



NORTHWESTERN
UNIVERSITY

FY16 Information Technology Planning Document

Prepared for

the Information Technology community
at Northwestern University (IT@NU)

Prepared by

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Executive Summary

This is the annual Information Technology (IT) planning document, prepared by NUIT to share our perspectives on the IT environment that surrounds us, what we've heard through our partnerships within the community, and the directions we're pursuing as a result of these inputs. The paper begins with an overarching introduction followed by four sections that correspond to the areas in the IT governance framework with a fifth section on Information Security. [A separate Appendices document](#) has expanded activity roadmaps for each area and annual reports for the IT Governance committees.

The Drivers of Change

The context for the delivery of Information Technology (IT) services at the University continues to be shaped by the significant drivers that have been present for many years. Consumerization of IT, mobility, cloud computing, "always-on," globalization, big data, social media, and information security continue to be themes that are not only discussed in the IT world, but also the mainstream press. Taken together, these drivers are creating increased demand and changes in the expectations, consumption and delivery of online services.

Within this context, the University community continues to grow larger and more diverse, both geographically and in terms of people's connections to the University. All of these people need access to University services that are or should be online, and their online identities, which provide access to these services, need to be managed well.

At the same time, the core missions of the University – Teaching and Learning, and Research – continue to be the foci of their own versions of these changes.

- The focus in Teaching and Learning has become more settled on blending the online world with the face-to-face physical world that is the strength of Northwestern, and while the intensity of the conversation around online education has receded, the overall interest has spread.
- In Research, the growth of disciplines where research focuses on or is augmented with digital content and computational approaches continues to increase, along with competition for funding and faculty, the number and sophistication of hacking attacks, the regulations that reflect this environment, and the administrative burden that accompanies these pressures.

Responding to the Drivers of Change

These drivers impact the need for IT services and the way they are provisioned at the University. Regardless of the area being looked at, our overarching goal is to provide a leading user experience so we can attract and retain the best faculty, students, and staff. To do this, we need to provide a unified common infrastructure that is secure, reliable, resilient, flexible, and innovative where strategically advantageous. Our focus, therefore, remains on addressing pressing business needs while prioritizing the foundational work that is necessary to create a new framework for responding faster and more effectively to the business needs of the University.

- *Teaching and Learning*: Supporting the degree of growth, change, and experimentation with online learning is the defining dynamic for this area. The one-year transition to Canvas increases functionality and flexibility but also creates significant additional support requirements. As the focus shifts from platform migration to pedagogical transformation, the support challenges will intensify as people learn and adapt to new platforms, tools, and approaches. Skill sets need to change across campus, better tools need to be found, and new support structures and processes need to be created within our environment of distributed and uneven levels of instructional support.
- *Research Technology*: Finding ways to scale technology investment and support efforts is imperative as the importance of shared research IT infrastructure and facilities intensifies and

spreads across research domains. The six-year funding plan for research computing began last year, providing a good base for core infrastructure. A new emphasis on engagement by NUIT A&RT with the community showed widespread results in an environment that is typically very individualized in focus. Storage remains a driving concern, and solutions in this area offer multiple opportunities. Consolidation on shared resources and engagement within the community needs to continue.

- *Administrative Systems*: Our systems that support administrative areas are functionally very capable, but the absence of integration between systems and the common infrastructure limits our agility and administrative functionality. Our administrative systems should be as frictionless and adaptable as possible (to find and use, and to develop and support), providing appropriately secure access to services and information when they are needed, and facilitating the core missions of the University. We have begun development of integrating infrastructure and services (service oriented architecture, identity and access management) and integrated data and data services, but progress is limited by competing requirements. To meet our customer service goals, a key area of focus is aligning IT services, efforts, and priorities across providers.
- *IT Infrastructure*: IT infrastructure should also support the University in a responsive, sustainable, and cost-effective manner. Recent successes – the shared virtual server environment (NUCloud), the forthcoming shared research storage service, and shared end-user support tools – need to be taken to the next level. Key elements are: developing a roadmap for the incorporation of cloud-based infrastructure; easing the many pain points associated with storage; and accelerating the capability to scale basic levels of end-user support so these tasks can be handled more effectively and efficiently, allowing resources in distributed IT units to be redeployed to higher value work.
- *Information Security*: The University’s online data and resources should be available, easy to use, and appropriately secured with risk mitigation mechanisms in place. Responding to an increasing threat landscape in a decentralized institution requires an enterprise approach to coordinate all service providers. Policies, education, and engagement are critical for success, but providing services that make doing the right thing the easiest thing is also a necessary element for an effective and sustaining information security environment. Our focus is on leveraging a more structured approach to risk mitigation, building default services and processes that scale in order to protect our most sensitive assets, and increasing foundational preventive controls.

Surrounding this foundational work are multiple levels of engagement that improve our collective ability to prioritize the most valuable topics, and to respond to the chosen targets. IT Governance remains active for educational technology, administrative systems, and infrastructure. In each area, successful work is being connected to governance involvement. Communities of Practice are growing that tie together the decentralized community on a level closer to where the work is done. Shared and federated service offerings continue to be conceived and deployed. Existing organizational lines continue to be rethought and adjusted to improve our ability to deliver services.

Pivoting to this new framework by changing our technologies, the skill sets of our people, and our processes for interacting requires ongoing commitment and a degree of patience at times. The press of everyday responsibilities to keep the organization running competes with the time and resources required to be transformational, particularly with processes that are not yet well aligned or finely tuned.

The sections that follow include work – done in FY14 and projected for FY15 and FY16 – that is transformational. However, all of that work is being done incrementally, as we look for ways to accomplish it within operational requirements and other line of business priorities. To be more aggressive in transformation, we need to be able to optimize our operational efforts, and we need to have more alignment focused on transformation activities. Conversations about increasing this alignment have begun during the fall quarter, and we are looking forward to adjusting our sights as those discussions continue.

Introduction and Purpose

This is the annual Information Technology (IT) planning document, prepared by NUIT to share our perspectives on the IT environment that surrounds us, what we've heard through our partnerships within the community, and the directions we're pursuing as a result of these inputs. This paper is intended for the IT@NU community, including our partners in schools and departments, and our governance and advisory groups.

Because the IT Governance committees are the primary forums for discussions about the enterprise IT direction, this paper is organized around the IT Governance structure, and some familiarity with the material is assumed. Our goal is to help drive strategic and the resulting tactical discussions and agendas in these forums by articulating situations, context, and recommended responses. This is not a living document, and we are not anticipating written responses. If there is something in it that you feel is particularly off target or leaves a gap that is important to fill, we welcome any and all input.

Structure of the Document

This paper begins with an overarching introduction followed by four sections that correspond to the areas in the IT governance framework – Educational Technology, Research Technology, Administrative Systems, and IT Infrastructure. A fifth section is on Information Security.

These last five sections are four pages each:

1. one page to describe the IT context and drivers in that area;
2. one page to articulate our plan for responding to this context;
3. one page to give an overview of what we did last year (FY14) within this plan; and
4. one page to highlight some of the key activities anticipated within this plan for FY15/FY16.

For those wanting more detailed roadmap information, each section has a corresponding Appendix with unabridged activity roadmaps. These appendices are consolidated in [a separate document](#). Also included in this document is an Appendix that includes annual reports from the three active IT Governance Advisory committees.

Responding to the Drivers of Change

External IT Drivers

The context for the University continues to be shaped by the significant drivers that have been present for many years. Consumerization of IT, mobility, cloud computing, “always-on,” globalization, big data, social media, and information security continue to be themes that are not only discussed in the IT world, but also the mainstream press. All of these trends are now firmly entrenched and drive how we shape our business, how we interact with each other, and what is expected regarding the delivery of services. For example:

- Cloud computing continues to grow, with Google, Microsoft, and IBM competing on a massive scale with the early leader in this space, Amazon, who now is adding enough server infrastructure each day to handle its entire 2004 e-tailing business¹.
- Virtualization continues to grow beyond the pivotal role it has in the world of servers and desktop computing. Applications and infrastructure are all becoming software defined, and a significant change in skill sets will be needed in technology organizations to take advantage of this.
- Mobility is still driving the shape of the IT landscape even though tablets' incredible sales trajectory of the past two years has weakened, as smartphone physical dimensions have

¹ <http://www.enterprisetech.com/2014/11/14/rare-peek-massive-scale-aws/>

become bigger, laptops lighter, and tablets' pace of new differentiating features has slowed. 60% of U.S. adults own smartphones, up from 45% less than two years ago,² and the tech industry is being remade, with the smartphone sector (4 billion people buying every 2 years) dwarfing the PC sector (1.6 billion people buying every 5 years).³ Wearable computing and mobile payments will accentuate this trend.

- Mobile devices and applications are becoming extensively context-sensitive, with applications being location-, time-, user-, and function-aware. These applications collect and transmit this data (which can come from people, things, or processes) to repositories, and they can drive remote analytic processes to deliver context-sensitive information to the mobile device owner or a machine. The expectation is that data is collected and used “intelligently” everywhere.
- In line with these expectations, Gartner’s annual big data survey⁴ found investment plans for big data technologies growing (64% to 73%), but still with a minority of big data projects actually deployed (8% to 13%). Companies are starting to turn from conceptual questions about how to derive value to operational concerns about data governance, and security and risk.

Information security is an even more amplified news story. Beyond issues related to the preponderance of information security breaches, the threats to facilities and delivery of services (e.g., SONY) are increasingly becoming more of a concern, and organizations are struggling with how to respond. At the same time, as firms are trying to ensure the security of their environments, there is recognition that nothing is impenetrable. As the Gartner organization stated in their IT predictions for 2015:

All roads to the digital future lead through security. However, in a digital business world, security cannot be a roadblock that stops all progress. Organizations will increasingly recognize that it is not possible to provide a 100 percent secured environment. Once organizations acknowledge that, they can begin to apply more-sophisticated risk assessment and mitigation tools.⁵

In addition to the developments in technology, people and process issues are also changing. Applications and processes are being selected or built to allow flexibility to rapidly adapt to change, agile methodology is replacing traditional development approaches, and development and operations (which used to be very discrete parts of the IT project lifecycle and IT organizations) are now often combined to speed up the production of software products and services. Reflecting Gartner’s statement above, attitudes to risk are also changing. For instance, in order to innovate quicker and have continually improved products, development times are shortening and companies are becoming more accepting of releasing software products that they know/assume will need patching/updates immediately. Similarly, more companies are becoming accepting of the risks associated with some of the new technologies (e.g., mobile devices and cloud-based services). In each of these situations, the reaction is not a simple resignation to increased risk; it is a measured and conscious acceptance of risk within a landscape that is increasingly based on pervasive digitization.

Higher Education Drivers

Within this context of growth and developments in the digital world, the core missions of the University – Teaching and Learning, and Research – continue to be the foci of their own versions of these changes.

² <http://www.pewinternet.org/fact-sheets/mobile-technology-fact-sheet/>

<http://www.pewinternet.org/2012/09/11/smartphone-ownership-update-september-2012/>

³ <http://ben-evans.com/benedict-evans/2014/10/28/presentation-mobile-is-eating-the-world>

⁴ <http://www.gartner.com/document/2841519?ref=QuickSearch&sthkw=big%20data&refval=145557356&qid=d4666ec76620e59f129f886905ec3642>

⁵ <http://www.gartner.com/newsroom/id/2867917>

Online learning changes are no longer commanding the degree of media attention as two years ago, but the trend toward online learning – in whole or in part – is still very much in play. Many students come to universities already accustomed to online learning approaches and online life in general. Universities are working to accommodate these expectations, whether by incorporating online tools and approaches into blended and active learning formats, or institutionally exploring what the right mix of online and on-campus offerings might be. Pivoting to these new approaches requires changes on many levels – in technology platforms and tools, skills, organization, policy, and investment – in order to move towards a seamless digital integration of the physical and virtual learning environments.

The research area is also very much in flux. Competition for funding is intensifying. The scale of the science and data that requires advanced infrastructure, and the number of disciplines where research is augmented with or focuses on digital content continues to grow. The regulation of sensitive data is increasing along with the number and sophistication of hacking attacks, yet facilitating collaboration with co-researchers beyond the institution continues to be critical. The administrative burden on research also continues to grow. Institutions wishing to attract and retain world class faculty need to provide an IT environment that supports research: an infrastructure that enables their work, support for unfamiliar tools and methodologies, and tools and processes that reduce administrative burdens.

Finally, change in the nature of a university community that needs access to university resources continues to drive changes in IT services. These communities are increasingly geographically diverse, with varying levels of connection to the university, e.g., external research and teaching and learning collaborators, remote faculty and students, alumni, contractors and consultants, parents, practitioners in the community, participants in community partnerships, students in short-term but recurring professional certifications, ad hoc library patrons, etc. Often the desire of a university is to interact with and track these people over a longer period of time. In a digital world, they all need varying levels of access to services that are, or need to be, online.

Responding to these Drivers

All of these trends drive IT initiatives at Northwestern, where, like most other institutions of higher learning, there is a desire to improve service offerings to help drive the core missions, to reduce duplication of services and infrastructure, and to reduce risk. The drivers combine a little differently in each area, but their impact is obvious when you look at the challenges and our priorities in each area:

- ***Teaching and Learning:*** Supporting the degree of growth, change and experimentation with online learning development is creating new demands for technology and support for faculty and students. On the technology side, the introduction of new platforms such as Canvas, Media Site and Turnitin increase functionality and flexibility, and create requirements for significant support of faculty, staff, and students. This support requires investment in time and skills development: in the exploration and application of new technologies, and in learning and adopting new approaches to teaching and learning. New alignment of support organizations and processes is required to provide these services in our environment of distributed and uneven levels of instructional support.
- ***Research Technology:*** In a time of heightened competition for research funding and faculty recruitment, finding ways to prioritize and scale technology investment and support efforts is imperative as the growth of shared research information technology infrastructure and facilities continues and spreads across research domains. Ensuring researchers have the right tools and support requires an institutional and coordinated support environment, with central IT research support resources effectively engaging with researchers who historically have worked within a more individualized research environment.
- ***Administrative Systems:*** Our systems supporting administrative areas are functionally very capable, but the absence of integration between systems and the common infrastructure limits

our agility and administrative functionality. Our administrative systems should be as frictionless and adaptable as possible (to find and use, and to develop and support), providing appropriately secure access to services and information when they are needed, and facilitating the core missions of the University. To meet these customer service goals, we are focusing on aligning IT services, efforts, and priorities across providers to ensure that the collective potential of our administrative systems is maximized, while the most important individual line-of-business needs are still met. To this end, the development of integrating infrastructure and services (service oriented architecture), identity and access management, and integrated data and data services are priorities.

- *IT Infrastructure*: IT infrastructure should support the functioning of the University in a responsive, sustainable, and cost-effective manner. Recent successes – the shared virtual server environment (NUCloud), the forthcoming shared research storage service, and the shared end-user support tools (e.g., Dell KACE, Footprints) – need to be taken to the next level. Key elements are: developing a roadmap for the incorporation of cloud-based infrastructure; easing the many pain points associated with storage; and accelerating the capability to scale basic levels of end user support so these tasks can be handled more effectively and efficiently, thus allowing resources in distributed IT units to be redeployed to higher value work.
- *Information Security*: The University's online data and resources should be available and easy to use, and appropriately secure with risk mitigation functionality in place. Responding to an increasing threat landscape in a decentralized institution requires an enterprise approach with coordination across all of those who have responsibility for information security as part of their role at the University. Policies, education, and engagement are critical to this success, and providing services that make doing the right thing the easiest thing is also a necessary element of an effective and sustaining information security environment. Our focus is on leveraging a more structured approach to risk mitigation via community partnerships targeted at our highest risks, and on building default services and processes that scale in order to protect our most sensitive assets.

In all of these areas, our overarching goal is to provide the best possible user experience so we can attract and retain the best faculty, students, and staff. To do this, we need to provide a unified common infrastructure that is secure, reliable and resilient, flexible, and innovative where strategically advantageous. Our focus, therefore, remains on addressing pressing business needs while prioritizing the foundational work that is necessary to create a new framework for responding faster and more effectively to the business needs of the University.

This foundational work comes in the area of technology (e.g., the transition to Canvas as an academic learning management system, shared storage and virtual server solutions, and the development of a new enterprise architecture with web services and a new approach to identity and access management) as well as on the people and process levels (e.g., engagement work within the research community to develop awareness and leverage individualized skills and knowledge for a wider audience, new support efforts in teaching and learning that cross existing organization boundaries, and a changing model for doing information security that expands the role of community-level engagement around risk mediation).

To respond nimbly to the institution's needs in this increasingly digital world, we not only have to have the right technology in place, but we need to ensure we appropriately develop people and processes. This translates into a need to have the appropriate skill sets and staffing models, a shared understanding of priorities, and organizations that work well together to avoid wasted time and energy from misaligned priorities and effort. Achieving success in these requires continued attention in many key areas. For example:

- *IT Governance* remains active for educational technology, administrative systems, and infrastructure, with successful work being connected to their involvement, e.g.:
 - The ETAC-led transition to a new learning management system (Canvas) exceeded expectations in campus-wide support for the direction and the resulting speed of conversion.
 - IAC is fostering the continuing trend toward shared infrastructure services, tools, and platforms, and is starting to play an active role in information security risk mitigation.
 - ASAC continues to play a role in supporting the SOA, IAM and data integration initiatives.

ASAC and IAC have created subcommittees to stay in closer touch with the business requirements and work being done in key functional areas, some of which have had relatively thin historic connections to broader enterprise coordination and support. Examples of the functional groups span the organization, including finance, human resources, the student experience, IT service platforms, and security/risk, just to name a few. Another important subcommittee is ASAC's Information Management Committee, which is tasked with helping to craft and guide a holistic approach to administrative systems information so it can be used as a strategic asset as broadly as possible, while maintaining appropriate security and controls over that information.

- The presence of *Communities of Practice* is growing across the University. Historically, there have been several such groups at Northwestern – IT support teams have participated in UNITS, and web developers have been meeting together for years -- but additional communities are beginning to emerge as the spirit of partnership spreads to researchers, application developers, marketing administrators, web service developers, and people interested in using Agile methodology to do IT-related projects.
- Reflecting the distributed nature of the University in general and IT resources within the University in particular, the delivery of services via *federation* has been promoted as part of an emphasis on developing new relations between NUIT and distributed IT units. Instead of services being offered either by NUIT in a traditional vendor/customer relationship, or by a distributed IT unit and only consumed by its own parent organization, alternative modes of delivery are being encouraged. In these federated models, shared services can be offered by anyone (though always with some form of participation by NUIT). Online forms/workflow was a new example of a federated service last year. This year a graduate student tracking system and a federated virtual desktop service are poised to launch.

An organizational extension to the idea of federation is beginning to emerge around a set of *shared user-support tools* being used on campus, e.g., desktop management (KACE) and ticketing systems (Footprints). This model features NUIT-supported technology that is individually managed and/or configured by the participating distributed IT organizations. At this point, the technology is shared, but the people and processes are still localized. The most important level of value will become available when we start finding ways to share people and processes around these services.

- *Organizational developments such as the integration of Project Café and NUIT* create more unified support for administrative applications. The Project Café example resulted in organizational integration in application development teams (Finance, Facilities, Research Administration, and Alumni Development) and reporting and analytics (Enterprise Reporting and Analytics), and the creation of a new NUIT Project Management Office to focus on cross-functional area projects. Other developments have involved staff supporting HR, Student, and Grad applications, both within central units and partnering schools.

Pivoting to this new framework by changing our technology, the skill sets of our people, and our processes for interacting requires ongoing commitment and a degree of patience at times. The press of everyday responsibilities to keep the organization running competes with the time and resources required to be transformational, particularly with processes that are not yet well aligned or finely tuned.

We conclude this section with a comment on transformation. When IT work is analyzed, it is often divided into three basic categories. Using Gartner’s terminology for these categories –we have: Run (ongoing operations), Grow (incremental growth and improvements), and Transform (innovative and disruptive solutions that give a competitive advantage). An organization’s ability to choose between these three types of work varies by an organization’s level of technological and process maturity. Less mature organizations find themselves mired in keeping the organization running, and have trouble dedicating resources to transformational work. As the organization progresses and moves up the maturity scale, it improves its ability to spend less time on keeping the organization running, and increases its ability to change the balance between these three types of activity as needed.

The sections that follow include work – done in FY14 and projected for FY15 and FY16 – that is transformational. However, all of that work is being done incrementally, as we look for ways to accomplish it within the existing set of “run” and “grow” tasks.⁶ To be more aggressive in transformation, we need to be able to optimize our “run” and “grow” efforts, and we need to have more alignment around coordinated efforts focused on transformation activities. Conversations about increasing this alignment have begun during the fall quarter, and we are looking forward to adjusting our sights as those discussions continue.

⁶ We should note that “foundational” does not always equal “transformational.” For example, not all parts of the foundational IAM initiative are transformative. Replacing the end-of-life NUValidate product is essential and has to be done, but it falls into the “Run” or “Grow” category because we already provide that service and replacing an end-of-life product, even with a better version, is not transformative. On the other hand, coming up with an IAM solution to easily, but securely, enable collaboration with external researchers around sensitive data would be transformational because it would have such a big impact on the ability of Northwestern researchers to do their research, both in terms of removing the friction from that process and reducing the risk associated with it.

Educational Technology

Context and Drivers

Over the past two years, Northwestern has been in a heightened state of engagement related to the use of technology in teaching and learning. The University has witnessed transformations in its teaching environment with the expansion of interest in blended online learning, the start of MOOCs and Semester Online, the introduction of Canvas to replace Blackboard after its 15-year tenure, and with the genesis of the Educational Technology Advisory Committee (ETAC) and multiple faculty working groups in the online and educational technology areas. Throughout this dynamic period, Northwestern's primary commitment to its historical strength of in-person teaching and learning has been affirmed, but there is now keen interest in supplementing it with effective online approaches such as blended learning in undergraduate courses or as fully online courses in some graduate professional programs. The increase in interest and discourse, and the advances in technology, are resulting in faculty experimentation with new approaches.

These are exciting times, filled with many opportunities to improve the University's core mission. Many more faculty members are actively engaged in this discourse and are exploring new opportunities provided by new learning models and technology. Our students have given the new approaches high approval ratings, and their instructors report higher levels of engagement and improved learning outcomes.

The increased attention to this area has resulted in the following major activities and initiatives:

- The replacement of our learning management system from Blackboard to Canvas in one year is a massive undertaking affecting most members of our community. Faculty and support teams are learning the new platform and transferring or creating new content. Development teams are integrating and enhancing the new platforms with established and new tools. Students are being asked to use the new platform and often have to use both platforms during this transition year.
- The changing educational technology landscape and the increased participation and experimentation by faculty is creating an increased requirement for support. This support is leveraging expertise across many units for assistance (often innovative) in faculty affairs, pedagogy, instructional design, technology, and resource access, to name a few. The new opportunities are driving the use of new and existing tools and place more emphasis on the training and support to use these tools. For instance, a faculty member should be able to edit a snippet of a lecture recorded in a face-to-face classroom, add illustrations and annotations, post it to his or her course site for students' exam reviews, and get seamless support for these activities.
- New pedagogies, new opportunities for tracking usage and outcomes, and a desire to assess experiments before their iteration require new analytics. Explorations of analytics are beginning, but the area of learning analytics, including the tools, approaches, and data sources are still primitive in the industry.
- Opportunities for providing more comprehensive faculty support in such a changing world presents new requirements for support models. An instructor's problem using Canvas' iPad Speedgrader can now be resolved at 1 AM by a quick phone call or a chat session with our support arrangement with the vendor's help desk, although more integrated and deeper support continues to be required from multiple on-campus service providers.
- Some new pedagogical approaches are complimented with new forms of interaction in the classroom. With most of the University's physical classroom spaces optimized for lecture forms of interaction, this has led to exploration of options to transform or add additional space better suited to new classroom approaches.

Vision: How to Respond

Digital engagement could be used to describe the extent to which a college or university uses digital technologies and systems to connect and interact with students, faculty, and other stakeholders in ways that effectively advance individual and institutional objectives. In a world that is both online and face-to-face, engagement is not an either-or proposition—it is about how to blend the best of both worlds to engage stakeholders....Ultimately, the goal is digital integration whereby the physical and the virtual worlds become seamless...

—Diana Oblinger, Educause President, in [Educause Review](#) (September 2014)

The concept of digital engagement reflects the commitment to maintaining Northwestern's excellence in face-to-face learning while extending and enhancing that core experience with online tools and approaches where appropriate. To be effective, the online experience needs to be done well and needs to blend well with the face-to-face experience. Developing a superior digital experience can become a competitive advantage for the University.

Our goal is to help realize the University's ambitions for an integrated and superior educational experience by creating a learning environment that is seamless, secure, accessible, adaptable, and engaging. To do this, we believe we need to focus on these three areas:

Engage with faculty and senior academic administration, fostering their innovative agenda and helping to shape the teaching and learning environment, to meet their identified needs.

This is the first and most important tenet, particularly in this time of great change. Technological innovations provide new pedagogical opportunities, and IT leadership and their organizations need to offer possibilities and advise on the adaptability of solutions. However, technology does not drive how the institution wants to change with regard to teaching and learning, and to be effective IT needs to understand with utmost clarity the direction and choices being made by the faculty and the senior leadership of the University. ETAC will be a principal coordination point for these discussions, along with the Faculty Distance Learning Workgroup, the Coordinated Services Committee for Online and Blended Learning, and the many relationships across the University and within schools.

Continue to enhance the core learning platforms, both virtually and physically.

Both virtual platforms, Canvas and Coursera are undergoing significant development by their providers. Northwestern's continued engagement with these educational technology leaders, and with the providers of complimentary tools, needs to continue. Further, development of additional resources will continue in areas such as rich media services and learning analytics.

On the physical side, the portfolio of Registrar classrooms should also evolve along with the virtual environments, led by the University Classroom Committee and ETAC. Changes will need to happen in the physical layout of the rooms and with the array of supporting and available technology.

Transform the support network to align with the new pedagogical needs

There is a voracious appetite for training and guidance on the new platforms and tools, instructional design, and on new approaches to pedagogy. How does one calibrate effective levels of support in a world where change is ubiquitous across tools, apps, and digital content, and the distribution of available support across the University's schools and departments is uneven? New skills will need to be developed, and new ways to create synergies between existing resources will need to be found, both within central University units (the Library, the Searle Center for Advancing Learning and Teaching, School of Professional Studies and NUIT, to name a few), and between and with schools.

What have we just done? (Abridged review of FY14. See Appendix I for an expanded review.)

2014 was a year of significant change on many fronts. Blackboard was replaced after 15 years of use, MOOCs were launched, the Semester Online consortium was tried and ended, faculty engagement was high, and new support partnerships were developed. For example:

Engage with faculty and senior academic administration, fostering their innovative agenda and helping to shape the teaching and learning environment, to meet their identified needs.

- Campus-wide adoption of cloud-based Canvas as replacement for Blackboard, recommended in April by the LMS Review Committee and ETAC. The successful planning by faculty, staff, and students resulted in the ambitious one-year plan to transition to Canvas being ahead of schedule. (59% of fall quarter classes had Canvas course sites.)
- Since September 2013, 8 unique [Northwestern MOOCs](#) were launched on Coursera with 4 subsequent runs; 3 more new MOOCs. 3 reruns are slated for production and launch in 2015.
- Northwestern participated in 2U's Semester Online consortium program, providing synchronous, online, credit courses before the initiative ended.
- The Office of the Provost led the Distance/Online/Blended Learning Service Center Group effort, resulting in the development of a cross-unit Coordinated Service Center that brought resources together from different parts of the University (in instructional design, learning content production, information technology, Intellectual Property, and assessment) to support these faculty-driven projects.
- ETAC and the Northwestern Classroom Committee were active in planning and engaging faculty and students in the area of educational technology.

Continue to enhance the core learning platforms, both virtually and physically.

- A dozen 3rd-party applications were licensed and integrated into the Northwestern instance of Canvas; an initial learning analytics toolset was developed in Coursera that is being repurposed to Canvas.
- Several of the early MOOC experiments have led to repurposing of the learning content and rethinking of classroom practices for on-campus Northwestern courses, with encouraging results.
- New classroom designs to encourage different interaction within class continue to be built. For example, SESP opened an active engagement classroom, and Law is constructing a hybrid learning classroom.
- A base set of Wi-Fi services is now available in all 120 Registrar-scheduled classrooms in Evanston.
- NUIT A&RT and staff from the University Library reviewed requirements for existing media management systems, and then targeted the in-house development system MediaSpace for retirement in FY15 in favor of a 3rd-party product, Mediasite, and the Library's Avalon systems.

Transform the support network to align with the new pedagogical needs.

- Two Blended Learning support specialists, and two Canvas support specialists to help with the migration to Canvas, were hired in NUIT.
- The Coordinated Service Center actively supported the development of MOOC's in a collaborative fashion across the activities of planning, production and support.

What are we doing next? (Abridged roadmap for FY15/FY16. See Appendix I for expanded roadmap.)

The educational landscape around us is still changing, the community is not unanimous in judgment of online opportunities, and the University's response to it will continue to evolve, but we benefit today from the sharpening of a shared vision among many of our stakeholders. Our top priority is moving from the transition to Canvas to the larger task of supporting the transformation of Teaching and Learning at Northwestern: supporting faculty in instructional design and pedagogical experiments, adding new tools around Canvas, and prioritizing seamless access to resources. The following recommendations, which assume continued movement in current directions and tendencies, empower our faculty to experiment with and refine their commitments to blended learning, and they represent progress towards "digital integration [for learning] whereby the physical and the virtual worlds become seamless."

Engage with faculty and senior academic administration, fostering their innovative agenda and helping to shape the teaching and learning environment, to meet their identified needs.

- Expand the current Office of the Provost program in digital education, overseen by the Faculty Distance Learning Workgroup and the Coordinated Service Center. Build partnerships with key pioneer faculty or programs. Measure the learning outcomes for Northwestern students of these next-step experiments.
- Support a process to engage faculty in discussing and determining directions, priorities, and services in the area of learning analytics. Possible directions include individual systems to identify academic progress issues, course content engagement, and mapping of student team dynamics.
- Establish a working group to identify teaching and learning needs that should be better supported by a suite of mobile applications.

Continue to enhance the core learning platforms, both virtually and physically.

- Retire Blackboard from use in Northwestern courses in August 2015.
- Encourage faculty and student experimentation by allowing access to data and Canvas APIs for approved developers.
- Advocate with our peers and directly to Instructure for continued improvements and critical additions to the existing Canvas platform, including comprehensive mobile services, improved media management services, and an improved open-services framework for learning analytics.
- Improve the University's capacity for creating and managing rich media content for instruction.
- Establish a working group to identify teaching and learning needs that should be better supported by a suite of mobile applications.

Transform the support network to align with the new pedagogical need.

- Evolve faculty training in Canvas from the current "Canvas mechanics" to higher-order features, and create paths towards blended and active learning practices.
- Strengthen coordinated consulting services and resources available to faculty for all aspects of online learning, including technology support, instructional design, assessment, etc.
- Reinstigate advanced boot camp offerings for faculty and TA's on curriculum investigations and educational technologies as a joint effort with the Searle Center and academic departments.
- Develop a distributed portfolio of services for the production of video course nuggets.

Research Technology

Context and Drivers

Multiple trends are combining to strain the ability of universities to provide for researcher needs and to impact the traditional approach of faculty using their own personal IT resources to accomplish their research objectives. Collaboration of researchers and their teams – within and across disciplines – continues to increase. More data of more types is being generated or gathered in more subject areas than ever before. Modeling, simulation, data analytics, and visualization continue to grow as standard research tools. This growth is even more significant in non-traditional computational research areas, such as medicine, social sciences, the arts, life sciences, and the humanities. Growing regulations for the management and publication of research data place additional pressures on our faculty to ensure the preservation and accessibility of the results of federally funded research, and today's information security landscape further complicates this environment with increased risk of the exposure of sensitive data and intellectual property. These, in turn, increase the requirements for institution-wide infrastructure, policies, standards, and procedures. All of this requires the broadening and development of new technology, technical skills, and best practices by researchers and the staff who support them.

Additional pressures face institutions and researchers on the funding and provisioning side of IT infrastructure and services. The traditional model for funding research is by directly supporting the researcher. This has enabled researchers to procure their own IT infrastructure, to direct funds into a shared service model with other researchers, or to commit funds to support central sustainable shared research cyberinfrastructure and services. Over the recent past, higher education has seen a trend towards more shared infrastructure with significant contributions by researchers. With the increased competition for scarce research dollars, and, in some areas of study, the reduction in the availability of funding, faculty are increasingly under pressure to sustain basic research. This creates a destabilizing element that is no longer just felt individually, but is now transferred to the ongoing development of shared infrastructure and services, which is increasingly important in attracting and retaining researchers.

Some of the pressures to provide increased on-campus infrastructure can be offset by the use of regional and national shared computing resources, which are growing in use by researchers. These facilities work well when research requirements align to these facilities or when the research requirements exceed capabilities on campus. When there is alignment, they are a great option for scaling and augmenting campus resources. However, using these specialized remote resources often requires learning new computing environments and data management methods. Thus, they come with hidden costs in agility and support.

Another pressure is that research continues to be highly differentiated and typically is a very localized experience within the University. The need for support, training, education, and consulting on fundamental tools and techniques, which vary or are applied differently across disciplines, is continuing to accelerate. To meet the growing demand within this differentiated environment, we need to find new approaches to scaling skills, knowledge, and resources.

Vision: How to Respond

Delivering shared infrastructure services, consulting, and training requires increased partnerships. These partnerships need to occur across schools, departments, and faculty to prioritize, provision, and support critical research services. Key tenants of this approach are:

Continue to refresh and build out core research computing services, while looking for external opportunities where appropriate.

With the growing need for central research services and infrastructure, we must be vigilant about maintaining them at enticing levels. When done well, these services reduce duplication, wasted resources, and risk within our schools, academic departments, and research centers.

We also must continue to explore emerging external solutions for computing and data management (e.g., cloud services managed locally, and research applications offered as software-as-a-service in the cloud). National computing centers, such as XSEDE and Blue Waters, enable researchers to explore their research at fidelity and scale that generally exceed on-campus resources. Development of regional and national partnerships also can provide access to an increased level and diversity of computing and storage resources. As our researchers continue to push requirements for research infrastructure beyond campus borders, solutions to provide support at scale will become more important.

Consolidate research onto centralized infrastructure where it is available and appropriate.

Shared services have the potential to more seamlessly enable collaboration, increase access to resources, and manage costs. These are important aspects of providing a sustainable research environment. Simply hosting research computers in the data center addresses security and compliance concerns. Consolidating these computers into shared resources provides further benefits over locally hosted workstations and servers in terms of performance, security, power, access, cooling, etc.

Value can also be gained from shared IT infrastructure in ways that do not require using a computer in a central facility. Storage is an enormous challenge for all universities, and providing a shared storage solution that is functionally attractive and cost-attractive would be transformative for the University.

In order to be successful at this, we need to reduce service barriers that impede the faculty's desires, and/or improve the incentives, to move their infrastructure to the center. For instance, direct local control can be viewed as simplifying asks, such as sharing access, doing backups (e.g., to an external hard drive), and performing upgrades or repairs. These barriers – real or perceived – need to be addressed. Developing an understanding of where natural aggregation points occur may illuminate pathways for broader access to research infrastructure.

Develop a shared vision for a new model of delivery and support of research cyberinfrastructure.

Just as research itself is becoming more collaborative, the traditional highly individualized methods of training and resource provisioning should be supplemented with a more integrated approach. A collective understanding of direction and priorities is necessary whether it is for addressing the growth in demand for advanced tools, techniques, and methodologies, for aggregating pockets of demand, or for training and support. A mixed model of central (within and beyond the campus) and distributed services and support is a logical outcome of the pressures previously mentioned.

As the central research computing staff broadens its focus from just being a technology provider to serving as an enabler to strengthen the computational research community, it will become easier to identify appropriate training, consultation, and staff levels, as well as hardware and software services. This is especially true in less understood and less supported computing arenas, such as GPGPU programming, statistical computing, social sciences, and the digital humanities.

An institutional research technology governance structure will help to surface needs and opportunities, make choices, and set priorities for the provisioning of research infrastructure and services.

What have we just done? (Abridged review of FY14. See Appendix II for an expanded review.)

FY14 was notable for the adoption of a six-year research computing funding plan, and a shift in focus for the research technology team (including redeploying a position to increase engagement) to emphasize engagement within the University and externally with the broader research community. We saw gains in both the number of researchers investing in Quest and in engagement activity across the University.

Continue to refresh and build out core research computing services, while looking for external opportunities where appropriate.

- A 6-year plan for growth and renewal of core computing, storage, datacenter, networking, and visualization services is underway. For instance, in FY14:
 - Quest 1 was refreshed with upgraded processors, with the new equipment physically rearranged in the datacenter to facilitate future expansion with less downtime. However, the excess capacity gained by the refresh was offset by increased faculty buy-in (~\$.5M in FY14).
 - Initial research networking capabilities were developed for Evanston and Chicago with funding from the 6-year plan, the NSF CC-NIE program, and the Illinois Gigabit Challenge. Worked with the City of Evanston on technical details, began build out of the core infrastructure on campus, and held initial meetings with interested researchers.

Consolidate research onto centralized infrastructure where it is available and appropriate.

- Eight new racks of server space were added to the central data center for research computing.
 - The need to expand the research co-location facility at 2020 ridge was mitigated through increased buy-in to Quest. This is the first time in several years that expansion was avoided.
- Box.com was deployed, providing improved collaborative features for researchers. Developed a research storage shared offering in cooperation with WCAS, Feinberg, SESP and the Library.

Develop a shared vision for a new model of delivery and support of research cyberinfrastructure.

- A focus on community development, training, and support lead to several advances within the Northwestern community, including:
 - An inaugural Computational Research Day was held, which increased interaction between computational researchers and other organizations on campus. We hosted or helped plan multiple boot camps, workshops, and tutorials. (See Appendix II for a complete list.)
 - The NUIT Research Computing website was refreshed to help increase awareness of IT research-related services. Created a Facebook page and YouTube channel to showcase Visualization.
- In collaboration with UIC, University of Chicago, Argonne, and Fermi, began development of an Advanced Computing Innovation Partnership proposal to provide researchers with access to enhanced research services.
- There was increased focus on engaging the broader research community in support of on-campus research computing:
 - More deeply engaged peers on sustainable methods for research computing support through the Coalition for Academic Scientific Computing. Sponsored Northwestern faculty involvement.
 - Built out a more comprehensive dialog on the importance of support beyond hardware support through Northwestern-organized events at research conferences, such as SuperComputing2014.
- Continued developing the NUIT Research Computing support team:
 - Brought in a new hire with an increased focus on building engagement, developing learning opportunities in cooperation with our researchers and schools, and driving funding sustainability for shared services.
 - Continued an active candidate search for an open position on the Visualization services team. The reduced staffing slowed outreach and adoption of visualization services during FY14.

What are we doing next? (Abridged roadmap for FY15/FY16. See Appendix II for expanded roadmap.)

Our biggest challenge remains supporting the growing number and diversity of researchers across a growing diversity of platforms. Building on successes in FY14, engagement with the research community must continue to be a top priority if we are to be successful in increasing the quality of our services and support and the participation levels of our researchers. We will continue to execute the six-year researching computing funding plan and finish use of the research network funding grants, while exploring new research networking tools, and developing a roadmap for a qualitatively broader solution for research storage. Increasing awareness and growth of visualization services will be important, and launching a research technology IT Governance committee will be a priority.

Continue to build out and refresh core research computing services, while looking for external opportunities where appropriate.

- Computational and Data Storage Services:
 - Action Phase 2 (FY15) and Phase 3 (FY16) lifecycle refreshes of Quest.
 - Evaluate Quest for support in analyzing regulated data. (FY16)
 - Provide new, secure desktop-mountable research storage services. (FY15)
 - Evaluate the ongoing fit of Vault collaborative storage alongside Box.net. (FY15 – FY16)
- Research Networking and Visualization Services:
 - Evaluate scale of need for networking tools, such as Science DMZ and Globus Online for NU. (FY15)
 - Expand research networking services to additional locations on campus. (FY15-FY16)
 - Raise awareness of emerging visualization services and expand services where needed. (FY15)
 - Plan for necessary supporting visualization infrastructure (FY15 – FY16) and staff. (FY16 – FY17)

Consolidate research onto centralized infrastructure where it is available and appropriate.

- Continue to expand power, cooling, and rack capacity to support research computing. (FY15-FY16)
- Participate in the development of the next generation of research storage solutions. (FY15- FY16)
- Clarify and promote the value proposition of central research services. (FY15 – FY16)
- Transition people on individual servers into clustered environments where appropriate. (FY15+)
- Continue to support and grow features that users need and prefer from central services. (FY15+)

Develop a shared vision for a new model of delivery and support of research cyberinfrastructure.

- Charter a formal research computing governance committee in the ITGOV structure. (FY15)
- Expand networking events, boot camps, workshops, and tutorials to strengthen relationships and knowledge in our research community. (FY15+)
- Cultivate a new peer-to-peer network of research consultants to improve support, training, and time-to-resolution. (FY15 – FY16)
- Evolve services to better address emergent needs for communication, collaboration and participation. (FY15 – FY16)
- Develop new Research Data Management Consulting Services with NU Library. (FY15 – FY16)
- Participate in proposals to meet emerging data science research requirements and training. (FY16+)
- Evaluate needs for increased support and services for across-the-board research activity, such as statistical computing, GPGPU programming, survey tools, and the digital humanities. (FY16-FY17)

Administrative Systems

Context and Drivers

Northwestern University has a wide range of administrative systems with extensive functionality, critical to supporting the mission and operation of the University. These systems include: the commonly understood “enterprise systems” supported by central units, systems that serve the broader University but are supported in business units, systems that have emerged through a decentralized fashion but have grown or are growing beyond the originating unit, and systems that continue to be used and supported by local units.

These systems are quite powerful, providing a range of functions, reports, lookups, and workflows. Despite the sophistication of these individual systems, the Northwestern community still experiences difficulty in: deriving meaningful information about university business; viewing and acting on information in real time, bringing new people into Northwestern systems (employees, collaborators, etc.) and implementing new software in the administrative systems environment.

Underlying these challenges are a variety of issues with one common theme among them: the people, processes and technologies that support the administrative function have evolved without an overall system perspective, with little integration, and often no guiding best practices or standardization.

Technology: The applications in the administrative environment are relatively self-contained, with little of their functionality or data exposed in real time for integration. This leads to a set of challenges:

- Common data elements are managed to meet the needs of their system of origin and exchange between systems is mostly via asynchronous, non-scalable, batch interfaces. This leads to difficulty reporting across systems and synchronizing data between systems.
- The inability to access data and functions within other applications restricts the ability to build workflows across systems or new applications that utilize data from multiple systems, and may result in developers duplicating functionality in new solutions.

People and Process: The people who implement, design and maintain systems (and the processes by which they do so) are primarily organized within their own functional areas, as are the user-facing processes that enterprise systems support. Notable improvements to this approach have been taken, but there is still much more to do on this front.

- Historically, planning has been done largely on a system-by-system basis, resulting in line of business needs trumping enterprise application architecture needs. This has begun to change, with a growing emphasis on enterprise planning through governance committees and cross-functional area decision-making processes.
- The teams that support these applications historically worked with a high degree of independence from other business system units, with few bridges within enterprise system teams and between teams in central IT and those distributed in the schools and surrounding business units. Efforts have begun to bridge these gaps through organizational change, new approaches to interacting, cross-system projects, and other community-building engagements.
- More sophisticated applications contain workflows for individual processes within their own boundaries, but the requisite enterprise application architecture (SOA, IAM) to enable application-spanning processes is just now being built.

Vision: How to Respond

The effectiveness of the systems environment can be measured by how well it serves the needs of the University community. Given the situation just described, there are two key goals in this area:

- Enable key business questions to be answered from a holistic perspective.
- Reduce friction in the administrative process, making tasks easier and faster to complete.

To make progress in these areas, we will pursue the following strategies:

- Create an integrated systems architecture focused on a holistic approach, connecting our administrative systems into a consciously interactive portfolio of resilient systems via the use of enabling technologies, unifying applications, and sound business practice.
- Emphasize engagement to promote coordinated planning and development. As part of this effort, we will embrace the different technologies and priorities at the University as a benefit to be leveraged, and grow skills and a sense of belonging to a bigger community by connecting the Northwestern IT population.

To achieve these strategies, we will focus on these areas:

- *Enabling Technologies*
 - Service Oriented Architecture (SOA) is the foundational methodology of this approach. It will enable real-time integration of systems and data, provide the framework to support the development of innovative tools, and provide a more unified view of institutional information.
 - Identity and Access Management will support more efficient, secure, and scalable access and identity lifecycle management, decrease implementation time for new systems, provide services to external participants more easily, and offer a more seamless user experience across systems.
- *Information Management*
 - Sound practices for classifying, integrating, maintaining, safeguarding, and providing access to administrative data will enable the University community to improve the efficiency of its business processes and measure the success of its efforts.
- *Unifying Applications*
 - Disparate data and functions need to be brought together by applications that multiply their individual value by “unifying” them, e.g., online workflows and automated processes, portal technology, and the maximization of data warehouses with effective front ends.
- *Engagement*
 - Engagement comes at many levels – IT governance, diverse involvement in strategic initiatives, integrated interactions across teams; common processes, tools, and training; communities of practice; and a project management office that fosters cross-unit interaction.
- *Disaster Recovery/Business Continuity*
 - Renewed focus on minimizing risk to business processes and information assets, and ensuring the availability of systems and data, is required to provide resiliency to the administrative systems environment.

Being successful in these efforts will allow us to:

- make decisions based on institutional information, regardless of the data’s point of origin,
- create easier-to-use user interfaces to administrative functions,
- enable the institution to be a better collaborative partner in research, teaching and learning, alumni relations, and beyond, and
- deploy solutions more rapidly and frequently with existing resources.

What have we just done? (Abridged review of FY14. See Appendix III for an expanded review.)

FY14 was a year focused on creating foundational elements in technology, people, and process. New strategic visions for [enterprise architecture and administrative systems](#), and for [Identity and Access Management \(IAM\)](#), were articulated in strategy documents. Web services were emphasized via the Service Oriented Architecture initiative. ASAC created seven functional area subcommittees to bring the pre-existing, fragmented, system-oriented oversight within the IT Governance framework, including the Information Management Committee, which is actively addressing the need for improved data integration and access.

Enabling Technologies

- The SOA (Service Oriented Architecture) initiative started to provide web services, which are fundamental across the new enterprise application architecture and its parts, including information management, IAM, workflow, cross-system automated processes, and portal technology.
- A strategy whitepaper on Identity and Access Management (IAM) was released, detailing a vision and beginning roadmap for re-architecting Northwestern’s fragmented IAM systems. Multiple identity authentication projects progressed, each designed to more appropriately target the level of identity assurance needed for the online functionality being accessed.

Information Management

- An Information Strategist was hired by NUIT.
- ASAC chartered an Information Management subcommittee to serve as an advisory governance body for the Enterprise Reporting and Analytics group and as a working committee charged with guiding improvements to the information management domain at Northwestern.

Unifying Applications

- Reporting and Analytics
 - NUIT Business Intelligence and Project Café reporting teams merged to create the Enterprise Reporting and Analytics (ERA) team. Developed an eighteen month plan for building out an integrated data environment per [the Data Warehouse and Analytics paper](#).
 - Led a multi-unit review of Tableau as another possible enterprise data analytics tool.
- Workflows - Organic growth of workflows continued around the University with the WCAS federated forms/workflow engine, and workflows in OnBase.
- Portal - A series of initial interviews was conducted with researchers and research administrators as part of an initial envisioning effort in response to requests for a research-focused information portal.

Engagement

- The Administrative Systems Advisory Committee (ASAC) chartered seven functional area-focused subcommittees (Alumni, Facilities, Finance, HR, Information Management Research Admin, and Student) designed to integrate the oversight role within IT Governance.
- A reorganization of existing units brought the Project Café teams within NUIT, creating a NUIT Project Management Office (one of whose goals is to improve customer service by enabling cross-functional-area assistance) and a consolidated Enterprise Reporting and Analytics (ERA) team.
- The directors of the enterprise system units continue to meet bi-weekly to coordinate efforts.
- The IT@NU Agile community of practice was established to provide a forum to support growing awareness and adoption of agile methodologies in software development and service delivery.

What are we doing next? (Abridged roadmap for FY15/FY16. See Appendix III for expanded roadmap.)

These two years will include increased activity in system and tools upgrades. Within this context of a heightened allocation of resources to keeping systems running, enabling technologies will remain a priority. The SOA initiative needs to continue in order to enable fundamental changes in all aspects of the University's portfolio of online services. The IAM redesign will provide more timely access to online resources and the ability to improve security around identities. The Information Management effort will show tangible progress in making data more integrated and appropriately accessible. The pace of change shown in this roadmap projects the current pace forward, without a fundamental shift in emphasis. These two years are projected to also include increasing interest in improving workflows/automated business processes, and more attention on disaster recovery/business continuity.

Enabling Technologies

- With the establishment of the services infrastructure, initial services being developed by the enterprise system teams, and training in place for the University, the SOA initiative focus will shift to getting wider involvement in the community, and from developing services for "first out of the box" projects to identifying services of highest value and getting them prioritized.
- High-level requirements identified for the replacement of NUValidate in FY15 will allow a solution to be chosen, and work to commence on this multi-year project. Parallel work will also proceed on such projects as Identity Federation, multi-factor authentication, and single sign-on.

Information Management

- Continue work, via the ASAC Information Management subcommittee, on data dictionaries, data classification, information access processes, and associated data policies.

Unifying Applications

- Reporting and Analytics - ERA will prioritize foundational work in FY15 and FY16, building significant portions of an integrated enterprise data warehouse environment, migrating current data marts and independent processes into a unified environment.
- Workflow - There is interest in implementing cross-system workflows to streamline the completion of administrative tasks (e.g., as articulated in the working group document "[A New Vision for Research Administration](#)" released in FY14). But that work is not likely to begin until staff are more available to identify critical business processes to be brought online, chose a workflow engine, and build the workflows. Until that time, NUIT will continue to monitor and support solutions being developed in the schools.
- Portal -Proposals for a research PI Portal, and a school-level institutional dashboard that aggregates management data for business decision-making are pending prioritization, though initial scoping work has begun on the PI Portal project.

Engagement

- The structure and staffing of the NUIT Project Management Office is complete. Work has begun on initial projects and a roadmap of projects is being developed.
- Continue to foster the development of Communities of Practice, where skills and knowledge can be shared, and common practices and tools can be identified.

Disaster Recovery/Business Continuity

- A workgroup will assess the current DR/BC environment and begin work to form recommendations for continuity of services and restoration of systems after significant incidents.

IT Infrastructure

Context and Drivers

Many drivers impact the IT infrastructure discussion: mobility, cloud-based services, globalization, security/compliance, consumerization of IT, digitization and big data, and ongoing changes in research computing. These drivers affect the requirements and the way infrastructure developments are provisioned on and beyond the campus with an increased direction towards the integration of new cloud solutions, and an increased direction at universities towards shared services deployed from university data centers.

This section mirrors the responsibilities of the IT Governance Infrastructure Advisory Committee (IAC). As such, it covers not only the “classic” IT Infrastructure components such as facilities, networking, and service platforms (servers and storage), but also software functions such as communication and collaboration services, process areas such as the management of personal devices (i.e., end point management), and IT service management (e.g., handling and processing service requests, building service catalogs, tracking and managing configurations).

One way of thinking about this is that the facilities, service platforms, and communications services are the bricks and mortar of the IT infrastructure, while the support processes included here make up the basic day-to-day infrastructure presumed by the services discussed here and in the other sections of this document.

Vision: How to Respond

Maintain the existing common infrastructure.

Ongoing operations are always a consuming part of an IT organization’s responsibilities. The ability to manage this infrastructure and effort effectively, directly affects the capacity to support transformation and to decrease infrastructure duplication, which, over the years, was driven in part by languishing common infrastructure. Cloud computing, shared services, information regulations, and information security are all changing the models and approaches to infrastructure maintenance. In order to avoid downtime whenever possible, we need to continue eliminating single points of failure in systems or integration points as well as designing and adopting systems so that routine maintenance does not adversely impact service delivery.

In this age of digitization, a special note on storage is needed. Digital storage will remain a constant pressure (e.g., for research in progress and completed research that is required to be archived and available for review, for library archives, and for digital media storage for academic, co-curricular, and marketing content). All of these examples are currently the focus of ongoing discussions about needs and alternative solutions, which will result in projects over the next two years.

Develop dynamically defined services.

We seek to continue moving the IT infrastructure towards the point where ultimately it allows the University to dynamically decide in response to changing conditions where services reside, their levels of resiliency and redundancy, and how they are secured. This level of agility and flexibility in resource provisioning will enable us to better absorb both spikes and valleys in demand.

Reduce duplicate IT infrastructure.

We continue to look for opportunities to decrease our fragmentation and duplication by consolidating and integrating our IT infrastructure and services. The shared services that emerge from this effort may exist either on site or in the cloud, either at the center or in a federated solution within the distributed units. This collective approach will provide opportunities to leverage increased purchasing power, free up previously duplicative effort and expenditure, and even deploy new technologies. When doing this, we need to be aware that the changes in service delivery models will require new funding models that

take into account both the added responsibilities of the providing unit and the savings to the participating units.

Look to incorporate new technologies that provide new opportunities for the University.

We not only want to look for new ways of deploying existing technologies, we also want to look for ways to succeed in using the new technologies that are driving the change and offering opportunities within them. We need to get better at identifying and assessing those opportunities and integrating them when they offer appropriate solutions. Similarly, when we assess the services we currently offer, we need to realistically consider the likelihood of their adoption if compelling consumer-oriented options are readily available. Policies, education, and engagement can affect adoption rates, but the most effective and sustaining approach is providing services that make doing the right thing the easiest thing.

Prioritize support, remove process hurdles, and reduce fragmentation and duplication of support.

Of equal importance to the technology underlying our portfolio of services is the provisioning of an effective support experience for the community. We want to make it easy for users of our services to submit service requests and have those requests addressed quickly. While progress has been made in the areas of automation and self-service, more is needed.

Prioritizing the integration of support is particularly important in a decentralized environment where services span the areas of responsibility of multiple support organizations. For example, a FASIS service is deployed on NUIT-managed servers, delivered over the NUIT-managed network, and accessed via an endpoint device that is primarily supported by distributed IT units.

Similarly, in a time when we are looking for ways to reduce duplications in our IT infrastructure and realize the benefits of more shared services, it is important to demonstrate that the basic levels of end-user support can be delivered centrally. In order to build up trust of the user community and the distributed IT units who have direct contact with this community, these processes need to be responsive and smooth, and the central organization needs to demonstrate awareness of its capabilities and its alignment with the needs of the community.

Endpoint management (i.e., management of individuals' computers, tablets, and smartphones) is a key focus of this support matrix, and every IT unit on campus has a direct role in the delivery of these services. In this era of BYOD (Bring Your Own Device), we need to remain agile and responsive in our support for the ever-evolving set of consumer devices and applications, and we need to continue to investigate the most appropriate ways to enhance data security within this context.

Actively address prioritized risks and compliance requirements.

Last, but certainly not least, in an environment of ever-increasing scrutiny on issues surrounding security, privacy, and regulatory compliance, it is essential that we identify and respond to all applicable regulations and manage any risks appropriately. Also, as mentioned above, this includes ensuring appropriately resilient systems and supporting processes to mitigate the risk of outages to our systems.

What have we just done? (Abridged review of FY14. See Appendix IV for an expanded review.)

FY14 was a year of significant progress on the IT infrastructure front. Expanded use of the shared data centers continued to grow. A new technology approach was taken for infrastructure storage by augmenting our existing solutions with the cloud-based Box.com file-sharing solution. Consolidation occurred in the collaborations environment, with multiple individual Microsoft collaboration instances migrated to the University's enterprise offering. Integration of support systems and services was initiated (e.g., Footprints and Tier 1 support for the Feinberg School of Medicine was shifted to the NUIT Support Center). Progress was made on communications infrastructure development and planning (e.g., selecting a vendor for a new Voice Platform and finding a viable solution for indoor cellphone coverage).

Maintain the existing common infrastructure.

- FY14 Wi-Fi Expansion – Campus coverage was increased to 85% of indoor space.
- Data Center – Arc-flash remediation was begun across the data center, and larger, mission-critical 1.5MW diesel generator was installed.
- Network – Obtained grant awards and began building out a research computing network, which will preserve the bandwidth available on the community network.
- SharePoint 2013 – Latest version of SharePoint deployed for faculty and staff.

Reduce duplicate IT infrastructure.

- Kellogg Exchange Migration – Consolidated existing Kellogg faculty and staff instance into the central Exchange environment.
- NUCloud – Obtained full subscription of additional units to the Phase II expansion of NUCloud.
- Research Storage – A research storage shared service offering was developed in cooperation with WCAS, Feinberg, SESP, and the Library.

Look to incorporate new technologies that provide new opportunities for the University.

- Box.com - This cloud service was deployed for web-based, cross-platform, secure file sharing for faculty, staff, and graduate students.
- Voice Platform Replacement – After issuing a bid request for a replacement system, the field of vendor respondents was narrowed down to three.
- Distributed Antenna System (DAS) – Entered into an agreement with an integrator to move the DAS project forward, completing initial carrier contract and identification of a location for centralized head end equipment.

Prioritize support, remove process hurdles, and reduce fragmentation and duplication of support.

- Continued the expansion of integrated IT support and the IT Service Management platform, FootPrints; shifted tier 1 support for the Feinberg School of Medicine to the NUIT Support Center.
- Created a dedicated permanent staff position to focus NUIT efforts in Service Management.

Actively address prioritized risks and compliance requirements.

- NMFF/FSM secure network initiative – In partnership with Northwestern Medical Faculty Foundation (NMFF) and the Feinberg School of Medicine (FSM), deployed a set of firewalls that provides secure access to NMFF clinical resources and protects FSM computers from external connections.

What are we doing next? (Abridged roadmap for FY15/FY16. See Appendix IV for expanded roadmap.)

Many of the foundational projects begun in FY14 will continue in FY15/FY16 (e.g., new Voice Platform, Distributed Antennae System, research networking build out). Successful projects in FY13 and FY14 need roadmaps developed beyond their current incarnations. For example, NUCloud needs to be positioned on a solution path that will take more cloud-based technologies into account; the SMB (desktop mountable) storage solution for research data was a good next step in the development of a qualitatively broader solution; and the common usage of the Dell KACE service management software needs to be leveraged so that people and process are shared in addition to the technology. This last example needs to be part of a broader discussion about how to streamline Tier I support.

Maintain the existing infrastructure.

- Network – Work with IAC to identify remaining upgrade sites and a path for technology upgrade of the Wi-Fi network; increase off-campus network capacity with 100Gbps links; continue build out of a separate research computing network.
- Microsoft Collaboration Suite – Pursue multiple upgrades and investigate hybrid cloud options.
- Data Center - Develop and begin implementing a long-term data center strategy, including ascertaining the University's tolerance for geographic separation.
- Storage – Be an active participant in storage-related planning for research, library archiving, and mass media.

Develop dynamically defined services.

- FY15: Develop an overall cloud services strategy in conjunction with the IAC.
- FY16: Working with the IAC and the Service Platform L3 committee, identify needs and timing for Platform as a Service (PaaS) campus services (e.g., for storage, database, development).

Reduce duplicate infrastructure.

- Continue to merge separate Microsoft instances into NUIT's Collaboration Suite.
- Incorporate planning for the next phase of NUCloud into the development of a cloud strategy.
- Finish the service definition for deployment of the SMB research storage solution, and work with the IAC to identify other leading use cases and alternative storage solutions.

Look to incorporate new technologies that provide new opportunities for the University.

- Continue the Voice Platform Replacement and Distributed Antennae Systems (DAS) projects, targeting completion in FY17.

Prioritize support, remove process hurdles, and reduce fragmentation and duplication of support.

- Review existing support models across campus, and develop a roadmap for scaling support capabilities in the center in order to reduce redundancies in the distributed units.
- Tighten integration of NUIT Cyber Infrastructure and enterprise system operations and support models.
- Develop processes to more quickly address emergent issues, such as security vulnerabilities, patching, and software updates across the infrastructure. (FY15/FY16)

Actively address prioritized risks and compliance requirements.

- Review the data center firewall architecture and associated change management process (FY15) before implementing a new architecture in FY16.
- Participate in disaster recovery/business continuity discussions in IT Governance. Articulate options for sustaining system availability and reducing recovery time, while continuing to build more automated resiliency into the architecture of new services.

Information Security

Context and Drivers

Media headlines in the last year have included multiple reports of massive cyber security breaches – Sony, Target, Home Depot, JP Morgan, AOL, Community Health Systems, and others had exposures of millions of records. Indiana University, the University of Maryland, and North Dakota University all had breaches affecting hundreds of thousands of records. The latest wave of headlines included highly publicized revelations about security vulnerabilities – HeartBleed, OpenSSL, BASH/Shellshock, and SSLv3/Poodle – that have been there for many years and put millions of computers at risk. It is safe to say that the speed and degree of infiltration into information technology systems worldwide is happening at a faster pace, and institutions are struggling to manage the onslaught.

Clearly, universities are not immune to information security breaches. Recent reports indicate that a third of all information exposed is exposed at higher education institutions. We have very sensitive data of all types – including health and financial information, student and research data, and precious intellectual property – and we are accountable to protect this data. This accountability is for many reasons, including being responsible to our stakeholders, ensuring confidentiality of sensitive business information, and being compliant with ever-increasing regulations. Complicating this environment in higher education is the need for high amounts of collaboration beyond our local institutions and geographic locations, and the decentralized nature of university information technology

In the midst of this increased threat landscape, the trend is towards cloud-based services accessed by personal mobile devices, anytime, and from anywhere. Thus, the challenge of securing our systems and data continues to grow across the board.

The good news in this bleak landscape is that we have had relatively few breaches at Northwestern, and there are positive steps being taken on many different aspects of our cyber security portfolio:

- A new enterprise security framework, based on international security standards, has been adopted at Northwestern, providing a framework for policy, standards, and practices. A risk assessment survey was implemented as a beginning step required by the new standards, and based on assessment results, actions are being taken to manage and mitigate risks.
- The University's main data center is HIPAA/HITECH compliant, and computers with research data continue to migrate to it. 53% of the center's rack space is now devoted to research computing (up from 37% just two years ago), and even more research is moving to the data center and being done on Quest, the shared high performance computing cluster.
- Leading-edge firewalls have been deployed on the network borders, providing more robust information about activity, and added functionality to block threats.
- More schools are using, and more are interested in using, centralized endpoint management software to keep the software on individuals' desktops and laptops patched.
- A pilot is being performed with the Human Resources system, requiring use of a multi-factor authentication system (DUO) to gain access to it. This will markedly lower the chances that unsuspecting victims of phishing maneuvers will have their accounts surreptitiously breached.

Even with elevated levels of due diligence and applied resources, we will only be as strong as our weakest link, and no person or institution will ever be immune from information security breaches. However, with an organized effort and some improved capabilities, we can continue to mitigate our risks and improve our ability to respond when vulnerabilities or incidents are identified.

Vision: How to Respond

Wherever possible, our best defense against compromise is providing services that make doing the right thing the easiest thing – whether that is providing scalable information security services for use by distributed units, or tools for faculty, staff, and students to use for their daily activities. Even if we do this exceedingly well, there will still be risk and compromises. In a decentralized institution that has an increasing number of services and resources being offered offsite via the cloud, an enterprise approach with coordination among resources (NUIT, distributed unit IT departments, and third-party IT service providers) is key to the success of the University’s information security practices. Additionally, it is critical that external partnerships, expertise, and resources are part of our approach to ensure we are attuned to the ongoing critical threat landscape, monitoring activities and response opportunities.

Within this collaborative context, the approach to identifying and mitigating risk must be structured.

- In order to coordinate responsibilities in the delivery of secure services, the process of risk assessment and mitigation should be structured, based on industry standards but allowing for variances in the individual business units. Scalable security will come with the ongoing adoption of these standards, consistent assignment of responsibilities at the right level in the organization, and a collective assessment and implementation of tools.
- Part of this structure will include a cyclical review of risks and mitigations in place. “Set it and forget it” is not a maxim of security.
- The community needs to be continually engaged via IT governance to jointly develop and vet security practices, identify business-driven opportunities for risk reduction, and facilitate the development of practical security measures and standards-based guidance (guidelines, standard practices, and policy) that the community is expected to follow.
- As part of this network of services, central services should be deployed when they require a high degree of consistency and can scale across the institution. These services come in different varieties. Some are the complete responsibility of NUIT; others are deployed and maintained centrally, but are deployed and administered locally. Given the decentralized nature of the University, and the desire to efficiently scale resources, both varieties play valuable roles.

Once threats have been identified and ranked, and risks have been associated with them, the choice of the most appropriate mitigations will come from three categories:

Prevention Controls

These are services and control measures (guided by guidelines, standard practices, and policies the community is expected to follow) that are designed to prevent a malicious intrusion into a network of systems and devices. Examples include software patching, data encryption, multi-factor authentication, required minimum strengths for passwords.

Activity Monitoring

Risks are often mitigated, reduced, or prevented by actively monitoring activity on the network and taking steps to shut down harmful or potentially harmful activity

Education and Engagement

A system is only as secure as the awareness and practices of the people who use it. It is vital that members of the Northwestern security community work together to build common expectations and expertise. It is equally important that the broader community understands the security implications of online actions, and the message of personal responsibility must be highlighted.

It is critical to note that no degree of prevention will insure a completely safe environment. Optimized infrastructure services, mitigation via preventative controls, active monitoring, and education and engagement are vitally important. Still, having an effective *incident and vulnerability response* protocol is necessary to respond responsibly and timely when breaches or data losses occur.

What have we just done? (Abridged review of FY14. See Appendix V for an expanded review.)

In FY14, our approach to information security focused on two overarching goals: 1) to become more structured to insure we're working on our most important risks, and 2) to employ a new, more community-based approach to information security. An initial structured survey of risk was undertaken, IT Governance was positioned more centrally to the risk identification/mediation process to help engage the broader community in the security process, the need to reduce risks around some of our most sensitive data was emphasized, key preventive processes and monitoring were broadened, and our ability to respond to breaches was improved.

Structured collaborative approach to Information Security

- Adopted the Information Security Management System (ISMS) – a structured approach to information security based on international standards -- and published the Information Systems Security Plan/Practice (ISSP/P), a compilation of all IT security policies.
- A risk assessment survey was conducted as the initial step in adopting a security framework. A report of the results was released to the IT Governance and Risk Assessment communities in May.
- Launched the Security/Risk Advisory Committee, a Level 3 subcommittee under the IT Governance Infrastructure Advisory Committee. Both committees will integrate security practices and direction-setting more closely with other IT units at the University via advisory feedback and working groups regarding information security guidelines, standards, policies, and services.

Preventive Controls

- Worked with the Enterprise System Directors to develop a patch management process guidelines document for enterprise systems.
- The Feinberg School of Medicine implemented hard drive encryption on 600+ laptops.
- A multi-factor authentication proof of concept was conducted in which NUIT and Human Relations staff used DUO to access FASIS self-service pages.
- Implemented procedures calling for enhanced blocking of malicious traffic using Palo Alto firewalls.

Activity Monitoring

- Enhanced analysis and reporting capabilities of activity at the borders of the University's network were implemented using the Palo Alto firewall.

Education and Engagement

- Published the HIPAA/ISO User's Guide, introduced a HIPAA training video, and trained several NUIT units on handling electronic Protected Health Information (ePHI).
- Increased the number of University sites using assessment services by 23% (1,700 to 2,100) through greater promotion of these services to the user community.

Incident and Vulnerability Response

- Executed remediation programs for multiple wide-scale vulnerabilities (e.g., Heartbleed, OpenSSL), providing University-wide scanning activities and reports.
- Implemented network access control (NAC) services on wireless and wired networks, which provide the capability to "quarantine" compromised devices, thereby limiting the access privileges of that device, instead of turning off a NetID or disabling a network port.

What are we doing next? (Abridged roadmap for FY15/FY16. See Appendix V for expanded roadmap.)

As the threat landscape continues to increase with multiple wide-scale vulnerabilities being identified and the nature of hacking continuing to intensify, we need to: address the highest risks identified in the risk survey, continue to increase our interaction with the community to address risks associated with a decentralized environment, increase participation in our vulnerability testing, enhance our monitoring capability, improve our ability to respond to breaches and vulnerabilities, and continue to focus on our most sensitive data.

Structured collaborative approach to Information Security

- Working with the business units and IAC, focus on mitigation efforts with the greatest risk reduction potential that were identified via the Risk Assessment survey, including patch management, end-user device encryption and management, an expanded use of multi-factor authentication, and controls around administrative access to systems with sensitive information.

Preventive Controls

- Begin using features of the network access control (NAC) solution to determine the security posture of a device before allowing it to connect in areas where sensitive data is processed or stored.
- Continue to promote the use of Dell KACE and other configuration management solutions for end-user devices as risk containment/mitigation tools.
- Adapt the enterprise system patch management guidelines for application in distributed IT units, and vet them with IT Governance in first quarter of 2015.
- Identity Management: a multi-factor authentication (DUO) pilot has been deployed in production use for FASIS self-service with 6,200+ participants. A more scalable architecture needs to be implemented so it can be deployed more broadly with a better user experience across the University.
- Develop process standards for using Box.com for storage of sensitive research and administrative data.
- Increase the number of new sites using ISS/C vulnerability assessment services on production mode systems by 20% each year. Expand coverage to include system and application development sites.
- Revise the Service Provider Security Assessment (SPSA) form/process (used to establish the security maturity of third parties providing services to the University) to increase its agility and value.
- Credit Card Processing: Participate in the University's Payment Card Industry/Data Security Standard (PCI/DSS) Council to design, implement, and maintain a PCI/DSS infrastructure with documented processes for payment card processing at the University.

Activity Monitoring

- Investigate the addition of Palo Alto firewall appliances, along with a log aggregation tool, to assist in the identification, control, and monitoring of traffic on the University's internal network.

Education and Engagement

- Identify missing documentation that would help mitigate the highest risks identified for the University. Engage the community to ascertain needs for security reporting.

Incident and Vulnerability Response

- Develop tracking and escalation processes to insure the highest level vulnerabilities are remediated once they've been identified. Expand the vulnerability assessment process so it can be a more valuable tool in responding to widespread vulnerabilities such as Heartbleed.
- Update the incident management protocol process to ensure it reflects today's requirements, and work to make it communicated, understood, and practiced.