EdUnify: Harmonizing and Harnessing Electronic Services.

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Keywords: System Integration, Interface, XML, Protocols, SOAP, REST, Infrastructure, Web Services, Registry, Look-up, Semantics, Vocabulary, Data Standards, Business Methods, Reuse, Harmonizing Data, Information Practices

1. ABSTRACT

The PESC[1] (Postsecondary Electronic Standards Council) *EdUnify* is a set of core services enabling the universal registration, annotation and look-up of web services allowing users to search, access and secure data exchange through a federated platform supported by software implementers. This global initiative involves the participation of implementers worldwide working to integrate electronic services published by application providers to enable the reuse of shared data and information practices spanning electronic systems in support of research, teaching, learning and credentialing.

EdUnify will address deployed, implemented and abstract web services. Deployed services are operational and can be accessed using prescribed protocols enumerated by the publisher. Implemented services have been defined and actualized, but are not deployed and operational. Abstract services are typically either specifications or designs, and they may or may not be deployed or implemented at any time.

The high-level goals of EdUnify are to:

- open and secure access of structured information managed across distributed stakeholder applications and databases;
- be compatible with existing technologies, tools and applications;
- enable development of new technologies, tools and applications;
- connect disparate systems, applications and technologies;
- leverage internet connectivity;
- provide abstract services to buffer physical properties underlying data sources;
- utilize a common framework, protocols and semantics accepted by industry stakeholders;
- communicate data and processes securely; and
- reinforce reuse of the investment in application integration and interfaces.

This session will provide the background, plan and progress to date of the EdUnify Task Force launched in December, 2009.

2. WHAT IS EDUNIFY?

EdUnify is a specific web services registry and look-up service intended to augment data and process interchanges between education stakeholders respecting their application rules, security and design. A Task Force was formed by PESC (Postsecondary Electronic Standards Council), with cooperation from SIFA[2] (Student Interoperability Framework Association), to develop this registry and build it as a joint venture for the public and private sectors.

The long-term goal is for *EdUnify* to be part of the worldwide web infrastructure like the plumbing or electricity that we take for granted in our home, business or institution. It is intended to be a network of stakeholders committed to the sharing, reuse and augmentation of present and future information technologies. *EdUnify* will support data, information and process interchange while aligning with the mission of education spanning the education ecosystem. Now is the time to come together and work toward the foundation of new systems to support teaching, learning, credentialing and research across the 21st Century.

3. HOW IS EDUNIFY DIFFERENT FROM OTHER STANDARDS INITITIATIVES?

One cannot have a conversation today about electronic data and information standards initiatives without revealing a significant amount of confusion because there is no universal resource one can view to describe all standards and how they intersect or apply. Unlike the building trades where engineering and architecture govern how materials are utilized to build, education does not have such prescribed disciplines available. This renders confusion when searching for what is relevant information. Subcontractors must reference their local building codes, request third party certifications and validate compliance to safeguard the consumer before occupancy. Imagine having a place that documents electronic services much the same way.

Why are there so many "standards initiatives" across the education landscape? Which ones matter and should be supported? Much of the confusion comes from the organizations stimulating the advancement of common practices and how they relate to the data and information that describe the inputs, outcomes and methods employed by developers of applications and systems. Part of the challenge is rooted in not having a registry or index to search. Developers don't know specifications or standards exist, so they are constantly "reinventing the wheel." That is why *EdUnify* is so different from other standards initiatives, because its focus is on how to reduce the variation in practices while offering the ability for all to publish data and information so it can be found and reused.

4. WHAT ARE ELECTRONIC DATA AND INFORMATION STANDARDS?

Let's define electronic data and information standards as specifications designed, developed, deployed and adopted by stakeholders either on a voluntary basis or by act of governance or law. The level of adoption and uniformity would reflect a significant impact on the education ecosystem. Standards apply to practices that are not just electronic, but that will impact automated systems and applications as well as the data gathered and reported by them. Practices evolve over time through innovation.

4.1. STANDARDS ARE DETERMINED BY LEVEL OF CONFORMITY AND ADOPTION

Just as the means to measure a mile or kilometer requires definition to enable the practice of measuring distance, so do standards. One can derive common meaning and application from the use of standards.

Standards are achieved either through market forces or by law and regulation. There is agreement in definition and specification about how to apply a standard. Both attempt to alter and reduce the diversity of a practice by employing common, comparable methods. Conformance to a definition or specification can be measured. Often we refer to de facto standards, like the IBM-PC or the architecture of motherboards that utilized an 8bit or 16bit bus to connect adapters to the CPU and Memory. If you wanted to create an aftermarket video card for the IBM PC, you had to accept the de facto standard and build to the specification. If you did not follow the specification, the end product would not work and consumers would not use it since its operation would be impaired.

Standards by their nature have to be rated by how they evolve through innovation, experimentation, adjustment, compromise and acceptance across a community. Many standards initiatives currently underway across the education ecosystem are developed in groups and begin with requirement gathering. Specifications drawn are focused on gaining potential adoption around applications, tools, definition of uses and common practices that have been merged to conform to community agreement. The landscape covering the development of data and process specifications mirrors the complexity and breadth of the variations found in business and academic processes spanning institutions worldwide. There is no easy way to fully characterize it (because there are so many moving parts), even though some have attempted to model the education ecosystem at both macro and micro levels by limiting the boundaries of what is involved or the details surrounding it.

4.2. CONTROL AND EVOLUTION OF PRACTICES

There are many groups driving the development and adoption of common tools that span teaching, research and learning applications. Everyone from associations to informal communities are combining best practices with the evolution of data and process standards. These groups compete for resources and attention in the education ecosystem. All of this contributes to the lack of adoption, since the voluntary nature must align with the market forces attracting the stakeholders to adopt specifications that merit resources and following.

4.3. ORGANIZATION AND METHODOLOGIES DIFFER

Some standard groups are "open source" playing in a shared competitive sandbox and offering specifications that are licensed or sold as technology itself. These differ only in the economic business models that support sustainability and reuse across an install base. The concept of communities sharing a code base or specification is motivated by cost saving efforts and influence centers driven by collaboration and governance funding the joint development.

There are also communities developing full scale applications such as Moodle[3], uPortal[4], and Sakai[5] that call themselves standards based. These platforms enable clients to adopt a common architecture, following practices explored as a community and published to serve the market as an alternative to proprietarily, home grown or commercially developed applications. Many of these communities build an "open source" product that is then adopted across a range of implementers, some of which build sustaining support organizations around the product. There are other communities like OCW[6] (Open Courseware Consortium) or groups that have an affinity to define best practices through collaboration and sharing that converge on uses of technology such as OpenEAI[7].

Other groups focus on core application specifications, such as e-learning, Learning Management Systems (LMS) and Informational Management Systems (IMS). Still other groups focus on the exchange of learning components or objects such as SCORM[8] and ADL[9]. SIFA has developed an integration platform to augment a district or school's management and governance which enables data and process sharing across common interface points published with message specifications. PESC has developed transactional, data transport and public methodologies to govern how electronic documents and schemas are used across stakeholder applications and systems. Internet2's[10]

Shibboleth is focused on how credentials and authentication work across systems supported by trust and assurance.

Government formed groups are found everywhere. In the United States, the Department of Education is funding NEDM, the National Education Data Model[11]. Organizations like the Council of Chief State School Officers (CCSSO)[12] and the State Higher Education Executive Officers (SHEEO)[13] are working on policy data standards funded by private foundations trying to address the feedback loop issues facing education stakeholders. In Europe, the Committee for European Standardization (CEN)[14] and the movement fostered by the European Higher Education Area[15] foster initiatives to publish common specifications and funding of adoption across member countries and consortiums throughout the European Union. Metadata for Learning Opportunities (MLO) and PLOTEUS, a portal to promote learning opportunities reveal the grey line between creating specifications and how they are utilized in applications. Europass[16] is a good example of a specification that is governed by principals of collaboration and commitments made by political leaders to foster commerce and mobility based upon the roots of HR_XML. The RS3G (Rome Student Systems and Standards Group)[17] is developing a web service platform to support student mobility through state sponsored consortiums who are members addressing the ELM (European Learning Mobility) specifications.

4.4. THE CONFUSION ACROSS STANDARD GROUPS

The confusion between standard groups is due to the sheer number of groups and the fact that they are poorly defined because their focus has blurred as they compete for resources and adoption given the limited budgets allocated toward improving their IT infrastructure.

Depending upon the need for data standards to support policy or the need to drive improved practices, different groups work on developing specifications aligned with their objectives and mission. Applications under development are impacted, but legacy applications are often ignored due to the cost to retrofit. Given that most stakeholders have systems and hundreds of applications employed, very few retool their systems to support any of the major groups promoting specifications unless there is wholesale change across the enterprise. This is a rare occurrence, since such a high percentage of postsecondary institutions have significant investments in technology that can't be displaced or disrupted.

The standards driven initiatives across education are all faced with the same challenge. The education ecosystem has not evolved as other industries have because of the decentralized nature of governance and lack of oversight. Thus, the standard bodies or communities promoting standard practices are further adding confusion and questions about their viability and following.

4.5. THE LACK OF INFRASTRUCTURE TO SUPPORT EVOLVING STANDARDS

Our world's investment in knowledge creation, delivery and credentialing in the 21st century is increasing as countries recognize the importance of an educated workforce with the impact of globalization. Even as content expands and alternative methods of teaching leverage internet connectivity, education is impeded by the lack of shared infrastructure to accommodate the basic processes of assessment, validation and authentication of credentials.

People and businesses are mobile and global. *We cannot efficiently or effectively address the worldwide need to expand education delivery, satisfy electronic forms of credentialing and foster knowledge creation by duplicating and polarizing our differences when our resources are so limited.* For too long proprietary interests, fear of the unknown, the desire to control information because "we" are the custodians of it coupled with the lack of a common technology infrastructure has been

at the root of underlying reasons why application integrations, interfaces and the exchange of data or information is so complex, expensive and only marginally effective.

Information management technologies have been haunted by the need to augment and control the technology investment, rendering disparate vocabularies and semantics across applications and systems of all following the path of innovation and improvement. Even in countries that have a common language, advancing the movement of data and information across or between applications and systems is very difficult and costly. We spend valuable resources attempting to artificially support the needs for data and information portability, but rarely accomplish or satisfy expectations.

It has been made ever more difficult, by the applications and systems we employ that cannot communicate outside of their design because external requirements were not considered. The business of education has more commonalities than differences, yet our IT system resources have such difficulty sharing data and information across components that they consume 50-70% of development budgets[18] just to remain operational. Applications that could address data portability reflecting people's mobility are hampered by disparity, frustration and resignation that our efforts will not impact the status quo.

In order to expand information access as well as social and economic development, we must have a more effective plan on leveraging information technology while working across autonomous organizations that create barriers to reuse, exchange and collaboration. At the core, issues of data security, privacy, identity management, credential claims and validation of those claims must bridge stakeholder systems and individual rights. Governance, whether mandated or voluntary, must respect the natural forces that drive systems and application isolation by locale. Compliance, whether dictated by government regulation or law has not achieved transparency or interoperability and offers further evidence that trying to accommodate differences of region, country, language and practices will be a daunting process no matter where one starts.

Whether we like it or not, market forces will drive us to recognize governance must employ incentives to work toward conformance and collaboration, rather than by force and law. Building the road enables commerce and exchange.

5. WHY IS PESC UNDERTAKING THIS INITIAITVE?

The Task Force was created to face one of the toughest challenges persisting in postsecondary education and all education efforts in general. The inhibitors to data access and movement, as well as the huge costs of the movement and the exchange of data across computer applications are obstacles that need to be overcome. How can we do this in order to foster new methods needed to address the challenges of research, teaching and learning in the 21st century without boundaries, physical or otherwise.

The Task Force of forty participants first convened in December 2009. The participants included people from higher education institutions, the private sector, the Federal government and non-profit organizations. Subsequently, the Task Force launched a Technical Workgroup to develop the Proof of Concept and a Business Workgroup to develop a Business Plan for sustainability.

It is both difficult and costly to access data and processes spanning education because the industry is a decentralized network of stakeholders with individual control over their data systems and applications. The impedance to progress is felt across policy, governance, management and operations. Student services, guidance, measures and progress are directly affected by the lack of a network and connectivity. Data and process interchange standards are not widely implemented by vendors, academic institutions or government agencies. Today, there is an ongoing call for better

data management. We need to replace the "afterthought approach" with a proactive strategy. The *EdUnify* data management strategy would replace the current complexity, costs and burdens that impede improving the outcomes of our education investment as a society.

Where standards are implemented, they are not registered or documented in an infrastructure that allows them to be readily used by people building integrations and looking for data. *EdUnify's* infrastructure will allow all stakeholders to register their data interchange specifications and implementations and map them to standard terminology for interoperability. Users of *EdUnify* will be able to employ this registry to build integrations and inventory services, as well as access data available across postsecondary education. PESC, along with SIFA, is the right organization to undertake this effort as the organization is a neutral party with a track record of success in developing and implementing data exchange standards across education.

Today, we can track a package sent by UPS better than we can track a student's progress across educational institutions over their lifetime. It is understandable given the decentralized nature of our education ecosystem, but it is unfortunate we as a society cannot utilize existing technological resources to better serve the challenge of working together while respecting the autonomy of our institutions and privacy of our citizens. *EdUnify* is not about changing how data is used locally or what data is under management. It is about stimulating the development of infrastructure needed to build better systems and applications that will address the challenges of the 21st century learner and the institutions they attend.

6. THE UNINTENDED CONSEQUENCE OF DECENTRALIZATION

Across education, the utilization and effectiveness of data and information technologies is severely inhibited by access methods, differing protocols, nonstandard payloads, varying data definitions and the inability to trust disparate applications stove piped by proprietary design. Billions are spent annually trying to move data across components employed by stakeholder computer systems, usually with very ineffective and inaccurate outcomes. The current state of automation with all its redundancy, unnecessary aggregation and inaccuracy, render a tremendous burden on the educational investment society as a whole is making.

Policy, governance, research, teaching, administration, funding and learning are all impacted. The unintended consequence of metered design without considering the external interchanges that contribute to additional obstacles and costs is avoidable. The accurate, authoritative and secure transmission of data would respect and reinforce autonomy and roles by connection, rather than push the work around mentality that has been fostered by an industry fearful of data access, use and security.

The education industry spends approximately 4% of operating expenses on information technology, which is $50 billion annually in the United States. The money spent on IT is comparable in Europe, but varies significantly across countries. Of the funds spent, around 50% is used to support connections and movement of data across disparate applications inside and outside the institution.

7. RATIONALE FOR EDUNIFY

We often view external challenges which seem to be outside the boundaries of our organizations as out of reach and not something we can or should focus on. Assumptions are drawn and acceptance of the current state of affairs continues. Innovation and progress push to improve the status quo and this takes effort. We must explore how communities can work through differences, compromise and set the stage for progress. We need to realize progress is incremental and doesn't have to be addressed all at once. We need to apply our efforts to a shared vision that addresses our individual circumstances and know how the effort can help us achieve great things together.

Think about our use of email today and how easy it is to send and receive messages. It does not matter which program we use, the interchange works the same. Who, how and when did we establish the convention of dmoldoff@academyone.com? How does the program I use, reference and send my email and how does it get to its destination without someone lifting a hand? How did the @ sign become the separator? These standards reflect how solutions and decisions made just few years ago have made email computing services simpler to use. Adoption and compromise were voluntary decisions that made this possible, not laws or governmental decree.

We can learn a great deal by understanding the evolutionary path of email. What came first, the demand or the innovation? How did a community come together to face the challenges of exchanging electronic messages? How can we learn from the path taken by early ventures to bridge email systems? What compromises were made? Moving or accessing data, whatever form it is in, from program to program across computers is complex. How did they reduce the complexity and overcome the legacy of doing it "my way?"

In our recent memory, significant events often fade and we forget about how difficult it was to gain access to knowledge or people prior to Google or the cell phone. How did we search for information in the past? What was life like before Amazon or Facebook? Do you recall Gopher, Compuserve or BackRub? These are three major technology innovations born by a few people who came together to change our world for the better. They decided to overcome the challenges and invest in developing ideas to bridge frontiers once thought of as overwhelming. Not only did they change our world, they improved how we live by reducing the distance and time we spend moving from place to place both physically and virtually. Collaborative efforts can realize great results.

8. WHAT IS THE TASK FORCE DOING?

We are presently gathering requirements and considering candidate technical architectures and design. However, it is important to put some stakes in the ground and say what we know or what we think we know in order to have a productive discussion about what *EdUnify* will be and what applications we can build using *EdUnify* once it exists. Presently, we believe *EdUnify* will be a:

- **Web service registry or index** with a suite of applications built on top of it.
- **Web service search** implemented as a web application interface for human interaction with the registry or index and an interface for programmatic searches of the registry or index. The service may be free, a fee based service or some combination thereof based on the requirements of the business model (e.g., a simple search may be free, but semantic query tools and functionality might require a fee).
- **Web service search management and notification system** providing users with a means to specify and manage searches of the registry or index over time.
- **Interoperability services** to assist in annotating web services definitions with common concepts, so that *EdUnify* can apply reasoning to infer equivalencies between web services and perhaps mediate in federated queries of multiple web services.
- **Feedback and rating services** allowing users to provide evaluations on the quality of the design and performance of the web services. This provides valuable knowledge to developers and administrators and most importantly generates more metadata for the *EdUnify* web service registry or index. As services are rated, a user may search by quality of design and service level ratings in addition to searching by publisher and function.
- **Monitoring services** included in the registry or index which are designed to be monitored for availability by independent third parties. For example, the publisher of a service provides target service level information and details of how to monitor their service in their publication feed, *EdUnify* monitors that service for availability, presents that data to users and measures the availability of the service against the target service level. These operations provide a valuable service to the web service provider, and this process generates

more metadata about the service for the registry or index. Users may search by service level and performance, as well as publisher, function, data, user feedback and ratings.

9. FUNCTIONAL GOALS OF EDUNIFY

The following are examples of potential high-level functional goals:

- Respect the federation and autonomy of information service providers with their own interests to design, develop, deploy and maintain data and analytic systems with different data stores across education enterprises.
- Provide fast, reliable and secure access to a federated Registry and Look-up Service to improve people's productivity through applications designed to channel request for services and response to service requests abstracting the differences in data and methods behind them.
- Enable the PESC and SIFA community to foster sharing of data and method reuse across stakeholder applications, utilizing direct and indirect automated bridges.
- Enable the development of alerts and feedback loops across the P-20 landscape without dictating how, by letting the open marketplace and motives drive improvement in services through collaborative technologies.
- Respect organizational controls, business policies and practices over their data and services.
- Enable people and organizations to align initiatives, improve outcomes and reduce duplication dispersed across information technology investments.
- Allow everyone access to data definitions, semantics and enumeration improving how services are developed and delivered to people through online applications.
- Create an expandable platform to explore and request advertised services by stakeholders honoring protocols, business rules and requirements managed by providers of the advertised data services.
- Build, deploy and extend a commercially profitable online marketplace to foster competition, innovation and the abstraction of proprietary interests among stakeholders reducing risk, fear and anxiety which inhibit efforts to leverage common specifications for data and methods.

The following are examples of enumerated types of services *EdUnify* will register and publish so stakeholders throughout the industry can find, share and utilize them in their applications:

- Student and Faculty Data Services
- Institutional and Academic Data Services
- Course and Program Transferability Disclosure Services
- 21st Century Learners Spanning Multiple Institution Services
- Student Access to their Data through Electronic Services
- Enabling New and Innovative Technologies to Support Teaching and Learning Services

The Task Force is preparing very specific, structured use cases that the *EdUnify* frameworks will support to help identify specifications and technology it will develop or apply. We are preparing a set of use cases in a common format to help determine the constituents served and processes addressed in each use case.

10. WHO IS INVOLVED?

For a complete list of Task Force members and contact information, see the PESC EdUnify Task Force Participants page on the EdUnify WIKI hosted by Emory University. To enroll other participants contact Michael Sessa, PESC Executive Director, at michael.sessa@pesc.org.

11. FUTURE APPLICATIONS FOR EDUNIFY

This is a summary of some killer applications that anyone (application vendors, states, agencies, academic institutions, people in their garage, Facebook, Google, Microsoft) could develop when *EdUnify* is up and operable. *EdUnify* infrastructure will enable these composite applications. It is not the intention of *EdUnify* to build killer applications, but rather lay the groundwork to promote the development of new applications that reach across postsecondary education stakeholder systems. Building these killer applications without infrastructure like *EdUnify* is cost prohibitive and, in fact, many applications won't even be conceived until the landscape of web service across higher education and other sectors is imaginable.

Here are ten examples, but there are many more. The applications envisioned help provide motivation for building the *EdUnify* infrastructure. Like the Web itself, the real killer applications will likely follow the infrastructure.

- Faculty Search for Expertise, Schedule, etc.
- Student Search for Enrollment Status
- Student Progress Traceback Search
- Teacher Traceback Search
- Look-up Program and Course Learning Outcomes and Comparability
- Government Agency Data and Information Collection
- Student Guidance and Advising Services
- Applications to Accelerate Learning, Research and Knowledge Gathering
- Applications for Mobile, Portable or Wearable Computer Devices
- New Media Applications (gaming, simulations, testing, online labs, etc.)

12. WHAT FUNDING IS NEEDED?

Currently, the Task Force is developing a Business Plan that will determine a sustainable charter and business model we believe will not impede adoption. PESC is seeking seed funding to augment a startup and development phase that will include marketing and promoting *EdUnify* to the PESC and SIFA communities and expanding beyond their footprint.

PESC has gathered sponsorships and partial funding to bootstrap the initial Task Force meetings. New funds will be sought to support the development, beta and production environment of *EdUnify*. PESC anticipates there will be funding for implementation of *EdUnify* through private/public partnership efforts involving governments, private foundations and members.

The return on investment for funding the *EdUnify* project is enormous. Imagine saving just a portion of the money spent ineffectively on integration and information services today which span thousands of organizations, as well as approximately halving the cost of transfer or student exchange costs impacting students, institutions and the government everywhere as they assess methods of credentialing and comparability.

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