

# ADL Enterprise Learner Record Repository Prototype Final Report

22 October 2021

This work was supported by the U.S. Advanced Distributed Learning (ADL) Initiative (24361820D0001). The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the ADL Initiative or the U.S. Government. The U.S. Government is authorized to reproduce and distribute reprints for Government purposes.



## Distribution Statement A

Approved for public release: distribution unlimited.

<b>REPORT DOCUMENTATION PAGE</b>					<i>Form Approved</i> <i>OMB No. 0704-0188</i>	
The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.						
<b>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</b>						
<b>1. REPORT DATE (DD-MM-YYYY)</b> 09-20-2021		<b>2. REPORT TYPE</b> Document		<b>3. DATES COVERED (From - To)</b> 09/21/2020- 09/20/2021		
<b>4. TITLE AND SUBTITLE</b> Enterprise Learner Record Repository Prototype Report				<b>5a. CONTRACT NUMBER</b> FA701420STS10		
				<b>5b. GRANT NUMBER</b> N/A		
				<b>5c. PROGRAM ELEMENT NUMBER</b> 0603769D8Z		
<b>6. AUTHOR(S)</b> Flamer, Eric Adusei-Poku,Adjoa				<b>5d. PROJECT NUMBER</b> N/A		
				<b>5e. TASK NUMBER</b> N/A		
				<b>5f. WORK UNIT NUMBER</b> N/A		
<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b> Deloitte Consulting LLP 1919 North Lynn Street Arlington, VA 22209				<b>8. PERFORMING ORGANIZATION REPORT NUMBER</b> N/A		
<b>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b> Defense Support Services Center Advanced Distributed Learning Initiative 13501 Ingenuity Drive, Suite 248 Orlando, Florida 32826				<b>10. SPONSOR/MONITOR'S ACRONYM(S)</b> OUSD/P&R/DSSC/ADLI		
				<b>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</b>		
<b>12. DISTRIBUTION/AVAILABILITY STATEMENT</b> Distribution A						
<b>13. SUPPLEMENTARY NOTES</b>						
<b>14. ABSTRACT</b> The Enterprise Learner Record Repository (ELRR) Prototype report details the project design and development activities associated with building the prototype ELRR capability. The ELRR capability is designed to be a a repository composed of local learner profiles that contain data from a various set of records, and can be used to follow a service member or DoD civilian throughout their career to optimize their career development. Specifically, this report details lessons learned, best practices, standard operating procedures, and potential future directions.						
<b>15. SUBJECT TERMS</b> Course Catalogs, Database Design, Enterprise						
<b>16. SECURITY CLASSIFICATION OF:</b>			<b>17. LIMITATION OF ABSTRACT</b>  UU	<b>18. NUMBER OF PAGES</b>  44	<b>19a. NAME OF RESPONSIBLE PERSON</b> Joe Camacho	
a. REPORT  U	b. ABSTRACT  U	c. THIS PAGE  U			<b>19b. TELEPHONE NUMBER (Include area code)</b> 757-572-6206	

**Final Report in Support of:**

**Advanced Distributed Learning**

**Enterprise Learner Record Repository Development**

DISTRIBUTION A. Approved for public release: distribution unlimited.

## Document Control Information

<b>Document Name</b>	Final Report
<b>Client</b>	Advanced Distributed Learning Initiative
<b>Task Order Name</b>	Enterprise Leaner Record Repository Prototype Development
<b>Document Owner</b>	<b>Eric Flamer, Adjoa Adusei-Poku (Deloitte Consulting LLP)</b>
<b>Document Version</b>	1.1
<b>Document Status</b>	Baseline

## Document Edit History

<b>Version</b>	<b>Date</b>	<b>Additions/Modifications</b>	<b>Prepared/Revised by</b>
1.0	8/23/2021	Baseline submitted to ADL Initiative	Deloitte Consulting LLP
1.1	9/20/2021	Update including outcomes from ELRR Prototype test and evaluation activities	Deloitte Consulting LLP

## Distribution of Final Document

The following people are designated recipients of the final version of this document:

<b>Name</b>	<b>Organization/Title</b>
Dr. Sae Schatz	Contracting Officer Representative
Ashley Howell	Government Technical Point of Contact
Brent Smith	Government Technical Lead
Dawn Riddle	Government Testing Lead

## Table of Contents

<b>1.0 Introduction</b>	4
1.1 Problem Statement	4
1.2 Proposed Solution	4
<b>2.0 Prototype Approach</b>	7
2.1 Technical Work Planning	7
2.2 Design Approach	9
2.2.1 <i>Business Use Case Discovery and Refinement</i>	9
2.2.2 <i>Data Modeling</i>	10
2.2.3 <i>UX/UI Approach</i>	11
2.2.4 <i>Solution Workflow Design</i>	14
2.3 Development Activities	16
2.3.1 <i>The Learner Persona: Developing an Enterprise Transcript</i>	16
2.3.2 <i>The Manager Personas: Envisioning a Snapshot into Unit Learning &amp; Development</i>	19
2.3.3 <i>A Machine Persona: The Learner API</i>	21
2.4 Deployment of Prototype	22
2.4.1 <i>The Administrator Persona: Monitoring Initial Deployment</i>	22
2.4.2 <i>Solution DevSecOps</i>	23
2.4.3 <i>Prototype Deployment and Integration with TLA</i>	25
2.4.4 <i>Prototype Testing and Evaluation</i>	25
<b>3.0 Next Steps</b>	29
3.1 Prototype Lesson Learned: Refining the Business Use Case for DoD Stakeholders	29
3.2 Prototype Lesson Learned: Incorporating Security and Privacy into Design/Development	29
3.3 Prototype Lesson Learned: Planning for Initial Implementation and Resulting Federation	30
3.4 Coordination, Maturation, and Scale	31
<b>Appendix A: Updated RTVM for ELRR Prototype Deployment to TLA Sandbox</b>	33

## 1.0 Introduction

In July 2018, the Department of Defense (DoD) Chief Management Officer (CMO) and the Reform Management Group formally initiated the Enterprise Digital Learning Modernization (EDLM) reform initiative. The goal of the EDLM initiative is to build an enterprise-wide integrated digital learning environment that enables efficient acquisition and spending management for DoD education and training products and services. The Enterprise Learner Record Repository (ELRR) is one of the three major EDLM lines of effort supported by the Advanced Distributed Learning (ADL) Initiative.

Based on the xAPI standard, adjudicated performance records are routinely collected in a Learner Record Store (LRS), the system with specific data storage and retrieval capabilities for xAPI statements. These statements typically exist to capture the first and primary control loop for abstracting and organizing learner records throughout the continuum of learning, capturing the learner activity. Assertions may also include other information such as physical/psychological/behavioral attributes, personal preferences, and competencies not associated with a credential. Assertion of competence – the progress made based on the mapping of the learning event towards a defined credential – is based on the combination of individual learner records, the environment in which the learning activity occurred, and represents the second control loop. Multiple credentials together form competency-based assertions in relation to a learner's job, duty, gig, or assignment.

Taken together across multiple jobs, duties, gigs, or assignments in a learner's lifecycle of work and training performance (e.g., Control Loop 3), the sum total of learning activities, learning credentials, and the current job form the basis of a career trajectory (e.g., Control Loop 4). These elements may or may not include a separate career trajectory (e.g., Control Loop 5) should a learner entertain or embark on a new career trajectory unrelated to the expected one described above. The data exchanges across this control loop hierarchy form the abstract basis of an "evidentiary chain" critical to the reference implementation of ELRR.

### 1.1 Problem Statement

Siloed systems, coupled with a lack of raw learner data at the enterprise level, lead to a loss of awareness into learning technology configurations and configuration changes. This then results in an inability to observe variances in learning outcomes at scale across the enterprise, and difficulties adapting learning experiences to specific learner needs. These issues happen within large organizations as well as across separate organizations. Currently there are many different repositories across organizational systems that store valuable learner data insights; the intent is to provide interoperable access to all of them to unlock these data for improved reporting and analytics.

Learner records are scattered across internal and external organizational systems, and the underlying data about these learner records and learning experiences varies greatly. Without a method or system for aggregating these disjointed enterprise data points, learners and learning and development managers have an incomplete view of a learner's enterprise development portfolio at any given point in time. The reduction of time accessing aggregated learner information from disparate training and information systems provides potential for cost savings.

### 1.2 Proposed Solution

An ELRR capability benefits the DoD by connecting repositories with detailed learner performance data and making data available to various command, learning system, or activity across the DoD to support adaptive instruction, improved decision making, and analytical insights into learners and the systems

In addition to this persistent reconciliation of credential, job, and career information that “rolls up” at the enterprise level based on individual learner activity records, an ELRR solution would maintain an evidentiary chain to reconcile and manage the individual local learner profiles that, taken together, contribute to the view of an enterprise learner record. This is important given the sizable amounts of learners will have or maintain a local learner profile associated with one or more assignments taking place across organizational boundaries and across edge systems. In the management of federated learner identities, one challenge has been that not all systems store user information the same way. Learners may also use different local account names for different purposes. There is no guarantee these accounts, or systems know about each other, so a federated approach to Identity Management is required to resolve this issue. Taken together, the identity and credentialing evidentiary chains follow the pattern from local learning record systems to the ELRR, as demonstrated in Figure 1 below.

The diagram illustrates the ELRR Data Fabric architecture, showing the flow of data from external sources through a central fabric to various data stores and dashboards.

**External Sources and Ingestion:**

- 8** **ELRR Enterprise Web Portal**: A user icon points to this portal, which feeds into the **Enterprise Data Usage Aggregation** component.
- 2** **Enterprise Learner Profile**: A separate data source that also feeds into the **Enterprise Data Usage Aggregation** component.
- 7** **Enterprise Data Usage Aggregation**: A central component that aggregates data from the web portal and learner profiles, feeding into the **Authoritative LRS (Evidence)** component.

**Central Fabric and Data Stores:**

- 1** **Authoritative LRS (Evidence)**: The central component of the fabric, which stores and manages evidence. It is connected to **Org. Learner Profiles** and **Dashboards**.
- 3** **Linked Data Database**: A component that feeds into the **Authoritative LRS (Evidence)** component.
- 4** **Competency Registry** and **Credential Registry**: These registries feed into the **Linked Data Database**.
- 5** **Schema.mil**: A component that feeds into the **Linked Data Database** and is connected to the **USALEARNING Enterprise Course Catalog**.
- 6** **Authoritative Data Source for Identity (FICAM)**: A component that feeds into the **Authoritative LRS (Evidence)** component.

**Data Flow and Output:**

- The **Authoritative LRS (Evidence)** component feeds into **Org. Learner Profiles** and **Dashboards**.
- The **Org. Learner Profiles** component feeds into **Transactional LRS** components.
- The **Transactional LRS** components feed into various **Output Devices** (represented by icons for a smartphone, a group of people, a presentation screen, and a document with a magnifying glass).

5

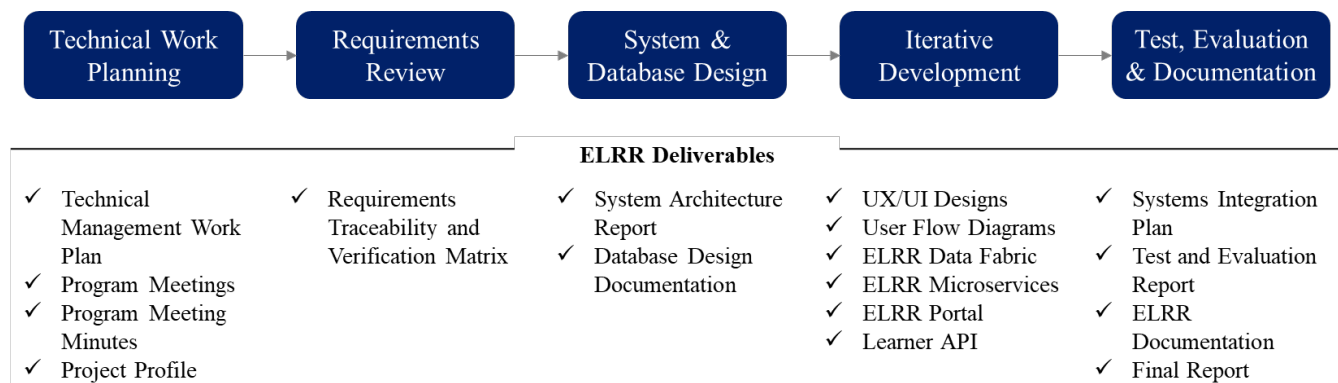
*such mapping may include information related to learning experiences, supported by the TLA ECC component. 6. Such a mapping may include information related to identity and employment status, supported by a DoD identity, credential, and access management component. 7. The authoritative records, extracted from various sources, demonstrate an evidentiary chain through the use of the above data services loosely coupled with a data fabric. The new enterprise records are aggregated in the ELRR solution, supported by an API to search the aggregated record repository. 8. A web portal provides role-based access to information about the aggregated, enterprise learner records to assist learners and managers in reviewing status of current competence.*



## 2.0 Prototype Approach

The stated end goals of the ELRR Prototype efforts were to develop a solution component that demonstrates a minimum viable product (MVP) to: 1) integrate into the ADL Initiative's Total Learning Architecture (TLA) DevSecOps sandbox environment; 2) connect to three different DoD Learning Record Providers (LRPs) to capture various learner record use cases, evidentiary chains, and credentialing/competency frameworks; and, 3) use the ADL Initiative's DATASIM project to stream simulated learner data across the ELRR data fabric. To accomplish these stated objectives, the ADL Initiative provided the Deloitte project and technical leadership with a standard project management approach to Prototype development activities, one that is deliverable-based, appropriately paced, and matches the standard software engineering support task order, represented in Figure 2.

**Figure 2: ELRR Prototype Technical Approach**



Deloitte applied its Enterprise Value Delivery (EVD) methodology for Agile software development projects to the ELRR Prototype project management approach. The EVD methodology consists of three project phases (Discovery, Sprint Cycle and Release) that represent the progression of key groupings of activities within the project life cycle starting from the project vision until the product is successfully launched, matching to Figure 3.

**Figure 3: Deloitte's Three-Phased Agile Methodology Aligning to the ELRR Prototype Technical Approach**



The Deloitte development team adopted Agile practices in planning and delivering the software engineering work, but admittedly did not fully realize the Agile values related to frequent releases and ongoing customer usability testing. This was driven by ongoing ramping up of the newly developed ELRR code pipeline and associated target of a single deployment to non-production environment towards the end of the project timeline. The team mixed elements of the dominant Agile approach with traditional waterfall methods, specifically planning for a single, final release after requirements validation, solution design/development, and a single, planned set of formal testing events culminating in solution deployment in the non-production environment.

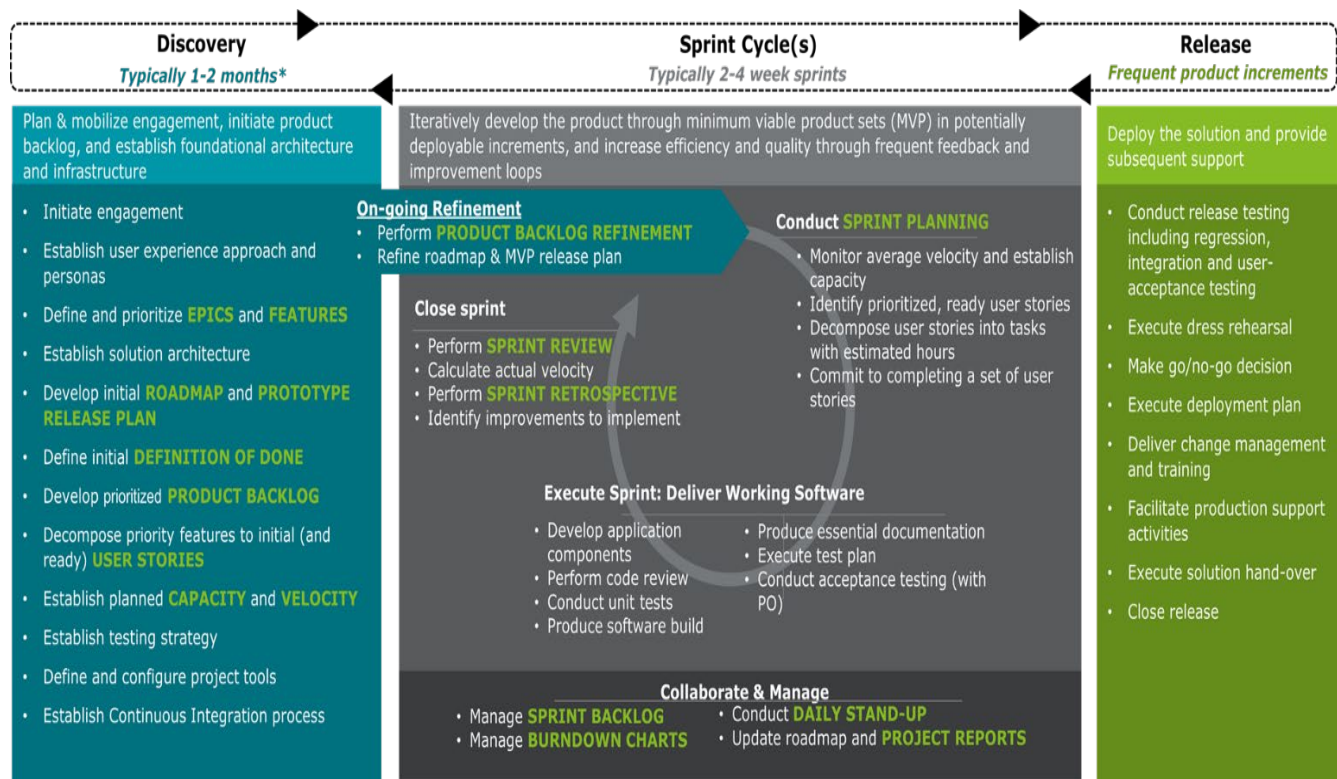
### 2.1 Technical Work Planning

The Deloitte team's first project activity related to organizing the project. We worked with ADL Initiative project leadership to plan for development milestones and progress, engage with project stakeholders (IPT and DSR), and communicate progress to these project stakeholders on an ongoing

basis. Initial work planning consisted of defining a reporting and development cadence, establishing a project schedule for use across the project schedule, establishing norms related to change requests, and providing a summary overview on the project management approach selected by the Deloitte team for the ELRR Prototype's development. This also included the initial submission of a project profile summarizing the problem statement, expected benefits, and proposed scope of the ELRR Prototype development effort.

Deloitte's EVD for Agile methodology provided ADL Initiative project leadership and IPT members with project phases, activities, and tasks WBS structure, integrated into our project planning and status reporting activities. Phases are a stage within project life cycle containing defined tasks to be completed. Each phase included key categories of activities designed to guide, organize, and enable superior execution throughout the project life cycle. Deloitte's EVD methodology provides a repeatable, verifiable WBS library for each activity package, allowing the Deloitte project manager to quickly adapt and deliver an IMS for use in tracking and reporting project progress linked to deliverable-based milestones. The work planning activities related to the EVD for Agile methodology are presented in the figure below.

**Figure 4: Deloitte's EVD for Agile Activity-Level Work Breakdown Structure**



The project IMS served as the basis for project reporting across bi-weekly and monthly intervals, resulting in a structured, predictable cadence whereby the project manager reported on progress linked to the initial technical management work plan, the status of deliverables, and identified risks and issues. One mechanism for escalating risks and issues built into the Air Force Strategic Transformation Services (AFSTS) contract vehicle used for the ELRR Prototype was the Problem Notification Report (PNR). The PNR served as a direct escalation method for highlighting a key risk or issue area from the perspective of the contractor, providing the opportunity to respond to an element of scope, integration,

of stakeholder management. Deloitte used the PNR method once during the project to escalate a key issue related to scope; Deloitte and the ADL Initiative were in agreement as to using the PNR to initiate a contract modification. After our Discovery activities related to requirements review, the team confirmed with the ADL Initiative that the enterprise learner profile was not originally intended as the contractor's responsibility, as written in the PWS. Deloitte collaborated with the ADL Initiative and the AFSTS contracts office to propose a solution for adding project scope, resolving associated funding modification, and successfully closing the roadblock within a bi-weekly reporting cycle. Taken together, the Deloitte and ADL project managers had strong, fluid working dialogue to maintain the technical management work plan while remaining flexible to changes in solution requirements that are natural in the solution discovery process and resulting iterative development cycles.

## **2.2 Design Approach**

After the first of month of project work planning and ramp up, Deloitte began designing the ELRR Prototype to adhere to ADL's recommended enterprise architecture principles and best practices, including the use of human-centered design, focus on solution extensibility, and promotion data interoperability.

### ***2.2.1 Business Use Case Discovery and Refinement***

In alignment with the project management approach defined in the technical management work plan, the Deloitte team started with solution discovery to establish a user experience approach, develop solution personas, and review potential epics and features. The team also prioritized decomposing the ELRR requirements matrix provided by the ADL Initiative as part of the Prototype scope, as many of the initial stated requirements required elaboration and further decomposition.

The team received current state briefings from each of three ELRR Prototype IPT members (NETC's MyNavyLearning team, Air Education Training Command, and the Army Training Information System). Based on these three sessions, the team assessed that the three IPT members were in different stages in the authoritative learning record development lifecycle. The MyNavyLearning team presented on capabilities that were the most mature with regards to the TLA's solution architecture: the team had successfully implemented xAPI, had a verifiable LRS used to track conformant learner records, and had a DevSecOps approach with corresponding CI/CD pipeline matching the Deloitte's planned solution and development approaches. The MyNavyLearning solution intends to provide a means for delivering adaptive training content to sailors in shipboard environments, so the planned ELRR Prototype Learner API component could be of impactful to the Navy's effort to demonstrate the extensibility of the adaptive learning business rules.

The AETC and ATIS teams did not offer similar alignments to TLA architecture and solution components in their respective demos. AETC presented non-functional prototypes, or wireframes, of a future state solution, highlighting a stakeholder-validated UX/UI approach to building Air Force learner record dashboards. Despite not having a verifiable source for xAPI learner records to contribute to ELRR Prototype development effort, AETC's lessons learned from its UX/UI cycle were nonetheless valuable to the Deloitte team as they influenced the team's own UX/UI approach. The ATIS team spoke to broad TLA solution component alignment and plans for solution development in its presentation, but did not offer any direct information on the status of the current authoritative learner record efforts.

As the Deloitte team engaged with IPT members, a common set of questions arose regarding the expected use and associated value of an ELRR capability. As the intended ELRR solution relies on organizationally-authoritative records to establish an enterprise-authority, IPT members had difficulty

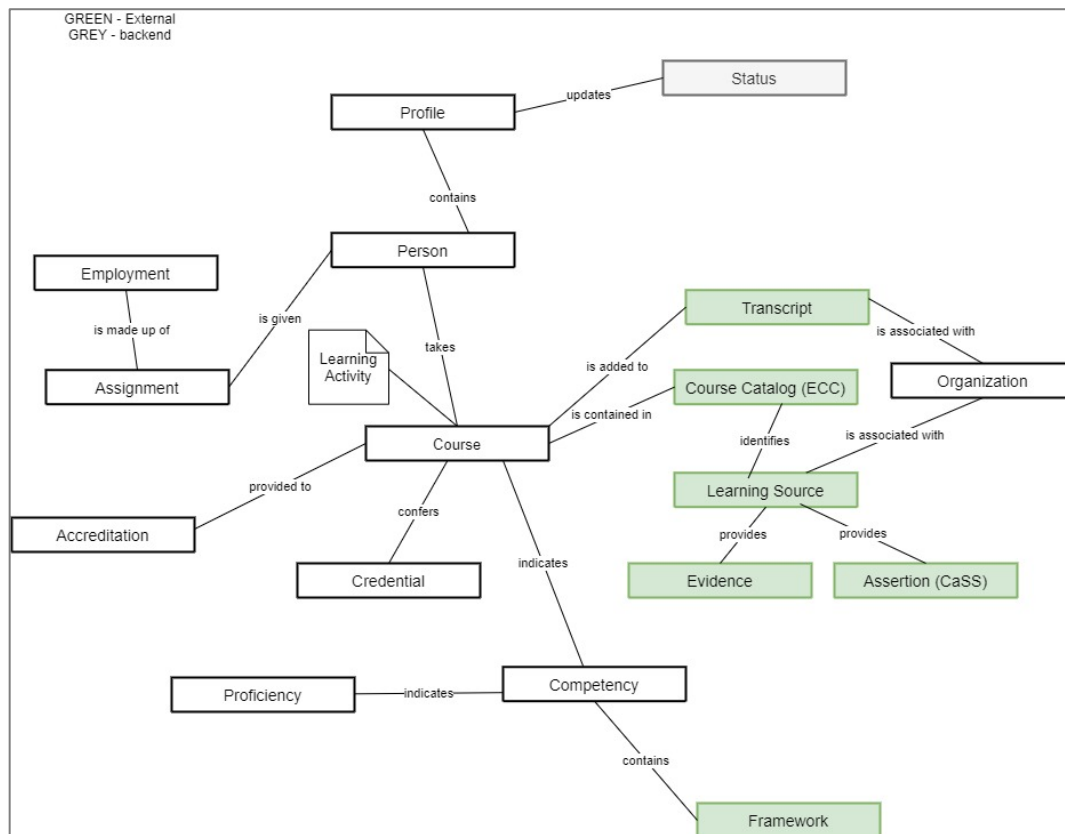
understanding how an ELRR capability would add value to their organizations. Additionally, they quickly voiced concern about the source of the authoritative record: would the ADL Initiative manage the truly authoritative record? If this were the case, how would the solution synchronize between federated learner record sources to maintain an accurate set of learner records? Accounting for this bi-directional data flow would add significant solution complexity and potentially impact the ability to develop the Prototype solution.

## 2.2.2 Data Modeling

Information for the ELRR capability is expected to come from multiple, external sources and will be combined within the system to generate a learner record. As a result, the definition of the underlying data model, data attributes, relationships between these systems and attributes, and corresponding required data services was an absolutely critical step in the solution design process. These elements taken together, when paired with the solution application services, represent the ELRR's Data Fabric component.

As part of the data architecture efforts, the Deloitte team attended the ongoing IEEE Draft 1484.2 Enterprise Learning Records (ELR) study group. The current learner profile standards do not meet all of the TLA requirements, and the ADL Initiative is a steward to drafting new standards; the Draft ELR standard is in the process of development and modification based on input from numerous industry groups. Updates made to the underlying ELR data model would need to be tracked and implemented as part of the ELRR Prototype data and solution architectures.

**Figure 5: ELRR Prototype Conceptual Data Model**



Aligned to best practice enterprise architecture methods, Deloitte solution architects developed the logical and physical data models providing progressively detailed entities, attributes and relationships defined. Key functional requirements such as the minimum set of data elements to support a learner record, the roles involved, the auditing, the monitoring and record update requirements also influenced the data architecture. The ELRR conceptual data model (DIV-1) shows the data concepts that will be addressed by the MVP as well as how those concepts relate to each other. The conceptual data model in Figure 5 above is based on the Draft ELR data attributes. Further information on the conceptual, logical, and physical data models is made available in the [ELRR Prototype Database Design Documentation](#).

As noted in the above conceptual data model, a 'Person' will have a 'Profile', which indicates some level of personal, employment, and learning information. The 'Profile' has an associated 'Status' to show system-related characteristics such as date of last update, active/inactive, and potentially the associated ELRR role. When the 'Person' receives a 'Competency' by completing a 'Course', the profile will be updated to reflect this change. These entities and relationships form the basis for the initial enterprise learner profile that Deloitte developed as part of the Prototype development effort.

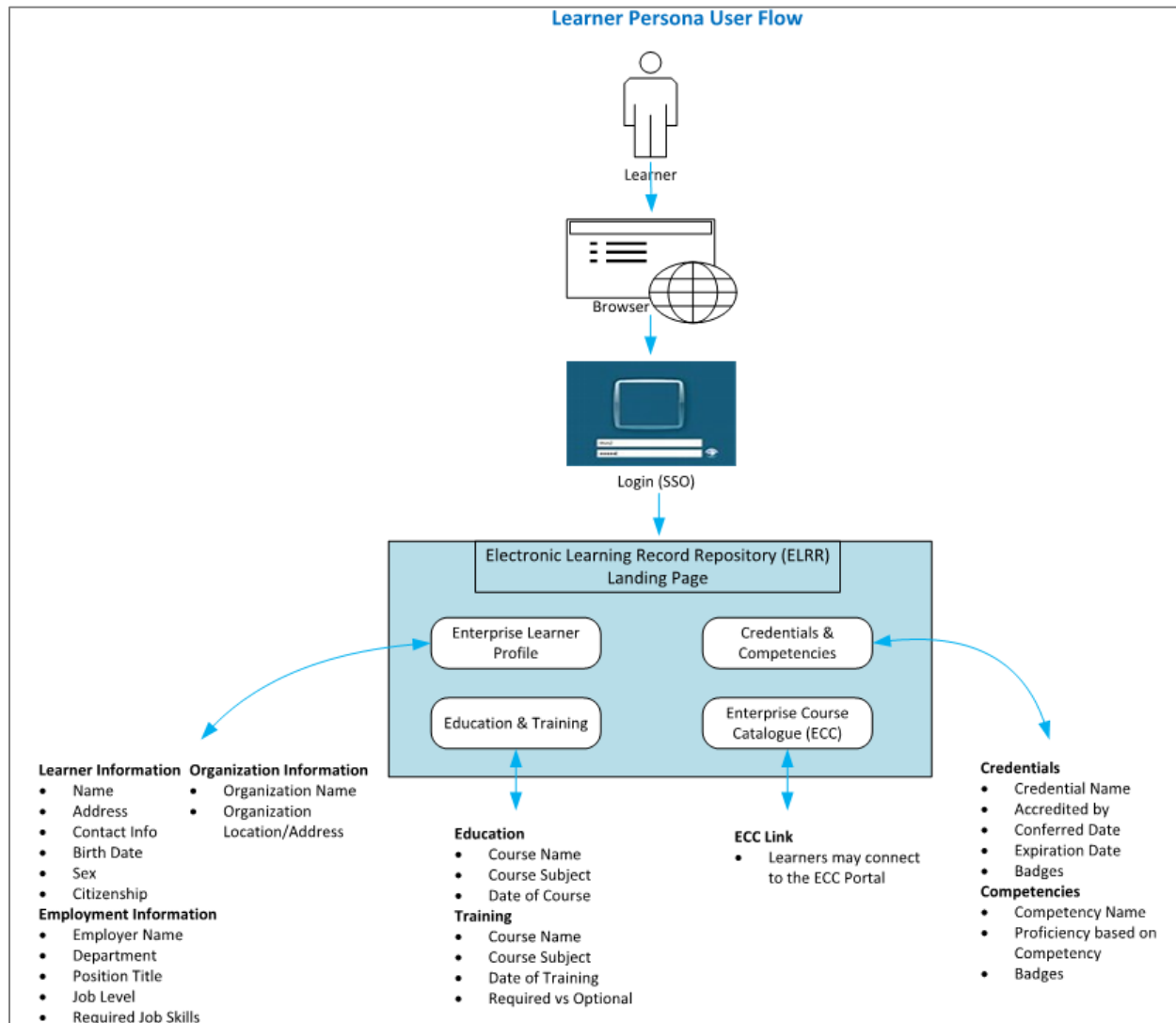
Early in the solution and data architecting process, Deloitte solution architects expressed the need to use a purpose-built enterprise architecture tool to manage the complexities of the ELR data model and the corresponding impacts to application architecture. Tracking a data model with routine changes using Microsoft Excel or Visio did not provide sufficient features to track entity relationships, manage changes, or generate outputs that were relevant to the solution development. After an internal review of available solutions, and with the ADL Initiative's overarching solution themes (e.g., open source or license-free, where possible), Deloitte selected Idera as a solution and data architecture management tool. Idera is a relatively low-cost, licensed solution providing significant functionality when modeling DIV-2 and DIV-3 data models. As demonstrated to the ELRR IPT and DSR stakeholders in the second quarterly demo, this project tool allows with the ability to generate the data definition language (DDL) and physical data model directly for use in the implementation of the solution database structure. It also provides us the ability to manage data attributes on a permission-basis, reflected in the DDL. Finally, the tool supports a standard-based output for both the DDL outputs, provides the ability to directly generate an updated data dictionary, and provides the ability to export the various data models into a range of formats. Taken together, such a tool significantly reduces administrative work time involved with data model complexity.

### **2.2.3 UX/UI Approach**

As part of the discovery activities, Deloitte conducted an initial analysis of each task a user needs to perform, including identified permutations of workflows, mapped to the ELRR requirements. We then incorporated principles of user-centered design in the development of persona-driven UX/UI artifacts. We used these artifacts to demonstrate initial project progress, solicit feedback from IPT members, and plan for solution development activities. As part of the system architecture planning and requirements reviews with IPT members, Deloitte identified three primary personas for UX/UI consideration: a Learner, a Training Manager, and a Career Manager. Given that the System Administrator is an important persona for initial deployment of the ELRR Prototype, but not a priority for IPT members, we worked with the ADL Initiative to define the UX/UI for this persona. Deloitte provided the IPT team with user workflow diagrams linking ELRR UX/UI to expected system functionality linked to the Prototype requirements, as demonstrated in Figure 6.



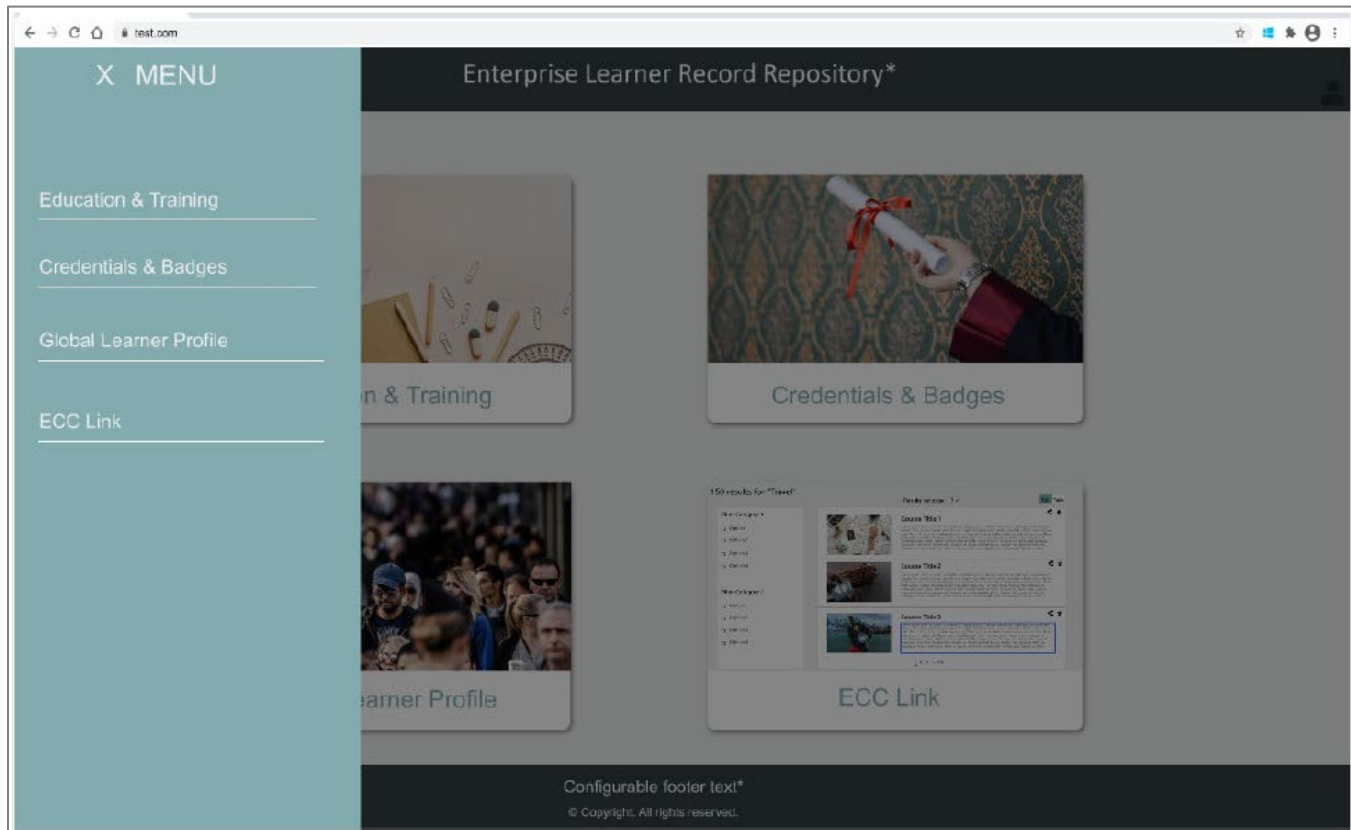
**Figure 6: Initial User Workflow for ELRR Learner Persona**



Deloitte next explored refining the proposed user interface designs to demonstrate the gradual elaboration of priority software requirements. These design iterations provided an important measure of progress for the first iterative demo – when we were still reviewing requirements, managing potential scope changes related to the enterprise learner profile, and standing up our development pipeline. We used a readily-available digital design tool In Vision to build dynamic, clickable wireframes, linking each developed screen directly to an identified ELRR requirement. We used these clickable wireframes to once again solicit feedback from the ADL Initiative and IPT stakeholders, beginning to implement a series of dashboards for the ELRR Prototype front end to demonstrate how learner data could be used at

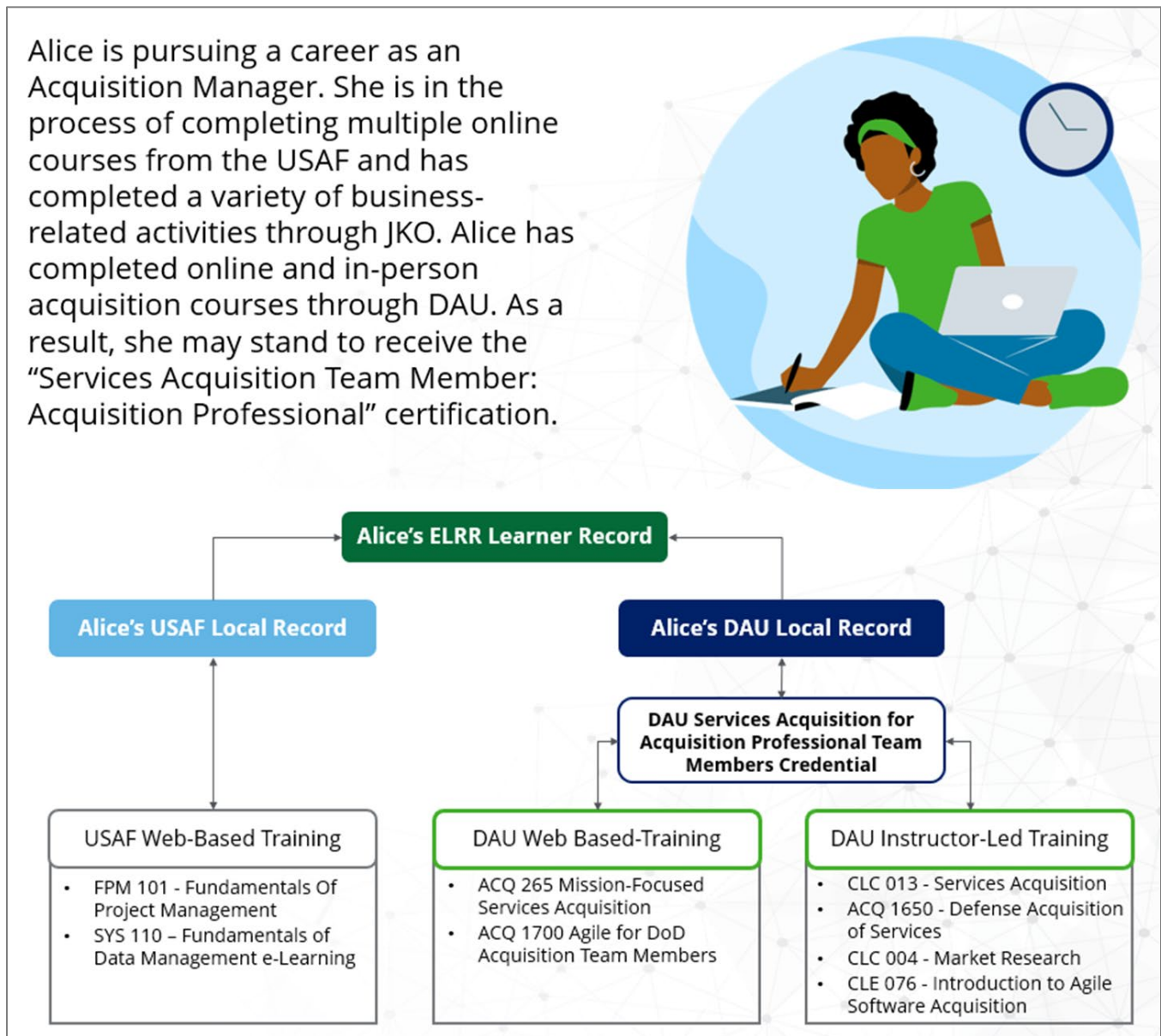
different stages to support different personas. The figure below provides an example of an early iteration of the wireframes for the Learner persona.

**Figure 7: Sample Clickable Wireframe for the ELRR Prototype Learner Persona**



As the development team iterated and elaborated through these Prototype wireframes, the underlying data story related to the learner – what made the dashboard meaningful and useful – remained an abstraction for both the IPT and the development team. At times, the difficulties in approaching the problem statement ELRR solves for in terms of disparate systems containing unconnected learning and development data are obvious. It can be difficult tracking the abstract linking of data elements to meaningful learner activities that relate back to the work human capital and training practitioners perform on a day-to-day basis. Capturing basic information on a course catalog entry, or information about a competency level, or a limited information on a learner: these are easy to visualize and track individually, but are complex to track when they are integrated, dynamic, and meant to express themselves at the scale of the enterprise. As part of our ongoing bi-weekly check-ins with the IPT, the Deloitte team elaborated on the Prototype Personas by personifying the data elements of the ELRR evidentiary as Alice Smith, an Air Force employee completing learning experiences offered by DAU and JKO stakeholders shown in Figure 8 below. While this information may not have had any direct meaning to all the IPT members, it formed an important basis for development planning, and ultimately led to the development of a learner record data set supported by a competency framework and course catalog for use in the ELRR Prototype test and evaluation plan.

**Figure 8: Alice's Demonstrated Evidentiary Chain**



## 2.2.4 Solution Workflow Design

As demonstrated in Section 1.2 above, the ELRR development team started with the expected organizational LRS as the target for record extraction. Given that we did not have direct access to any IPT member LRSs and corresponding learner records, we modeled our application development based on the the ADL Initiative's TLA LRS, an authoritative LRS containing xAPI records conforming to the Master Object Model (MOM) profile for Level 3.



Deloitte proposed and developed a three-tiered ELRR Prototype architecture comprising a presentation/client tier, the application tier, and the data tier. The ELRR Presentation Tier represents the user-facing aspect of the system designed to enable human or external system/machine interactions. The ELRR portal provides role-based access for learners, training managers, career managers and system administrators. The ELRR Application Tier contains the business or functional logic for the enterprise learner record repository; at the TLA's enterprise level, application services will be advertised through a service registry. The ELRR Data Tier contains the persistent storage (relational database management system) with a data access layer to enable the data to be independent of the application logic. The Deloitte team developed an initial draft of the system architecture two months after project kickoff, and submitted a [final version of the documentation](#).

The resulting ELRR Prototype microservices architecture to accomplish the highlighted solution workflow are presented in the table below:

**Table 1: Summary Overview of ELRR Microservices Performing the ELRR Solution Workflow**

ELRR Microservice	Microservice Description
Extraction Agents	The application service for extracting xAPI records from an authoritative LRS and moving the extracted records to the staging database.
ELRR Staging Databases	The application database and corresponding data services for storing the extracted, consolidated xAPI statements from one or more authoritative LRSs, along with the MOM-conformant records.
API Gateway	The application service for managing the routing of the extracted record to the correct Kafka topic. And additional application service manages the validation with the appropriate TLA MOM profile.
Kafka/ Zookeeper	The application service to stream data from the staging database on partitions to the ELRR Record Aggregation service using 'topics'.
ELRR Agents	The fine-grained application services that execute the ELRR business logic by interacting with systems in the data fabric. Some of the ELRR Agent(s) are associated with a Kafka 'Topic' and execute their business logic to transform, validate, and load data into the relevant database.
ELRR Record Aggregation	The application database and supporting data services for storing and reporting the aggregated, enhanced enterprise learner records.
Learner API	The application service for retrieving data from the ELRR Record Aggregation, as well as facilitating persistent competency status for the enterprise learner profile.

As part of the data passing through the ELRR Prototype data fabric, the application services keep the associated JSON object to build a level of redundancy into the transformation process. Deloitte started down this road to have a method for checking where in the process an error may have occurred in order to recover the data record and correct the issue. Additionally, we used this approach to plan for the presentation services related to the Learner and Manager dashboards described below in Section 2.1–2.2. With regards to the front-end solution, this approach provides a method for limiting the information that

is stored for page rendering, a small feature for control over the underlying data contained in the Record Aggregation service.

With regards to an enterprise record management service, the Deloitte team spoke extensively with IPT members who had difficulties accepting a solution workflow whereby changes made to enterprise records in ELRR would not reflect back to the local, authoritative source of that record. A significant amount of discussion examined the feasibility of maintaining a two-way flow of data between the local, authoritative records and the enterprise record as part of the solution architecture. There are too many factors to control for this to have been the case; the IPT and the ADL Initiative teams agreed that the ELRR is the aggregation service, not the maintaining source of truth, of the enterprise learner record.

## **2.3 Development Activities**

As a bridge between design and development, Deloitte identified the methods and tools to effectively plan, deliver, and support software development activities is critical to the ability to install, configure, develop, deploy, and test the ELRR Prototype. Deloitte's technology decisions and recommendations were informed by the guiding principles and the requirements established in the prior work planning, requirements review, and system/data architecture activities.

Deloitte opted for two-week software development sprint cycles to meet the bi-weekly reporting cadence with the ELRR IPT. Sprint planning was a Deloitte-only activity and we reported our upcoming sprint goals and prior sprint velocity as part of our bi-weekly IMS review. Given plans for a bi-monthly demo for ELRR DSRs, each program sprint comprised of four, 2-week cycles; bi-monthly demos were a demonstration of 8 weeks of software development activities. The team ultimately identified 46 out of 85 RTVM requirements for Prototype prioritization; additionally, we included 12 out of 22 Enterprise Learner Profile requirements as part of Prototype prioritization.

### ***2.3.1 The Learner Persona: Developing an Enterprise Transcript***

The Deloitte team prioritized the Learner persona use cases due to our early technical focus on xAPI statement generation, use of DATASIM, and review of the MOM profile. Intuitively, an enterprise learner represents any and all personnel with a learning record acquired by either formal or informal means within the DoD; within a corporate or government organization, we are all employees and learners, making this an easier persona to influence solution design and development. The Learner's primary goal using ELRR is to view his or her learning or training records from various institutions, in aggregate form, within ELRR.

Within this Learner persona, two primary facets of the 'evidentiary chain' demonstrated by ELRR take shape. The first is the ability to view learner records that span beyond organizational boundaries. For example, if an Air Force Learner completed acquisitions training at Defense Acquisition University and an Air Force education or training center, we would expect these records to exist in different systems, available individually but not together. The Learner's primary motivation for using ELRR is in navigating to a method for a 'universal transcript' – demonstrating a chain of evidence across DoD system bounds. In the future, one might expect this evidentiary chain to extend beyond DoD system boundaries to external learning record providers (e.g., civilian universities, programs offering credentials, or digital learning academies).

The second facet of the 'evidentiary chain' demonstrated by ELRR takes into account control loop associated with competencies, credentials, and skill frameworks. As the Learner completes learning experiences across the development lifecycle, linked learner records that contribute to the conferral of a

competency, credential, or skill should be reflected in this ‘universal transcript’ as a conferred competency, credential, or skill. ELRR, reliant on the other components of the TLA, will track and manage the status of these digital assertions of competence. The development team planned for building a UX/UI to facilitate these two primary goals for the Enterprise Learner. Figure 9 provides the landing page presenting a Learner with the ability to drill down to the course and competency reports. As part of this landing page, Deloitte also accounted for a direct navigation link to the Enterprise Course Catalog, providing a means for a Learner to go directly to experience discovery based on his or her assessment of the reported courses and competencies.

**Figure 9: Learner Persona Dashboard Landing Page**



Providing reports for completed courses and conferred competencies to the Learner demonstrated a capability likened to a universal transcript: a Learner could complete a course or learning experience across organizational bounds, and the ELRR would reflect the completion of the course or experience. As we expect, these reported lists could be significantly long, impacting the user experience. We tried to minimize the amount of information presented within in the report, and reinforced the ability to make access to relevant information easier through a search field, filtering tools, and other expansion page elements. Another key feature for the Learner to use was the ‘Export’ functionality, rendering a digital copy of the report in an associated format. The team has gone back and forth between making the exported report a PDF or CSV file; the current Prototype provides the option for either, although it currently defaults to a CSV formatted file. Figure 10 provides insight into one of these reports with the major page features highlighted above.

**Figure 10: Learner Persona Completed Course Report**

Course ID ▼	Course Name ▼	Start Date	End Date	Instruction Method	Organization
ACQ 101	Fundamentals of Systems Acquisition Management	12/21/2020	01/15/2021	Web	DAU
CLC 067	Mentoring the Acquisition Workforce	01/15/2021	01/25/2021	Web	DAU
CON 100	Shaping Smart Business Arrangements	01/15/2021	01/25/2021	Web	DAU
DOD-US1364-21	Department of Defense (DoD) Cyber Awareness Challenge 2021 (1 hr)	03/03/2021	03/20/2021	Web	JKO

One weakness to highlight with these reports is their limitation in providing real-time data based on the ongoing ELRR system workflow. A Learner may want to navigate to ELRR to view an up-to-date, comprehensive enterprise learner record, but the information presented in ELRR may not be the most current or updated learner record reflecting all experiences or competencies from the ingestion of various enterprise learner record sources. The individual contributing systems may only schedule record extraction on an infrequent basis for solution performance purposes. Both of these factors may cause for the perception of an out-of-date record; Learners would need to recognize that ELRR will not consistently contain information on learning experiences and competencies that were completed within the preceding hours or days.

Every ELRR Prototype role has access to an account profile containing limited information matching to the draft ELR data standard and representing the learner's enterprise profile. As mentioned above, the Deloitte development team added this feature set to the requirements backlog, and worked to pulse IPT members for a minimum viable set of data attributes from the draft ELR standard that would help to meaningfully distinguish individual Learners at the enterprise level. The Prototype enterprise learner profile contains a limited set of attributes across personal, organizational, and employment attribute categories, as demonstrated in Figure 11. Demonstrating this developed capability to the IPT members generated good discussion on the nature of the enterprise learner data, which attributes are relevant for identification purposes, and which attributes are relevant for presentation purposes. The team did not agree on the definitive list of data attributes for consideration in an enterprise learner profile, but this development feature has spurred valuable conversation on privacy and access controls.

**Figure 11: Enterprise Learner Profile as Part of the Learner Dashboard**

The screenshot displays a web application interface for a learner's profile. At the top, a navigation bar includes links for 'Home', 'Personal Information', 'Courses', and 'Competencies'. The user 'Alice Smith' is logged in, with a 'Sign Out' button. The main content area is titled 'Personal Information' and is divided into three sections: 'Personal', 'Organization', and 'Employment'.

**Personal Information Section:**

First Name: Alice	Name: Beth	Name: Smith
Last Name Prefix: Ms.	Preferred Name:	Title:
Email: alice.smith@us.af.mil	Name Suffix:	Birthdate: 07/04/1985
Primary Language: English	Maiden Name: Smith	Citizenship:
Emergency Contact: Email	Email Type: Personal	Veteran: Y
Sex: F		

**Organization Section:**

Organization Name: NAVY
-------------------------

**Employment Section:**

Employer Name: NAVY	Employer Department:	Hire Date: 06/30/2012
Employment Start Date: 2012-07-07	Occupation: Mass Communications Specialist	Job Level: Petty Officer Third Class
Employer Name: NAVY	Employer Department:	Hire Date: 06/30/2012
Employment Start Date: 2012-07-07	Occupation: Mass Communications Specialist	End Date:

### 2.3.2 The Manager Personas: Envisioning a Snapshot into Unit Learning & Development

While the Deloitte team prioritized the Learner persona use case, we also reviewed the multi-faceted Manager persona. Two distinct personas emerged from our initial requirements reviews with ELRR IPT members. The first is similar to a direct supervisor, responsible for establishing that a Learner or group of Learners meet their local or general training requirements. This Training Manager role may also monitor learner records for evidence of course completion, expiring courses, and competency or credential status of the Learner group. The team purposely tried to scope this Manager persona to emphasize smaller groups or organizational units, which the IPT validated.

The team struggled to connect with and represent an Observer/Instructor/Controller/ Supervisor (OICS) persona independent from the Training Manager role. It made sense that an OICS persona would manage or oversee a group of Learners similar in size as the Training Manager, and accessing information on competencies, credentials, and skills might aid the OICS to differentiate instruction based on this information. However, from a UX perspective, as ELRR would only contain limited information on the group of Learners, and is not an administrative management system, the OICS would continue to use the organizational system of record primarily to accomplish his or her tasks. The team rolled the OICS ideas into the Training Manager persona. Figure 12 below provides a summary view of the Training Manager's primary report listing the number of learners and corresponding roles for courses and competencies. Page elements remain consistent with the Learner reports, including the ability to search and filter. The Manager also has the opportunity to toggle across organizations or work units for which he or she has authority to view.

**Figure 12: Training Manager Course and Competency Report**

Home - Personal Information - Courses - Competencies - Search Learners' Info Bill Christian Phillips Sign Out

Home/Search Learners' Information

**Search Learners' Information**

Course Search		Organization	
Course Search	Search Results	Select	
Course Name	Organization	No. of Learners Who Completed Course	Ranks of Learners Who Completed Course
Fundamentals of Systems Acquisition Management	DAU	2	Petty Officer Third Class
Mentoring the Acquisition Workforce	DAU	2	Petty Officer Third Class
Shaping Smart Business Arrangements	DAU	1	Petty Officer Third Class
Department of Defense (DoD) Cyber Awareness Challenge 2021 (1 hr)	JCO	1	Petty Officer Third Class
Facilities Capital Cost of Money	DAU	1	Petty Officer Third Class

Competency Search	
Competency Search	Search Results
Competency Name	Number of Learners with Conferred Competency
Skill and Roles Business Skills and Acumen	2
Contract Principles General Contracting Concepts	2

The second Manager persona represents a subject-matter expert who identifies the training requirements of a career field. This Career Manager is a more strategic role that will plan for personnel readiness within a career field. This may include participating in progression and succession planning to ensure that there are sufficient personnel with the necessary skills and training to accomplish the mission. Unlike the Training Manager, the focus of this persona is to survey an assigned organization for competency or credential information, rather than drill down at the learner level for this type of information. To this end, ELRR provides a summative view of competency, credential, or skill balances across one or more organizational units made available to the user.

Demonstrating the Manager dashboards spurred further business use case identification with the DCPAS stakeholders. DCPAS validated the feature set related to monitoring and reporting on specific courses across organizational course units based on course objects that were directly linked to a designated employment attribute (e.g., supervisory level). Each year, across each DoD organization, DCPAS engages in a manual data call to identify this compliance training, confirm which organizational learners are expected to take the training, receive the individual report-out on course completion, and collate these individual reports for mandated enterprise-wide reporting. Further, DCPAS has been working with the Air Force A1 HR Data Warehousing initiative to identify and link a key data attribute in the Air Forces updated HR data model to quickly identify which Air Force managers and supervisors require the compliance training.

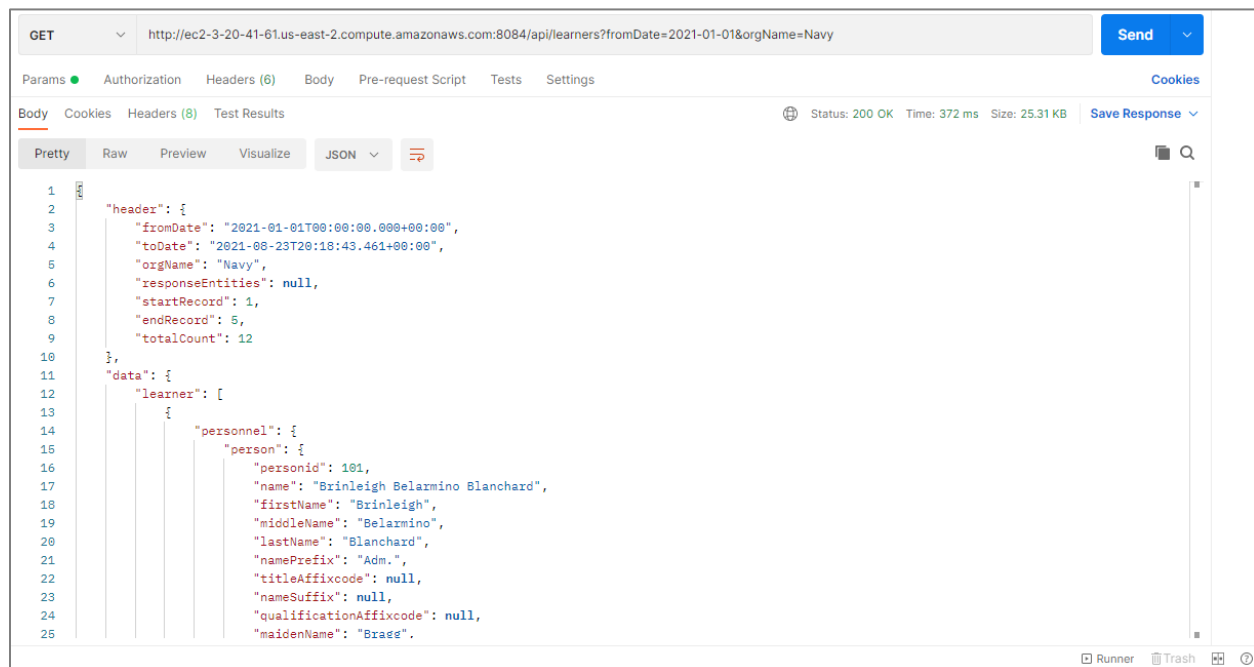
Four identified courses within the Air Force catalog – two for each role – are made available for Learners to complete. Despite working with AETC ELRR stakeholders also involved on ECC, the ELRR development team was not able to locate the specific manager/supervisor courses within the AETC catalog referenced by DCPAS. However, this presents a promising lead that would deliver significant value to the DCPAS IPT member, support a linked data attribute and verifiable system alignment between ADL/AETC/Air Force A1/DCAPS, and likely lead to a demonstrated time savings aligned to proposed ELRR KPIs. Deloitte recommends exploring this type of use case further and prioritizing it in future ELRR business case validation activities.

### 2.3.3 A Machine Persona: The Learner API

As described above in Section 2.2.4, a primary ELRR solution component is a data tier component aggregating learner records with detailed learner record information. The very development of this component provides the possibility for search and discovery of these aggregated, detailed records, and so the Deloitte team prioritized the development of an API service to query the aggregate ELRR at the end of the development lifecycle. This prioritization benefited from ongoing updates to the ELR data standard, the corresponding updates to the data services underlying the ELRR data fabric application, and the team's creation of a test data set for testing and evaluation activities.

The Machine persona is compelling in its own right and directly ties back to the problem statement in terms of time reduction for finding learner information and the ability to adapt learning experiences to specific Learner needs. The team developed the ELRR Learner API to provide a mechanism to synchronize the data in the ELRR with the data in the local learning systems. This API uses an HTTP Get method to allow a local learner system to request data from the ELRR by date range, or by starting date to ending date, and by organization (e.g., DAU, NAVY, etc.). Organization (orgName) and start date (fromDate) are mandatory, whereas, end date (toDate) is optional. If the end date is not provided by the requester, then the current date will be used as the end date.

**Figure 13: Sample Get Request for the Learner API**



As documented in the Learner API Interface Control Document that is part of the final System Architecture Report submission, Deloitte accounted for several potential failures when using the Learner API. The service generates a validation failure when one or more of the parameters provided in the query are invalid (e.g. incorrect data format). The error message returned includes the specific parameters that failed. The service generates a system failure in the event that the error occurs during the processing of a valid request (e.g., the database times out). The error message returned includes an action for the user, which may include trying again later or contacting the System Administrator.



The Machine persona represents a powerful server-side output of the ELRR Prototype efforts, and the Deloitte development recommends further development efforts to match this capability to several distinct use cases that have been highlighted in the sections above. The first represents a pathway to an adaptive learning capability: the enterprise learner record contains information on conferred competencies which can contribute to a more personalized or impactful recommendation of learning experiences. This recommendation may also close a gap, or match to a competency or skill framework encouraging a separate career trajectory. The second use case provides a rudimentary method for synchronizing learner records between local and enterprise authoritative sources. The local authoritative record source could validate that a learner record is complete, and import ELR standard-aligned metadata into the local authoritative system. A final use case that requires much greater solutioning relates to the underlying data pipeline potentially available based on the aggregated learner records. As the ELRR presentation services are limited, yet the underlying data may be significantly impactful for business intelligence, analytics, and dashboarding, a service similar to the Learner API could pipe in learner record data sets. Each of these three follow-on use cases for this persona require additional solution design and represent separate solution components/services.

## 2.4 Deployment of Prototype

Our project plan for four successive, incremental sprint cycles included planning for ongoing delivery of source code to support test-related project activities. This step ensured that acceptance criteria defined in the requirements process were demonstrated in the final software product.

### 2.4.1 *The Administrator Persona: Monitoring Initial Deployment*

Given the ELRR RTVM requirements, the team recognized the need to account for a System Administrator persona as part of design and development. Although a lower priority in the initial product backlog, the Administrator user interface would be an important tool for future deployment of the ELRR Prototype solution. The ELRR System Administrator will be responsible for validating and monitoring the ELRR system. The System Administrator should view configuration data stored in the ELRR application, as well as monitor imports from the authoritative LRS, and from other external services such as, ELRR, CaSS, etc. Consequently, the initial user interface for System Administrators allows for monitoring of imports and configurations. It allows the System Administrator to monitor overall flow of enterprise learner records through the data fabric to observe potential issues arising when adding additional data services for detail of source data records.

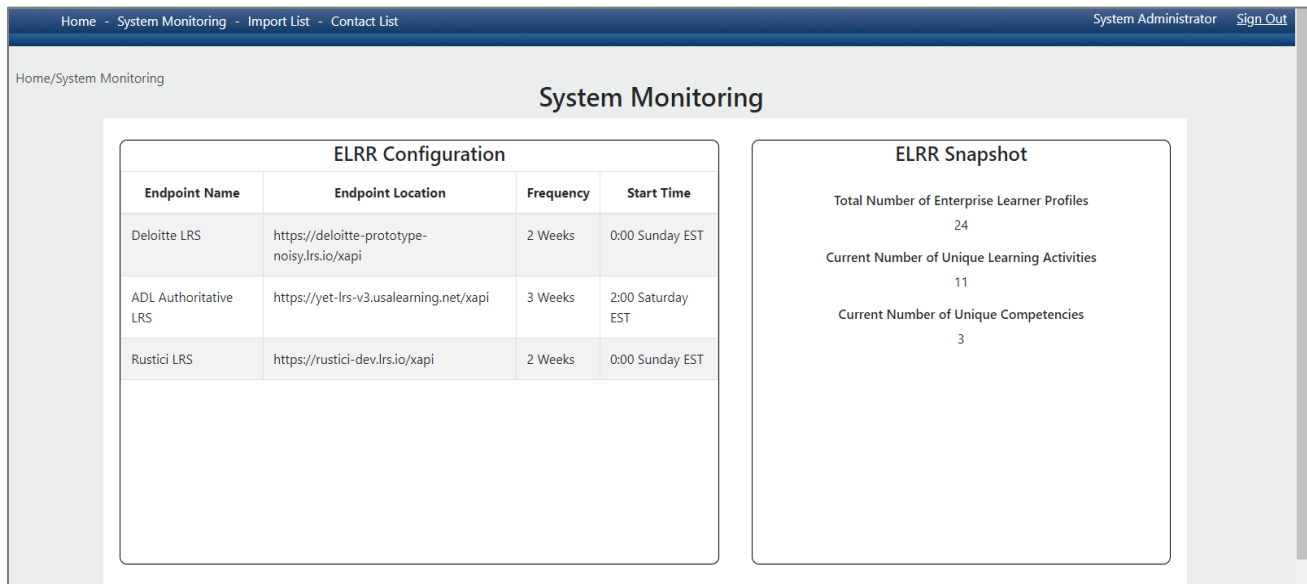
The team again took a simplified approach in accounting for this persona, based on several challenges that became apparent during the design and development of the System Administrator UI. The first relates to the ambivalence with the purpose of ‘deployment’: the ELRR’s intended microservices architecture is reliant on DevOps tools and technologies for software configuration, validation, deployment, and monitoring. A System Administrator’s deployment of ELRR solution elements (e.g., application services, database configurations, front end services) will be managed and accomplished using other identified tools, such as Docker.

Several complications present themselves when considering the UX/UI design for an ELRR role. Given the sheer quantity of systems and records anticipated in future use, an effective ELRR System Administrator UX/UI might replace viewing and configuring of individual system elements and instead focus on providing an overall view of ELRR operation. Given the nature of the federated deployment, the ELRR System Administrator is ultimately an observer of a steady working state, rather than a user configuring the individual systems contributing to the ELRR data fabric. This suggests more of a



‘reporting’ feature set rather than a business workflow-enabling UI, as demonstrated in the System Administrator dashboard in Figure 14 below.

**Figure 14: System Monitoring Report for ELRR System Administrator**



The Prototype’s completed System Administrator UX/UI emphasizes the ability to view various system learner record configurations and imports. The dashboard provides option to add learner record and data services (e.g., CaSS, ECC) endpoints. Listing out all the associated endpoints and corresponding information is not ideal from a security control standpoint, but does provide initial functionality to viewing imports, viewing import status (e.g., import success, import error with information on the important error), and viewing the overall status of the ELRR deployment.

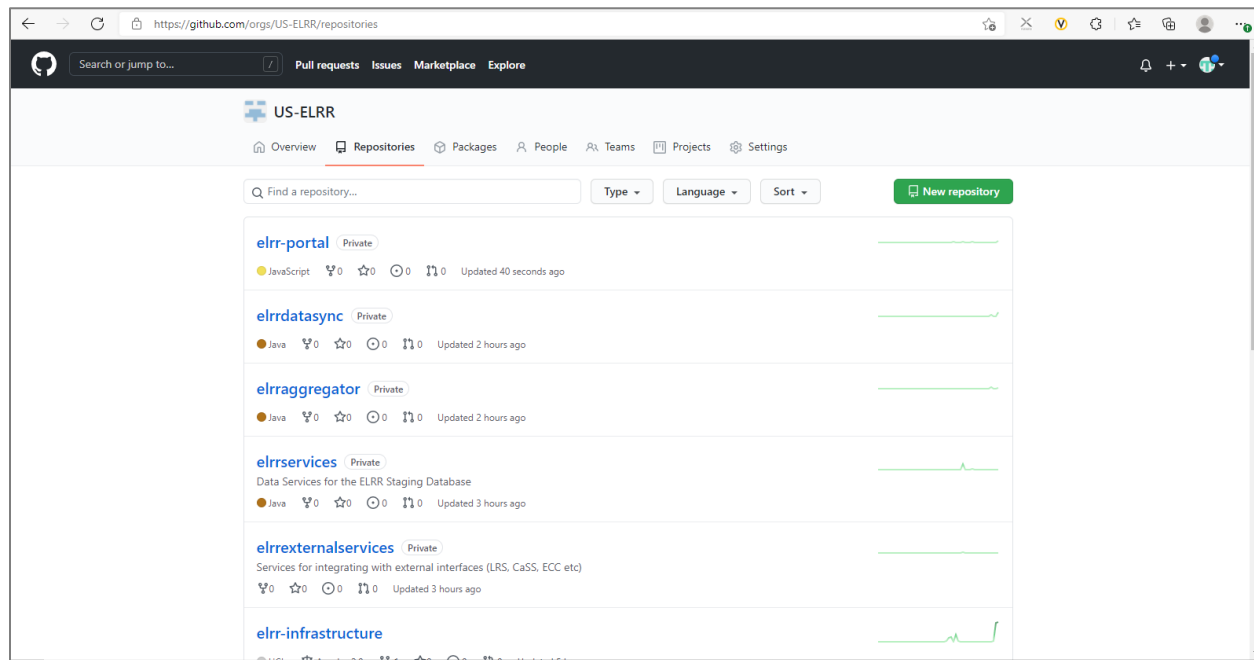
A final point on the System Administrator persona impacted the Deloitte team’s design and development: while initial discussions with the ADL Initiative technical team members suggested the need to incorporate a user management feature, the Deloitte team ultimately opted against including an ELRR role-based permissions management feature. One reason for this decision was to match the overarching data architecture, whereby ELRR reflects the local authoritative data set as the source of ELRR-relevant data, rather than establishing a separate set of data values and business rules, which may complicate deployment and maintenance. The second reason speaks to the impact of implementation: if the System Administrator’s role is more important as a monitor of systems integration, the team decided to avoid including a user management responsibility, especially given that no business process for provisioning and managing users currently exists across organizational boundaries.

## 2.4.2 Solution DevSecOps

As solution components and resulting technologies were defined as part of the Prototype Design activities, the Deloitte team of application and DevOps engineers mapped the Prototype solution to hardware and software infrastructure specifications (e.g., memory and CPU specifications). As part of our system integration planning efforts, we documented the architectural guidance and specifications for all environments required for developing, testing, deploying, and operating the Prototype solution. As the technology and infrastructure was designed, the team also aligned a deployment method to these

requirements, and reflected these updates to code and documentation in our ELRR project GitHub repository.

**Figure 15: ELRR GitHub Code Repository Tracks Solution Components and Associated Documentation**



The ELRR Prototype deploys components using Docker containers to manage the ongoing development of the microservices architecture. Docker containers are portable, scalable, and reliable. ELRR Docker images are stored in the public Docker Hub registry, allowing interested parties the ability to pull and deploy the image. Docker images are also cloud agnostic which allows for deployment on any cloud provider. Images can be deployed as a single Docker image, a cloud provided container service, and using Kubernetes for orchestration. The ELRR teams worked to deploy component images on Kubernetes to orchestrate solution containers for scalability, reliability, and high availability. The Kubernetes service will be especially important in the future scaling of the ELRR capability as new LRPs and data systems are added to the data fabric.

Consistent with the overall ELRR development approach, the team's CI/CD pipeline offered a consistent and repeatable experience to install and configure ELRR within an existing the ADL Initiative TLA sandbox. The CI/CD pipeline offers more consistency and trust that the latest versions of the ELRR will operate as intended within the the ADL Initiative TLA sandbox. The team selected the Jenkins tool, an industry-leading open-source CI/CD pipeline automation tool, to help orchestrate the build, testing, and deployment of the Prototype's applications.

At the time of this document's release, the ELRR Prototype has only been tested/verified on the AWS platform; though with slight modifications, developers may leverage other cloud providers. The ELRR Prototype is deployed using Infrastructure-as-Code scripts with Terraform and configuration management with Ansible. The IaC scripts using Terraform define all facets of the ELRR application from networking, servers, and storage to deliver a repeatable, consistent deployment experience, facilitating a 'one-click' deployment. For example, a Terraform IaC script can be used to build the Kafka / Zookeeper server specifications, storage, and networking to run a cluster of servers at the run of a single command. Once Terraform completes the build of the infrastructure, an Ansible playbook starts

the Kafka / Zookeeper application via Docker-Compose and conducts additional application configuration, along with unit tests to ensure the application has been successfully deployed. Using Terraform and Ansible together mitigates the risk of user error when deploying the ELRR Prototype. It also provides rapid adaptability as the ADL Initiative makes final decisions on which accredited environment the ELRR solution will be hosted in.

### ***2.4.3 Prototype Deployment and Integration with TLA***

Once Deloitte detailed the methods for deployment of the ELRR infrastructure and applications in its [Systems Implementation Plan](#), the next step was to integrate with source systems within the ADL Initiative TLA sandbox. As part of these documentation efforts, the Deloitte DevOps engineers developed a cloud component architecture demonstrating system boundaries, subnets, and port access. The three ADL Initiative TLA source systems accounted for in the ELRR Prototype included the ADL Initiative's Authoritative LRS, CASS, and ECC. This proved somewhat challenging as it presented separate coordination activities for Deloitte and ADL Initiative technical teams to recreate the underlying TLA sandbox environment so that ongoing solution development aligned to the target environment. The Deloitte team found some of the ADL Initiative's solution documentation helpful, but felt that it did not provide genuine interface control documentation with specific information on specific environment parameters.

Additionally, the ELRR Prototype was meant to connect with a deployment of the ADL Initiative's Data and Training Analytics Simulated Input Modeler (DATASIM) to produce xAPI records to conduct testing for the ELRR Prototype. One of our priority development items coming out of the discovery sessions and initial product backlog was deploying DATASIM based on documentation and recommended deployment methods. The Deloitte application and DevOps engineers faced similar difficulties working with DATASIM to meet the stated objective of the ELRR Prototype.

DATASIM acts as an xAPI statement generator with 'noisy' xAPI statement outputs at scale; this provided the team with an opportunity to test data quantity, but hardly any opportunity to use it for generating quality data matching the UX/UI approach and business use cases. Further challenges arose when reviewing documentation on an active ADL Initiative project: as the application was in current development by another ADL Initiative project team, the team dealt with inefficiencies reviewing updated guidance on deployment and use of the tool. Finally, the team also had challenges making use of the TLA's MOM profile registry to establish a test profile for the expected ELRR learning records. We found the process of profile creation to be manual and not fully documented. This caused the team to spend sprint cycles unsuccessfully implementing the recommended solution for MOM-aligned xAPI records. In the end, to accelerate our other development efforts, the solution team ended up building its own data set to meet the needs for development, deployment, and testing.

### ***2.4.4 Prototype Testing and Evaluation***

For the purposes of the ELRR Prototype project, Deloitte assumed a simplified test environment reflective of ongoing development efforts in this early state of solution development. As there is currently no designated pre-production or production environment of the ADL Initiative's TLA, Deloitte used a Deloitte-managed Amazon Web Services (AWS) environment as its stated development environment to expedite software development efforts and minimize the administrative and cost impacts to the ADL Initiative. The test and production environment are the same: we planned to deploy the ELRR software services developed in the Deloitte development environment to the ADL Initiative-managed AWS TLA environment. This test will allow the ELRR testers to run the defined test

cases using the proposed test methods. The Deloitte quality assurance team members used this environment to test system integration, perform functional, regression, smoke, usability, security, performance, and user acceptance testing. Our approach and plan for these activities were documented in the ELRR Prototype [Test and Evaluation Plan](#). Deloitte developed non-functional test cases to include 10 user interface test cases, 12 data test cases, 4 performance test cases, and 5 security test cases. We updated our RTVM submission to reflect 178 test cases for the ELRR and 42 test cases for the Local Learner Profile. The results of Deloitte’s internal Test and Evaluation activities are provided in **Appendix A**.

Additionally, Deloitte conducted an acceptance/usability test and evaluation session with the AETC IPT organization on September 15<sup>th</sup>, 2021. Four AETC individuals participated in the session; they represented a range of job responsibilities, and Deloitte did not target a specific job responsibility for this testing. The purpose of this session was twofold: use an IPT member to run through structured user acceptance test scripts to verify intended software function while also asking the session participants to work through an unstructured scenario-based use case matching to the ELRR personas. The scenario-based use cases broadly mapped to one of the initial KPI identified by the ADL Initiative in the ELRR business case for EDLM; measuring time to gather learner information aims for a reduction of time and associated cost savings for finding information about a set of learners. Deloitte led an activity to estimate a “time to gather” baseline, talking through a high-level business process AETC uses to reflect learner information in an associated learner record system. The table below summarizes the output from this activity.

**Table 2: IPT AETC ‘Time to Gather’ KPI Baseline Summary Results**

ELRR Scenario	Number of Steps	Summary of the Estimated Process	Estimated Time to Complete
<i>I’m an Air Force learner and I would like to be able to demonstrate with a single student transcript that I have completed training at AETC as well as at DAU.</i>	4 to 5 steps across 3 to 4 unique system environments	<ul style="list-style-type: none"> <li>Logging into the MyPERS system to see Air Force learning record information</li> <li>Using MyVector system to self-report any training not reflected in MyPERS</li> <li>Working directly with the external partner to certify training completed outside of Air Force</li> <li>Working directly with the relevant Air Force technical school to enter externally certified training</li> <li>Working directly with the relevant Air Force technical school to add degree credentials</li> </ul>	2 to 6 weeks, with upper range applying to requests related to academic credentials

*I'm an Air Force career planner and I would like to run a report to view the status of all the competencies or credentials awarded to a unit or other organizational grouping.*

Multiple steps across 1 or more unique system environments

- Using MyLearning to run a structured ancillary training report. This step is comprised of multiple smaller steps, including extraction of the initial data.
- As part of the extraction process, needing to re-format the data, reconcile the data or any outstanding data extracts to reflect the expected 'actual'. This may be facilitated using a custom tool or query to support data extraction (e.g., Excel template)
- Use similar methods with each additional desired data set, such as MILPDS, the Special Trophies & Awards Database, etc.

1 to 2 hours within MyLearning, but the data extraction and reconciliation process can range from several days to week to months depending on the desired data output

Deloitte and the ADL Initiative found this baselining activity to be a very useful exercise, albeit a generalized first pass that will require further examination by specific organization and by specific job role. One identified high-value use case for the AETC participants was Special Trophies and Awards, which are unit-level recognition. While this a separately tracked and managed database, the AETC users felt this type of credential translates well to ELRR and would be useful to track alongside other credential, competency, and course information. After the first exercise, Deloitte provided AETC users with user acceptance test scripts for the Learner, Training Manager, and Career Manager personas. The AETC users went through each assigned test script and indicated the ability to complete each test step; they provided additional feedback on test steps if they saw fit. The results of AETC's internal Test and Evaluation activities are provided in **Appendix A**, aligned to corresponding test step performed by the Deloitte test team.

AETC users provided feedback as part of the acceptance testing steps. Broad feedback on the usability of the ELRR Prototype across the four users focused two general topics. The first referenced the rendering of data displayed in ELRR into the formatted resumed (.pdf) output. The second reflected feedback on the navigation steps provided through the use of the landing page and the hyperlinked breadcrumb. One user commented that "multiple links do not offer additional convenience, reflecting unnecessary redundancies in in terms of buttonology. Some of the users had issues with using the searching and filtering features within the course and competency reporting. After the acceptance testing activity, Deloitte provided AETC users with unstructured scenario prompts requiring the user to attempt using the ELRR Prototype to fulfill the data request, as well as timing the completion of the scenario.

**Table 3: IPT AETC Average Time to Complete ELRR Prototype Scenarios**

ELRR Persona	ELRR Prototype Scenario	Scenario Prompt	Average Time to Complete (n=4)
Learner	<i>You are planning to retire/leave government service and you are pulling together employment and training information across your career to write your resume for civilian sector jobs.</i>	Find and export the following information from ELRR: Transcripts (list of courses taken) and Competencies Conferred	6.5 Minutes
	<i>You need to submit your request for Continuous Learning Points. You haven't applied for points for any of the courses you completed this year.</i>	Find and export information on the courses you have completed so far this year (Jan 2021 to present)	4.75 Minutes

Training Manager	You anticipate an upcoming personnel gap in a key organizational position.	Use ELRR to determine the number of personnel who have completed the following course: "Facilities Capital Cost of Money," or have been conferred with the following competency: "Skill and Roles: Business Skills and Acumen"	6.5 Minutes
	You are a Training Manager responsible for monitoring and ensuring compliance of personnel with annual training requirements.	Identify Learners assigned to you who have completed each of the following course requirements: Facilities Capital Cost of Money, Fundamentals of Systems Acquisition, Management, and the Department of Defense (DoD) Cyber Awareness Challenge 2021	7.25 Minutes

After the unstructured scenario activity, the ADL Initiative and Deloitte provided AETC users with a usability form to provide anonymous feedback on the use of the ELRR Prototype along with an assessment of usability based on a series of questions. The assessment questions used a 5-point Likert Scale to quantify use of the ELRR Prototype to accomplish the acceptance testing and usability scenarios. Two out of four users indicated that it took them more time than expected to use the ELRR scenarios; the remaining two users indicated that it took them less time than expected.

**Table 4: IPT AETC Usability Survey Results**

Usability Assessment Survey Question	Average Rating (n=4)
How efficient you were in searching for learner information using the ELRR Portal. (1 = Not at all efficient; 5 = Extremely efficient)	4.25
How would you rate the difficulty level of the tasks you have performed? (1 = Extremely difficult; 5 = Not at all difficult)	4.5
How intuitive is the content of the ELRR Portal? 'Intuitive' refers to a design that is easy to understand and use without conscious effort. (1 = Not at all intuitive; 5 = Extremely intuitive)	5
How would you rate the ease of use of the ELRR system? (e.g., Were you able to locate links easily, was the size of web controls appropriate, etc.) (1 = Very hard; 5 = Very easy)	4.25
"How would you evaluate the overall responsiveness of the ELRR system? 'Responsiveness' refers to the ability of the ELRR Portal to complete requests in a desired amount of time." (1 = Very slow; 5 = Very good)	4.5
How would you rate the degree to which the learner information is accurate and is representative of what you would expect to see in your learner record? (1 = Not at all accurate; 5 = Extremely accurate)	4.25



### 3.0 Next Steps

Deloitte identified challenges associated with the current approach that warrant more design work and yield opportunities at refining the existing solution's impact. These recommendations can help to plan future design and development efforts as the ADL Initiative seeks to mature, harden, and scale the ELRR capability and adjoining solution services.

#### 3.1 Prototype Lesson Learned: Refining the Business Use Case for DoD Stakeholders

A major challenge articulated in the section above pertaining to the UX/UI approach is that of the intended use of ELRR by DoD stakeholders, such as the IPT members that supported the Prototype Development. Early in the Discovery process, the Deloitte team fielded questions on how the ELRR will work given a service's adoption of underlying xAPI standard in efforts to create their own organizational authoritative record. After confirming that the ELRR does not serve as a system for owning and managing the authoritative record, but rather as the method for streaming the information related to the record, this left IPT members still questioning the potential impact for the ELRR Prototype beyond the work they were already engaged with in creating their own organizational-level authoritative record.

For example, the AETC IPT members asked about the business use cases for reporting, having spent their prior Airman Learner Record development cycles establishing Air Force-specific requirements for an aggregated learner record dashboard – for both the Learner and Manager personas. To realize the full potential and adoption, ELRR would need to recreate this UX/UI approach, moving away from the established requirements for the ELRR capability.

The value of the ELRR capability begins to collect around two specific areas: first, it provides an initial direction towards an invaluable AI/ML framework for learner records, with obvious, dramatic effects on the TLA implementation. Having an aggregated record repository tracking information on competence, career trajectory, and potential career trajectory would significantly assist local organizations in adapting experiences, recommending experiences linked to enterprise, priority competencies and skills, as well as trigger updates to recommendations as a Learner's job, gig, duty, or career path changes – which is one of the underlying realities that nearly all Learners contend with in today's global talent marketplace.

The second area with demonstrated value is for the Career Manager persona at the enterprise level. ADL stakeholders like DCPAS struggle with cross-organization data requests because the system dispositions and underlying data models are not currently interoperable. The DCPAS ELRR use case, arising towards the tail end of development, showcased a seemingly narrow alignment (a few identifiable e-learning courses in a single agency for a specific set of learners) that could yield an important justification for development efforts. The ELRR stands to save an OSD human-capital stakeholder significant amounts of time and energy in collecting and presenting enterprise data on learning and development outcomes. Deloitte recommends that the ADL Initiative be more selective in choosing IPT members to align to specific value drivers. This might lead to smaller, better-defined 'sprints' for building specific ELRR capabilities for an IPT stakeholders, but the focus can yield verifiable outcomes that are useful in the present as other stakeholder organizations begin to adopt the underlying TLA standards.

#### 3.2 Prototype Lesson Learned: Incorporating Security and Privacy into Design/Development

Another major obstacle presented itself due to the current security posture of the solution. The ELRR solution which is expected to centralize almost all major facets of an individual's personnel data and major elements of PII. IPT members had questions and reservations about Learner data and Manager

access to such data. Combined with the challenges in hosting and deploying an un-accredited service, the fact that the Prototype represented the initial development cycle for the TLA's reference implementation of enterprise learner records, and the changing nature of the Draft ELR data standard, IPT members took a 'wait and see' approach to providing data vital to solution development.

At the same time, the IPT members supporting the Prototype build represented training program managers administrators. These stakeholders are nominally charged with the system ownership and oversight of the learning management system or learning record system, but are not themselves IT or data stakeholders within their respective organizations. While these IPT members provided significant insight and expertise into the organizational business processes and personas, the multi-faceted data standard (abstracting relationships between traditional learning and development activities, talent and competency management, and HR/employment attributes) was not in their direct span of responsibilities. As a result, they were not able to provide specific insights on how to build a meaningful organizational data set to support the simulated learner records for the Prototype.

Again, Deloitte recommends that the ADL Initiative be more selective in choosing IPT members to align to specific value drivers. This might also include developing a 'sample ELRR data set' for IPT members to generate prior to or as part of project launch. While it sounds complicated, identifying just a single competency or skill framework, the associated learning experiences, and some sample organizational learner profiles to model/simulate for ELRR development, deployment, and testing activities accomplishes several objectives. It provides IPT members with an artifact for which they can understand the security and data implications, as well as a data set reflecting their organization's unique learner record data model, and it provides avenues for pushing adoption of the ADL Initiative's CaSS and ECC components.

### 3.3 Prototype Lesson Learned: Planning for Initial Implementation and Resulting Federation

The path to a successful enterprise learner record capability requires both the local organization (such as the ELRR IPT members) and enterprise organization (in this case the ADL Initiative) to build the supporting components required for successful end-to-end use. While adopting the xAPI standard and establishing the necessary learning record stores for the capture of noisy, transactional, and authoritative data are the most significant precursors to contributing to the ELRR, the Deloitte Team observed these actions are baseline for a path towards contributing to a valuable ELRR capability. Further, trying to contribute ELRR capability without a firm grasp of the local authoritative record led to difficulty in framing Prototype requirements for participating stakeholders.

The MyNavyLearning IPT member was a good example of how tricky it can be to coordinate across all levels of the enterprise to demonstrate a truly integrated, enterprise capability. The MyNavyLearning team continues to make progress on multiple TLA capabilities, and are in the process of developing organizational learner profile, competency/credential tracking, and adaptive learning capabilities. There is no better candidate than MNL for taking their organizational, authoritative work and linking it to the ELRR extension through the enterprise Learner API, enterprise learner profile, and overall DevSecOps approach. Yet the difficulties that we faced in engaging with the Navy team for meaningful collaboration on an 'end-to-end' learner record capability stemmed from challenges we reported elsewhere: data model, access to Navy data model, access to Navy learner records, and underlying solution security.

Again, Deloitte recommends that the ADL Initiative be selective in choosing IPT members to support the development of specific components related to a more readily defined 'business workflow'. Deloitte



recommends establishing a roadmap for integration of systems into the data fabric, which can provide direction and guidance to DoD organizations as they consider not just when to adopt the TLA but how to adopt the underlying system components important to digital learning modernization.

### 3.4 Coordination, Maturation, and Scale

The Deloitte team is under contract to support optional tasks to further mature, test, harden, the ELRR Prototype and develop enhancements as part of ongoing software development efforts. Specific future efforts include, but are not limited to:

- **Platform One Deployment:** The ADL Initiative has kept the Deloitte development apprised of ongoing updates on planned environment, planned cybersecurity requirements, and the resulting impact to the existing Prototype software components and deployment methods. As the ADL Initiative moves toward using the Air Force’s Platform One program for cloud based, DevSecOps accredited application services and environments, Deloitte will use this opportunity to update its development pipeline and harden the current solution. This is a preliminary, significant step for solving some of the underlying questions around cybersecurity controls and processes.
- **Policy-Based Access Controls:** Another method for solving some of the underlying challenges related to cybersecurity and intended ELRR use is to update the ELRR solution and data architecture to reflect a policy-based access control (PBAC) framework as part of the ADL Initiative’s broader effort to explore methods for enabling data security, privacy, and trust across the TLA solution architecture. While the Deloitte team planned for Role-Based Access Controls as part of the baseline solution architecture, we welcome working with IPT members to design and implement an access control method that limits data visibility given ELRR’s potential significant information management capabilities.
- **Identity, Credentialing, and Access Management:** The move towards Platform One’s accredited container services also puts the ELRR team on a path towards planning for and implementing a DoD solution for an ICAM service. Beyond implementing user authentication – a fundamental part of the overall UX/UI for ELRR – implementing ICAM into the data fabric will provide additional enterprise learner profile data attributes that are paramount to the ELR data standard and ELRR capability, including the ability to track employment status across an individual’s development lifecycle.
- **Coordination with Adjoining ECC Capability:** As the Deloitte team accounted for ECC in its initial Prototype deployment, a growing ECC capability and ECC catalog yield dividends as the team accounts for additional ELRR requirements. The Deloitte team understands that a shift to learning experiences – rather than simply structured course objects – via the ECC capability means that underlying data related to a range of learning objects at the course, task, and sub-task levels can be captured and tracked as part of a learner record capability. Together with the capabilities CaSS brings in managing credential and skill frameworks, the development team sees the ability further develop the ELRR capability to track and present these various experience and competency levels within ELRR.
- **Continued Front End Development:** Now that the initial MVP release is available for ongoing usability testing, the Deloitte team recommends taking another pass at designing the ELRR user experience based on lessons learned in development testing. The team should pay attention to

streamlining the navigation across various page elements and potentially exploring simplifying the transcript views for courses and competencies.

- **Graph Database:** Also aligned to progress with ECC, the Deloitte team continues to see the potential for a Graph Database using Neo4J for storing aggregated ELRR records. Beyond the solution architecture, database model, and associated performance impacts to the current Prototype solution, Deloitte anticipates that a linked data model can improve the definition and parameters of the data fabric. Such efforts will also clarify how the enterprise schema service can be a facilitating agent for ELRR development and stakeholder adoption.
- **Persistent Focus on Documentation:** As described above, the ELRR Prototype was part of a larger ADL Initiative effort to harmonize technology systems to meet the digital learning imperative – in an accelerated fashion using tools that are still nascent in terms of underlying use and securitization. This is absolutely no small task, and for the entire effort to be successful, it relies not only on increased adoption and sound software engineering processes but the ability to drive on both with sufficient documentation. Along with other opportunities for coordination, maturation, and scale, the Deloitte team plans to contribute to the ADL Initiative’s growing documentation library and support the development of quality deliverables that assist in our DoD organizational stakeholders’ ongoing success adopting the TLA and all associated services.

## Appendix A: Updated RTVM for ELRR Prototype Deployment to TLA Sandbox

ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
ELRR	1	The ELRR portal shall provide an enterprise capability that allows users to view learning characteristics and competencies, and where those records are stored across different DoD organizations.	Verify that Learner is able to view learning experiences from multiple learner records	Pass	Not Tested
			Verify that Learner is able to view learner achievements from multiple learner records	Pass	Not Tested
			Verify that Learner is able to view evidence of learner achievement from multiple learner records	Pass	Not Tested
			Verify that Learner is able to view personal information from multiple learner records	N/A	N/A
			Verify that a DoD Learners are able to view their courses	Pass	Pass
			Verify that a DoD Learner can search for a course	Pass	Pass
			Verify that a DoD Learners are able to view their competencies	Pass	Pass
			Verify that a DoD Learner can search for a competency	Pass	Pass
			Verify that a Learner can view the competencies within their service from the DoD career	Pass	Pass
			Verify that a Learner can view the digital version of each credential that points to the evidentiary chain of local records	N/A	N/A
			Verify that a Learner can view the digital version of micro credential that points to the evidentiary chain of local records	N/A	N/A
			Verify that a Learner can view the digital version of assertion of competency that points to the evidentiary chain of local records	N/A	N/A
			Verify that a Learner can view the other assertions such as physical_psychological_behavioral attributes, personal preferences, and competencies not associated with a credential	N/A	N/A
ELRR	3	The ELRR portal shall support an administrator role that can install, configure, monitor, and validate the ELRR system.	Verify that a System Admin user can access a System Admin portal in the ELRR	Pass	Pass
			Verify the System Admin can browse all available pages	Pass	Pass
			Verify that Search option is available on the User Profile Management screen	N/A	
			Verify that System Admin can install ELRR portal system using automated operations required to download, extract, and deploy the system components comprising the ELRR solution	N/A	N/A
			Verify that System Admin can install ELRR portal system using manual operations required to download, extract, and deploy the system components comprising the ELRR solution	N/A	N/A

ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
			Verify that System Admin can configure ELRR portal system using automated operations required to enable each system component and persona to interact with other system components and personas.	N/A	N/A
			Verify that System Admin can configure ELRR portal system using manual operations required to enable each system component and persona to interact with other system components and personas	N/A	N/A
			Verify that System Admin can monitor ELRR portal system using Automated operations required to enable observation of system activity	N/A	N/A
			Verify that System Admin can monitor ELRR portal system using manual operations required to enable observation of system activity	Pass	Not Tested
			Verify that System Admin can validate ELRR system	N/A	N/A
			As a System Admin I shall be able to identify incoming xAPI statement with an invalid user, registered component, or identity group	Pass	Not Tested
			As a System Admin I shall be receiving an administrator alert if invalid xAPI statement is received	N/A	N/A
			As a System Admin I shall be able to identify if an incoming xAPI statement is not well formed	Pass	Not Tested
			As a System Admin I shall be able to identify that an incoming xAPI statement is not from a registered device	Pass	Not Tested
			Verify that the latest updates are captured on the Import List.	Pass	Pass
			Verify that date and time information is present on the System Monitoring screen	Pass	Pass
			Verify there is a brief description of the event logged	Pass	Not Tested
			Verify the event status is displayed	Pass	Pass
			Verify that details related to any anomalies and errors detected are provided	Pass	Not Tested
ELRR	4	The ELRR portal shall support Manager and Supervisor roles.	Verify that a Manager user can access an ELRR portal	Pass	Pass
			Verify that a Supervisor user can access an ELRR portal	Pass	Pass
			Verify the Manager can browse all available pages	Pass	Pass
			Verify a Supervisor can browse all available pages	Pass	Pass
			Verify that Manager can view the number of Learners with completed courses	Pass	Pass
			Verify that Supervisor can view the courses that an assigned Learners have completed	Pass	Pass
			Verify ELRR portal supports Manager's role	Pass	Pass
			Verify ELRR portal supports Supervisor's role	Pass	Pass

ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
			Verify that Manager can search for completed course to see the Ranks of Learners who completed this course	Pass	Pass
			Verify that Supervisor can search for a course and see how many Learners have completed this course	Pass	Pass
			Verify that Manager can view the competencies their assigned Learners have	Pass	Pass
			Verify that Supervisor can view the competencies and see the number of Learners with conferred competencies	Pass	Pass
			Verify that Manager can search for a competency so they can view how many Learners have a certain competency	Pass	Pass
			Verify that Supervisor can search for a competency so they can view what Learners have a certain competency	Pass	Pass
			Verify that Manager can search for a course to see how many Learners have completed it	Pass	Pass
			Verify that Supervisor can search for a course to see what Learners have completed it	Pass	Pass
			Verify that Manager can filter search results of a course with Completed statuses	N/A	N/A
			Verify that Manager can filter search results of a course within Progress statuses	N/A	N/A
			Verify that Supervisor can filter search results of a course with Completed statuses	N/A	N/A
			Verify that Supervisor can filter search results of a course within Progress statuses	N/A	N/A
ELRR	5	The ELRR portal shall support a learner role.	Verify that a Learner can access the ELRR portal	Pass	Pass
			Verify that a Learner can browse all available pages	Pass	Pass
			Verify that a Learner can view the courses that are completed with the date of completion	Pass	Pass
			Verify that a Learner can view the courses that are In Progress with the date of enrollment	N/A	N/A
			Verify that a Learner can view information with each course with course name and subject	Pass	Pass
			Verify that a Learner can view a competency information with the name of the competency	Pass	Pass
			Verify that a Learner can view the level of proficiency based on the competency	N/A	N/A
			Verify that a Learner can view Personal information in one location	Pass	Pass
			Verify that a Learner can view Employment information in one location	Pass	Pass
			Verify that a Learner can view Organization information in one location	Pass	Pass
			Verify Learners Personal records	Pass	Not Tested
ELRR	6	The learner shall be able to view that			

ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
		learner's aggregated local learner profile data in the ELRR portal.	Verify Learners Organization records	Pass	Not Tested
			Verify Learners Employment records	Pass	Not Tested
			Verify Learners Course records	Pass	Not Tested
			Verify Learners Credential records	Pass	Not Tested
			Verify Learners Competency records	Pass	Not Tested
ELRR	7	The ELRR portal shall allow for a system administrator to view the endpoints from (the Navy and DAU) local learner profiles.	Verify that System Admin can view the endpoints from the Navy local learner profiles on the Import List	Pass	Pass
			Verify that System Admin can view the endpoints from the DAU local learner profiles on the System Monitoring	Pass	Pass
ELRR	8	The ELRR Portal shall list local learner profiles that are displayed in the global learner profile.	Verify that a Learner can view the organization that a Course is taken	Pass	Not Tested
			Verify that a Learner can view the organization that a Competency is taken	N/A	N/A
ELRR	9	The ELRR shall support global discovery and federated data structures between enclaves.	Verify CaSS interface is available and working as expected	N/A	N/A
			Verify ECC interface is available and working as expected	Pass	Pass
			Verify LRS interface is available and working as expected	Pass	Not Tested
			Verify Learning Experience Index interface is available and working as expected	Pass	Not Tested
ELRR	10	The ELRR portal shall display digital credentials (badges, licenses, and/or certificates) for each asserted competency.	Verify that Learner digital badges for each asserted competency are displayed in the ELRR	N/A	N/A
			Verify that Learner digital badge displays appropriate name for each asserted competency	N/A	N/A
			Verify that Learner digital licenses for each asserted competency are displayed in the ELRR	N/A	N/A
			Verify that Learner digital license displays appropriate name for each asserted competency	N/A	N/A
			Verify that Learner digital certificates for each asserted competency are displayed in the ELRR	N/A	N/A
			Verify that Learner digital certificate displays appropriate name for each asserted competency	N/A	N/A
			Verify that a Learner can view what digital credentials are related to each competency	N/A	N/A
ELRR	11	The ELRR shall provide a digital export of credentials for civilian portability.	Verify the data is exported to the excel document	Fail	Pass
			Verify the data is exported to the PDF document	Fail	Fail

ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
ELRR	12	The enterprise capability shall maintain the already established chain of evidence between the local learner data and the global learner data.	Verify that ELRR maintains the link to the physical psychological behavioral attributes and personal preferences assertions, as well as competencies not associated with a credential	N/A	N/A
			Verify that ELRR maintains the link to the assertion of competence that is based on the combination of individual learner records and multiple credentials in relation to a learner's job, duty, gig, or assignment	N/A	N/A
			Verify that ELRR maintains the link to the individual local learner profiles	N/A	N/A
			Verify that ELRR stores the digital version of each credential and assertion of competence, with pointers to the evidentiary chain of local records from each location maintaining records of the learner's career history	N/A	N/A
ELRR	13	Manager/Supervisor and administrators can set visibility on an individual's learner data by role and user group.	Verify that Manager can set visibility on an individual learner data by role	N/A	N/A
			Verify that Manager can set visibility on an individual learner data by user group	N/A	N/A
			Verify that Supervisor can set visibility on an individual learner data by role	N/A	N/A
			Verify that Supervisor can set visibility on an individual learner data by user group	N/A	N/A
			Verify that System Admin can set visibility on an individual learner data by role	N/A	N/A
			Verify that System Admin can set visibility on an individual learner data by user group	N/A	N/A
ELRR	16	The ELRR Portal shall maintain an import status for the various DoD systems that are displayed in the ELRR.	Verify that System Admin can view an import status for the MNL	Pass	Pass
			Verify that System Admin can view an import status for the DAU	Pass	Pass
			Verify the timestamp is available	Pass	Pass
			Verify the status (pending, running, or done) is available	N/A	N/A
			Verify a message containing the details of the operation is displayed	Pass	Not Tested
ELRR	18	The ELRR portal shall maintain a mechanism to prevent hacking/loss of data integrity.	Cyber Security and Authentication	N/A	N/A
ELRR	22	The ELRR shall support up to 12000 local learner profiles that are aggregated into one global learner record for each learner.	Verify that ELRR data fabric supports 12000 local learner profiles that feed into each global learner record	N/A	N/A

ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
ELRR	23	Global learner record shall migrate between enclaves preserving data integrity.	Verify that authoritative data is kept with the owners of the systems where these data are generated	N/A	N/A
			Verify that references to the evidentiary records are preserved	N/A	N/A
			Verify that the digital version of each credential of competency has the pointer to the evidentiary chain of local records	N/A	N/A
			Verify that the digital version of each assertion of competency has the pointer to the evidentiary chain of local records	N/A	N/A
ELRR	26	Enterprise learner records shall indicate assignment/courses with Launched and Initialized assertions.	Verify that Enterprise learner records indicate courses with Launched assertions	N/A	N/A
			Verify that Enterprise learner records indicates courses with Initialized assertions	N/A	N/A
ELRR	27	Enterprise learner records shall indicate assignment/courses that have been closed out with Completed, Terminated, or Abandoned assertions.	Verify that Enterprise learner records indicates courses with Completed assertions	Pass	Pass
			Verify that Enterprise learner records indicates courses with Terminated assertions	Pass	Not Tested
			Verify that Enterprise learner records indicates courses with Abandoned assertions	Pass	Not Tested
ELRR	28	The ELRR shall be able to link logically lower level enclave data with higher level data to form a complete picture of performance.	Verify that ELRR is linked back to data and services at lower enclaves (Noisy LRS)	N/A	N/A
			Verify that ELRR is linked back to data and services at higher level data (Authoritative LRS)	Pass	Not Tested
ELRR	34	The ELRR shall store career state updates from (IAW xAPI MOM).	Verify that ELRR stores the career update of Certified	N/A	N/A
			Verify that ELRR stores the career update of Completed	N/A	N/A
			Verify that ELRR stores the career update of Passed	N/A	N/A
			Verify that ELRR stores the career update of Failed	N/A	N/A
			Verify that ELRR stores the career update of Success	N/A	N/A
			Verify that ELRR stores the career update of Launched	N/A	N/A
			Verify that ELRR stores the career update of Initialized	N/A	N/A



ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
			Verify that ELRR stores the career update of Waived	N/A	N/A
			Verify that ELRR stores the career update of Satisfied	N/A	N/A
			Verify that ELRR stores the career update of Abandoned	N/A	N/A
			Verify that ELRR stores the career update of Terminated	N/A	N/A
			Verify that ELRR stores the career update of Asserted	N/A	N/A
ELRR	36	The enterprise capability shall maintain all conferred competencies and effective dates for each learner.	Verify that ELRR maintains all conferred competencies	Pass	Pass
			Verify that ELRR maintains the effective dates related to each conferred competency	Pass	Pass
ELRR	41	The learner state shall be able to include events which link back to experiences in the local Experience Index (See 2019 TLA Report).	Verify that learner state is updated with the latest learner's information	Pass	Not Tested
			Verify that learner state is updated with competencies	Pass	Not Tested
			Verify that learner state is updated with learning content	Pass	Not Tested
			Verify that learner state is updated with the latest learners' activities	Pass	Not Tested
			Verify that learner state includes valid URL to identified learning events	N/A	N/A
			Verify that API endpoint from Experience Index (xAPI) to ELRR is created	Pass	Not Tested
ELRR	42	The learner state shall be able to include courses and assignments which link back to catalog entries in the (global) Enterprise Course Catalog (See 2019 TLA Report).	Verify that the Learner state shows courses in the ELRR that link back to the ECC	N/A	N/A
			Verify that API endpoint from ECC to ELRR is created	Pass	Not Tested
ELRR	43	The Learner state shall indicate whether courses, activities, competencies, have been asserted.	Verify that the Learner state indicated if courses have been asserted	N/A	N/A
			Verify that the Learner state indicated if activities have been asserted	N/A	N/A
			Verify that the Learner state indicated if competencies have been asserted	N/A	N/A
ELRR	69	The enterprise learner profile shall use schema.mil to maintain a record of aptitude definitions (as locally defined		N/A	N/A

ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
		name value pair sets).			
ELRR	70	Roles and Personae shall depict an arbitrary level of hierarchical specificity.	Verify Learner Role	Pass	Pass
			Verify Career Manager Role	Pass	Pass
			Verify Training Manager Role	Pass	Pass
			Verify System Admin Role	Pass	Pass
ELRR	72	The learner records shall be developed consistent with the TLA learner profile metamodel (Spec TBD IEEE P1484.2).	Verify Learners Personal records	Pass	Not Tested
			Verify Learners Organization records	Pass	Not Tested
			Verify Learners Employment records	Pass	Not Tested
			Verify Learners Course records	Pass	Not Tested
			Verify Learners Credential records	Pass	Not Tested
			Verify Learners Competency records	Pass	Not Tested
ELRR	73	Client and Server components of digital badges shall use the Open Badge Standard.	Verify that ELRR is using Open Badges standard to display digital badges	N/A	N/A
ELRR	74	The local capability shall support use of Open ID Connect (OIDC) to authenticate user identity.	Verify that ELRR is using Open ID Connect (OIDC) to authenticate user identity	N/A	N/A
ELRR	75	The enterprise learner profiles shall maintain consistent links to DoD ID (EDIP) from authoritative data source of identity - cannot be addressed in the MVP - DoD ID.		N/A	N/A
ELRR	76	The local learner profiles shall manage all data input and output requests using Secure REST and TSL.	Verify that all data input and output is using Secure REST	Pass	Not Tested
			Verify an API provides expected output for a given input	Pass	Not Tested
			Verify the inputs appear within a range and values crossing the range are rejected	Pass	Not Tested
			Verify an empty or null input are rejected when it is unacceptable	Pass	Not Tested
			Verify that incorrectly sized input is rejected	Pass	Not Tested

ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
			Verify that TSL is used to manage all data input and output requests for ELRR	Pass	Not Tested
ELRR	77	All REST requests shall use encrypted user credentials or single sign on to establish access.	Verify that user can access restricted information using trusted IP addresses only	N/A	N/A
			Verify that user is not able to upload a file exceeding the maximum permitted file size	N/A	N/A
			Verify that user is not able to upload a restricted file type	N/A	N/A
			Verify that user is not able to download data from a restricted site to check if the application is allowing such actions	N/A	N/A
Learner Profile	35	The Local Learner profile shall be able to report assertions for “other learner attributes or behaviors” and effective dates to the global ELRR capability.	Verify the level of proficiency for education experience is displayed	N/A	N/A
			Verify the level of proficiency for training experience is displayed	N/A	N/A
			Verify the level of proficiency for operational learning experiences is displayed	N/A	N/A
			Verify the Local Learner Profile displays the effective dates for the education experiences	N/A	N/A
			Verify that the Local Learner Profile displays the effective dates for training experiences	N/A	N/A
			Verify that the Local Learner Profile displays the effective dates for operational learning experiences	N/A	N/A
Learner Profile	39	Local Learner records shall be able to cache/store learner state data.	Verify a Local Learner state data	N/A	N/A
Learner Profile	44	Local Learner profiles will be updated according to local policy to indicate whether courses, activities, competencies, or credentials have been attempted and the completion state for each attempt.	Verify that attempt is logged with course is Launched	N/A	N/A
			Verify that attempt is logged with course is Initialized	N/A	N/A
			Verify that attempt shows the date and time	N/A	N/A
			Verify attempt number is displayed	N/A	N/A
			Verify the completion state is indicated each time a course is Launched	N/A	N/A
			Verify the completion state is indicated each time a course is Initialized	N/A	N/A
			Verify that attempt is logged when competency is Launched	N/A	N/A
			Verify that attempt is logged with course is Initialized	N/A	N/A
			Verify that attempt shows the date and time	N/A	N/A
			Verify attempt number is displayed	N/A	N/A
			Verify the completion state is indicated each time a competency is Launched	N/A	N/A
			Verify the completion state is indicated each time a competency is Initialized	N/A	N/A

ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
Learner Profile	52	The Local Learner record shall preserve references to evidentiary records in an (external) "authoritative" ADL LRS for locally earned competencies.	Verify that authoritative data is kept with the owners of the systems where these data are generated	Pass	N/A
			Verify that references to the evidentiary records are preserved	Pass	N/A
			Verify that the digital version of each credential of competency has the pointer to the evidentiary chain of local records	N/A	N/A
			Verify that the digital version of each assertion of competency has the pointer to the evidentiary chain of local records	N/A	N/A
Learner Profile	55	The Local Learner Profile record shall conform to the "to be identified" attributes in the P1484.2 Draft.	Verify Learners Personal records	Pass	N/A
			Verify Learners Organization records	Pass	N/A
			Verify Learners Employment records	Pass	N/A
			Verify Learners Course records	Pass	N/A
			Verify Learners Credential records	Pass	N/A
Learner Profile	56	The Local learner record shall display changes of learner data to the ELRR .	Verify Learners Competency records	Pass	N/A
			Verify that all changes to the Local Learner profile are integrated to the ELRR (log)	N/A	N/A
			Verify there is no errors in data entry, transfer, or transformation accuracy	N/A	N/A
Learner Profile	57	The Local learner record shall update the enterprise learner data within the ELRR for new learners.	Verify there are no missing or out-of-range values and logical inconsistencies	N/A	N/A
			Verify that when a new Learner is added to the local level, the Local Lerner Profile will be updated	Pass	N/A
			Verify there is no errors in data entry, transfer, or transformation accuracy	Pass	N/A
Learner Profile	60	The Local learner record shall update the enterprise learner data within the ELRR for new learners.	Verify there are no missing or out-of-range values and logical inconsistencies	Pass	N/A
			Verify that the Local Learner profile uses CaSS to report on competencies	N/A	N/A
			Verify that the education experiences attributes are incorporated to the Local Learner Profile	Pass	N/A
Learner Profile	65	The local learner profile shall integrate competency management service for reporting of competencies.	Verify that the training experiences attributes are incorporated to the Local Learner Profile	Pass	N/A
			Verify that the operational learning experiences attributes are incorporated to the Local Learner Profile	Pass	N/A
			Verify that the Local Learner Profile includes the effective dates for education experiences	N/A	N/A
Learner Profile	66	ELRR to display a list of assertions (competencies, credentials, other learner attributes) and their effective dates.	Verify that the Local Learner Profile includes the effective dates for training experiences	N/A	N/A
			Verify that the Local Learner Profile includes the effective dates for operational learning experiences	N/A	N/A
			Verify that the Local Learner Profile includes the effective dates for education experiences	N/A	N/A
Learner Profile	67	The local learner profile shall store user specified learner preference		N/A	N/A

ELRR Component	ID	Requirement Description	Test Case Description	Deloitte Test Results	UAT Test Results
		attribute data as defined in the P1484.2 Draft.			