Executive summary

Information Systems as an Infrastructure for University Research Now and in the Future: Their Role in Helping Public Universities Cope with Financial and Political Stress

David Shulenburger, Senior Fellow, Association of Public and Land-grant Universities and Professor Emeritus, University of Kansas

- Data come at us rapidly from nearly every quarter and demand to be analyzed. High speed, high capacity computers, blindingly fast networks and massive storage capacity, huge quantities of digitally searchable text and considerable expertise will be required to deal with it all. And finally, it must be affordable. Can public universities afford to compete in this future?
- Public universities operate at a distinct disadvantage relative to our competitors in both private universities and in the corporate world. Public universities' major patrons, the 50 states, have been defunding them on a per student basis for last three decades.
- How do we as public universities acquire (or acquire access to) the information infrastructure that will enable us to maintain or improve our position in research, especially funded research, despite our financial weakness?
- What I recommend is that public universities promote the development of mechanisms and patterns of thought and behavior that enable sharing among all actors of the information infrastructure vital to the research enterprise.
- Elias Zerhouni's vision of the ideal future of medical research involved building the systems in which all research studies were placed freely available on-line. The scientific literature, genome, tissue and whole organism data sets and repositories and the research data bases that grew from his vision at NIH are precisely the kind of publicly available resources that enable public universities to compete and also permit all researchers, wherever they are housed, to be more productive.
- The information infrastructure required to compete in the research environment of the next decades will be less affordable to public research universities than to others because of their financial disadvantages. They would therefore differentially benefit if information infrastructure were made publically available to all without regard to financial factors. Making such resources available in this manner is good for science and for society.

Trends, Disruption, and our Knowledge-Based Economy

Rob Duncan, Vice Chancellor of Research, University of Missouri

- The rate of advancement in our markets is accelerating today. Over the last twenty-five years, the primary seat of innovation and discovery have shifted from industrial laboratories to major, research-intensive universities, and hence social expectations are shifting to universities to lead future advances in technology commercialization that will preserve and extend the United States' international competitiveness. All advances in technology trigger creative disruption of pre-existing market structures, and universities are not historically good at managing such disruption.

- Twenty-five years ago, 70% of all R&D-100 awards were won by industrial laboratories, while today over 70% of these awards go to universities and public research foundations. Still, very little direct commercialization is conducted by universities, in favor of technology licensing of university technology to industry. Our future industrial competitiveness will continue to depend more on innovative methods of cooperation between universities and industry.
- Business today understands that the best ideas and technology rapidly displace earlier innovations in the markets, and while years ago many companies fought to extend their product life cycles by opposing technological advancement, today there is much more of a philosophy of embracing new ideas, and striving to be on the beneficial side of these inevitable disruptions. Similarly, universities that boldly innovate today, and which are open to new and much more aggressive strategies of technology management and industrial relations, will in general win big as well. Today, much more so than ever before, the risk of not taking the risk is actually much greater than the risk itself.
- History shows time and again that exceptional innovation moves disruptively against well-established trends, without attempting to be disruptive. Though it is easy for the common wisdom in Universities to think that small visionary efforts cannot create revolutionary advancement, in fact it is the only thing in retrospect that has. It remains critically important for university leaders to permit innovative faculty members to continue to do research that their peers often consider a clear waste of time.
- In many cases, innovations come in waves, with the much larger market penetration come only much later, when the fundamental organizational principles are discovered. Today universities can take advantage of these natural transitions through interdisciplinary innovation teams that critically evaluate and improve basic discoveries as they emerge, with a focus on how to scale upon the product demand to huge levels.

Developing Infrastructure for Informatics Research: Experiences and Challenges

Prem Paul, Vice Chancellor for Research and Economic Development, University of Nebraska-Lincoln

- Scientific advances are generating massive amounts of data, fostering the need for new strategies to access, store, analyze, and mine data. The need to manage "big data" is especially acute in the life sciences. t UNL, our faculty are working on plant and animal genetics and utilizing genomics in their research to improve productivity, particularly regarding traits for disease resistance and/or drought tolerance. These studies require major investments in computing and bioinformatics infrastructure and personnel trained in bioinformatics.
- Scientific advances are generating massive amounts of data, fostering the need for new strategies to access, store, analyze, and mine data. The need to manage "big data" is especially acute in the life sciences. UNL invested in 10Gb Dark Fiber connecting Lincoln and Kansas City at a cost of over $1 million to connect with Internet2. The cyberinfrastructure we developed to manage big data has been very helpful in supporting our faculty who require supercomputers.
- We have a bioinformatics service in our Center for Biotechnology core facility; however, the facility's staffing is not sufficient to meet the needs of all faculty because there are

more users than talented experts. We are exploring ways to add bioinformatics staff in the core facility and hire additional bioinformatics faculty, including a leader who can coordinate bioinformatics resources and services across campus.

- UNL has significant strengths in social and behavioral sciences, including the Gallup Research Center, the Bureau of Business Research, the Bureau of Sociological Research and the University of Nebraska Public Policy Center. Though each program is highly successful, there is an opportunity for strengthening these programs through collaborations. This is critical, especially considering the importance of social and behavioral sciences in major societal challenges. Therefore, we have launched a taskforce to better understand our institutional strengths and needs for infrastructure.
- UNL faculty members have recognized the need for a Research Data Center (RDC) to access economic, demographic, health statistics, and census data. RDCs provide secure access to restricted use of microdata for statistical purposes. Qualified researchers prepare proposals for approvals by the Census Bureau. Following approval, work is done in secure facilities where scientists may access centrally held data.
- Since RDCs are expensive to maintain and require hiring a director that is Census Bureau employee, it might be more appropriate to pursue a regional RDC that could serve universities in Nebraska, Iowa, Kansas, and Missouri. We propose to build such a center at UNL that would be available to our regional partners.
- Several years ago at the Merrill Conference, discussion took place regarding what can we do together that we cannot do alone – especially with regard to creating shared research infrastructure to support large-scale research projects and programs. The RDC concept represents such an idea for regional collaboration to access big data in social and behavioral science research.

Skating to Where the Puck is <u>Going</u> to Be

Steven Warren, Vice Chancellor for Research and Graduate Studies, University of Kansas

- What is it that we really want from information technology? Scientists want the speed and power to communicate, teach, and learn from anywhere in the world at any time, with ease. We want to have the power and speed to analyze remarkably complex problems.
- One of our ongoing goals is to transform the research administration experience for scholars at the University of Kansas by creating a fully integrated electronic research administration system - where researchers can check the financial balance of their grants, look at projections given their present rate of spending, update and submit a request to the Institutional Review Board, work on a new proposal, submit and monitor a travel request, and on and on.
- The most exciting place to be is on the front end of innovation. It can also easily be the most expensive, complicated, and disappointing place to be. Bottom line, letting others serve as the early adopters may mean that you get a better, more reliable and cheaper product in the end.
- A fundamental outcome of the IT revolution has been the change it has made in terms of how easy it is to collaborate with anyone almost anywhere. My experience has been that

scientists will seek out whoever they need to solve the challenges they face, often without regard to location. This has contributed to the explosion of scientific knowledge over the past couple of decades.

- It is getting much easier to detect certain types of scientific misconduct due to breakthrough technologies. The biggest change is in our ability to detect plagiarism. Scientific journals can now subscribe to services that will scan each submission they receive and compare it to countless related papers that have been published all over the world, in a search to detect instances of plagiarism.
- We live in truly remarkable times. The pace of technological and scientific innovation is staggering. Universities in fact are the origin of much of this disruptive, creative destruction that is rolling across virtually every corner of the world - but being part of the source of this revolution does not in any way inoculate us from its transformative effects. Will the basic model of research universities survive the exponential changes in information technologies?

Information as a Paradigm

Jeffrey Scott Vitter, Provost and Executive Vice Chancellor, University of Kansas

- We are in an information age. Computer science, information, and IT have made huge advances in the last few decades. Advances in computer technology have fundamentally changed the way we live. In fact, computer technology has become the infrastructure that drives commerce, entertainment, healthcare, national security, transportation and innovation.
- The takeaways that emerge about the growth of billion-dollar IT sectors: Each one of these sectors can trace its formation to university research and, in almost all cases, to Federally-funded research. It takes a long time for the research to pay off, in most cases one or two decades. Finally, the research ecosystem is fueled by the flow of people and ideas back and forth between university and industry. This system has made the United States the world leader in information technology.
- IT is not only a key driver for research at KU. We are also using IT in a broad sense to build an infrastructure for innovation – for instance, in our new Center for Online and Distance Learning (CODL), which helps faculty build online or hybrid courses and also serves as a central point for students to access online learning.
- KU was the first public university to adopt an open access policy, which makes faculty members' scholarly journal articles available online for free. KU Libraries hosts a public portal called KU ScholarWorks that provides free access to all faculty publications under the policy. KU is also using technology to maintain Faculty Professional Records Online (PRO), and to build capabilities for sophisticated analytics that allow us to examine our effectiveness and productivity as a university.
- The state of Kansas demands a flagship university in the top tier of public international research universities. KU continues to actively engage with communities throughout Kansas and the world, with a focus upon entrepreneurship, commercialization of technology, and vibrant business partnerships. All of these depend upon IT.

- Though it is no longer so relevant that Kansas is at the geographic and geodesic center of the continental United States, it is significant that through IT, we can truly immerse ourselves anywhere in the world, link together key partners, and form vibrant collaborations. IT drives society, and it drives KU. Through our research at KU and as a core part of how we operate, we use information in fundamental ways to improve our understanding of the world and to make it a better place.

Scholarly Communication in the Age of New Media

Brian Foster, Provost, University of Missouri

- **S**cholarly communication is critical for both the research and educational missions of universities. Given the centrality of scholarly communication to the mission of higher education, it is unsettling that all we know about the current model is that it will not work in the future. Most of the focus of this paper is on publication. The main point is that we are really looking beyond books and journals as we know them, to media of the future that are not known.
- Faculty members expect open communication with regard to content in scholarly publication. However, there are many limitations on open communication that arise from security and commercialization interests such as protecting intellectual property (IP), national security issues, and classified research.
- The main quality assurance mechanism for scholarly publishing is peer review. We expect that work archived in prominent publications has been vetted and can be considered reliable. However, since the most respected publishing venues tend to be conservative, it raises the question of whether really innovative, high-impact or interdisciplinary research will be "accepted" for publication.
- In many ways, the most important function of scholarly publication is the archival function. Yet there are some significant questions about the long-term viability of the digital publications as an archival function. For example, there does not seem to be a coherent plan to migrate the staggering amounts of "archived" digital data if significant new technologies emerge.
- Finally, articles and monographs are critical resources for advanced education. But there are many practical and legal challenges to the use of such materials in digital format. It is a certainty, at least in my view, that we will see dramatic changes in the formats of educational materials. These issues will create daunting questions with respect to IP rights of faculty creating the materials.
- Whatever the future path, there will be unexpected consequences. For instance, there is a perspective by which digital subscriptions in libraries limit access to scholarly results. One doesn't need to "sign in" to take a paper volume off the shelf in the Library; but if one wants access to the digital journals, one has to be a "member" of the "organization" (e.g., university) to be able to "sign in" to get access to the on-line material—a condition of the licensing.
- The issues involving scholarly communication are very complex. A key issue is that we must identify the unintended consequences of change—and the only certainty is that dramatic change will occur. A sustainable revenue stream must be found. In any case, we

must mitigate the unintended consequences such as limiting access as a condition of library subscriptions. We need new models for scholarly communication, and we need to understand that the only thing we really know is that the current system is not sustainable.

Smart Infoware: Providing University Research Stakeholders Soft Power to Connect the Dots in Information Haystacks

Chi-Ren Shyu, Director, Informatics Institute, University of Missouri

- While resources have been allocated to build computing infrastructure everywhere in the nation, the value of infoware to assist the university scientific communities has been underestimated, or even ignored. The organization and coordination of available infoware is needed to leverage regional talents to equip researchers with soft power as opposed to the hardware-based computing muscles.
- The informatics community at MU continuously develops infoware to serve the worldwide research community in three major areas – bioinformatics, health informatics, and geoinformatics. This infoware has played a significant role in handling the ever- growing size of data in genomics, proteomics, biometrics, and imaging technologies.
- Without smart infoware to analyze the data, the financial burden to purchase larger computer clusters becomes bigger and unmatchable to the growth of information. All the infoware shares the same goal: to provide open-source tool access to the entire scientific community with speedy search from large-scale and complex data sets that normally cannot be organized and processed without high performance computing.
- Infoware has been developed independently by colleagues in Iowa, Kansas, Missouri, and Nebraska. However, most informaticians are unaware of these developments in their surrounding institutions. Thus it is unlikely to expect researchers in other fields to understand the regional talents that can greatly enhance their research using the existing infoware. Therefore, it is necessary for infoware developers from the region to meet and put together an info-warehouse for tool sharing and education.
- Moreover, a research social network which is searchable by university researchers and industry partners is also needed for the region. This linkage of researchers may consist of co-authored publications, collaborative proposals for extramural grants, student committee memberships, national/international committee services, etc.

Finding Subatomic Particles and Nanoscopic Gold in Big Data

David Swanson, Director, Holland Computing Center, University of Nebraska

- Modern data intensive research is advancing knowledge in fields ranging from particle physics to the humanities. The data sets and computational demands of these pursuits put ever-increasing strain on University resources. The need to constantly evolve and grow resources economically requires careful strategy and provides incentive to combine and share resources wherever possible.
- HCC maintains a Campus Grid that is able to transparently submit large batches of jobs first to the campus, then to Big 10 peers Purdue and Wisconsin, and finally to the OSG. This method of computing is also able to access resources on the Amazon EC2 Cloud. Recent studies by the DOE concerning storage have continued to conclude that Cloud re-

sources, even if capable of the scales demanded by data centric science -- not yet confirmed -- are currently far too expensive compared to locating resources at Universities and Labs.

- HCC's relationship with the Open Science Grid (OSG) has grown steadily over the last several years, and HCC is committed to a vision that includes grid computing and shared national cyberinfrastructure. The experience with OSG to date has proven to be a great benefit to HCC and NU researchers, as evidenced by the HCC's usage of over 11 million cpu hours in the last calendar year.
- HCC is a substantial contributor to the LHC (Large Hadron Collider) experiment located at CERN, arguably the largest cyberinfrastructure effort in the world. HCC operates one of the seven CMS "Tier-2" computing centers in the United States. Tier-2 centers are the primary sites for user analysis of CMS data, and they are also the primary sites for generating collision simulations that are used by physicists throughout the experiment; these jobs are submitted over the grid by a central team of operators. The Nebraska Tier-2 currently has 3000 processing cores and hosts 1200 TB of CMS data with redundant replication.
- Movement of data sets of these sizes requires the use of high performance networks. UNL has partnered with other regional Universities in the Great Plains Network (GPN) to share the cost of obtaining and maintaining connectivity to Internet2. The Tier2 site at HCC routinely moves data at rates approaching 10 GigaBits per second to and from other LHC collaborators, often via this shared Internet2 link.
- While shared high throughput computing (HTC) is a major thrust at HCC, it should be emphasized the majority of computing done at HCC is still traditional high performance computing (HPC), since this is what most HCC researchers currently need to advance their research. The fact that HPC coexists so well with HTC at HCC is strong evidence this model of shared computing can be extended to other locations.

On the End of Paper Based Communication

Perry Alexander, Director, Information and Telecommunication Technology Center (ITTC), University of Kansas

- The post-PC world is upon us. We are consuming more information in more ways than ever in our history. The industrial revolution snatched up our information infrastructure and made its products commodities. Yet, Accounting still needs physical receipts for my trips. Whatever happened to the paperless office promised two decades ago? The technology is most clearly here and available. What's missing? What does paperless mean?
- Paperless means literally less paper, lowering costs, and producing less waste. Instead of reams of paper and stamps, we now consume terabytes of bandwidth and storage. We need greater bandwidth and storage, new kinds of data archives, more software with far higher complexity. Still, paper establishes trust. We need *new ways of establishing trust* that reflect our new ways of storing and transmitting information.
- The tools of virtual trust are cryptographic functions for encrypting and signing messages and cryptographic protocols for exchanging information. Encrypting information with a key provides the same trust as a sealed. Signing information with a key provides the same

trust as a physical signature. Protocols provide us methodologies for using encryption and signing to exchange information.

- Asymmetric key cryptography gives us the tools to electronically replace envelopes that guarantee confidentiality and physical signatures that guarantee integrity. *Protocols* then specify how those tools are used in practice. We are seeing these protocols implemented in everything from software distribution systems to lab information maintenance.
- Establishing trust electronically is problematic. Key management – particularly revocation of compromised keys – is an ongoing area of research and development. But the tools are there for us to use. The time is now for us to move forward and begin to put trust on equal footing with information in the electronic world.

The Role of Information Systems in Clinical and Translational Research (Frontiers: The NIH Clinical and Translational Science Award Driving Information Systems)

Paul F. Terranova, Richard J. Barohn, Lauren S. Aaronson, Andrew K. Godwin, Peter Smith, and L. Russ Waitman, University of Kansas Medical Center

- Headquartered at the University of Kansas Medical Center, the NIH-CTSA-supported Frontiers program, more formally called The Heartland Institute for Clinical and Translational Research, is a network of scientists from institutions in Kansas and the Kansas City region. The Frontiers program is developing more efficient use and integration of biorepositories, genomic information and biomedical informatics which are important components for attaining the CTSA goals.
- Many partners are involved with accomplishing the goals of our Frontiers program. These partners include academic institutions and health care institutions and centers in the region. The basic infrastructure of Frontiers includes the following components: Clinical Research Development Office, Clinical and Translational Research Education Center, Biomedical Informatics, Biostatistics, Clinical and Translational Science Unit (CTSU), The Institute for Advancing Medical Innovations, Translational Technologies Resource Center, Pharmacokinetics/Pharmacodynamics (PK/PD), Personalized Medicine and Outcomes Center, Pilot and Collaborative Studies Funding, Community Partnership for Health, Regulatory Knowledge and Support, and Ethics.
- The bio-repository includes numerous components requiring integration of multiple sources of information flow with a goal of enhancing discovery to improve health. Our goal is to enter genome and other types of 'omic' data such as metabolome, transcriptome and proteome into the system.
- Bioinformatics services at KUMC are provided largely by the Smith Intellectual and Developmental Disabilities Research Center which is a collaborative effort with KU at Lawrence Bioinformatics studies and utilizes methods for storing, retrieving and analyzing biological data, such as DNA, RNA, proteins and their sequence as well as their structure, function, pathways and interactions. The overall mission of the core facility is to advance the understanding of integrative functions in biological systems, including human, through the application of computational models and data analysis with focus on Next Generation Sequencing Data Analysis and Microarray Data Analysis. The core identifies opportunities and implements solutions for managing, visualizing, analyzing, and interpreting genomic data, including studies of gene expression, pathway analysis, protein-

DNA binding, DNA methylation, and DNA variation, using high-throughput platforms in both human and model organisms.

Research, Data, and Administration Management in the Animal Health/One Health Plan

James Guikema, Associate Vice President for Research, Associate Dean of the Graduate School, Kansas State University

- The theme of the current Merrill Conference – information systems as infrastructural priorities for university research both now and in the future – unites the research office and the information technology (IT) office at each university institution within our four-state region.
- There is an unprecedented demand on our IT infrastructure from nearly all sectors of our collective clientele. Students are sophisticated users of IT networks, and push the limits of what we can provide in communication, academic course content, and social networking. This is amplified when considering the needs of the distance-education arena. Our research-faculty investigators are developing larger databases that challenge our ability to archive, manage, manipulate, mine, and share essential information.
- High on the list of research priorities are the 'omics' – genomics, proteomics, metabolomics, lipidomics, etc. – with the i5K genome project [sequencing and annotating 5,000 insect genomes], described elsewhere in this volume, as an excellent example. Policy makers, and the managers of funding programs at both the state and federal levels, are sending our universities mixed messages regarding what data may (or must) be shared and what data must be secured.
- Relative to IT demands, our universities are looking into the tunnel at the light – not knowing if that light is in fact the end of the tunnel, or if it is the headlight of the oncoming train. One thing is certain: a sense of a deadline approaching. This was perhaps best described by Dr. Samuel Johnson: "Nothing so concentrates the mind as the sight of the gallows," and the IT challenges are relevant across all disciplines on our campuses.
- Each of our institutions has risen to the IT challenge in various areas and disciplines. This article seeks to place the IT / research infrastructure challenges within a 'comparative medicine' context, since these challenges touch upon research strengths of the region, of strengths within each institution, and of the growing regional opportunity represented by the relocation of a major federal comparative medicine laboratory [NBAF] to Manhattan, KS.

Trends in Technology-enabled Research and Discovery

Gary K. Allen, CIO, University of Missouri-Columbia; Vice President for IT, University of Missouri System

James Davis, Vice Provost for IT & CIO, Iowa State University

- Discovery, innovation, learning, and engagement are core to the mission of the university, and support for those objectives pervades all processes. An effective information technology infrastructure (or *cyberinfrastructure*) is central to the success of a robust research program. The infrastructure must provide anywhere, anytime access to information, peer collaborators, systems, and services needed to advance the program.

- Even with the rapidly increasing capacity of contemporary storage, the management of large collections of data is demanding. The complexity of maintaining large data stores coupled with curation requirements and rapidly expanding security requirements makes a compelling case for developing an institutional approach to data management. Another challenging component of processing large research data sets is simply moving them quickly and reliably.
- IT is in the largest outsourcing trend in history, and public cloud Infrastructure as a Service (IaaS) will be a key component of outsourcing decisions because it offers commoditized infrastructure and increased agility. A different rate of evolution is evident in IT services supporting research activities. New models are rapidly developing among communities of use whose members have these requirements in common. Project teams expect that technology will mitigate the impact of distance and create a community where participants can interact as if they were located in the same space.
- Joint efforts, many of which are regionally focused, are also growing in number as institutions work together to develop new approaches to satisfy their research cyberinfrastructure needs. In many cases, these efforts include both research universities and corporate partners.
- We believe that there is an important role for a regional approach to developing strategies to bridge between the campus and national research cyberinfrastructure initiatives. All of the represented states in the Merrill retreats are EPSCoR-eligible; this could represent a significant opportunity to obtain federal funding support to begin creating a regional support model for cyberinfrastructure.

Communicating Science in an International Arena: the i5K Initiative

Susan Brown, University Distinguished Professor of Biology, Kansas State University

- As technical advances lower the costs of high through-put sequencing, genome sequencing is no longer limited to large sequencing centers and external sources of funding. This creates special challenges in how to store, share and analyze huge datasets with an international cohort of collaborators.
- As sequencing costs plummet, sequencing projects are directed toward more ambitious goals. At K-State, we established a center for genomic studies of arthropods affecting plant, animal and human health. The next generation sequencing technologies that have yielded the most dramatic cost reductions produce exceedingly large datasets. Many algorithms have been developed to assemble a genome from these whole genome shotgun reads, and all are computationally expensive.
- In March 2011, the i5k initiative was announced. The goal of the i5k is to sequence the genomes of 5000 insect and related arthropod species. The i5k consortium is interested in all insects of importance to agriculture, medicine, energy production, and those that serve as models, as well as those of importance to constructing the Arthropod Tree of Life.
- Sequencing 5000 insect genomes will provide a wealth of information about the largest group of species on earth. The genome sequences will serve as a resource for gene discovery. Genome sequences will also serve as substrates for analysis, to detect signatures of selection and structural rearrangements associated with their evolutionary history. Genome

sequences will also serve as gateways for biological inquiry, providing a "parts list" of genes for investigation.

- At K-State, we are using NGS sequence data to improve the original *Tribolium castaneum* genome assembly. In addition, we have sequenced the genomes of three related species. Each project generates terabytes of data to be archived, analyzed, and shared with an international group of collaborators.
- We currently provide community access to three genome projects at K-State through agripestbase (agripestbase.org). To solve problems in distributed resource sharing we are working with our high performance computing (HPC) group to explore solutions offered by Globus. Sequencing the genomes of the interacting members of these communities will provide the foundation for arthropod community genomics and even larger datasets to consider.

Advancing Clinical and Transformational Research with Informatics at the University of Kansas Medical Center

Lemuel Russell Waitman, Gerald Lushington, Judith J. Warren, University of Kansas Medical Center

- Biomedical Informatics accelerates scientific discovery and improves patient care by converting data into actionable information. Pharmacologists and biologists receive improved molecular signatures; translational scientists use tools to determine potential study cohorts; providers view therapeutic risk models individualized to their patient; and policy makers can understand the populations they serve. Informatics methods also lower communication barriers by standardizing terminology describing observations, integrating decision support into clinical systems, and connecting patients with providers through telemedicine.
- The University of Kansas Medical Center's (KUMC) pursuit of a National Institutes of Health (NIH) Clinical and Translational Science Award (CTSA) catalyzed the development and integration of informatics capabilities to specifically support translational research in our region. The NIH-CTSA-supported Frontiers program, also called The Heartland Institute for Clinical and Translational Research (HICTR), is a network of scientists from institutions in Kansas and the Kansas City region.
- The vision for the informatics section is to provide rich information resources, services, and communication technologies across the spectrum of translational research. Broadly the initiative would adopt methods which facilitate collaboration and communication both locally and nationally, convert clinical systems into information collection systems for translational research, and provide innovative and robust informatics drug and biomarker discovery techniques.
- In addition, the informatics section will work with state and regional agencies to provide infrastructure and data management for translational outcomes research in underserved populations, and measure clinical information systems' ability to incorporate translational research findings.
- In the latter years of the grant we plan to leverage regional informatics capabilities to complement the long history of engaging the community through outreach via telemedi-

cine, continuing medical education, and our extensive community research projects in urban rural and frontier settings. In the coming year, Frontiers plans to optimize the use of clinical systems for disseminating translational evidence and recording measures to verify adoption.

Creating Information Infrastructure for Research Collaboration

Arun K. Somani, Anson Marston Distinguished Professor, Electrical and Computer Engineering, Iowa State University

- High performance computing (HPC) is essential for advanced research in virtually all disciplines of science and engineering, and in particular in the fields of bio-, materials-, and information-technologies, all identified as strategic priorities of Iowa State University.
- The merit of the new HPC platform includes the far-reaching and impactful research growth that it enables, by accelerating knowledge and discovery, spanning areas as diverse as animal sciences, plant genomics, climate modeling, and wind power generation.
- ISU has large, well established interdisciplinary research and education programs at the forefront of biological sciences. These research efforts span microbial, plant and animal species, and are fully integrated with teams of computational scientists due to the transformation of biology as a data-driven science.
- The computational and bioinformatics tools needed to drive such research share common methodologies and computing needs. The emergence of high-throughput DNA sequencing technologies and their rapid proliferation and throughput gains during the past five years has created a compelling need for the HPC equipment.
- A group of faculty members was identified to develop external funding for this proposal, specifically targeting the NSF MRI (major research instrumentation program. A successful $2.6M proposal for a large heterogeneous machine was developed that met the needs of a plurality of researchers.