Major Issues: As the use of technology in higher education continues to mature, proper infrastructure planning, development and management becomes increasingly critical to delivering the quality experience that our students, faculty and staff expect. User mobility, expanding use of video, cloud computing, growth in research computing and physical development of the campus represent a number of factors that drive the need for IT planning. In addition, procurement, use and management of technology on campus have a significant impact on sustainability, from energy consumption to electronics end-of-life management issues.

A. Background/Rationale

The Boulder campus is undergoing unprecedented growth in facilities, as evidenced by the number and size of projects that are under construction or being planned (e.g. as of March 31, 2010, construction is underway on the 302,318 square foot Center for Community; a 127,724 square foot, 500-bed residence hall at Williams Village; a 281,800 square foot Systems Biotechnology facility in the Research Park; and a 50,565 square foot facility to consolidate the Institute for Behavioral Sciences in Grand View). Additionally, final planning for a high performance computing facility is underway on East campus. Beyond these large projects, there continue to be hundreds of small renovation projects underway. Although these projects vary from renovating a lab for a new professor to constructing a world-class bioscience research center to providing housing for students, there is a common thread that runs throughout virtually all of these projects – the need for information technology.

The Colorado Commission on Higher Education requires that a Facilities Master Plan be developed and approved every ten years to provide a roadmap for physical development of the campus. The current Master Plan was approved in 2001, and it is currently in the process of being updated. Although the Facilities Master Plan provides a roadmap for developing the physical campus environment, it does not specifically address the infrastructure that must be provided to accommodate demand for IT services and telephony.

As our reliance on technology increases and it becomes more ubiquitous, expectations of students, faculty and staff will undoubtedly continue to increase. Our students and workforce are becoming increasingly mobile and expect to be able to access applications and data from virtually anywhere, placing new demands on wireless infrastructure. Shifts in application architecture are occurring, such as cloud computing; demand for video applications is growing in academic and administrative settings, placing an increased burden on the network backbone; and extended building hours and an increasing need to electronically schedule and control labs and meeting spaces are requiring improved tools for managing and monitoring access to space. These are just a small number of trends that are currently impacting technology infrastructure, facilities and service delivery.

The campus does not have comprehensive standards or guidelines that outline the space allowances that should be provided in order to accommodate computing labs, servers and other technology-based infrastructure. As technology continues to evolve and the campus grows, space allocated to IT programs and the sustainability impacts will become increasingly important.
Significant space is used to house servers or data centers. Rough estimates suggest that the campus has at least 40 data centers and many other spaces where servers are housed. The campus recently articulated its objective to transition to a more centralized data-center approach for managing significant technology-related resources. Based on information from the Facilities Master Plan, along with more detailed IT-related programmatic information, the campus has an opportunity to adopt a phased or modular approach for data center development and expansion, optimizing the campus’ capital investment and cost of operations.

A significant amount of space is also used to house computing labs. With mobile computing devices widespread, opportunities may exist to improve the utilization of lab space by reducing the number of desktops and increasing the amount of space that supports students with their own laptops with available power data access. Demand for lab space continues to be high in areas that require large or specialized applications, such as Engineering, Environmental Design and Business. Virtualization technologies and cloud computing options may influence this demand in the coming years.

Data center consolidation has the potential to not only improve the efficient use of space, but it also provides a significant opportunity to reduce energy consumption. Data centers are known to be energy hogs, with approximately 40 percent of the cost of operations directly related to energy. Accordingly, they serve a key role in addressing the campus’ sustainability and carbon neutrality goals. Consolidation would result in the elimination of specialized cooling units that are oftentimes inefficient and take advantage of large-scale, high-efficiency equipment and modern space and HVAC design that capitalizes on the heat generated by the equipment as a heating source for other parts of the building or even separate buildings. It would also enable the campus to expand the use of virtualization technologies, which more efficiently utilizes hardware capacity, reducing the number of servers and energy consumption.

The volume of electronics equipment purchased by the university presents challenges. The campus has a well-recognized electronics-recycling program to ensure an environmentally appropriate outcome for the surplus equipment; however, some IT staff on campus have expressed an interest in being able to exchange equipment directly with other departments prior to officially declaring a piece of equipment surplus. This practice has the potential to extend the life of some equipment, reducing surplus volume and saving the university money. In addition, there is currently very little involvement of vendors in reclaiming their electronics equipment at end-of-life. Opportunities may exist to leverage our purchasing volume to require support on the part of the vendor for addressing recycling or reuse of electronics.

**B. Accomplishments to Date**

- Facilities Management recently partnered with ITS to successfully renovate the Marine Street Computing Center. As a result of the project, energy consumption has been reduced, the space is more functional, additional capacity has been obtained and building occupants are more comfortable.

- Facilities Management and ITS continue to work on plans to finalize development of a high performance computing center at the CINC facility as well as other potential options for developing a centralized data center for campus research and administrative computing.

- ITS is running a pilot of virtualization desktop infrastructure with thin clients with a vendor partner. The outcome will be an assessment of the benefits of VDI technology, and any cost or other beneficial savings it may provide to the campus.
A baseline has been developed detailing current energy use by computer model and lab that is potentially applicable to departments across campus.

**Action Plan**

**A. Explicit Assumptions**

These recommendations assume that the campus continues to support the data center consolidation concept. They also assume that campus sustainability programs remain a high priority. Many of the recommendations outlined in this chapter are intended to support the President's Climate Commitment and the Governor's Executive Order Greening State Government.

**B. Specific Recommendations**

1. Develop an IT infrastructure master plan that would help ensure that core infrastructure, such as the network backbone, telephony capabilities, wireless infrastructure, space, etc., are sufficient to accommodate the demands anticipated in the Facilities Master Plan as well as ongoing changes in the use and management of technology. Additionally, in order to ensure that the Facilities Master Plan serves as an effective baseline, make sure that strong IT representation is achieved in developing the Facilities Master Plan.

2. To successfully meet campus demands for services, Facilities Management and ITS must collaborate to improve the understanding of the impact that changes in IT modality and trends have on facilities. This understanding, combined with a clearly articulated campus IT strategy, will facilitate development of effective standards and guidelines that result in facilities and other infrastructure that will accommodate the campus' needs today and in the future. In order to accomplish this, campus governance should designate roles and responsibilities in Facilities Management and ITS to develop, communicate and enforce standards and guidelines as well as collaborate in regard to program planning and building design. Increased collaboration will help ensure proper consideration and accommodation for communications infrastructure, power, cooling, physical security and space. In addition, IT participation on the Boulder Campus Planning Commission may also be considered in order to heighten awareness of IT issues on the Commission.

3. IT facilities and infrastructure should adhere to the vision and associated standards for campus IT. All standards, whether they define space allowances or specific technologies, should be consistently applied regardless of who manages the resources. For example, classroom IT equipment standards that are applied to centrally scheduled classrooms are not consistently followed for departmentally-controlled and funded classrooms, causing some support issues for ITS. In addition, incentives should be developed to encourage significant change, such as data center consolidation.

4. Define and inventory data centers, and implement a program for an energy conservation/sustainability review of all existing facilities in collaboration with data center owners, ITS and Facilities Management.

5. Enhance the annual review program for computer labs to validate whether the labs meet programmatic needs based on the changing mobility requirements of students, options for
delivering specialized or complex applications (e.g. virtualization or thin-client technologies), among other factors. In addition validate that sound sustainability practices are being followed in the management of lab equipment.

6. To support end-of-life management of electronics, investigate development of an intra-campus online exchange, whereby staff from across campus could post surplus items for direct transfer to other departments prior to declaring the equipment surplus.

7. Work closely with the Procurement Service Center in conjunction with their strategic sourcing efforts to place responsibility for reuse or recycling of electronics on vendors, when possible.

8. Increase coordination among ITS, Facilities Management and other campus IT organizations regarding infrastructure related to backup power to reduce duplication of efforts and costs.

C. Long & Short Term Objectives/Timeline

Short-Term:

1. Develop IT Infrastructure Strategic Plan to support the campus Facilities Master Plan; (2) designation of roles and responsibilities in Facilities Management and ITS by campus governance to increase understanding and collaboration on issues impacting facilities; (3) develop standards that articulate the campus’ vision for management of technology; (4) review and update lab oversight process to ensure effectiveness and include sustainability; (5) enhance electronics end-of-life management; (6) survey, identify and begin sustainability audits of data centers; (7) begin uniform and consistent enforcement of standards; (8) and, improve coordination of backup-up power infrastructure management.

Long-Term:

2. Reduction of energy consumption through consolidation or efficiency improvements of data centers; (2) evolve standards, balancing changing needs and technology with long-term sustainability.

D. Possible Risks

The recommendations outlined in section B present a number of risks. In general, however, they can be categorized as business risks as opposed to technology or security risks. In other words, failure to successfully execute the recommendations could result in an inability to deliver the quality or range of services desired by the campus community.

Adoption of new standards or strict adherence to existing standards could potentially negatively impact the cost of new construction or renovation projects.

E. Resource Allocation

The recommendations outlined above may require the addition of a new planner position in ITS or Facilities Management. If required, the overall cost would likely be in the range of $80,000 to $100,000, including salary and benefits. Although there would be an ongoing, operational
component to the position, at least a portion of the funding could be recovered from project recharge.

Funding is currently available through Xcel Energy rebates as well as Department of Energy and Governor’s Energy Office grants for energy conservation projects. These one-time funding opportunities should be pursued to address deficiencies in existing data centers or development of consolidated centers.

F. Responsible Parties

ITS; Facilities Management; Campus Administration; Procurement Service Center

G. Evaluation

- Review the reduction in number of data centers on campus compared to the baseline.
- Monitor consumption of electricity, steam and chilled water in facilities housing data centers.
- Monitor the volume of electronic equipment that is directly transferred between departments.
- Monitor the volume of electronic equipment that is returned to vendors at the end of equipments’ useful life.
- Adherence to standards or guidelines.
- Successful completion of a campus IT infrastructure master plan.