
Teaching &
Learning
Connected Campus &
School Experiences
Student Lifecycle &
Success Management
Academic
Research
Microsoft

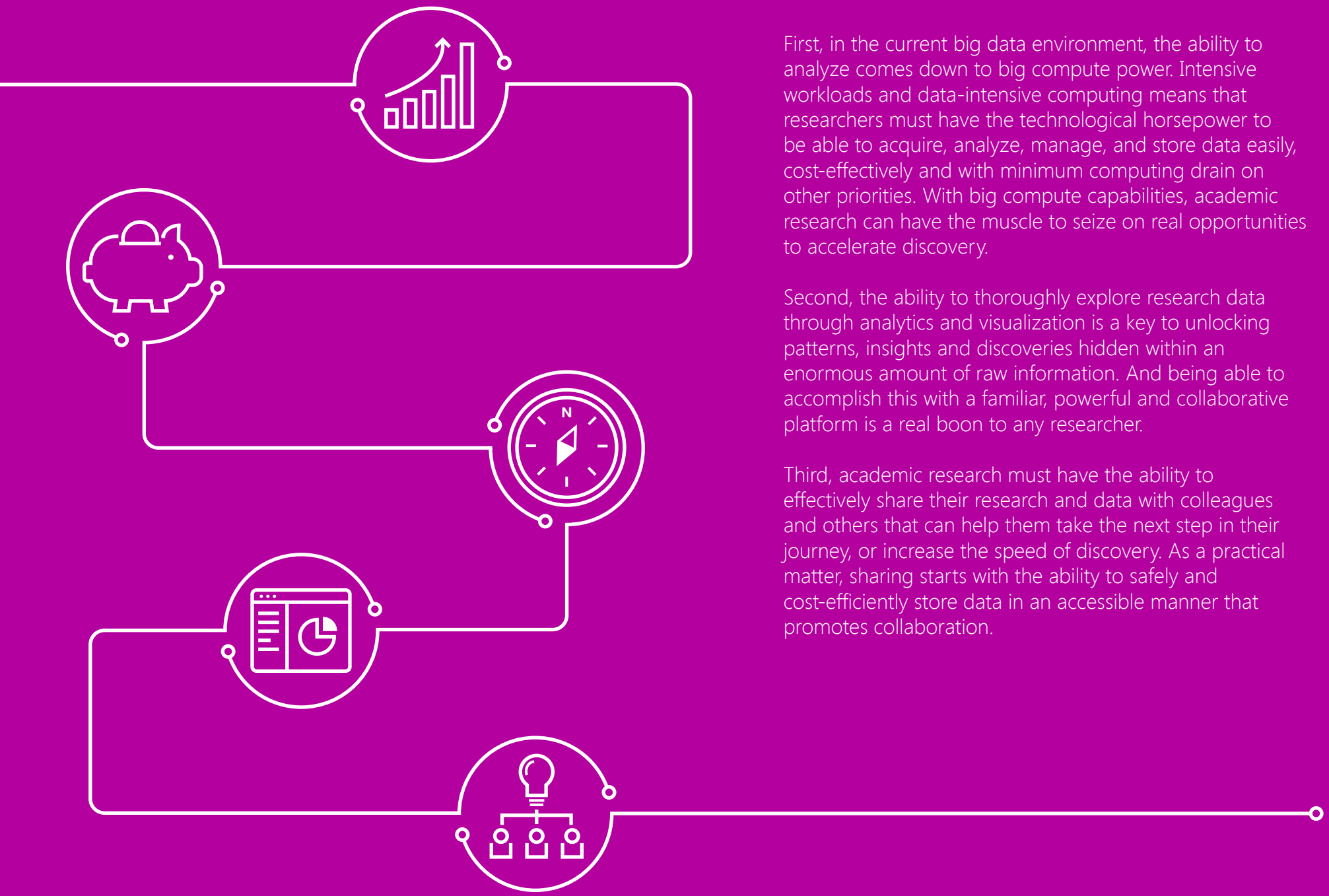
Table of Contents

Academic research is among one of the most important endeavors in today's changing world. It's at the core of every leading learning institution.

Adding to the excitement is that fact that research today is advancing at a tremendous rate in all disciplines, including computer science, engineering, life sciences, environment science, social sciences, and more.

From mapping the human genome to building smarter traffic infrastructure to weather forecasting, academic researchers tackle a diverse range of areas that have the potential to prevent disasters, advance worthy causes, cure cancer, and impact generations to come. Academic research – like any diligent and methodical research – is an endeavor of imagination, ideas and innovation.

But in order to properly execute any college and university level program, academic researchers need to rely on three action keys to all successful research: analyze, explore, and share.



First, in the current big data environment, the ability to analyze comes down to big compute power. Intensive workloads and data-intensive computing means that researchers must have the technological horsepower to be able to acquire, analyze, manage, and store data easily, cost-effectively and with minimum computing drain on other priorities. With big compute capabilities, academic research can have the muscle to seize on real opportunities to accelerate discovery.

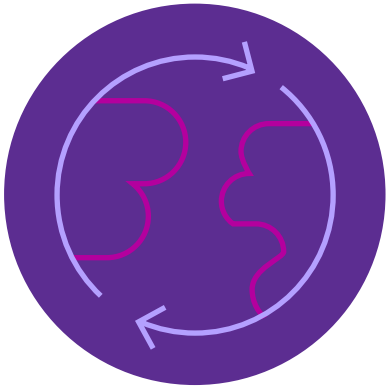
Second, the ability to thoroughly explore research data through analytics and visualization is a key to unlocking patterns, insights and discoveries hidden within an enormous amount of raw information. And being able to accomplish this with a familiar, powerful and collaborative platform is a real boon to any researcher.

Third, academic research must have the ability to effectively share their research and data with colleagues and others that can help them take the next step in their journey, or increase the speed of discovery. As a practical matter, sharing starts with the ability to safely and cost-efficiently store data in an accessible manner that promotes collaboration.

At Microsoft, our goal is to let researchers be researchers. And we believe central to achieving that goal is the ability for academic researchers to analyze, explore and share.

Leading universities on the frontlines of scientific, medical, sociological and other vital research areas have relied on these three keys to greatly contribute to their college or university program.

In this e-book, we'll take a peek at a vision for tomorrow's academic research, as well as some of the foundational cloud technology research professionals seek today. Then we'll explore these three keys, and the best solutions available to put those capabilities in the hand of your academic research team. Throughout, we'll also look at relevant case studies.



$10.4 billion

At Microsoft, we are deeply committed to research. We have backed research to the tune of $10.4 billion in funding since 2013. We focus on innovations in computing, breakthrough in social science research, powerful new products, and more.

The challenges for academic researchers today are ones of data volume and complexity.

It's somewhat of an irony that the majority of researchers use laptops and desktop computers, and are able to do more than ever, but yet are often overwhelmed by the amount of data to process. While computing technology has introduced an unprecedented opportunity in academic research, it has also created its own obstacles, rooted in volume and complexity.

For example, many researchers are finding analysis more and more difficult, and sharing even harder without the right technology and collaboration platforms. Without total access to more advanced, flexible and efficient tools, analysis becomes a chore and a burden, rather than an accelerator of discoveries.

Some institutions today have embraced high-performance computing (HPC), or the use of super computers and parallel processing techniques for solving complex computational problems. HPC can solve advanced problems and perform research activities through computer modeling, simulation and analysis, and has the ability to deliver sustained performance through the concurrent use of computing resources.

However, many researchers are not able to use HPC, either because they do not have access, or do not have the IT skills to fully leverage its capabilities.

In addition, the continued maintenance, upgrades and IT resources needed to sustain a physical super computing environment for an academic research program are often cost-prohibitive, and have the potential to drain limited research budgets.

A new research paradigm

Tomorrow's research paradigm addresses and overcomes these obstacles by focusing on unification and empowerment. In order to conduct academic research at the highest levels, and with the utmost proficiency and professionalism, teams at all institutions have to be unified and empowered with:

- Powerful tools and resources
- Data and analysis capabilities in the cloud for cycles, storage, and support
- The ability to build communities around research results
- Capabilities to marshal needed resources on demand, easily, and effortlessly
- An environment that fosters accelerated discovery

Most researchers today have embraced cloud technology in lieu of the HPC approach in order to make progress in gaining these capabilities, and achieving a unified and empowered state.

51 percent

The majority of workloads were on the cloud for the first time in 2014. Approximately 51% were processed in the cloud, versus 49% in the traditional IT space[1].

What researchers want from the cloud

Cloud computing has fundamentally changed the way research teams can interact with each other and their devices, providing large scale connections, efficiencies and cost economies never before available at the university level.

In particular, academic researchers have specific needs when it comes to cloud computing. Research teams value cloud capabilities that are:

- Open
- Flexible
- Fast
- Cost-effective
- Scalable
- Efficient
- Responsive

Analyze

At Microsoft, we believe in a simple vision for Big Compute – democratization of capabilities like performance and scale.

Big Compute, *noun:*
Intensive workloads or data intensive computing

The ability to analyze data effectively is the foundation of any research project. Academic research teams have diverse data and computation needs that scale from desktop to supercomputers, with the latter being the growing trend. There can be no doubt that, as more and more academic research teams delve into highly complex and challenging areas ripe with big data processing needs, that the need for high-performing, super computation power will only continue to soar.

Besides the nature of the application and the domain, the resource needs for the applications also vary over time, as the collaboration and the data collections expand, or when seasonal campaigns are undertaken.

For academic research teams, analyzing large volumes of big data can present a myriad of challenges. Besides the need for significant storage and processing capabilities, the economics of processing big data can drain even the most robust research budgets. For example, a cluster of 10 x (A8-A11) rack mounted blades can cost upwards of $300K. Procurement and delivery is not often expedient either – usually about six weeks.

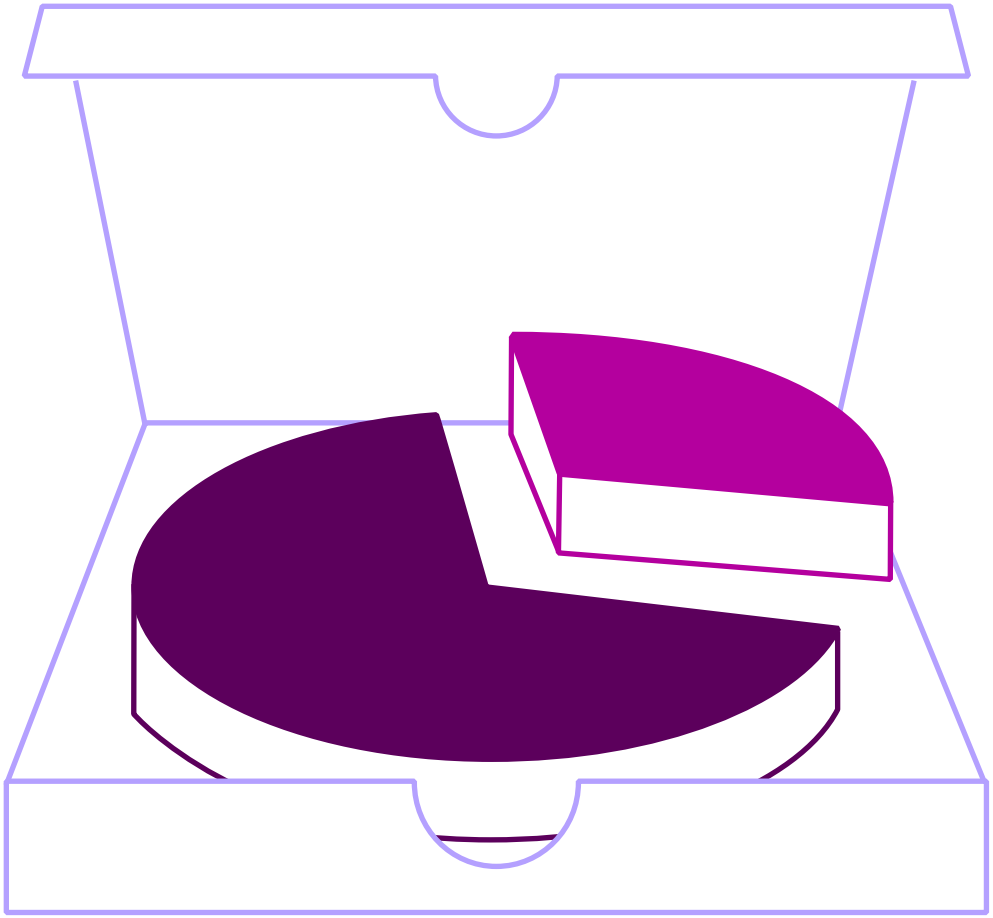
Academic research, Big Compute and cloud

Using available cloud solutions can overcome these "Big Compute" challenges, as well as bring many other benefits to research teams. For example, that same cluster of 10 x can cost only $50K. As impressively, procurement and delivery can be as fast as a pizza delivery, usually about thirty minutes or less.

From purely an economic viewpoint, cloud is fundamentally changing cluster computer, which is a mainstay of research analytics. It makes Big Compute power available when you need it, so that higher learning institutions only pay for what they use.

And cloud computing solves the problem of flexibility and seasonal needs too. Cloud holds promise for researchers across the computing spectrum, from desktop users who need on-demand compute power, to HPC cluster users who wish to scale out further.

Bottom line, cloud offers a scalable, economic, on-demand model well-matched to evolving academic research needs.



Federal University of Minas Gerais

Academic research team uses big data to beat traffic at this Brazil University. Microsoft Research joined forces with this institution, home to one of the country's foremost computer science program. They tackled the seemingly intractable problem of traffic jams.

Situation

- Brazil's traffic jams exacted a toll of $72 million in 1998 – autos increased threefold since then
- Research team creates a predictive solution, but faces big data challenges
- Historical and real-time data must be mined to open up roads and plan for tomorrow

Solution

- Research team uses Azure for scalability, immense storage, and big compute processing power
- Cloud-based platform ensures that traffic data is accessible to all users in real time, all the time
- Tests in other cities and social media data helps achieve 90% accuracy in traffic predictions

Learn more

Explore

Once research teams are empowered to analyze, the ability to explore data through the use of analytics and visualization tools is paramount to uncovering new truths and patterns, and accelerating discoveries.

The Big Compute capabilities available with today's cloud solutions also gives rise to specific exploration opportunities through the use of sophisticated analytics and other advanced tools focused on visualization.

For example, the ability to explore data through rich visuals can greatly enhance the ability for academic research to:

- Spot trends and patterns within complex and high volumes of data more easily
- Collect and organize data more efficiently so teams can focus on exploring
- Get consolidated and full-picture views of different streams of data
- Share complex information much easier with research colleagues or institutions
- Expedite advances in your research with greater teamwork and collaboration

Visualization requirements

There are a number of visualization solutions and technologies available to researchers, especially those leveraging cloud. When selecting a visualization product or platform, teams should consider three core requirements: familiarity, powerful, and collaborative.

Visualize with Power BI

Power BI is a suite of business analytics tools to analyze data and share insights ideal for the needs of academic research team.

Learn more

Familiarity

Ensure a quick ramp up and widespread adoption by selecting a visualization tool that is compatible with other products, and that members of your team are comfortable using.

Powerful

The tool should be able to integrate with multiple data sources, have data cleansing capabilities, and be able to support hundreds of millions of rows.

Collaborative

It should be flexible enough to connect with cloud services, have private or public access options, and can be securely shared with named users or groups.

University of Texas

In order to centralize flood data in the cloud for better predictions and responses, the University of Texas used Microsoft Azure. The result was a groundbreaking prototype for a national flood data-modeling and mapping system with the potential to provide life- and cost-saving information to the general public.

Situation

- Faulty waterway gauges put the public and first responders at risk during potential flooding
- Lack of accurate flooding predictions makes disaster response a huge challenge
- Developing a predictive model presents big data, analytics, and disparate source challenges

Solution

- Azure and Cortina Intelligent Suite helps create predictions for three million river reaches in the U.S.
- Enables geographically-distributed researchers to collaborate in the cloud with a single interface
- Actionable intelligence helps predict potential flooding before rainfall, even with faulty gauges

Learn more

Share

Collaborative research and data sharing round out our keys to academic research success, and can act as a catalyst for existing research, or potential discoveries on the cusp of a breakthrough.

When collaborative research is lacking, there are significant financial implications to any project. For example, the inability to share data can have an impact on funding by outside agencies. The reality today is that researchers are increasingly burdened with demands for reporting and compliance as government and private funding agencies require them to make their data publicly available. Years of using internal infrastructure tools and applications have often made this difficult.

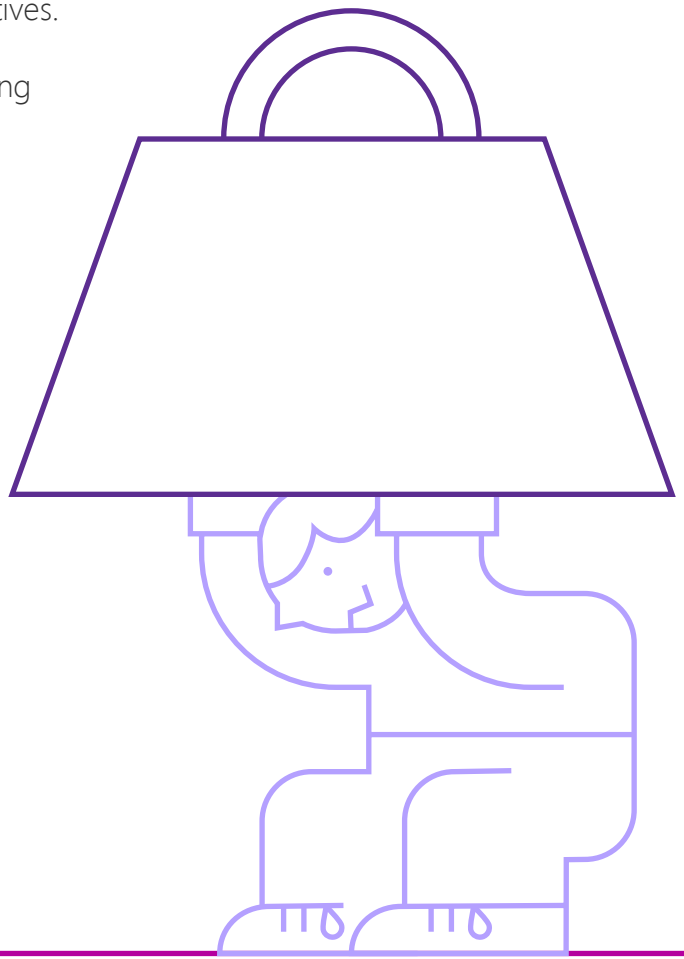
But, with the right technology, collaborative research can be strongly supported, eliminating these disconnects and compliance hurdles so that teams can work methodically toward their objectives. With the right tools, researchers are unencumbered by troublesome funding worries, and other hurdles that lead them astray from their primary research goal.

Having a maximum capacity to share your research allows you to:

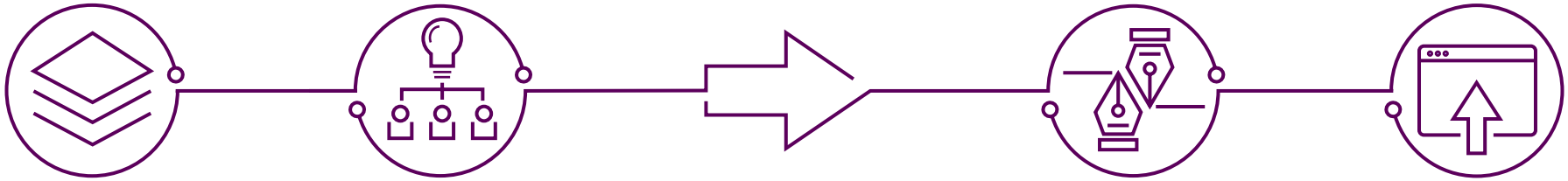
- Combine expertise
- Distribute workload
- Pool resources

These capabilities translate into benefits that make it easier for your research team to:

- Gain insight from others
- Comply with requirements
- Build credibility with peers



The lifecycle of collaborative research



Support of a collaborative research environment is an important pillar of modern research in any disciplined endeavor.

So the support of a sustained sharing operation within these environments should be an important focus of modern academic research teams. In order to support research communities in dealing with challenges inherent in sharing, let's take a look at a typical collaborative research lifecycle.

From data gathering to publishing, support of this lifecycle ensures sharing with your university, other institutions, named partners, and trusted communities. With the proper technology platform and tools, the collaborative research lifecycle has an inherent workflow and logging support function that supports process compliance as well.

In addition, control, security, and identity and access management (IAM) are important aspects to consider as you support this lifecycle and sharing.

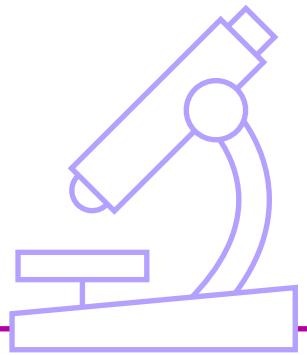
Solutions should have the ability to:

- Provide view or edit links
- Name specific users or groups
- Federate identities using proven IAM tools

Sharing creates a "virtual research environment"

The benefits of collaborative research are recognized in many disciplines, not just at the academic level. Collaborative research is sometimes referred to as a virtual research environment to emphasize true sharing – including with other academic research teams – and that joining forces can help teams go beyond their physical or institutional constraints.

But, no matter what you call it, sharing within your designated research communities can have an enormous impact on any program, and greatly accelerate discoveries.



Virginia Tech

DNA sequencing analysis can lead to medical and pharmaceutical breakthroughs, but it requires supercomputing resources and big data storage that many researchers lack. Computer scientists at Virginia Tech developed an on-demand, cloud computing model using the Microsoft Azure HDInsight Service.

Situation

- Human genome sequencing speeds disease breakthroughs, but requires costly computing power
- Medical and genome research teams around the world are limited by strapped budgets
- Virginia Tech aims to share genome tools, but other researchers may not have supercomputers

Solution

- Research team uses Azure HDInsight Service to help put Genome Analysis Toolkit in the cloud
- Virginia Tech's SeqInCloud helps run visualizations and identify cancer-causing gene mutations
- Medical researchers now have access to affordable tools that simulate lab results very quickly

Learn more

Why Microsoft?

We've explored the three action keys that can greatly contribute to the success of your academic research program – analyze, explore, share.

When your researchers have all the right tools and technologies to help them execute in each of these three areas, discoveries can be great accelerated.

So how exactly can these keys be unlocked, and what role can Microsoft play? Simply put, Microsoft provides the technology can help you unlock your academic research potential in each of these three areas.

Microsoft delivers an economy of scale that universities simply cannot match on their own, including:

- 100,000s of servers in data centers around the globe
- 99.95% monthly availability with 24/7/365 support
- Secure, on-demand access to vast storage and supercomputing resources to supplement your university's infrastructure
- No additional investment in capital assets or IT infrastructure, which frees up funding for new projects and priorities

Microsoft Azure

Academic research teams need cloud solutions that work in the way they're used to, allowing them to be off and running, and enable new breakthroughs.

Fact: Microsoft Research has more than 125 teams worldwide.

Microsoft Azure (cont.)

Microsoft Azure offers three service models:

- Infrastructure (as a Service)
- Platform (as a Service)
- Software (as a Service)

Each of the service models remove many of the IT burdens from personnel, so your researchers and support staff can focus on one thing – research. Best of all, Azure is a completely open cloud platform, and totally compatible with Linux products, including CentOS, Oracle, Ubuntu, Suse, CoreOS, and Redhat. Azure let your researchers run their favorite open-source tools and kits too, such as OpenJDK, Python, NodeJS and more, which makes for familiarity, quick adoption, and expedited processes.

Azure Data-Egress Fee Waiver

We want the cloud to work the way the academic research community works. That's why we're waiving the Internet egress fee for qualified learning institutions.

- Ensures predictability and stability in cloud costs
- Removes a significant barrier to cloud adoption, allowing researchers to move data freely
- Paves the way for researchers to accelerate the pace of the important work they're doing

Get Started

If you're a college or university administrator, and would like to begin your journey toward a Connected Campus, all it takes is three steps…

1. Identify your priorities.

2. Choose solutions that best fit the needs on your campus.

3. Talk with your Microsoft rep who can connect you with the right partners.

Or visit [URL] and fill out the form.

Sources and references

1. http://www.zdnet.com/article/cisco-projects-data-center-cloud-traffic-to-triple-by-2017/