Reflections on Evolving Services

By Sharon Collins and the 2009 EDUCAUSE Evolving Technologies Committee

“As we go forward, I hope we’re going to continue to use technology to make really big differences in how people live and work.”

—Sergey Brin, Google co-founder

Ten years ago, when EDUCAUSE established the Evolving Technologies Committee to consider the future of information technologies and how they would drive, or be driven by, educational endeavors, there were no iPods, iPhones, fluid webcam conferencing—and definitely not many thoughts about green computing. Times have indeed changed.

Over the years, more services and the enhanced delivery of those services have moved to the forefront in importance. Institutions are now thinking of ways to use past and future technologies to streamline and positively affect these services for teaching and learning, research, and administration. Doing so is a two-way street: technologies need services, and services need technologies to be effective. Thus this year, the Evolving Technologies Committee is emphasizing the evolving role of technologies in the development and support of enhanced services, rather than specific technologies, and looks at how technologies can make “really big differences” in service delivery for higher education.
Each year, the members of the EDUCAUSE Evolving Technologies Committee identify and research the evolving technologies that are having—or are predicted to have—the most direct impact on higher education institutions. The committee members choose the relevant topics, write white papers, and present their findings at the EDUCAUSE annual conference.

This year, under the leadership of Committee Chair Sharon Collins, the committee selected five evolving technologies, presenting a brief overview at EDUCAUSE 2009. Published below are excerpts from the white papers on each topic, written by individual members of the committee: cyberinfrastructure and high-performance computing, by Stephen Landry; open-source learning management systems, by Sharon Collins and Stephen Landry; product managers in IT organizations, by John W. McGuthry; information resource management technologies for libraries, by Beth Forrest Warner and Stephen Landry; and IT service management, by Stephen Landry.

In addition, 2009 marks the ten-year anniversary of the Evolving Technologies Committee. The article’s final section, written by Melody Childs and Molly Tamarkin, offers a brief overview of the past decade of committee work and white papers.

The full white papers can be found on the Evolving Technologies Committee website (http://www.educause.edu/EvolvingTechnologiesReports). These white papers address many other strategic areas for each evolving technology: key questions to ask; the implementation challenges; the major vendors and how to judge among them; how to proceed and the issues to be addressed; and the likely impacts in the next three to five years.

Cyberinfrastructure and High-Performance Computing

Cyberinfrastructure refers to the evolving access to high-performance computing and networks to support research. Fifteen years ago, access to such high-performance computing was limited to a few researchers at institutions that operated supercomputers. Since then, the costs of computing, storage, and bandwidth have plummeted. Grid computing, for example, enables many relatively slow and inexpensive computers to be connected together to process large amounts of data, resulting in a system that rivals the power of traditional supercomputers—at a fraction of the cost.

Why Are Cyberinfrastructure and High-Performance Computing Important to Higher Education?

Many research problems that were intractable twenty years ago have yielded to the application of high-performance computing. Faculty in the sciences, social sciences, business, and economics routinely use computers for analysis of large data sets, for computationally intensive computer simulations, for remote access to research instruments,
In some disciplines, the availability of high-performance computing has completely remade research projects by enabling new ways to find and analyze data.

With support from the National Science Foundation, high-performance computing and networking infrastructure and tools continue to advance. Nevertheless, Higher Education IT and Cyberinfrastructure, an EDUCAUSE Center for Applied Research (ECAR) study published in 2008, found that overall support and funding in higher education for high-performance computing and campus cyberinfrastructure continue to be inadequate, indicating that there is room for improvement in providing these critical services to faculty and students.

**How Are Cyberinfrastructure and High-Performance Computing Evolving?**

The role of the central IT organization in supporting research computing is expanding. A few years ago, most high-performance computing was supported by individual departments or research groups, largely through grants. But as issues of security and sustainability have increased in significance, and as the cost of high-performance computing has declined, a number of central IT organizations have implemented research computing support. Moreover, CIOs are increasingly being held responsible for the overall campus IT security and so may need to become more involved in ensuring that all computer systems on campus are secure. Rather than rekindling the “centralization vs. decentralization” debate, we can view the role of the central IT organization in supporting faculty research as largely one of shared governance, with recognition that some resources, especially those that benefit large numbers of researchers, are best provided centrally, and that other resources are best acquired and managed locally while taking advantage of certain centrally provided services, such as networking and authentication.

For smaller institutions, a centrally supported research computing infrastructure may be the most feasible and cost-effective way of bringing such resources to campus. There may be a perception at smaller teaching institutions that a centrally supported research computing facility would not fit the mission of the institution or might not support enough faculty to be economically justifiable. On the other hand, access to high-performance computing is increasingly necessary to support high-quality research by students in the sciences and other disciplines, and the relatively modest cost might make a small research computing facility financially viable even if just a few research projects sign on initially. At larger institutions, providing centrally supported research computing facilities may be a way of leveling the playing field and ensuring that all researchers have basic access to high-performance computing. In some cases, the central IT organization may play a role in supporting the sharing of research facilities, allowing researchers in different departments to access distributed research computing resources at times when those resources would otherwise not be in use.

**Conclusion**

CIOs at institutions of any size that do not have centrally supported research computing systems or services should become knowledgeable regarding the
high-performance computing systems that may already exist on campus or that may be within their financial reach, and they should start planning to help faculty access research computing systems. There may be campus research projects that would benefit from a centrally supported research computing infrastructure, however modest at the beginning. On some campuses, the central IT organization may serve as a broker, better enabling faculty to access research computing facilities in another department or at another institution. In any case, the evolution of the campus cyberinfrastructure and the need to support the changing research computing needs of faculty form an increasingly important part of the CIO's agenda.

**Open-Source Learning Management Systems**

Learning Management Systems (LMSs) have become mission-critical services for colleges and universities. These systems have a wide variety of features—such as synchronous and asynchronous communication and collaboration tools, online assessments and grading, and tools for tracking students’ progress through their courses—to support teaching and learning. Over the past ten years, the number of commercial LMSs has declined from several dozen to just a few. Blackboard, the largest of these commercial providers, has acquired several rival systems, including WebCT and Angel, and has alleged patent infringement against another competitor, Desire2Learn. This has caused many in higher education to become concerned about a possible monopoly in the commercial LMS marketplace. Moreover, proprietary systems like Blackboard do not allow users to modify or access the database, making it difficult to produce targeted usage reporting, to integrate the system with other campus technologies such as ERPs, or to customize the system for a particular campus environment.

In response to this challenge, a number of campuses have worked together to develop open-source LMSs. Two of the most widely used are Sakai and Moodle, both launched in the early 2000s. Sakai, initially a collaboration among several institutions (including Indiana University, MIT, and Stanford), now has more than 150 installa-

Open-source LMSs have now evolved to the point that a campus can implement these solutions “out of the box,” with little or no need to develop or customize.
Why Are Open-Source Learning Management Systems Important to Higher Education?
Open source develops community and fosters innovation. As budgets shrink, colleges and universities are looking for new ways of doing business. The processes used in the past may not survive in the future. Open-source solutions give the academic community options in adding functionality on the fly. Some institutions look for similarity in coursework, and others allow faculty to choose their course design and content. Open-source solutions provide the freedom to do both. In addition, they can be updated on the academic schedule rather than the vendor schedule, and they support guest access for browsing or unlimited user access.

How Are Open-Source Learning Management Systems Evolving?
Technology is a catalyst for constant change, making it difficult to keep pace. Thus it is very important that platforms integrate with campus systems, such as for single sign-on and student records. The Moodle platform does so with little additional programming. However, another Moodle feature adds synchronous interaction with the virtual world Second Life: Sloodle (Simulation Linked Object Oriented Dynamic Learning Environment) is the name, and integration is the game! Sloodle is an open-source project that integrates blogging and quizzes, using a multi-function toolbar to make this integration occur. Other tools being constructed for this project were supported by a grant from the Carnegie Trust for the Universities of Scotland. Two worlds are being brought together to make one application, resulting in an almost seamless environment of constant interaction with two different products. This is the evolution of open source and reveals what can be accomplished when individuals pull together to realize integration.

Conclusion
Whether institutions look at Moodle, Sakai, or other open-source products, the main point to remember is that there are choices offering potential cost savings. Support costs are reported to fluctuate depending on an institution's commitment and layers of support, such as 24/7 technical support and server administration. Regardless, institutions continue to move toward open-source products as viable solutions for providing a rigorous LMS.

Product Managers in IT Organizations
Product managers are almost a standard in companies that deliver products and services to external customers—in industries such as telecommunications or computer equipment manufacturers. But product managers are not as common in organizations that support internal customers or employees—such as traditional, internally focused IT organizations and, especially, higher education IT organizations. As those organizations move toward an IT service management model, the product management position and/or the functions performed by product managers may become more prevalent.
Why Are Product Managers in IT Organizations Important to Higher Education?

When traditional IT organizations deliver services to internal customers, there is often a tendency to focus on delivering specific technologies rather than the complete services. For example, when IT organizations deliver an e-mail solution to internal customers, they may refer to the e-mail application name or to the manufacturer or the specific technology used for that system. When traditional service-based organizations deliver similar solutions, they most likely will focus on the entire solution rather than on the technology used to deliver the service. The entire solution includes not only the technology but also all of the associated business and operational processes necessary for the service or product to be successful.

Product managers help IT organizations focus on service rather than on technology. Product managers in IT organizations would concentrate on the large enterprise applications and the related technologies and processes used to deliver those services—applications and technologies such as telephone systems, e-mail systems, work-flow applications, financial applications, and customer relationship management (CRM) applications.

How Are Product Managers in IT Organizations Evolving?

Product managers document the requirements and features of a particular product or service with a document called a product description. Typically, a product description is developed and maintained for the entire life of the product or service. The document contains a description of the standard features, a list of the available options, and detailed explanations of the components and procedures required to successfully market, sell, operate, and support the product or service. This product description document is generally used as an internal company or institutional guide.

Conclusion

Many IT organizations that are internally focused, especially in higher education, may not have the budget or the resources to dedicate individuals to performing product management duties on a full-time basis. However, all IT organizations must deliver services to their internal customers, and many are increasingly being asked to deliver services to external customers. Similarly, many of the services being delivered by these organizations are increasingly becoming more mission-critical and thus more important to the entire institution. By using product managers to help implement IT service management models for key technologies and services, IT organizations will be better prepared to manage customers’ expectations as well as to manage the operations of the services delivered.

Information Resource Management Technologies for Libraries

The traditional role of libraries has been to select, collect, preserve, and facilitate access to and use of information resources. Until fairly recently (in the history of libraries), this role has been applied primarily to print and has focused on building local collections. The increasing primacy of highly distributed digital resources has brought disruptive change to the way libraries must approach their work to remain relevant to their parent organizations and constituencies. Although libraries have adopted many new technologies to address these environmental changes, several new areas of development, at both the global and the personal levels, will have a significant impact on how libraries interact with information resources and information users in the near future:
Collaboration and the Cloud. The convergence of cloud computing (both for data storage and for applications), applications based on service-oriented architectures, and digital data and information resources in a highly collaborative environment has the potential to radically change the way libraries define collection building, share management of information resources, and provide access to those resources for their user communities.

Semantic-Aware Applications. The vision of the semantic web—the capability to present connections between seemingly unrelated concepts, things, events, or people—is coming nearer to realization with new applications that gather and aggregate the context of information and that use this context to extract embedded meaning, preferably without the need for previous human intervention to attach additional descriptive tags, for example. This capability, applied to digital scholarly resources, could significantly shift the focus of libraries from describing and managing individual resources to developing semantic algorithms and natural language lexicons for mining and extracting answers from those resources.

Visualization Tools. As the sheer volume of information increases, providing more meaningful and intuitive methods for interacting with and drawing insight from available resources becomes critical. And as these methods develop, promoting visual literacy skills for deciphering the data presented and for determining its credibility and authenticity becomes equally important.

Personalization Tools. Organizing content to support research and learning is at the heart of the library’s institutional role. Once limited to applying subject terms, co-locating physical materials, and producing research guides, this role has been changed by the volume and variety of online resources, which require new tools to more effectively meet the needs of users. A growing collection of technologies and tools can be used to more granularly organize, customize, and personalize the online information environment to fit professional, learning, and research activities.

These technologies are evolving and converging to create new environments and methods for accessing, managing, and using information resources.

Why Are Information Resource Management Technologies for Libraries Important to Higher Education?
The library’s traditional location at the physical center of campus has symbolized its role as the crossroads for intellectual activity in higher education. Today, however, institutions are being defined less by their physical boundaries. The growing number of digital information resources, combined with the increasing availability of tools connecting students, scholars, and researchers across the world, is allowing teaching, scholarship, and research to transcend traditional boundaries of physical space and time more easily. Users within these virtual intellectual communities are expecting more collaborative work environments, services, and resources spanning both intra- and inter-institutional boundaries. To meet the needs of the changing higher education institution, libraries are beginning to move beyond the model of a relatively independent service provider to implement technologies that work collectively and seamlessly with a broadly defined set of services, resources, and collections both within their home institutions and around the world.

How Are Information Resource Management Technologies for Libraries Evolving?
These technologies are evolving away from being strictly stand-alone tools and

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resources and are converging into a more interoperable, collaborative, enterprise-level information management environment—one more closely integrated with teaching, learning, research, and administrative systems. Underlying system architectures are focusing more on providing discrete services (service-oriented architecture) rather than monolithic systems, enabling more interoperable and customizable workflows. By combining discrete services with cloud storage and cloud-enabled applications, institutions can build collaborative work environments between libraries as well as between libraries and non-library units, both on and off their home campuses, for discovering, acquiring, describing, and managing all types of resources. Layered over this enterprise-level resource management environment, information discovery and management tools are providing individuals and workgroups with much more intuitive and productive ways to discover, manipulate, incorporate, and share information for teaching, learning, and research, allowing users to shift time from the mechanics of managing specific resources to a focus on analyzing the information itself.

Conclusion
Ultimately, these technologies—individually and in convergence—will enable both institutions and individual users to think differently about libraries and information management. Libraries will be able to become less institution-centric and to reshape themselves as specialized components of multi-institution service providers, sharing resources and staff in collaborative environments. And users will be able to gain effectiveness and efficiency in teaching, learning, scholarship, and research through improved information discovery, access, management, and creation.

IT Service Management
Over the past twenty years, IT systems and organizations have become much more complex as a result of the Internet, distributed computing, and the increasingly rich array of available technology choices. At the same time, IT services have become mission-critical to colleges and universities, to the point where even short outages can have a major impact on course delivery, recruitment, and other essential functions. Moreover, as the complexity of these systems increases, so does the potential for data breaches and the need to maintain compliance with an evolving set of regulations.
IT Service Management (ITSM) is a set of practices that help organizations manage their infrastructure and services to improve the reliability and performance of information technology and to continually improve the delivery of IT services. The focus of ITSM is the customer's view of IT services; from the customer’s perspective, the failure of a single component of IT services can disrupt the customer's work. ITSM seeks to help IT organizations understand the interrelation of their systems and services to enable users' work and to put in place policies and procedures that minimize the impact of IT problems or changes on users' work.

One of the more popular ITSM frameworks is ITIL. ITIL originally stood for IT Infrastructure Library, a set of manuals developed in the early 1990s by the U.K. government's Central Computer and Telecommunications Agency. These manuals examined the processes needed to effectively manage problems with and changes in IT systems, to continually improve services, and to establish effective service levels for users. The original framework identified key processes as problem management, configuration and change management, and capacity and availability management, and it combined the processes to enable the delivery of clear service levels for end users. With the recent release of ITIL V3, the ITIL framework has expanded to a service lifecycle approach. Alternate ITSM frameworks include ISO20000 and COBIT.

**Why Is IT Service Management Important to Higher Education?**
Higher education is under increasing scrutiny to improve outcomes while maintaining or reducing costs. At the same time, higher education and IT units in general have increased pressures to comply with regulations and to reduce data security vulnerabilities. While this can be seen as a mandate to do more with less, ITSM frameworks provide a set of tools that can help IT managers in higher education gain invaluable insights into not only the services they deliver but also the reliability, security, and costs of those services. The current political and regulatory climate may cause boards and other oversight organizations to require industry-standard frameworks for IT services and security.

**How Is IT Service Management Evolving?**
Although ITSM is not itself a technology, one of the interesting developments in ITSM is an evolving set of software and services designed to allow organizations to more readily implement ITSM frameworks. For example, help desk systems such as BMC's Remedy and FrontRange Solutions' ITSM are examples of software suites designed to help organizations implement ITIL management processes. As ITSM evolves, it is becoming more practical for implementation at smaller organizations. In addition to software tools, new iterations of ITSM frameworks—such as ITIL Lite and ITIL Small Scale Implementation—allow targeted implementation of ITSM concepts to improve IT service processes without requiring the substantial time and resource investments often required for full ITSM implementations.

ITSM adoption in higher education is still at an early stage, with only a few early adopters moving through full implementation. To date, adoption of ITSM practices has occurred primarily at larger institutions that have complex services and organizations. Cornell, NYU, the University of Wisconsin, and Yale University, for example, have started ITIL implementations. As more colleges and universities adopt ITSM frameworks, these frameworks will likely adapt further to meet the needs and goals of higher education.

**Conclusion**
Larger organizations may already be looking at ITSM frameworks to help them manage both the increasing complexity of their IT services and organizations and the increasing pressure to improve service and reduce cost while complying with the growing number of regulations and security requirements. IT leaders who are not actively considering an ITSM framework should learn about ITIL and other popular frameworks and begin considering how some ITSM processes might be adopted at their institutions.
Ten Years of Evolving Technologies

In this section, we review the past ten years of research by the Evolving Technologies Committee, reflect on the technology trends, and consider if any abstractions or general principles might be drawn from this data. Which evolving technologies identified by the committee proved to be significant over time? Which did not? Which technologies or trends were missed? How is the work of the Evolving Technologies Committee useful to the higher education IT community?

Technologies, Topics, and Trends

We reviewed the past ten years of committee white papers (from 2000 to 2009) and noted the areas of impact associated with each technology. We then aligned the areas of impact according to the EDUCAUSE focus areas of teaching and learning, managing the enterprise, and e-research/e-scholarship. (Considering the committee’s focus on technology topics, we did not classify areas of impact in the fourth EDUCAUSE focus area, which addresses the evolving role of the IT profession and leadership.) When a technology was identified as having an impact in more than one area, we counted it twice. For example, last year’s committee identified “location-aware computing” as an evolving technology with significance both for administrative applications and for teaching and learning. We thus counted this technology in two EDUCAUSE focus areas: managing the enterprise; and teaching and learning.

Using this subjective rubric, we uncovered some interesting trends in technology topics. Mobile devices—including handheld PDAs, wearable devices, webpads, and e-books, as well as the wireless infrastructures and protocols required to enable and connect these devices—dominated the investigations of the Evolving Technologies Committee during the first few years of the decade (from 2000 through 2002). These years also saw a burgeoning interest in securing campus networks and data via a combination of policy, physical security, identity management (e.g., Shibboleth, digital certificates, PKI), and hardware devices such as smart cards and biometric technologies. Less emphasized, but nonetheless significant, were topics related to digital asset management: how to acquire, manage, and disseminate not just textual information but also still images, audio, video, and real-time experimental data, both within and external to the traditional college/university library context.

In 2003, the committee remained interested in network infrastructure and the support of the enterprise through better disaster recovery planning and IT security. But in addition, the topics began to shift in that and the following years as the committee started to explore more academic technologies: vended and open-source course management systems, learning objects, and academic portals. Social networking and collaboration tools such as blogs, wikis, web publishing tools, and podcasting were worthy of inquiry, alongside topics that
would have previously been considered outside the realm of exploration. Even subject matter not historically related to student computing but now considered part of the broader student living/learning experience—namely, interactive gaming and game consoles, simulations, and 3D/virtual worlds including Second Life, Wonderland, and Croquet—was the focus of committee white papers, as were, by 2008, best practices in business process management and regulatory compliance in information technology.

Indeed, many of the technology topics chosen in the earlier years continue to arise, but with slight changes in emphasis. For example, in 2003, course management systems (CMSs) were identified as an evolving technology. The 2003 white paper defined CMSs and noted their migration from the realm of distance learning into the entire academic enterprise. The paper discussed WebCT, Blackboard, and Desire2Learn, as well as three open-source initiatives: CourseWorks, CHEF, and Stellar. Finally, the author noted the need to resolve issues of interoperability, content management, cost, and assessment. In 2006, the CMS topic again rose to the forefront, but with an emphasis on open source. This white paper noted Blackboard’s acquisition of WebCT and identified Angel and Desire2Learn as the two other primary CMS vendors. The open-source alternatives noted in 2003 were not mentioned in 2006, but Sakai and Moodle were discussed. This paper identified the same interoperability and content migration concerns from the earlier white paper and added the issue of litigation, stemming from Blackboard’s claim against Desire2Learn. And again this year, in 2009, the committee chose “open-source learning management systems” as a technology topic to be addressed. It seems clear that even if the players and instruments may be changing, the song remains—mostly, and for now—the same.

Although an overview of grid computing appeared in 2003, it wasn’t until 2006 that a technology topic (research portals) was directly associated with the e-research/e-scholarship focus area. Since that time, five more topics have been classified in this focus area, most of them associated with virtualization in one form or another. This appears to be an area of growing interest.

The pie chart at Figure 1 illustrates the evolving technologies topics classified according to the three EDUCAUSE focus areas. The graph at Figure 2 shows the number of evolving technologies topics by year presented.

Conclusion
Over the past ten years, we have seen a shift from an almost exclusive focus on enterprise management—vis-à-vis managing networks, mobile devices, phones, and application/portal development—to a broader focus on academic applications. Neither the overall student experience nor research computing has garnered much attention, but both topics have appeared recently, which perhaps indicates an emerging trend.

Given these trends away from enterprise management and toward academic technologies, we must ask: Are our current IT leaders prepared to support this shift? What skills, if any, are needed to lead in this new era?
In the introductory paragraph of this section, we asked: “Which technologies or trends were missed?” Only one oversight comes to mind: the impact of Google on information search and delivery. Google’s rise as the preeminent commercial search service has created customers with search expectations and behaviors different from those of previous library patrons; and as a search tool, Google has certainly raised issues regarding information privacy. Although the committee has discussed the impact of Google’s higher education applications, the overall effect of Google on information, both inside and outside the academy, was not explored.

We are pleased that in 2009, information resource management technologies for libraries are, for the first time, featured as an evolving technology. Also, the work of this year’s committee in the area of “managing the enterprise” emphasizes service approaches to technology rather than specific technologies, perhaps indicating an evolving view of the role of technology in service delivery.

Finally, we feel that the work of the Evolving Technologies Committee continues to be relevant both as an instrument of sharing with the EDUCAUSE community—via presentations, articles, and white papers on evolving technologies—and as, we hope, a way to preserve, if not inspire, a sense of wonderment about the potential for enabling the academic mission via technology. Although not everyone in the higher education IT community will find all of the topics to be significant for or relevant to a local situation, the various evolving technologies explored over the years offer a broad spectrum of appeal to a diversity of educational institutions.

2009 White Papers

The full white papers on the 2009 evolving technologies—cyberinfrastructure and high-performance computing, open-source learning management systems, product managers in IT organizations, information resource management technologies for libraries, and IT service management—are posted on the Evolving Technologies Committee website:

http://www.educause.edu/EvolvingTechnologiesReports

Also on this website are links to the Evolving Technologies Committee white papers from the years 2000 through 2008.