Cyberinfrastructure as a strategic university asset
- For Hessian HPC Competence Center Leaders

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Associate Dean, Research Technologies
Indiana University

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First a language issue

Cyberinfrastructure (primarily an US term): Cyberinfrastructure consists of computing systems, data storage systems, advanced instruments and data repositories, visualization environments, and people, all linked together by software and high performance networks to improve research productivity and enable breakthroughs not otherwise possible. (Stewart, 2007)

eScience (primarily an EU term): “In the future, e-Science will refer to the large scale science that will increasingly be carried out through distributed global collaborations enabled by the Internet. Typically, a feature of such collaborative scientific enterprises is that they will require access to very large data collections, very large scale computing resources and high performance visualization back to the individual user scientists.” (National e-Science Centre, 2010)

Probably cyberinfrastructure = eScience + support staff
Agenda

- Background about myself and about IU
- User service and e-learning
- Software for business functions: Kuali
- Networking
- Research
- Assessment and Governance
- Some lessons learned and thoughts about the future
### Key Events in my Professional History

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>Graduated with BA in biology and mathematics from Wittenberg University (Springfield, OH). Started as graduate student at Indiana University in biology.</td>
</tr>
<tr>
<td>1982</td>
<td><strong>Met Marion Krefeldt (in Bremen geboren)</strong></td>
</tr>
<tr>
<td>1984</td>
<td>Switched from being teaching assistant in biology to assistant consultant with Bloomington Academic Computing Services, starting with Lotus 1-2-3 Key Disks.</td>
</tr>
<tr>
<td>1985</td>
<td>Full-time appointment at BACS Information Center (Service Desk).</td>
</tr>
<tr>
<td>1986</td>
<td>Manager, Business Computing Facilities (IU School of Business), finished Ph.D. in Biology</td>
</tr>
<tr>
<td>1991</td>
<td>Manager, Center for Statistical and Mathematical Computing (UCS).</td>
</tr>
<tr>
<td>1995</td>
<td>Manager, University Computing Services Support Center.</td>
</tr>
<tr>
<td>1996-7</td>
<td>Senior Manager, Assistant Director, Acting Director, Director research and academic computing</td>
</tr>
<tr>
<td>1997</td>
<td>Michael McRobbie arrived at IU from the supercomputing center at ANU to become IU’s first full VP for IT and CIO and reorganized IT organization into University Information Technology Services.</td>
</tr>
<tr>
<td>1997</td>
<td><strong>US Dept. of Commerce imposes a 4X tariff on purchase of Japanese supercomputers within the US</strong></td>
</tr>
<tr>
<td>2005</td>
<td>April Fool’s Day: Promoted to Associate Vice President for Research and Academic Computing and COO of Pervasive Technology Labs</td>
</tr>
<tr>
<td>2008</td>
<td>Associate Dean for Research Technologies, Executive Director of Pervasive Technology Institute.</td>
</tr>
</tbody>
</table>

**Key point:** *I have been around a long time – from when IU was unimportant in IT to when IU was sued by Metallica to having the #23 system on the Top500 list. Long enough to see technological and cultural change happen at IU, lead some of it, and learn from all of it.*
IU – Founded in 1820

<table>
<thead>
<tr>
<th>Campus</th>
<th>Academic appointees</th>
<th>Nonacademic Staff</th>
<th>Undergrad Students</th>
<th>Grad. &amp; Prof. Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUB</td>
<td>2,942</td>
<td>5,379</td>
<td>32,371</td>
<td>9,762</td>
</tr>
<tr>
<td>IUPUI</td>
<td>3,895</td>
<td>4,449</td>
<td>22,271</td>
<td>8,180</td>
</tr>
<tr>
<td>IU Northwest</td>
<td>425</td>
<td>243</td>
<td>5,636</td>
<td>548</td>
</tr>
<tr>
<td>IU South Bend</td>
<td>542</td>
<td>305</td>
<td>7,860</td>
<td>630</td>
</tr>
<tr>
<td>IU East</td>
<td>267</td>
<td>159</td>
<td>4,052</td>
<td>134</td>
</tr>
<tr>
<td>IP Fort Wayne</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>IU Kokomo</td>
<td>191</td>
<td>138</td>
<td>3,581</td>
<td>138</td>
</tr>
<tr>
<td>IU Southeast</td>
<td>498</td>
<td>243</td>
<td>6,203</td>
<td>701</td>
</tr>
<tr>
<td>Totals</td>
<td>8,760</td>
<td>10,916</td>
<td>81,974</td>
<td>20,093</td>
</tr>
</tbody>
</table>

1,200 degree programs

IU community: 121,743 people total
1.2 million credit hours per semester

Two core research/education campuses, six regional campuses

Tuition and mandatory fees per year: $10,209 FY 13/14 for IUB Undergrads
Key IU metrics

<table>
<thead>
<tr>
<th>IU Budget Category</th>
<th>2012/2013 Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrestricted</td>
<td>$2,155,174,476</td>
</tr>
<tr>
<td>Restricted</td>
<td>$640,532,854</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>$403,026,761</td>
</tr>
<tr>
<td>Total</td>
<td>$3,198,734,091</td>
</tr>
</tbody>
</table>

IU Health Patient Metrics – 2012/2013

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admissions</td>
<td>143,219</td>
</tr>
<tr>
<td>Outpatient visits</td>
<td>2,244,320</td>
</tr>
<tr>
<td>Staffed Beds</td>
<td>3,326</td>
</tr>
</tbody>
</table>

- No engineering
- No agricultural research
- No Veterinary school
# IU Bloomington Annual Budget (~ 40,000 people)

<table>
<thead>
<tr>
<th>OPERATING INCOME</th>
<th>%</th>
<th>$US</th>
<th>EXPENSES</th>
<th>%</th>
<th>$US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition (35.5%)</td>
<td>36%</td>
<td>$304,836,512</td>
<td>Compensation &amp; benefits</td>
<td>65%</td>
<td>$712,789,200</td>
</tr>
<tr>
<td>Grants and contracts</td>
<td>16%</td>
<td>$136,532,410</td>
<td>Student financial aid</td>
<td>6%</td>
<td>$63,696,000</td>
</tr>
<tr>
<td>Other operating revenue</td>
<td>10%</td>
<td>$82,434,662</td>
<td>Energy and utilities</td>
<td>3%</td>
<td>$28,201,600</td>
</tr>
<tr>
<td>Auxiliary Enterprises</td>
<td>12%</td>
<td>$103,043,328</td>
<td>Travel</td>
<td>2%</td>
<td>$18,898,000</td>
</tr>
<tr>
<td>State Appropriations</td>
<td>17%</td>
<td>$148,554,131</td>
<td>Supplies, general expense</td>
<td>19%</td>
<td>$208,725,200</td>
</tr>
<tr>
<td>Investment Income</td>
<td>2%</td>
<td>$13,739,110</td>
<td>Depreciation/amortization</td>
<td>5%</td>
<td>$56,306,400</td>
</tr>
<tr>
<td>Gifts</td>
<td>3%</td>
<td>$29,195,610</td>
<td>TOTAL</td>
<td></td>
<td>$1,088,616,400</td>
</tr>
<tr>
<td>Other nonoperating</td>
<td>5%</td>
<td>$40,358,637</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>$858,694,400</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FY 12-13 IU FOUNDATION**

<table>
<thead>
<tr>
<th>Contributions</th>
<th>$50,783,283</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment Income</td>
<td>$63,964,288</td>
</tr>
<tr>
<td><strong>IU FOUNDATION TOTAL</strong></td>
<td><strong>$114,747,571</strong></td>
</tr>
</tbody>
</table>

**FY 12-13 FINANCING**

| Debt payments                     | $387,693,200 |
Office of the Vice President for Information Technology and Chief Information Officer

CIO for the entire university

“The Indiana University Office of the Vice President for Information Technology and Chief Information Officer provides leadership for the continued development of a modern information technology environment throughout the university. The primary responsibility of this office is the development and use of information technology in support of the university's vision for excellence in research, teaching, outreach, and lifelong learning. University Information Technology Services reports to the Office of the Vice President for Information Technology.”

NB: The text in bold is our strategy; everything else is tactic
## Office of the VP for Information Technology

### Staffing and Budget

<table>
<thead>
<tr>
<th>Category</th>
<th>FTEs</th>
<th>Distinct Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Student Academic</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Appointed Professional Staff</td>
<td>967</td>
<td>977</td>
</tr>
<tr>
<td>Hourly Staff</td>
<td>126</td>
<td>505</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,106</strong></td>
<td><strong>1,501</strong></td>
</tr>
</tbody>
</table>

### Budget

~$120 M US / year

Of this, roughly $13 M US / year is from grants and contracts, primarily federal research grants and contracts.
Office of the VP for Information Technology and CIO

Bradley C. Wheeler
Vice President, Chief Information Officer and Dean

Laurie G. Antolovic
Deputy Chief Information Officer and Finance Officer

RESEARCH TECHNOLOGIES
Craig A. Stewart
Associate Dean

LEARNING TECHNOLOGIES
Anastasia S. Morone
Associate Vice President and Dean of IT

CLIENT SERVICES
and SUPPORT
Sue B. Worlman
Associate Vice President

ENTERPRISE SOFTWARE
Rob J. Lowden
Associate Vice President

NETWORKS
David E. Jent
Associate Vice President

ENTERPRISE INFRASTRUCTURE
Dennis J. Cromwell
Associate Vice President

Council of Enterprise Architects
Laurie Antolovic, Chair
Tom Davis, Chief Security Architect
Mike Floyd, Chief System and Storage Architect
Jon Paul Herron, Chief Network Architect (Interim)
Brian McGough, Chief Software Architect
Kurt Seifert, Chief Storage Architect
George Turner, Chief Systems Architect
vacant, process vacant, data

President
Indiana University

Nasser Paydar
Executive Vice Chancellor and Dean of Faculties

D. Craig Brater
School of Medicine Dean

Brenda Johnson
University Libraries Dean

Pervasive Technology Institute (PTI)

David Lewis
Assistant Vice President
Dean, IUPUI University Library

Vincent J. Sheehan
School of Medicine CIO

Robert McDonald
Associate Dean

PUBLIC SAFETY and INSTITUTIONAL ASSURANCE
Mark S. Bruhn
Associate Vice President

Thomas R. Davis
Chief Security Officer

Kim Milford
University Information Policy Officer

Research and Education Networking Information Sharing and Analysis Center (REN-ISAC)

Center for Applied Cybersecurity Research (CACR)

Elizabeth Van Gordon
Chief Information Officer
IUK, IUN, and IUSB

Tom Sawyer
Chief Information Officer
IUE, IUPUC, and IUS

Deb Allmayer
Human Resources Officer

Gustav Meglicki
Technology Advisor

Executive Office Support
IU goals

• To be a leader, “in absolute terms for uses and applications of IT” (Myles Brand, 16th President of IU, 1996)
  - In 1996 IT services at IU were so bad people laughed at this goal
  - Modems were always busy
  - Research computing was inadequate
  - Services were not well organized

• Two IU IT Strategic Plans
  - 1998 plan – get technology right
  - 2005 plan – serve needs of IU community specific to different roles

• To be one of the great public universities of the 21st Century (Michael A. McRobbie, 18th President of IU, 2005)
A University IT strategic plan – *not a strategic plan for the university IT organization*

10 Recommendations, 68 Actions

Theme: Get the technology stacks right (We did not have them right in 1997.)

Financing
Network access “*In the language of today's technology, “No busy signals!”*”
Incentivize use of IT
Teaching and learning IT
Research

Student systems
Telecomm convergence
Learning IT
Digital libraries
Policies
2008- 2\textsuperscript{nd} IU IT Strategic Plan, Empowering People

The hard part: role-centric view: 15 Recommendations, 72 Actions.

http://ep.iu.edu

<table>
<thead>
<tr>
<th>IT Foundations</th>
<th>Human-centric IT</th>
<th>Grand Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Infrastructure</td>
<td>8. IT Development</td>
<td>12. Scholarly Record</td>
</tr>
<tr>
<td>5. Security</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. IT Staff</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A few non-research service examples
Starting in 1995, users were trained to consult the knowledge base first: “Do you have a web browser? Great. Go to http://kb.iu.edu. Got it? Great. Search on <whatever>. See the question Entitled <something>? Great. Read it, follow the directions, call us back if you have any more problems.
# UITS Support Center Contacts and Costs

<table>
<thead>
<tr>
<th>Support Center Contacts – FY 2011/2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td><strong>Human – to - Human</strong></td>
</tr>
<tr>
<td>Email</td>
</tr>
<tr>
<td>Chat</td>
</tr>
<tr>
<td>Walk-in</td>
</tr>
<tr>
<td>Telephone</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td><strong>Self-serve</strong></td>
</tr>
<tr>
<td>KB</td>
</tr>
</tbody>
</table>

*These costs are draft as of giving of this talk. These represent fully-loaded activity based costs for these services, representing all of the services such as financial management, administration, network management, server management that contribute to the overall service.*
Featured Software

Office 2013
Office Professional Plus 2013. Includes Access, Excel, OneNote, Outlook, PowerPoint, Publisher, and Word.

Windows 8
The latest version of Windows. Only $20 from the IU bookstore.

Acrobat XI
Edit PDFs far more intuitively. Build forms from scratch in minutes. And more.

Creative Suite 6
Adobe Creative Suite 6 delivers a whole new experience for digital media creation, enabling you to work lightning fast and reach audiences wherever they may be.

UITs Network Repair Tool
Helps troubleshoot and resolve network issues when connecting to IU network.

IU Wireless Wizard
Configure your computer to use the IU secure wireless network.

Most Popular Downloads
- Office 2013
- Creative Suite 6
- Symantec Endpoint Protection

Latest Releases
- 08/08/2013 - TurningPoint 5
- 08/08/2013 - ArcPad 10.2
- 08/08/2013 - ArcGIS Server 10.2
A New Personal Computing Model: Common Good Services

- Microsoft SCCM for managing the machines
- IUanyWARE – Citrix for application and desktop virtualization
- Support for smart devices
- New model of licensing
- Efficiency and effectiveness
- A new model for student labs
- Public and private cloud storage
- Efficient file/print serving
This is how students use computers today (not big rooms of old computers paid for by the university)
e-Texts Initiative

Physical textbooks are part of an economic game in which students are generally the losers.


Students “lease” access and the cost is included as a course fee, Students gain in ease of access, cost, ability to use the text integrated with eLearning system.

Publishers gain since it puts an end to students using the text without paying.

Faculty have more e-publishing options.

Opt in – Students gain in ease of access, cost, ability to use the text integrated with the eLearning system – ~10,000 students in 250 classes, spring 2013.

Analytics capability added through third-party software.
Networking – IU GlobalNOC and IU network connectivity

- Started as statewide networking organization in Indiana
- Supports 22 networks or landing points
- National networks (e.g., Internet2)
- International connections (TransPAC, new 100 Gbps link between the US and the EU)
Internet2 and InCommon

Internet2
• started as network organization
• Serves hundreds of universities in the US
• First production 100 Gbps network backbone in US
• Someday there will be no reason to have Internet2 run networks

InCommon
• Meets two needs:
  • Identity management
  • Creates reason for Internet2 to continue existing
• Based on legal certification of quality of local identity management
• Uses XSAML certificates and authentication management
• Supports collaboration
• E.g. Box
Box is designed as a flexible storage service and collaboration tool, but is not acceptable for any institutional data classified as "limited access/restricted" or "critical".

Please review the Enterprise Box acceptable use responsibilities for more information.
An Array of Viz Systems

The key issue here: perceived value, perceived ease of use
Changing the Way We Interact with Cyberinfrastructure – IU CI Gateway

- **Born-mobile Web interface will allow users to access IU cyberinfrastructure from anywhere.**
- Access to IU’s Big Red II, Quarry, and Mason computing queues
- File transfers from desktop to IU to national systems
- Information on resource availability, usage
- Accounts secured with CAS and InCommon authentication
We’ve supported some REALLY interesting and important research and creative activity along the way.

Higgs boson
One-Degree Imager
Operation Ice Bridge
*Daphnia* genome
Fetal alcohol spectrum disorder
Indiana CTSI
Cell-surface function
History of philosophy and science
Variations
Ethnography
Music composition
Fine arts
Performing arts
Trinity, developed at the Broad Institute and the Hebrew University of Jerusalem, represents a novel method for the efficient and robust de novo reconstruction of transcriptomes from RNA-seq data. Trinity combines three independent software modules: Inchworm, Chrysalis, and Butterfly, applied sequentially to process large volumes of RNA-seq reads. Trinity partitions the sequence data into many individual de Bruijn graphs, each representing the transcriptional complexity at a given gene or locus, and then processes each graph independently to extract full-length splicing isoforms and to tease apart transcripts derived from paralogous genes. Briefly, the process works like so:

- **Inchworm** assembles the RNA-seq data into the unique sequences of transcripts, often generating full-length transcripts for a dominant isoform, but then reports just the unique portions of alternatively spliced transcripts.

- **Chrysalis** clusters the Inchworm contigs into clusters and constructs complete de Bruijn graphs for each cluster. Each cluster represents the full transcriptional complexity for a given gene (or sets of genes that share sequences in common). Chrysalis then partitions the full read set among these disjoint graphs.

- **Butterfly** then processes the individual graphs in parallel, tracing the paths that reads and pairs of reads take within the graph, ultimately reporting full-length transcripts for alternatively spliced isoforms, and teasing apart transcripts that corresponds to paralogous genes.

From: [http://trinityrnaseq.sourceforge.net](http://trinityrnaseq.sourceforge.net) - no copyright terms stated
Aiding global environment and Indiana economy

- Working with Cummins exploring combustion of new biofuels
- How are soot particles created during and after combustion
- Collaborating with Convergent Sciences, maker of the popular Converge CFD application, and Lawrence Livermore National Lab
Collaboration and self promotion can be very useful, especially starting off
What is RT’s mission?

The mission of the Research Technologies division of UITS is to develop, deliver and support advanced technology solutions that improve the productivity of and enable new possibilities in research, scholarly endeavors, and creative activity at Indiana University and beyond; and to complement this with education and technology translation activities to improve the quality of life of people in Indiana, the nation, and the world.

We are a mission- and value-driven organization. We are not a technology-driven organization.

We identify needs, identify possibilities, and discover new ways to meet those needs, realize those possibilities, and create new ones. In so doing, we create, deploy, and support technology. We are a technology-driving organization.

Roughly 40% of personnel are funded by external agencies
Pervasive Technology Institute

Research tools and technology
Requirements to PTI research centers

Service and support
Requirements to PTI service centers

US and international research communities

Research
IT services

PTI Service Centers
IT support
Product development and delivery

Basic knowledge and new technologies

PTI Research Centers
Basic research and technology development

IU research leadership priorities

US science and technology priorities and funding

Based on original graphic by Beth Plale and D.F. “Rick” McMullen
Growth of CI support and research staff over time in PTI
How the University Sees IT at IU

Formal survey, done with human-subjects approval, executed by independent office

All results since 1991, and every comment since 1992 (except obscenities and names) are available on the Web (http://www.indiana.edu/~uitssur/)

Leads to fact-based discussions
• “I think this service is terrible” …. And survey agrees => service change
• “I think this service is terrible” …. And survey results are different => why?

Current overall satisfaction with IT organization services (2013 Survey)

<table>
<thead>
<tr>
<th>Area</th>
<th>Ave Score (Likert)</th>
<th>% Satisfaction (≥3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching (faculty)</td>
<td>4.03</td>
<td>93.2</td>
</tr>
<tr>
<td>Research (faculty, staff, grad)</td>
<td>4.06</td>
<td>96.0</td>
</tr>
<tr>
<td>Learning (students)</td>
<td>4.15</td>
<td>97.4</td>
</tr>
<tr>
<td>Overall</td>
<td>4.11</td>
<td>97.1</td>
</tr>
</tbody>
</table>
Governance & Organization

Good operational principles
• Make decisions at lowest level of hierarchy possible
• Depend upon organizational structure for execution
• Do NOT depend upon organizational structure for information, discussion, flow of ideas

Formal Governance Model
• Weill & Ross - IT Governance: How Top Performers Manage IT Decision Rights for Superior Results
• Decision rights, input rights, and right to execute

OVPIT/UITs is one organization across the whole university
• All “IT Organization” staff on all campuses now report to CIO and are on University Account financial chart
• @iu.edu email addresses

Contentions:
• Work flows to demonstrated competence
• Over a long time, you can make significant changes in organizational roles, accomplishments, national standing, and the world’s collective body of scholarly and artistic works
• Having ‘the basics’ right is essential to having good community support for research HPC
Value creation & destruction, guiding structures

What we experience in our private lives is the result of an ongoing process of value creation, stock speculation, and value destruction

• Once important, now quaint: MySpace, Lycos, Alta Vista, Reinhard Mey
• Currently hot, soon to be quaint: FaceBook, Twitter, ColdPlay

How do you manage mission and service orientation in an organization?
• We for many years focused on:
  • User Satisfaction
  • Activity Based Costing
  • Leadership training (via one approach)
• We are now adding focus on
  • Architecture-based methods
  • ITIL

How do we manage service destruction and creation?
• Budget reductions – 5% per year (most years) cut from each budget
• Formal proposal process for creating new services from $ pool
Mistakes we made, things we learned (1)

**Mistakes we should try not to repeat**

- Some times: too much tactic, not enough strategy (especially at times we were ahead of our faculty)
- Not saying goodbye quickly enough to staff who did not adhere to our goals & principles *(NB: US employment laws are different than German laws)*
- Sometimes promising too much first, figuring out how to deliver later (=> too much stress). You have to promise somewhat more than you know how to deliver or you simply won’t be at the front edge of technology. The key is ‘how much depends upon miracles’?

**Things that went wrong that we will repeat as necessary**

- Pursuing a strategy and having that strategy collapse for external reasons
- But we try to get good data from the industry and community to improve our guesses
Mistakes we made, things we learned (2)

Things the literature tells us
• Technology adoption choices are based on perceived value and perceived ease of use

Things we learned
• *First and second derivatives matter much more than current location*
• *Collaborations are important especially early on*
• Support and promote the staff who support the mission strongly
• Embrace (the good part of) your history, believe in and build organizational capacity.
• Build on your unique capabilities to differentiate your organization
• Your opportunity to distinguish your organization depends upon supporting current & future distinguished researchers  Work and responsibility flow to demonstrated competence
• Cloud computing is just a technology trend, and all we need to do is figure out how to deliver and support cloud services effectively
What technologies are strategic for the future?

Is email in general a commodity or a differentiator? Probably commodity

Is it hard to sell part but not all of your soul to Microsoft? Hard but possible

Is file storage strategic? Sometimes, not always

eLearning and business systems? Definitely, at least for now

Cloud computing? Sometimes

High-performance computing? If you can manage to be different

Curation and archiving of artistic, scholarly, and research output (including source data): Definitely

Big data – hype or important? Currently mostly hype, but it will be important
Contentions

• In the coming several years, universities are likely to sort themselves into categories of those that treat IT as a commodity and those that treat IT as a strategic asset.

• There are critical areas of research and development that require advanced IT, eScience, or cyberinfrastructure, and universities that wish to lead in these areas must invest in IT as a strategic asset.

• Leading in research IT is possible only if everything else is also working well

My conclusions:

• IU’s IT organization has shown that it can deliver a wide variety of excellent services, and in the process change science, scholarship in the humanities, artistic expression, and at least affect the world a little bit.

• Collaboration is important to success – and can make up for a lot of money

• If we can do it, so can you
Examples of rolling rocks up hills:

- Physics
- Global climate change

Sisyphus (1548-1549) by Titian, Prado Museum, Madrid, Spain
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Thanks!

- This talk represents the results of decades of work by thousands of staff of OVPIT, the groups that report to OVPIT and the predecessors of those groups, and the investment of hundreds of millions of dollars of taxpayer money from residents of Indiana and the US overall. All of these people deserve thanks.

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- Thank you for your attention

I never mistake the leader for the team
Questions and discussion?