

The Ken Kennedy Institute for Information Technology

Fiscal Year 2015 Annual Report

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RICE | K²I
KEN KENNEDY INSTITUTE
for Information Technology

Executive Summary

During Fiscal Year '15, the Ken Kennedy Institute experienced tremendous momentum in terms of developing new collaborative efforts and achieving scalable returns on investment. As a "service institute," we have been recognized for our efforts to build and support a sustainable and robust shared computing research infrastructure for Rice's research community. We also continued to provide multiple platforms for intellectual engagement amongst faculty, other universities, students and industry. In FY '15, we embarked on many endeavors to strengthen our organization that included:

- Expanded our graduate fellowship program:
 - Added Computer Science & Engineering Supplemental fellowships to help recruit high achieving students in the application pool.
 - Continue running our well-established and highly successful industry funded Graduate (enhancement) Fellowship program for students already at Rice.
- Strengthened our industry engagement with another record year for the annual Rice Oil & Gas High Performance Computing Workshop (OG-HPC Workshop).
- Deployed Phase I of the Billing Application Service Center Software (BASCS) web application. This software application reduces the manpower required to manage billing for shared computing services.
- Procured and deployed the Big-Data Private-Cloud Research Cyberinfrastructure (BDPC), also known as BiRD Cloud (Big Research Data Cloud).
- Engaged with IDC on benchmarking study for Rice University, "Best Practices in Securing Funding for University-based HPC Centers."
- Co-wrote Rice's Data-Science Initiative that was presented by the Provost to the Board of Trustees.
- Delivered two week long summer training classes open to external and internal participants:
 - HPC Summer Institute (the 6th in the series)
 - Data Science Summer Institute (the 2nd in the series)
- Hosted 4 Distinguished Lecture and 8 monthly member luncheons in support of community development.
- Prepared for and hosted an external review.
- Increased visibility of Institute faculty member led research by featuring more than 30 news stories on our webpages and email distribution lists.

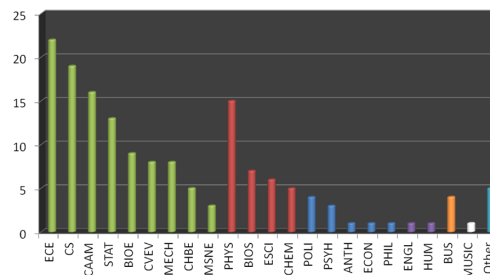
Institute Space and Leadership

The Ken Kennedy Institute is located in Duncan Hall where we occupy three offices (rooms 1084, 1085 and 1088). No other space is currently dedicated to the Institute. The Director (since 2001) of the institute is Moshe Y. Vardi, Karen Ostrum George Distinguished Service Professor in Computational Engineering. The Executive Director, Jan E. Odegard joined the institute in 2002. The institute has two staff members supporting the operation of the Institute, Victoria Langlais, Institute Administrator and Deborah Heath, Administrative Assistant.

Institute Membership

The Ken Kennedy Institute's Membership is comprised of 150 Rice faculty members, 65 associate members who are part of the greater campus population, and 15 non-Rice members who are affiliated with industry, the Texas Medical Center, or other organizations outside of Rice University.

Institute Members by Department & School



Internal Collaboration

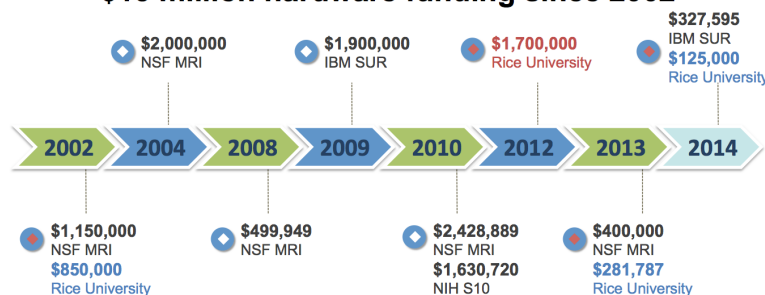
Shared Computing Infrastructure

Since 2002, the Ken Kennedy Institute has successfully worked with faculty to build Rice's shared computational infrastructure. Today, the Institute, in partnership with Rice's Information Technology division, supports the computational research needs of more than 120 faculty members and over 600 shared computing users. In any given month about 250 users working with 70 PIs use the systems to support their research. While the Institute is not a research institute that actually engages in doing research, the Ken Kennedy Institute has benefited Rice as a leading service organization that has helped raise over \$13 million in research computing infrastructure funding through a number of successful grant proposals and industry partnerships.

We could not operate and continue to build upon our shared computing infrastructure without the technical support of Rice's Office of Information Technology, the financial support of Rice University, industry sponsors such as IBM, and that of external organizations, such as the National Science Foundation (NSF). On average, the Institute has invested approximately \$1 million per year in average in Rice's research Cyberinfrastructure.

Research Cyberinfrastructure Funding History

\$13 million hardware funding since 2002



~\$1 million invested in shared hardware per year

faculty "condominium" hardware investments not included
staff, facility, power, cooling & service center misc expenses not included
Note: this does NOT include funding for storage for data compliance

Data Science Initiative

The Institute led much of the development of the \$50 million University wide Data-Science Initiative. This leadership involved conversations across Rice as well as numerous discussions with colleagues in the Texas Medical Center and Houston energy industry. The \$43 million initiative was embraced, further enhanced, and presented to the Board of Trustees by Provost Marie Lynn Miranda. The Data Science Initiative's goal is to enhance Rice's capabilities in the core technologies of the data era (data analytics, machine learning, and the underlying hardware and software systems) as well as expand its reach into increasingly data rich disciplines across campus. With this initiative in place, techniques in data science will be applied towards solving problems in energy, education, health and urban systems. The proposed initiative will enhance Rice's capabilities in these core areas and will encourage their application in data-enabled research and education broadly across the entire institution. The initiative will leverage strengths of the Ken Kennedy Institute and strengthen Rice's reputation in the core fields that underlie data science, computer science, computer engineering, statistics, and applied mathematics. The initiative will also enhance Rice's capability to engage in important data-driven decision-making around complex problems. This will increase our national reputation and stature more broadly as a place to turn to for evidence-based decision-making. The Ken Kennedy Institute is poised to help develop, and if asked, lead the development of the Data Science Initiative.

Community Engagement

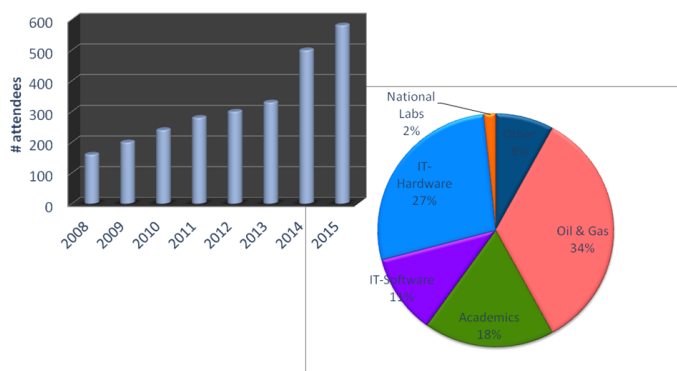
The Ken Kennedy Institute continues to engage with and support the local community at Rice and in Houston with a variety of educational workshops, public lectures, and monthly networking opportunities. We see our power in relationship building at the forefront of intellectual ambitions. We believe it is critical to our mission to continue building and maintaining strong relationships across the community at Rice, the Texas Medical Center, and Houston.

External Collaboration

2015 Oil and Gas High Performance Computing Workshop

The Oil and Gas High Performance Computing Workshop (OG-HPC Workshop) continues to be a flagship industry engagement for the institute and Rice University. In 2015 we once again exceeded our projections and had more attendance, more speakers, more sponsors and more poster student posters than in any of the prior 7 workshops. We had another sold-out event, with approximately 550 attendees, up from 525 in 2014, and 28 sponsor companies (5 Gold (up from 2 in 2014), 11 Silver, and 12 Bronze sponsors). The Ken Kennedy Institute and Rice are viewed as a convener and enabler for a critical community that drives return on investment in both

Attendee History and Demographic



energy and IT.

As a result of the successful partnership established between the energy industry and the IT industry, we were able to raise a total of \$181,000 (net \$117,595) from this one event. These funds will be used to fund the Ken Kennedy Institute Computational Science & Engineering Fellowships (recruiting “supplemental fellowships”) to help departments across computational science and engineering focused on high performance computing attract the best talent into their degree programs. Beyond the funding from the workshop the Ken Kennedy Institute also received fellowship support (\$60,000) from energy industry partners (BP, ExxonMobil, Shell, and Schlumberger) and IT industry (Cray endowment) partners that are being used as named “enhancement graduate fellowships” for current students. These fellowships raise awareness of the opportunities and interesting problems offered by the industry.

Because of the explosive growth of this engagement, the OG-HPC Committee decided that the description “workshop” was not descriptive and that in the future we would be better identified as a conference. Beginning in 2016 the name will be Oil & Gas High Performance Computing Conference or OG-HPC Conference.

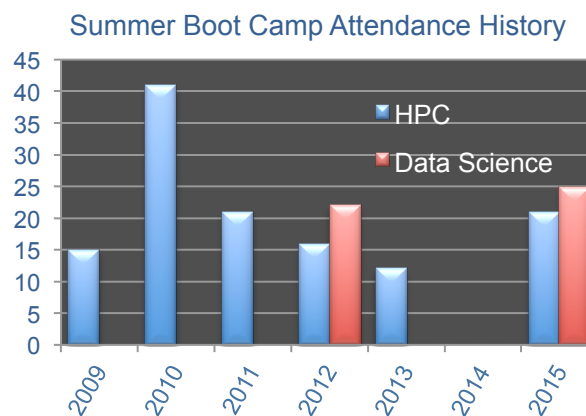
HPC Summer Institute

The 6th annual 2015 HPC Summer Institute hosted by the Ken Kennedy Institute for Information Technology addressed continued for training and education in the “art” of high-performance computing and scientific programming. While the main driver for the Summer Institute has been participation from the oil and gas industry, the curriculum is broadly applicable to any field engaged in scientific computing where there is a need to harness more of the computing power offered by modern servers and clusters. The HPC Summer Institute offers participants, with a wide array of backgrounds, opportunities to be trained in modern programming techniques and tools. After a break in 2014, we resumed in 2015 with twenty-one participants. The participants brought a large representation from the energy industry from companies such as ExxonMobil, Schlumberger and Chevron. The Ken Kennedy Institute heavily subsidized participation from Rice.

To avoid confusion on campus with regards to use of the term “institutes” we will rebrand the program and in 2016 it will be known as the *Ken Kennedy Institute HPC Boot Camp*.

Data Science Summer Institute

In 2015 the Institute also resurrected the Data Science Summer Institute after a two-year hiatus and regrouping. This was the 2nd time we hosted the data science training (originally titled Big-Data Summer Institute). It was offered as a four-day training program with leading Rice Data Science faculty in charge of instruction. The program was designed to attract attendees that needed the skills required to start leveraging the latest data analytics methods and tools with



their data. Twenty-five participants completed the program in 2015. The participants were largely from the Texas Medical Center including Baylor, MD Anderson and The University of Texas Health Sciences Center in Houston. Several Rice students and staff members also completed the course. The Ken Kennedy Institute heavily subsidized participation from TMC and Rice.

Given the success of the training we are planning to offer it again in 2016. As with the HPC training we will also rebrand the data science training. In 2016 it will be known as the *Ken Kennedy Institute Data Science Boot Camp*.

International Data Corporation Consultants

In October '14 consultants from International Data Corporation (IDC) completed an analysis and benchmarking study for Rice University, "Best Practices in Securing Funding for University-based HPC Centers." This IDC study was initiated by the Ken Kennedy Institute, in partnership with IT to help develop a long-term sustainable business and operational model for Rice's shared research computing infrastructure. The Ken Kennedy Institute and the Office of the Vice President for Finance jointly funded the study.

This engagement was undertaken in response to the IT Task Force findings on research computing that specifically requested that we:

- (1) develop a five-year strategy and funding plan,
- (2) initiate a total-cost-of-ownership study, and
- (3) develop a business model and support for utilizing cloud-based infrastructure.

The results of the IDC study reaffirmed the importance of investing in Rice's high-performance computing resources to support the growing need for computationally intensive research and provided valuable information on the importance of developing a scalable and sustainable plan, and gave us indicators on broader market trends and peer institutions. Key findings from the study indicated that:

- Rice should begin to fully leverage its reputation in HPC by elevating its baseline funding for HPC resources to a level that is consistent with its reputation.
- Rice should increase its investment in high-performance computing resources by at least 50% more than the 7.4% market Compound Annual Growth Rate for the next 5 years.
- Rice is generally viewed by the global computational science community as a tier 1 HPC site, thanks in part to the pioneering work of the Ken Kennedy Institute and Rice's strong ties to the increasingly important oil and gas sector.
- Rice should acknowledge the growing importance of computational research in all areas, including humanities and social sciences.

Based on these findings, the Ken Kennedy Institute plans to increase awareness of the University's stature as a tier 1 HPC site to help the University attract additional high-quality computational researchers and to further enhance the visibility of Rice's researchers amongst federal funding agencies and its industrial collaborations – these entities will have a direct impact on the future of our HPC data centers. The findings in the study was also a

key consideration in forming the much tighter relationship with OIT through the appointment of Jan Odegard as the Associate Vice President of Research Computing. As a result of the partnership we have already made progress towards “goals” suggested by the IDC study and we are continuing to work towards a scalable and sustainable research cyberinfrastructure.

Student support

Graduate Fellowships (\$102,500 Awarded)

We awarded fourteen supplemental graduate fellowships during FY15 to students across Computer Science (CS), Computational & Applied Mathematics (CAAM), Earth Science (ESCI), Electrical & Computer Engineering (ECE) and Mechanical Engineering & Material Science.

These fellowships are made possible by the sponsorship from the energy industry (BP, ExxonMobil, Shell, and Schlumberger) as well as from income from the Rice Oil & Gas HPC Workshop, the Ken Kennedy-Cray fellowship endowment and the Andrew Ladd Memorial Excellence Fund.

Ken Kennedy Institute Computational Science & Engineering Fellowships

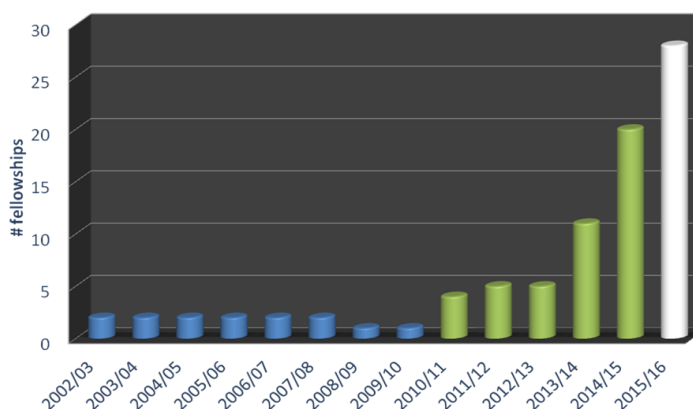
This year we continued to expand our Supplemental Fellowship program by offering up to ten (10) \$7,500 four-year “supplemental fellowships” to CS, CAAM, ECE, and ESCI, in recruiting very well qualified graduate student applicants. The fellowships also require a department match of an equal amount therefore the total award is \$15,000 over four years. Of these ten offers a total of seven students accepted admission and will be graduate students at Rice this fall. This money (a total of \$105,000) was added on top of the regular departmental stipend as a recruiting incentive. These fellowships were made possible by the Rice OG-HPC Workshop. Based on the past success we have had, this program will be continued moving forward. We will be working closely with departments to ensure this program is being leveraged to effectively promote our programs.

Research Cyberinfrastructure

Big-Data Private-Cloud Research Infrastructure

Direct government funding and research grants continues to be our largest funding source for HPC resources, and we estimate that over 50% of Rice’s annual research expenditures significantly benefit from infrastructure awards by agencies such as the NSF, NIH and DOE. Infrastructure awards as a result of the Ken Kennedy Institute leadership and coordination since 2002 have been a critical enabler to Rice’s

Graduate Fellowships



research growth and have also helped it gain recognition as a tier 1 HPC site. The Ken Kennedy Institute for Information Technology, in collaboration with the Vice President and CIO at Rice University, is working with faculty to expand Rice's shared research cyberinfrastructure. The current project, "Big-Data Private-Cloud (BDPC) Research Cyberinfrastructure," is made possible by funding in the amount of \$400,000 from the Major Research Instrumentation program from the National Science Foundation and by funding from Rice University.

Chevron Visualization Lab – Dell Butcher Hall, Room 110

The NSF-funded DAVinCI visualization wall at Rice's Chevron Visualization Laboratory (the "Viz Lab") enables researchers to interact with data in more effective ways and to probe details and develop understanding in ways that were not possible until now. The 200-inch wall (measured diagonally) lets users display and analyze images of all types, from atoms to galaxies, to archeological structures and sites, to urban developments and planning. This "studio" is not only able to help researchers across science and engineering, but can be a

Chevron Visualization Laboratory



valuable resource for art, architecture, anthropology, sociology and other fields. On average the space is booked 10-15 hours per week with recurring events and frequented by others as needed to support visualization needs. The lab services extend past the physical facility and we help support and develop in-situ data visualization workflows.

In addition to regular office hours Erik Engquist, Director, Center for Research Computing oversees the Chevron

Visualization Lab, organizing monthly tutorials for students, researchers and faculty. Visitors, including VIPs, prospective graduate students and prospective faculty members, are regularly given tours and demonstrations.

Research Computing Service Center Operation

K2I continues to assume the responsibility of administering, managing and charging for access to Rice's shared computing infrastructure. During FY15 this included operating of the Shared Computing Service Center and the BlueGene/P Service Center. Earlier this fall, we successfully deployed the Billing Application Service Center Software (BASCS) that to large degree help automate large portions of the billing process and includes web pages for department staff or PIs to manage assignment for funds for different PIs and users. In an effort to ensure a seamless transition to the new BASCS system, the Institute administered BASCS training to all department administrators who have faculty using the shared computing infrastructure. The feedback we received on the training and the value of BASCS is all positive and while there is room for further improvement to the web app the current

version has had a profound impact not only on our time required to support the service center but the time required by departments to reallocate charges (in the new system there is NO need for reallocation).

K2I Sponsored and Co-Sponsored Public Lectures

2014-2015 K2I Distinguished Lectures

- **Katy Börner**, Victor H. Yngve Professor of Information Science at the Department of Information and Library Science at the School of Informatics and Computing, Adjunct Professor at the Department of Statistics in the College of Arts and Sciences, Core Faculty of Cognitive Science, Research Affiliate of the Biocomplexity Institute, Founding Director of the Cyberinfrastructure for Network Science Center at Indiana University in Bloomington, IN and Visiting Professor at the Royal Netherlands Academy of Arts and Sciences (KNAW) in The Netherlands, "Envisioning Communication and Collaboration"(11.11.14)

Dr. Michael Franklin, Professor of Computer Science at UC Berkeley, Director of the Algorithms, Machines and People Lab (AMPLab), Thomas M. Siebel Chair in Computer Science at UC Berkeley, "Making Sense of Big Data with the Berkeley Data Analytics Stack" and "Big Data and Data Science: Some Hype but Real Opportunities" (03.25.15)

John Treichler, Co-founder of Applied Signal Technology in 1984, AST business unit's Chief Technical Officer, IEEE Fellow and Distinguished Visiting Professor at Rice, "Keeping Other Countries Honest: Using Signal Interception to Collect Foreign Intelligence"(03.31.15)

- **Partha Ranganathan**, Principal Engineer, former HP Fellow and Chief Technologist at Hewlett Packard Labs where he led their work on next-generation systems, "End of Moore's law or A Computer Architect's Mid-life Crisis?" (04.14.15)

K2I Member Luncheons (average attendance: 50)

Fall 2014

- **Jan Odegard**, Executive Director, Rice Ken Kennedy Institute, Associate Vice President, Office of Information Technology & XD, Rice University, "'Moore's Law is Dying, What Now?'" (09.05.14)
- **Chuck McConnell**, Executive Director of the Energy and Environment Initiative, Rice University, "Energy and Environment Initiative – FY2015 Goals & Strategy" (10.10.14)
- **Yousif Shamoo**, Vice Provost for Research, Professor of Biosciences, Wiess Career Development Chair, Director, Institute of Biosciences & Bioengineering, "How can we build better and more sustainable research infrastructure at Rice?" (11.07.14)
- **Erez Lieberman-Aiden**, Assistant Professor, Department of Genetics, Center for Genome Architecture, Baylor College of Medicine, "How Genes Fold" (12.05.14)

Spring 2015

- **John Treichler**, Co-founder of Applied Signal Technology in 1984, AST business unit's Chief Technical Officer, IEEE Fellow and Distinguished Visiting Professor at Rice, "The Historical Impact of DSP and Adaptive Filtering on National Defense" (02.06.15)
- **Caroline Levander**, Vice President for Strategic Initiatives and Digital Education, Carlson Professor in the Humanities, Professor in English, "Digital Education at Rice" (03.13.15)
- **Klara Jelinkova**, Vice President for Information Technology and Chief Information Officer, Rice University, "Office of Information: Organization, Culture, Innovation, and Scale" (04.10.15)
- **Jose Onuchic**, Harry C. and Olga K. Wiess Chair of Physics; professor of chemistry; professor of biosciences, "From structure to function in proteins: the convergence of structure based models and co-evolutionary information" (05.01.15)

Miscellaneous

Master of Computational Science and Engineering Degree Program

K2I assisted with the application review and Rice offered admission to 13 of the 32 students that applied to the Master of Science in Computational Engineering (MCSE) Professional Masters Program, a joint program between Computer Science, Computational and Applied Mathematics and Statistics. Of the 13 admission offers made, two students enrolled in the program.

Institute Sponsorship

- Provided \$1,000 in prize money for the 2015 Rice Undergraduate Research Symposium (RURS) and recruited a panel of five industry judges to evaluate and determine the K2I winners.
- Supported Computer Science students attending the Grace Hopper Conference with \$3,000.
- Assisted with the coordination of the September 2014 Mathwork MatLab Seminar.

Other Activities Supported by Institute

- 2014 Medicine, Energy, Space and Technology Conference (MEST Conference) <http://www.mestconference.com>
- Electronic Health Research Institute (eHRI) initiative (exploration between researchers at MD Anderson, BCM Center for Space Medicine, & Ken Kennedy Institute, Rice University).