EDUCAUSE Center for Applied Research

Research Bulletin

Volume 2005, Issue 10

May 10, 2005

Information Technology and Campus Facility Planning

Catherine Finnegan, Board of Regents, University System of Georgia

Tom Maier, Board of Regents, University System of Georgia

4772 Walnut Street, Suite 206 ◆ Boulder, Colorado 80301-2538 ◆ www.educause.edu/ecar/

Today, students, faculty, and staff in higher education expect to find accessible, adequate, and reliable technology at any campus location. For the past decade, the Campus Computing Project has reported on the growing use of technology in communicating with students and delivering course content. In 2004, Green reported that 75.6 percent of all college classes used e-mail, 52 percent of classes used electronic presentations, and 19 percent used computer simulations.[1] Eighty-one percent of all U.S. institutions of higher education offer at least one fully online or blended course.[2] Additionally, the Campus Computing Survey reported nearly 83 percent of college classrooms are wired, with a significant expansion of wireless networks. Over one-third of college classrooms now have wireless access.[3] Faculty and students now come to campus wondering why this access is not available universally, particularly since they may already have wireless in their homes or in public coffee houses.

To meet these and other growing demands for ubiquitous access requires an integration of technology and facilities planning, both for new construction and for the renovation of existing space. For years, many colleges and universities have recognized the impact that computer technology, the Internet, and multimedia forms of learning have had on traditional classroom delivery methods. As with most capital expenditures, planning for new campus facilities should be based on pedagogical and programmatic requirements, including technology. Since buildings are intended to have at least a 30-year lifespan, considering the impact of technologies for the future of learning on campus is a critical step in planning 21st-century facilities. As institutions identify innovative ways to meet the challenges of a growing, mobile student body, IT professionals need to provide guidance and expertise to architects and facilities administrators to ensure an effective combination of technology and facilities, or “clicks and bricks.”

Facilities construction and maintenance have been the purview of building and construction managers. As campuses have been encouraged to develop master plans, issues such as technology integration in instruction and changing student social interactions have been discussed on a par with green space, water, electricity, and parking needs. The planning challenge is to provide a learning environment in which the values inherent in traditional instruction continue to be fostered, as distance and other learning technologies enable new opportunities and universal access. Because chief information officers (CIOs) are expected to provide and maintain the infrastructure and connectivity necessary to meet this challenge, it is imperative that they also be involved in planning for new building construction and existing building renovation.

Despite this obvious connection between building planning and technology infrastructure, a review of the literature and of the documentation on facilities planning reveals a surprising lack of integration between technology and facilities management. Most literature is focused on two areas:

- descriptions of the ways in which technology changes how buildings are used; and
- descriptions of the construction of a specific building (for example, library or science center) and the cooperation between various constituencies, including IT specialists, faculty, facilities managers, and architects.

The first set of literature[4,5] describes how advances in technologies that are available to students and faculty change the way that buildings are designed. As an example, increased use of personal laptops and Web content by students and faculty necessitate wireless access, additional power outlets, and LCD projectors in classrooms. Such decisions may have an impact on other design choices such as windows, heating, ventilation, and air conditioning (HVAC) systems, and carpeting. While these articles are informative, they do not address the organizational requirements for constructing buildings to accommodate these needs.

In general, writers who focus on the cooperation between form and function teams for specific buildings provide some organizational hints that can be extrapolated to larger construction and planning efforts.[6,7] Three key success factors are generally acknowledged. First, a vision for the building was identified during the conceptualization and design stages. The vision was shared by campus administrators, building occupants, facilities planners, architects, and construction managers. Second, based on this vision, facilities planners and managers worked closely with the occupants/users of the building to identify key functions of the building and determine the best ways to accommodate those functions, often in innovative ways. Finally, communication channels remained open throughout the process, even after the building was designed.

Applying general principles of the impact of technology on building design and construction, this research bulletin describes how the University System of Georgia developed and implemented statewide facilities planning guidelines and policies that require that information technology (IT) professionals provide guidance and expertise to architects and facilities administrators to ensure an effective combination of technology and facilities, or “clicks and bricks.” The bulletin discusses how a system-wide IT office met the challenge to integrate effective technology planning into the building and renovation of campus facilities and outlines the considerations that informed the design of the policies and practices.

Highlights of Information Technology and Campus Facility Planning

ECAR research on IT alignment in higher education[8] identified four factors that contribute to the successful integration of the IT organization onto the campus: governance, planning, communication, and measurement. These factors are useful in discussing the role that technology professionals should play in the established workflow of new building construction and renovation.

Governance

Although campus planners and facilities managers have responsibility for the development and implementation of building projects, they must seek the advice of many constituents to construct a building that meets campus expectations and needs. Early input from building user groups and campus technology staff is critical in constructing facilities that accommodate information and instructional technology successfully. It is suggested that the participants in the building planning process be organized into two basic groups—a Core User Group and an Extended User Group. The Core User group is a small group of people charged with the authority to provide overall direction during the construction process. They review the progress at key decision points, make decisions, and keep the project on track. The CIO should be included in this group to ensure that technology needs are kept in the foreground of decision making during the design and construction phase. A larger group including staff, faculty, and students might constitute an Extended User Group. Input from this group is essential in determining the technology needs of the building. The CIO may request that instructional designers and other IT staff be included in this group as well.

Depending on the rules and regulations governing building construction, a third group may be considered if circumstances merit extensive involvement of neighboring or external constituents. In some cases, approval from a statewide coordinating body may be required before a building may be sent to bid. For instance, in Georgia, the CIO for the University System must review designs and plans submitted for approval to the System Facilities Office. This review ensures that statewide shared resources are appropriately leveraged. Since this is a system-wide requirement, the campus CIO can more easily persuade building design professionals to consider information technology concerns seriously.

Approval

Until recently, the CIO’s approval of building plans and construction was not considered necessary. As technology becomes more integrated and ubiquitous, however, facilities planners must consider the impact of technology on new and renovated spaces in the same way that they consider the impact of new facilities on utility infrastructure and parking plans. CIOs should be included in all major decisions from building design through construction closeout. They should be included in the interviews to hire a design professional for the project. The campus CIO should review and approve building designs based on the technology needs for the building occupants and the overall technology plan for the campus. In addition to campus CIO approval, some institutions may require sign-off by system and/or state technology officials.

In Georgia, a project must be certified by the university system CIO, as well as the state CIO before funds can be released for construction. During construction they should review and approve any changes that might affect the installation of technology infrastructure and equipment. When the project is ready for closeout, the CIO should ensure that the technology infrastructure is operating as expected, and should report any problems to the design professionals during the building warranty period.

At each stage in the process, technology needs and approval should be considered.

Preplanning and Initiation

Preplanning is necessary to establish and reinforce user objectives, to confirm the practicality of the project, and to assess the multiple relationships that will affect the project and its costs. Facilities planners determine the project requirements based on user group input. The CIO should determine if the designer can adequately address the technology needs of the building. Although many architectural firms have staff engineers, they may not have expertise specifically with instructional and information technologies.

Design

During this phase, facilities planners work together with chosen design professionals and campus constituents to develop a set of design goals. A building program is developed to include the building square footage, utilities impact and need, landscaping, project schedule, and project cost estimate. IT professionals should be involved in a number of ways during this phase.

The CIO or his or her representatives should communicate technology needs to the campus programming committee and to the design professionals. They should review the schematic design to ensure that the needs of technology and associated infrastructure are addressed. If there are special technology design requirements, they should inform the design professional. Are there a sufficient number of wiring closets? Are they large enough to accommodate both current equipment and eventual expansion? Are they located appropriately throughout the building? Are they protected from potential plumbing or air conditioning leaks? Do they have the appropriate type of security (door locks, cardkey access)?

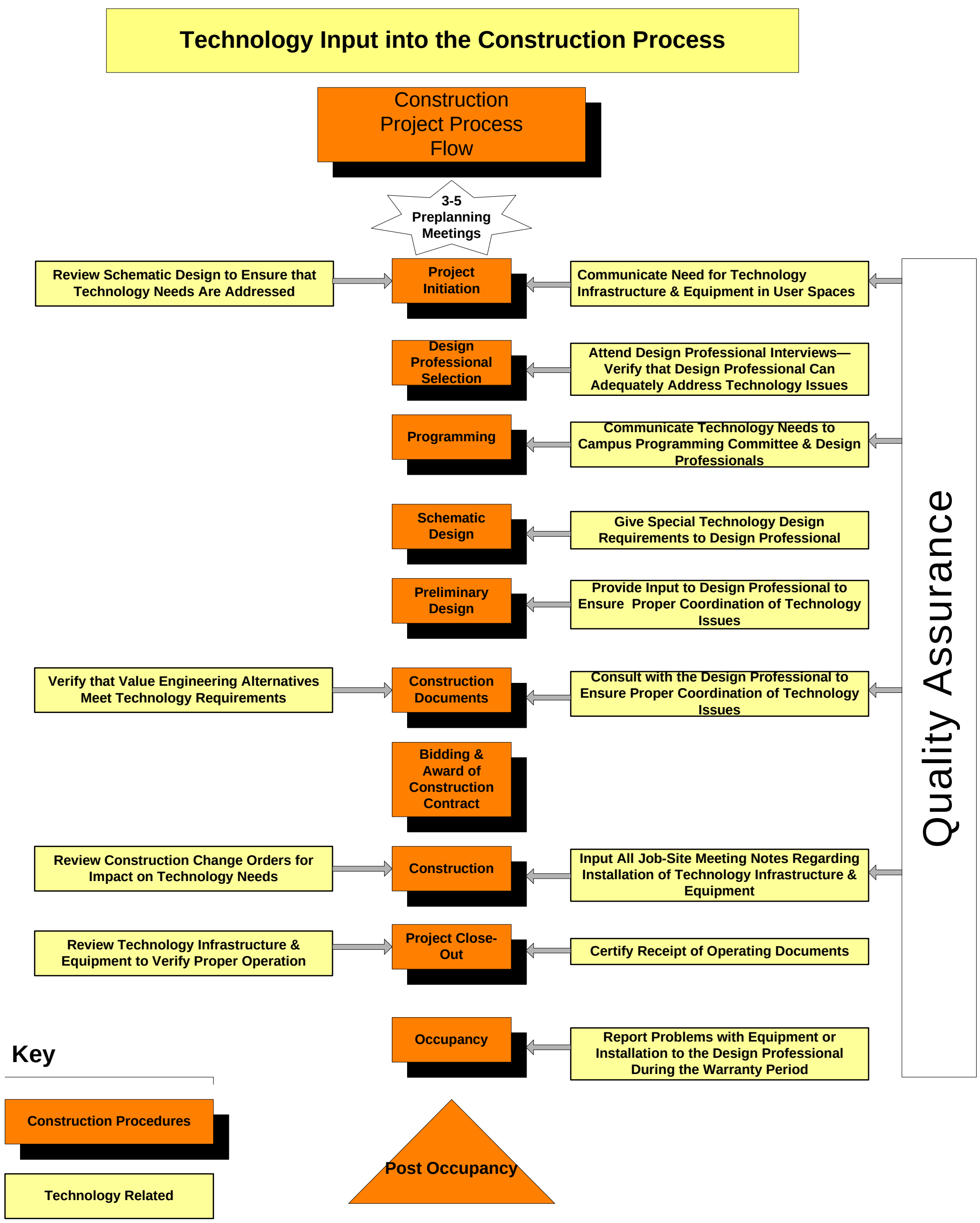
As the preliminary designs are reviewed and approved by the campus and other external bodies, the CIO should provide input to the design professionals to ensure proper coordination of technology issues. This communication and review should continue as the construction documents are completed.

Construction

Once the campus and others have approved the design and building program and a funding source has been approved, most facilities projects must be bid before a construction contract is awarded. Once construction commences, the CIO's office should continue to be closely involved with the project. CIO representatives should attend jobsite meetings regarding the installation of technology infrastructure and equipment. They should review construction change orders to determine if they impact technology needs. As cost adjustments are frequently required during the budgeting and construction process, the CIO's office should verify that alternative engineering decisions, when they are required, will meet technology requirements without compromising the needs of the campus and building occupants.

At the conclusion of construction, the CIO's office should review and test the technology infrastructure and equipment to determine if it is properly installed and operating as expected. The CIO's office may be asked to certify receipt of operating documents. Once the institution has occupied the newly constructed or renovated building, the CIO's office should report problems with equipment or installation to the design professional during the warranty period. Figure 1 illustrates a typical workflow for technology input to a construction process.

Figure 1. Technology Input into the Construction Process



Communications

In addition to providing expertise on technology infrastructure, the CIO and staff can facilitate active communication of technology needs and uses between building occupants and the design professionals. Awareness of the campus master plan and technology master plan allows greater coordination of efforts across the campus fabric.

Additional Considerations

In addition to providing expertise on technologically related infrastructure and equipment, CIOs may assist facilities planners and design consultants in making choices that work well with technology needs.

Building Uses

College and university buildings are often multipurpose and include a mix of different types of classrooms, laboratories, public spaces, and offices. For example, classrooms should be designed to accommodate a range of teaching methodologies that best support the academic discipline(s) that will use the building. Teaching spaces, including computer classrooms, public spaces, laboratories, and office space, can require dedicated support spaces, as well as areas reserved for storage and maintenance of computer-related equipment and supplies. Consideration should be given to grouping computer laboratories around or in the vicinity of central support facilities. The need for security and 24-hour access, if applicable, should be considered. There is a need to zone HVAC appropriately for independent control. Sufficient power requirements and air conditioning must be provided wherever data centers and computer-related equipment are concentrated. Increasingly, measurement tools used by a variety of disciplines are network-based and accommodation must be made for ubiquitous network connectivity. Attention should be given to the placement of printers and other shared equipment, including consideration of costs, power, and data cabling.

Nontechnology Related Considerations

In addition to providing expertise on technologically related infrastructure and equipment, the CIO may assist facilities planners and design consultants in making choices that work well with technology needs. Multiple areas of building planning and construction are impacted by and have an impact on technology. The following items are drawn from the University System of Georgia Facilities Planning guidelines.

- **Seating**—Users of various space types may require different seating arrangements, varying from extremely flexible to fixed. As part of the building design, IT may ask the design professional to consider different options for access to data and power through any of the surfaces in the room: wall, floor, and ceiling, as well as consideration of wireless technologies.

- **Sightlines**—Sightlines are extremely critical in setting up rooms for multimedia use. Industry guidelines for the angles that define the cone of vision are available and can have an effect on the proportions of the room: length, depth, and height.

- **Lighting**—Special lighting issues should be considered if televisions, ceiling-mounted projectors, or wall-mounted video displays are to be installed. Sources of natural light should be equipped with blinds. Switches or control panels for the zoned lighting should be located at the front of the room near the instructor's stand and at the back of the room next to the door.
- **HVAC**—Sufficient cooling and humidity control capacity is needed if any type of computerized equipment is to be extensively used in a room. The environmental requirements of non-occupied technology spaces such are wiring closets cannot be overlooked.
- **Sound**—Acoustical characteristics in presentation spaces are particularly important since speech intelligibility can be degraded by excessive reverberation and background noise. Traditionally, classrooms have been constructed with minimal amounts of acoustically absorptive materials and acoustical deficiencies have been tolerated. Today, many classrooms are being equipped with systems to project and record sound. Industry standards should be considered when constructing these spaces.
- **Quality of finishes**—Room finishes (surfaces and furniture) should be selected for control of reflected light and glare while retaining sufficient surface luminance to provide an efficient and comfortable environment.
- **Network and wireless**—Networking infrastructure should be thorough and comprehensive. If the room is designed for the use of laptops, hardwired power sources and data ports should be located at seating locations. Otherwise, the appropriate number of wireless transmitters should be considered in place of hardwired ports.
- **Power**—In addition to standard installation, sufficient electrical outlets should be provided to supply portable equipment such as computers, laptops, and other equipment. The points of access should be located where this equipment might be positioned. If extended use of laptops is expected, power to individual seating locations will provide the necessary backup power for batteries.

What It Means to Higher Education

Generally, the completion of a building on time and under budget is the main measure of a successful building project. From the IT perspective, however, the success of building projects may be measured by the usability of the building from the point of view of the occupants. Four key factors should be considered: flexibility, accessibility, life cycle, and cost-benefit.

Flexibility

Flexibility of technology options in higher education buildings becomes more critical as disciplines adopt and adapt different technologies to meet the needs of instruction, research, and service. Technology infrastructure, as well as the hands-on systems and equipment, must support a variety of teaching and learning styles via alternative modes of instructional delivery. Considerations include addressing *adaptability* and *scalability* of the systems used. By definition, *scalability* is how well a solution will work when the size of the project increases. *Adaptability* is defined as responsiveness to change, ideally without compromising the quality of space, systems, or networks during this evolutionary process. Over the 30-year lifespan of a building the level and type of technology use will evolve. More users will expect connectivity to the building technology infrastructure. An ever-increasing number and range of devices will require connection to this same infrastructure.

Measures of flexibility include considerations about whether the space:

- Can be used for intended and unintended purposes.
- Is designed and equipped to meet the changing needs of users.
- Can be easily reconfigured at little or no cost.

Accessibility

Technological accessibility and campus connectivity to various spaces should be designed to be flexible, reconfigurable, and serve multipurposes. Users must be able to easily access the system, applications, and information they need. They should be able to rely on the infrastructure and equipment being available when they need it. As more mobile devices become available, buildings may want to allow students and faculty wireless access to information and instructional resources. Technology access should also be designed to accommodate users with physical limitations. For instance, permanent desks should be able to accommodate a wheelchair and fire alarms should be equipped with special lights to alert the hearing impaired.

Measurements of accessibility include:

- Measures of user satisfaction
- Numbers of network accesses from wireless sources
- Service availability trends
- Compliance with ADA regulations

Life Cycle

In evaluating the projected longevity of physical plant and equipment outlays consideration should be given to the concept of life cycle. Life cycle can describe the phases, costs, and characteristics of buildings, technologies, programs, and skills. The operational life cycling of buildings includes maintenance, staffing requirements, and upgrades. Life cycling of technology tools often has phases such as acquisition, setup, operation, upgrade, and disposition. In general, buildings are expected to have a life cycle of 30 or more years, while technology tools and infrastructure may need to be replaced every two to five years. With relatively rapid changes in technology needs, the institution must be committed to providing staff and resources to maintain and replace the infrastructure and equipment. Often when operations or upgrade costs exceed reasonable levels, replacement rather than upgrading may be the most cost-efficient solution. As the introduction of technological innovations intensifies, planned obsolescence of current technologies will speed up the product life cycle. Thus, a life cycle ends when the item no longer possesses the qualities of usefulness that caused its acquisition.

Measurement for life cycles may include:

- Schedules for maintenance and replacement of equipment and infrastructure
- Plans for upgrade and renewal
- Inclusion of technology upkeep in building maintenance budgets

Cost-Benefit

With generally limited funds for the construction and outfitting of buildings, cost efficiencies are always considered. It is important that all decisions regarding an investment balance the merits of the benefit against the added cost of acquiring that benefit. It is also extremely important that the appropriate technology budget is set in the early stages of planning, agreed upon and adhered to throughout the process. While this is the ideal, budgets for technology infrastructure are often not included in the construction budget. Instead, they are included in a separate, more discretionary equipment budget. While this may be a more palatable arrangement for funding agencies, issues arising during construction may impact the quality and extent of infrastructure and equipment eventually installed. Cost overruns in construction may require facilities planners to make decisions to cut “extraneous” technology infrastructure and equipment in order to afford walls or electrical wiring. During the building planning stage, CIOs should insist on the inclusion of a technology budget in construction funds to ensure an adequate level of infrastructure.

Measurements for cost-benefit might include:

- Total cost of construction compared to planned costs
- Total cost of equipment compared to planned costs

Key Questions to Ask

- What are the current policies and procedures related to technology integration in capital projects?

- To what extent has the campus IT organization been involved in construction projects?
- Does the proposed project budget adequately address technology infrastructure and equipment?
- Does the program include plans for connection to the campus fiber backbone both in terms of fiber path and capacity?
- Have plans and funds been provided to deal with increased capacity back along the network backbone and in the main network center (NOC)?
- Does the program incorporate the need for wiring closets (MDF and IDFs) with sufficient space, security, power, and HVAC?
- Are there plans and funding for the active electronics (hubs, switches, routers, access points) needed in the building itself and back at the campuses NOC?
- If this construction/renovation project interrupts service to other facilities, how will this be addressed?

Where to Learn More

- I. E. Allen and J. Seaman, *Entering the Mainstream: The Quality and Extent of Online Education in the United States, 2003 and 2004* (Needham, Mass.: The Sloan Consortium, November 2004), <http://www.sloan-c.org/resources/entering_mainstream.pdf>.
- National Clearinghouse for Educational Facilities (NCEF) provides Web-based access to resources lists, publications, and construction data related to school buildings, <http://www.edfacilities.org/>.
- The Society for College and University Planning (SCUP) focuses on many aspects of higher education planning, including construction, <http://www.scup.org/>.
- The University System of Georgia (USG) has created a set of documents that incorporate master planning, building planning, and technology integration. See the USG Office of Real Estate and Facilities Capital Program at <http://www.usg.edu/ref/capital/>.

Endnotes

1. K.C. Green, *Campus Computing 2004: The 15th National Survey of Computing and Information Technology in American Higher Education* (Encino, Calif.: Campus Computing, 2004), <http://www.campuscomputing.net/>.

2. I. E. Allen and J. Seaman, *Sizing the Opportunity: The Quality and Extent of Online Education in the United States, 2002 and 2003* (Needham, Mass: The Sloan Consortium, September 2003), <http://www.sloan-c.org/resources/sizing_opportunity.pdf>.

3. Green, op. cit.

4. R. Grossman, "Building with Purpose," *American School & University*, Vol. 72, No. 5, January 2000, p. 26.

5. K. Havens, "Drawn to Knowledge," *American School & University*, Vol. 75, No. 12, August 2003, p. 138.

6. M. S. Valenti, "The Black Box Theater and AV/IT Convergence: Creating the Classroom of the Future," *EDUCAUSE Review,* Vol. 37, No. 5; September/October 2002, p. 52, <http://www.educause.edu/ir/library/pdf/erm0254.pdf>.

7. S. Heaton and K. Marks, "Planning the UNLV Lied Library," *Library Hi Tech*, Vol. 20, No. 1, 2002, p. 12.

8. B. Albrecht et al., *Information Technology Alignment in Higher Education* (Boulder, Colo.: EDUCAUSE Center for Applied Research, Research Study, Vol. 3, 2004), <http://www.educause.edu/LibraryDetailPage/666?ID=ERS0403>.

Acknowledgment

The authors wish to thank Libby Morris, Associate Professor and Graduate Coordinator at the Institute of Higher Education at the University of Georgia, Brian Finnegan, Director of Emerging Instructional Technologies, and Linda Daniels, Vice Chancellor, Real Estate and Facilities, at the Board of Regents, University System of Georgia for their contributions to this research bulletin.

About the Authors

Catherine Finnegan (catherine.finnegan@usg.edu) is Associate Director of Assessment and Public Information for the Board of Regents of the University System of Georgia. Tom Maier (tom.maier@usg.edu) is Assistant Vice Chancellor for Information Technology for the Board of Regents of the University System of Georgia.