



EDUVENTURES

***Service-Oriented Architecture and  
Web Services: The Next Big Thing in  
University Enterprise Computing***



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Enterprise Computing***

*Standards-Based Web Services Built on  
Service-Oriented Architectures Are  
Changing the Way Institutions of  
Higher Education Operate*

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For more than a decade, Eduventures has been the most trusted and influential name in education market research, consulting services, and peer networking. Our clients include senior administrators and executives from leading educational institutions and companies serving the K-12, higher education, and corporate learning markets, as well as decision-makers in government agencies and the investment community. Additional information can be found at [www.eduventures.com](http://www.eduventures.com).



## INTRODUCTION

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### The Challenge

*Obsolete legacy systems are interfering with business process efficiency, making it unnecessarily difficult to implement university-wide best practices.*

Traditionally, universities have been operated as highly decentralized enterprises, with faculty and business units allowed considerable autonomy to choose their computing systems, business rules, and operating practices. As a result, university-wide assets (e.g., the brand) and operating budgets may face compromises not necessary in a more centrally run environment.

In such an environment, university IT managers may find themselves supporting, at relatively high cost, a diverse array of computing platforms and applications, each with its own programming language, tools, and training requirements. Many institutions of higher education today are saddled with aging legacy systems that are hard to integrate because individual departments were allowed to order machines and applications on an ad hoc basis, with little centralized control. While decentralization provides advantages for some users – especially when applications have historically had little need to communicate with one another – today, these legacy systems pose serious obstacles to seamless cross-application computing capability, easy-to-navigate interfaces, and real-time enterprise-wide access to data that is both accurate and up-to-date.

Burdened with obsolete systems, colleges find themselves having to devote significant time and money to managing multiple interfaces and communication protocols, solely for the purpose of making sure their institution's systems can talk to one another. Meanwhile, users – including students, faculty, administrators, and members of the university community outside of the campus – are frustrated. Navigating multiple logins and unfamiliar applications, these users spend too much time trying to find the information they need. Too often, they find that data is inaccurate, inconsistent with information from another database, or too old to meet current requirements. Facing such a scenario, many college senior administrators have characterized themselves as “data rich, but information poor.”

### The Solution

*Web services built on a service-oriented architecture (SOA) promise to integrate systems seamlessly, while also offering campus stakeholders easily customizable solutions and real-time information from a “single source of truth.”*

Universities’ senior academic and business leaders are coming to the realization that application-centric silos no longer make sense in the Internet age and that it is time to shift to a computing environment that, from the perspective of the university’s many users, more closely resembles popular web-based commercial businesses. Consumers today, using a single web-browser interface, can go online to buy a computer, book, or airline ticket with intuitive point-and-click functionality. Indeed, it is the success of web-based businesses like Travelocity.com, Amazon.com, Dell.com, and a host of other vendors that has energized universities’ search for a solution to their enterprise systems quagmire. In short, the “expectations bar” has been raised for university computing as a result of the Internet’s commercial success.

Much of the solution to universities’ computing systems integration woes can be solved through web services – enterprise computing that gets students, job applicants, faculty, staff, and others the information they need to complete a task quickly – whether a user is applying for admission, hiring a new employee, submitting a purchase-order request, or locating student records in the registrar’s office.

**Web services** are built from component applications available on a cross-enterprise basis to authorized users. With a single sign-on browser interface, users can access a diverse collection of applications from multiple vendors, including legacy systems. Once built, web services can be used repeatedly to develop new custom-tailored business processes – resulting in a major savings on development costs. Such customizations are easily protected when the underlying applications are modified. In addition, the university has dynamic access to higher-quality, more secure data. As a result, web services offer campus constituencies a more satisfying computing experience.

A **service-oriented architecture (SOA)** is the standards-based backbone that makes web services possible. Besides serving-up “fused” applications from multiple vendors through a single portal interface, SOA includes a master registry (i.e., the “single source of truth” for the system) to authenticate system users’ access to data and applications. Some institutions will want to build SOAs, while others may decide – at least in the initial stages – that it makes more sense to invest in an integrated solution from a single vendor.

By developing single sign-on portals, IT will deliver key applications – called “services” – together in one place. Users will no longer face the hassles of having to pull data from disparate, unfamiliar systems – with calls being made to other departments to get missing data, or to the IT staff for help working across systems. With web services, data can be brought forth dynamically from various applications and enterprise databases, and streamed to campus users regardless of the kind

of device they use – including desktop, laptop, tablet PCs, and PDAs – to any location, including beyond campus walls.

As an added bonus – and key to its return on investment – this solution does not require scrapping the university's legacy systems. With web services built on a service-oriented architectural backbone, universities can integrate legacy and best-of-breed applications from multiple vendors and back-end platforms. SOA makes it possible for a department that prefers the Apple operating system to stick with Apple, or with Unix, Linux, Solaris, or Windows.

### The Solution in Practice

A number of leading universities have embarked on implementation projects aimed at transforming obsolete enterprise architectures. Their challenge is to improve business processes while making it easier for campus users to do their work efficiently using the university's IT infrastructure. A few institutions, as detailed in this paper, are on their way to making the transition from legacy application silos to cross-platform web services.



## INSTITUTIONS AT THE FOREFRONT

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The sections below detail how three universities are implementing web services with SOAs or equivalent single-vendor solutions to empower them to better manage their business processes while making computing more user-friendly. The institutions profiled below are the University of Wisconsin at Madison, Embry-Riddle Aeronautical University, and Cornell University.

### The University of Wisconsin at Madison

The University of Wisconsin needed to regain control over its enterprise data to ensure that campus users were working with accurate versions, getting the information they needed, and only the official data they were authorized to receive. As a result, the University decided to replace the existing enterprise systems infrastructure with a service-oriented architecture (SOA).

The University of Wisconsin at Madison (UW-Madison) serves 45,000 students. The UW-Madison IT department not only serves the Madison campus, but also provides support for the rest of the University of Wisconsin system, which includes 12 four-year and 13 two-year campuses. Improving operating efficiency across UW-Madison departments was a key factor in deciding to move to web services and a service-oriented architecture. Managing multiple interfaces between 14 different university systems that each relied on batch-file transfers was proving increasingly costly for the IT staff to maintain. And, the school's legacy systems architecture posed other problems as well.

“We needed to get control over the data exposed to all of the different interfaces,” notes Brian Busby, who supervises the University's Collaborative Applications Group. As Busby explains the problem, data sent by batch-file transfer from one department to another on campus is data that could easily get loose and move “downstream” into local systems at other business units. This scenario could lead to the exposure of information about students; for example, academic or health center files could become available to unauthorized persons – creating a breach of privacy.

*“With all the data transfers between applications, you don't know what is going to happen to the data. You may be sending too much information, including information that another user should not be seeing.”*

*– Brian Busby, Supervisor, Collaborative Applications Group,  
University of Wisconsin at Madison*

Silo-to-silo circulation of batch files poses other problems as well. For one hypothetical example, the campus crisis center may see 50 students on a given Tuesday. Were the center to request data on student academic records, the central IT staff would be forced to send over all 45,000 student records in a batch, which the crisis center would load into its system's database – just to be able to look up the current grades of the 50 students due to arrive for counseling that day.

Data sent by batch transfers could also be “misinterpreted” easily, because different departments are often using different business rules – or different versions of data that have been altered to suit unique departmental needs. For example, Recreational Facilities may define a “current student” that is authorized to use campus facilities as a student who is not only enrolled, but who has also paid all college fees. The library, on the other hand, might define a “current student” eligible to check out books as a student who is enrolled, but who may or may not have paid all fees. Inconsistent business rules across campus departments, coupled with batch transfers of flat files, create these kinds of data-translation problems. Different versions of “the truth” begin to circulate, creating inconsistencies in the way policies are carried out. Shipping large data files to departments – each a one-off solution each time a request for data is made – also puts a heavy burden on computing resources to generate and transfer large files using production-scale applications.

Upon hearing about Oracle's Fusion Technology, Wisconsin's senior IT management spotted a way out of their enterprise systems challenges. Senior IT Architect Jim Phelps explains: “Industry research states that up to 50% of large IT enterprise budgets are spent on integration and interfaces, and our numbers show that this holds true for us. We need to find a better way to do integration and interfaces, and have identified SOA as the better way.”

Once web services are rolled out, enterprise-wide business rules can be standardized, thereby eliminating the “data-misinterpretation” problem. Data about students and employees and their respective roles will be called up from a master registry – the system of record or the “single source of truth.” For example, PeopleSoft Campus Solution (a student information system) will be the “single source of truth” for students. In addition, decisions can be expedited because accurate information is served up dynamically, in real time. For example, if a student shows up at a recreational facility, a staff person can enter the student's name and ID number and know immediately if the student is eligible to use the facility – as a “currently enrolled” student based on uniform, university-wide business rules.

Although implementing web services on an SOA backbone poses a number of technical challenges, local departments' resistance to change can also be a serious obstacle. Local units may resist giving up their familiar legacy applications. Convincing them that application-centric attitudes have to give way to an enterprise-centric view can require a university's IT managers to expand their roles to include “marketing” the needed overhaul to other campus leaders, so that everyone is working together, from the start of the SOA implementation to the final rollout of web services.

*“A change in culture is required. When I give presentations on the value of having a service-oriented architecture, I try to point out opportunities that web services provide and how it compares with obsolete batch-file transfers. For example, I’ll explain how a company like Travelocity, the web-based travel accommodations business, would be impossible to build if it had to rely on flat-file transfer technology. I use that example to drive the point home.”*

*– Jim Phelps, Senior IT Architect,  
Collaborative Applications Group, University of Wisconsin*

From the senior administrator’s point of view, SOA can mean real-time access to institutional data, a “single source of truth” to prevent the dissemination of corrupted information, and improved data security. Regulatory compliance, data accuracy, and data integrity are all improved – facilitating better decisions.

To be successful, SOA implementations can require other changes as well, including a new budgetary model. At the University of Wisconsin, IT budgeting has historically been application-centric, with each application having its own maintenance and support budget. For example, if the Registrar’s office needed an application, it would fund the development from its departmental budget. But with SOA, which makes loosely coupled, or “componentized,” applications available as web services on a campus-wide basis to many different departments and groups, the next logical step for the University will be to move to an enterprise-centric budgeting model – one in which budgets are pooled to support web services development costs.

### Embry-Riddle Aeronautical University

Embry-Riddle’s leadership saw web-based enterprise systems as the solution to building better business processes for its globe-spanning “extended campus.”

Embry-Riddle Aeronautical University serves more than 30,000 students at two residential campuses in the United States, 130 off-campus teaching centers, and a Distance Learning Program – a global “extended campus” of tens of thousands of constituents. The University’s highly decentralized, far-flung learning network presented a unique challenge for the University’s senior IT management, which has launched a “Quantum Leap” transformation initiative in enterprise computing.

With so many faculty and students working remotely, Embry-Riddle needed a robust, highly agile, and scalable enterprise resource planning (ERP) system that could provide its globally dispersed staff and students with real-time, web-accessible services, while also improving the speed and accuracy of its business processes. Quantum Leap kicked off with the implementation of Oracle’s E-Business Suite, which had the desired robustness and flexibility. As Cindy Bixler, Chief Information Officer at Embry-Riddle, explains, “Before we implemented Oracle E-Business Suite, we would send our remote faculty their direct-deposit pay slips by express mail. Now, with HR self-service, which is part of the Suite, Embry-Riddle employees can go online directly to find out how much money was deposited into their accounts.” In addition to a dramatic improvement in

service for the more than 90% of employees who have direct deposit, the University also realized substantial savings on paper and mailing costs.

The bottom-line payoff from the implementation has been that faculty and staff can accomplish key tasks faster and with fewer difficulties. Paper-based workflows that formerly required frequent manual interventions have been transformed into digitized workflows that significantly cut the time required to complete a process, while also delivering overhead cost savings.

### *Business Process Improvements*

Embry-Riddle's new-hire process provides an interesting case example of the benefits of the new approach. With iRecruitment, one of the HR modules, job applicants' resumes become immediately available to the departmental hiring manager at the time the job seeker applies online. Previously, a hiring manager might have waited as long as two weeks before seeing the resume, which the HR department would print out and route to the person responsible for the hiring decision. With the new solution in place, cycle time – from a resume's submission to its review by a manager – has been cut from two weeks to a few hours.

In terms of accounting, the web-based, self-service modules have also cut the processing time required for purchase orders. With the iExpense and iProcurement finance modules, entire processes can be handled electronically, from the time a University employee decides to make a purchase and requests authorization, to the point that a check is written and delivered to the vendor.

*“If an employee wants to make a purchase, that person goes into the iProcurement module and enters the purchase request. The budget manager is alerted electronically and either approves or denies the request. If approved, the order goes to the purchasing department, which converts the request to a purchase order – all done without passing paper or securing signatures. When the order gets delivered, the employee who initiated the purchase goes online to authorize payment to the vendor.”*

*– Cindy Bixler, CIO, Embry-Riddle Aeronautical University*

Driving back-office efficiency by deploying Oracle's E-Business Suite, with business best practices embedded, is only the first phase of Embry-Riddle's Quantum Leap transformation. Because the University wants to combine key legacy and best-of-breed applications with Oracle enterprise systems, the IT staff is taking the transformation further by implementing a service-oriented architecture. When completed, the SOA is expected to make all applications available to authorized campus constituents as web services.

“Once we roll out Oracle Portal and Oracle Internet Directory later in 2006,” explains Becky Vasquez, Embry-Riddle's Director of IT Services, “students, administrators, and staff will only have to log in a single time to access all applications.” Only one sign-on will be needed because the database housing the master registry will know immediately, either through the E-Business HR module for staff or the student information system for students, whether the person signing in has authorization based on their assigned roles.

*“There’s been a lot of frustration with multiple log-ins, which require constituents to first log in to the University portal, then log in a second time for email, and then again to access individual applications. Students have been asking for single sign-on for five years, and very soon we’ll be able to provide it. It’s a quantum leap forward because campus constituents will have a seamless, unified environment to work within.”*  
– Becky Vasquez, Director, IT Services, Embry-Riddle Aeronautical University

Web services’ benefits extend well beyond improved ease of use for students, alumni, faculty, and staff. For the IT department, it means a sizeable reduction in account administration costs. “With single sign-on, we anticipate a 30% savings on IT staff time, because account administration will be vastly more efficient,” Vasquez explains.

Embry-Riddle has tens of thousands of constituents who need to access different applications at any time, day or night. As things exist currently, new employees have to be manually entered into the HR database, then into the email application directory. Should an employee decide to take a course, he or she would need to be re-populated as a multi-role user in the student information and course management systems. “It could take as long as two days to set up an account for a new employee, and manual intervention was often required because of multiple, independent directories – or confusion caused by constituents who happened to share the same names,” notes Vasquez. Once Oracle Internet Directory is in place, account information will be centralized and portal access automated across all applications, including legacy systems. Fewer manual interventions will be needed.

### *Reduced Need for Training*

IT resources are being optimized in still other ways. For example, previously, the different vendor platforms, each with its own proprietary tools and databases, meant that IT had to train campus constituents on each new application. “For example, with multiple best-of-breed applications, navigation was different for email, for the HR application, for the student information system, and so on. People had to be trained how to use each application,” notes Bixler. “With Oracle E-Business Suite, once a manager learns to navigate one module, he or she can easily move through new modules because of the standardized approach. This improves constituents’ comfort levels when they’re introduced to new solutions, while allowing everyone to focus on the business process, rather than having to spend time figuring out how to work the technology,” Bixler adds. When Oracle’s Collaboration Suite is fully implemented, training can be further standardized around a single tool set, language, and database, further leveraging Embry-Riddle’s IT resources.

*“The old IT silos arose because of multiple legacy and vendor systems. We had different systems analysts who specialized in different languages and database tools. As we begin to extend Oracle technology forward, those silos become a thing of the past.”*  
– Cindy Bixler, CIO, Embry-Riddle Aeronautical University

### Cornell University

At Cornell University, a hodgepodge of IT systems silos had developed over the years, creating burdensome integration challenges for the IT team – along with inefficient business processes for users. Complying with new government mandates like the USA Patriot Act added to IT's burden, because existing systems lacked the agility to deliver real-time data on students. With web services, Cornell's IT team will have less need to patch together unique solutions each time there is a new demand for data, and campus users will be able to do their work more efficiently.

Cornell's Office of Information Technologies faced a problem. Over the years, multiple, independent systems were allowed to develop throughout the University because local units had broad latitude to invest in siloed applications, with little regard to the implications for enterprise-wide integration. As a result, at Cornell, administrative computing alone encompasses three major database applications, four operating systems, four hardware platforms, and six development centers.

Cornell's systems *mélange* has given rise to locally controlled “shadow systems” that not only duplicate central administrative systems, but can also generate multiple versions of the same data. This places a heavy burden on Cornell's IT department to support so many different systems.

Cornell's senior IT management refers to the University's current SOA initiative as a business and not a technology architecture, as the strategic driver behind Cornell's enterprise systems rebuild is business process improvement. When coupled with web services, Cornell's new business-driven SOA will allow users to view enterprise data dynamically across silos, and to access componentized applications as needed.

*“We want to open up the application silos and make key functionality available to staff and faculty so they can design customized business processes that meet their needs.”*  
– David Koehler, Director, Information Systems,  
Cornell Information Technologies, Cornell University

Presently, several web services are up and running, with many more to follow. For example, WSPerson looks up the role of employees in the PeopleSoft database that serves as the official registry and, in conjunction with data from other sources, enables a decision as to whether an individual is authorized to access applications or data. A staff member seeking travel expense reimbursement types his or her ID number into a form available on Cornell's portal. WSPerson automatically populates the rest of the form, slotting in the appropriate account number and other data needed to authorize payment. Before WSPerson, the IT department had to copy over data to the finance office to verify that an individual requesting reimbursement was authorized, and to determine that person's department and account numbers. With a synchronized database and official registry, there is now one officially sanctioned source of process authorizations.

Cornell plans to make equivalent functionality available to managers who need to access student information, such as staff in the Registrar's, Bursar's, and Financial Aid offices. Data on students

will be transferred from a legacy mainframe database into Oracle's Learning Solutions, where it can then be accessed in real time via a web service.

How else might Cornell leverage web services? Like other universities, Cornell faces a growing roster of regulatory compliance requirements, which pose added challenges because of the need to assemble information quickly for new purposes. The USA Patriot Act, for example, requires institutions to capture data on specific types of students. In turn, this requires that software be written and put in place to mine other systems in order to aggregate relevant data, which carries the potential to be very labor intensive. With web services, universities such as Cornell could extract from existing data sets quickly, facilitating and reducing the cost of incremental regulatory compliance efforts.



## CONCLUSION

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### **SOA and Web Services Enable Institutions to Build and Operate Customized Business Processes**

Higher education institutions, especially large universities characterized by decentralized operations, are finding themselves challenged by aging information systems that are expensive to maintain and that lack the necessary functionality for enterprise-wide computing. In addition, today's computing environment is one in which users may be logging in from beyond the walls of the campus – indeed, from all over the globe.

Web services based on a service-oriented architecture offer promise as a way to optimize enterprise systems for enhanced business unit operations and end-user satisfaction. Because web services and SOA also offer standards-based, cross-platform computing, universities' senior IT leadership are able to select among best-of-breed applications from diverse vendors, and bring legacy applications into the fold.

Perhaps the biggest benefit to an SOA approach is that it allows university departments to build and operate customized processes that conform to their unique needs without compromising the internal standardization needed to maintain centralized control of data through an official database registry. As a result, universities obtain uniformity where they want it – in brand image, for example – without needing to resort to centrally imposed processes. Cornell's IT Director David Koehler sums up this key benefit as follows: "You can't decree the same business model for everyone. Because business process needs vary so greatly across schools and departments, the common solution for accommodating the different needs of the Veterinary School, Medical School, Business School, and other departments is web services."



## SOURCES & ACKNOWLEDGEMENTS

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