Expanding corporate funding research for KU
  o Kansas City, KS and Kansas City, MO are Google infrastructure cities; KU has exceptionally strong alumni ties with Google
  o Kansas Bioscience Authority
  o Bioscience and Technology Business Center
- International opportunities for funding and project development

- Urgent environmental, social, and economic challenges that require research universities including those identified in previous summits; specific examples include cybersecurity, data access, and data stewardship; smart communities; climate change; health and well-being
- Technological advances that shrink geographical isolation including online collaboration tools; data sharing capabilities; virtual libraries; interactive media; high-speed, resilient networks; social networks
- Increasing the computer support for "big data" projects at KU which would lead to more federal dollars
- Department of Defense (DoD) and NIH are already in this space and potentially represent larger, longer funding than NSF. However, we have to walk the halls in Washington if we hope to have success with these agencies.
- Physical size of Kansas results in need for information technology and bioinformatics to communicate with people across the state
- Availability of massive data sets that bridge several disciplines on campus
- If KU can provide the tools to access the "big data" that are available then we can level the playing field with institutions that have historically had access to greater facilities
- Buyer's market for new faculty
  - KU overcomes the disadvantage compared to other institutions of not having easy access to major astronomical facilities
- Partnering environment among institutions is strong
  - New Large Synoptic Survey Telescope (LSST) is the top priority in the recently released Decadal Survey from the American Astronomical Society
  - Large data sets are generally freely available to all researchers without the need to be part of a consortium or to write a proposal
  - Priorities of the Decadal Survey are used by NSF and NASA in funding decisions
- A large majority of future projects in the physical and life sciences areas will require the storage, archiving and access to big data sets. Increasing the computer support for "big data" projects at KU would lead to more federal dollars, retention of faculty and recruitment of new faculty.
- Individuals in the research community with loyalty to KU
- Expertise in extraction of information from large data sets could enable new funding opportunities from DOE as part of specific new initiatives. Examples of other universities that are building collaborative approaches to research infrastructure and information management that might serve to model possibilities for KU — [Indiana University Pervasive Technology Institute, http://pti.iu.edu/ ; Yale Information Management office, http://www.odai.yale.edu/; DataOne; HUBzero; CaliforniaDigital Library; and UC3, http://www.cdlib.org/services/uc3/partners/index.html]
- We can position ourselves to train the next generation in the combination of computing and scientific skills that will be needed

Threats

- Impending decrease in research funding at the federal level
- The regulatory infrastructure we exist in, be it KU or Kansas, makes contracting with industry difficult and slows contracting with government agencies other than NSF or NIH
- Collaboration mechanisms with regional schools are not well developed; physical distance causes difficulties when establishing regional collaborations
- Without better support of "big data" projects at KU we will lose both federal dollars and faculty over the next five years; it will be difficult to recruit new faculty in "big data" areas of research; and we will not be able to perform state of the art (let alone ahead of the art) research projects
- Global financial instability leading to risk aversion
- Reputation the state of Kansas has with respect to science makes it more challenging to attract good, young scientists
- The general area of our strategic initiative thrust is well-trodden from a computer science perspective. There is still significant work to be done, but others are ahead of us. We must find niches and focus on them.
- Generational shifts in protocols of knowledge transfer
- Increasing demand to reduce complexity in the media and other forms of communication
- Space Telescope (JWST) is likely to constrain the astrophysics budget at NASA

Additional Threats Identified at Summit

- Community of scientists is aging and not being replaced at an adequate level. Not enough PhDs are being produced to meet demand.
- Privacy, access and security issues
- Need more private funding