

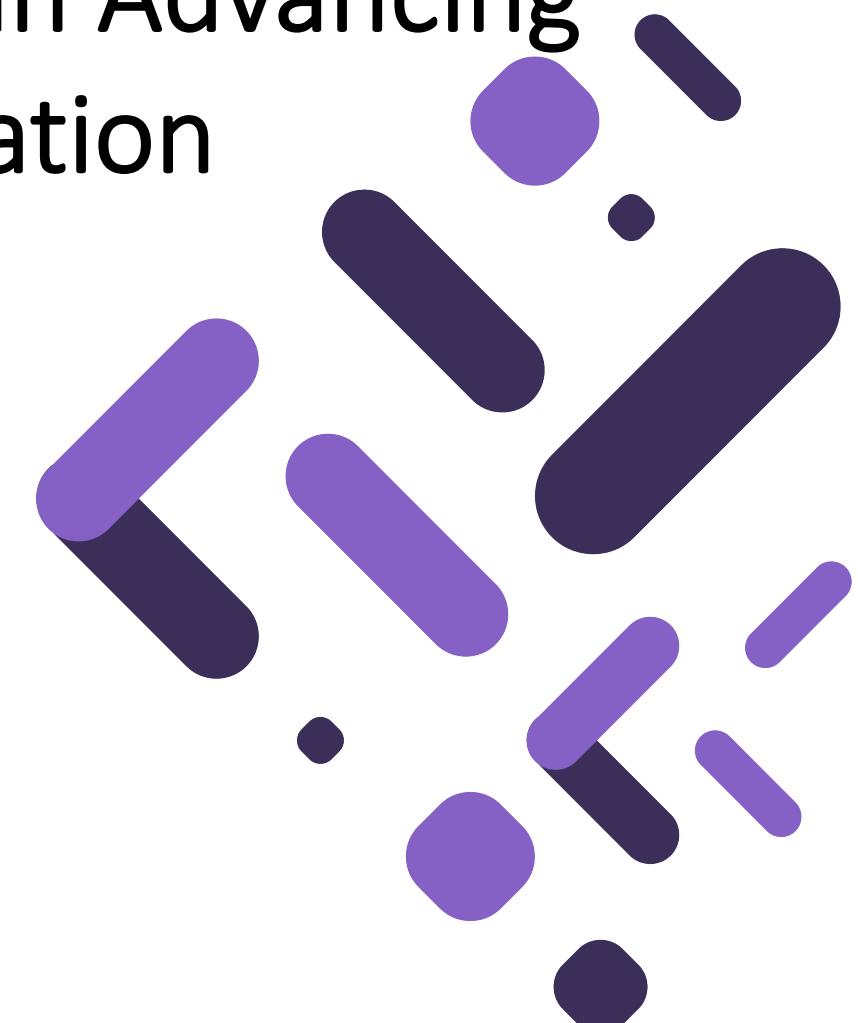
# The Critical Importance of Information Technology in Advancing Research in Higher Education



*Brian D. Voss*

*Pervasive Technology Institute  
Indiana University*

## Technological Frontiers Leadership Forum

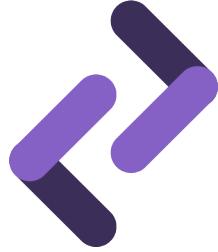




# La Importancia Crítica de la Tecnología de la Información en el Avance de la Investigación en la Educación Superior



# Who am I and what's my bona fides?



- I am not a researcher – *but I've been involved in IT in research universities environments and national initiatives for more than 35 years*
  - Central IT roles in leadership, CIO/Institution Executive
  - Board/Advisory positions in several key cyber areas
  - EDUCAUSE Presidential Fellow
  - Independent Consultant – campus IT reviews, community engagement facilitator, op-ed writer on the state of IT/CIO Profession ([bdvooss.com](http://bdvooss.com))
- Respected voice in the higher education CIO community
- Awarded over \$13-million in grant funding to build IT infrastructure and support service
- I am like 'Forrest Gump' ... I've been in key places when transformative change has impacted IT in higher education



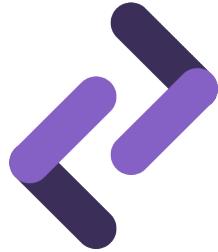
# What I'm going to talk about today



- ◆ **The Critical role of (Information) Technology in Higher Education – A general discussion**
- ◆ **The Role of IT in Advancing Research (Today and Coming)**
- ◆ **Focus on the Importance of PEOPLE in Supporting Research Using Technology (cyberinfrastructure)**
- ◆ **Details on an Initiative at Indiana University – Humans Advancing Research in the Cloud**



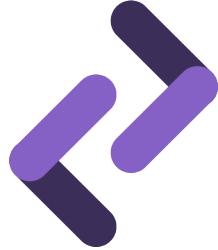
# The Critical role of (Information) Technology in Higher Education



- IT is pervasive in EVERYTHING in support of the missions of Universities in the 21<sup>st</sup> Century
  - Enterprise Functions
  - Teaching and Learning
  - Student Recruitment & Retention
  - Student Life
  - Community Engagement & Fund Raising
  - Research, Innovation and Economic Development



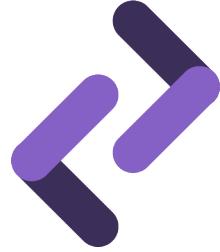
# It's a dangerous world



- Protecting the Integrity of our Information and Environment (physical and virtual)
  - Threats – breaches, intrusions, phishing and other scams
  - Institutional Reputation at stake
  - Protecting information – our community members and more
  - Attacks are inevitable – Protection is important but so is responding
- Enterprise Risk Management Strategies Needed



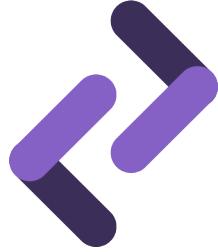
# Broad and Diverse Investments Required



- Basic Infrastructure
  - Networking, WiFi, etc.
- Information Systems
  - Supporting enterprise operations and all aspects of mission support
- Advanced Infrastructure
  - Supporting Research



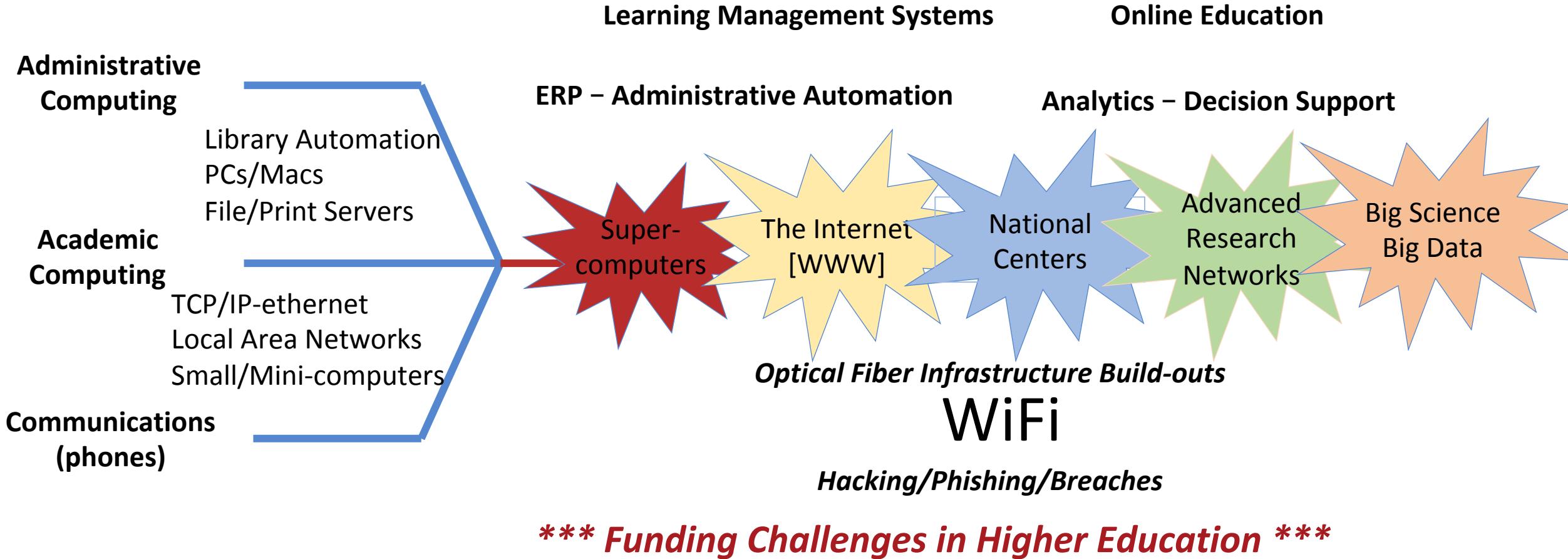
# A Critical Item for Executive/Board Engagement



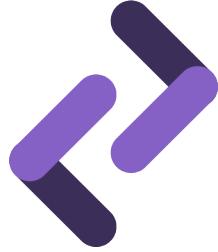
- Where does the IT/CIO Report?
  - Do you have the “right” CIO?
- How aware/engaged are campus executives (Presidents, Provosts, CBOs, CROs, and Boards) in IT strategies and policies?
- How is IT funded? ‘Strategy vs. Plumbing’
- How engaged is IT in Research/Innovation?



# Key events in the evolution of IT in higher ed



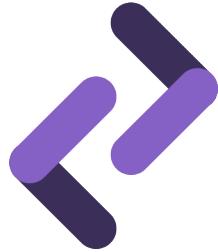
# The Role of IT in Advancing Research - Today



- **Providing Infrastructure – Cyberinfrastructure**
  - MAXIMIZED Computational platforms (HPC)
  - Networks – robust campus and border connections
  - Software – common (and uncommon!) products
  - Visualization and other rendering tools/resources
  - Compliance and Security
- **Facilitating Collaboration – on campus and broadly**
- **Grant Support – PI or co-PI**
- **Strategic Partner (within campus leadership)**
- **PEOPLE**



# Challenges to the Status Quo



- **Funding – *No Buck\$ No Buck Rogers***
  - Reduction/ending of grant funding (NSF, NIH, etc.) for infrastructure
  - Continued challenges to institutional funding/revenue
- **Emphasis on teaching/learning (*de-emphasis on research/discover*)**
  - Degrees that lead to jobs
- **Sustainability of campus HPC infrastructure (the ‘arms-race’)**
  - Growing viability of Cloud for Research
    - But ... Cloud providers still don’t “get research”
- **Continued lack of grasp/understanding/appreciation for IT by university leadership (presidents, provosts, CBOs, Boards)**
  - Inability to communicate ‘ROI’ of Cyberinfrastructure to Research



# The Role of IT in Advancing Research - Coming



- **Providing Infrastructure – Cyberinfrastructure**

- **MINIMAL Computational platforms (HPC) for local test & development**

- Networks – robust campus and border connections
  - *Software – common (and uncommon!) products*
  - Visualization and other rendering tools/resources
  - Compliance and Security

- **Facilitating a move to the Cloud**

- Shift away from dependence on campus/institutional infrastructure
    - **Facilitating Collaboration – on campus and broadly**
    - **Grant Support – PI or co-PI**
    - **Strategic Partner (VPR and in Cabinet)**

- **People – the critical element of cyberinfrastructure often missed**



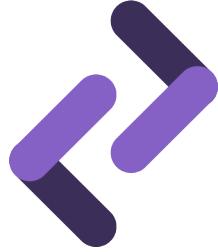


Let's delve deeper into that last component –  
**PEOPLE**

Or the Humans in the Loop



# Fundamental Premise of Users of Technology

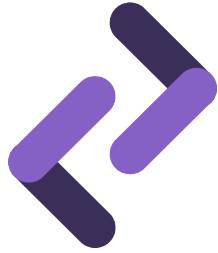


**HEY MAN ... I JUST RIDE 'EM. I DON'T KNOW WHAT MAKES 'EM GO.**



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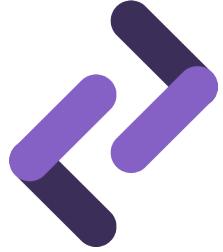
# Humans in the Loop



- In the beginning, computing and support was centralized
- Evolution of the technology of computing/IT drove change
  - Distributed ‘mini-computers’ in the late 70s and early 1980s
  - Personal computers in the late 80s and 90s
  - Advent/Advance of parallel/cluster computers in the 90s
- Role of central IT also played a part in the distribution of computing/IT
  - *(Not usually by design or in the best ways ...)*



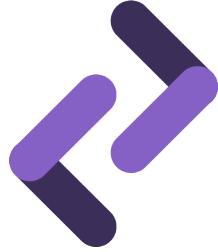
# The Rise of Local/Distributed Support



- Distributed systems still required support
- Best support is that which comes when you yell for it
- A model emerged – often organically (feral)
  - The role of the user (be generally knowledgeable)
  - The role of local support (technical, but part of the local culture)
  - The role of central IT
    - Give users training and tools (online knowledgebase, HelpDesk, etc.)
    - Support Local Support Providers (training, tier-2 tech, build community)
    - Provide deep support in some areas (e.g., cyberinfrastructure)



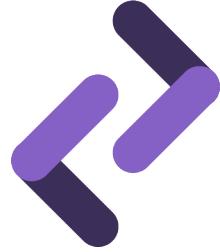
# Humans in the (Research/Cyberinfrastructure) Loop



- Research use of computing/CI has had its own history
  - Centralized ‘supercomputers’
  - National Centers
  - ‘Closet Clusters’
- People in roles supporting CI use in research vary
  - Central IT system and application-area experts
  - Grad students, Post Docs, local staff
  - Technically interested and astute faculty/researchers



# The Premise of the importance of Humans



- The most effective use of technology comes when those who use it are capable of fully understanding its use and application to their challenges
- OR ...*
- **Those who use it are supported by people who are capable of fully understanding its use and the application to the challenges faced in given disciplines**

*This latter situation is where humanware is relevant*



# Humanware?



- **Cyberinfrastructure** – defined as comprising “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.”
- In 2011, the National Science Foundation Advisory Committee for Cyberinfrastructure (ACCI) Task Force on Campus Bridging published its final report, wherein the need for address and funding of *humanware* was articulated.

[https://www.nsf.gov/cise/oac/taskforces/TaskForceReport\\_CampusBridging.pdf](https://www.nsf.gov/cise/oac/taskforces/TaskForceReport_CampusBridging.pdf)



# What that report said about Humanware

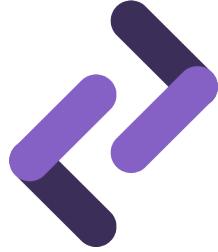


“Time and again, at all levels of the acquisition and deployment of information technology through the past several decades, we have seen that without this humanware component – the people who make all the other components work – **investments made in those other components – however significant in amounts!** – do not realize their full potential without attention to and investment in the support of their use by scholars.”

“Scholarly productivity and knowledge breakthroughs and discovery, however enhanced they may be by advanced cyberinfrastructure do not reach their full potential without the human element.”



# Aye, there's the rub ...



- While the report highlights the importance of the need for humanware, it did leave open the question of where responsibility for support for its provision would rest – with funding agencies, or with the institutions that received funding?
- **This key question remains, and further explanation and justification of the role people play is required to lead to better address of this question.**



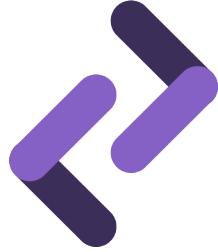
# A CIO's view



- We spend a \$-load of money on buying all the other ‘wares’ in cyberinfrastructure, but are challenged to devote funds to humanware
  - Institutions are reluctant for a wide variety of reasons/challenges
  - Funding agencies (NSF, NIH, etc.) are similarly reluctant
- Why is that?
  - “Stuff” can be purchased with one-time money (though that conveniently ignores the need to eventually replace it)
  - “People” require ongoing commitment (in most cases) and that kind of money is harder to come by in budgets



# What's happening at US Research Universities



- Pressure establishing or sustaining investments in CI
- Many priorities for central IT making it very hard to focus on research enablement
- Lack of good research-savvy IT leaders (CIO pipeline issues)
- Lack of understanding/appreciation for IT/CI among institutional executive leadership (presidents, provosts, CBOs, Boards)
  - ***Not helped by a lack of good ROI data for IT/CI investments***



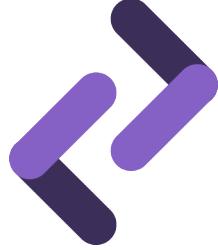
# Directions from funding agencies (e.g., NSF)



- Overall funding reductions due to politics in the US government
- A sense that investing in campus infrastructure is something institutions should be funding rather than asking for federal grants
- A sense that the 25-year effort to establish, expand, and maintain ‘National Centers’ (NCSA, SDSC, PSC, TACC, Teragrid/XSEDE) is not sustainable
- Various funding programs establishing a ‘toe in the water’ for cloud credits as a replacement for capital infrastructure
  - **Growing awareness of the need for humanware**



# Cloud Providers reaching out to researchers



Amazon, Google, Microsoft (Azure), IBM, etc.

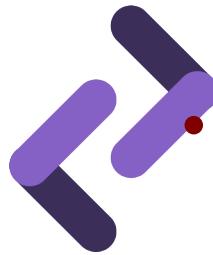
However, all is not glittering gold ...

- Tools, documentation, and support are not good
- Lack of product-trained technical support (humanware)
- Key challenges with overcoming the ‘ka-ching!’ element of cost per use
- Research use is still a relatively small business compared to enterprise (revenue) – *and it shows in sales/support interest*



# Human resource more critical with the cloud

*... And just as absent from strategies*



- Cloud requires even more support for adoption and ongoing use
  - Especially true if researchers eventually hope to see the various providers as ‘commodity’ ... being able to move from one to another based upon pricing and performance
  - People are still a ‘base-budget’ resource; hard to fund in shrinking budgets
  - Skill levels with cloud environments are lacking and the vendors don’t have good programs for education and certification
    - *Real challenges in getting these same vendors engage in pedagogy on campus*



# ROI remains hard to grasp ... *no Buck\$, no Buck Rogers*



- Metrics for the benefits of CI-enablement of research are hard to quantify and qualify
- Costs are more difficult to control in the cloud
  - Campus allocation and consumption versus \$/cycle or \$/TB costing
- Scientific data and analysis is illuminating the ‘woods dark and deep’ but we have miles to go before we sleep.
- In many cases, there is an intuitive feeling that CI investments advance research, ***but it is largely an act of faith on the part of administrators***



# A Possible Way Forward



- Minimal investment in local compute/storage resources – consider them ‘development and test’ platforms
- Grasp how moving to the cloud (in essence IaaS) impacts campus/institutional funding/spending (capital vs. expense)
- Continue to look for ways to express ROI beyond ‘faith-based initiatives’
- ***Now more than ever FOCUS ON PEOPLE!***



# What we're doing at Indiana University



INDIANA UNIVERSITY



## Humans Advancing Research in the Cloud – HARC

WORKSHOPS

TEAM

Technological Frontiers **Leadership Forum**

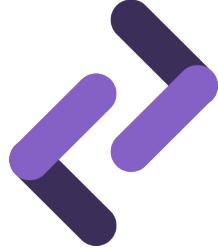
**There are multiple projects going now about people, research, and clouds in the US**



- NIH STRIDES (<https://datascience.nih.gov/strides>)
- NSF Cloudbank (<https://www.cloudbank.org>)
- Internet2 "Exploring Clouds for Acceleration of Science (E-CAS)" (<https://www.internet2.edu/vision-initiatives/initiatives/exploring-clouds-acceleration-science/>)
- HARC (<https://harc.iu.edu>)



# HARC – About the Project



- **Objectives:**
  - To study and improve the understanding within the higher education community of how people in support roles advance the use of cloud-based cyberinfrastructure (CI) in the advancement of research at universities.
    - *Establish ‘credibility’ for the topic in the academic record*
  - To provide detail in the form of ‘**return on investment**’ (**ROI**) of the use of cloud-based CI by offering case studies on its use as compared to campus-based or existing national CI resources
- **Funding:** A contract-based award from Microsoft Corporation. While the award is provided by Microsoft, the project entails examination and use examples of all cloud CI vendors.



# Project Phases



Phase 1: Provide support to campus-based research support engineers (post-docs, research associates) so that they may explore use of cloud services in conducting a diverse set of CI-enabled research endeavors.

- Our goal was to support case-based analysis of use of the cloud for research and establish credibility of our efforts in the broader academic community by engaging in research and producing publications
- Findings were presented at a workshop at PEARC19 in Chicago July 2019



# HARC Workshop at PEARC19

- Peer-to-Peer style format
- 13 presentations on relevant projects
- 9 peer-reviewed papers published in the ACM digital library with open access for all

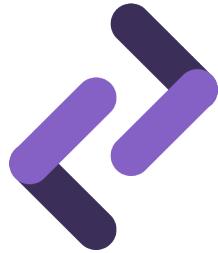


Agenda, Abstracts & Presentations available online:

[harc.iu.edu/workshops/pearc19-conference.html](http://harc.iu.edu/workshops/pearc19-conference.html)



# Phase 2 Goals



**Increase Awareness** by further building the community and continuing support for further publication and presentation of activities in the community

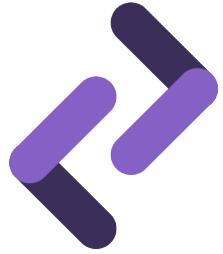
**Support further research endeavors** under a project-based solicitation format and advance experiences with cloud CI

**Support the development of an engaged community** sharing experiences and detailed use-case information that will increase broader technical understanding

**Provide feedback to vendors** on the challenges faced by researchers attempting to make use of the cloud to replace or enhance premise-based or other available CI resources.



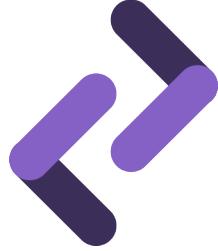
# What we've learned so far



- ROI for use of the cloud, where premise-based CI exists, is still not financially competitive
  - **Especially true for ‘capacity’ use, less true for ‘capability’ use**
- The burden of learning how to make use of cloud services makes it challenging, and none of the vendors are doing an acceptable job of marketing and supporting research use
  - **Lack of documentation and vendor support with pre-built tools**
  - **Lack of focus on researchers – more vendor focus on enterprise**



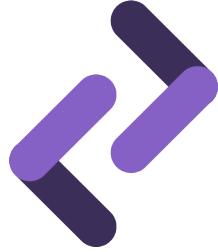
# What we've learned so far ... *continued*



- AWS has a substantial adoption-lead due to early entry into higher ed research; Google seems to be more aggressively entering the market; Microsoft has a corporate interest but is really challenged in several ways that could inhibit success.
- ***The importance of people is even more critical when using the cloud, due to lack of available support resources***



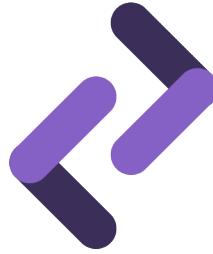
# What we're thinking is needed



- A Leveraged Support Model in the community to advance the use of cloud services in support of research
  - Role of the Cloud Vendors Defined
  - Role of Community Resources
    - Tools, information, forums for exchange of ideas
    - Role of campus-based cloud research support engineers (CRSEs)
    - Awareness of researchers of cloud capabilities



# For more information about HARC



- Project related materials (papers and presentations), personnel, and workshops will be communicated via the project website:
  - <https://harc.iu.edu>
- A GitHub Repo will be established (by mid-October) to share papers, presentations, use-cases, pre-built tools, and other community-supplied experiences and discussion. This will be an ecumenical resource for information supporting research in the cloud – all clouds:
  - <https://github.com/HARC-PTI>
- For more information contact the HARC project leader for PTI, Brian D. Voss  
[bvooss@iu.edu](mailto:bvooss@iu.edu)



# Key Take-Away Questions



- ◆ What is your institution's view of the importance of IT?
  - ◆ Does your investment and executive engagement support that view?
- ◆ What are your goals for advancing research?
  - ◆ How does technology (cyberinfrastructure) support those goals??
- ◆ Do you have a research strategy that is technology enhanced? Are you looking for local resources, collaborative efforts? Does the cloud play into your thinking?
- ◆ Do you grasp the importance of people in supporting research using technology?



# Questions? Comments? Discussion?



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# Thank you

