EXTERNAL REVIEW
OF
UNIVERSITY INFORMATION TECHNOLOGY DEPARTMENT

Prepared for

KUTZTOWN UNIVERSITY

Kutztown, PA

July 27, 2017

In Response to

KURFP-0259

REQUEST FOR PROPOSAL

VANTAGE

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1. Introduction

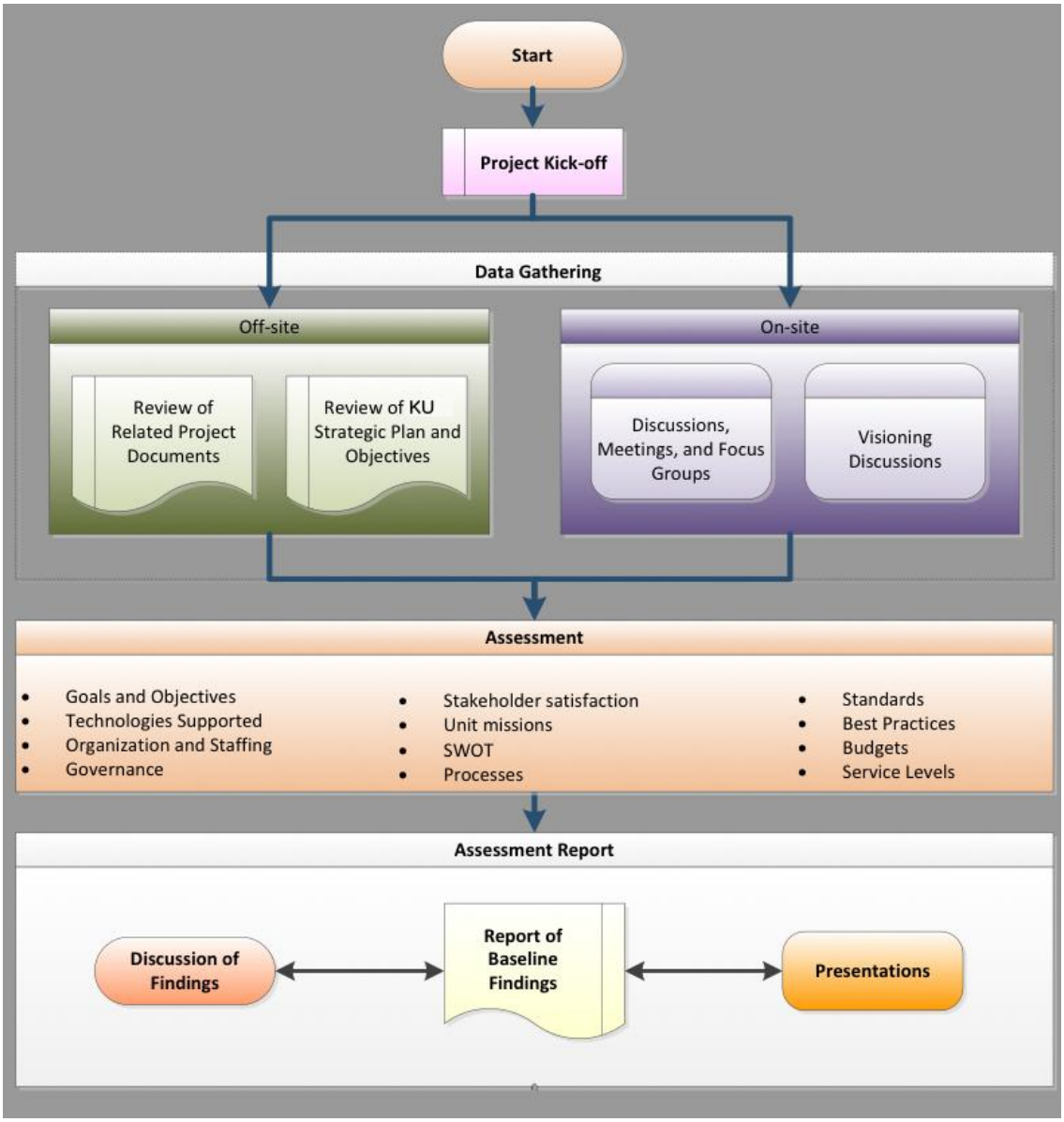
Vantage Technology Consulting Group (Vantage) was hired by Kutztown University (KU, the University) to provide an independent assessment of the state of information technology (IT) at the University. We have, in a few cases, gone beyond the scope of a review or assessment to make some priority recommendations. At the top of the list of these is the need for strategic leadership. In doing so, we need to stress that we are *not* advocating "disruption." Disruption as an approach to change in higher education IT is very much in vogue. And it has its place in some schools. But not at KU.

What Vantage found at KU was a dedicated and cohesive team of IT professionals achieving impressive results given the resources available to them. We therefore believe that change in KU IT should be evolutionary, not revolutionary. Change that is not thrust upon the staff, but carried out with and by them.

Vantage would like to stress that this is a current-state assessment, relying on the documentation provided and interviews conducted. It is not a planning document or a roadmap forward: although going somewhere, it is always a good idea to know where you are first. Without interactive planning sessions leading to a coherent vision for IT at the University, it is inappropriate for Vantage to make detailed recommendations.

2. Methodology

The diagram below is a visual representation of Vantage's methodology. Descriptions of the tasks involved follow the diagram.



Many of the tasks listed sequentially below were conducted in parallel (e.g., interviews and meetings overlapped document gathering and site inspection activities).

Task 1 Project Mobilization

The Vantage team and the KU project team met via videoconference and reviewed the project goals, schedule, desired outcomes, and information to be gathered by Kutztown University Information Technology. The joint team also set dates for the Vantage on-campus activities.

Task 2 Data Gathering

The next step in our proven process utilizes a four-pronged approach to data gathering:

1. Gathering of existing documentation (see Appendix A)
2. Review of EDUCAUSE Core Data for Kutztown and Peers
3. Physical inspections (of data centers, server rooms, critical wire centers, and switch rooms, and spot-check a reasonable sampling of distribution closets, building entrances, etc. We also inspected sample office spaces, classrooms, and collaboration spaces.)
4. Meetings and interviews.

The on-campus activities (3 and 4 above) were conducted during two on-site visits April 17-9 and May 4-5.

Stakeholder Meetings

April 17	Cabinet, Academic Technology Committee, Administrative Offices
April 18	3 groups of Faculty, Students, Provost
April 19	AFSCME, Library Staff, Deans, Associate Deans, Registrar, Institutional Research
May 4	Provost, Budget and Financial

KU IT group meetings (including groups outside Central IT *)

April 17	Systems Administration and Integration
April 18	Help Center, Distance Education*
April 19	Web group, Enterprise Software Development, Distributed IT Personnel*
May 4	Network Technology, Enterprise Software Development, Contracting and Administration
May 5	Distributed IT Personnel*, Systems Administration and Integration, MS Windows and Apple Support and Labs

Physical Inspections

April 17	Data Center, North Campus
April 19	Library

Task 3 Develop Current State Assessment

Vantage worked with the information gathered to develop a description of the current KU IT organization and the services it provides.

Task 4 Assessment Report

Vantage provides this assessment of the present organization, staffing, structure, and business processes of KU IT. It will also report on the perceived strengths and weaknesses of, challenges to, and opportunities for KU IT.

Vantage provided a draft of this report for review and comment. We then discussed our findings with appropriate personnel and made revisions as necessary.

3. Findings

3.2 Goals of the IT Review

3.2.1 KU IT Services Operational Review:

"Identify IT services and make recommendations that would elevate the value of Information Technology throughout the institution.

Conduct a review that will convey the proficiencies of the IT organization, and the university IT service stakeholders, while making recommendations to mitigate existing deficiencies."

We discuss in this section aspects of IT at Kutztown University that transcend the listing in section 3.3:

- The resources, both human and fiscal, available to the IT department
- The differences between strategic and tactical thinking and action, and
- Security, which is called out 6 times in different subsections of section 3.3, but needs to be considered globally.

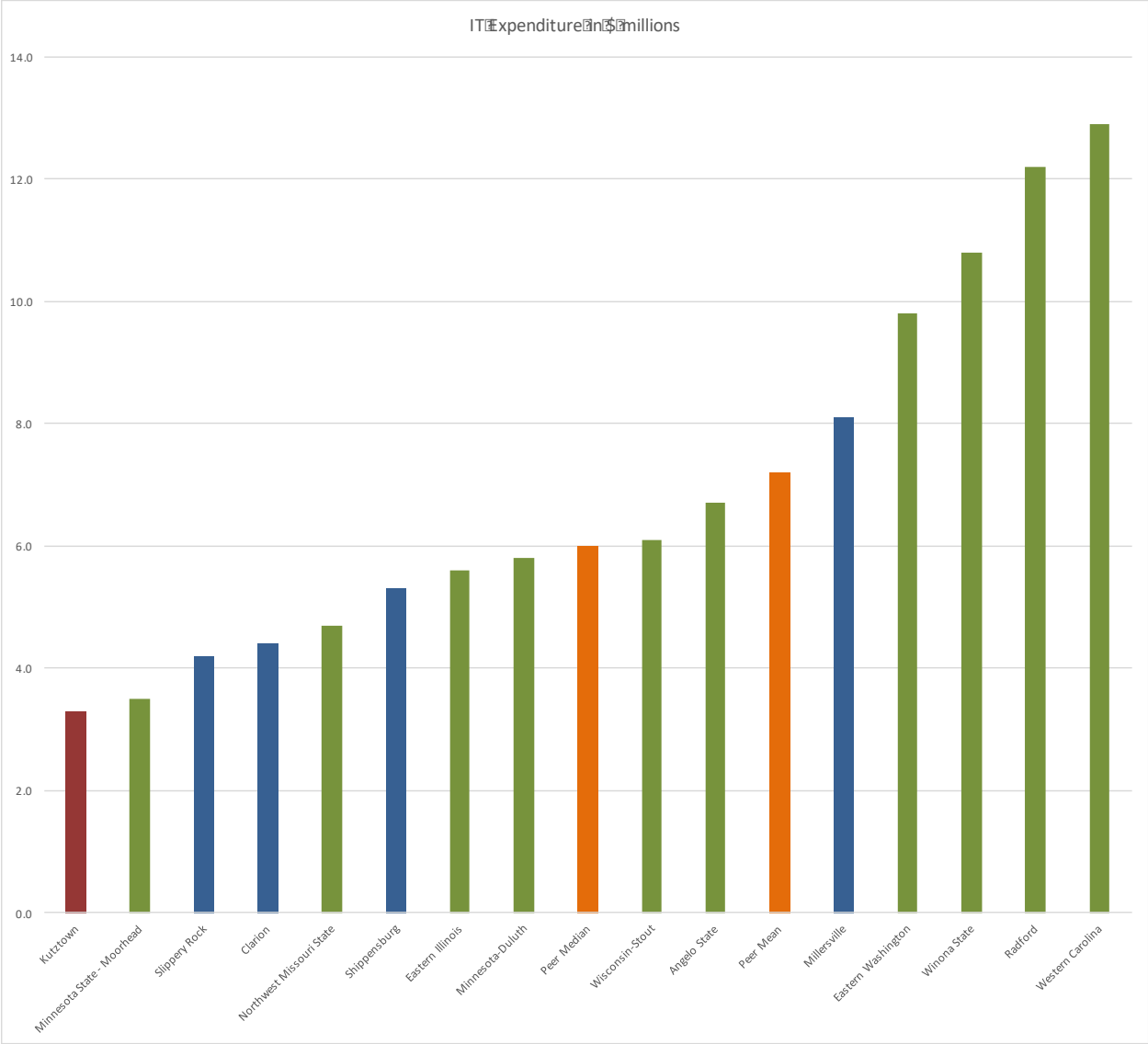
Resources

Vantage has reviewed the human and financial resources of KU IT via the data for the 2015 and 2016 fiscal years as submitted to EDUCAUSE for the Core Data Service (CDS).

We compared the KU IT financial and human resources data against the information submitted by the primary and PASSHE peer institutions as defined by KU. The universities are listed in the table to the right with whether they submitted data (✓)to each year's survey or did not submit data ( ). Below we omit the 3 institutions that did not submit data for 2015 or 2016.

In general, we have relied on the 2016 data, but for Northwest Missouri State University and University of Wisconsin-Stout (which did not complete the 2016 survey), we have cautiously included 2015 data. To adjust for this in financial figures, we have used the available amount (whether 2016 or 2015) if only one was available, and the average where we have both numbers. This is a valid statistical approach to missing data.

PASSHE Peers	2016	2015
Bloomsburg University		
Clarion University	✓	
Edinboro University		
Millersville University	✓	
Shippensburg University	✓	✓
Slippery Rock University	✓	
Primary Peers	2016	2015
Angelo State University	✓	✓
California State University-Bakersfield	✓	✓
Central Washington University	✓	✓
Eastern Illinois University	✓	✓
Frostburg State University		
Minnesota State University-Moorhead	✓	
Northwest Missouri State University		✓
Radford University	✓	✓
University of Minnesota-Duluth	✓	✓
University of Wisconsin-Stout		✓
Western Carolina University	✓	
Winona State University	✓	✓



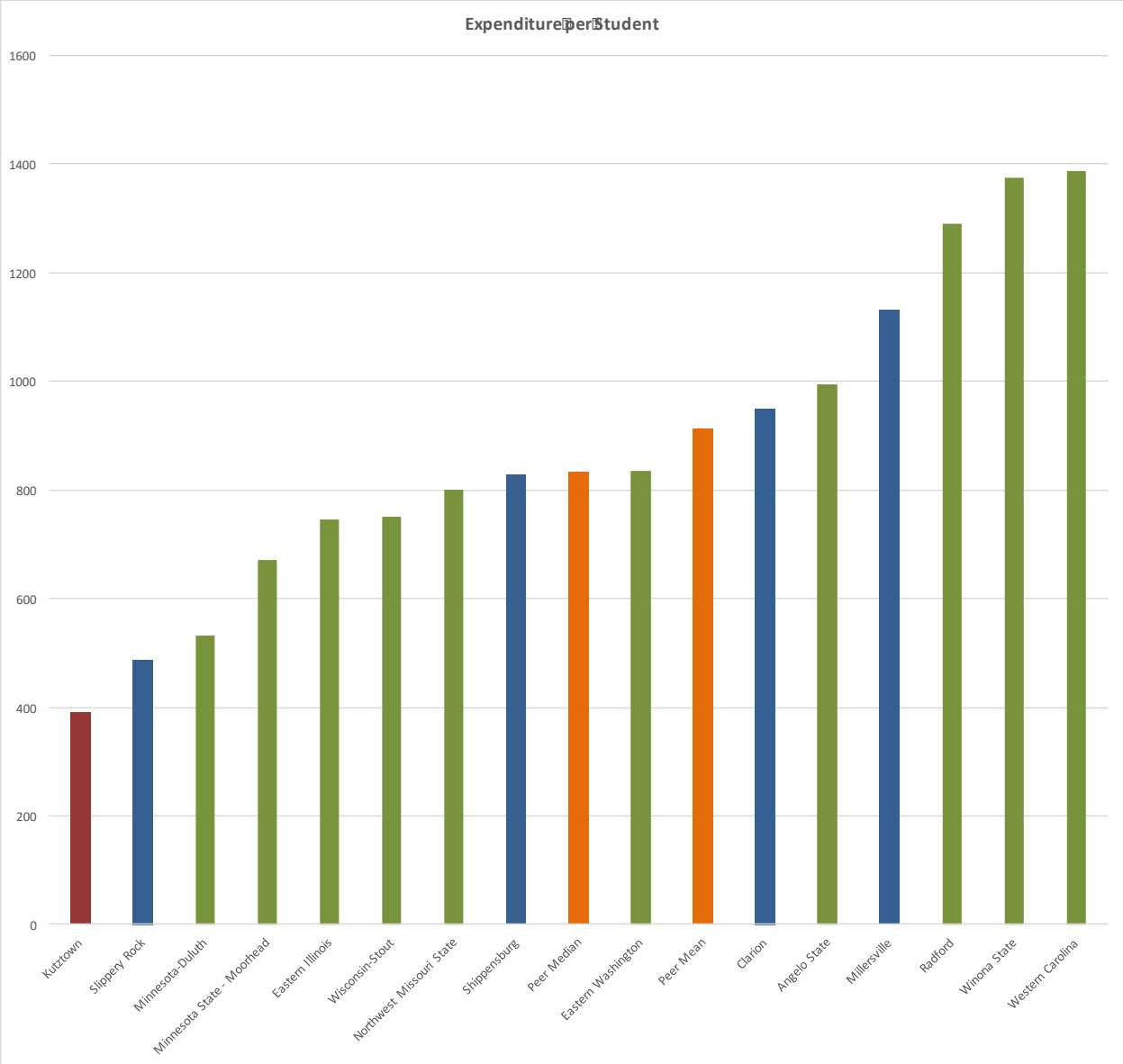
Financial Resources

Baldly stated, Kutztown's expenditures are the lowest amongst the peers considered. Kutztown spends on central IT only 46% of the peer median and just squeaks over half the median at 55%. There is some variation in the responsibilities of central IT between schools, but that does not explain this disparity in spending. The graph above shows expenditures per school (computed as explained above to account for missing data).

- Kutztown is shown in red
- the 4 PASSHE schools chosen as peers that submitted CDS data are shown in blue
- the ten primary peers are shown in green
- the mean and median of the peers, not including KU, are shown in orange

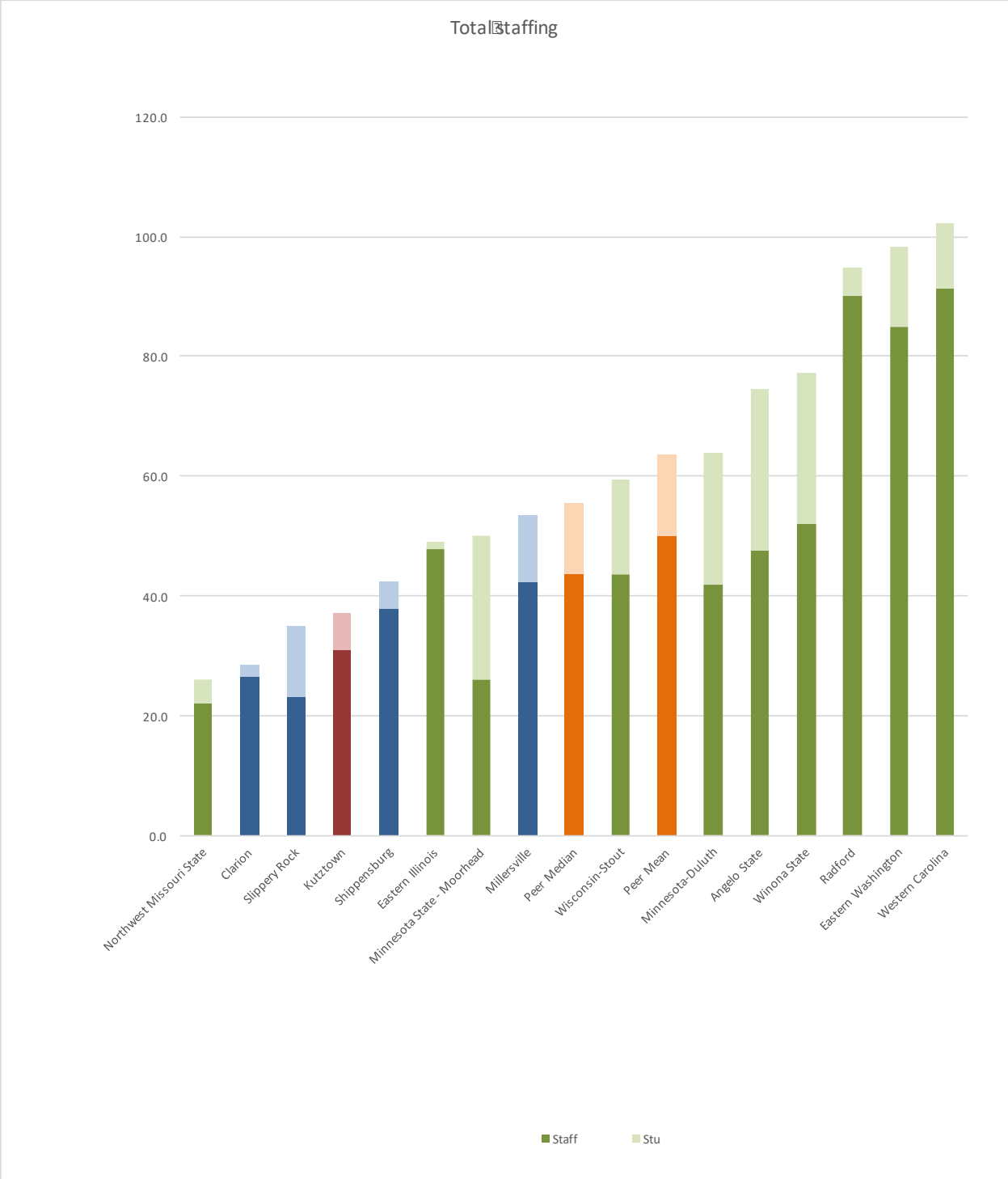
Vantage considered the possibility that the size of institution could affect these numbers. To some extent, there are economies of scale and perhaps this accounted for the large variations. However, when expenditures per student are considered, much the same picture appears. If anything, the

situation becomes more apparent, as the gap to the next lowest expenditure is larger, and, per student, KU spends 43% of the mean or 47% of the median.



Human Resources

This section provides a partial response to section *3.5 KU IT Personnel, Organizational Structure, and Staffing Level Review* of the RFP which engendered this report. Since the cost of personnel represents a large proportion of IT expenditures, we can expect the human resource picture to more-or-less match the financial resource situation. In fact, the picture is less extreme. As a whole, the PASSHE Peers have low staffing numbers (whether we consider just professional staff or include students). We see that KU is significantly lagging the mean and median in staffing numbers. Since all the schools augment staffing with student employees, Vantage provides a graph of the combined numbers, where the student numbers are added on top of the staff numbers in a lighter shade of the same color. (Note: Vantage's experience is that student numbers are both highly variable and imprecise in the CDS.)



*We note that in the combined staff and student graph, the "Peer Mean/Median" column represents the sum of the mean/median staff number and the mean/median student number. The result for the median differs from the actual median.

With the deficit in both financial and human resources, KU IT cannot be expected to compete with KU's peers in every aspect. Vantage has no doubt that the staff in IT are dedicated and work hard.

They form a cohesive team with good internal communication. For further discussion of human resources, see section 3.5.

Strategic versus Tactical

The planning documents that KU IT has provided to Vantage, in particular, the *Kutztown University Information Technology Self-Study 2016* and the *Five (5) Year Strategic Budget Plan*, are good mid-to-long-term *tactical* documents. This does not in any way lessen the value of these documents, but it reinforces the need for IT leadership.

These documents lack several key ingredients that are considered necessary for strategic documents. And this deficit in the documents carries through to the organization. Vantage also heard from both IT staff and stakeholders that KU IT lacked vision, direction, and higher-level goals.

Vision

Vantage also observed the lack of vision in the construction of the Self-Study and the 5-year Budget Plan.

In the Self-Study, each separate unit within KU IT has developed a good description of the current state of affairs. And, in the 5-year Budget Plan, each has clearly outlined budgetary needs for things – hardware and software. In both cases, these are separate descriptions by department. The Self-Study had no overarching view of information technology. The 5-year plan did not include staffing. This is in stark contrast to the way the staff acts as a cohesive, mutually supporting team.

The mission statement for KU IT in the Self-Study is:

> *"The mission of the Kutztown University Information Technology Department is to provide the highest quality technology resources, in a cost-effective manner, and deliver innovative systems, processes and solutions, based on best practices and industry standards, in accordance with the University mission."*

This statement is all about the stuff: systems, processes and solutions, not students, faculty, staff and administration. By contrast, the University mission statement is about students. The addition of "in accordance with the University mission" on the end of the mission statement does not make it so. In Appendix B, Vantage lists the places in the KU Strategic Plan which directly involve information Technology, whether explicitly or implicitly.

Higher–level Goals

It is important when setting strategic goals to connect them to the university's mission as noted above, but also to express them in terms of values or high-level goals. For example, the first goal listed in the Self-Study is replacing the current firewalls "to better protect the University's information systems." But the general point is that the replacement of firewalls should be an action toward a security goal or objective.

Architectures

The term "architecture" comes up several times in the RFP. Vantage understands an architecture to be more than "what equipment we buy/have bought" or "the way things will be/are connected," although both are determined by an architecture. Vantage believes an architecture is an explicit, usually documented, approach to equipment selection, programming, and connection that follows from the institutional strategic goals. EDUCAUSE describes enterprise architecture as:

> This holistic practice of enterprise architecture plans the entire IT landscape, examines requirements across applications, and provides an overall blueprint for how IT can contribute to an organization's strategic goals.

In this sense, Vantage has not reviewed any KU IT architectures. We will comment in the operational sections below on the equipment, programming and connections that we observed or of which we have been informed via documentation, e.g. equipment listings and network diagrams. The purpose of this section is not to criticize what KU IT accomplishes with the resources it has available. On the contrary, **we have high praise for the teams and what they do**. The lack of architectures is a symptom of the lack of guidance from above for strategic, rather than tactical, thinking.

Security

There is a balance between security and ease of access. It is possible to increase security without adversely affecting ease-of-use and to improve ease of use without reducing security, but typically the more stringent the security measures, the harder it is for both the wrong and the right people to access the data. It is therefore important to have clearly enunciated security objectives in order to appropriately protect resources without needlessly inconveniencing employees (which directly costs time, and therefore money, and indirectly decreases employee satisfaction which has a variety of bad effects).

Security leadership, planning KU's security stance, and setting security and compliance objectives is the responsibility of a Chief Information Security Officer (CISO). Setting appropriate objectives requires specialized knowledge which means that the role of CISO should not just devolve to the CITO.

A brief example may help make the point more clearly. The single most common complaint from faculty in our focus groups was the adverse impact of time-out policies, both on lectern computers and the wireless network. The need to re-authenticate on wireless was a top-of-mind issue among students and identified by the Help Center. Are these policies appropriate and adding value? It is impossible to know without having security objectives to measure the value and effectiveness of these policies against the impact on productivity, class-time, and the satisfaction of faculty and students and their impact on the desired objective.

The Center for Internet Security (CIS) has suggested institutions ask themselves the questions below as high-level assessment of security posture.

- Do we know what is connected to our systems and networks?
- Do we know what software is running (or trying to run) on our systems and networks?
- Are we continuously managing our systems using "known good" configurations?
- Are we continuously looking for and managing "known bad" software?
- Do we minimize risk by tracking the people who can bypass, change, or over-ride our security defenses?
- Are our people aware of the most common threats to our business or mission, and what they can do about them?

We do not believe KU is in a good position to answer these thoroughly. The staff is highly capable and willing, but the University is under-resourced in the area of security.

3.2.2 KU Five Year IT Strategic Budget Plan Review:

Review the current Five (5) Year Strategic Budget Plan for accuracy based on the existing technology footprint and appropriateness to meet current and future needs.

See section 3.3.4

3.2.3 KU IT Personnel Organizational Structure and Staffing Review:

Review the composition and allocation of the KU IT department personnel in terms being able to meet operational requirements in the most efficient effective manner to meet strategic university projects for an educational institution of our size and make up.

See section 3.5

3.3 Information Technology Services Operational Review

3.3.1 Customer Service Approach

Improvement of customer service in all areas for students/faculty/staff

Vantage would like to draw a distinction here between customer service *approach* and customer service *provided*. The customer service provided by KU IT was praised in many of the interviews conducted by Vantage. The KU IT team members are acknowledged to go out of their way to provide good customer service, and the cohesive team makes that all the more effective.

Interviews with KU IT personnel reported previous leadership has not led in a direction of open conversation with stakeholders and the KU community in general.

This approach is disastrous for an organization that seeks to provide quality service. Such a policy isolates IT staff from the community and leads to misunderstandings both ways. IT staff members should be encouraged to seek contact with the community and such a directive needs to be stated "early and often." Vantage heard comments, both from some IT staff members and from academic and administrative stakeholders, that showed a lack of understanding of the other side's point of view.

Communication goes both ways. Restricted interactions between IT and faculty may be responsible for a belief on the part of some faculty members that, whatever desktop, server, or cloud software they choose to purchase and employ without consultation, KU IT should be able to implement and fully support. This attitude carries over to some administrative departments. It is unrealistic to believe that a small staff, such as KU IT's, will have all the subject-specific knowledge, let alone the familiarity with the specifics of a chosen package, necessary to provide such support. A common theme of budgeting at KU seems to be to procure the software and assume that IT will provide whatever resources are needed to implement and maintain without consultation or funding.

This also may be the cause of the practice of funding implementation of departmentally requested IT projects without recognizing and providing for the ongoing costs of maintenance, upgrades and support.

3.3.2 IT Best Practices

Review of KU's use/implementation of 'best practices in Higher Education Information Technologies' across the Information Technology Services Department

There is not always a consensus on what is best practice in higher education. And sometimes there is a standard, such as the Information Technology Infrastructure Library (ITIL), which, in its full glory,

is only possible to implement in a huge university with hundreds of IT staff members. This is not to say that ITIL principles cannot be selectively applied in smaller organizations.

Vantage has commented on the level of KU IT's achievement of best practice throughout the following subsections of section 3.3.

3.3.3 Classroom Technology Operations

Vantage's overall impression of Classroom Technology unit (CT) is amazement at the amount two (and most recently, one!) full-time staff members have achieved and are achieving. One consultant described the effort involved as "heroic." The recently installed "digital" classrooms are up-to-date, well-provisioned, and clearly well-maintained. Faculty praised reaction and resolution times for issues. Vantage notes that this is a sore point on many campuses with considerably greater resources. Classroom technology exists to support pedagogy – as that pedagogy changes, so will classroom technology needs.

a. Classroom Technology equipment architecture

Please see Section 3.2.1 for a discussion of architectures. One thing that an architecture provides is a road map of supported devices and protocols. Two examples follow.

- With regard to resolution, of visual displays, both projectors and monitors:
  - when will KU support full HD video on projectors?
  - Should KU be installing only UHD /4K flat panels?
- With regard to media, what media-types will KU support:
  - Should KU support SD cards?
  - And when will KU no longer support VCR tape?

In classrooms, we consider there to be four principal "legs" on which the technology stands:

- Audio inputs (microphones, recorded audio) and outputs (speakers, audio recording devices)
- Video inputs (cameras, document cameras, recorded video) and outputs (projectors, monitors, video recording equipment)
- Switching devices and cabling to connect inputs to outputs, and
- Control devices to manage any and all of the above.

Vantage believes that the equipment CT purchases, and the way it is connected, is generally a compromise between limited financial resources and best practice for a higher education institution of KU's size and nature.

A small yet perhaps significant note: CT has been buying Christie LW401 projectors and the equivalent Hitachi CP-WX8240A for the last five years. These have proved themselves reliable and the purchase price is advantageous. However, five years is a long time for technology, even in the audiovisual regime, which changes less rapidly than the data world. Vantage believes this model to be very near end-of-life. This could cause problems in a few years when the manufacturer drops support and the control manufacturers (Extron, Crestron) no longer provide interfaces to current generation controllers. These projectors support resolutions up to 720p, but not full high definition.

b. Classroom Technology support

Support has two dimensions, what needs to be supported and whether the support is in advance, in the moment or after an event, incident, or request. Vantage represents this in the diagram below.

	Avoidance	Mitigation	Resolution
Hardware	Maintenance	Alternative	Replace / Repair
Software	Updates	Work Around	Fix (homegrown) or Pray (vendor)
User Needs	Interface Design / Training	Classroom Help	Interface Design / Training

The ATC members and faculty otherwise interviewed had nothing but praise for the CT group and their responsiveness.

c. Classroom Technology security

Please see Section 3.2.1 for a general discussion of security which is applicable to CT security. There are, however, specific considerations which apply to modern audiovisual systems. Which, if any, of the issues discussed below require mitigation depends on KU's and IT's security objectives.

Physical Security

In urban areas, there have been organized thefts of projectors and large-screen monitors going back at least a decade. KU is less vulnerable because of its location and the tight-knit community. Never-the-less, these items are high-value on the resale and foreign markets.

Vantage did not observe, or was informed of any physical security measures, such as tethers or cages. These do deter the "amateur" and slow down the organized criminal.

Using network monitoring to generate an alert if connectivity fails tends to have false alerts since the devices are turned off and on routinely throughout the day. But there are also specific network security devices that report if their direct connection to the device is unplugged or ripped out.

Finally, there is obtrusive (and objectionable in an academic environment) surveillance as a deterrent and method of apprehension, but not theft prevention.

Data Security

Older "smart" devices are not as smart in more than one way. Smart devices, such as IP-enabled audiovisual controllers, smart televisions, IP enabled projectors, have embedded operating systems that are, generally speaking, fully smart enough to be a security risk on the network if compromised. Audiovisual manufacturers have been, to date, less security conscious than a Microsoft or Cisco.

Even if the manufacturer issues patches for recent models, they are less likely to do so for older models, and deployment of patches is typically more difficult and less consistent than computing devices.

Some mitigation of this vulnerability could be achieved if CT devices were segregated from other devices on the network.

d. Review of Classroom Technology needs in reference to:

i. Personal Response System "Clicker" Technology
ii. Automated attendance markers (card swipe or other)
iii. Distance learning synchronous classroom computing capabilities (for example: the synchronous "Real Time" approaches for teaching that are currently in place for the Computer Science Department using Blackboard Collaborate)

With respect to these technologies, the issue is not typically what is the "best," but much more importantly:

- How do they fit into KU's pedagogical goals?
- Does the cost create an unreasonable burden on KU's students?
- Are there accessible options?

The system of clickers that KU currently employs, iClicker, is in use in many colleges and universities. It is a reasonable choice of system for KU, and, given the existing investment in both money and time by students, faculty, and the KU IT staff, Vantage would recommend continuing with this choice.

Vantage does not know for what situations KU is considering automated attendance. However, given the trend toward asynchronous, learner-centered education, the application of automated attendance markers is generally limited to situations where licensure requires a minimum number of hours of practicum or other 'hands-on' experience. Since card-swipe stations don't know who has swiped the card, the only way to be certain who has attended is with biometric recognition systems. This does not seem like a practical solution to assuring attendance.

e. Classroom Technology equipment lifecycle replacement approach

In the Self-Study, CT states:

> *"Classroom technology has a replenishment cycle plan in place for all classroom equipment. The cycle varies by type of equipment and ranges between 5 and 12 years."*

Vantage has not seen documentation on which device-types are intended for which period. Replacement cycle between 5 and 12 years could be appropriate, provided:

1. purchases are made with this lifetime in mind, and
2. the length of the lifecycle is chosen appropriately for the type of equipment.

Vantage has some concerns on both counts. These are not to be construed as criticisms of the CT staff. On the contrary, their work is conscientious and of high quality. It is rather a reflection on the financial resources available to them. Below are examples of our concerns.

1. Purchases are made with the lifecycle in mind

We have already alluded to the choice of standard projector, which is reliable and cost-effective. However, as we pointed out, this is a projector at or near end-of-life for the manufacturer. Also, its maximum resolution is 720p, which is two thirds of HD. But, UHD and 4K resolutions are the current industry standards.

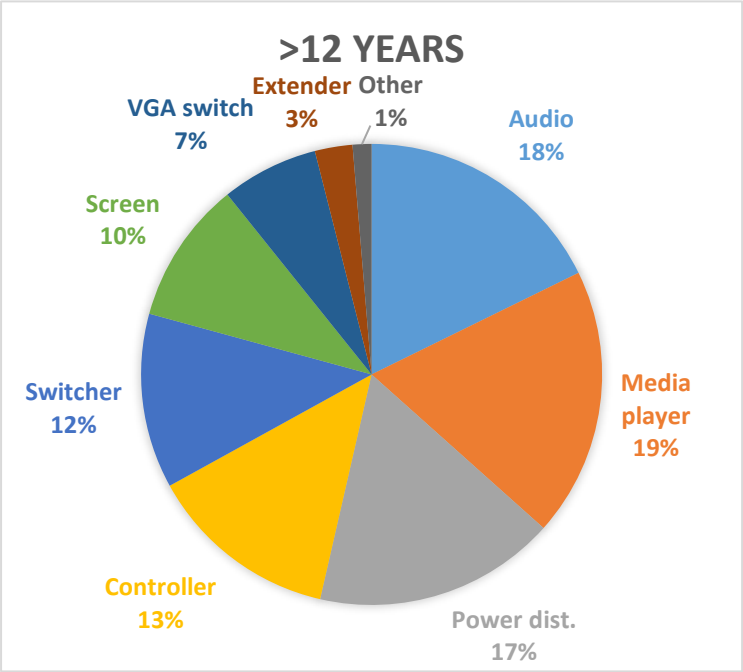
2. Lifecycles are appropriate for equipment types

Manufacturers do not support the firmware on their control systems with patches, upgrades and code beyond about seven years. And compatibility with current versions of remote management systems would become questionable. This makes older control systems a further security risk (see subsection c of this section above). Vantage would therefore recommend that the lifecycle for controllers be no longer than 7 years. Unfortunately, KU has 117 controllers that are more than 7 years old but less than 12 and 71 controllers older than 12 years.

The equipment inventory supplied lists 515 (17%) items older than 12 years (Vantage is ignoring an additional 194 devices with no date of acquisition, however, most of these seem to be at least 12 years old. Their addition would bring the "out-of-cycle" fraction to 23%).

The 515 devices are:

- 94 pieces of audio equipment (including 81 sets of speakers and 6 wireless microphones)
- 100 Media players
- 90 Power distribution devices (principally power strips)
- 71 Controllers
- 65 Switchers
- 53 Screens
- 36 VGA switchers
- 14 Devices for extending connectivity
- 7 Other devices



If we look, instead, at the 238 rooms listed as CT rooms, we find 127 (53%) with analog (and therefore obsolete) technology which is not remote-manageable. CT reports that 48 are scheduled to be upgraded this summer, which is a tremendous effort with only one or even two staff persons to oversee the upgrades. But it is still only 38% of the analog rooms.

Vantage believes that CT is seriously under-resourced for the scope of their responsibilities, but doing an excellent job with the resources available.

3.3.4 Microsoft Windows and Apple Computing Operations

This group has been called a number of different things in the documentation provided to Vantage, including the title of this section. Since they also support tablets, we abbreviate they group EUT for End-User Technologies.

a. Microsoft Windows and Apple desktop, laptop and tablet computing hardware and software support

In section 3.3.5, Vantage considers the Help Center's support of end-user computing, i.e. desktops, laptops, and tablets. We commend the Help Center for the rapid response they provide to issues.

From our interviews with stakeholders, it is evident that, despite an organizational structure which places Help Center and EUT in different reporting lines, the support from these two groups is seamless to the users. This seamless support shows a high level of communication and cohesiveness of the IT organization despite a poorly performing ticketing system.

The point of this is that our praise for end-user support via the Help Center also applies strongly to EUT. That said, and as pointed out by Chris Walck, the manager of EUT, like most of KU IT, the group is "only one-deep everywhere." Despite focus on cross-training, there are large areas of knowledge that are held by single individuals in the group.

The clearest example, and one to which stakeholders referred, is that deeper knowledge on the Apple side is limited to one person. This is an issue that can be mitigated, but can't easily be overcome, by cross-training. Most of the EUT staff need to be operating in a MS Windows-centric environment and it is difficult to provide operating-system specific support if you aren't using that OS. When the individual with the requisite knowledge is on vacation, away at training to stay proficient within their area of expertise, sick, or engaged with another urgent issue in the field, they are not available for a new issue.

The disruption caused when such a specialist leaves the University, for whatever reason, could have far-reaching negative impact. This is particularly true in an environment where personnel replacement is only considered and posted after termination of employment and hiring cycles are long. This means that there is no opportunity for passing on institution-specific knowledge to the replacement.

b. Public Computing Lab and Instructional Computing Classroom support

EUT supports 82 non-teaching computer labs. Some of these labs have as few as 1 computer. They also support 36 teaching classrooms with machine counts ranging from 8 to 30, including at least 10 "mobile classrooms" of laptops on carts. These 118 spaces use 13 separate images. 36 use the base image, 30 use the Apple image (one uses both), and 30 use the Physical Sciences image (EUT builds this single image for Biology, Chemistry, Geography, Geology, Marine Science, and Physics labs and classrooms.). These 3 images account for 95 of the 118 spaces. Image management is a significant pain point at most institutions. While no implementation is perfect or cannot be improved, KU has endeavored to automate and simplify image management to balance the effort with the end-user value.

c. Automated Windows and Macintosh Software Delivery approaches

For software delivery and updates, EUT uses common tools: Microsoft's System Center Configuration Manager (SCCM) on the MS Windows side, and Jamf Pro (formerly Casper Suite) on the Apple Macintosh side. This is a sound approach to software delivery.

d. Microsoft Windows and Apple Macintosh security patching and compliance

The most vulnerable computers are often those in labs, especially general-use computer labs. Between users, the computers each return to a clean state that retains none of the changes made while the previous user was logged in. This is achieved using a product called Deep Freeze on the MS Windows computers and with the native Macintosh management suite. This means that any malware or exploits of vulnerabilities should be short-lived.

These lab computers are then updated at the two least disruptive times of year, during the summer and over the winter break. The computers are reimaged or patched as appropriate, depending on the extent of the set of operating system and application software installs and updates required. This approach is meant to balance the frequency of updates with the disruption and potential risks of applying those updates. In addition to the potential vulnerabilities of patch delays, occasional functionality gaps can result. For example, older versions of Adobe flash may be blocked by the web browser because of the severity of vulnerabilities which could render flash-based websites inoperable.

Faculty and staff computers are patched more frequently, approximately every six weeks. This certainly leaves a significant gap when there are new exploits of vulnerabilities. On the other hand, it is entirely prudent for EUT to test any patch. Deployment to a (pseudo) random, "beta" sample of computers is an excellent approach that further qualifies each patch. So, the lag makes sense. But whether this approach is the best one for faculty and staff computers at KU depends on security objectives. (See section 3.3.2 above on security.)

e. Campus Printing Architecture

Network printing and local printing

On the inventory supplied to Vantage, KU has 1,179 printers with close to 400 different models. Most were purchased in the last three years. But 184 have no installation date, including six HP (Laserjet) 4 printers. Bob Kuhn, one of the Vantage consultants on this project, installed 2 of these for the Mathematics Department at Harvard University, which he left for Radcliffe College in 1993. Admittedly, these were some of the best-constructed printers ever built, but 24 years is a long, long time for information technology! And 400 different models with 24 years-worth of different drivers is a nightmare to maintain. Our interviews reflected the pain involved in supporting the quantity and diversity of printers. Both end-users and IT are expending an unreasonable amount of resources on printer and print-related issues.

Vantage strongly recommends that EUT periodically publishes and provides to KU Procurement/ Purchasing Department a ***short*** list of acceptable printers and multifunction devices (printer/ scanners or network copiers with printing capability) for purchase using KU funds or supported by IT.

f. Idle Timeout "Screensaver Timeout" approach

KU IT has implemented a MS Windows policy on the network that causes a screensaver to start and locks the computer after 10 minutes of idle time. This policy applies to all KU-owned computers. As security goals are not defined, Vantage cannot comment on the effectiveness of this strategy, except to say that it is more aggressive than typically seen in higher-education for general-purpose computers.

Faculty informed us that this practice is an issue on computers that faculty use to teach (e.g., podium computers and faculty laptops). However, all computers that faculty use to teach in the classrooms

have the option that when the faculty member logs in they can elect to extend the screensaver timeout by 1, 2, 3, etc. hours. Faculty go back and forth between different teaching modes in a classroom, some actively using a computer, some passively using a computer (e.g. playing a DVD, displaying and discussing an image or using the whiteboard), some not using a computer at all. Requiring reauthentication while teaching is disruptive, as KUIT is aware. Perhaps, then, it is necessary to remind faculty that these options are available to them? It is also possible that the faculty were referring to network timeout for wireless connections.

Faculty members have administrative roles and having their credentials accessible to someone who walks into a classroom after a class is a potential security issue. How this is resolved depends on having clear security goals, as discussed in section 3.2 under Security.

g. Review of technologies for the efficient and effective delivery of personal computer application software.

See 3.3.4c

h. Desktop Computing equipment lifecycle management

EUT has just completed the replacement of nearly all of KU's 3,900-odd desktop computers, laptop computers, and tablets. Given the recency of this monumental effort, experience led us to expect some grumblings from faculty and staff in our interviews. There were none. No evidence of dissatisfaction is not evidence of satisfaction, but Vantage believes the replacement was handled well.

KU has a five-year replacement cycle, which is on the long side for desktop computers but fairly common in higher education, particularly state schools. Laptops and other mobile devices tend to have less compute power and are built to minimize weight and maximize heat dissipation. Despite that, laptops tend to run hot. Mobile devices are also inevitably subject to physical shocks and knocks. All of which goes to say that the expected effective lifetime of a laptop is typically closer to 3 years.

The latest replacement process (of 3,738 computers) took at least 14 months from first install (5/9/2016) to the last install (7/7/17), based on the inventory data provided to Vantage.

That's not a long time in people-years for EUT, because it is time-consuming to minimize impact on each user. After all, this represents over 250 computers replaced a month on average, with the regular work for the undersized group to accomplish at the same time. Of course, EUT uses outside services, but managing that and ensuring end-user satisfaction takes a lot of time.

It is a longer time in dog-years, the equivalent of over 8 years. But IT lifetimes tend to follow Moore's Law, with a generation under 18 months. So, in technology years, it represents more than 75% of a generation, or the equivalent of 15 people-years.

It is possible that, for example, the Lenovo M900 and M900Z were prudent choices for a 5-year lifecycle both at the beginning and ending of this period. But then again, maybe not. Vantage questions whether the more common approach to a 5-year lifecycle, namely to replace approximately 20% of systems annually, might be easier to manage and more prudent.

Vantage recommends that, as well as life*time*, EUT take seriously the notion of life*cycle*. In particular, of lifecycle costs. The reasons for shorter, rather than longer, lifetimes for computers include:

- the obsolescence of older models

- inability to run the latest operating systems and therefore software
- the lack of updates including security and driver updates
- the value to end-users and the institution of newer technology

But the biggest reasons are financial. Gartner reports that only 20% of the total cost of ownership of a computer is the purchase price. Gartner may be over-stating the case, but the costs of administration, down time, user time, and support time all rise exponentially (we are using this term mathematically, not just for emphasis or drama) with age. Partly this is because the complexity of the job of support, the time-to-solution for problems, and the probability of hardware failure, all go up with the number of different models supported.

3.3.5 Help Center Operations

a. Campus faculty, staff and student Central Help Center technology support

There are six roles below that the Help Center fills:

1. Dispatch
2. First Responder
3. Triage
4. Tracking
5. Communicating
6. Analyzing

1. Receiving problem calls from community members and obtaining preliminary information.

During semester, the hours for the Help Center are generally 7:00 am - 9:30 pm Monday to Thursday and 7:00 am - 4:30 pm on Friday. Considering the staffing levels, 67.5 hours per week is a good number of hours for the Help Center to be operating. Vantage would caution that, if hybrid and on-line courses increase, there may be an expectation of additional hours. Students in classroom courses with assignments due on a Monday might already find the lack of weekend hours a problem.

The physical locations for the Help Center are Stratton Administration 201 and Academic Forum 204. Only the latter has hours after 4:30 pm. This is an appropriate division of resources, since a greater proportion of academic users are likely to be on campus after 5:00 pm than administrative users. And the location only matters for walk-in customers and for calls requiring a visit to the user's location.

The Help Center receives issues via phone and email. When interviewed, the Help Center staff reported having a web form for submitting problems that was little used. The link to the Help Center under "services for faculty/services and technology" takes users to the IT home page. A feedback form is linked from the Help Center box on the right of that page, but a feedback form is not an issue submission form. Vantage found no specialized issue submission form.

Since emailed problems rarely have all the information that other parts of IT organizations need to work on the issue, typically an emailed problem requires a return communication to clarify information that a complex web form or query tree might collect. A web form could also pre-populate a ticket in the ticketing system, so that re-entry of the information is not required. Vantage would recommend a prominent position for such a web form.

Other communication modes are possible, and universities have tried everything from text messaging applications (typically embedded on the Help Center site) to Facebook and Twitter, and even a Help Center in Second Life. In person, telephone, and email submissions are necessary communication modes for a help center. A web form as described above and possibly an interactive text messaging mode are good additions.

2. Resolution of problems not requiring advanced support

By all accounts, the Help Center staff members and students go the extra mile to satisfy KU needs. Help Center staff report that the most common issue is connecting to BearNet (the campus WiFi network). Next on the list is resolving issues with local printers on individuals' desks.

3. Route/assign the issue to the appropriate queue

Vantage believes it to be important that users of information technology, i.e. customers of KU IT, not be required to triage their own ills and direct their queries to the appropriate technology doctor. By providing a single point of contact for problem resolution - the Help Center - KU IT does this and the reports from other teams and customers again indicate this is largely done well.

4. Track the issue through to resolution

Help Center and Vantage end-user interviews showed that, with limited exceptions, the Help Center does track issues to resolution. However, interviewees felt that the ticketing system does not adequately support this activity.

5. Communicate with the client

Communication appears to be good when resolution is straightforward on fully supported products. Stakeholders reported to Vantage that communications were not so satisfactory on less tractable issues, especially those with non-standard products. In these cases, it was reported that there was no way of telling what was happening on the ticket. In this, the KU Help Center does not differ greatly from help desks in most institutions, but best practice certainly is for frequent communication to set expectations and report actions taken and progress made toward resolution. There is a strong desire on the part of IT and the end-users to allow *submitters* to follow their ticket status. This is one of many limitations of the ticketing system implementation under review by IT (see 6b below).

6. Analyzing Issues and Resolutions

The Help Center staff look for the common issues and hence find re-usable solutions or, better yet, ways to avoid recurrence. This is something that the ticketing should make easier by, e.g., looking at printer problems by model to see if there is a problem to which a model is prone, or looking at the BearNet problems for common issues. It was specifically called out as something that the ticketing system failed to assist with. (see section b. below)

Ideally, the solution to common issues found could populate a knowledge-base. The solutions would be visible to the Help Center as a problem-solving aid and to the community for education and self-service resolution where possible.

b. Help Center Work Control System

The ticketing system used by the Help Center at KU is HelpStar by ServicePro. The Systems Administration group, which includes the Help Center, variously reported that the system was:

- Kludgy

- Buggy
- A waste of time
- Frustrating
- Has interface issues
- Requires lots of clicks
- Makes it too easy to put stuff in the wrong place
- Is difficult to use for projects as it is not a project management system
- Does not track time
- Can't be used to help find efficiencies/commonalities in tickets
- Queues do not well match the organizational structure of IT

Clearly the system, which should be helping the whole of IT, is not serving the Help Center well, let alone KU IT. At least some of the issues are likely implementation rather than systemic. On the other hand, the underlying system did not encourage good design. HelpStar is intended to be a bare-bones, fairly simple to implement, help desk solution with few bells and whistles. A more robust user-friendly system may be needed. Ideally, a single ticketing system would be implemented across the enterprise, consolidating the various ticketing systems in ResNet, the Help Center and Distance Learning.

c. "BYOD" Bring Your Own Device Support

KU does not have an approved policy on BYOD support for faculty and staff. Combined with the lack of defined security objectives, both IT and users and left unsure of what is and isn't appropriate and supported. The self-service sections of the Help Center's website do not facilitate end-users posting comments, suggestions or helping each other. BYOD trends in higher-education combined with the longer KU equipment lifecycles strongly point to an increasing desire for BYOD. Future BYOD policies should include where and how BYOD is allowed, encouraged and discouraged. Additionally, policies outlining what the Help Center can and will try to do, who is responsible for backing up the system before the Help Center touches it, how far the Help Center will go in trying to resolve the problem, what might go wrong and who is responsible for doing what if it does would be valuable.

3.3.6 Enterprise Software Development and University Web Operations

a. PeopleSoft Student Information System

i. Project Prioritization and Project Management

Holly Fox, Director of Enterprise Software Development and University Web Operations, meets every two weeks with a group of senior administration officers. This meeting has representation from:

- Registrar's Office
- Admissions
- Bursar's Office (Student Accounts)
- Financial Aid
- Institutional Research (invited but does not attend)

The meeting serves two important functions.

1. It provides a mechanism for two-way communication between the Enterprise Software side of the group (ESD) and their principal customers. The customers can make requests, give feedback on changes, and keep ESD in touch with the thought processes of the users of their products. ESD can also communicate upcoming changes and issues with the customers.
2. It acts as an (informal) governance group, helping to prioritize larger projects. Any size team has a maximum capacity for development, and smaller teams, however accomplished and efficient, have smaller capacities. What order ESD works on projects is only partly an IT issue. It is an issue for KU as a whole. The informal nature of this group as a governance committee limits their ability to make important decisions.

Never-the-less, Vantage heard some dissatisfaction from these same administrative departments with the rate at which projects are accomplished. This was described as inhibiting some administrative departments' abilities to meet their goals. It also leads to a desire to have access levels that would allow their departments to do PeopleSoft development. These issues were expressed as frustration with ESD, not with its limited staffing, which means that the communications with the informal group need some work.

Vantage reviewed three project documents provided by ESD and found them to be comprehensive and, combined with ESD's source code control system, show good control of versioning and a good development process in general. Given the size of the department, it is not surprising that source code does not typically get reviewed by a different developer, nor is there a separate quality assurance process, other than the burden on the director of testing all her group's products. When the director writes the code, she does have the product tested by a Senior Systems Analyst.

Vantage heard more than once that the HelpStar ticketing system (discussed above in Section 3.3.5) was not an effective project management system, although it is pressed into service as such. This meets ESD's needs for the smaller projects. Since the administrative departments with which we met reported that "day to day customer service and urgent issue response from IT is great," we are led to believe that it is adequate in this regard.

For larger projects, ESD employs project documents (such as those reviewed above) stored on the Microsoft SharePoint server. In both cases, the code is managed by a source code control system. Project management software might be an effective tool for ESD.

ii. Change Management

Change management was discussed to some extent above under project management, but two points need to be added. Quoting from the Self-Study:

> *"the Software Development Life Cycle (SDLC) methodology is employed for all software development to ensure an appropriate solution is developed. This includes the gathering of requirements, software design, implementation, testing, deployment and ongoing maintenance."*

Also, restricting Oracle new functionality implementation to quarterly bundle installation, and technical updates to twice annual events, reduces the disruption those changes can cause.

iii. Data integration / Business Intelligence / Reporting

ESD provides file loads to 5 internal (on-campus) and 13 external (hosted/cloud) systems and receives file input from one internal and 3 external systems. There are 6 systems (4 of which are

external) providing inputs. There are also 3 systems connected to the PeopleSoft system via web services. That is a large number of interfaces for ESD to manage. Changes in software at either end (PeopleSoft changes or changes to the connected systems) could potentially "break" a link, or worse, provide false data without an error condition. The move towards more web services-based connections is a prudent, forward-thinking one.

Currently, most reporting is conducted against the transactional PeopleSoft database. Institutional research and Administration do report off a static model built and populated by ESD. There is a current PASSHE initiative to build a common data warehouse and use the SAS tools to analyze the data. It remains to be seen whether this will fulfill the needs of KU's administrative departments.

Currently, reports that are needed repeatedly are built by ESD for clients. KU does use PeopleSoft Query Manager for ad hoc reporting. Note that ad hoc queries against the transactional database can cause performance degradation if stuck in infinite tight loops.

iv. "MyKU" PeopleSoft/Desire2Learn Mobile Application

As ESD points out in the Self-Study, traditional age students (18-25) organize their lives and manage their communications with smart phones. MyKU is ESD's accommodation to that approach. MyKU has modules that give KU students access to both PeopleSoft and Desire2Learn (KU's learning management platform) data and allows them to interact with that data. ESD prudently chose to implement MyKU modularly, rather than present all functionality at once. This way of implementing is reminiscent of the agile development philosophy and entirely appropriate for the development of today's applications.

That said, we heard from stakeholders some criticism of the application (app), unfortunately, it wasn't always clear whether they were referring to the web or mobile app:

- the application is "not wonderful, making it difficult to understand where in the app they were."
- myKU interface issues slow down and complicate workflow
- myKU is not user-friendly
- myKU has a short timeout causing frequent needs to login

Some teething issues with a newly developed application are to be expected and there was no mention of bugs. We mentioned in section 3.3.5 the lack of user interface design expertise. While some members of the ESD team have had exposure to UI design principles, that is not an area of strength in the department. We will see in subsection f. below that this expertise is needed for the design of the KU website as well. Vantage would like to see a UI design specialist added to the web team and working with the whole of IT on data presentation. There are multiple priorities in hiring new staff and available funding to do so is not unlimited. If hiring a UI design specialist is not possible, then KU IT should consider contracting for this service with an external provider. As was done in the myKU development, there may be opportunities to leverage KU academic programs to assist in UI design.

v. Security Approach

See the general comments in section 3.3.1 and the more specific comments below in section 3.3.7 e.

b. Review of the PeopleSoft Student Information System software agreement, the associated Oracle Database agreement and other comparable campus software agreements

Vantage has reviewed both current Oracle agreements which are PASSHE agreements currently being negotiated with the vendor. What is most critical is the term of the Software Agreement, which expires October 24 of this year. The review was conducted by an information technology management consultant very familiar with technology licensing agreements such as these. He is not a lawyer, and no comments here should be construed as legal advice.

The terms of the current agreements are typical of such agreements and contain no elements that Vantage found to be out of the ordinary.

In the opinion of Vantage, the Hobson's CRM software agreement provided, being a Pennsylvania state standard blueback contract, protects the interests of the state and KU.

c. Review the approaches in place for required periodic software updates for enterprise systems such as PeopleSoft and associated Oracle Database instances and the management of those updates

Quoting from the Self-Study:

> *The PeopleSoft servers are patched by using the software bundling process (a bundle is a collection of software updates wrapped into one "bundle"). Although bundles are applied 4 times per year, patches are applied twice per year. The first patching cycle will occur during the summer bundle (typically June timeframe). The second patching cycle will occur during the winter bundle (typically December timeframe).*

There is a tension between, on the one hand, providing new functionality and fixes to problems with older functionality as quickly as possible, and, on the other hand, refraining from disrupting operations. The KU approach certainly falls within the acceptable parameters, except possibly for urgent security patches. That question depends, as we point out throughout this report, on having defined security objectives.

d. Hobson's Radius Customer Relationship Management system development and support

Hobson's Radius is a CRM designed specifically for education and released in 2014. At KU, it is used largely by Admissions for communicating with prospects, applicants, and accepted students. Radius is used widely in higher education, especially considering it has only been available for three years.

e. Microsoft SharePoint software development and support

KU uses MS SharePoint as a document repository. The Web CRM, Ingeniux, uses web services calls to integrate these documents into the KU website. Unfortunately, many of these documents are in PDF form. That is appropriate to hold them fixed or to print them, but for presentation online it would be preferable to have them in a dynamic format (database, XML… etc). PDFs are not responsive. They are fixed structurally to a page width and length. For responsive display, a document needs to present its content based on the size and shape of the screen/window in which

it is displayed. The web team is migrating to more responsive versions of the information displayed on the website, but this is a mammoth task.

f. University Website development and support

i. Ingeniux Content Management System

The Ingeniux CMS is properly deployed with development and test instances as well as the production CMS. This greatly reduces the possibility of significant problems with either the software or form and content from distributed departmental content. The latter relies on those responsible for managing KU's brand acting as gatekeepers for both content and form (e.g. colors, fonts, images). Too stringent an application or too slow a response could hamper the freshness of content from distributed sources, but too permissive an approach could impact KU's image.

ii. Responsive university website design

Vantage has tested the Kutztown website design and finds the responsiveness of the design well implemented. Without knowing the design objectives, it is hard to comment on the design as a whole. Vantage found that the three-column layout on 'intranet' pages often displayed important links in the third column that were easily missed. The "marketing" aspects, which are front and center, are easier to navigate and more pleasingly laid out in one- and two-column formats, albeit with much less dense information and links.

Vantage has spent most of its time on Kutztown.edu in the IT pages. While there is plenty of information here, it is neither easy to navigate as a tree, nor by searching. The search engine returns multiples of the same page and, while this is common, even with the "big" search engines, it hampers the ability to find the right location.

We have mentioned user interface design issues more than once in previous sections. Vantage suggests that the augmentation of the web team with a User Interface Design Specialist would benefit the whole University.

g. Review IT's role and responsibility to review, implement and maintain enterprise software.

This includes representative systems such as: "EMS" scheduling; "Adirondack" Housing/Meal Plan; "T2" Parking Registration, a future "Early Alert" system for the early identification of at risk students; "Intellenetics Intellevue" document imaging; "Point and Click" health center, "Microsoft Exchange" email, "Rapid Insight" predictive analytics, etc. (Please note that the planning, software configuration and upkeep of those systems is a joint venture between the Enterprise Software Development and Systems Administration groups. Development provides interface integration and Systems Administration provides authentication, hardware and software installation and maintenance, and data backup services for local campus systems).

Some cooperative units in KU work with IT to review, select, and implement products for specialized extensions of the core systems, whether they be software systems to run on-campus or software-as-a-service, a.k.a. cloud services. Such was the case for T2, the parking system used by the KU Parking Department. Other units are less collaborative, and choose products without reference to IT.

There are downsides to this approach:

- Other units are not equipped to evaluate the security of software or services

- Tight integration with the core systems is not assured, requiring Enterprise Systems to build translation services between the Applications Programming Interfaces (APIs) of the systems
- KU-wide considerations of shared applications get ignored for the needs of the individual group
- Possible existing alternatives with similar functionality may not be considered at all

It appears that frequently these systems are purchased with one-time funding with the expectation that IT will provide any implementation and support funding. This is a systemic problem that Vantage feels compelled to highlight. We have spoken before about the importance of lifecycle costs, rather than purchase prices. Most technology purchases require consideration of:

- initial/ongoing user training
- initial/ongoing user-departmental administration training
- implementation
- initial/ongoing "back-end" training for Enterprise Systems and/or Systems Administration
- maintenance
- updates
- ongoing vendor and/or value-added reseller (VAR) support, and
- replacement cost

This is all on top of the initial purchase price. The longer the lifecycle, the more important (and relatively expensive) the other "stuff" becomes.

Vantage recommends that IT be included in the process of purchasing any information technology, whether it be enterprise-level or desktop software or anything in between; whether it be server or desktop hardware or peripherals like printers.

h. Data Integration/Business Intelligence/Reporting

Presently queries are made and reports, including MyKU calls, are largely generated against the transactional PeopleSoft database. There is a current project to build a data warehouse for PASSHE as a whole at the Millersville State System Data Center. Institutional Research and Administration do report off a model built for them by ESD. Such a model, as well as data warehousing, allows the integration of data from throughout PeopleSoft and other data sources, such as Desire2Learn. These two solutions also protect the performance of the transactional database. But, in building a database warehouse to meet the needs of many different institutions, it is possible that it satisfies none of them. ESD is encouraged to play an active role in the design of the data warehouse in order for KU's needs to be met.

ESD uses the SAS analytics tools and, for ad hoc reporting, PeopleSoft Query Manager. The latter is not the most user-friendly ad hoc query tool.

3.3.7 Systems Administration Operations

a. Server and Storage architecture

Please see the general discussion on the use of the term "architecture" in section 3.2.1. The interconnection of servers and storage through Brocade switches is discussed below under 3.3.8 a. This arrangement is best-practice for an institution of KU's size.

Vantage is impressed by the high degree to which KU's System Administration team has virtualized the many KU servers. Few universities have been this effective, which places KU in very good position to take advantage of the flexibility of this design and to manage the large number of servers. In addition, the redundancy built into the Cisco UCS chassis provides resiliency to equipment failure.

KU has two fiber-channel storage arrays/storage area networks (SANs), one for the PeopleSoft system (EMC VNX5600) which has mirrored drives with 153TB capacity and another SAN for (almost) everything else (currently Hitachi with 45TB of raw space which is being replaced by a new HP SAN).

There are 6-10 departmental network attached storage devices (NASs) whose administration (including management, security, and backups) is not under the System Administration group's control. Some of these devices may, indeed, be unmanaged and not backed up. Without a review of the data and purpose of these departmental devices, Vantage cannot comment on the appropriateness of them for the task. While KU does not do classified research, the recent case at NYU[1] provides a cautionary tale of poorly managed storage devices.

b. Data backup and archiving

System Administration Operations backs up the data resident in databases and in the regular file system with weekly full and daily incremental backups. Journaling of database changes during the day might be appropriate to reconstruct data entered between a problem occurring and its discovery. KU uses NetBackup software, which is commonly used throughout higher education. Once a month, a full backup is written to tape for archiving. No formal practice to test the completeness and availability of backups exists. Of note, while backups are a key piece of a disaster recovery plan, they are only a piece. No KU institutional or IT business continuity or disaster recovery plans exist.

KU interprets that regulations require that they keep the PeopleSoft data for seven years. No formal data retention policy exists for other data.

Backups are not simply for the restoration of whole systems and datasets when catastrophic events destroy the data, although that is one of their functions. Data corruption due to issues with the underlying data manipulation and presentation software can creep slowly into a system and not be detected for some significant time.

Enterprise storage for end-users at KU is extremely limited and often inadequate from an end-user perspective. The result is that individual and institutional data is scattered in alternate locations without enterprise management or controls. The potential for data to become corrupt, lost, or for sensitive data to be exposed is significant. As pointed out in the Self-Study, the lack of a backup solution for user files represents a risk to the institution in two ways: loss of data and release of sensitive data. This is a hard nut to crack. Individuals are used to the very large capacities of systems like Google Drive, Microsoft OneDrive, Box, and DropBox and expect that sort of level of individual capacity. Moreover, faculty and students in some areas, such as the sciences (in the analysis of large data-sets) or the arts (particularly visual arts), legitimately generate enormous amounts of data. Perhaps the current negotiations with PASSHE will yield a solution. In which case, other state school systems might well learn from PASSHE.

[1] https://www.sciencealert.com/details-of-a-top-secret-encryption-breaking-supercomputer-were-put-on-the-internet-by-mistake

c. Authentication and Identity Management

The Shibboleth Federated Identity system used by KU is a great way of managing authentication and identity. For example, visitors from other institutions can be granted rights based on their credentials (logins) from their home institution, and KU people can have reciprocal access to other institutions without needing the hassle of having to open new accounts there.

In our interviews, we heard that KU has an automated password reset protocol, which, at one stroke removes the bane of many a help-desk: namely, the calls that involve resetting passwords. This sort of call has severe security issues, besides using valuable help-desk resources. It is difficult to ensure that the caller is the actual owner of the account in question without examining a picture ID, which would be onerous on both sides.

d. Purchased server-based software application support

Campus Local and Cloud Applications

Please see the discussion under 3.3.6 g.

e. Database Administration

i. Oracle PeopleSoft databases

The Underlying Oracle DBMS for the PeopleSoft databases is treated with the care and attention it requires.

ii. Microsoft SQL databases

Vantage cannot comment on the management and support for Microsoft SQL databases.

f. Change Management process

Vantage has reviewed the change management process description found in the Self-Study:

> *The "Helpstar ServicePro" system is used to track changes. The process:*
>
> 1. *Users submit a ticket to request an enhancement.*
> 2. *Director of IT reviews the change and approves.*
> 3. *Director of IT assigns a developer.*
> 4. *Director of IT schedules the change.*
> 5. *The developer develops the change, tests and documents.*
> 6. *Users review the change.*
> 7. *If change passes testing, Director of IT and users approve for Production.*

Even as a process for individual changes, Vantage would suggest that this change management process needs some work:

1. This describes a change management process for Enterprise Systems, not IT as a whole.
2. There is no needs assessment step.

3. The process described is not interactive and collaborative until testing, e.g., it does not include an interactive process to define the change.
4. Changes that impact network or operating systems do not be appear to be included, nor are potential impacts of changes to the network or the underlying operating systems.
5. There is little formal quality assurance or automated testing to verify a system is properly functional before or after a change.

Fortunately, the process *as described in the Self Study* does not reflect the actual process conducted. Needs assessment is conducted in meetings with Enterprise Systems and Enterprise Systems does go over the POC or documentation with the users.

g. Security

Vantage clearly recognizes serious security efforts on the part of the Systems Administration Team. Efforts include purchasing, configuring, and implementing security equipment such as firewalls and intrusion detection systems, software such as that which analyzes system log files for security threats, training (one team member is a Certified Information Systems Security Professional (CISSP)) and services support to conduct vulnerability and PCI compliance scans. However, as elsewhere in this document and first described in 3.3.1 Security, Vantage points out that these efforts lack the underpinnings of security objectives.

h. Review of current resources hosted at the Millersville State System Data Center

N/A as this sharing arrangement has been discontinued.

i. Possible future usage of the Millersville State System Data Center

Discussion of an alternate site is preliminary without business continuity or disaster recovery objectives.

j. Server and storage equipment lifecycle management

As described in section 3.3.7a, KU lacks adequate storage to meet institutional needs.

3.3.8 Network Operations

a. Campus Wired and Wireless "WiFi" network architecture

Wired Network

KU has a homogeneous network based on Avaya switches and routers. The datacenter uses high-throughput Brocade switches to interconnect the blade servers and the Storage Area Network.

Both Avaya and Brocade have been purchased by Extreme Networks. KU should evaluate how this affects future planning, and follow the impact of this consolidation on, for example, the support lifetime of KU's purchased products. There is no reason to believe that there are or will be problems, but vigilance is appropriate.

The network is well designed and appropriate for an institution of Kutztown's size. The wired network design is a star with all switches (or rather switch stacks) connected via fiber to each of the two core routers. This provides redundancy for the failure of the fiber ports at either end of either fiber and for the failure of either core router. Since the routing of the fiber is not diverse, a single cable-cut could, potentially, disconnect all the switches in several buildings. Concrete-encased

conduit makes this sort of event less likely. Diverse routing of the fiber and separation of the core routers into different buildings would be options to improve disaster preparedness. As independent projects these would be expensive, so they should be considered opportunistically in conjunction with the building master plan for the University.

Vantage understands that KU does not segregate or differentiate traffic by type or role with access lists and other mechanisms. Such separation can ensure the "principle of least privilege" which states that the access granted should be the least that allows all legitimate operation. This internal openness has security implications, or rather insecurity implications. To discuss them, we take a short digression into the "Internet of Things."

The Internet of Things is not just about home automation with Internet-enabled refrigerators and home security devices. We discussed in section *3.3.3 c Classroom Technology Security* the risks engendered by old audio-visual controllers and other "smart," internet-enabled AV devices. The building automation systems that KU is running over the data network, printers, security cameras, door access panels, laundry kiosks, lights, VOIP phones, and so on, are all part of the Internet of Things.

The problem is that the embedded intelligence in all these devices is not very intelligent. Nor do the manufacturers produce security patches very fast, if at all. And when security patches are released, they are rarely applied. The result is that they represent security concerns, both by providing access to the devices themselves and by providing a vector for malicious code. So, for example, a malicious attacker might access building controls and cause inconvenience or even expensive damage to resources in a building. Or, that same weakness could allow the device to be used as a stepping stone to more critical systems or as a "bot" to flood an administrative system, so legitimate users are denied access. There have been several recent examples of higher-education institutions being heavily impacted by these types of events.

It is true that, for example, placing systems on separate virtual local area networks (VLANs) by type and creating access control lists (ACLs) that limit access by role, greatly increases the complexity of the network. That makes the work of an already stretched-thin Network staff that much harder and more time consuming.

Without security objectives defined, it is impossible to determine if the current architecture effectively meets those objectives. Vantage does not believe that the current open architecture meets accepted best practices for higher-education.

Wireless Network

In interviews, Vantage heard a number of complaints regarding KU's wireless networks.

- The top-of-mind complaint with faculty and students was the timeout on connections. We are told the timeout is set to 3 hours to match the longest classes. This "security measure" should be evaluated against security objectives. We note that this practice is an outlier in higher-ed.
- Vantage heard complaints about dead spots in WiFi coverage on campus, as well as needing to reauthenticate if moving from one building to another.
- Students reported frequent issues with WiFi dropping and impacting the ability to successfully complete tests/quizzes.

WiFi is primarily funded through the student tech fee. As such, that investment has been limited to places of clear benefit to students rather than the ubiquitous approach to WiFi generally found (and commonly expected) in higher-ed. Upgrade plans in the Self-Study referred to classrooms and residence halls. The dearth of WiFi has a negative impact on student learning, administrative staff, faculty and staff productivity and is a competitive disadvantage for KU.

b. Bandwidth Capacity and Bandwidth Management, including Streaming Media Bandwidth Management

According to the 2016 KU IT Self-Study:

> *"The Academic and ResNet networks have a total of 3Gbps of bandwidth provided by two Internet Service Providers (ISPs). The Academic network has 1Gbps of bandwidth provided by Level 3 and the ResNet network has 2Gbps of bandwidth provided by PennREN. In addition to the 3Gbps of bandwidth, PennREN is providing a separate network path for Netflix and other bandwidth-intensive sites that is shared between the Academic and ResNet networks. The dual ISP connections can function as a failover in the event of any individual ISP outage. In addition, the ResNet network includes a "NetEqualizer" bandwidth management appliance which automatically applies equalization rules whenever total bandwidth consumption reaches 90% of capacity. During the 2015-2016 academic year, bandwidth consumption never reached 90% of capacity, so the NetEqualizer rules were never put into effect."*

Vantage has not seen utilization graphs for the two Internet gateways, but there is every reason to believe that the current capacity is appropriate for current traffic. The statement above that "During the 2015-2016 academic year, total bandwidth consumption [on the ResNet network gateway] never reached 90% of capacity," implies the capacity is adequate (assuming that the average is over a suitable period). Also, Vantage heard no complaints about internet speed or downtime in any of our interviews.

In general, network traffic is doubling every 18 months, so it is a constant challenge to keep adequate capacity. KU is well positioned in this regard because of the "separate network path for Netflix and other bandwidth-intensive sites." The exponential growth (and Vantage means this mathematically, not just that the growth rate is rapid) of demand for bandwidth is being driven by these bandwidth-intensive sites. KU may therefore experience a lower (though likely still exponential) growth rate in bandwidth demand.

c. Review of the University's Fortinet Fortigate Firewall/Intrusion Prevention System used in network security

Fortinet is a well-known and well-regarded manufacturer of security software and devices. However, as indicated above in section 3.2.1, without a set of objectives defined by a responsible security officer, we have no way to measure the effectiveness of KU's firewalls.

The trend in higher education recently has been to focus less on border firewalls and to concentrate on protecting the repositories of the institution's data and value. This is in the Network group's plans as described in the Self-Study.

d. Network equipment lifecycle management

The plans for replacement of the wired networking equipment on a 6-year cycle and the wireless networking equipment on a 4-year cycle, as outlined in the Self-Study, are reasonable. One should, however, bear in mind that generational change in networking (both wired and wireless) could make

it advisable to extend or reduce replacement times so as not to purchase immediately before or immediately after a significant change in technology. For example, to purchase wired equipment just before a change would result in being behind the technology curve for 5 or more years, while purchasing wireless equipment that is version 1.0 after a generational change could result in dealing with both hardware and software bugs for 4 years.

We note that, on the switch inventory provided, there are 27 switches that were installed in fiscal 2006-2007. These switches, which are over 10 years old, are located on both the academic (in the Honors building M3G) and ResNet (in the Dixon Building) networks. This age is beyond the design life-time of the devices. Longer would risk more outages and place an unwarranted burden on a dedicated but less than average sized (never mind best practice in staffing) staff. Also, a lot changes in network technology over a 10-year period. Vantage would recommend that a 6-year replacement cycle as set out in the Self-Study and subject to the considerations above, is prudent and cost-effective and should be considered a necessity. Before buying replacements, it is necessary to examine the value of upgrading at that time, as opposed to accelerating or delaying: weighing issues of management, support, maintenance, repair, and monitoring of obsolete equipment against the cycle of change in the network device industry and the opportunity to delay purchase.

3.3.9 ResNet Residence Hall Network Operations

a. ResNet Help Desk improvement of residential student customer service

Vantage understands that the source of funding for ResNet is Residence Life, and hence the ResNet Help Desk is intended for resident student support. It is, however, inefficient to have separate organizations providing end-user support. Many of the help documents provided on ResNet are just as relevant to any student, or indeed, to faculty and staff. Here are the results on a search for "Microsoft" on ResNet:

- Recommended Computers
- Installing Microsoft Office
- Office 365: Online Applications
- What happens to my KU files and account when I leave KU?
- Download Anti-Virus Software
- Storing Your Files on the OneDrive Cloud
- Setting up email / Office 365 on your phone or tablet

In addition, the result included the ResNet FAQ with these questions:

- How do I get a KU username and password?
- How do I get a KU email address?
- Do I have to use my KU email address?
- What kind of computer should I buy?
- What software do I need?
- Am I eligible for other discounted software or hardware?
- What kind of anti-virus should I have?
- What if my computer gets infected with a virus?
- Does Kutztown University sell computers?
- Can I use a laptop in class?

- ♦ How do I secure my laptop?
- ○ Where can I get my computer repaired or serviced?
- ○ Does the ResNet help desk charge a fee?
- ○ Is Internet access included in the housing fee?
- ○ Is there Wi-Fi available in the residence halls?
- ○ If I don't want to use Wi-Fi, can I have a wired connection to the Internet?
- ○ Can I use my own wireless router?
- ○ Do I need a printer?
- ♦ Must I pay for printing?
- ○ How strong is the cellular phone service in the residence halls?
- ○ Is my TV compatible with the cable service, or do I need a box?
- ○ Will Google Chromecast work in my room?
- ○ Will Apple TV work in my room?
- ○ Will my Roku device work in my room?

All those items above marked with a diamond are relevant to all students, those marked with a circle are only relevant to resident students. The ResNet HelpDesk uses a home-grown FileMaker Pro database for ticketing. In addition to the benefits and risks of a homegrown application, using a different system makes it difficult for the ResNet and the rest of IT to learn and collaborate with each other in that system.

Vantage applauds the efforts on the part of the ResNet staff to advertise the services they have available. Communications can be difficult for IT organizations, and making services visible to the community is important. We would encourage IT as a whole to look at these approaches as a stimulus to find ways to reach out to users.

b. ResNet Help Desk BYOD support

Please refer to the discussions of BYOD in sections 3.3.4 and 3.3.8.

c. Residential Network Support

i. Campus Wired Network

ii. Wireless "WiFi" Network

iii. Network Security

For each of these parts, see the discussion under 3.3.8 Network Operations, where the physical networks are the same.

d. End Point Device Management/Network Access Control

KU uses ForeScout Network Access Control on the ResNet network.

e. Bandwidth management

i. Streaming Media Management

The discussion of streaming media management for ResNet is the same as for the academic network. Please see the discussion in section 3.3.8 b above.

f. Student Cable Television service

Cable TV service is provided by Service Electric (a division of Cablevision). The channel line-up is short compared to that with which students are likely to be familiar at home. Cable TV is distributed to each building over single-mode fiber. Within each building it is distributed via coaxial cable. Traditionally, the lion's share of cable TV usage is in the residence halls. Cable TV viewership is down nationwide, in large part due to people using internet connected devices such as Amazon Fire TV, Apple TV, ChromeCast, and Roku and content providers such as Amazon, Hulu, Netflix, Twitch, and YouTube.

It may now, or will be soon, time to consider the cost/value of Cable TV service in all the residence hall rooms.

g. ResNet Network equipment lifecycle management

Resnet equipment lifecycle management is the same as that for the academic network, the discussion above under 3.3.8 Network Operations covered both.

3.3.10 Campus Telecommunications Operations

a. Campus Telecommunications architecture

Please see the general discussion of architectures in 3.2.1.

KU has a Nortel CS1000 PBX rebranded as an Avaya CS1000. The system has 5,214 telephone lines of which 4300 are analog. It has served the University well, but the manufacturer, Nortel, is no longer in business and the "inheritor," Avaya, has filed under Chapter 11 of the bankruptcy code. The announced end of support by Avaya before the filing was 2020, but could well be accelerated by the company under the Chapter 11 reorganization. For the discussion of lifecycle management as a consequence of this situation, see section d, below.

KU uses Call Pilot for voicemail without employing Call Pilot's unified messaging capabilities. The Call Pilot is already out of manufacturer support and any support will be "best effort." In short, the PBX and supporting systems are past-due for replacement.

b. Central Public Branch Exchange telephone system maintenance approach

This is year 2 of the support contract for the current telephone system which ends on January 31, 2021. The current fees as described in the contract break down as follows:

Maintenance	2017 Estimated Costs
Port Maintenance	$25,000
PASS Plus Charges (Software Upgrades)	$75,000
iView/Call Pilot/Contact Center	$8,000
Onsite Technician	$71,000
Blanket "Not to Exceed" Orders	$95,000
Total	**$274,000**

In interviews, KU IT reported 1700 faculty, staff and administration lines and between 100 and 200 student lines in use. That leaves more than 3,300 or 63% of the lines unused. This, coupled with the high support costs Avaya extracts for the products they inherited from Nortel, explains the high maintenance cost. This is an additional reason to consider an expeditious replacement of the system. During system replacement, we recommend rethinking the maintenance approach and doing away with student lines.

c. Campus cellular telephone signal strength

Cellular signal strength on KU's campus is reportedly poor, with no signal in many places including inside buildings. Without a substantial investment in distributed antenna system(s), this is largely out of KU's control. Unfortunately, this is common at many rural institutions and getting the carriers to invest without a major draw like a (frequently televised) football field is difficult at best.

d. Telephone equipment lifecycle management

As noted above, the existing telephone system should be replaced. Typically, a PBX replacement process from inception to cutover takes at least 18 months. In order to meet a deadline of the first half of FY 2020, KU needs to be planning for replacement of the entire telephone system as soon as feasible. Replacing the telephone system is a complex process that will require:

1. Hiring an experienced, independent consultant to assist with the process
2. Gathering detailed information on the current system and stakeholders' pent needs
3. Exploring additional functionality that may be available
4. Designing a replacement system
5. Writing an RFP for system replacement
6. Ensuring it is received by all potential vendors
7. Conducting an onsite bidders' conference
8. Receiving and analyzing the responses for content and compliance
9. Choosing a vendor
10. Negotiating with the chosen vendor
11. Running an on-campus marketing campaign
12. Oversight of the installation and integration by a qualified vendor
13. Training (end-user and staff)
14. Cut-over
15. Acceptance testing

Given the need for considerable funds, the necessity of passing documents through the PASSHE and State review systems, and then getting sign-offs from University General Counsel, Attorney General's office and Office of the General Counsel, Vantage recommends that the project be started sooner rather than later.

Vantage's experience is that a rough estimate for the cost of a new telephone system at the current size (5,200 lines) would be $3.6 million, whereas a 1700-line system would cost on the order of one-third of that or $1.2 million.

Vantage's back-of-the-envelope calculations are that the cost of a new 1,700-line system would be recouped by maintenance-cost savings in 5-6 years. (This calculation assumes that, with a smaller modern system, there would be fewer adds, drops, and changes and, since the core would be an

application running on KU virtual servers, the maintenance would not require an outside technician and that the open order could be drastically reduced.)

There are still details to consider. A new voice-over-Internet Protocol (VoIP) system would require power over Ethernet (PoE), which the currently-installed edge-switches can supply. But is there significant energy loss (heat generated) by using the PoE on a significant number of lines? Are the provisions for cooling the telecommunications/data communications rooms adequate? And is there sufficient backup power for running the network equipment and the cooling in these rooms to provide emergency calling in the case of a power failure?

3.4 KU Five Year Information Technology Strategic Budget Plan Review

3.4.1 IT Five Year Strategic Budget Priorities

a. Please review the budget priorities

that comprise the Five Year plan for pricing accuracy, realizing that some items have been forecasted for the future based on existing component pricing

The KU Five Year Information Technology Strategic Budget Plan is not strategic, nor is it truly a plan. It is a list of purchases, mostly to maintain existing services given the exponential (again, this is mathematically exponential, not an intensifier) rate of growth of storage, compute, and network requirements.

The largest single cost is the replacement of the telephone system. The estimate listed for 2019 is $1M. This is pretty close to the low-end estimate that Vantage made in section 3.3.10 d, assuming that the student phone lines in the residence halls would not be continued. This is the largest pill for KU to swallow, and it is a necessity as discussed in section 3.3.10.

Another large bill is related. FY 2017-2020 each list $138,000 for replacing building cabling that was installed in 1994. The description tells us that cabling will continue through 2021, so the total is just shy of $700,000. Since the Category 5e standard wasn't defined until 2001, the best the cabling could be is Cat 5, which is certainly inadequate for today's connections. If, as is probable, the new telephone system is going to be VoIP, should KU wire fewer lines to offices and residence halls? Is this built into the estimate or not? Is fiber to the desktop for future use included, or not?

Vantage is not clear on what is included in the WiFi estimate. However, we strongly agree that expansion of WiFi coverage is a high priority.

Vantage would recommend that KU consider lifecycle costs, rather than individual expenditures. Thus, if KU commits to the purchase of a piece of equipment or software, the University is also committing to the maintenance of that equipment and its replacement when it has reached its useful lifetime.

Let's take the example of the server computing power.

In FY 2016, KU purchased a second chassis (let's call it B) of blade servers. It cost approximately $180,000 and its useful life is probably 6 years. The maintenance cost on each chassis is $30,000, which is likely to rise quite steeply each year, say at 10% per annum. Now the existing chassis (A) at that time also has a 6-year life, and will be due for replacement in 2019, so in 2022 B will need to be replaced and in 2025 we'll be around to replacing A again. One might argue that we can't predict what technologies for running applications will exist in 2025, but we can be sure that whatever those technologies are, they will no doubt cost the University the same or more than the cost of the

current technology, adjusted for the rising costs of technology (somewhere between 5% and 15% p.a.) So, costs of compute power would be as follows:

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Purchase A				240						424
Maintain A	30	33	36	-	44	48	53	58	64	-
Purchase B	180						319			
Maintain B	-	33	36	40	44	48	-	58	64	71
Total	**210**	**66**	**72**	**280**	**88**	**96**	**372**	**116**	**128**	**495**

All figures in $,000, 10% annual increase in all costs. NB: We have assumed that one year's maintenance is included in the $180,000 for purchase in 2016 and hence in the purchase figures every 3 years thereafter.

The point is that once committed, there is no such thing as one-time funding. The time comes around again sooner or later. In the case of cabling, that may well be 20 years if fiber to the desktop is being installed as well as Cat 6e. Or as little as every 3-4 years.

To conclude with the server example, we question whether the right amount has been allowed in each year for server maintenance and updates.

As stated before, most of these costs maintain KU's equipment or software and replaces them in lifetimes that are not accelerated. Figures are reasonable, perhaps understated for projections forward. The new Enterprise Software proposals are modest. The proposals for Classroom Technology in 2020 are likely to be in demand considerably earlier.

b. Please examine the budgeted priorities and processes

for correctness relative to the university's existing technology footprint and future needs

See section a. above.

3.4.2 Please examine if the Strategic Budget Plan is appropriate to meet Kutztown University's current and future needs

See section a. above.

3.4.3 Please review the 5-year strategic budget priority listing in conjunction with the current budget allocations for the Information Technology Department, as well as the implementation of those priorities

Baldly stated, the current budget and staffing are not adequate to meet the expectations of students, faculty, and staff or position KU for success. The IT group's success to this point is a strong credit to the hard work of an incredibly dedicated staff. Implementation of all these proposals, while necessary, will put significant stress on a hard-working staff. Transitioning from a break/fix group to a strategic enabler of KU success will require significant additional resources.

3.4.4 Examine and recommend how the funding will occur for the technologies using the university's existing funding mechanisms, which are the Base IT Budget, Central University Funding, Auxiliary ResNet-Housing Fee, or New Money

IT management has done an excellent job of working the various funding mechanisms to maximum value. Where additional funding may come from to adequately fund KU IT is outside of our purview

3.4.5 Are the items reflected in the plan base-budget recurring expenses or one-time money?

See section a. above.

3.4.6 Is the current plan sufficiently accurate and comprehensive, in terms of personnel needs and resources?

The current plan, as presented to Vantage, does not cover personnel needs. Some consulting is included (for developing MyKU for faculty), and presumably some implementation services are included with the large ticket-price hardware. As noted, the KU IT budget is far short of peer institutions and does not appear adequate to KU's needs.

3.4.7 Please review other technology requests coming from faculty/students/staff that are not part of the IT strategic budget plan, such as an upcoming student early alert/early intervention system, the existing Desire2Learn Learning Management System annual costs, and library resources such as annual electronic database subscriptions and other electronic library technologies

These items were not part of the Vantage assessment.

3.4.8 How should the university plan to approach computer replenishment in the future, given that the university's base of Windows and Mac computers were replaced in 2016?

As discussed in section 3.3.4, Vantage believes that an annual replacement of approximately 25% or failing that, 20%, of computers annually has several benefits over a replacement of all the computers every five years. As with timing the share market, even the experts lose. Predicting the cycles in end-user computing is difficult, and it is all too easy to choose sub-optimally in terms of timing and choice of model. Moreover, the process for installing those machines took at least 14 months, while 3 months a year could see even a quarter of the computers replaced over the summer (of course, faculty away for a large fraction of the summer may need to be left until the fall semester). In terms of budgeting, it is also easier to plan for a more-or-less flat annual expenditure, rather than to ask for funding once every 5 years.

But the question was not to abstractly describe the best approach, but rather, what should KU do from the current situation. Vantage believes that KU should move towards annual replacement, by staggering the next replacements over 2 summers (practically speaking, this would take longer than just the summers), which could be over 3 fiscal years. Further adjustment in the following cycle could leave the distribution fairly even. Different purposes do not put equal demand on computers, and there may be sound reasons to have shorter cycles for some users anyway.

Of course, KU could decide to just go with a 5-year cycle, or a 4-year cycle. Vantage would strongly recommend not stretching the cycle to 6-years.

3.5 KU IT Personnel, Organizational Structure, and Staffing Level Review

There are nuanced differences between the three requested reviews, 3.5.1, 3.5.2, and 3.5.3. Between them, they cover 3.5.4, and the Central IT portion of 3.5.6. This section of Vantage's review covers of these parts. For a review of distributed IT, see section 3.5.6 below.

Personnel

One important observation, perhaps the most important that Vantage could make, is that the tactical-level leadership in KU IT has instilled a spirit of "we're all in this together," which has led to a remarkably cohesive department with an excellent cooperative culture. Moreover, the rapid response of KU IT to issues is praised by academic and administrative stakeholders.

No IT department is perfect, and we have pointed out areas where changes might be beneficial. Given the resources available, and in the absence of the vision and leadership of a CIO, Vantage commends the senior management team of Holly Fox, Rick Miller, Kevin Schukraft, and Chris Walck for their tactical leadership. We would also include Donna Killo, who has retired, in this group. Her role (if not title) with respect to the organization, and especially contract management, certainly qualified her as a senior manager.

The teams they have built are strong, but only one person deep in many areas, meaning that the loss of any members of the team could result in lost institutional and/or technical knowledge.

Organizational Structure

The organizational structure of KU IT is atypical. We hesitate to give examples because the current departmental culture is so good that messing around with the organizational structure is almost certain to be detrimental to the culture and hence the effectiveness of the organization.

Never-the-less, Kutztown University has asked us to point out possible inefficiencies. There are two that Vantage has specifically identified.

- Firstly, the separation of the Distance Learning group from IT is politically, rather than organizationally, motivated. It isolates IT from the core function of the University – teaching and learning. It also separates those designing technology for the classroom from those working with faculty on course design.
- Secondly, IT has three separate groups providing desktop support: the Help Center (3 employees and students), Microsoft Windows and Apple Computing Operations (7 employees), and the ResNet Help Desk (2 employees and students). Again, the separation, particularly between Help Center and Help Desk, is political, rather than based on function. It should be noted that the groups work very well together, but on the other hand, the two "Help" groups use different trouble-ticketing systems, making it difficult to share information.

Staffing Level

We discussed Staffing level under 3.2.1. What that section showed is that the department, relative to its peers, is resource-starved. Since the funding level is so low, it is not surprising that the staffing level is also low compared to peers. There are consequences to this which provide further evidence, if any is needed, that staffing is inadequate:

- Senior management has too much tactical to accomplish to have a chance for strategic thinking.

- Staff work long hours – willingly because they are dedicated and many have been with KU for a long time (many are former students).
- Many staff members carry information and skills that are unique to them, risking disruption should any leave and even when they are sick, on vacation, or in training.

We have pointed out some areas that could be strengthened, such as user interface design. But there are two clear gaps in the senior management of the KU IT organization. We have discussed the need for a Chief Information Security Officer in section 3.2.1. The difficulty evaluating security for the different groups is a result of the lack of security objectives. We have also heard from stakeholders and IT staff that there is a lack of vision and leadership in IT. The next section discusses the role of Chief Information Technology Officer (CITO) or Chief Information Officer (CIO), as it is more commonly called.

Recommendations for seeking a CI(T)O

Introduction – The CIO

For purposes of this section, we are going to regard Chief Information Officer (CIO) and Chief Information Technology Officer (CITO) as synonymous and use "CIO" as it is the common usage. This is not to say that KU is not free to use CITO. There are some aspects of the role of CIO that are common, independent of the industry, enterprise, or institution. Others are specific to higher education, and, in particular, to public institutions.

Since Kutztown University, like most other institutions, has an IT department with its own culture, ethos, current role, strengths and weaknesses, there are skills and approaches that are more likely to result in a good match between KU and a new CIO. In this and the next three subsections, we'll examine this "hierarchy of needs."

Technology is woven into every level and area of most institutions, be they corporations, non-profits, government, healthcare, or higher education. It is part of the strong foundation required for enabling, supporting, and advancing the institutional mission. As institutions develop new models to stay competitive and focus on outcomes and cost containment, the role of technology has become ever more critical and pervasive. As a C-level executive, the CIO works with other members of the executive team to identify the opportunities and value that IT can provide in realizing these strategic institutional goals.

To be effective, the CIO must be well positioned to be a strong partner with other C-level executives. S/he is in a unique position to look across the institution for partnerships, learn about needs and develop strategies for solving organizational problems. To accomplish this, the CIO must have a demonstrated understanding of the institution's short and long term goals and what part technology can play in creating evolutionary, transformative and innovative advantages to help achieve those goals.

The successful CIO must have an array of leadership and management skills:

- Leadership & Vision – The CIO must create and articulate a vision and provide inspirational leadership across the institution
- Communications – A successful CIO is an effective communicator, cultivating connections within IT and across the institution
- People management – Of the IT staff
- Financial management – Of operational and capital budgets

- Contract management – Including contract negotiation, for outsourced services

How the does the CIO differ from any other high-level executive? Any good CIO understands the technologies the enterprise employs at a more-than-superficial level (i.e. the CIO should know how the technologies work at a level to meaningfully communicate with the technology experts they manage). That requires a knowledge of networking and network devices, of servers and storage, of databases, of end-user (e.g. desktop, laptop, printer) technologies, and those technologies specific to the enterprise. This is not to say that the CIO should be a micro-manager, overseeing the work of each person in IT. On the contrary, the CIO needs to be a leader who can and does trust the IT directors and their staffs to do their jobs.

More than that, the CIO must have an understanding of technology trends that might impact the enterprise.

The Higher Education CIO

The knowledge of classroom and distance education technologies separate the higher-ed CIO from his brethren outside education. But the understanding of these technologies at the strategic level of the CIO requires a significant understanding of teaching theory and practice.

Those are the obvious ways the CIO in higher education is different from the CIO in non-educational enterprises.

It has been said of academe (many times and by countless luminaries going back possibly as far as Woodrow Wilson) that the politics are so vicious because the stakes are so low. Whatever the truth of that cynical aphorism, the CIO requires experience successfully navigating the politics of a higher-educational institution. Those include external and internal politics. Externally, one example is the importance of the *U.S. News and World Report* ratings of Colleges and Universities. These have a, some would say unwarranted, impact on the applicant pool of any school.

One counterpoint to the cynicism quoted above is that higher education remains more "collegial" within and between institutions ("co-opetition") than business at large and the role of the CIO as the chief technology *advocate* is all the more important in higher education. This means that in higher education, there is more need for good communication because of greater emphasis on persuasion than in the for-profit world. Decisions are made in consultation with the appropriate groups. Depending on the nature of the decision, these will often include, among others:

- The President and the Cabinet
- The Faculty
- University staff
- The student body
- The Academic Technology Committee
- Other governance bodies
- IT Directors/senior IT staff members

The communication skills a CIO requires are two-way: not just advocating technology to the various constituencies, but listening to the needs and ideas of the individuals who make up the university and the IT senior managers and staff. That sort of communication translates into management-by-walking-around. It is important that a higher education CIO have a tolerance for the time and effort it takes to work by achieving consensus, the drive and savvy to guide projects through to completion

in a reasonable amount of time, and the and the ability to forcefully communicate the importance and impact of any decision. Vantage also feels that successful CIOs in higher education are actively involved in all discussions at the cabinet level because it is hard for even an IT professional to be aware of how technology can impact any decision to improve outcomes.

Technology is present within every corner and layer of higher education. Almost every institutional process relies on technology. This uniquely positions the CIO to see the process flows and integration of each part of the institution. As a result, they develop institution-wide visibility and knowledge. The CIO is at the center of all this process and technology, and is often the best person to bring people together to meet new institutional needs and to advance the mission of the university.

In order to communicate well with the various constituencies on campus, it is important that a higher education CIO have insight into higher education. An advanced degree (although the area is not particularly important) will help add credibility, but not necessarily provide the understanding of the faculty viewpoint. For that, some experience teaching is the surest, but not the only, way to gain such insight.

Considerations for Public Institutions

Public institutions come under scrutiny from state and federal governments, and, through public information laws, the public at large. So, all state university CIOs must be willing to work within procedural requirements and always aware of the possibility of public scrutiny.

Recently, in most states, public institutions have seen a tightening of funding from the state budget. Grant funding, particularly federal grant funding, has also been cut back and is likely to see further reductions. These trends increase the importance of fiscal management for a public university's CIO. In addition, the CIO has a unique capability to identify and implement efficiencies to enable institutional success while realigning resources.

Kutztown University's Unique Requirements

Vantage has frequently encountered IT departments within which the different areas have quite different cultures and the organization is deeply "siloed." The culture of the IT department at KU is unusual for the cohesion and consistency across different areas. The whole department appeared to Vantage to be unified and dedicated to the good of the University. Turnover is also low, which is another sign of a valuable, positive culture.

It is imperative that a new CIO not disrupt what is working well in this culture. Moreover, we often heard praise for the department in stakeholder focus groups that cited the department's dedication as well as rapid and effective response to problems with core technologies, common applications, and hardware. These factors tell us that Kutztown should not look for a CIO to turn the department around, shake things up, or revitalize the department. What the department needs is vision, leadership, and direction, that builds on the existing solid foundation, rather than disruption.

The culture and successes of the department clearly owes a lot to the skills of the senior technology directors/managers. Retention of this cadre should be an objective of the new CIO.

Past CIOs at Kutztown have had the title "assistant vice president" and reported to the Provost. Vantage's opinion is that the position should be at the vice-presidential level, have a seat on cabinet, and report directly to the President.

In the table below, we present the information on the highest-ranked IT officer at KU's peer institutions. The data shows that, among primary peers (as distinct from members of PASSHE), the IT leader reports to the CEO (typically the President) in 5 of the schools, to the Provost in 3, and to the CFO in 2. However, in only one case does the IT leader not have a seat on Cabinet.

The situation in PASSHE is diametrically opposite, with the CIO reporting to the CEO in only one case.

When looking for an IT leader, only one school appointed someone who was not already a leader in IT on campus or an IT administrator. The majority of the leaders of central IT have the title CIO, possibly with other titles.

		2016	2016	2016	2015
Peer Group	**Institution**	**Highest-Ranking IT Officer Title**	**Reports to**	**In Cabinet?**	**Prior Position**
KU	Kutztown University	CITO/Assistant vice president	Provost	No	-
PASSHE Peers	Clarion University	CITO	Provost	No	-
	Millersville University	CIO/Associate vice president	CFO	No	-
	Shippensburg	Vice President	CEO	Yes	Administrator
	Slippery Rock University	Associate provost/Associate vice provost	Provost	No	-
Primary Peers	Angelo State University	CIO/Associate vice president	CFO	Yes	IT leader, not central IT
	Eastern Illinois University	Assistant vice president	CFO	No	IT admin, central IT
	Eastern Washington University	CIO/VP	CEO	Yes	Administrator
	MN State University Moorhead	CIO	Provost	Yes	-
	NW Missouri State University	Vice President	CEO	Yes	IT leader, not central IT
	Radford University	CIO	CEO	Yes	IT admin, central IT
	University of Minnesota-Duluth	Director	Provost	Yes~	IT leader, not central IT
	University of Wisconsin-Stout	CIO	CEO	Yes	IT admin, central IT
	Western Carolina University	CIO	CEO	Yes	-
	Winona State University	CIO/Associate vice president/Dean	Provost	Yes	IT admin, different institution

~ Change from 2015

A word of warning: having performed the analysis of KU IT department resources both financial and human (see section 3.2.1), Vantage agrees with the consensus of stakeholders and staff of IT that the IT department is under-resourced. Unless that changes, there is a limit on how much a CIO can achieve. The lack of resources to affect change may further limit KU's ability to recruit an effective CIO.

Summary

Putting all this together, Vantage believes Kutztown should be seeking a CIO:

- A visionary technology leader capable of articulating that vision to, and inspiring all the constituencies that make up Kutztown University
- An approach to change through evolution rather than disruption
- A leader, not a micromanager
- A skilled manager of resources, both human and fiscal
- Experience with contract negotiation and the management of contract services
- Understanding of the broad range of technologies employed in higher education for administrative and academic purposes and the trends in those technologies and their use in higher education
- A good and persuasive communicator to the entire University community, who can act as an advocate for technology in the support of the University's mission

- A willingness to work within the laws and rules for a public institution in the State of Pennsylvania
- Demonstrated understanding of the faculty role through experience teaching in higher education or otherwise.

Note: an advanced degree is advantageous when interacting with faculty and would be recommended if academic technology were ever to be the responsibility of the CIO.

3.5.1 Review the composition of the IT department in terms of effectiveness and efficiencies

See above in section 3.5

3.5.2 Review of staffing abilities and expertise. Do we have the right mix, in the right organization, providing the right services within the Information Technology Department

See above in section 3.5

3.5.3 Review of the existing skill sets, leadership, staff support and reporting structure across the Information Technology Department

See above in section 3.5

3.5.4 Is the Information Technology Services Department structured following best practices?

See above in section 3.5

3.5.5 How does IT interact with the campus including the Academic Technology Committee?

Under the previous CIO, interaction with the community was discouraged. Fortunately, this is not natural for many of the employees of KU IT. There is, however, a residual distancing and more active communication should be encouraged. In our interviews, Vantage found that the attitude to central IT was much what KU IT believed it to be. Namely, a break-fix role.

It does not seem that departments look to IT for a deep understanding of how the technologies might be used in administration or teaching and learning. This is unfortunate, because there is a valuable pool of knowledge being untapped.

We heard conflicting statements from different members of ATC. We heard "[I would like] the ability to more quickly and without as much IT involvement deploy software." While we also heard "the pace of support for new software or classroom tech support is very good and very quick. ... IT is good at listening to my needs."

IT does need to be involved in any software deployment and it is surprising to hear the former statement from a member of ATC, a group which should be a liaison to IT and understand their University-wide obligations. Vantage feels that this is a symptom caused by:

- The earlier policy of limited communication, and
- The separation of the Distance Education group, which is *de facto* the academic technology group, from IT.

- Lack of other governance mechanisms

3.5.6 Provide a review of the entire central and distributed Information Technology organization

including: Central Information Technology Services; ResNet (a part of central IT); and independent distributed IT personnel reporting to other units, including: one Business Systems Manager reporting to the Finance and Business Service Department, one Facilities Technology Specialist reporting to the Facilities Department, one Student Union Electronic Systems Technician reporting to the McFarland Student Union, one Library Technician, reporting to the Library providing library technology support, and Desire2Learn distance education support and other associated distance education systems which constitute the Distance Education Department, part of the Academic Affairs Division

See above in section 3.5

The small number of distributed IT personnel are a mix of technicians, developers, and other departmentally focused roles. All reported good interactions with central IT but, scratching the surface showed little real collaboration with central IT. In most cases, central IT, the individual distributed IT employee and the departments would significantly benefit from a more direct relationship with central IT. As time is one of the resources in inadequate supply for the IT staff, further collaboration with the distributed IT staff is difficult. It is Vantage's opinion that an effective CIO will work with the departments to better understand their needs and how technology can best enable the departmental missions. That understanding and communication will lead to discussions on the appropriate role and placement of any distributed IT staff.

3.5.7 Review of how KU benchmarks itself

against other institutions of similar size, offerings, and service levels including the help desk, other services, and support for other areas with IT functions like facilities, one-card, dining, library, and distance education. Please examine how that interaction is viewed and is the combined current central and distributed IT structure effective

Vantage has seen no benchmarking information from KU. We have provided benchmark information from Vantage's experience and from the EDUCAUSE Core Data Service.

4. Conclusion

Vantage's overall finding is that the IT department at Kutztown University is a cohesive, well-functioning team achieving excellent results. With the current level of human and fiscal resources, it was surprising how much they achieve. More cannot be expected of them without an increase in resources.

The areas where we see the lack of resources showing are in strategic leadership, security, and user interface design. Also, the (remarkably effective given the size) classroom technology "group" of one has been forced to hard choices on equipment replacement and there are a significant number of devices still in service beyond their design lifetimes.

For an IT organization to be most effective in supporting a university's mission, Vantage has found that it is important for the highest-level technology officer (CITO) to be at the cabinet level. Vantage also sees the effects of KU not having a Chief Information Security Officer (CISO). Vantage believes that an appropriate, comprehensive security policy at KU would improve the defense of the University's resources and alleviate the problems the faculty have reported with access to resources in the classroom.

Vantage believes that, with appropriate strategic leadership and an increase in resources, there are many additional ways that this dedicated staff can contribute to the mission of Kutztown University.

Appendix A: Documents Requested and Received

KU RFP Ref.	Review Area	Documents Requested
3.1 3.2	Mission of the IT Organization Goals of the IT Review	• Kutztown University Information Technology Self-Study 2016 • Kutztown University IT Five (5) Year Long Term Budget Summary
3.3	Information Technology Services Operational Review	
3.3.1	Customer Service Approach	
3.3.2	IT Best Practices	• KU policies and procedures • Access to EDUCAUSE Core Data through KU
3.3.3	Classroom Technology Operations	• Classroom technology standards • Classroom support SLA • Classroom equipment inventory • Classroom lifecycle plan
3.3.4	Microsoft Windows and Apple Computing Operations	• Support SLAs • Printing Architecture documentation • Desktop computing equipment inventory
3.3.5	Help Center Operations	• Support SLAs
3.3.6	Enterprise Software Development and University Web Operations	• PeopleSoft SIS in-house docs (SLAs, BI/reporting guidelines, …) • PeopleSoft Student Information System software agreement • Hobson's Radius CRM in-house docs • Web standards, including accessibility • Ingeniux CMS user documentation • University policies on software implementation and maintenance

KU RFP Ref.	Review Area	Documents Requested
3.3.7	Systems Administration Operations	• Server architecture • Storage architecture • Document retention policies • Contracts for server-based software support • Hosting agreement with Millersville State System Data Center • DRP agreement with Millersville State System Data Center • Server and storage hardware inventory
3.3.8	Network Operations	• Network diagram • Bandwidth management (user) explanation

		• Network equipment lifecycle policy • Network equipment inventory
3.3.9	ResNet Residence Hall Network Operations	• ResNet/BYOD SLAs • ResNet/BYOD/Cable TV documentation for students
3.3.10	Campus Telecommunications Operations	• Telecom architecture • PBX maintenance and support agreements • Telephony equipment inventory
3.4	KU Five Year Information Technology Strategic Budget Plan Review	• Five Year Information Technology Strategic Budget Plan • Current budget allocations • FY 2017-18 budget (budget request if budget not yet available)
3.5	KU Information Technology Personnel Organizational Structure and Staffing Level Review	• IT organizational chart • Condensed job descriptions (from Self-Study) • University organizational chart with IT staff outside IT marked • List of IT governance bodies • Academic Technology Committee (ATC) list of members with positions • KU benchmarking

Appendix B: Technology in the Kutztown Strategic Plan

GOAL 1: Academic Excellence

Kutztown University will promote, enhance, and recognize excellence in teaching, learning, creativity, scholarship, and research.

Objective 1: Develop and deliver distinctive and high-quality academic programs.

Actions:

- Infuse high-impact practices throughout the student learning experience.
- Utilize the academic program review process to ensure high-quality, viable, and innovative academic programs and services.

Objective 2: Attract, retain, and support qualified, high performing faculty and staff

Actions:

- Ensure that faculty and staff have and are using current technological tools.

Benchmarks:

- Increased use of effective educational technology.

Objective 3: Attract, retain, and support motivated, high performing students

Actions:

- Develop and implement a multi-media marketing campaign that promotes the recruitment of motivated, qualified new, transfer, and graduate students.

GOAL 2: Community Engagement

Kutztown University will partner with the community to serve the needs of the people of the Commonwealth and the region.

Objective 1: Provide increased access to educational opportunities for the region's citizens

Actions:

- Increase online educational experiences and non-traditional delivery methods (e.g., weekend academy, evening courses, non-traditional schedules)
- Provide lifelong learning opportunities for
  a) adult learners
  b) non-degree seeking students oriented to regional culture, agriculture, business, and government
  c) seekers of certificates and specialized programs that address the needs of professionals in the workforce, and
  d) non-degree seeking students that meet their personal needs

- Promote dual admissions, dual enrollment, and other initiatives with community colleges as well as develop partnerships with other four-year institutions.
- Increase educational opportunities for alumni.

Benchmarks:

- Increased number of new online academic programs.

Objective 2: Increase the education-related experiences available to the public

Actions:

- Increase education-related entertainment and service events.

GOAL 4: Stewardship of the University's Infrastructure

Kutztown University will maintain and enhance physical, financial, and human resources necessary to fulfill its mission.

Objective 1: Enhance the University's human re- sources to better support the academic mission

Actions:

- Enhance the quality of the University's workplace experience by providing improved communication and employee engagement.

Objective 3: Enhance the physical facilities to better support the University's academic mission

Actions:

- Renovate classrooms and faculty offices in Lytle Hall and DeFrancesco Building.
- Replenish campus computers Initiate the library master plan.

Benchmarks:

- Improved classrooms and faculty offices in Lytle Hall and DeFrancesco Building.
- Complete computer replenishment.