Findings and Recommendations on Information Technology Resources
EXECUTIVE SUMMARY

The College of Engineering is conducting a review to examine current practices around the use of information technology in support of its programs, research and outreach. The 2011-2016 Strategic Plan published by the College identified major goals to drive Engineering from excellence to preeminence. One of those specific strategies was to provide more centralized IT support to the College units.

Centralization efforts for the College have been attempted before with an implementation plan drafted in 2011. At that time, the culture was not prepared to move forward with the recommended strategy; however, the conversation has been kept alive and in 2012 some progress was made when a second more modest proposal was adopted.

Technology provides a foundation on which programs, research and academia can thrive. The College recognized the need for better management of its investment in this area and in its most recent Strategic Plan charged Engineering’s Chief Information Officer to develop a plan to realign College IT staff and technology resources.

The findings and recommendations presented in this report are based on a broad assessment of the information technology services, systems and structure in place today, with a vision to develop a department that will be situated to meet the growing support needs of research efforts, partners, employees and students.

The significant dependence on technical solutions coupled with rising pressure for operational efficiency makes this an optimal time for positive change. Understanding the current landscape will assist in future decision making and strategic positioning.

To integrate core technologies throughout the College while staying mindful of the College’s unique missions is a significant undertaking. It could not be achieved without the support of Dean Williams and his leadership team. This new model is based on the perception that the outcomes will produce improved technical operations that will be more effective, produce efficiencies through economies of scale, and create an environment that is flexible and responsive to the educational, research and program needs for the College of Engineering.
PURPOSE AND SCOPE

Simply put, the purpose of this exercise is to identify areas in information technology that can be modified to produce improved outcomes in service, support, operations, investment and overall process. Decision points will be based around three areas:

1. Operations that should be centralized and considered basic College wide service offerings
2. Support which should stay distributed
3. College operations that overlap and require both approaches.

This will define the hybrid model for information technology.

This document will present a baseline of how IT operates today, identify areas for improvement, and propose an operational outline on how to move towards a desired end state. With mounting internal needs and growing external mandates, there is urgency to make mindful choices now.

There is not one correct path for this journey. There will be crossroads where the College must make thoughtful decisions. The first step however is that stakeholders are receptive to the concepts put forth in this document.

An emphasis should be placed on an optimal organizational structure and core service offerings. Once that is decided and has sponsorship, the details on how to operationalize it will be furthered. A primary goal is to mitigate risk, improve service levels, and build depth in support for our academic areas and research endeavors.

Questions to keep in mind:

- What types of College support areas should be centralized?
- How do we develop a model that bolsters support for the Centers and College units?
- What would a hybrid model of centralized and distributed IT look like?
- How do we position our IT personnel for success?
- Where would the centralized unit be located?
- What would the reporting structure look like?
- How do we ensure we have the right people in the right roles?
- What services are not provided today and why?
- How would a new model be funded?
- What challenges can we turn into opportunities?
- How does IT become a streamlined operation?

This report presents an initial recommendation for the structure of information technology resources and the expected outcomes followed by an overview of our current landscape and technical complexity.

This writing is not intended to be critical of past or present operations, but rather should be seen as a roadmap and used as such in support of the College’s future growth.
METHODOLOGY

Information gathered for this document include interviews with:

- College of Engineering Information Technology leaders and staff (30)
- Chairs and Directors on the Executive Committee (13)
- Operational Directors
- Researchers
- Center Directors
- Leadership within the Office of the Chief Information Officer (6)
- Information Technology leaders from other Colleges
- Outside partners

Additionally,

- Site visits were conducted to all major research centers
- Historic reports on centralization reviewed
- Online survey targeted at College of Engineering Information Technology leaders (objective)
- Written responses (CoE IT leaders) on concerns and opportunities (subjective)
- Financial reports and personnel breakdown by unit were assessed

WHY CENTRALIZE ANYTHING?

The answer: economies of scale for fixed and variable costs, consistency, time management, defined service levels, improved security, data management, flexible resource allocation, shared data center facilities, expertise for University imposed mandates and reduced complexity.

The centralization decision must add value to the organization. For Engineering, a fully centralized model would not be practical. There are too many unique areas, specifically in research that need specialized support.

There are many areas where support and service offerings are common throughout the College, but the quality and timeliness of IT service excellence varies between these units. Several Chairs and Directors have voiced great satisfaction with their IT support levels and the current staff in those roles. Concern has been expressed that a centralization effort could be disruptive or decrease the IT delivery they receive today. On the contrary, centralization of some services would have a neutral effect or improve support for those groups.

College programs are being diversified and faculty are hired to instruct across disciplines, yet we have constructed significant barriers that preclude users from consuming resources between academic
departments. The very technology we expect to make us more efficient becomes a burden. With proper planning and execution, our resources (people and solutions) could be leveraged to bolster the efforts of faculty and staff.

The network topology in place today is designed to segregate units. Adopting a centralized approach for common core services and removing technical barriers may prove advantageous if built to foster innovation and collaborative efforts.

Today's distributed model for information technology staffing has its challenges. It makes it difficult for the College to be flexible when responding to new incentives or startups. The ratio of staff to departments and centers is unbalanced and specialized skill sets for certain areas are not in place.

If additional technical specialists were available through a central service offering, then IT professionals from two units (department and central) could team together when needed for an accelerated result. Smaller units could take advantage of this same model to provide basic support not available to them today.
RECOMMENDATIONS

Engineering could gain operational efficiencies and expand support offerings by operating under a hybrid or federated model of centralized services complimented with distributed IT resources. This structure would improve resource gaps, reduce duplication in effort and investments, add support for research endeavors, and address high-risk concerns.

The major Research Centers are sponsors of highly sensitive data, but are deficient in the technical resources allocated to support the operation. The level of security in place to protect access to intellectual property and systems is unknown. These Centers are competitively driven to be the experts and leaders in their field. Having senior IT specialists readily available to provide technical assistance and knowhow would enable the Centers to be flexible and highly responsive to time-sensitive requirements.

The staffing ratios of IT support personnel to a Center ranges from zero to two. Similar disproportionate support ratios are observed in the Departments.

The recommendations that follow focus on staffing, structure and process. By redefining the information technology operation, the College will remediate current risk, leverage its investment, and transform to a proactive support model.

Services

One approach for centralized offerings is to identify core and value added services. Core services would be available to all units and funded centrally whether units opted to use them or not. Those choosing not to use a core service would bear a financial burden of maintaining that IT service and infrastructure for their unit.

Value added services would be identified, implemented and managed by the central operations. This provides relief for smaller and under resourced areas to take advantage and receive an immediate benefit through quick response for a specific need. A value added service could be categorized by consumption and service level agreements. Low consumption may not incur a cost whereas increased utilization of a value added service would acquire incremental costs still to be determined.

A value added service that transitions to a core service becomes centrally funded.

- Core Service
  - Services considered essential and standard operations for any unit
    - e.g. College Active Directory (AD), firewall management, help desk, web site design/hosting, storage and backup of home directories or file shares, classroom support
  - Funded centrally.
- **Value Added Service**
  - Unit specific requirement above core service level
    - e.g. hosted servers/storage, managed servers/storage
  - Funded centrally or charged back to unit. Based on volume or consumption.

A hybrid model would build a foundation (Central Operations) on which to identify and implement core services.

Some units may choose to continue providing these services as they are today. This may be especially true for the larger departments. However, the offerings would be available if and when the need arose.

The goal here is to be successful and resourceful by investing wisely and placing the right people in the right roles.

The central operation will need to earn trust and gain efficiencies.

The balance of central resources to College-wide support will be monitored and adjusted as the model grows and consumption of services rises.

**Staffing**

Information technology staffing levels fluctuate throughout the College (table 1, page 14). When interviewed, the majority opinion amongst Chairs, Directors and Information Technology Leaders was that the IT support group is under resourced. Perhaps. What we have constructed is a model that squanders our resources by reinventing the wheel over and over instead of pooling together our knowledge and expertise.
As we move to a hybrid model we would reduce the duplication of effort occurring today and add services and leadership not currently available. As a common service (ie. firewall management) transitions from a unit to the central group, the workload is shifted resulting in the local technician having more time to concentrate on unit specific requirements.

The model being presented would also fill voids by establishing roles and responsibilities that are highly desired but not in place today. One example is a dedicated resource to oversee the needs of research computing. The role would become the resident expert on compliance, stay informed on US Government and Department of Defense controls, act as a liaison with the research faculty, and provide guidance to local IT on required security measures. Leadership from this role would extend beyond the Centers.

The central resource pool would be a group of highly seasoned technicians able to assist with Center startups, projects, emergency situations, under-served departments and consultation.

The central operational diagram on the preceding page identifies four broad domains of Infrastructure, Support Services, Application Development, and Research Computing and Compliance. They are devised to provide College-wide common support needs and address current gaps in service.

<table>
<thead>
<tr>
<th>Infrastructure Group</th>
<th>Research Computing and Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data Center</td>
<td>• Oversee IT Center support</td>
</tr>
<tr>
<td>• Network Security</td>
<td>• Staff Augmentation</td>
</tr>
<tr>
<td>• Server/Storage Consolidation</td>
<td>• Authority on Government Mandates</td>
</tr>
<tr>
<td>• Data Backup</td>
<td>(Export Controls, DFARS, ITAR)</td>
</tr>
<tr>
<td>• Authoritative Active Directory</td>
<td>• OCIO Directives</td>
</tr>
<tr>
<td>Support Services</td>
<td>Application Development</td>
</tr>
<tr>
<td>• Help Desk</td>
<td>• Web Site Hosting</td>
</tr>
<tr>
<td>• Resource Pool</td>
<td>• Web Site Development</td>
</tr>
<tr>
<td>• Licensing</td>
<td>• Database (future)</td>
</tr>
<tr>
<td>• Learning Technologies</td>
<td>• Middleware (future)</td>
</tr>
<tr>
<td>• Volume purchasing</td>
<td></td>
</tr>
</tbody>
</table>

In total, seven to nine positions would be required and funded through a central budget:

- Center Support (located at the Center’s) 2
- Resource Pool 1 – 2
- Research and Compliance 1 – 2
- Infrastructure 3

In addition to the above there are eight employees already providing some College-wide services. It is predictable that certain IT employees currently serving individual units would have interest in transitioning to a centralized role. The final need for new FTE’s would not be fully realized until people had completed shifting roles and the volume of services transferring from a unit to central operations was realized.

It is expected that there will always be a presence of distributed information technology professionals supporting the local needs of the College. The central and distributed groups would work together and strive for excellence.
Funding

It is recommended that a budget be established in support of centralized operations and overseen by the Chief Information Officer. The allocation would account for employee salaries, student help, enterprise licensing, servers, storage area network (SAN), data backup and supporting management tools. Capital equipment would operate on a 4 to 5 year life cycle.

Technology investments throughout the College are inconsistent. Servers and storage devices are a necessity for all areas to access general file shares and home directories. Housing for much of this data could be accomplished through an enterprise level SAN. The College has almost three-dozen different investments into various data storage solutions. With the implementation of a centralized SAN for personal home and shared directories we remediate risk of undersized or low-budget systems, and provide the same level of service to the customer.

This transition would take place over time as many units have a substantial investment in their SAN hardware and software that has not reached end of life. A purchase would be proportional to meet current needs, but designed on technology that is scalable for future growth. The units using this service continue to manage access to their data; it just resides on a shared system.

The cumulative investment into technology is significant. This chart captures costs from fiscal year 2011 through fiscal year 2014 and the first seven months of FY 2015. The dollar amounts are from unrestricted general funds and the learning technology fee. It excludes sponsored projects. (Purchases coded against the computer services category are small in comparison and therefore do not display on chart 1.)

Chart 1

![Chart 1: Technology Purchases by Category and Year](chart1.png)
A budget model for the central operation should include funding to support long and short term project planning, and growth such as storage, servers and networking.

Additional charts illustrating spending patterns are included at the end of this report in appendix B.

**Reporting and Compensation**

The reporting structure of information technology employees varies between the Chair, Director, Associate Director, Research Specialist and Associate Dean. When a vacancy occurs, these leadership roles decide whether to refill the IT position as is, reclassify or eliminate.

Inconsistency in the reporting structure of whom the employee reports to, compensation, and the technical environment exacerbate the situation. Employees supporting unit A are not necessarily payrolled through unit A’s budget.

Chart 2 shows total IT salaries, the number of technical staff supporting a specific unit, and the number of technical staff actually carried in that unit’s budget.

It is recommended that information technology staff have a direct reporting line up through the office of the CIO with dotted line accountability to an authority within the unit. Such a model would regulate supervisory practices, provide early identification and remediation for resource needs, and assist with proper prioritization of work efforts.
If the changes in reporting structure are accepted, it is further recommended that the funding of the IT FTE be moved to the CIO budget line, as it is logical that the funding source follows the reporting structure.

This shift would: 1) eliminate the burden of engineer’s having to decide whether or not to hire an IT support person due to budgetary constraints, 2) facilitate pay equity based on service years, performance and job classification, and 3) improve resource utilization.

Current employee information including technology titles, salaries, years of service and employing unit are broken out in appendix A.

**Process Improvement**

Technology purchases and accountability for the asset is done via the units. Purchase requests and account coding are presented to the local business manager by the IT employee and then submitted through the eRequest System, which routes to the Business Office for processing. Subjective coding out in the units makes it more difficult to identify and quantify the actual technology investment by the College.

Except for enterprise site licenses, the unit handles software management. Area A, B and C may all have similar needs, but cannot take advantage of price negotiations or shared licensing. Specialty software can be extremely expensive. Unit A may have an available license that unit C could utilize, but that coordinating effort is not in place today.

A large annual spend occurs for the replacement of desktop computers. This vendor negotiation and procurement is repeated within the boundaries of each unit. This is a sizeable investment for the College. Under state contract these vendor’s are obligated to offer the same quote regardless of the purchase size; however there may be an opportunity for even greater savings if we would leverage the purchasing power of the whole and not the parts.

Information technology leaders identified seven different methods in which they receive requests for technical support. This places the burden on students and staff as they must understand the unique process by department or building for requesting assistance. A consistent approach to how Help Desk requests are entered, tracked and resolved would result in an improved user experience. By implementing a software driven solution for the College it ensures requests are not lost in email or voice mail when the IT staff member is away from the office, and provides metrics on volume, resolution time and service satisfaction.

The responsibility of interpreting research computing needs, mandated controls and technical requirements is left up to the local IT professional. Government regulations over research computing are complex. The lack of process creates frustration, bottlenecks and places the burden on the local IT support person. Establishing consistent processes to meet these control measures could be achieved by having a central subject matter expert on mandated requirements act as the liaison to researchers.

Under the hybrid model, the central unit could add value with oversight or coordination for these five areas.

1. Work with local IT staff on consistent chart field coding and establish a general review process for technology purchases over $5,000.
2. Establish an inventory for all major software licenses owned by the College that units could query. Evaluate the use of central licensing servers.

3. Coordinate the annual computer purchases with local IT and attempt to negotiate pricing less than the standard quote. Establish the same practice for similar large commodity procurements.

4. Choose a single Help Desk software product to be used in the College. Establish ticket priorities based on urgency, impact and expected response times along with workflows so that a request is immediately routed to the proper local IT person and/or have an IT staff member dispatched.

5. Create a new role to focus on and be a liaison in support of Research Computing across the College.

**Location for Central Services**

Moving to a shared support model to expand and improve information technology services is a bold move for the College and will encounter its share of challenges. The central start-up team will need sponsorship and encouragement as they transform into their new areas of responsibility. To foster this growth they should have contiguous workspace. An office setup that would provide workspace for 16 IT professionals would be a starting point for phase 1. The space should be designed to support collaborative work efforts and be in close proximity to the academic core.

Space on the first floor of Smith Laboratory has been identified as a potential initial location for the centralized operations unit. Remodeling efforts are underway and completion of the project is slated for August of 2015. Unfortunately the space is sized to house only 10 employees during phase 1; therefore the web services team will remain in Hitchcock.

It is recommended that larger space be planned for in the future. When that is accomplished, the web team, support for learning technologies, and other natural outgrowths of the centralized effort would be located together. Efforts towards central services will be significantly hindered if contiguous office space is not established for the new central operations team.

Under the hybrid model, the local IT staff that support Departments, School, and Centers would remain in their physical space so that service levels are not disrupted. Exceptions could be made if local support needs are not being met.

A site for the College shared data center (DC) does not need to be adjacent to the central workspace in Smith Laboratories. Current software tools allow management of servers, storage and networks to be done remotely.

What will be required is that the DC is secure, has acceptable environmentals, power, redundancy, and space to accommodate servers, storage, backup systems and networking. There are several areas identified and under consideration at this time.
**Web Services**

The Engineering Computing Services (ECS) group offers centralized web services. The web service offering was implemented a few years ago and has been well received; however, some have chosen to opt out placing additional hardware, software and maintenance support on their local technology professional.

It is recommended that all web hosting be moved under the ECS group to leverage a proven shared service offering.

**Expected Outcomes**

The areas targeted for improvement through the reshaping of above operations include:

- Centralized data center
- Authoritative Active Directory
- College-wide Help Desk
- Stability and equity in human capital
- Reduction in technical barriers
- Operational efficiencies through shared services
- Research support
- Security and compliance
- Policy and process
- Disaster Recovery
- Flexible staffing model

The successful implementation of these improvements will deliver solutions that:

- Create an agile Information Technology organization
- Central network to support core services
- Improve access to resources
- Life Cycle approach for hardware and software
- Server consolidation and hosting
- Enterprise data backup solution
- Excellent customer service
- Better investment strategy
- Assistance with compliance mandates
- Apply best practices
- Foster collaborative efforts
- Cohesive IT practices
- Expertise to facilitate research efforts
- Service Level Agreements
CURRENT MODEL

Currently, information technology support staff and technologies operate under a highly decentralized model. The following section overviews how support staff are organized, deficient areas, the headcount of IT professionals per unit, and technical complexities.

IT Organizational Structure

If you ask the question ‘What does the IT organizational structure look like today?’ the answers will differ. Individual units have an understanding of who supports their area, but rarely have a concept of other departments or centers. Even those in the central office have a difficult time trying to articulate the structure of the overall IT personnel presence.

The College of Engineering is home to almost 10,000 students and 1,000 faculty and staff. Growth in research efforts, partnerships and enrollments has the College in high gear. Between the various departments, centers and units, there are about 20 unique areas needing IT support and resources.

The aggregate number of technology professionals is around 49. Staff are hired and funded through the individual units on an “as needed” basis. The direct reporting for these personnel is up through the unit with the IT manager most often reporting to the Chair or Director.

There are several deviations to the above practice. The Engineering Computing Services (ECS) group has several employees that provide support for multiple areas. Another arrangement in practice is for an individual(s) to support more than one area. This resource sharing is in place at two research centers (CAR and CEMAS) and secondly for the Departments of Civil, Environmental and Geodetic Engineering, Food, Agricultural and Biological Engineering and the Engineering Innovation Education Center.

Technical support at the major Centers is inadequate and introduces high-risk security concerns. Smaller departments also suffer from insufficient IT staffing. Under investing in technical resources leads to the IT professional working as a “generalist” in all areas instead of being a “specialist” in a few. Daily operational needs become unmanageable, which can lead to the IT worker being overwhelmed, feeling unappreciated, and increases the staff turnover rate resulting in lost institutional knowledge. In the month of March, two senior level technicians have left the College to accept technical positions that offer intrinsic rewards not present in Engineering’s structure.

The IT staffing ratio in the units varies from zero to 10. Emergency or unplanned technology needs are accomplished by having current IT professionals commit to a 120% appointment for a period of time. Table 1 shows the number of IT support staff per unit. The staff person may be supporting a wide-range of needs including customer requests, a complex set of infrastructure services, research efforts, daily operations and account management. Often the IT operation is working in a reactive rather than a proactive manner.
Table 1: breakdown of Information Technology Support Professionals excluding vacancies.

<table>
<thead>
<tr>
<th>UNIT (spring 2015)</th>
<th>IT Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME</td>
<td>1</td>
</tr>
<tr>
<td>CAS</td>
<td>Supported by ECS</td>
</tr>
<tr>
<td>Eng Admin</td>
<td>1</td>
</tr>
<tr>
<td>ECS</td>
<td>7</td>
</tr>
<tr>
<td>CBE</td>
<td>1</td>
</tr>
<tr>
<td>CEGS</td>
<td>5.25</td>
</tr>
<tr>
<td>CSE</td>
<td>9.75 *</td>
</tr>
<tr>
<td>ECE</td>
<td>4.5</td>
</tr>
<tr>
<td>EEIC</td>
<td>Shared with Civil</td>
</tr>
<tr>
<td>FABE</td>
<td>Shared with Civil</td>
</tr>
<tr>
<td>ISE</td>
<td>1.75</td>
</tr>
<tr>
<td>KSA</td>
<td>5</td>
</tr>
<tr>
<td>MAE</td>
<td>4</td>
</tr>
<tr>
<td>MSE</td>
<td>1</td>
</tr>
<tr>
<td>Airport</td>
<td>2 **</td>
</tr>
<tr>
<td>ARC</td>
<td>.75</td>
</tr>
<tr>
<td>CAR</td>
<td>1.5</td>
</tr>
<tr>
<td>CDME</td>
<td>0</td>
</tr>
<tr>
<td>CEMAS</td>
<td>.5</td>
</tr>
<tr>
<td>ESL</td>
<td>2</td>
</tr>
<tr>
<td>NRL</td>
<td>0</td>
</tr>
<tr>
<td>SIMCenter</td>
<td>.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td>48.5</td>
</tr>
</tbody>
</table>

* 1 FTE in CSE is a College-wide resource  
** 1 FTE is the General Manager and only provides partial IT support.

**Technical Environment**

The expertise of support a unit receives is tied to several factors: 1) The skill level of the IT staff member(s), 2) the investment by the individual unit for hardware and software tools, 3) established customer service level, 4) ratio of support staff to systems, students and employees and 5) the complexity of the environment. The requirement for technical expertise and time is magnified in research-intensive areas.

Our technical environment is filled with complexity and duplicate infrastructure. An example is Active Directory. When individuals log into the network they authenticate against Microsoft’s Active Directory (AD). AD is a very powerful security and management tool.

In Engineering, we have implemented around 25 AD’s or 25 security boundaries. These are self-imposed technical barriers that are considered normal because they are engrained behaviors.

Each AD instance requires duplicate hardware, software, virus protection, connectivity, storage and technical expertise. It’s a significant investment in hardware, software and staff. Given our current practice, any area regardless of size can move forward with a new AD implementation.
A collaborative effort to design and implement a centralized authoritative AD would reduce the financial burden, resource strain and security risk experienced by many of the smaller units or new startup areas. Based on business requirements an organization should determine if one or more AD’s are necessary.

Engineering is also home to 25 data centers, 26 storage solutions and 27 firewalls. Another large investment in hardware, software and staff time that could be reduced if scaled down to an appropriate size by shifting some of those services to a central operations area.

Appendix C has a further breakdown of some of the common services supported throughout the College.

Keeping in mind the technical infrastructure today, the IT managers group was asked to identify areas they saw as opportunities for improvement. Common responses were:

- Converge on core technologies
- Central Active Directory
- Enterprise networking team
- Colocation of servers
- Central storage and backup
- Service Level Agreements
- Project planning
- Formal help desk and ticketing system
- Data center consolidation
- Centralize common services
- Central IT budget
- Written guidelines
- CIO involvement with University leadership
FINAL REMARKS

The findings and recommendations presented in this report are intended to identify and correct problematic areas and deficiencies around staffing, structure and process.

In summary:
- (As a whole) Professional technical staffing is inadequate
- Staff ratios are disproportionate between departments
- Smaller departments operate with higher risk
- IT resourcing and high level expertise to support the Centers is not sufficient
- Heavy workloads in understaffed areas results in reactive operations
- Insufficient planning or dedicated staff on projects
- Leadership for Governmental controls that are tied to research is void
- Shortage on expertise to meet OCIO compliance mandates
- Poorly designed supervisory structure
- Technical environments create barriers
- Duplication of effort is widespread
- College-wide purchasing power is not fully leveraged
- Customer experience varies between units
- Lack of College-wide information technology policies
- Weak controls surrounding technical investments
- IT professionals are invited to conversations as an afterthought

As a College, we are capable of turning the above challenges into opportunities by redefining the operation and investing in our information technology resources.

The expected results would establish a technical infrastructure and support system that is fluid and flexible. Self-imposed technical barriers would no longer dictate who is denied access to a College resource. The technology would become the conduit to open doors, yet maintain security boundaries where needed.

If crafted appropriately, this new technical foundation and resource stabilization establishes an infrastructure that fosters innovative thinking. It could assist with room constraints by starting a dialog to consider the sharing of computer lab space. Future labs could be designed to accommodate the general College population while leveraging the technology to ensure the student logging into the system only receives the specialty software assigned to their program.

The planning and implementation to transform the department into a highly efficient collaborative team will take time and sponsorship. Urgency should be attached to high-risk areas and readily achievable targets.