

## **Education and Training Technology Requirements for DoD Distributed Learning**

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### **ABSTRACT**

The Department of Defense faces a growing challenge to meet the breadth, depth, and tempo of its expanding education and training needs. While budgets are shrinking, the complexity of missions is increasing and demands on personnel are growing. Learning technologies can help address this, but the research and acquisition communities must make informed decisions about which technologies to pursue. Various military offices publish guidance on this question. For instance, some Defense agencies publish “Science and Technology Objectives,” including direction on next-generation learning requirements and associated technologies. However, these publications generally lack linkages to one another—particularly those authored by different Services—which leads to duplications of effort and missed opportunities for coordination. Further, because these publications typically derive from high-level strategy guidance (i.e., “top-down” direction), they may inadvertently omit some lower-echelon needs (i.e., “bottom-up” inputs). To address these gaps, the Advanced Distributed Learning (ADL) Initiative executed an interagency requirements campaign to collate existing publications, crosswalk Defense agency needs, and search for yet-undiscovered requirements associated with training, education, and related performance support. As part of this effort, we also conducted interviews with widespread stakeholders across the Department. The results are being assembled into a data visualization, which viewers will be able to access via a government website. Although our Requirements Campaign is still underway, this paper describes our requirements engineering process as well as initial results from it. In particular, we highlight the “top ten” requirements in terms of frequency and apparent priority (for the stakeholders), and we discuss opportunities for developing or acquiring new learning technologies to address the priority objectives.

### **ABOUT THE AUTHOR**

**Andy Johnson** has been working professionally in distributed learning technology for the last 15 years. He was a developer as the Sharable Content Object Reference Model (SCORM) emerged and was involved in every version of SCORM. He has been working at the Advanced Distributed Learning (ADL) Initiative, a research and development unit overseen by the Office of the Under Secretary of Defense for Personnel and Readiness (OUSD(P&R)), for a majority of his career, and is currently serving as the Experience API (xAPI) lead. He has designed competency-based content architectures supporting SCORM and xAPI for various government projects, most notably Joint Knowledge Online courses and a series of Pharmacy Technician Training courses designed for the Services by the Veterans Administration. Andy received both his Bachelor’s degree in Computer Science and Master’s degree in Education, Communication and Technology from the University of Wisconsin-Madison.

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### BACKGROUND

Two important trends define today's U.S. Department of Defense (DoD) landscape—shrinking budgets and growing threats. Looking at compiled data from the President's budget, the sequestration (which was put in place to force down spending) continues to impact DoD's ability to perform (U.S. Government Spending, 2016). According to the White House, the sequestration and associated budget cuts “jeopardize our military readiness and eviscerate job-creating investments in education and energy and medical research, and don't take into account whether they eliminate some bloated program that has outlived its usefulness, or cut a vital service that Americans depend on every single day” (White House, 2016). Similarly, from the foreword in the *National Military Strategy 2015* from the Chairman of the Joint Chiefs of Staff paints a powerful picture of the challenges DoD faces today:

Today's global security environment is the most unpredictable I have seen in 40 years of service. Since the last National Military Strategy was published in 2011, global disorder has significantly increased while some of our comparative military advantage has begun to erode. We now face multiple, simultaneous security challenges from traditional state actors and transregional networks of sub-state groups—all taking advantage of rapid technological change. Future conflicts will come more rapidly, last longer, and take place on a much more technically challenging battlefield. They will have increasing implications to the U.S. homeland (Joint Chiefs of Staff, 2015).

While budgets are shrinking, the breadths and complexity of missions are increasing. It logically follows that personnel engaging and providing support in these missions must have correspondingly broader, more sophisticated, and more agile sets of knowledge, skills, and attitudes (Schatz, Fautua, Stodd, and Reitz, 2015). Learning technologies can help address this need, but the research and acquisition communities must make informed decisions about which training and education technologies to acquire, particularly given the increasingly constrained fiscal environment.

Various military offices publish guidance on next-generation learning requirements and associated technologies. However, these publications generally lack linkages to one another—particularly those authored by different Services—which leads to duplications of effort and missed opportunities for coordination. Further, because these publications typically derive from high-level strategy guidance (i.e., “top-down” direction), they may inadvertently omit some lower-echelon needs (i.e., “bottom-up” inputs).

To help address these issues, we are conducting a requirements campaign to identify the status quo of distributed learning technologies across the DoD and related Federal security agencies, and to pinpoint shared areas of need across these stakeholders. The following sections outline the origin of the requirements campaign and then discuss the process by which requirements were gathered—strategies around contacts, questions, requirement data, and refinement of that data. Next, the findings of the initial data collection are discussed, including the top ten requirements and possible ways-ahead for each. Finally, we outline future plans for the campaign and associated reporting of the complete results.

### REQUIREMENTS CAMPAIGN

## Purpose

The Advanced Distributed Learning (ADL) Initiative was established to explore how Federal training programs, initiatives, and policies can better support flexible, lifelong learning through the use of technology (Executive Order 13111, President Clinton, January 12, 1999). To that end, ADL conducts research and development to provide learning science, specifications, guidance and best practices, and technology applications to the DoD, Federal agencies, and coalition military partners.

In August 2015, under guidance from the newest ADL director, the ADL team implemented five new guiding principles for the program: Do fewer things better, craft the vision, curate knowledge, serve our customers, and be data driven. Two of these principles, *serve our customers* and *be data driven*, served as catalysts for establishing the ADL Requirements Campaign. This human-centric requirements engineering process is envisioned as a multiyear, iterative exploration of interagency stakeholder requirements related to distributed learning, broadly defined. Its intent is to identify shared areas of need, to uncover unique solutions that could be expanded from smaller-scale centers of excellence, and to help coordinate collective investments.

Several factors point for the need to explore DoD distributed learning stakeholder requirements, such as the continued effects of sequestration (and thus increased emphasis on enhancing training and education efficiency and affordability), evolution of DoD distributed learning strategy, renewed emphasis on quantifying the human-aspects of readiness, and the update of DoD Instruction 1322.26 (Distributed Learning). In addition to these specific motivations, good design principles, in general, encourage human-centric requirements collection. For instance, DoD policy requires that programs embrace a Human-Systems Integration approach, which includes human-centric design methods such as systematic requirements management (Department of Defense 1991, 2007, 2015), and empirical research demonstrates that poor requirements engineering process are among the leading causes of system failure. That is, projects most frequently fail because “(1) an inadequate understanding of the intended users and the context of use, and (2) vague usability requirements, such as ‘the system must be intuitive to use’” (Pew, Mavor, et al., 2007, p. 191).

## Method

This year, 2016, marks the first year of the ADL Requirements Campaign. Initially, ADL focused on collecting DoD (ADL’s primary customer) requirements related to distributed learning, broadly defined. Even within this scope, determining the coverage of the requirements campaign was difficult because of the varying sizes, structures, levels of influence, levels of security, and knowledge of distributed learning across DoD stakeholders. We considered mapping of all of the DoD offices, but quickly determined this resulted in a “box-checking exercise” rather than a strategy-focused approach. Instead, a “web of influence” strategy was chosen. That is, ADL began by collecting requirements from organizations immediately associated with the Defense Advanced Distributed Learning Advisory Committee (DADLAC) and used contacts gained during interviews with those stakeholders to expand the web.

Since 2007, the DADLAC has served as an advisory group to foster information exchange, resource sharing, and collaboration across the DoD. The DADLAC includes the ADL director as well as the distributed learning leads from the Joint Staff J7, Army Training and Doctrine Command, Marine Corps Training and Education Command, Naval Education and Training Command, Air Force Air Education and Training Command, and DoD Chief Learning Officer, along with other invited DoD or Federal distributed learning decision-makers from organizations such as the Office of Personnel Management and Defense Language and National Security Education Office.

Two different methodologies were used to collect inputs. First, participants completed person-to-person interviews, responding to scripted questions about requirements (see Table 1). Second, participants were asked to identify releasable publications that documented relevant requirements, such as published white papers detailing service-level science and technology objectives. The intention of this second step was to aggregate and “cross-walk” existing needs, rationales, and objectives from across other related requirements efforts.

**Table 1. Requirements Campaign Interview Questions**

*Respondents were provided with these questions prior to the interview. Questions were used to guide the discussion.*

- What types of online learning technology does your organization use? Which provide the most problems?
- What is your biggest concern with Systems (Learning, HR, etc.)? Mobile? Peripherals?
- Does your organization use an ultra-customized version of a Learning Management System?  
...If so, which one? (for smaller organizations, do their sub-components use the larger organization's system?)
- What (if any) distributed learning technology issues hinder your organization's ability to develop, deliver, or improve learning experiences?
- Do you feel like your organization's decision-makers are well-informed of new educational technologies?  
...What could be done to improve that (either way)?
- On a scale of 1 to 10, how well does your organization support Cloud-based technologies?
- How does an administrator gain access to student records to compare them or do checking on the content itself?
- What are some areas you think the ADL Initiative can help your organization with?

*The following questions were asked for each area, as described by the last question.*

- On a 1-5 scale (5 being highest), how big of a "win" if completed; how big of a "loss" if not completed?
- Do you have any specific guidance, publications, or links to resources that document this area?
- What is the impact on organizational readiness if you meet this requirement?

### Encoding Requirements Data

We initially used a simplified Volere-like template to determine the data fields for representing gathered requirements (Volere, 2016). The rationale was to begin with a broadly accepted template and then modify it based on our needs analysis as well as early perceptions by and data from respondents. Table 2 shows the data fields.

**Table 2. Final Requirements Data Fields**

Name	Description
Requirement Number	An index for the requirement
Requirement Type	Chosen from a vocabulary of defined types
Description	The entire requirement in text
Originator Point of Contact (POC)	The individual that stated the requirement.
Originator Organization	The POC's organization (which they were speaking on behalf of)
Supporting Materials	Link to the survey or other documentation
History	If this requirement evolved, a link to the previous version
Conflicts	Requirement numbers of any direct conflicts
Use Case	Link to documentation of use cases this requirement fits
Rationale	Answers: "Why is this under consideration of ADL as a requirement?"
Fit Criterion	The unit of measurement to determine if this requirement were satisfied
Customer Satisfaction	1-5 scale (5 = highest), importance of fulfillment of this requirement
Customer Dissatisfaction	1-5 scale (5 = most damaging), negative efforts of not fulfilled
Priority	1-5 scale (5 = highest), level of importance
ADL Efforts	Short description of how ADL could help meet the requirement

After initial feedback on the interviews, both explicitly collected and implied by some of the questions to answers, some modifications were made to the data encoding scheme. First, we decided that “ADL Efforts” would be useful to document, in particular if a specific suggestion was made by respondents. Next, it was inferred by the lack of commonality of responses that “Customer Satisfaction,” “Customer Dissatisfaction,” and “Priority” were not providing worthwhile data for a number of reasons. First, answering these items required a real-time breakdown of what the requirement was within the framework of the interview, whereas this detailed technical breakdown was better handled through analysis after the interview. Second, respondents are unlikely to discuss unimportant requirements, and are relatively unlikely to prioritize their own requirements below those from other organizations. Thus, we decided that the ADL team would coordinate internally (along with other DoD collaborators) to determine a prioritized list post hoc.

**Collecting Data**

Data collection began in May 2016 and are continuing. This paper represents the first cluster of data. In this first campaign iteration, data were collected through a series of 21 telephone-based interviews, including a total of 38 people from 16 different organizations. The table below shows a list of the general agencies who have participated to date; the list does not include specific office names in order to somewhat anonymize responses and allow participants to speak frankly. Most interviews included at least two ADL staff members, who collaboratively recorded the interview responses on a synchronous (Google) document. Respondents received the questions in advance, and the questions were used as guideposts for semi-structured interviews.

**Table 3. Participating Organizations to Date**

<ul style="list-style-type: none"> <li>• Joint Force Development (J7)</li> <li>• Joint Forces Staff College</li> <li>• Army Training and Doctrine Command</li> <li>• Army Combined Arms Center</li> <li>• Army Research Lab</li> <li>• USMC College of Distance Education and Training</li> <li>• Marine Corps Systems Command</li> <li>• Naval Education and Training Command</li> </ul>	<ul style="list-style-type: none"> <li>• Naval Seas Systems Command</li> <li>• Naval Postgraduate School</li> <li>• Naval Surface Warfare Center</li> <li>• Air Education and Training Command</li> <li>• Air Force School of Aerospace Medicine</li> <li>• Air University</li> <li>• Department of Homeland Security</li> <li>• Office of Personnel and Management</li> </ul>
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**Data Sensitivity**

When collecting data, it is important to be sensitivity of any personally identifiable information (PII). The safest way of protecting PII is to not gather it when it is not needed. For this reason, minimal PII was collected and recorded—even internally. A second level of sensitivity was also used. Once data were encoded from an interview transcript into the data fields, references to any particular organization or Service were generally scrubbed. There were some high-level exceptions, such as “Service A is working with Service B on a full capability integration,” but exceptions were kept only when the named attributions were common knowledge. These types of attributions were uncommon.

**Translating the Data**

Once an interview was transcribed and the transcript verified through peer review (a process for determining quality and accuracy), the transcript was encoded into discrete requirements. For this approach, qualitative data analysis was used in a methodology similar to what Miles and Huberman (1984) recommend. Quite often, induction was used, which involved identifying “important categories in the data, as well as patterns and relationships, through a process of discovery” (p. 322). It was also important that this process had an emic focus, meaning the participants and their viewpoints were the setting to be represented, as opposed to relying on terms brought to the study. Even though our requirements template used named data fields (based upon Volere, as mentioned above), the content type, amount of

information, and vocabulary were driven, bottom-up, by the data. In effect, the data were used to “train” the resulting content categories. In this way, the requirements’ fields could be rigid but were not completely inflexible.

## RESULTS

The interviews yielded a great deal of information, more than what was originally expected, and on average, each interview uncovered more than 12 requirements. Participants greatly appreciated the open-endedness of the questions and the conversations around them, and generally, the open-ended interviews were easily translated into more discrete granular requirements.

After translating the interviews into requirements, we first looked for results in conflict with one another, but the Volere data field “Conflict” remained empty for every requirement. While we implemented mechanisms to catch and prioritize any requirements at odds with each other, it is a testimony to DoD’s ability to think jointly and collaboratively that no such conflicts arose from this initial data set. Next, we checked the individual requirements for commonalities and aggregated the results into 39 distinct requirement categories. The individual requirements lost some of their specificity when combined but could be more easily articulated and applied globally when merged in this way. Further, one of our data fields maintains a pointer to the granular requirements, so the low-level requirement records remain linked to their rolled-up aggregates.

For the purposes of this paper, another cycle of aggregation was performed, which focused on identifying a “Top 10” listing of aggregated requirements. These ten requirements represent a significant portion of the findings of the campaign to date. In each section below, the collected requirements are spelled out in detail, as well as some of the actions that ADL and the DoD Community can take to begin to meet the requirements. *These requirements are not sorted by rank, but the ten listed are the most common and highest priority based on collected data to date.*

### **Requirement: Enable Enhanced Performance Tracking and Associated Analysis**

Videos, simulations, games, and other “browser-less” content types often provide insufficient performance data to instructors, evaluators, and organizations. Survey respondents report a need to extract more extensive learning performance data from a broad range of technology-based learning interventions and to conduct associated analyses that help better determine the capabilities of learners.

Currently, collecting and extracting data from browser-less learning interventions (i.e., learning conducted outside of standard e-learning systems) is frequently done by hand. For instance, instructors and proctors spend valuable hours observing participants in simulated exercises, often times simply monitoring for obvious mistakes that an automated system could record. An even more common issue is that many learning technologies cannot report data out of the given technology or application, nor can they export rich performance data into learners’ formal records. Correspondingly, instructors find themselves less able to provide meaningful feedback. Organizationally, this also limits the ability for learning professionals to monitor the quality of learning interventions in aggregate; for example, if a given test question is misleading or lacks diagnostic ability that would be good to know, or if students all tend to skip specific parts of a video, that might be useful to understand.

*Possible Way Forward:* The Experience Application Programming Interface (xAPI) specification may help address this issue. Generically, an Application Programming Interface is a set of programming instructions and standards that allow network-enabled applications to “talk” (pass data) to each other without any user intervention. xAPI lets applications share data about performance (broadly defined), letting systems capture (potentially big) data on human performance, along with associated instructional content or performance context information (i.e., *experiences*). This enables nearly dynamic tracking of activities from any platform or software system—from traditional learning management systems to mobile devices, simulations, wearables, physical beacons, and so on (Advanced Distributed Learning, 2015). Many commercial vendors and government institutions are already using xAPI and to encourage its widespread uptake, the draft revision to DoD Instruction 1322.26 (Distributed Learning) recommends its use throughout the Department (Defense Technical Information Center, 2006; the 2016 update to DoDI 1322.26 is

currently under formal review). Although xAPI does not fully address the entire “learning analytics” requirement, together with the supporting DoDI policy, it represents a solid first step.

**Requirement: Enable Competency-Based Education and Training**

Most DoD organizations have a requirement to move toward a competency-based environment. To say an educational or training program is *competency-based* means that learners acquire credentials for demonstrating their knowledge, skills, and abilities (KSAs); similarly, tasks and professions within competency-based systems are mapped and defined via their required KSAs. *Competencies*, for this effort, are defined broadly, ranging from abstract high-level concepts, such as being proficient in leadership or critical thinking, down to the low-level tasks, such as tying one’s shoes. Competencies are useful in a multitude of ways. First, they can identify job skills and prerequisites for future opportunities, which can help identify, determine readiness, place, and otherwise manage talent. Competencies can supply rich context to be used in performance and assessment data, and they provide a “common currency” to help translate human performance information across specialized systems and through Service Members’ careers.

Within DoD, several needs related to competencies exist. For example, at the most basic level, work developing and validating competency models is needed. Systems are needed to help translate training, education, or other performance data into meaningful competencies, to translate across different competency frameworks, and to help maintain the concurrency of KSAs included in those competency frameworks. Many questions also surround team competencies; for instance, a prevalent need is determining whether a team shows readiness. If managed effectively, competencies could enable a view into what each member of a team brings to that team, thus supplying a great deal of context to evaluate team performance.

*Possible Way Forward:* A single DoD competency model was not mentioned as a requirement, but many respondents requested the ability to translate competency models across components. DoD organizations should work together to ensure competency-based programs don’t become stovepipes.

**Requirement: Mature Research Technologies to More Usable States**

Research and development takes concepts, to prototypes, and eventually to products. However, too often the research prototypes fail to mature into robust, fieldable systems. A multitude of our survey requirements can be summarized into a simple request of “give me something I can use.” The most common use case offered by respondents goes roughly like this: A Senior Leader is shown a technology that seems ready for acquisition, and she requests it be implemented as soon as possible. The organization then tries to operationalize the technology, only to find it is won’t work in their environment, for example, because of security issues, budget constraints, time required, poor usability, buggy software, or the involved contractual language wasn’t specific enough.

Requiring that authoring tools, content delivery systems and learning and training content adhere to standards is the recommendation of many respondents. Having implementation details in the standard saves time and holds contractors more accountable. It is critical that Senior Leaders obtain more information from research organizations and rely on prototypes developed specifically for the intended environment.

*Possible Way Forward:* Involving Senior Leaders by providing them information and prototypes that showcase current operational capabilities is key to getting organizational buy-in. Advancing xAPI to a standard is extremely important to increase adoption from tools, other Communities, and other organizations that influence DL.

**Requirement: Mitigate Cybersecurity Restrictions to an Acceptable Level**

DoD must agree on policies and procedures that balance the possibility of innovation with the very real threats of cyberattacks that are present in today’s world. Respondents recognize the importance of cybersecurity (formerly known as Information Assurance (IA)), but many of the cybersecurity restrictions slow or even stop DoD innovators from advancing distributed learning capabilities. Burdensome cybersecurity policies make acquisition cycles longer,

restrict many mobile or cloud capabilities, and make it difficult for deliverables built by contractors to be tested in their final operational environments. Many organizations claim to be “trapped” with the Defense Information Systems Agency (DISA) and the allowances they provide. DISA is responsible for supporting the IT needs of the entire DoD, including moving to a Net-centric environment, eliminating bandwidth constraints, and defending DoD infrastructure. In addition to DISA, the Services have their own cybersecurity personnel to enforce policy.

*Possible Way Forward:* Creating a Working Group to harmonize the efforts of those on the DL/innovation side with organizational level cybersecurity experts and DISA would be a great start. The Office of Personnel and Management (OPM) is stepping up efforts to alleviate the Services and the rest of Government of managing cybersecurity efforts at the proponent level by leveraging their own cybersecurity expertise.

**Requirement: Improve the Quality and Accessibility of Learning Content**

Content delivered to DoD learners should be of high quality and available anytime, anyplace. While there is a great deal of outdated and uninspiring content throughout the DoD, there is a strong desire to improve upon it. There is a great concern that (significant) learning gains may not be achieved with the modules that currently exist. In most DoD learning environments, content is not able to react to a learner’s past achievements or proficiencies to even do simple remediation or allow a learner to test-out of a topic they have mastered. Content is often seen as a “checkbox” on the way to a promotion – in other words, DoD DL is not a culture that rewards long-term retention.

Learning and training managers want to do more. They want to develop training with higher interactivity and engagement - wargaming, team-training, etc. They want contracted developers to be accountable in terms of learning gains, not just delivery, of content. They want to support individuality of learners and the organizations they represent. Enabling these requirements means a chance at higher quality and higher retention rates.

The other side of the coin is to increase the availability of content. There is a great deal of content that is FOUO (For Official Use Only), and by current restrictions, cannot be located in an unsecured environment. Only a small percentage of this content has any substance that requires the FOUO classification. However, there is no easy process to “declassify” content and the benefits of getting the content to a mobile platform or other unclassified content areas are far outweighed by the cost of doing so. This problem is perpetuated by content development practices that design to FOUO as a default. Respondents report that this process has become so indoctrinated that very few developers have knowledge or resources to leverage to determine whether content should be FOUO classified or not.

*Possible Way Forward:* To improve upon the status quo, it will take a strong, concerted effort from all of DoD. A significant cultural shift from “the way we always do things” needs to occur. This shift could start with access to data. Tracked data leads to analysis, analysis leads to justification of change, and hopefully the justification is enough to execute. DoD must be willing to change to make this happen.

**Requirement: Increase Effectiveness of HTML5**

DoD, in its adoption of HTML5, needs to improve development best practices, remain abreast of technology updates, and continuously improve on responsive design. HTML5, when used conceptually, is a conglomerate of web technologies used, among other things, for the development of web-based content. DoD content development is strongly trending in the direction of HTML5. This migration is to maintain compatibility with current Internet Browser technology, in particular for use on mobile devices.

DoD respondents identified a number of challenges to this movement which create challenging requirements. First, the sheer number of Internet Browsers and their significant number of versions, each with minor differences in HTML5 implementations and features, are costing DoD significant development resources. Publishing content to mobile devices is seen as too expensive. When moved to secure networks like the NIPRNet, some features of HTML5 are disabled by cybersecurity restrictions, which introduce another layer of complexity. While HTML5 was seen as a way to increase interoperability, DoD Stakeholders are already needing to find workarounds, including

supporting only certain Internet Browser and version combinations. DoD requires guidance and consistency as they work through these challenges; organizations that are having success need to share best practices.

Another thrust in the HTML5 migration is because of the deprecation of Adobe Flash™ (Flash). Apple™ doesn't support Flash and Google™ will be blocking it by 2017 (BBC, 2016). This lack of support, particularly in mobile environments (where Flash™ was never supported), breaks a great deal of the interactive Web-based content DoD has developed. Cost-savings measures are required to aid the conversion of this content to HTML5, both in cases where the source files are available and where they are not.

*Possible Way Forward:* The best approach for DoD is to share information wherever possible. There is a need to test and evaluate tools, improve awareness of new technologies that could see a niche role based on Flash™ deprecation and HTML compatibility, identify best practices, and open lines of communication. Reporting on successes and failures will save a substantial amount of collective resources.

### **Requirement: Liberate Learning and Training Data**

The results of learning and training data, which remain trapped in large enterprise systems, needs to be freed to enable advanced metrics, feedback loops, and to save time and money. While every DoD organization is able to track data, many have the need to extract the scores and completions out of the primary Learning Management System (LMS) to share it with other systems, such as those for Human Resources or other record keeping databases. Unfortunately, these systems are “stovepiped”, meaning that the data in each system can only be accessed by that system. Most DoD organizations face this problem at some level, and often times have to resort to manual data entry as a means around this obstacle, wasting valuable manpower. The need for automation is paramount. To add to the problem, the learning data that is tracked can only be run in canned reports offered by the provided LMS. In some cases, this is sufficient, but parts of DoD still find themselves without a learning dashboard capability. DoD instructors and designers require access to this data to increase the quality of learning content through feedback loops and other mechanisms.

*Possible Way Forward:* It was this primary use case for which the xAPI was developed in 2013 - getting access to data by a means other than loading that specific content as that specific user. Using xAPI in a specific case like tracking a learner with scores and completions requires some data interoperability. For that reason, cmi5 (not an acronym), a profile of xAPI, was developed by the AICC (Aviation Industry Computer-Based Training Committee) and ADL (Advanced Distributed Learning, 2014). The cmi5 specification allows the benefits of xAPI, but applies enough structure to enable interoperability in tracking sessions, scores, completions, and pass/fail determinations.

### **Requirement: Create a Collaborative Learning and Training Environment**

DoD, despite the hurdles it faces to remain secure in cyberspace, must foster an environment of collaboration to meet its learning and training needs. Collaborating across DoD organizations is important, but collaboration within in an organization is vital to its success. DoD organizations have requirements to use collaborative tools, but are having great difficulty realizing these requirements. Sending collaborative products through FedRAMP (GSA, 2016) is an exhaustive task for vendors, which means there are far fewer choices for DoD than for those in most commercial environments. Cybersecurity was cited most often as the reason for lack of collaborative tools in learning and training environments.

DoD learning and training leaders, including those interviewed, have great vision of future DL capabilities which involve innovations like notifications across devices, just-in-time training, and task lists based on job role, to name a few. They want to implement these things with a Service-based approach, such that their environment is not so restrictive.

*Possible Way Forward:* While the need for cybersecurity won't and shouldn't go away, DoD organizations can lean on OPM staff to be their proxy in the cybersecurity processes or provide information on how to be more successful. ADL's future plans for DL include an entire set of Web Service specifications known as the Total Learning

Architecture (TLA) (Advanced Distributed Learning, 2016). The TLA includes the xAPI as a component, but also includes competencies, learner profiles, and learning content and its delivery.

### **Requirement: Reduce Hurdles Encountered in Acquisition**

Barriers impacting the acquisition of learning content, tools, technologies, and licenses must be reduced or eliminated if DoD is to improve or even maintain currency in a dynamic world. Technology is versioning more rapidly than ever (Meyerweb, 2015). Java updates seem to be disseminated weekly. Browser updates are so frequent that many configurations don't even require user acceptance to execute. This is the environment all Internet users live in. The level of complexity added to the DoD with budget cycles, sequestration, and the aforementioned cybersecurity concerns is astronomical.

DL program leaders require more licenses in some systems and fewer in others, but are impacted by a) inability to procure a flexible license and b) timing acquisition around yearly cycles. These cycles can be so long that a new capability is needed before the previous one arrives. In addition, there are many instances where yearly fees are growing tremendously, especially in cases where COTS (Commercial off the Shelf) products are being used. With mandatory cost reductions from sequestration, there is a substantial need for cost savings wherever possible.

*Possible Way Forward:* OPM is actively working to save time and money across DoD acquisitions. OPM can do purchasing independent of the budget cycles of the Services and other DoD organizations. They can negotiate flexible prices for all of government. This can be done without changing the infrastructure or culture of the organization they are working with. OPM is already in the process of acquiring a DoD-wide LRS to allow advanced tracking with xAPI.

### **Requirement: Collaborate to Enable Best Practices**

DoD must work together to enable best practices through working groups, shared information, events, and reviews. None of the requirements already listed will reach their potential if DoD doesn't work collaborate to define and follow best practices. Use of strategies, tools, and code templates should be something that is shared across the DoD. With a clear necessity from the previous requirements to move towards xAPI or a similar technology solution, it must be realized that such an effort cannot be done in vacuum. In the case of xAPI, strong agreement of the terminology and data properties to use is necessary for interoperability. DoD respondents aware of xAPI expressed the need for aid and collaboration in adoption.

With less time and money to create new content, efficiency through collaboration is the key to sustainability. Instructional designers and subject matter experts shouldn't have to be programmers-their authoring environments should give them this affordance. Additionally, visualizations enable rapid feedback and evaluation capabilities, which puts power in the hands of content developers rather than having them rely on manually-entered datasheets.

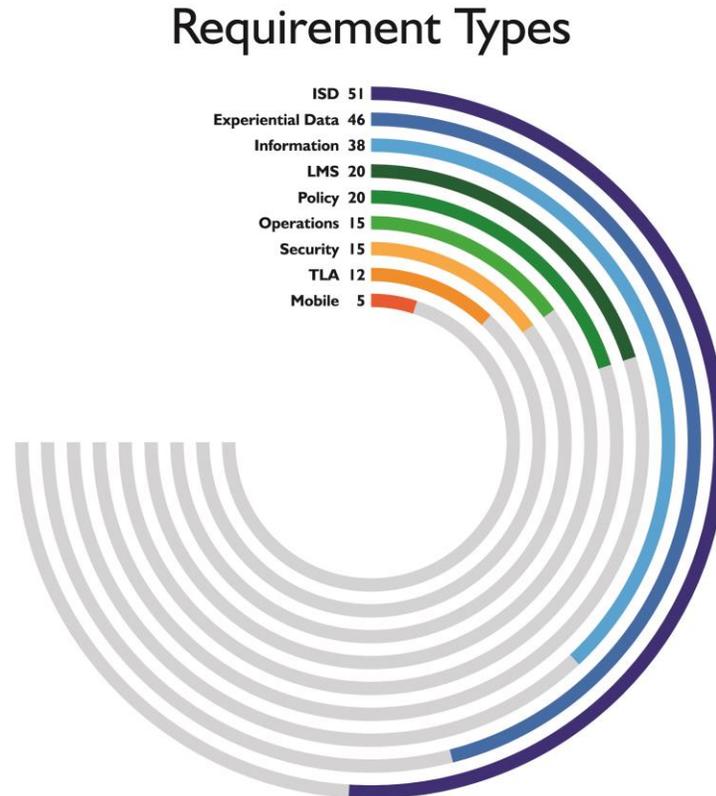
*Possible Way Forward:* As many of the respondents specifically asked for ADL support in knowledge of future technology, ADL should provide more support in terms of workshops, webinars, and distribution of news. DoD Communities of Practice are needed in many of the requirements mentioned above to establish vocabularies and rules for wargaming, simulation, team-based data, competency models, and more. Finally, DoD should share information about their experiences with products, good and bad, to avoid duplication of mistakes.

## **NEXT STEPS**

With a critical mass of requirements gathered from interviews, ADL will inform DoD and solidify existing requirements. There isn't a reason to stop gathering data, so more contacts will be sought to engage in discussions. Collaborative capabilities will be leveraged to increase the fidelity of data, create visualizations, and decrease barriers to sharing requirements.

## **Visualizations**

The data acquired in this campaign can be used to create informative graphical visualizations of those data. An example can be seen in Figure 1.



**Figure 1. ADL Requirements Campaign “Requirement Types”**

While the above graphic is intended to be a demonstration of the capability, it does contain data about the early requirements data used to create it. The “Requirement Types” refers to the primary “type” of each requirement as classified by a controlled vocabulary. “ISD” as a type is quite broad – encompassing the instructional methodologies as well as barriers to producing quality content. “Information” refers to means of collaboration and communication, either internally, with the rest of DoD, or with ADL. “Mobile” is a bit low because many organizations a) felt other barriers, such as cybersecurity policy, prevented mobile from being a requirement or b) that mobile was a benefit of designing responsively with HTML5, which would be done for all content. This vocabulary and tagging of data is subject to change as more data is collected and refinements are made.

At the time of this paper submission, we were beginning to develop a web-based tool for extracting the requirements information and displaying it in simple tables. Resources permitting, it will be ready for the accompanying presentation to this paper.

### Reports

As a follow-up to the initial collection of requirements, we plan to develop a more detailed technical report of the

overall findings to validate these findings across DoD. In addition, ADL will be giving all DoD organizations and requirements campaign respondents a chance to discover new requirements discovered by fellow-DoD members as well as a chance to “tag” them for value within their own organization. For example, if fifteen out of sixteen of the DoD organizations surveyed found “Mobile video performance support” as a requirement, it is worth asking the 16th organization if it is indeed important to that organization, even if it was not determined in conversations, to ensure that requirements are “joint”. By using this process, even requirements that may have a single point of generation, but are high-value, could be expanded to all of DoD.

The eventual goal is to realize a complete data set of requirements in which all system-level technical requirements build up (through a number of layers) to organizational and even DoD-wide requirements. It will take much more effort to determine when a significant enough portion of each type of requirement has been collected, and even then, it will continue to be a moving target which will need a flexible capability to support it. ADL will continue to build to this capability with more interviews and research.

### **Expanded Web Capability and Crowdsourcing**

In the future, we hope to support on-the-fly creation and real-time updates to the data visualizations of the requirements. This is considered a valuable next-step to be able to allow stakeholders to see up-to-date information about our collected requirements and projects. A web presence also adds to the longevity of the project, as it will hopefully influence other DoD organizations, and as the scope is expanded, other government agencies, our partners, academia, and industry to communicate with ADL to best inform their direction.

While the interview process was very effective at gathering an initial set of requirements, it is not feasible to rely on a cycle of interviews to maintain requirements. Another benefit of a web capability is the ability to expand information contributions directly to our stakeholders. When an organization has a new or changing requirement, a representative could simply log-on to our portal and update the requirement themselves. This capability would also enable organizations to reveal which requirements they contributed to, if they desired. Ultimately, this could lead to an open environment and ADL wouldn’t need to facilitate requirements among DoD and other stakeholders. Exposing data would allow other tools to be built that leveraged the data and provide utility that may not otherwise exist.

### **CONCLUSION**

The results of the requirements campaign so far are extremely positive. Throughout the process, we focused the on capturing the human element in addition to technical requirements because ubiquity is necessary to enable personnel to be knowledgeable, agile, and flexible enough to engage in 21<sup>st</sup> century conflicts. The top ten requirements show that DoD organizations are all invested in a shared vision of a learning ecosystem, they only vary in degrees of implementation. By sharing information and breaking down barriers, all of DoD can attain optimal functionality. We must continue to evolve our methodologies and technologies around tracking a learner’s experiences and their competencies in a way that is meaningful to them and involves social collaboration. Through joint efforts of information sharing and advanced prototyping of what is possible, we can operationalize our shared vision.

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