

## Understanding Research Technology Support and Where it Fails

Dr. Dirk Colbry  
Computational Mathematics  
Science and Engineering  
Michigan State University

What does it mean to  
support research?

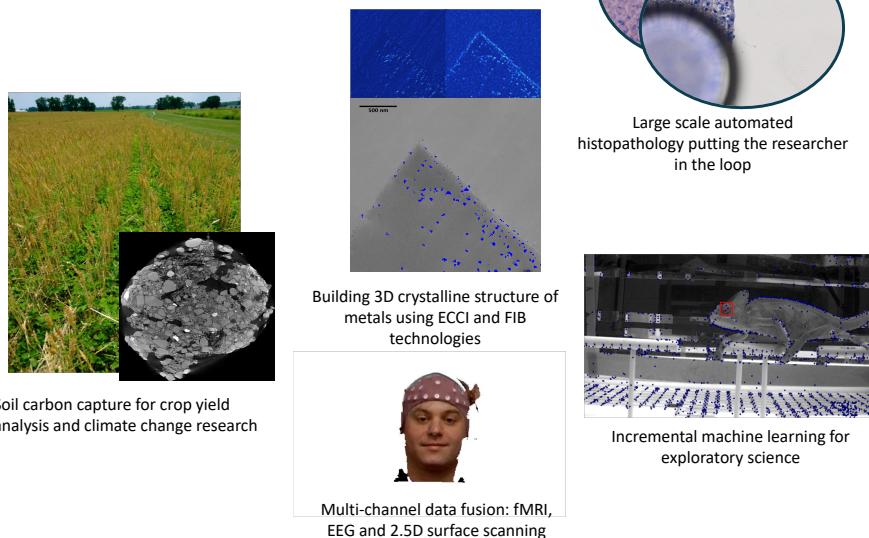


# What does it mean to fail?

## Outline

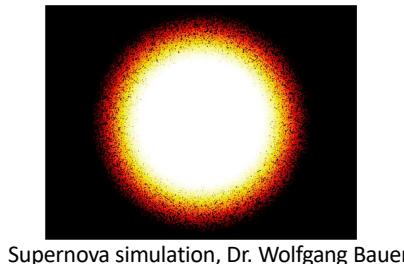
- A little about myself
- A brief history of research support in computing
- What makes Research IT and Enterprise IT support different?
- Where does research computing typically fail and what is being done to avoid failures

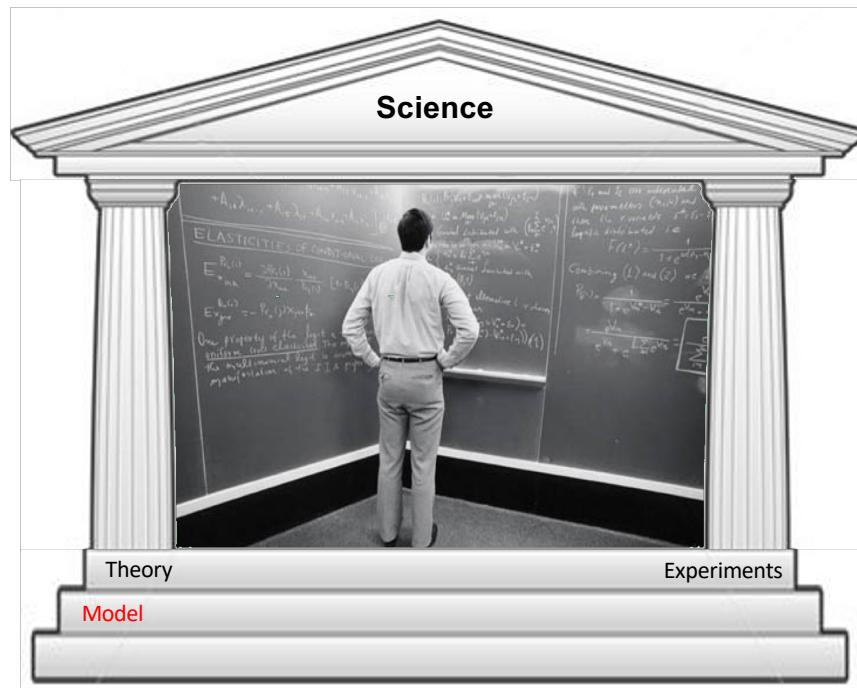
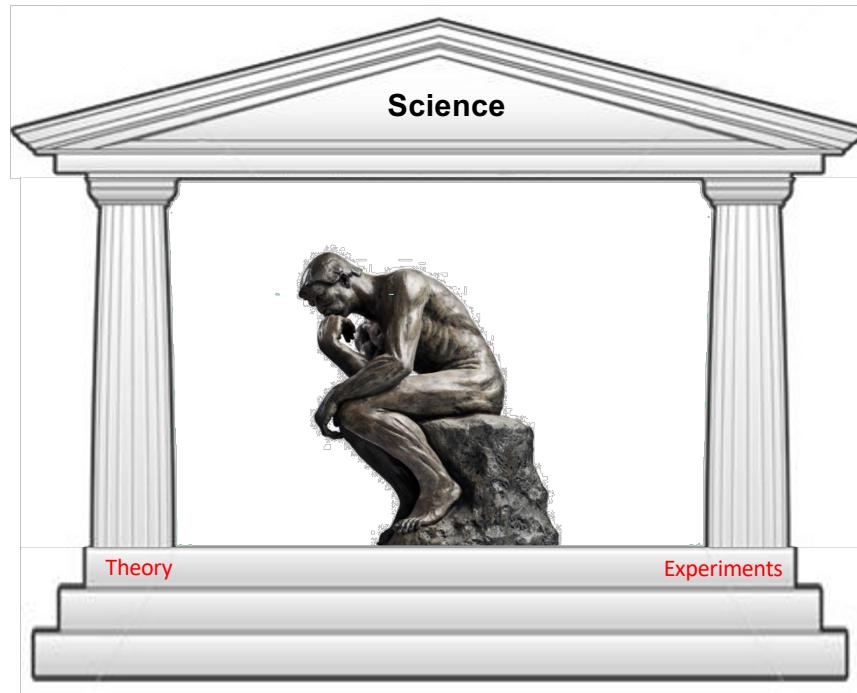
# Some of My Research

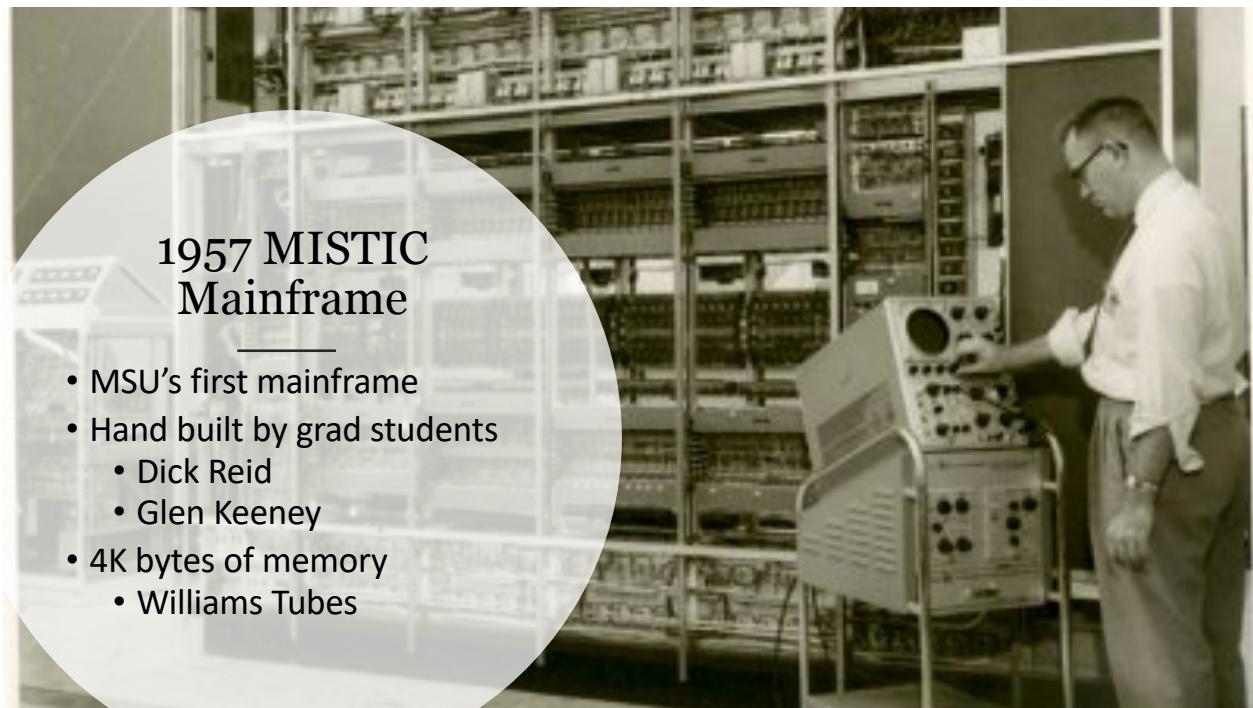
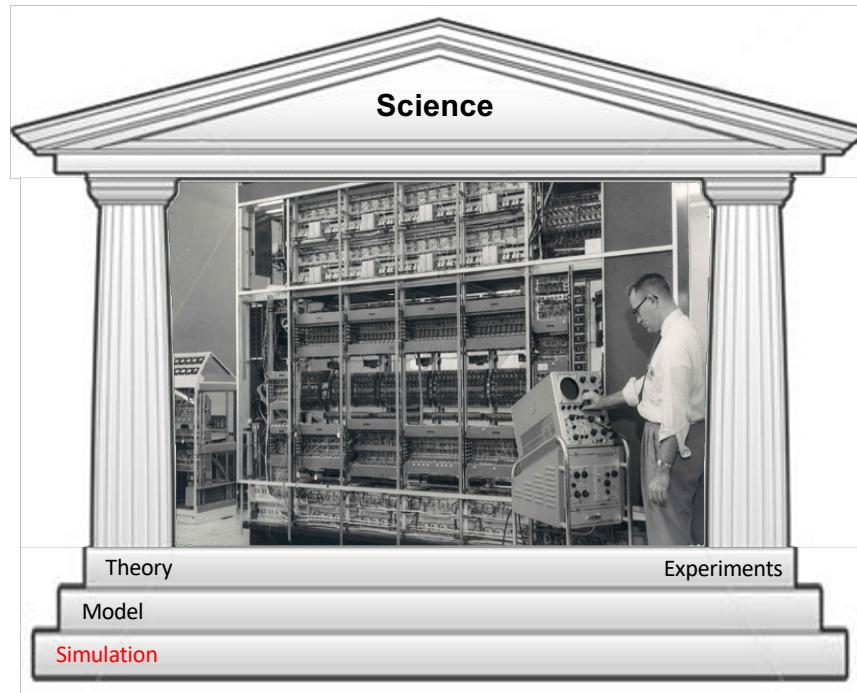


## Helping Researchers use computers to do science

- 2002-2007 Graduate student in Image analysis.
- 2005-present High Performance Computing Center User
- 2009-2014 HPCC Computational Consultant
- 2013-2014 XSEDE Campus Champion Leadership team
- 2014-2015 Director of HPCC
- 2015-present Director of HPC Studies, CMSE

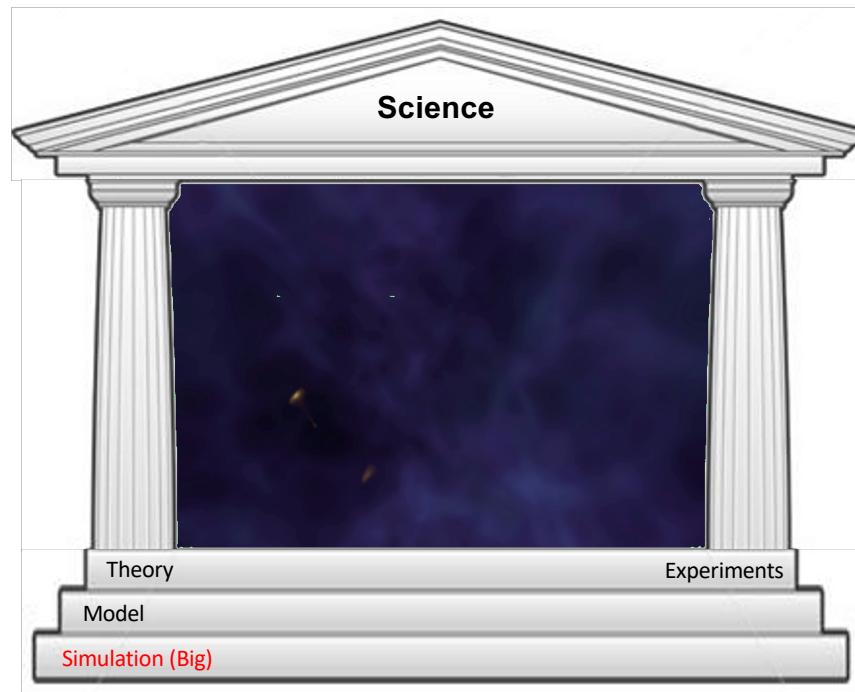


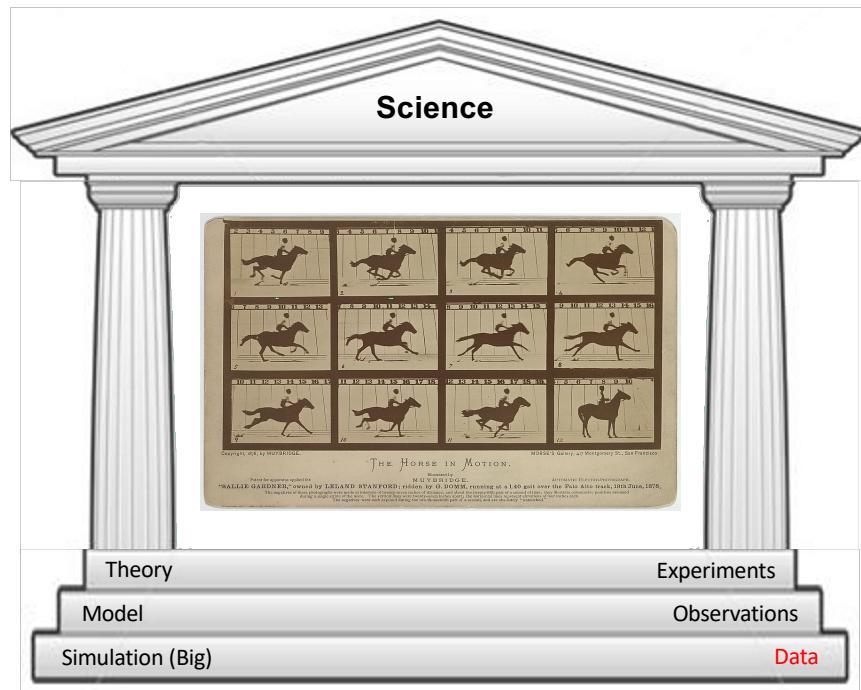
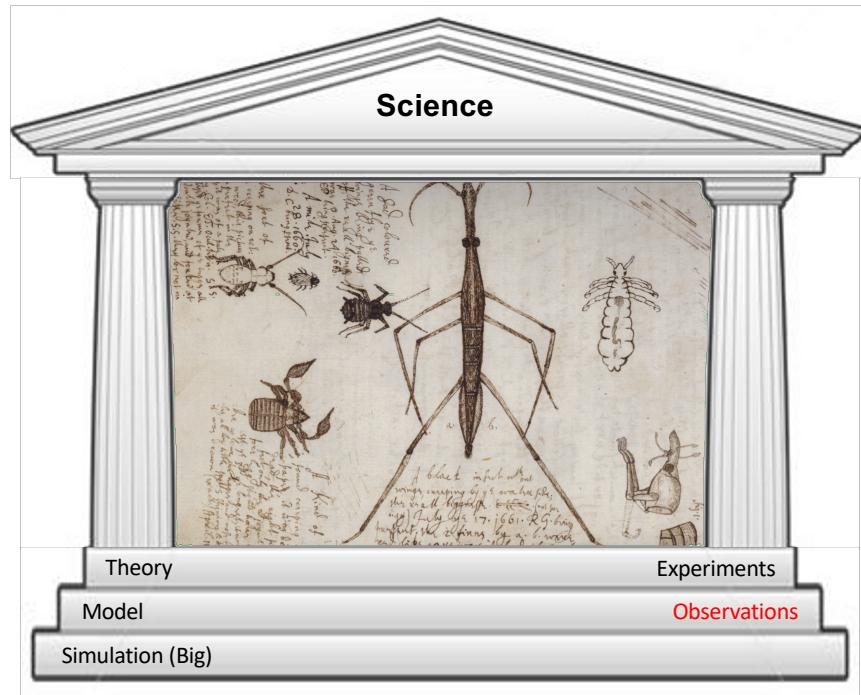


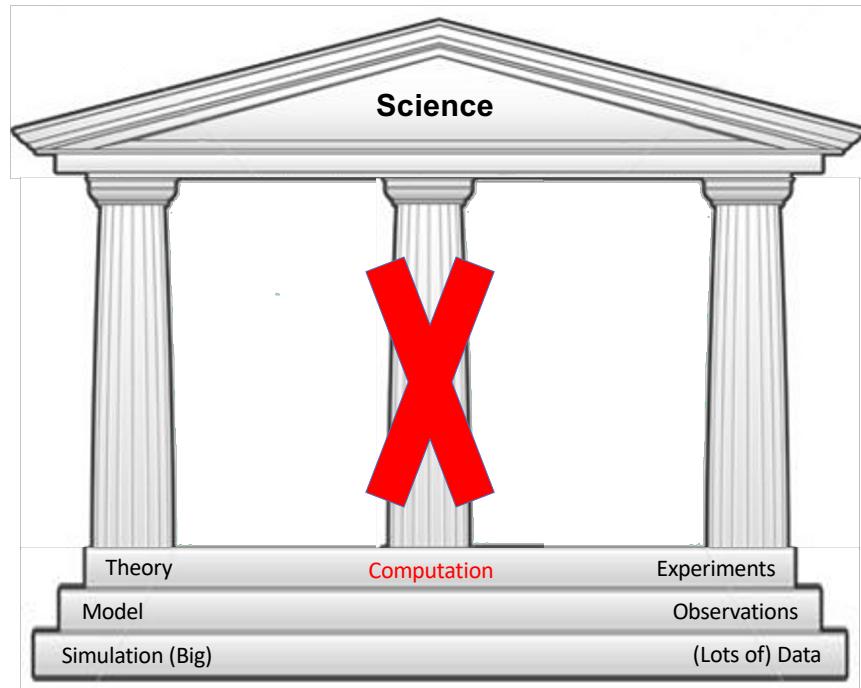
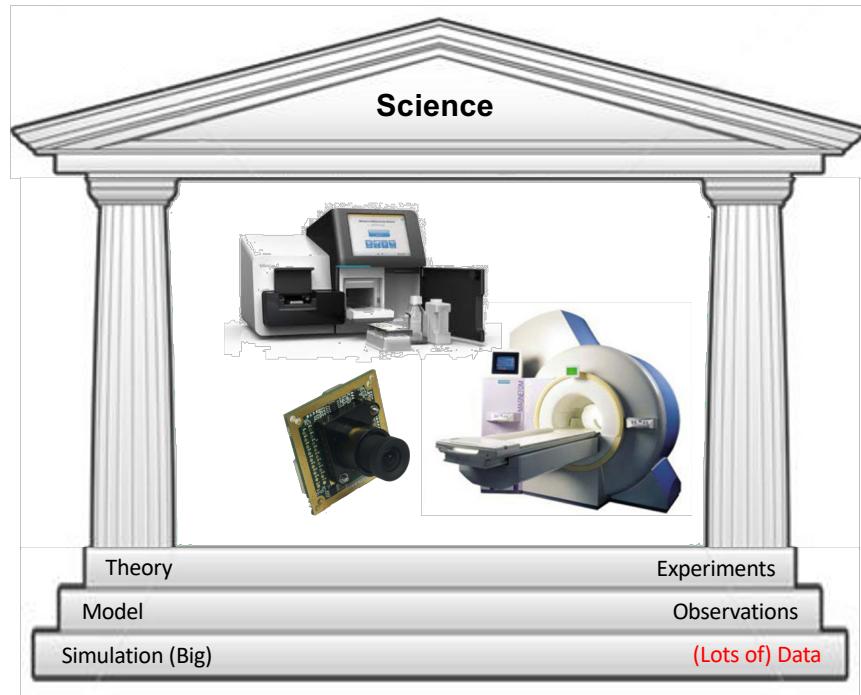


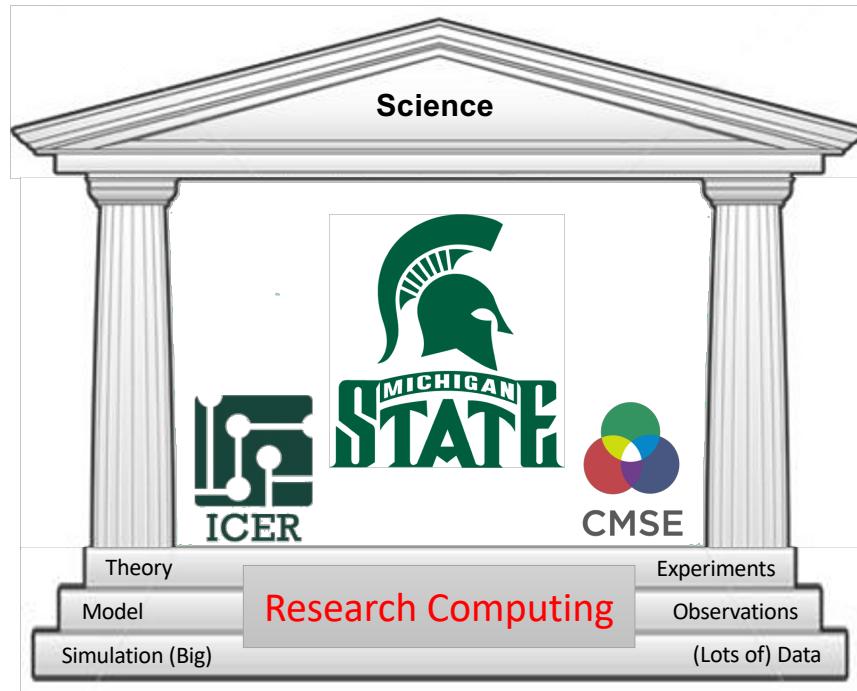
It was a  
miracle!

- At the 50<sup>th</sup> anniversary, MSU gathered researchers from the MISTIC era for a panel discussion:
- **question:** How could you work on something so (slow, unreliable, big, ...)
- **answer:** it was a miracle! 1000 mults/sec vs. slide-rule/paper is amazing.









## More research computing in MSU History

- 1960 - MISTIC, upgraded to 20K core memory
- 1963 – MSU Purchases CDC 3600
- 1968 - CDC 6500 (by S. Cray)
- 1975 – Additional CDC 6400 purchased as a supplement
- 1980 - Cyber 170-750



## Dawn of iCER

- No designated research computing at MSU for the 90's into the early 2000's. (personal computers and the internet)
- By 2004 a group of faculty petitioned to re-establish a research computing facility on campus.
- 2005 – MSU Formed High Performance Computing Center (HPCC)
  - Continuous Hardware refresh every 2-3 years.
  - Semi-Stable Operating System and File System.
- 2009 – MSU Rebranded HPCC to iCER (Institute for Cyber-Enabled Research)
  - More than just computing
  - Added Researcher Support Services
  - Added Training and Outreach



## National Research Computing

- 2001 - NSF Funded TeraGrid
  - Coordinated all NSF funded Supercomputing Resource Providers
- 2011 – NSF Funded XSEDE
  - More than just Computing
  - Research Support
  - Training



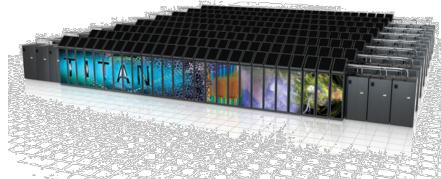
**XSEDE**

Extreme Science and Engineering  
Discovery Environment

## Many other Computing Resources



Extreme Science and Engineering  
Discovery Environment



What makes  
research IT  
different than  
enterprise IT?

Bigger is often better

New is often better

Different is often better

Cost/Time model is vastly different

One size does NOT fit all

# Bigger Science

- The goal of Research Computing is NOT:
  - Kflops (floating point operations per second)
- Instead, the goal of Research Computing IS:
  - KSciences / second
- Doing More Science, Faster
  - Reducing the “Mean time to Science”
- Research Computing should help researchers innovate and make discoveries.



How do we properly evaluate research software to be installed on an HPC system?

## The Cost of Research

---



Research time more important than computer time or money



Graduate/student time is cheap



We need to be innovative more than reliable



Money often comes after innovation

A large, irregular red ink splatter or stain covers the bottom half of the slide, centered over the text.

What about security?

# The story of five nines

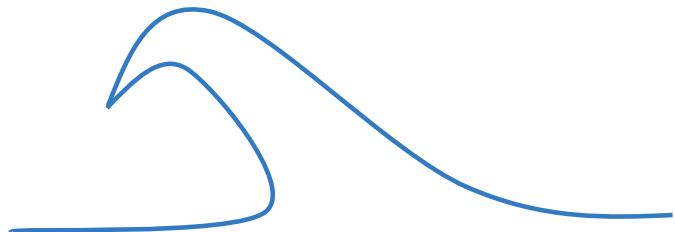
(Henry Neeman OK University)

- The best Enterprise IT can offer 99.999% uptime.
  - This is 5.26 minutes/year or 26.30 seconds/month.
- Research computing is best served by 95% uptime.
  - This is 18.26 days/year or 36.53 hours/month
- Not only do I not want five nines for research computing, whenever possible we try for one and a half nines. Why?

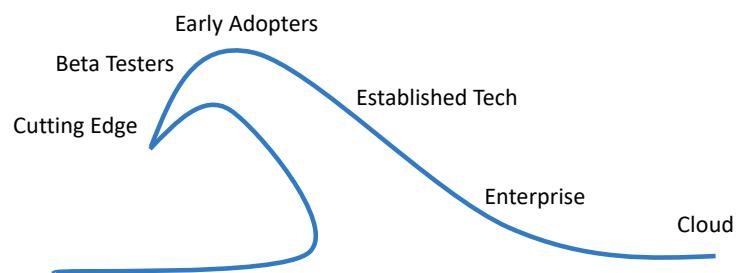


What about a disaster recovery plan?

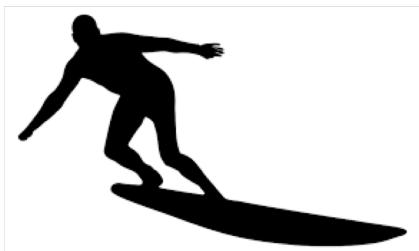
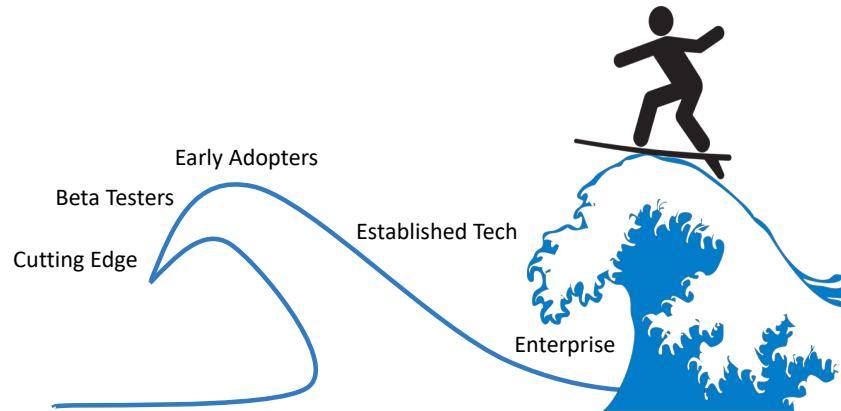
Research is also about Riding the Technology Wave



Riding the Technology Wave



Where should research fall?



Story Time

Accelerator Card Example

2008 What to pick?



Cell Processor

Vs.



Graphics Processing Unit  
(GPU)

2008 What to pick?



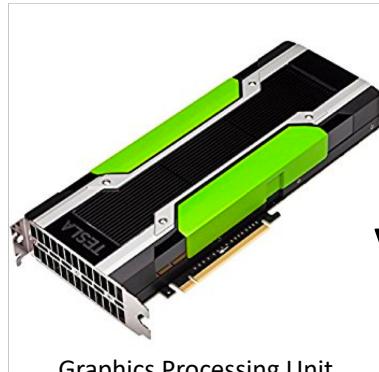
Cell Processor

Vs.



Graphics Processing Unit  
(GPU)

2014 What to pick?



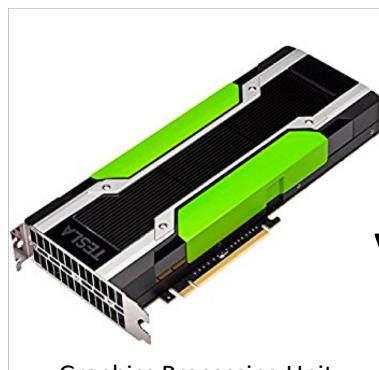
Graphics Processing Unit  
(GPU)

Vs.



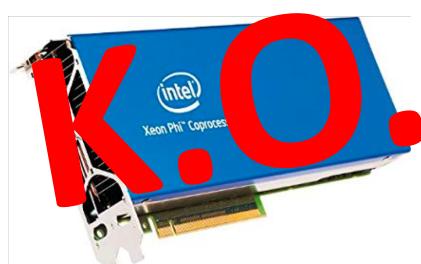
Intel Xeon Phi

2014 What to pick?



Graphics Processing Unit  
(GPU)

Vs.



Intel Xeon Phi

## 2018 What to pick?



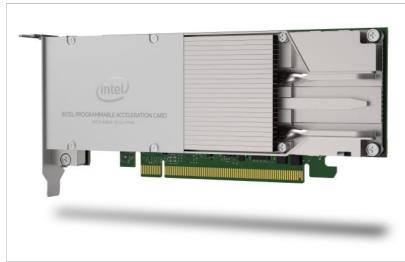
Field Programmable Gate Arrays  
(FPGA)



Vs.

Graphics Processing Unit  
(GPU)

## 2018 What to pick?



Field Programmable Gate Arrays  
(FPGA)

???

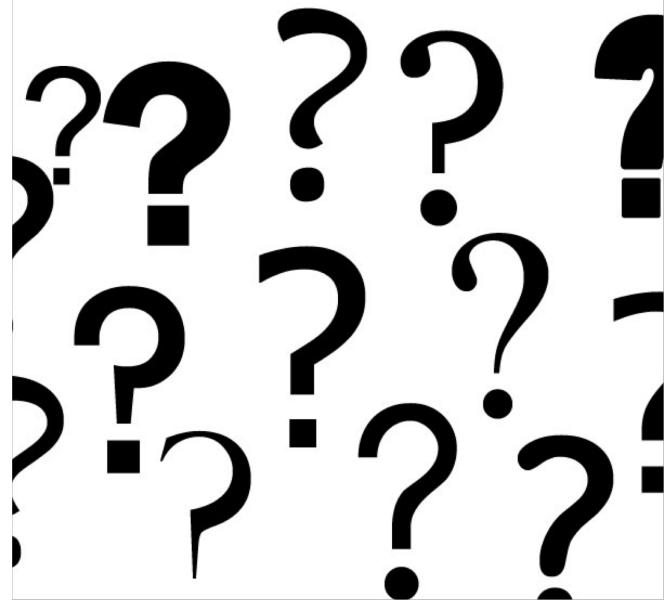


Vs.

Graphics Processing Unit  
(GPU)

Where does  
Research  
Computing  
typically fail?

---



## People and Communication



## How do we support research computing



Listen to the researchers and understand their needs

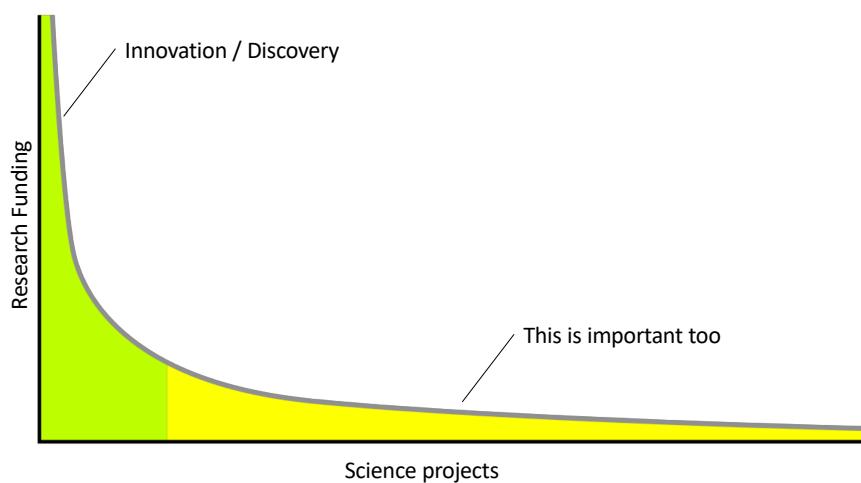


Lower barriers to entry



Support Rapid Innovation

Supporting both Innovation and the long tail of science.



# NSF CyberTraining initiative

Training-based Workforce  
Development for Advanced  
Cyberinfrastructure



## National Research Organizations

- **XSEDE** - The Extreme Science and Engineering Discovery Environment is supported by the National Science Foundation
- **Campus Champions** – Organization of Professionals dedicating to supporting research computing at US Research Institutions.
- **CASC** - The Coalition for Academic Scientific Computation is a group of most of the mid-to-large academic and government CI centers in the US.
- **SGCI** – Science Gateways Community Institute
- **CARCC** - Campus Research Computing Consortium
- **CyberAmbassadors** - Advanced Professional Skills Training for CI Professionals

# Campus Champions



CASC

- Primary attended by HPC/IT Directors and above
- Governmental Lobbying
- Sharing ideas at the Large Institute funding level.

COALITION FOR ACADEMIC SCIENTIFIC COMPUTATION • CASC

## SGCI

- Science gateways allow science & engineering communities to access shared data, software, computing services, instruments, educational materials, and other resources specific to their disciplines.



Science Gateways  
Community Institute

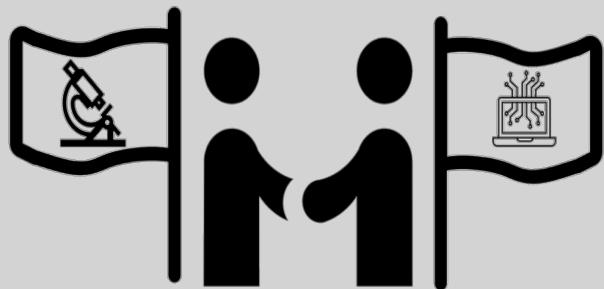
## CARCC



- Establishing Research support as a discipline.
- CI workforce development and professionalization.
- Developing the people network of CI, research computing and data professionals while promoting various facing roles:
  - researcher-facing
  - systems-facing
  - stakeholder-facing
  - software/data-facing.

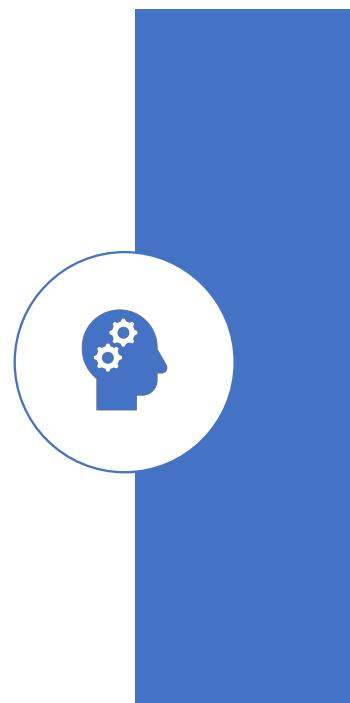
# CyberAmbassadors

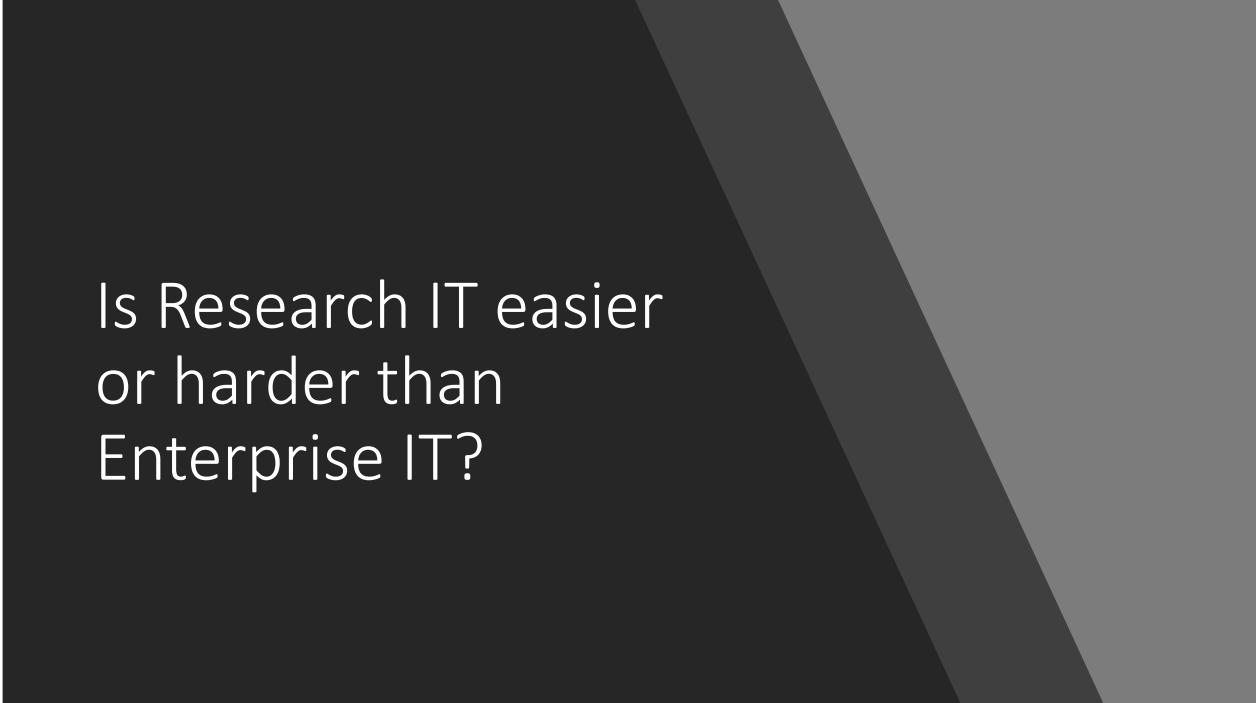
- Professional Skills training workshops to CI Professionals.
  - Communication
  - Teamwork
  - Leadership



## Concluding Thoughts

- There is a long history of research computing support at MSU
- Supporting Research is different than supporting Enterprise IT
- Research is driven by technology innovation not the “tried and true”
- Many national organizations are trying to solve the problem of effectively supporting research. We should not be naive and think we know everything there is.
- **Communicating with researchers is key**





Is Research IT easier  
or harder than  
Enterprise IT?