I am pleased to be able to present this annual report of the Office of Information Technology for the 2014-15 academic year. This year was one of change for our department as we turned our planning roadmap into our road forward.

You will see in this report the outline of an organization on a journey. This year, we set down our planning tools, picked up our building tools, and began the exciting work of turning our long-range plans into tangible realities for our campus. To better support the future computational needs of our faculty, we significantly increased the resources of our Research Computing group and expanded our expertise in high-performance computing to new areas. Responding to the needs of our administrative colleagues, we created three new centers to focus on developing new capabilities in OIT and across campus that will be of high value to the University. And, of course, we continued the good fight to provide a secure and reliable technology infrastructure in an increasingly hostile cybersecurity environment.

This year also marked a significant transition in the organizational workings of OIT. Throughout this report, you will see references to “OIT 3.0.” To us, OIT 3.0 represents the evolution of OIT from a technology-oriented department to one dedicated to excellence in delivering services. Embedded in this commitment is a focus on developing a culture of continual improvement. In practice, we will thoughtfully consider our service delivery from the point-of-view of the customer, with a close eye on delivering value for them in an efficient and professional manner. The engine that will power us down this road will be our Service Management initiative, which is rapidly ramping up and expected to fully kick-off in the 2015-16 academic year.

This report also highlights a number of the important, high-impact projects we completed this year. With our partners in the Office of Finance and Treasury, we successfully completed the first operational year of Prime and our new financial systems. With Human Resources and Student Administrative offices, we completed a significant upgrade to the HR system and to the technology stack supporting all of our PeopleSoft products, which will allow us to leverage that platform in more transformative ways. With input from members of the USG, we answered calls from our students for more innovative tools and worked together to enhance the Web Appointment Scheduling System and produce Timeline—a personalized, mobile-first student calendar. We also managed over 150 other IT projects, while providing a consistently high-level of operational reliability in a very complex environment.

What you may not readily gather from the pages of this report is the hard work and dedication of the 293 OIT staff that made all of this possible. They are at the heart of OIT and it is their passionate commitment to the ideals of OIT 3.0 and our mission of service that makes our successes possible.

Jay Dominick
Vice President for Information Technology and Chief Information Officer
Administrative Information Services (AIS)

AIS provides implementation and support services for the University's administrative systems.

Research Computing (RC)

Research Computing provides computing, storage, and software infrastructure and programming services to support faculty, professional staff, and students in their research.

Office of Information Technology (OIT)

O&P is responsible for overall organizational operations and planning efforts and for facilitating major initiatives that strengthen campus-wide IT services. O&P is also responsible for administrative initiatives that strengthen the OIT organization.

Project and Technology Consulting Office (PATCO)

PATCO supports the University IT governance process, facilitates the annual campus-wide IT project selection process, and provides project management methodology and assistance to project managers to help ensure project success.
Project and Technology Consulting Office (PATCO)

PATCO supports the University IT governance process, facilitates the annual campus-wide IT project selection process, and provides project management methodology and assistance to project managers to help ensure project success.

Information Technology (IT) Information Policy and Data Governance Office of Information Technology (OIT)

Academic Technology Services (ATS)

ATS supports University teaching and learning, and faculty and student use of instructional technology. ATS also builds, manages, and supports websites, applications, and related technologies that further the academic mission of the University.

Enterprise Infrastructure Services (EIS)

EIS manages the University’s data centers, server and storage systems, and collaboration technologies. EIS provides backup/restore, database administration services, authentication systems, and essential IT security services.

Information Security Office (ISO)

The ISO addresses institutional issues of information security policy and practice, data governance, risk assessment and business continuity, as well as compliance requirements that span the University.

Support Services (SS)

Support Services provides front-line information technology support to all members of the University community.

Service Management Office (SMO)

Support & Operations Center (SOC)

OIT Solutions Center

Network Infrastructure

Software and Managed Computers

Telecommunications

Information Security Education & Outreach

Information Security Consulting

Network Monitoring

Data Center Facilities Management

Collaboration Technologies

Enterprise Servers & Storage

Systems & Data Management Services

Cloud Infrastructure

Security & Data Protection

EIS manages the University's data centers, server and storage systems, and collaboration technologies. EIS provides backup/restore, database administration services, authentication systems, and essential IT security services.

Support Services provides front-line information technology support to all members of the University community.

The ISO addresses institutional issues of information security policy and practice, data governance, risk assessment and business continuity, as well as compliance requirements that span the University.

ATS supports University teaching and learning, and faculty and student use of instructional technology. ATS also builds, manages, and supports websites, applications, and related technologies that further the academic mission of the University.
In FY14, Jay Dominick, Vice President for Information Technology and CIO, announced “OIT 3.0,” a name coined for the far-reaching initiative responsible for transforming information technology at Princeton. In February of 2015, following thoughtful and collaborative long-range planning, OIT 3.0 was launched with the formal unveiling of OIT’s roadmap. More than a direction for organizational change, the map accelerates us toward a next-generation state of IT that is service-oriented, integrated, and more secure.

A new foundation and guiding team

With OIT 3.0 planning completed, focus shifted in FY15 toward its actualization. Guided by University priorities, OIT continues to leverage game-changing technology trends. At the same time, we are analyzing the way we do business from every angle, creating a flatter, more service-driven organization that can implement solutions faster and more cost-effectively than ever before. Tomorrow’s OIT is being defined by the initiatives taking root today.

In part, our future OIT will be guided by a new team of IT architects. In each OIT departmental area, these experts will offer best-in-class insight to guide the organization forward, from application development and cloud technology to development, infrastructure, usability, and networking. Working together, architect roles will help to inform better decisions about technology in all that we do. Additional organizational changes align like functions and reduce layers of management to increase cycle times and better serve our customers.

A focus on research computing

Underlying OIT 3.0 is a commitment to building and maintaining a powerhouse computational core for research. In keeping with our commitment to invest in our faculty, research computing is central among OIT 3.0 priorities.

In FY15, this translated into the initiation of two, high-profile projects in the areas of advanced networking and distributed research computing support. Meanwhile, some of Princeton’s greatest minds are hard at work redefining the national standard for research computing. More about the OIT initiatives designed to fortify the computation core for research at Princeton can be found on pages 10-13.

Security and risk management

As the campus becomes ever more technologically driven, our vision for security grows more strategic in kind. It is incumbent on each of us to be part of that picture. Therefore, security infuses every project and process that falls under the umbrella of OIT 3.0, and we will be working with partners across Princeton to broadly disseminate vetted security policies and methodologies.

FY15 security initiatives included:

• A new methodology for security incident response
• Expanded security forensics and an enhanced risk assessment process within OIT
• Additional security positions, including one with a focus on the campus critical infrastructure (partly funded by Facilities) to establish security protocols for technology-enabled campus safety systems

As part of the restructuring of OIT, an Identity and Access Management unit was assembled to work along with the Networking and Monitoring group to ensure a stable, well-protected system.

A new Security and Enterprise Infrastructure group will work to embed security throughout the University’s cyberinfrastructure, while the Storage and Automation unit will automate and protect information through new strategies for back-ups and automation.

High-value centers: An engine for innovation

OIT 3.0 emphasizes solutions informed by data and designed for maximum impact. In FY15, several high-value services took shape, each tasked with cultivating campus-wide expertise in critical areas of IT, including:

• Center for Data, Analytics and Reporting (CeDAR)
• Project and Technology Consulting Office (PTCO)
• User Experience Office (UXO)
Turning data into insight

Data is more than a snapshot. It is an institutional resource that powers innovation and guides Princeton toward new levels of insight. In March, the Center for Data, Analytics and Reporting (CeDAR) rapidly scaled to begin creating a new culture of analytics that will shape OIT—and the way the University does business. Among its many initiatives, CeDAR will create a consolidated and accessible view of Princeton’s data to guide the organization forward.

Building a culture of data expertise

In FY15, OIT complemented its current analytics and reporting team with five additional staff who specialize in data analytics, to start. As work completes to merge data from disparate sources, CeDAR data experts will elevate campus data expertise, from modeling and architecture to Efforts To Outcomes (ETO) and predictive analysis.

To inform new levels of business analysis, SAGIT funding was also secured for two powerful tools. A metadata management application will enable curated, more usable data experiences, while Tableau for Enterprise will raise the bar for business intelligence and data visualization.

Reimagining the Information Warehouse

In FY15, major work commenced to transform Princeton’s well-established Information Warehouse into an enterprise-level data repository and analytics engine that will serve as the backbone for Cognos and Tableau-based administrative reporting. Backed by advanced data management and reporting capabilities, the new warehouse will deliver more data, from more sources, and in more combinations.

Focus on outreach

As part of CeDAR’s mission to spark a new era of data interest and curiosity, concerted outreach and training will help campus partners refine their analytical approach and use of University information in new ways.
Improving business outcomes

OIT 3.0 requires a new way of thinking, contextualizing IT projects within a broader system of technologies and business processes. The Project and Technology Consulting Office (PATCO) was launched to help OIT and its campus partners find success in an age of rapid technological transformation, wherein IT has grown indispensable.

Annual project portfolio planning and SAGIT support

PATCO facilitates the annual planning process, which this year resulted in a record 150-plus proposals. The Strategic Administrative Group on IT (SAGIT) recently refined this process to gain greater insight into true project costs and value for the largest 10-15% of projects on the IT project slate.

Technology advising and project consulting

A key design point for PATCO is the provision of a single resource to help departments guide projects through their full life cycle, from ideas to decisions to delivery. Newly available PATCO senior IT consultants are trained and certified in business analysis and project management, and can assist with a wide range of requests, including:

- Technology-enabled business process improvement
- Technology solution evaluation and selection
- Departmental strategic technology plans

Enhancing process and project management skills across campus

PATCO continues to evolve Princeton's project-management methodology and provide departments with practical tools and templates to ensure project success.

In FY15, PATCO launched a new online tool, Smartsheet, which enables collaborative and easy-to-use project planning and tracking.

In keeping with SAGIT's special focus on projects that improve business processes, PATCO also began augmenting methodology and training to include business-process analysis. This past year alone, PATCO delivered project-related training to more than 250 campus members. The Office will continue to focus on process improvements and efficiency enhancements to align OIT with University priorities.

Crafting better IT experiences

Future-focused IT assumes as a standard that user needs must be integrated into every project, informing more effective solutions. With that in mind, OIT has invested in a new User Experience Office (UXO). Leading the usability charge, UXO will enable us to continually conceptualize and deliver IT solutions with a strong value proposition.

- **UX becomes a Standard Operating Procedure (SOP):** UXO will assist in the consistent implementation of accessible technology through routine application of UX tools and best practices.
- **Building a usability infrastructure:** A process-driven approach is to include new methods, templates, and continuous knowledge-sharing.
- **Early insight:** Better decisions and project outcomes will be guided by way of ecosystem research, usability testing, prototyping, and accessibility assessment.
OIT 3.0 is about harnessing technology to create lasting value, from redefining business practices to supporting students and faculty. To achieve this, we are redefining our approach to service planning, funding, and delivery.

Service Management: Continual improvement

Service excellence requires smart, measurable tools and processes. In FY15, we are in the early stages of a complex, three-year program to transform OIT into a service-oriented organization through IT Service Management (ITSM). This will ensure that all services and investments are aligned with the strategic objectives of the University. Emphasizing principles of Continual Service Improvement, we will adopt new processes and a new operating philosophy.

Backed by SAGIT funding provided in FY15, OIT’s new Service Management Office (SMO) is an initiation point for developing standard processes to measure performance and costs. The SMO will also guide actionable communication related to these measurements, directly supporting a key University objective to drive down operational costs while elevating performance.

- **Adopting ITIL:** In FY15, OIT narrowed the search for a new ITSM management tool, based on the globally recognized Information Technology Infrastructure Library (ITIL) framework. This tool will revolutionize our approach to incident and problem management.
- **Focused change management:** We will begin to establish a new change management protocol for all departments that manage systems using an ITIL-like process.
- **New efficiency:** The SMO will introduce repeatable, proven, automated processes.
- **Higher quality:** Refined cost- and quality-tracking will drive concrete improvements and better service design.
- **Superior service:** Campus partners will be more fully supported by OIT.

In FY15, the SMO roadmap was developed based on an extensive survey of higher-education best practices. Expect to hear much more in FY16, as plans begin to actualize.

Strategic Administrative Group on IT: Aligning IT Investments

As IT at Princeton evolves as an enabler of campus innovation, the Strategic Administrative Group on IT (SAGIT) will continue to dedicate funding to projects positioned for impact. That means aligning spending with University priorities, while harnessing data to foster cross-departmental efficiencies, create cost savings, and drive productivity gains.

In FY15, SAGIT funded the following projects:

- Global Programs System
- Event Ticketing System
- Point of Sale system for Dining Services
- Graduate School data analysis and reporting
- McGraw Center video server, management and annotation system
- Alumni Tigernet system replacement
Central to our OIT 3.0 mission is to redefine what’s possible in academic research—not just in engineering and the sciences, but across disciplines. Princeton is already renowned as a center for innovation in high-performance networking and advanced research computing. In that spirit, we dedicated significant time and attention to the continued development of world-class computing solutions across campus in FY15.

**New expertise and partnerships**

In keeping with our five-year plan, OIT began its journey to deepen support of research computing through a series of new expertise areas and collaborative opportunities.

**Advanced Networking: Building the network of the future**

OIT is keeping sight of its goal to set a national path forward in the arena of high-performance computing and networking. To that end, the Advanced Networking group was born, which will draw on the expertise of some of Princeton’s brightest minds.

The group’s primary charge is to:

- Analyze the University’s overall networking needs, with a specific focus on how faculty use and move research data in the course of their work
- Study existing network traffic, while also projecting forward to prepare for future growth
- Develop an advanced framework for privacy and security that encompasses both specific research data as well as enterprise data and critical infrastructure
- Ensure smooth, secure, high-performance data movement with reliable responsiveness to user needs

Though the initiatives are complex, the goal is simple: ensure the world’s best network for the world’s best research.

In early developments, the group received NSF grant funding in 2014 for a cyber-infrastructure engineer. The two-year position was filled on June 1. In partnership with faculty from Computer Science, Neuroscience, and Physics, the cyber-infrastructure engineer and the Advanced Networking team will assess the potential of Software Defined Networking (SDN) as a way to support seamless data movement and collaboration both on- and off-campus.

Related projects will serve as a staging ground for future investments with far-reaching impact—from big-data science, like the Large Hadron Collider, to time-sensitive applications, such as real-time brain imaging.

**Thinking “Big Data”**

Another “big” development for this fiscal year was an initial investment in big-data analytics. With the support of University funding, a three-year program was initiated, during which time OIT will assess Princeton’s needs related to the handling of the large data sets that are increasingly the norm in advanced research.

In April 2015, our first big-data cluster was purchased, which stores and analyzes large sets of unstructured information. A Big Data Analyst was also brought on board to help administer the cluster and to collaborate closely with departmental researchers from economics to the life and social sciences to load and analyze their data.

As a first foray into big data, this small cluster will enable campus partners to realize what is possible, and for OIT to better understand campus needs.
Frans Pretorius, professor of physics, creates virtual space explosions for his research. Perhaps more accurately, over the last year, he made over a hundred simulations of black hole and neutron star mergers to observe the gravitational waves emitted during the collision.

Even so, the professor, whose primary research lies in Einstein’s theory of general relativity, said they are barely scratching the surface of discovering whether black holes really exist or if they only fill the imagination of science-fiction writers.

“Black holes are the most profound and bizarre predictions of relativity,” said Pretorius. “There is circumstantial astronomical evidence that they exist, but no direct confirmation. What we know for certain is there are some dark and very massive objects out there.”

“If we can observe the gravitational waves, it will be as close to seeing black holes as we see something directly in front of us,” he said. “It would be an astonishing discovery.”

To see these things, Pretorius and his group, including post-doctoral scholar Vasilis Paschalidis and former Princeton graduate student William East (now a post-doctoral fellow at Stanford/KIPAC), create simulations and calculations that produce the templates of the wave form of neutron stars colliding. One of the machines that make it happen is the Orbital computer cluster at Princeton, which connects several hundred PC-class machines through high speed Internet.

“Modern super-computing is essential,” said Pretorius. “Having local resources available, like OIT, is a great benefit and advantage for us compared to other academic institutions.”

For FY15, they were able to increase the breadth of parameters modeled, such as adding spin to the neutron stars. This allowed them to make predictions at a larger scale.

“The increase doesn’t sound like a lot of change, but it’s significant enough to make a difference to what we can observe,” explained Pretorius.

Although OIT and national resources provided five million core hours towards the research, Pretorius said they burned through those hours within six months.

“I think this shows it’s essential to have local resources,” he said. “With OIT’s support, we were able to make up the hours that national resources couldn’t provide for us.”

Through it all, higher and faster computation power is still needed. With hopes that his National Science Foundation proposal for funding will prove to be fruitful, Pretorius said they will continue to improve existing technology.

“We are still far from answering ‘the ultimate question,’ but we are moving forward,” he said.
Research Application Analysts: Fostering collaboration

Another newly formed group within the OIT fold is the Research Application Analysts group. An engine for collaboration between researchers across the sciences, the group funds shared positions between OIT and partnering departments.

Their charge is to work with researchers to translate their scientific formulas into computer algorithms. Put another way, they will translate science into new computational capabilities, and create a shared platform by which scientists across fields may benefit from one another’s work.

Experts will be brought on board to work across five disciplines, bridging the gap between the natural and applied sciences along the way. In FY15, OIT hired the first of these experts. In the coming year, additional hires will be made.

Data Visualization: Information you can see

When data is made visual, it becomes accessible to a broader range of people in a shorter amount of time. In FY15, a new partnership between the University, Princeton Institute for Computational Science and Engineering (PICSIE), Princeton Plasma Physics Laboratory (PPPL), and the Geophysical Fluid Dynamics Laboratory (GFDL) was launched to develop new tools to turn data into visualizations.

Computational scientist Eliot Feibush, who heads development of web-based software for imaging data from PPPL fusion experiments, was tapped in April to lead the new collaboration. His experience ranges from projects to help researchers visualize expected plasma flows in the International Thermonuclear Experimental Reactor (ITER) in France, to creating easily digestible visualizations that showcase climate variability and change.

The collaboration has two purposes: first, to produce scientific insights in a “human” way by making them more visual; and second, to communicate findings to both researchers and the public in a more effective and efficient manner.

Time on National Resources

The high-performance computing resources and facilities at Princeton offer best-in-class learning grounds that enable Princeton researchers to become practiced computational researchers. The experience they gain on campus resources better prepares them when competing for time on national high-performance computing resources.

University researchers have recently been awarded time on national-level computational resources:

- The Carter Group, founded by Gerhard R. Andlinger Professor Emily Carter in Energy and the Environment, tested roughly 900,000 core-hours on the Titan high-performance computer at the Oak Ridge Leadership Computing Facility.
- Jeroen Tromp, Blair Professor of Geology and Professor of Geosciences and Applied and Computational Mathematics, was awarded a three-year allocation in 2013 that will clock in 250 million core-hours on Titan. The allocation is expected to run through 2017, with an application for renewal each year.

Research Application Analysts: Fostering collaboration

Another newly formed group within the OIT fold is the Research Application Analysts group. An engine for collaboration between researchers across the sciences, the group funds shared positions between OIT and partnering departments.

Their charge is to work with researchers to translate their scientific formulas into computer algorithms. Put another way, they will translate science into new computational capabilities, and create a shared platform by which scientists across fields may benefit from one another’s work.

Experts will be brought on board to work across five disciplines, bridging the gap between the natural and applied sciences along the way. In FY15, OIT hired the first of these experts. In the coming year, additional hires will be made.

A Need for Speed: Improving Performance

Propelled with the need to run calculations faster, Jim Stone, professor of the Department of Astrophysical Sciences, decided to update his group’s existing research code and rewrite it from scratch.

“If we can improve the speed of our code by a factor of two, we can get twice as much science done.”

“Our research is in fundamental astrophysics, understanding how stars and planets form, and how matter accretes onto black holes,” said Stone. “This requires solving complicated equations describing these processes. Our approach is all computation-based. What questions we can answer, and what problems we can investigate are all limited by the performance of the software we write. If we can improve the speed of our code by a factor of two, we can get twice as much science done.”

To be able to do more science was the driver to improve a code that was over a decade old. Stone, in collaboration with Ian Cosden, a research computing software and programming analyst for the Princeton Institute for Computational Science and Engineering (PICSciE), worked together as part of the Athena MHD Code Project.

Athena is a grid-based code developed primarily for studies of the interstellar medium, star formation, and accretion flows. Athena has been made freely available to the community in the hopes that others may find it useful.

The improvement has been enabling, according to Stone. The code now runs four times faster and scales better on modern multi-core architectures than the previous version.

“It generally made our research more productive,” said Stone. “Every computational scientist recognizes the importance of performance tuning, and everyone would like a faster code. But it is so much work, it’s not the top item on most people’s priority list. The University’s resources really allowed us to make it actually happen.”

Research code now runs four times faster and scales better on modern multi-core architectures.

For Stone, one of the most important features of the OIT partnership is the availability of expertise.

“If someone like myself has to go and learn performance monitoring tools on my own, it would take so much longer compared to sitting down with an expert,” Stone explained. “So it’s uncommon for something like this to happen.”

Performance Tuning Analyst: Connecting researchers with resources

OIT is currently in the process of hiring a Performance Tuning Analyst, a new position for the organization. Funded by PriCom, the individual in this role will help researchers better capitalize on available resources, including new computational hardware.

When researchers are positioned to get the most out of their computer code, they have a higher competitive advantage when it comes time to use those resources. They are also better able to compete for allocations on the large national supercomputing resources.

6,891,600,858,116,326,228,845 floating point operations performed by TIGRESS high-performing computing systems

2,025,839,050,883,072 bytes of data stored in the TIGRESS high-performance computing facility

95,059,377,291,002 bytes of RAM provided by the TIGRESS high-performing computing systems

52,334,453,333,589 hertz of processing power available on the TIGRESS HPC systems

5,360,137 jobs ran on the TIGRESS high-performing computing systems, more than doubling job numbers from the previous year

1 new “big-data” cluster works to analyze and store large sets of unstructured information.
Global Programs System: Delivering a world of opportunities

International study and research are integral to the Princeton undergraduate experience. In support of the University’s Princeton in the World objective to encourage 44% participation growth in educational travel, OIT and the Office of International Programming (OIP) launched the Global Programs System (GPS) on July 1, 2015. Created at the behest of program-sponsoring departments and the OIP, this new solution greatly expands the visibility of Princeton travel opportunities.

GPS tracks more than 380 global programs from 90-plus countries

In direct keeping with the University’s commitment to internationalizing the undergraduate experience, this integrated platform facilitates and tracks travel for all Princeton-approved programs. Encompassing everything from study abroad and international internships to international scholarships and global service projects, GPS streamlines the application, pre-travel, and evaluation processes with:

- **One-stop shopping for global experiences**: Students can explore all University-sponsored programs from one, central source.
- **Online applications**: A single site for submitting applications means students no longer have to manage applications across multiple sites and platforms.
- **Enhanced communication**: Sponsoring departments and student advisers receive alerts when students apply, allowing for improved guidance throughout the process.
- **Travel planning and preparation**: Once a student is accepted, departments and advisers can track student progress through the pre-departure process.
- **Post-travel evaluation**: Centralized post-program evaluations will help ensure better program assessment and enhance future program development.
- **Security and compliance**: In addition to promoting an internationalized undergraduate experience, GPS increases the security of student data, while ensuring Clery Act compliance.

Currently, there are more than 380 programs spanning 90-plus countries available in GPS. Further integration with the Student Activities Funding Engine (SAFE) and course data are in the planning stages.

TigerHub Milestone: Course Planning - Year One

Development on TigerHub concluded in plenty of time for its official use by students in the fall of FY15. Built to enhance the academic planning process for students, this intuitive, self-service system saw its first use for course planning and registration as students prepared for the Spring 2015 semester. Using the new, calendar-based Visual Course Planner, students were able to create multiple semester plans, print them for advising, and send approved schedules to the course queue with a single click.

Created in partnership with the Office of the Registrar and Graduate School, OIT designed TigerHub with input from a large constituency of graduate and undergraduate students. Integrated features include grad-student preceptorials, integrated announcements, course and exam schedules, and fast access to key information.

Media Central upgrades: Managing more media from any device

In FY13, Princeton selected Kaltura to power Media Central, our video repository. In the two short years since, the number of videos housed in the main repository has skyrocketed to more than 6,500 videos requiring 9.6TB of storage. In June 2015 alone, users streamed 4.2 TB of video through Media Central, a record high for on-demand streaming to date. Added to this, the shift toward multi-device access has accelerated.

In keeping with a growing departmental demand for fast, centralized video streaming, OIT completed an upgrade to Media Central that provides a seamless online media experience for viewers on any device. Using responsive design, the interface now automatically adjusts to any screen size, creating a better digital-media experience.
WASS: Scheduling more Office Hours appointments

Student-faculty engagement is a cornerstone of the Princeton experience. In FY15, OIT responded to an Undergraduate Student Government (USG) request to enhance the Web Appointment Scheduling System (WASS), which fostered greater usage of the University’s online appointment scheduling system for office hours. Improvements included:

- **Greater visibility**: Students can more easily access instructors’ office-hours calendars.
- **Blackboard integration**: Students can now request appointments from more places. Newly integrated with Blackboard, Office Hours scheduling is available from every course site.
- **Easy scheduling**: The appointment-request process is now simplified for ease-of-use.

**Students requested more than 60,000 Office Hours appointments**

The effect of this change was dramatic: WASS-scheduled appointments increased by 20% to more than 60,000. Moreover, the number of faculty using the system for scheduling rose by nearly 200, to a total of over 700. Additional enhancements to the Web Appointment Scheduling System are planned for fall 2015.

Course technology: Building a better Blackboard

With a rise in digital information sharing and collaboration, more departments and faculty are leveraging digital technology for course planning and education. In keeping with our mission to provide strong, ongoing support to students and faculty, a significant investment of time and resources were dedicated to launching several key upgrades to the Blackboard Learning Management System:

- **Migration to managed hosting**: From increased uptime to stronger security, managed hosting improves operational efficiency and reduces local storage reliance.
- **Sites as students see them**: Instructors can now view course sites exactly as students see them, to quickly confirm that information is presented as designed.
- **Collaboration**: Each course site now has a Collaborate Room, where students can easily work together online using a simple and intuitive web-conferencing tool that requires only a browser.
- **Blackboard / USG course evaluation pilot**: A midterm course evaluation was created using Blackboard’s survey tool and piloted in the spring. The project is ongoing.

Timeline: A personalized student calendar

Better planning creates better student outcomes. Developed in collaboration with the Undergraduate Student Government (USG), the OIT Timeline project addresses a growing demand for innovative, personalized tools to help students manage their schedules.

**Wireframes show USG- and OIT-inspired mobile interface design.**

Merging practicality and convenience, Timeline delivers:

- **Custom calendars**: From a single dashboard, students can access all of their personal dates and deadlines, while receiving targeted announcements.
- **An all-in-one snapshot**: Timeline incorporates the academic calendar, course meeting times, assignment due dates, and meeting times for clubs and activities.
- **Promoted events**: Students can add advertised events to their calendars or share them with friends.
- **Control**: Each student can designate how they wish to receive certain information, such as by text or email.

In addition, Timeline simplifies planning and coordination for administrators, from setting assignment dates to distributing important announcements.

**52,639,159,296,000 student emails stored in Princeton Gmail**

**Users viewed 385,087 pages in Blackboard on the busiest day**

**Students logged 231,155 hours in at the OIT computer centers across campus**

**63,392 instructor office hours scheduled using Web Appointment Scheduling System (WASS)**

The OIT Tech Clinic helped UG students resolve 5,785 computer issues
Critical Infrastructure: A collaborative vision

A close partnership between OIT, Facilities, Public Safety, and Princeton’s research laboratories was formed to share information about operations and changes to the University’s critical infrastructure. Sometimes called the “Internet of Things” (IOT), the critical infrastructure includes regulating doors, lights, temperatures, and other networked, physical control and safety systems throughout the campus.

Improvements to the critical infrastructure began this past year with a first phase of upgrades to the Princeton Private Network (PPN). The work on the PPN, in turn, will help OIT with the design for adding resiliency to the main campus network.

The campus wireless service map shows WiFi coverage in buildings and outdoor areas across campus.

Enhancing WiFi: Meeting next-gen needs with network overhaul

To accommodate the heavy and growing reliance on WiFi service on campus, OIT has been working on a significant, multi-year project to upgrade the campus wireless infrastructure with new hardware that takes full advantage of the security and bandwidth benefits of eduroam—the global federated network access service in which Princeton currently participates.

In FY15, OIT completed year four of the five-year plan and enhanced wireless service in 30 more buildings across campus. Special outdoor WiFi enhancements at all Reunions Weekend sites were also made. These improvements enabled OIT to provide wireless service to Reunions Weekend staff in place of temporary, physical cable connections used in the past. Outdoor WiFi coverage was also extended in several locations across campus, including the football stadium.
In FY16, OIT plans to upgrade the remaining 30 buildings not yet upgraded, which will then bring this project to successful completion.

**The Resiliency Project:**
**Better, stronger, faster than before**

In FY15, OIT began work on significant upgrades to the University’s fiber infrastructure. The enhancements that are underway create stronger, faster, and more resilient connections between the network center and the rest of campus.

Fiber runs from the network infrastructure center out to dozens of buildings that serve as “fiber hub sites.” Each hub site connects a number of buildings with fiber-optic cables. The original network design relied on a single path of fiber from the center to the fiber hub sites. The new design incorporates a second fiber path. In the event of a fiber failure in one of the paths, the alternate path can maintain all of the network connections across the campus. The estimated completion date for this project is FY16.

Stronger connections are also being made between Princeton researchers and researchers in Europe and other locations around the world. OIT established a new high-speed network connection between the campus network and a major network hub in New York City, linking Princeton to a major junction of networks and the flow of scientific data from research institutes in Europe.

Amazon Web Services also connects in the New York City facility and offers computing and storage services of interest to Princeton researchers.

**Distributed Antenna System:**
**Making stronger connections**

In FY15, OIT established a Distributing Antenna System (DAS) to enhance cellular service on campus and fulfill a goal to deliver signals to lower areas of buildings where signals are often nonexistent.

OIT made progress on several fronts, establishing a second Verizon cell tower as well as adding Sprint, AT&T, and T-Mobile towers. Service improvements from this ongoing process benefit the University and the surrounding Princeton community.

OIT continues to refresh network switches to increase network bandwidth. As the campus grows faster than the natural rate of technology growth, it is crucial to replace old technology networks that provide WiFi service and bring those to a new standard. In FY15, OIT upgraded the switches in several of our campus buildings.

**Security: Raising awareness with training and outreach**

OIT sponsored a number of workshops and programs designed to share information about safeguarding information. In this age of cyber attacks and identity theft, everyone at the University has a stake in information security.

In FY15, 235 University technical staff attended four security courses sponsored by OIT:

- **Data Breach Risk:** 2-1/2 day, hands-on course given by iScan; 85 participants
- **Security Essentials:** 2-day course; 40 participants
- **Yosemite Security:** 5-day course; 25 participants
- **Windows 10 Security:** 1-day session; 85 participants

**OIT-sponsored conferences host more than 300 attendees**

**Web Security Day:** 165 attendees participated in hands-on workshops held throughout the day. Kevin Johnson, CEO of Secure Ideas, opened the conference with his keynote on “Holes in the Net: Detangling the Web and Security.”

**SCAD/DCS Security Day:** The day-long event, with the overarching theme of “It’s all about the Data,” was host to 160 attendees. Technical specialists from across campus shared ways to secure data, protect data, transport data, and more. Ed Felten, Robert E. Kahn Professor of Computer Science and Public Affairs and Director of the Center of Information Technology Policy, explored the topic of Internet privacy with conference attendees.

**2,654 files** were safely and privately sent and received using Princeton’s SecureSend service

**423 Uninterruptible Power Source (UPS) units** protect against power loss and surges

**5,850 wireless access points** work to speed network traffic on campus

**75,712 devices** are registered to the campus network

**75.18 miles of fiber optic cable** connect the campus to the network

**1,928 databases** centrally managed by OIT

**8,761 user computers** backed up to the computer backup system
New chapter for Peoplesoft at Princeton

In FY14, a SAGIT-funded program was initiated to strengthen our long-term investment in PeopleSoft Human Capital Management (HCM) and Campus Solutions (CS) systems. This program included several independent but interrelated projects, all of which went live in July.

HCM upgrade enhances user experience

Central to the program was the upgrade of the PeopleSoft system that supports our Human Resources function—HCM. Bringing the HCM system to the most current version ensured our compliance with vendor support and legal regulations, while providing new features and system enhancements for our users.

In particular, faculty and staff will notice improvements to the Human Resources Self Service module—where users review and manage their personal information, benefit selections, payroll information, and leaves. With new Self Service features, campus users can:

- Use Paycheck Modeler to calculate the effect of potential changes to earnings, deductions, and/or tax withholdings on a paycheck
- Designate multiple direct deposits
- Submit NJ and PA W-4 online forms
- Forecast available vacation and sick time

Administrators also benefit from efficiencies introduced through tools designed to streamline payroll and hiring business processes:

- A new Payroll WorkCenter: A single location offers quick and easy access to the processes, reports, and inquiries Payroll staff use most often.
- A quick hire form: Fields required for hiring are now gathered into a single, scrollable page, simplifying tab-to-tab navigation of the past, and streamlining and expediting the hiring process for HR staff.
- An institute directory: A visual directory for central HR administrators, that shows a graphical representation of University departments and staff reporting relationships, with drill up and down functionality from any level in the chart.

Information Warehouse

The Information Warehouse for HCM/CS data was rewritten to load data from two environments using a new ETL (extract-transform-load) tool. A new data model with significant improvements was also created to benefit current and future reporting needs.

Separation leads to future system evolution

As a prerequisite for the HCM upgrade, a related project was completed to separate HCM from Campus Solutions (CS)—the system that supports the administration of student and applicant data.

Significant OIT resources were dedicated to this effort, which divided the complex, multi-layered environment that had been integrated since 2001. The now separated systems are backed by identical technology stacks, and set the stage for continuous system improvement and evolution for the foreseeable future.

Interaction Hub: A custom view for everyone

While the HCM/CS system split was a necessity, the separation afforded the opportunity for OIT to implement the Interaction Hub to create a single point of entry for all HCM and CS users.

In the fall of 2014, students were the first to experience the benefits of the Interaction Hub with the newly designed TigerHub and Course Planner. TigerHub gives students quick access to everything they need to do in PeopleSoft, from one central location, in an intuitive, easy-to-use interface.

In FY15, the PeopleSoft entry pages, also known as ‘landing pages’ for faculty, employees, and administrators were redesigned in the Interaction Hub. In addition to providing fast-track access to essential user-specific tools and delivering targeted announcements, the new pages feature the standard look-and-feel and framework with links to central University places, such as Time Collection, Prime, and the Information Warehouse, to name a few.
Drupal: 24/7 support and templated solutions

As Drupal takes the stage as Princeton’s preferred content management system (CMS) for departments, programs, and centers, we continue to invest in its performance capabilities, and ease-of-use.

Drupal to the Cloud

Cloud-based hosting offers a range of advantages over local hosting. As such, OIT’s Web Development Services group, has been engaged in the large-scale project of moving approximately 50 OIT-managed Drupal sites to a Drupal cloud service. Part of the OIT 3.0 initiative to align Princeton with IT best practices, this transition promises:

- **Improved security**: Cloud-based sites are monitored and protected 24/7, without the need for a large roster of locally based resources.
- **Faster incident response**: With 24/7 oversight, incidents and outages can be identified and addressed in a manner of moments.

Drupal template sites

Launched in March 2014, Princeton’s Drupal template sites continue to grow in popularity among campus partners seeking a self-service website development solution. Aligned with security standards and offering themes approved by the Office of Communications, the program allows partners to get up and running creating a site within days. Hosted, maintained, and protected by OIT, time and cost efficiencies will only deepen as the program continues to mature.

The templates are continually enhanced based on customer feedback. The customer-based improvements made this year include:

- Template upgrades
- New layout options
- Ability to share news and events between sites
- Training program for creating websites based on OIT-designed Drupal templates

WDS offers no-cost template site support, and in FY15, a new Drupal Template training program was launched. On-site training sessions were conducted for three large groups of template-site users. To expand the Drupal knowledge base across campus, three additional training sessions were held for departmental technical support staff. To date, more than 50 sites have been created.

Prime’s First Year: An update

FY15 was the first official year of Princeton Prime, launched on July 1, 2014. Advancing the University with an entirely new financials management system based on PeopleSoft 9.2, Prime underscores a commitment to data-driven financial stewardship in support of University administration, research, and learning. It also marks a great leap in security and compliance, while laying the foundation for user-experience improvements.

User-driven enhancements

Following the successful completion of the post-launch shakedown period, which concluded at the end of 2014, a series of upgrades were deployed to help Princeton fully leverage this modernized system. Based on departmental and user feedback, Prime-generated reports were greatly improved. Agility enhancements to batch-processing were implemented. Additionally, support continued for systems dependent on Prime data for reporting.

Preparations for FY15 fiscal closing

In the run-up to July 2015, when the first fiscal year-end close using Prime was to take place, numerous measures were taken to ensure optimal performance. This included the implementation of new functionality, data clean-up, and a dry run designed to flag and remediate any issues prior to the year-end closing.

16 departments were involved and collaborated on the PeopleSoft HCM/CS upgrade and split

96 people from departments and OIT contributed to the success of the HCM/CS upgrade and split

3,731 undergraduate students used TigerHub in the spring to register for fall FY16 courses

265 members of the campus community attended 21 sessions of Drupal training offered by OIT

50 OIT-managed Drupal sites scheduled to move to the Drupal Cloud service

11,477,010 valid chart field combinations in Prime

2,414,018 journal lines posted to General Ledger since Prime go-live
OIT by the numbers

52,639,159,296,000 bytes of undergraduate student email stored in Princeton Gmail
14,709,831,680,000 bytes of faculty, staff and graduate student email stored in MS Exchange
13,903,882,878,976 bytes of data in centrally-managed Oracle database environments
5,508,553,255,157 bytes of data in centrally-managed Microsoft SQL Server database environments
66,571,993,088 bytes of data in centrally-managed MySQL database environments

247,063,002 email messages passed through spam/virus filtering systems
7,147,112 sheets of paper printed to cluster printers by students
6,059,010 files stored in the new Princeton Google Drive
5,189,078 in funding awarded to undergraduate students through the Student Activities Funding Engine (SAFE)
4,685,017 documents managed in the OnBase Document Management System
3,756,799 email messages quarantined by Princeton Proofpoint
3,148,224 unprinted pages saved by print release stations and technology
2,702,771 Princeton Mobile site page views
1,674,766 unprinted color pages saved by print release stations and technology
1,376,716 print jobs submitted to OIT cluster printers, by students
1,290,651 calls handled by the Unified Messaging system
995,393 reports generated from the Information Warehouse
828,620 documents brought into the OnBase system in FY15, alone
385,087 page views in the Blackboard Learning Management System on the busiest day
225,443 in funding awarded to undergraduate groups through the Student Activities Funding Engine (SAFE)
187,102 hours spent logged in at the OIT cluster computers across campus
113,991 logins into OIT cluster computers across campus
113,097 requests for assistance logged in OPM, and addressed and closed by support staff in the various departments of OIT
89,492 sheets printed to the color OIT cluster printer
85,338 donations processed by the Stripes system
84,406 average daily page views in the Blackboard Learning Management System
80,643 print jobs sent to printers at the OIT computer clusters using the new mobile printing service
75,712 devices registered to Princeton’s network
63,392 office hour appointments scheduled through the OIT Web Appointment Scheduling System (WASS)
55,019 OPM tickets for assistance addressed and closed by the OIT Support and Operations Center (SOC) 24/7 resource
54,848 documents served through the Information Warehouse
48,375 network connections
21,044 calls to 8-HELP requesting technology assistance from OIT Support and Operations Center (SOC) consultants
54,848 documents served through the Information Warehouse
48,375 connections and 1,988 switches help run our campus network
21,044 calls to 8-HELP requesting technology assistance from OIT Support and Operations Center (SOC) consultants
14,154 unique client IP addresses served through Princeton’s CAS authentication system, of which 7,421 are non-Princeton addresses
10,588 university machines protected by campus security management software
8,761 user computers backed up to the new Crashplan backup system by June 2014
7,507 students printed to OIT computer clusters printers
7,450 check-ins for computer support at the OIT Solutions Center Tech Clinic
5,861 wireless access points strengthen and speed the campus network
5,785 undergraduate students sought technical assistance from the OIT Solutions Center Tech Clinic
5,291 University computers centrally managed and kept up-to-date by OIT
4,743 requests for hardware support addressed by OIT Hardware Support staff
3,281 requests for technology help through online chat with the Support and Operations Center
1,928 databases centrally managed by OIT
1,653 undergraduate students requested activities funding through SAFE
1,633 sensitive files were securely received using SecureSend services
1,201 requests for software support addressed by OIT Software Support staff
1,170 virtualized servers run on 23 centralized servers
1,021 sensitive files were protected and securely sent using SecureSend
927 clients actively use OnBase as their document management solution
528 technical support staff from OIT and the SCAD/DCS community use remote support capabilities to provide technical support to the University community
423 Uninterruptible Power Source (UPS) units protect campus technology protect against power loss and surges
422 Purchase Orders were created by the OIT finance group
407 requests to borrow mobile technology from the Mobile Technology Loaner program
353 Requests for new servers, of which 97% are requests for virtual servers
130 undergraduate groups requested funding through the Student Activities Funding Engine (SAFE)
110 database servers centrally managed by OIT
78 percent of the total visits to the OIT Solutions Center Tech Clinic were by undergraduate students
75 miles of fiber-optic cable connect technology on campus
23 centralized servers run 1,170 virtualized servers
1 OIT organization working toward OIT 3.0
The University is currently developing a new plan that will establish a framework to guide the growth and changes of the campus from 2016 through 2026. The 10-year plan with a 30-year view is the first strategic plan the school has done in many years and will have major impacts on the nature of the school itself.

The plan will consider what can be done with the physical lands the University owns, as well as how it is going to make major investments in its infrastructure. This includes but is not limited to heating, cooling, electrical, storm water, and transportation—all the components that make the city we have here.

A significant component of the strategic process is the infrastructure plan, in which OIT plays an important role. What has become clear during the course of planning is nothing will work in the future unless there is information technology to support it. The “City of the Future,” where sustainability goals are driven by its ability to monitor and control physical devices, is dependent on the network provided by the Office of Information Technology (OIT).

OIT has been working in close partnership with Facilities throughout the year to put together strategies for the campus-wide master plan. As part of the process, the Infrastructure Master Plan Advisory Group was created with a mix of faculty members and external experts to discuss potential opportunities.

The group broke down the strategic planning into four phases:

- To get everyone’s feedback on what they think the future will be like.
- To come up with basic strategies.
- To evaluate those strategies against the sustainability goals the University has planned.
- To figure out how the group should decide between the potential choices.

Rethinking the way we deliver data through our network

OIT has investigated new areas where more innovative and sustainable projects can be utilized. One of those areas includes updating the campus network design that was created nearly 30 years ago. When it was first implemented, a network core was built on one end of campus and “network boxes” that provided the Internet connections were scattered across campus buildings.

The new Passive Optical Networking pilot program seeks to cut out all the “network boxes” that consume power and use existing fiber to directly connect the network core to each individual user. This will help OIT rethink the way the network delivers its data, increase performance, and reduce the energy footprint within the network. OIT also seeks to increase reliability and lower maintenance costs. While OIT works to make everything else efficient, it is also important to have an ongoing project that can help determine how much energy the OIT infrastructure uses and to think about the sustainability of the network itself.

### For our campus

### The Campus Plan

Elie Bou-Zeid, Associate Professor of Civil and Environmental Engineering
Princeton University

Teresa Carlson, Vice President
Amazon Web Services Worldwide Public Sector

Mung Chiang, Professor of Electrical Engineering
Princeton University

Stuart Feldman, Vice President
Google

Florence Hudson, Senior Vice President and Chief Innovation Officer
Internet2

Margaret Martonosi, Professor of Computer Science
Princeton University

Kevin Ressler, Director
Global Application Engineering Broadband Network Solutions Commscope

Jen Rexford, Professor of Computer Science
Princeton University