The ADL Registry Client: Solving the Currency Issue of Content Reuse

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ABSTRACT

The Advanced Distributed Learning (ADL) Initiative and its Shareable Content Object Reference Model (SCORM) offer the education and training community tremendous potential for content object reuse and concomitant cost savings. Of equal importance is the potential for SCORM to allow for leveraging relevant expertise from multiple sources. Achieving this potential has been an evolutionary process as more content and learning management systems (LMS) become SCORM conformant. Implementing Department of Defense Instruction (DoDI) 1322.26 is the next step; as part of this instruction, DoD organizations will comply with SCORM, register content, and store content in repositories. The ADL Registry (ADL-R) allows users to search and discover information about reusable content, but it does not currently address the long-term sustainment of courseware. For example, if content is used by multiple sources, there must be a mechanism that alerts users to changes in that content to support long-term requirements. Without such notification and readily available updates, shared content may soon become outdated.

Since November 2005, the Distance Learning Division at the Joint Forces Staff College (JFSC) has taken an active role to solve these issues by developing the ADL Registry Client (ADL-RC) prototype application with support from the Joint ADL Co-Laboratory. The ADL-RC automates the long-term maintenance of learning objects within the SCORM environment. When a change to shared content is noted by the system, ADL Registry users running the ADL-RC are notified that the newer version of the learning content is available. Users are then given the option to download the new learning content. This tool ensures users can access the most current versions of the learning content they discover using the Registry.

This paper provides a baseline for organizations developing shareable, standardized, web-based learning content. It explains the ADL-RC and how it can provide the means to keep shared learning content both current and accurate.

ABOUT THE AUTHORS

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Dr. Kenneth Pisel is the Dean of the Joint Continuing and Distance Education School at JFSC. He led the development and implementation of the first SCORM-conformant Joint Professional Military Education curriculum within DoD and is actively engaged with the Joint Knowledge Development and Distribution Capability (JKDDC) in leveraging the power of SCORM across a range of initiatives. Dr. Pisel has done extensive research and writing on strategic planning for distance education and has presented at numerous distributed learning conferences.

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INTRODUCTION

A Shared Vision

The Shareable Content Object Reference Model, SCORM, results from collaborative efforts between government, industry and academia as a key part of the Advanced Distributed Learning (ADL) Initiative. According to the ADL website:

> *SCORM is a collection of standards and specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility and reusability of Web-based learning content* (ADL, 2006).

Besides presenting an overview of SCORM, the latest SCORM 2004 documentation defines a Web-based learning Content Aggregation Model (CAM), Run-time Environment (RTE), and Sequencing and Navigation (SN) guidelines. It explains how course components, data models and protocols interrelate to make content sharable across conformant systems (ADL, 2004).

Ideally, all newly developed Web-based learning content falling under the Department of Defense (DoD) umbrella should conform to the model's standards in efforts to realize the tremendous potential it offers.

Because SCORM content plays on all learning management systems (LMS) that conform to the model, it is now sharable among the Services even though they employ various content players. Before sharing SCORM content, components must determine what content exists and how to retrieve the requested content using the Advanced Distributed Learning Registry (ADL-R).

The ADL Registry is the DoD Global Learning and Performance Content Portal, found online at https://adlregistry.dtic.mil/. The ADL-R provides "the means and infrastructure to search, discover, and expose learning content" in an effort to realize savings and enhance education opportunities DoD-wide (DTIC, 2006). With the exception of content containing classified metadata, DoD components now can use this portal as their one central location to search for existing content.

With SCORM and the ADL Registry (ADL-R) available to all elements of DoD, they now have the means to freely share and reuse the best available learning objects. In order to promote this vision and prevent duplication of development efforts, the Department of Defense Instruction (DoDI) 1322.26 mandates requirements for defense components undergoing education and training endeavors. As part of the instruction, DoD organizations are directed to conduct a front-end analysis; conform with SCORM; search and submit content metadata using the ADL Registry; and store content in searchable, accessible, and registered repositories.

The Content Currency Issue

To date, the successes have been largely technical in nature. SCORM has specified how to develop and deploy content that can be shared. It further details how to tag content for future discovery. The steps that remain for SCORM to achieve its potential are more process oriented. What are the business rules for this process and what simple tools can support them? In establishing these rules, one can assume that the education and training community will have three broad options available when developing courseware. The front-end analysis will either identify a SCORM content package (collection of sharable content objects (SCO)) that is applicable for the new learning task without change, find a content package that is a partial solution (it requires some modifications and will result in new package or SCO), or find there is no existing content available to meet the task whereby new content will be created from scratch.

The ADL Registry allows users to search and discover information about reusable content, but it does not currently address changes to shared content necessary for the sustainment of content over the courses' lifecycles. If a content package is reused among organizations, how are users alerted to changes within the borrowed content? Without a mechanism in place

to push or pull change data, shared content may soon become outdated (see Figure 1).

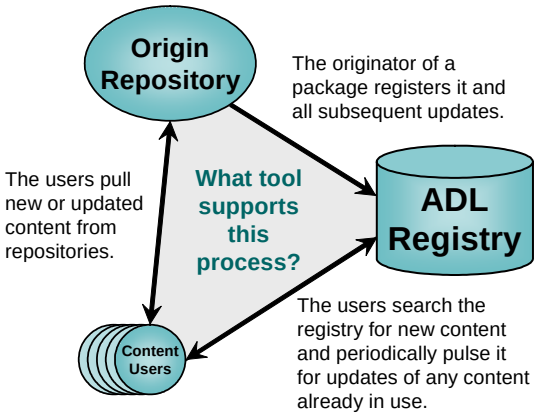

Figure 1. Content Reuse Issue

The ADL Registry Client – A "Joint" Solution

The Joint Forces Staff College (JFSC) Distance Learning Division (DLD), staffed by Northrop Grumman, is currently undergoing a research and development effort (funded by the Joint ADL Co-Lab) aimed at overcoming the content currency issue addressed. By the end of 2006, the DLD will produce a prototype of the ADL Registry Client (ADL-RC) application. This prototype will compare Registry data from JFSC's local repository to discover available content updates. This will be the single tool that automates the long-term maintenance of content packages within the SCORM environment.

In its final version, when a change to borrowed content is noted by the ADL-RC system, ADL Registry users running the ADL Registry Client are notified that a newer version of the content is available and are given the information necessary to download or retrieve the new learning content. This system will ensure that users know how to access the most current versions of the learning content they discover through the ADL Registry.

The ADL Registry Client will use cutting-edge, cross-platform technology that will make version control seamless and uncomplicated. Additionally, the ADL-RC source code will be open source and available for all to download, modify, and enhance. This approach allows for widespread usage across the Advanced Distributed Learning (ADL) community.

Motivating Factors and Players

The Joint Forces Staff College formed a collaborative partnership in 2002 when it awarded Northrop Grumman the task to design, develop, and maintain a distributed learning course to educate Reserve Component officers. This course was based on the Joint Professional Military Education (JPME) resident course at JFSC. It was the first JPME program developed in compliance with the SCORM. Since then, JFSC continues educating many of its student body remotely and striving to further the ADL vision.

The Distance Learning Division at JFSC works under college guidance to refine and develop tools and techniques to enhance reuse, building on the concept of SCORM. As part of their efforts, the team produced a prototype searchable repository and supporting applications. They also linked the college's data management system with the Blackboard LMS to automate enrollment changes and course updates. The ADL-RC prototype builds on these efforts.

The DLD works directly with the Joint ADL Co-Lab, the Alexandria ADL Co-Lab, and its subsidiaries to ensure its work is compatible with the ADL Registry and can therefore benefit the ADL community at large. This joint approach began early in 2005, shortly after ADL formed a Pilot Registry team of various stakeholders, which included the JFSC, ADL Co-Laboratories, Defense Technical Information Center (DTIC), Corporation for National Research Initiatives (CNRI), Carnegie Mellon University (CMU), and other military training and education outfits. During this pilot phase, multiple versions of the registry were tested prior to its public release. Based on its analysis, the JFSC team submitted two key requests to distinguish version changes; this included adding the capabilities to capture change description information and timestamps within submitted transaction files.

As part of the National Defense University (NDU) structure, JFSC naturally holds deep strategic ties with the Military Education Coordinating Committee (MECC) and its subcommittee, the Distance Learning Coordinating Committee (DLCC). Represented in these committees are the various schools educating today's warfighters. Schools producing distributed learning (distance learning) content convene for annual conferences and working group meetings to discuss and overcome comparable issues that affect military education missions.

In March 2006, the college hosted a DLCC conference focused on leveraging the power of SCORM for military education and training partners. As could be expected, SCORM and ADL matters were hot topics that generated mixed feelings among participants. Although some were skeptical as to whether content sharing will ever become a reality, the group displayed a general eagerness to pursue opportunities to reuse and repurpose existing content.

To advance the initiative and initiate the sharing process among military schools, JFSC leadership and its DLD team have taken steps to analyze and correlate its sharable content with other military courseware, tag and store SCORM content in a searchable repository, and submit content package metadata through the ADL Registry portal. Although the college has yet to reuse an existing content package as originally packaged, JFSC course developers have successfully repurposed sharable content objects (SCOs) in its courses to realize reduced development costs.

BACKGROUND

Before discussing the upcoming ADL Registry Client application in depth, this paper presents additional history on its supporting elements.

Department of Defense Instruction (DoDI) 1322.26: New Requirements for Military Learning Content

The purpose of Department of Defense Instruction (DoDI) 1322.26 is to implement policies, assign responsibilities, as well as prescribe new procedures and requirements for DoD Components that develop, manage and deliver distributed learning for DoD personnel. DoD policy lays the groundwork for this instruction; it promotes distributed learning as the primary means to meet training requirements, and encourages its components to share training resources by implementing standardized content across a joint architecture.

Leadership responsibilities are outlined for the key players. Particularly applicable is section 5.4.3, which states that the Heads of the DoD Components shall "Provide life-cycle management for distributed learning content" (OUSD P&R, 2006, p. 3). With leadership now responsible for keeping their ADL content current, a system to notify users of updated shared content should prove invaluable.

Of equal importance is section 6 of the DoDI 1322.26, which lists the procedures DoD Components must comply with; these include the following:

1) Complete a front-end analysis to identify audience(s), content, objectives, and delivery platform(s).
2) When LMS functionality (managing learning content and/or interactions) is necessary, the content and its delivery system(s) shall be SCORM-conformant.
3) For newly acquired or developed SCORM-conformant content packages, include metadata, register them in the ADL-R (except when containing classified metadata), and maintain them in searchable and accessible repositories (also registered in the ADL Registry).
4) Prior to new development or acquisition, search the ADL Registry to identify whether existing sharable content can be reused or repurposed.
5) Comply with and describe intellectual property rights in the registered metadata.
6) Do not pay royalties, recurring license/run-time fees, or similar payments for content developed for and by the DoD. Content, presentation/display software and licenses must be paid on an upfront royalty basis.
7) Legacy content (acquired or developed before the instruction was signed) does not have to be registered in the ADL-R or made SCORM conformant until the owner deems it "relevant, appropriate, and cost-effective" (OUSD P&R, 2006, p. 4).

Finally, the instruction also defines key terms, outlines specifics on the ADL Registry, instructs Repository Managers on registration requirements, and presents contractual/acquisition guidelines for distributed learning content and systems (OUSD P&R, 2006).

The ADL Registry (ADL-R): Registering/Searching SCORM Content and Repositories

The ADL Registry serves as a global, distributed learning and performance content portal for the Department of Defense. Figure 2 illustrates the publicly accessible ADL-R website home page, available at https://adlregistry.dtic.mil.

Figure 2. ADL Registry Portal Home Page

Note that the site serves several functions: users can perform basic and advanced searches for available content and explore retrieved metadata; register (submit) repositories and content; access supporting documentation, news, frequently asked questions, contact information, and training materials; and collaborate with colleagues in discussion forums.

As explained on the ADL Registry website

> *The ADL-R provides a framework for establishing a federation of content repositories known as the Content Object Repository Discovery and Registration / Resolution Architecture (CORDRA) to provide access to high quality educational resources, training performance aids, and pedagogies that may be shared and tailored to meet individual learner needs, and delivered cost-effectively at the right time and at the right place. The scope and vision of ADL-R is evolving.* (DTIC, 2006).

Although the site offers many benefits, key is its ability to quickly locate existing content thereby reducing duplication of effort, infrastructure and development costs (Kauchak, 2006).

ADL REGISTRY CLIENT (ADL-RC)

A Content Currency/Version Control Tool

The ADL Registry Client (ADL-RC) application will allow its users to easily monitor and track changes of

borrowed learning content that is formally registered online with the ADL Registry. The application will use cutting-edge, cross-platform technology that will make version control seamless and uncomplicated. This open source tool will promote sharing among Registry users that educate and train students to meet similar objectives.

The ADL Registry Client prototype that is set to be ready in fall 2006 is being designed to run initially on the Joint Forces Staff College (JFSC) server for its use only. The college's "Joint" student body (consisting of active and reserve officers representing all the Services) and blended education requirements increases the likelihood of utilizing objects across military institutions, and is, therefore, the ideal candidate to prototype this version control tool. Once complete, the ADL-RC will automatically email JFSC content developers when it recognizes registered updates to content used or repurposed elsewhere. The developers will then review the changes and update affected courseware at their discretion.

After rigorous testing at JFSC and within the JADL Co-Lab, the ADL Registry Client will be opened to the ADL community for all to download, modify, and enhance. Future versions of the ADL-RC, as developed in task six (See Table 1), will contain additional functionality as contracted.

Task Breakdown

The ADL Registry Client project is divided into six primary tasks. The first five tasks are funded and are expected to be complete during the winter of 2006 (approximately one year since the project's inception). Based on results of the prototype, task six may be executed to transform the working prototype into a customizable application. The task breakdown is depicted in Table 1.

Table 1. Task Summaries

Task	Title	Description
1	Research and Analysis	The key players met to initiate planning and establish communication. Afterwards, the development team began research to fully understand the interworkings of the ADL Registry and its supporting concepts and applications. As part of this task, the team provided management/staffing plans, progress reports, a milestone chart, and a System Requirements Document (SRD). The SRD captured the shared vision of the ADL-RC prototype and laid out expectations (or requirements) the application shall employ.
2	System Design	The ADL-RC team used the SRD as a baseline to create a detailed software design document of the prototype. Once approved, development commenced.
3	Prototype Development	The prototype is currently being programmed to run at JFSC according to the agreed-upon design documents. The developed prototype will: 1) parse through local metadata; 2) connect to ADL Registry and pull out data; 3) compare data; and, 4) create notifications client side.
4	Quality Assurance	Quality assurance (QA) measures include both creating and running test scripts to systematically assess the ADL-RC prototype application to make sure it functions between the ADL Registry and the JFSC repository. Errors and issues will be noted on test incident reports (TIR) and fixed/closed prior to prototype delivery.
5	Prototype Delivery	The team will demo the prototype at the Joint ADL Co-Lab and present JADL with a prototype technical report describing configuration and operations specifications, as well as any developed application code.
6	System Enhancements	If opted, the prototype will be expanded to the envisioned ADL-RC application and enhanced based on feedback from task 5. It will be open source and downloadable online to achieve widespread utilization throughout the ADL community.

A Closer Look

As previously explained, the ADL-RC application will compare versions of the client's implemented packages with the most current versions registered through the ADL Registry. When content metadata has been updated in the ADL Registry, clients using that content (whether as is, or as the basis for locally developed objects) will be alerted to the change and presented with information necessary to view and download the new object from the location specified in the ADL Registry. So how does this work?

The ADL-RC will run a data comparison process that reviews downloaded transaction data at the client site and data in the ADL Registry database. It will periodically execute the comparison on a set schedule (hourly, daily, etc.) set by the user. The ADL-RC will set up the Windows Task Scheduler.

A local copy of the XML transaction file will be compared to corresponding data in the ADL Registry. This XML transaction file will consist of fields such as timestamp, description, version number, location, etc. to look up and compare with the ADL Registry database.

When a content package is registered in the ADL Registry, it will be given a unique ID. This ID will be the primary key for lookup in the database. When the ADL-RC detects differences in the local transaction file and ADL Registry database, a notification is created and sent to the user. Notifications will also be viewable from a log file. Figure 3 illustrates the proposed design flow for this process.

The ADL-RC will be developed in the Java programming language allowing it to work on several different platforms such as Windows, Apple, Solaris, HP-UX, etc.

The ADL Registry Client process does not require a high-end server to run the comparison and notification process. A standard desktop personal computer with Internet access can be set up to act as the ADL-RC server at the client side.

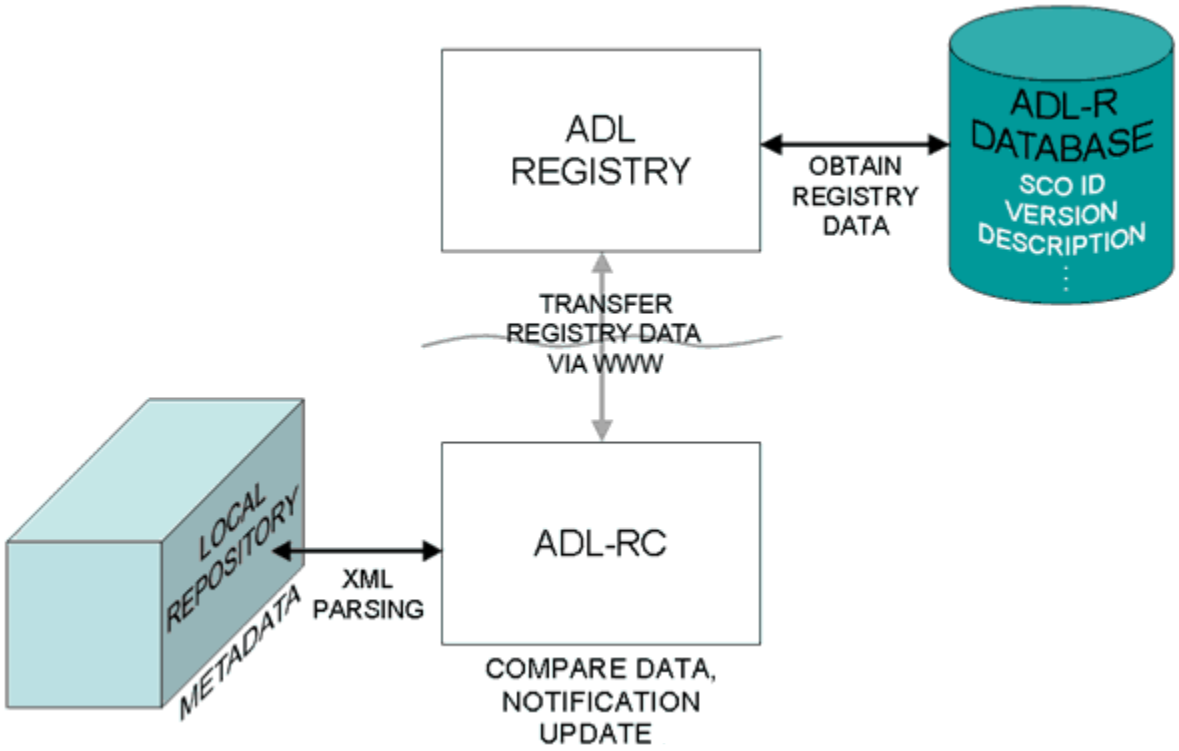

Figure 3. Information Design Flow

Design Considerations

Some basic considerations that impacted the application's design included: system requirements, design methodology and pattern, and network restrictions or security risks.

The ADL-RC will need to be installed on a personal computer or server running Windows with the Java Runtime Environment (JRE) 1.5.0_06 installed. The machine will also need access to the ADL Registry through an Internet connection and access to the local repository.

The ADL-RC will use object-oriented methodology to promote reusability and maintainability. This methodology allows the application to be more reliable, robust, and extensible. The design pattern for the ADL-RC application is the model-view-controller; this pattern offers a unique benefit by separating the presentation code (GUI) from the business logic code (application logic), and from the data access code (Value Objects).

Network restrictions may exist when the ADL-RC acts to send email notifications. Most email is sent through port 25; unfortunately due to massive spamming in recent years, many firewalls are configured to block mass emails to port 25. This could potentially hamper attempts by the application to email change notifications. Users may bypass email restrictions by going through their local network administrators or checking ADL-RC log file(s) manually. Results of the application "run" will be written and saved to a log file that resides on the local machine. The log will contain data such as when the comparison occurred and what content changes (if any) were discovered. Additionally, any errors or problems executing the application will be written to the log file.

Design Architecture

The ADL-RC application will consist of three main packages – the Installation Utility, Configuration Change Utility, and Core Utility. They will each import a common package of components (classes) used by one or more of the utilities to prevent duplicate coding.

The ADL-RC Installation Utility will run from an executable Java™ Archive (JAR) file in order to guide users through the ADL-RC installation process. It is an InstallShield®-type program designed to step users through the various configuration options and set up the Windows Task Scheduler. This utility will consist of four components - Directory Information, Task Scheduler, Install Desktop, and Write File. The Directory Information component will store information about the installation directory and the original content package directory. The Task Scheduler component will set up the Task Scheduler to run at intervals set by the user, such as the time of day, day of week, and number of times the application is to run. The Install Desktop component's sole purpose is to install the application. The Write File component is called from the Install Desktop component. This component will write the properties file that will be used by the ADL-RC Configuration Change Utility.

The ADL-RC Configuration Change Utility will allow users to modify properties set during the installation. It will be accessible through Windows main menus (Start → Programs → ADL Registry Client). This utility will contain four components; they are Read File, Directory Information, Task Scheduler, and Write File. The Read File component will view values in the properties file that is stored by the ADL-RC Installation Utility. The Directory Information and Task Scheduler components will hold the values read in from the properties file. When a user selects to change a value, the value will be changed in the Directory Information or Task Scheduler components. When the user has completed all operations, the ADL-RC Configuration Change Utility will write a new properties file.

The ADL-RC Core Utility will perform the key operations; it will connect to the ADL Registry, compare data for shared content packages, determine if updates exist, and produce email notifications when newer content packages are discovered. The Core Utility automatically runs based on user selections within in the task scheduler component. It will also have an option to run manually in a Windows environment through a typical menu selection process (Start → Programs → ADL Registry Client). The current design consists of five components – Read File, Directory Information, Communicate with the Registry, Compare Dates, and Send Notification. The Read File component will read the properties file and transaction XML file. The information from these files will be stored in objects to be used by the application. The Directory Information component will contain the directory path for the original content package. The Communicate with the Registry component will set up the connection with the ADL Registry; this connection is necessary to obtain the comparison

data. The Compare Dates component will compare version data stored within the Registry with data stored locally. The Send Notification component will send an email notification when the Registry content is more up to date than the user's content.

POTENTIAL CONTRIBUTION

The ADL-RC provides organizations the means to keep shared learning content both current and accurate. Implementing the ADL-RC will offer the ADL community a much needed version control tool designed to maintain currency across shared content objects. There will be a "push and pull" system in place that does not exist in the current CORDRA architecture: ADL-RC will push out change notifications to its registered users when shared objects are updated through the ADL Registry; users will then have the option to pull data from the appropriate repository to obtain content objects.

Integration of the ADL Registry Client into the ADL community will be almost effortless. There are no modifications needed to existing SCORM packages. No expensive hardware is required to run the application and no additional software needs to be purchased. All of the information required by the ADL-RC is available from the existing metadata submitted to the ADL Registry. Additionally, the ADL Registry will supply the packages with unique identifiers and the required transaction files are all the ADL-RC needs to carry out its processes.

The ADL Registry Client source code will be open source and available for everyone to download, modify, and enhance. This approach offers several key benefits. Custom tailoring would allow the ADL-RC to work with a specific client's software architecture; and finally, new features and functionality may be added to enhance application performance.

SUMMARY

Although DoD organizations have traditionally resisted sharing content, they now have the means and motivation to begin as new technologies and tools emerge.

With the signing of DoDI 1322.26 "Development, Management, and Delivery of Distributed Learning," DoD organizations are expected to utilize SCORM and register conformant courseware and repositories through the ADL Registry portal. These new requirements promote sharing within DoD of standardized learning content in order to reap the economic benefits brought by using content that is accessible, adaptable, affordable, durable, interoperable, and reusable.

With simple Google-like searches of the ADL Registry, users can discover appropriate content that may be used as is, or repurposed (customized to fit a new audience) – either way, costs incurred are reduced considerably when compared to creating content from scratch. Since the current ADL Registry system principally supports the front-end effort of searching and discovering information about reusable content, there is a greater issue of how to manage shared courseware through its lifecycle to notify users of updates.

The Joint Forces Staff College, Joint ADL Co-Lab, and Northrop Grumman teams have partnered to design and develop the ADL Registry Client, a content maintenance solution for the ADL community. The upcoming ADL-RC application will periodically query the ADL Registry to determine when borrowed content drawn from other repositories has changed. As changes are noted by the system, users are notified and provided data to retrieve the new learning content.

This initiative addresses the automation of ADL Registry searches designed to pinpoint content object updates and ensure currency among DoD-shared content packages. The research addresses interoperability issues and solutions across platforms, applications, and programming languages. The effort requires careful analysis to determine how to expand the current ADL Registry system to verify that metadata supports version control efforts and how to overcome complications due to repurposed learning content.

FUTURE WORK

Once the ADL Registry Client prototype is complete and running at the Joint Forces Staff College, the development team intends to revolutionize the prototype into the envisioned ADL-RC application that can be downloaded online to achieve widespread distribution. Based on beta tests and feedback generated by the working prototype, the ADL-RC development team anticipates adding additional system enhancements to better serve the ADL community at large.

ACKNOWLEDGEMENTS

Established under the ADL Initiative as the Co-Laboratory responsible for support to the DoD ADL community, the Joint ADL Co-Lab, located in Orlando, FL, funds an annual Prototype Program to further the state-of-the-art and to collect, analyze and report on lessons learned in the acquisition and implementation of ADL within DoD. The ADL-RC is an example of a Research and Development prototype that, when fielded, will result in tremendous savings to DoD ADL content developers.

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