AMERICAN WORKFORCE
POLICY ADVISORY BOARD

White Paper on Interoperable Learning Records

Data Transparency Working Group

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Objective

Members of the American Workforce Policy Advisory Board's Data Transparency working group authored this white paper, with major contributions by subject matter experts from their organizations as well as outside experts. The American Workforce Policy Advisory Board's Data Transparency working group reviewed the white paper and submitted to the full Board. Institutional affiliations listed below are for identification purposes only and does not necessarily indicate endorsement by any organization.

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Several of the organizations that contributed to this white paper have already developed and implemented components of interoperable learning records, albeit not on the scale envisioned in this paper. This paper does not describe these organizations' individual efforts. Instead, it lays out definitions, principles, and recommendations to catalyze further cooperation across organizations like theirs and others and ultimately lead to expanded pilots and adoption of interoperable learning records across sectors and the country. Implementing this paper's recommendations will require engaging a much broader set of stakeholders to ensure future policy and pilots related to interoperable learning records are informed by the full, constantly advancing range of existing innovations and approaches.

Executive Summary

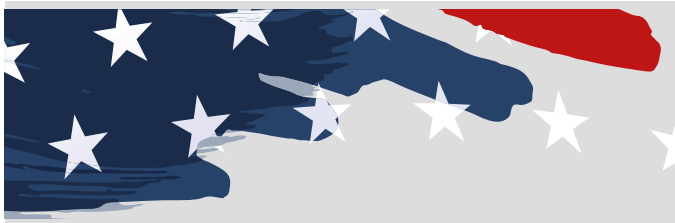
American workers, who are engaged in lifelong learning, deserve to have a way to translate their full education, training, and work experience to a record of transferable skills that will open the doors to higher wage occupations and careers. This is one of the fundamental problems President Trump set out to address in the July 17, 2018, Executive Order 13845, establishing the National Council for the American Worker (NCAW). He charged this interagency council with drafting the first-ever national workforce strategy which includes increasing data transparency to support informed decision making among American students and workers. Through this Executive Order, President Trump also established the American Workforce Policy Advisory Board (AWPAB). This 25-member federal advisory council is developing actionable recommendations for the NCAW under four focus areas and four corresponding working groups:

1. Develop a public campaign to promote multiple pathways to career success
2. Increase data transparency to better match American workers with American jobs
3. Modernize candidate recruitment and training practices
4. Measure and encourage employer-led training investments

Better information on workers' skills attainment, employers' skills needs, and educational institutions' programs to increase skills is an essential element across all of these focus areas. The AWPAB's Data Transparency working group has identified interoperable learning records (ILRs) as a novel and technically feasible, achievable way to communicate skills between workers, employers, and education and training institutions.[1]

Background: Empowering the American Worker

A learning record is verifiable information about a person's achievements in education or training processes, formal or informal, classroom-based or workplace-based. An ILR is a system that contains, and can manage communication of, credentials that describe an individual's skills and achievements. The potential audience for ILRs in the United States is enormous — 160+ million earners,[2] more than six million employers,[3] 700,000+ unique credentials offered,[4] 23,000+ apprenticeship programs[5], and 7,000+ institutions of higher education.[6] Today, job seekers rely on resumes, job applications, and credentials to tell prospective employers about their skills and work experiences.[7]



POTENTIAL AUDIENCE

160M+ earners

6M+ employers

700K+ unique credentials

23K+ apprenticeship programs

7K+ higher education institutions

1 See slide 5 of https://www.commerce.gov/sites/default/files/2019-06/AWPABJune18Slides_FINAL.pdf

2 https://fred.stlouisfed.org/series/CLF16OV

3 https://www.census.gov/data/tables/2016/econ/susb/2016-susb-employment.html

4 Credential Engine research. Report forthcoming on September 25, 2019.

5 https://doleta.gov/oa/data_statistics.cfm

6 https://nces.ed.gov/fastfacts/display.asp?id=84

7 For purposes of this paper, knowledge, skills, competencies, outcomes, proficiencies, etc. are referred to simply as "skills."

These traditional methods fail to capture the full range of skills that workers acquire in the classroom or on the job, do not allow for easy transfer of information from one job or learning experience to another, and cannot easily be combined into a single profile that represents the entirety of an individual's abilities. Additionally, these documents do not typically represent the skills in a manner that is universally understood, do not allow for easy verification that a specific skill was demonstrated by the learner, and do not give any indication of if/when the skill becomes outdated or needs to be renewed.

To fully realize the potential of empowering America's workers, ILRs must be transparent, relevant, equitable, private, secure, portable, shareable, verifiable, and, of course, interoperable. Adoption and implementation of ILRs would provide a system where Americans have agency over verified and universally understood records of their accomplishments wherever or however those accomplishments occurred, whether they are formal or informal, in-person or online, certification exams, single courses or full programs, discovery-based or training experiences, manager feedback or formal performance reviews, community-based library activities or non-profit experiences, and more.

One way to assess learners' fitness for specific jobs is to compare their skill sets against job requirements. In career planning, an ILR can allow learners (including workers looking for new jobs or expanded opportunities) to compare their skills to standard, interoperable, employer-deployed lists of occupational skill requirements. As learners consider new jobs, they can invest in learning the skills specific to that job, and when advocating for a promotion, they can use their ILR as evidence of their qualifications for the new role. For specific jobs, the learner and the employer can compare applicants' skills against the job's basic and more nuanced or granular requirements. This capability can also result in a more equitable hiring process as employers can hire based on skills, reducing the impact of implicit biases in the hiring process.

The ability to more efficiently match people with jobs will benefit both workers and employers by reducing time to hire and creating a more efficient labor market. According to the Society for Human Resource Management's (SHRM's) Human Capital Benchmarking Survey, the average time for employers to fill a position is 42 days with an average cost per hire of $4,129.[8] In larger organizations, it is often the case that human resources (HR) professionals review the candidate pool and pass on potentially qualified candidates to hiring managers. Without a recognized set of universally understood skills and competencies, employers may be missing out on qualified candidates because hiring managers and HR professionals might not be aligned on the required skills for a job.

AVERAGE TIME & COST PER HIRE[8]

42 days

$4,129

Being able to easily identify an applicant's skills and competencies will improve the hiring process. A widely used system that enables searching

8 Society of Human Resource Management's 2016 Human Capital Benchmarking Survey results available at https://www.shrm.org/about-shrm/press-room/press-releases/Pages/Human-Capital-Benchmarking-Report.aspx

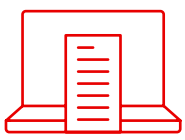
across ILR profiles could lead to more precise matching between applicants and employers, as well as transform how educational institutions, government workforce development efforts, corporate programs, and other training providers align learning outcomes and standard competencies to delivering in-demand skills. ILRs can allow employers to make hiring decisions based upon verified demonstrated skills rather than upon claims about previous job titles and completed courses. Empowered with this information, employers can better match a candidate's skill set with required occupational tasks.

Furthermore, workers are increasingly gaining new skills in contexts and in ways that are not acknowledged by traditional academic credentials. American workers learn by enhancing knowledge, skills, and abilities in a variety of ways: through obtaining academic credentials, non-traditional learning channels, on-the-job training, military experience, professional development, and other types of formal and informal learning.

As the recognition of non-traditional skills acquisition has changed, so must the traditional systems that students, workers, employers, and education and training providers use to record and communicate those new skills. The United States does not yet have a widely adopted and accessible system that allows individuals to own records of their achievements acquired through various means.

Interoperability is essential to the success of a system of ILRs. To connect learning gained from many different education and training providers, data must be able to be shared across multiple technology systems and sectors. Interoperability is built on open, common standards for data, both through the human terminology used and the machine-readable information that enables data transfer, linking, and combination of data from different sources. ILRs that use open standards can bridge education, training, and employment, thus helping employers recognize learners' competencies and allowing learners to exhibit their abilities, to apply their skills, and to advance in their careers. For example, using common standards in an ILR can enable the automatic match of a person's abilities to a job description or indicate opportunities for targeted upskilling.

This paper lays the first stones of the foundation for the development of tools that may enable adoption of ILRs across the education and workforce ecosystems. American workers, who this paper will refer to as learners, can share ILRs with employers to attain the best jobs that match their skill sets. This paper provides an overview of the key ILR terminology and the ILR ecosystem. Additionally, it lays out the core protocols that the system would require. The last section outlines the following recommendations to the AWPAB for moving forward with demonstrating the viability of the ILR ecosystem and towards implementing a scalable ILR system:



1
Create an ILR inventory

2
Convene an expert group to develop a project plan

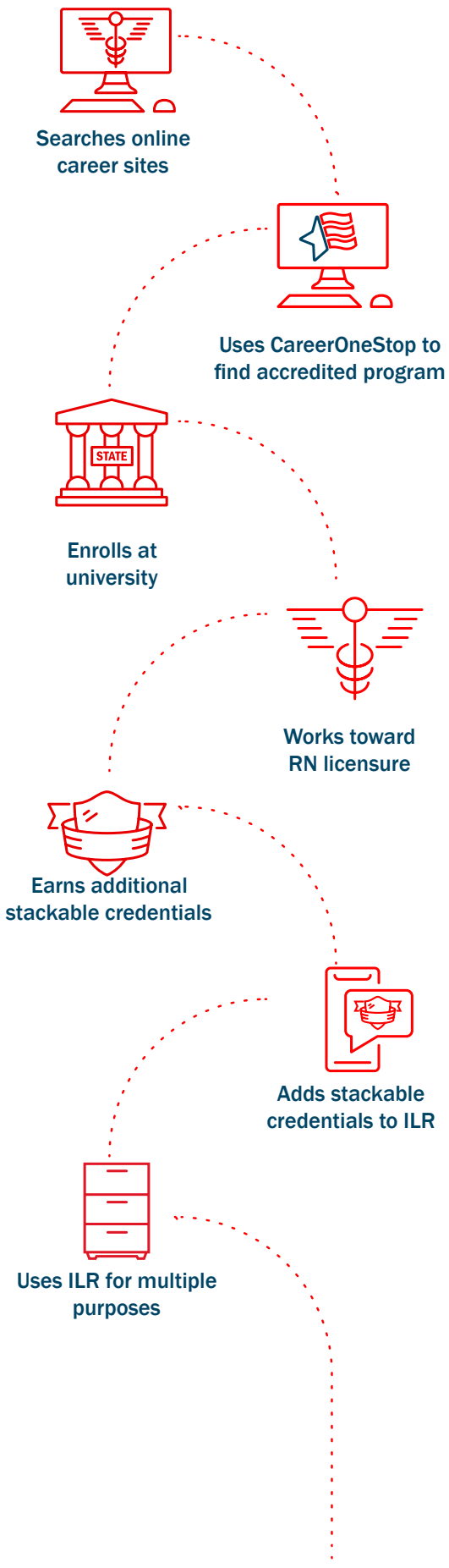
3
Champion fast-track prototyping

What is an Interoperable Learning Record?

To begin the discussion on ILRs, it is useful to consider Olivia Hafez and a near-future scenario.[9] Olivia wants a secure job with opportunities for advancement. Looking at career sites online, she discovers that the field of registered nursing has strong employment prospects, excellent earnings potential, and pathways for promotion near where she lives. She uses CareerOneStop[10] to find an accredited nursing program that best meets her needs and is endorsed by the Commission on the Collegiate Nursing Education (CCNE) and/or the Accreditation Commission for Education in Nursing (ACEN), which is required for credential eligibility for employment as a Registered Nurse (RN). She enrolls in the program at State University.

During the program, Olivia not only works toward RN-licensure eligibility, she also earns stackable professional, verified credentials along the way for part-time employment in the health sciences. More specifically, in addition to prescribed skills and procedures required for Certified Nursing Assistant (CNA) practice, she has also learned safety protocols, electronic records keeping, and communicating with people under stressful conditions that satisfy eligibility requirements for credentialing as a Certified Medical Administration Assistant (CMAA). Olivia can now gain access to entry-level employment in the clinical and administrative support aspects of her chosen profession, which reduces her need for federal financial aid.

As Olivia earns the stackable health science credentials, she adds them to her ILR, which is a private and secure digital application or interface available on her devices, analogous to a file cabinet, where she can manage all her data and records and also authorize sharing. Olivia uses her ILR for multiple purposes as a permanent, verifiable set of records.



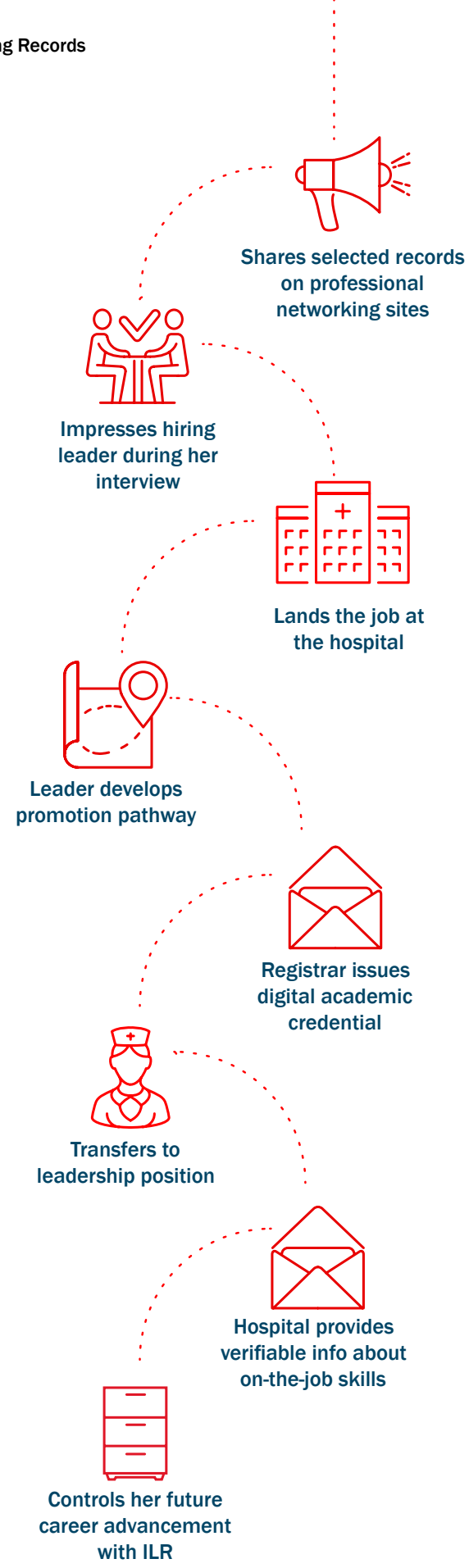
9 The persons and institutions named in this scenario are fictitious.
10 https://www.careeronestop.org/Credentials/default.aspx

Olivia gives permission to make selected records available to others on her social media professional networking site, where employers' systems use industry-standard terms and credentials that allow them to search across multiple platforms for candidates with specific skills and proficiencies. Very early in her RN degree program, Olivia is a candidate for a position at a local hospital.

In her job interview she is proud to talk about her relevant skills, including the work she did to achieve her CNA and CMAA credentials and all the relevant badges that required skills such as communication, safety protocols, and electronic records systems. This sets her apart from other candidates, and she accepts a position at Declan Hospital where her new manager is impressed by her strong clinical and administrative skills documented in the curated ILR she presented.

Olivia's Director of HR has read research by SHRM that shows offering employees career mobility can result in better retention and less turnover.[11] Because of this, Olivia's manager offers her a promotion pathway building on Olivia's goals and strengths, including a scholarship program for completion of her RN degree and license. Olivia now has the ability to focus even more diligently on her RN degree plan. Upon completion of her accredited RN program, the registrar will issue Olivia a digital academic credential that can be validated for RN licensure examination, which she completes successfully to become a state-licensed RN. Olivia is transferred to an administrative leadership position of a clinical unit (employing her CNA & CMAA credentials and experience).

During her next performance review, the hospital provides digital, verifiable information to Olivia about the skills she has learned and demonstrated on the job, including her recent work in an Emergency Department setting. Olivia's ILR gives her control over verified records of her achievements across contexts and pathways to her future career advancement goals to the benefit of her employer and patients.



11 https://www.shrm.org/resourcesandtools/hr-topics/talent-acquisition/pages/employees-stay-career-mobility-pay-raises-culture.aspx

Terminology and Key Conditions

Table 1 defines key terms relevant to the ILR discussion.

Term	Definition
Learner	An individual engaging in formal or informal learning processes that increase and evolve their skills. Synonymous with "worker," "student," and "job seeker."
Issuer	An organization such as an academic institution, employer, training provider, or testing agency that issues verified credentials to learners.
Consumer	An organization such as an employer, academic institution, or other to whom a learner may be applying and to whom the learner is submitting credentials in the form of an ILR for consumer consideration.
Learning record	Verifiable information about a learner's achievements in education or training processes, formal or informal, classroom-based or workplace-based. Learning records can broadly include a learner's credentials, skills, assessment results, grades, credits, co-curricular activities, experiential learning, internships, externships, work activities, and evidence of achievement. Learning records can reference common descriptions of credentials, skills, and other achievements.
Ontology/ framework	A set of terms and relationships that represent the structured content of a topic. Ontologies help communities develop trust through shared understandings. For example, an ontology related to a specific occupation might describe both the skills needed in the field and explicit relationships between the "work roles," "tasks," and "knowledge, skills, and abilities." This type of ontology facilitates occupational workforce communications, mappings to other fields, and machine-actionable representations (i.e., schemas) that applications could support.
Credential	A documented award that can be issued by a responsible organization when a learner has achieved specified learning and assessment outcomes. "Credential" is an umbrella term that includes degrees, diplomas, licenses, certificates, apprenticeships, badges, and professional/industry certifications. Credential definition" refers to the general description of the award and "achievement assertion" refers to the specific instance of the assertion about a learner. This paper uses the term "credential" to refer to the general description of a credential and the award of a credential to a specific person. Credentials and the skills they represent can be described using common ontologies.
Skill	Concrete action or ability that an individual can perform. "Competencies" and "skills" are often used interchangeably. The term "skill" refers to both the general description of a skill and the assertion that a specific person has demonstrated a skill. Skills can be described using common ontologies and collectively organized in "competency frameworks" and "skill sets."
Achievement assertion	The key concept that enables learning records to be combined from multiple sources is distinguishing the general credential or skill description, which can be shared between learners, from the achievement assertion for a specific learner. The achievement assertion record is the specific instance of that credential or skill description claimed by a specific issuer about a specific learner at a specific time. It can contain additional information regarding key concepts like evidence, verification, and endorsement as well as evidence to support the credibility of the issuer. This paper uses the term "credential" to refer to the general description of a credential and the award of a credential to a specific person.
Career pathways	Progressive levels of education and training that help learners achieve valuable credentials and skills that lead to educational and career advancement. In some cases, pathways will be linear (progressing through entry level to higher roles and/or through stackable credentials) and in some cases, they will have lateral, latticed, or adjacent connections. ILRs can provide support for a learner's qualification to advance along a pathway.
Learning outcome	A learning outcome is a clear statement of what a learner is expected to be able to do, know about and/ or value at the completion of a unit of study or learning activity and how well they should be expected to achieve those outcomes. It states both the substance of learning and how its attainment is to be demonstrated.[12]

12 Adapted from http://www.teaching-learning.utas.edu.au.

ILRs need more than technology to be successful. There are fundamental conditions that make them valuable for learners, employers, and educators (Table 2). These conditions are not all-encompassing, but they provide useful ways of discussing current practices and how to improve credentials, skills, and learning records — both generally and in the analysis of specific examples.

Table 2. Key Conditions for Interoperable Learning Records

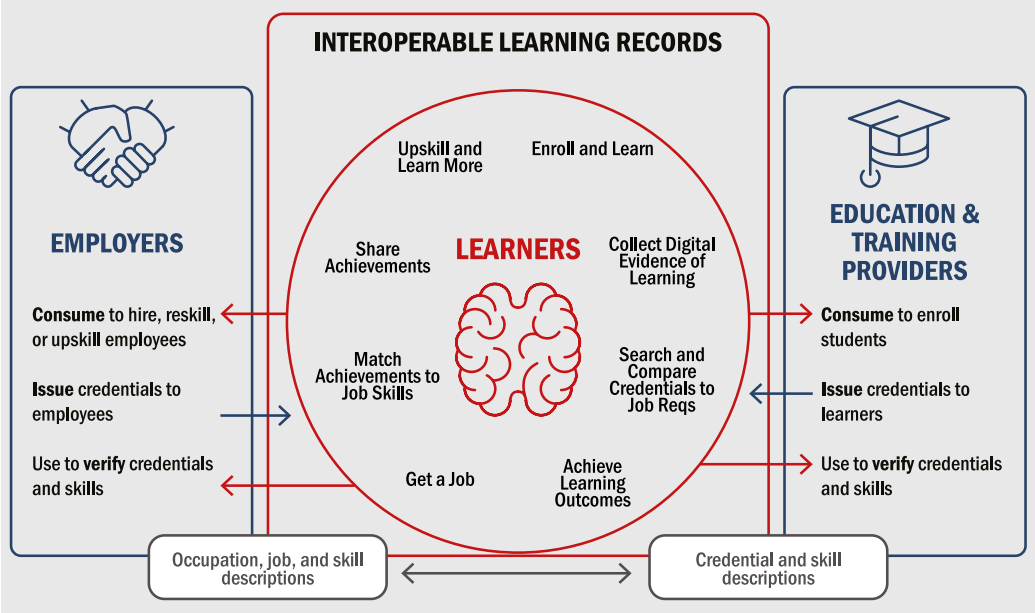
Criteria	Description
Transparent	Clearly defined, enables comparison, and is based on shared open standards, common language/descriptions, and skills ontologies/frameworks. Provides contextual information for determining relevance and skills mastered.
Relevant	Carries meaning and value applicable to useful purposes, including employment, career advancement, and ongoing learning. Enables endorsement by recognized experts and authorities for specific purposes. Remains up-to-date.
Equitable	Enables educational, social, and economic mobility for people with varying abilities, preparation, and skills. Supports pathways to better employment opportunities and to further education and training.
Private	Access to selected fields of the ILR is limited to the parties, purposes, and duration specified by the learner. Complies with relevant privacy standards and permissions to protect the individual's identity and record.
Secure	Complies with relevant security standards to protect the data from unauthorized editing or access.
Portable	Can be used in a variety of environments, across sectors and states, connecting to multiple purposes and opportunities in employment, education, and other contexts. Allows the individual to control the location, organization, and combination of their own records for their own uses.
Interoperable	Uses open standards and common ontologies/frameworks to enable data to be machine readable, exchangeable, and actionable across technology systems and, when appropriate, on the Web. Supports combinations of data from multiple sources. Enables human interoperability and can be understood by people in different occupations and industries from diverse backgrounds.
Shareable	Enables learners to share their ILRs when they apply for jobs or educational opportunities. Learners reserve the right to grant appropriate permissions to provide relevant access for the time duration specified by learners.
Verifiable	Can be digitally confirmed by one or more issuers to be authentic and intact. Supports expiration and revocation by the issuer.

The Interoperable Learning Records Ecosystem

Figure 1 displays the conceptual ILR ecosystem of stakeholders. The learner is at the center of an ILR ecosystem, continuously upskilling through cycles of learning and achievement. Learners collect credentials from multiple issuers (education, training, testing, and employer organizations) and curate them through an ILR application or interface to understand their own strengths and weaknesses as they progress on career pathways. Employers and education and training/testing providers are other key stakeholders in an ecosystem, as they both issue credentials and consume the ILRs that learners curate.[13]

Learners choose to earn credentials that are relevant to their career needs by participating in workplace learning or by enrolling in education and training programs. Common ontology descriptions for credentials enable learners and consumers to transparently understand and compare education and training programs.

Figure 1 | Interoperable Learning Record Ecosystem



Learners choose to share selected credentials in their ILRs with employers, career services, educators, and social networks, enabling them to match and apply their skills to career opportunities. Potential employers and educators can digitally verify the individuals' credentials — that is, whether the issuer asserts that the learner did what was necessary to earn the credential. The learners' cycles of upskilling and continuous learning builds on a secure and reliable foundation of ILRs.

13 This paper discusses the relationship between credentials and ILRs as the simplest scenario to describe the ILR ecosystem. However, some learning occurs without earning a credential. There is innovative work in the ILR community to enable employers and others to directly issue verification of skills, or competencies, that learners demonstrate, even in the case where there is not a credential awarded.

The issuers, learners, and consumers that come together in an ecosystem represent overlapping interests and have common challenges. They each also have unique requirements. Issuers of credentials are also often ILR consumers. Table 3 describes selected role-based activities of these stakeholders.

Table 3. Roles of Issuers, Learners, and Consumers

Issuers

Educators issue credentials for programs in schools, universities, and training programs.

Certification and licensure organizations issue credentials to learners who have met their requirements.

Employers issue credentials to employees as records of accomplishment in workplace skills, training, and compliance.

Learners

Learners use their ILRs to track their own credentials and skills and to chart their progress on career pathways.

Learners describe skills they gain on their own as they actively maintain their records and document their skills.

Learners curate their credentials and achievements into customized ILRs to make them relevant for specific jobs or educational opportunities. By definition, a curated ILR is one that the learner has approved for release to specific entities.

Learners share their ILRs when they apply for jobs or educational opportunities, or for other desired purposes.

Consumers

Employers use human- and machine-readable job descriptions that adhere to standards regarding the definition of needed skills.

Employers consume curated ILRs when they use them to evaluate job candidates and verify their credentials, optionally filtering for desired credential attributes like skills, location, etc..

Educators and training organizations consume ILRs when they assess a learner's current skill set in order to identify gaps and recommend additional learning opportunities.

Educators and employers consume ILRs when they leverage an ILR ecosystem as a strategic data asset to estimate skill supply and demand.

Hiring and recruitment platforms consume curated ILRs to aggregate talent pools of potential employees.

The power of ecosystems, as seen in the case of Olivia, lies in direct and indirect network effects. Job seekers' demand for an ILR ecosystem is partly determined by the number of employers who actively recruit based on ILRs. More job seekers will demand access to an ILR ecosystem if a large number of employers and educational institutions rely on the system. At the same time, as more job seekers are represented in an ILR ecosystem, more employers will want to tap into that ecosystem's talent pool. If an ILR ecosystem includes many potential employers of learners who use ILRs, traditional brick-and-mortar schools, online training platforms, apprenticeship programs, and other educators will want the credentials they issue to be well-represented. The demand for access from learners and individuals looking to up-skill or reskill will be greater if there is a robust, demonstrable ecosystem pipeline from physical and digital classrooms to actual jobs. The viability of any ecosystem is contingent on the viability of each participating side and each side's viability impacts the viability of all others.

The ILR process will need to address differing incentives and costs to participate, and to participate fully. Each employer participates in to the system not only by using ILRs for hiring, but also by issuing credentials to employees for their accomplishments in workplace skills, training, and compliance. There are obvious incentives for employers to do the former, but the incentives for employers to report and verify their employees' skills are less clear. Employers face the classic challenge of retaining highly-skilled workers. However, employers can leverage the ILR ecosystem to improve the mobility of employees out of entry level positions and into career pathways. Balancing the incentives to participate is important to ensure widespread and scalable adoption.

Protocols

If widely adopted, ILRs can provide a common approach to creating, maintaining, and sharing skill-related credentials and validation of learning, thereby providing a unified view of an individual's accomplishments. To successfully perform this role, ILRs need to integrate and coordinate credentials from a wide range of participants without requiring direct coordination or synchronized actions.

Interoperability depends on protocols that provide common frameworks and language to integrate learning records across independent parties without requiring them to formally coordinate their efforts. Protocols enable a broad range of stakeholders to work together, fostering innovation without imposing explicit oversight.

As a comparison, the innovation, efficiency, and opportunity unleashed by the internet was made possible, in large part, by open standards. Various internet browsers display webpages in the same manner (as long as the browser follows standards). Different models of computers allow users to surf the web in generally the same way. Transport and Internet protocol standards (TCP/IP) make it possible for machines in any country or by any maker to communicate easily.

The interoperability of the internet was made possible, in large part, by the Open Systems Interconnection (OSI) stack of the 1980s.[14] The model has seven layers, in which each successive layer serves the level above it and is served by the layer below it. No layer needs to worry about the implementation details of another layer.

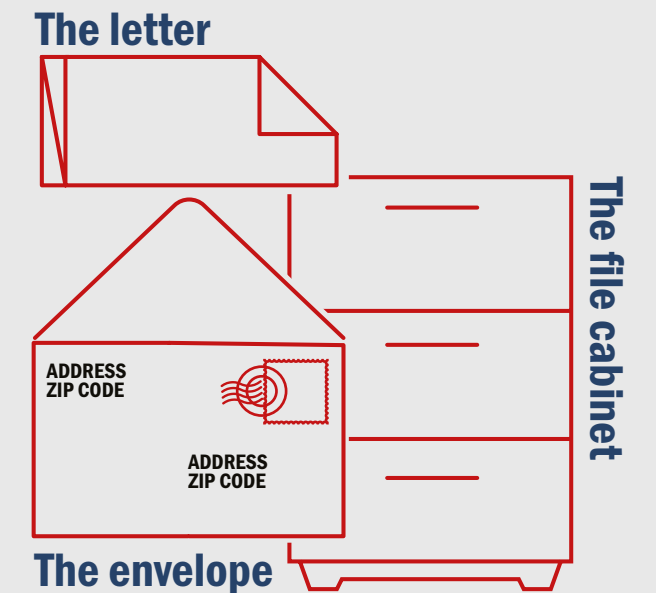
14 https://en.wikipedia.org/wiki/OSI_model

The ILR should be built upon open standards in order to power the same ecosystem innovation capability that has been seen in other areas of computing. Initially, ILR protocols could operate at four independent layers, with more to emerge as necessary:

- **The file cabinet (ILR)**: allows the curation and sharing of learner credentials
- **The envelope**: verifies the integrity of credential data and issuer/learner identity
- **The letter**: contains content details of a specific credential issued to a learner
- **The ontology**: represents common language and schemas for occupations, jobs, competencies/skills, and credential types, etc.

Comparing the ILR protocol to a file cabinet-based system helps to explain how ILR protocols generate interoperability. Consider the metaphor of a learner maintaining a file cabinet where they store credentials in the form of envelope-containing letters from each institution, sent to the learner through the postal system (Figure 2). Each envelope contains information on the outside and on the inside. The outside of the envelope contains public information in the form of a destination and sender address formatted in a standard way, including the use of a standard zip code. In this metaphor, a zip code functions as a type of ontology representing an agreed upon geographic destination. On the inside of the envelope, there is a private letter with private information. When the letter is mailed, the post office imprints the stamp with information such as location and date. The postmark establishes when the envelope went through the mail service and that the envelope cannot be delivered again without a new stamp.

Figure 2 | Letter in the postal system



Like a file cabinet, the ILR can store credentials safely so that the learner can choose which ones he/she wishes to share with potential employers. When locked, it keeps the credentials private and safe from tampering. The envelopes contain important information about delivery while the letter itself contains specific details about the earned credential. The learner is free to share specific credentials with specific employers as the learner chooses.

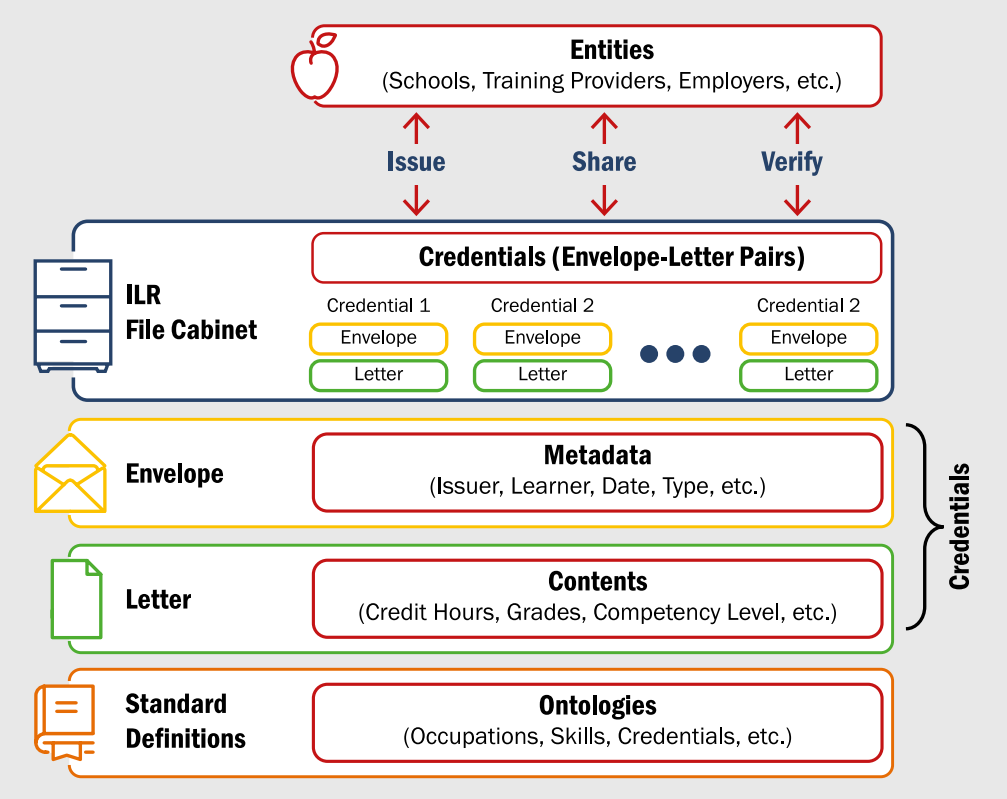
A credential, then, can be imagined as a combination of two components: the letter (the contents) and the envelope (to transfer the contents around) containing the letter and sealed with embossed wax to both convey sender identity and ensure content privacy. The credential envelope and letter formats drive interoperability and support the following stakeholder needs:

- Digital, tamper-evident, and machine readable;
- Learner at the center of exchanges of their data — they must consent to share;
- Learner cryptographically proves the credential is for them;
- Verification does not require consulting the issuer;
- Credential exists on an immutable record that is not dependent upon any issuer and has an audit trail connected with it, allowing for transparency on the record's "journey";
- Content of the credential can conform to a variety of schemas and vocabularies;
- Robust consideration of privacy, security, accessibility, and internationalization.

Just as the OSI standards enabled innovations to occur at any layer while leaving other layers unchanged, ILR protocols will enable the same. Innovations can occur at any layer, while building on existing solutions at other layers, or mixing and matching solutions at different layers and working across layers as needed (Figure 3).

Products and services offered in the marketplace can be at the envelope layer, the letter layer, the file cabinet layer, or some combination of layers. As with the differing approaches of operating systems for personal computers or smartphones, innovation approaches that focus on single layers may increase diversity of features and potentially drive price competition, while innovations that combine layers may improve usability while potentially reducing price competition.

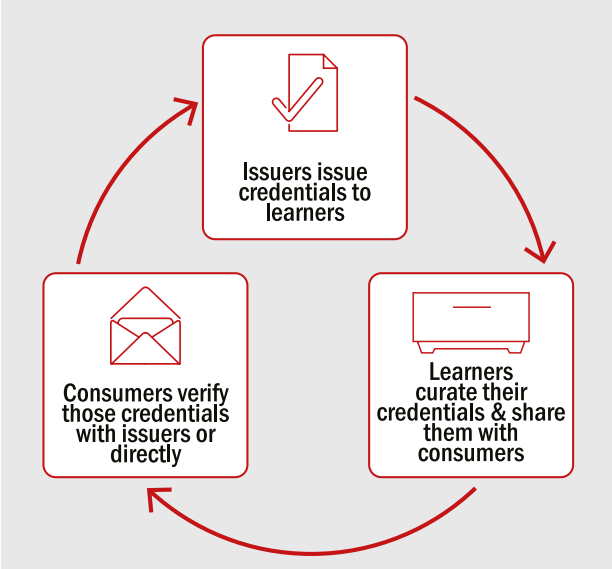
Figure 3 | Four-layer approach to the interoperable learning record protocol



The File Cabinet (ILR)

The ILR is the learner's place to receive, curate, and share credentials from one or more issuers. Systems currently in use that are consistent with at least some features of the ILR may go by the designation "backpack" or "wallet." Learners reach the ILR via a web browser or mobile app. ILRs could be hosted by third parties (who do not have access to the contents of the ILR), assembled independent of third parties through distributed ledger technologies, or, more rarely, by learners directly. Oversight of ILR hosts may be needed to ensure that privacy and security requirements are being met. The oversight role may be served by an organization similar to those that accredit higher education institutions or to those that audit corporate books.

Figure 4 | Credential cycle



The learner creates his/her ILR and then uploads and organizes credentials from one or more issuers (Figure 4). This action highlights two standards requirements related to ILRs: they need to be able to communicate with the credential issuing systems of an issuer or a distributed ledger via a mutually understood protocol and they need to be able to recognize and store credentials that were produced in different formats and potentially by different issuers

The optimal approach is that credentials are verified by the issuer upon issuance, such that the credential itself, perhaps in combination with a distributed ledger, will ensure the verification is true and secure. In this case, consumers will be able to trust verified credentials without having to re-verify them with the issuer. And issuers would not need to verify previously issued credentials, a task that many spend significant amounts of effort doing currently.

In preparation for sharing credentials with a consumer, the learner curates his or her ILR in a unique representation for a specific purpose such as a job opening. As the ILR contains the learner's full set of skills and abilities (the file cabinet), the learner might remove credentials showing non-relevant skills. Similarly, the learner might remove credentials that do not meet a certain threshold (e.g., degrees and courses are included, but webinars and readings are not). In addition, the learner might add self-asserted (as opposed to verified) information ranging from a cover letter to a description of relevant learning that did not result in a credential. From a consumer perspective, employers from various industries may seek to emphasize one type of achievement over another as being more relevant to their requirements.

Once satisfied with the curated ILR, the learner shares it with the consumer. This sharing points out a third standards requirement for ILRs: they need to be able to interface with HR and other systems employed by ILR consumers. On the receiving end of the ILR, the consumer can choose to consider any of the verified and self-asserted credentials.

The Envelope

Credentials represent learning experiences ranging from participating in a workshop to a full degree program to taking an online course to demonstrating mastery of a competency.

Adding digital technologies to the traditional credentials space enables four broad benefits:

- It increases efficiency of exchanging and evaluating credentials;
- It reduces fraud by enabling more reliable ways to protect and verify the credentials;
- It provides transparency and provenance to the credential, so the consumer understands its content and history;
- It increases learners' control over their credentials, enabling a verifiable history of lifelong learning.

The envelope protocols are critical to realizing these four benefits. The envelope contains information about who issued a credential and who it was issued to. It creates robust links to the identity of an issuer (e.g., a specific university or employer) and the learner (e.g., a particular person). It also ensures that nobody can look at the content inside the credential without authorization. And these identities and the integrity of its content can be verified to detect fraud or tampering.

Below are design principles that an envelope should fulfill (Table 4).

Table 4. Design Principles for an Interoperable Learning Record "Envelope"

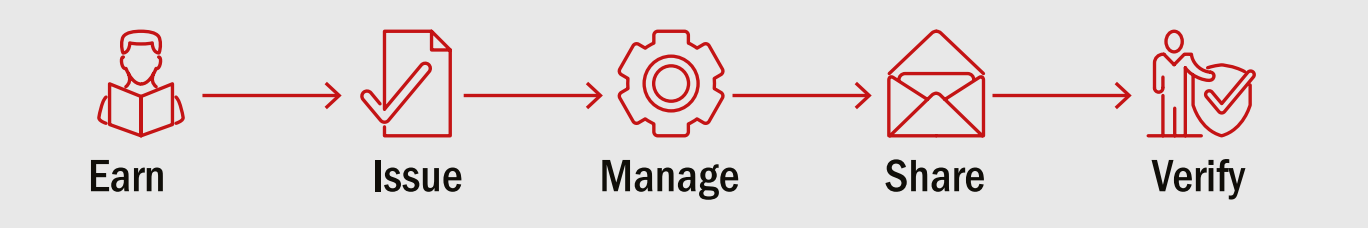
Empower Learners	
Require mutual consent to issue credentials	An issuance of a credential should require the consent of both the issuer and learner.
Optimize the need for disclosure	Sharing credentials should be optimized to the necessary amount of disclosure, in particular for any personally identifying information (PII). For example, learners need not send a detailed transcript if all that's requested is the equivalent of a diploma. Learners can tailor the information they share to prove qualifications. It is the role of the consumer of an ILR profile to perform due diligence to determine what information is needed for to qualify or disqualify an applicant.
Prevent tracking	As learners curate ILRs and share their credentials, the system should minimize the ability of the issuer or any external party to track activities of the learner or correlate information about them. For example, the learner may share credentials without involving or even informing the issuer.
Enable recovery or distributed access	The learner should be able to recover or access through other means their credential in the case of loss of access, perhaps with the support of the issuer or, for instance in the event that the issuer no longer exists, directly with a trusted record of the credential having been legitimately issued.
Offer multiple options for credential storage	Learners should be able to store and manage their credentials as they choose, subject to ILR standards requirements.
Prove trusted learner identity	The credential is only of value if a learner can reliably prove that the credential was awarded to them. Learners should be able to use their credentials during digital interactions with other systems that require authentication.

Enable Trust	
Prevent tampering and fraud	Minimize the ability to forge credentials. Credentials should be tamper-evident in content and presentation and have reliable means of establishing authenticity.
Allow only necessary auditability	Issuance and revocation events should be auditable (without disclosing PII). In addition, to provide verifiers with more confidence, this allows issuers to detect fraudulent activity. Auditability with timestamps may assist when someone needs to prove the credential was valid at some point in the past.
Provide display integrity	Humans rely on a range of cues (watermarks, signatures) to make a decision about a credential's integrity. An under-emphasized aspect of digital credentials is the integrity of how credentials may be displayed on different screens or devices ("display integrity") making sure that the underlying data and the visible credential are consistent.

Support Diverse Use Cases and Technology Best Practices	
Balance standardization and flexibility	The system should provide standards as a way to verify credentials from many different issuers and support different types of credentials (and credential data standards).
Remain efficient, scalable, fault-tolerant, and highly available	High-certainty verification of credentials should be possible with minimum time and cost overhead and should scale to the demands of global higher education and workforce systems. All aspects of the system that are relied on for learner and consumer usage should be highly available with appropriate consideration of points of failure.
Ensure longevity	The system should ensure that credentials can be used by learners at a minimum throughout their lifetime.
Design for sustainability	The system should avoid overly resource-consuming solutions and should design technical as well as governance structures that can evolve.
Prevent lock-in	No part of the standards or system should require the use of a proprietary solution or specific vendor or preference for any technological approach, though vendors are encouraged to build standard-compliant solutions. It's especially critical that learners have control over where their data resides, how they control it, and are not locked into a specific provider or solution.
Enable integration with existing infrastructure	The issuer functionality should be easy to integrate into systems of record, supporting the features demanded by all players involved in issuing credentials, such as ease of issuance, revocation, recordkeeping, and so on.
Ensure accessibility	The system should respect accessibility guidelines and best practices.
Support global use	Enable use in different languages, jurisdictions, regulatory environments, and conventions.

Distributed ledger technology provides an example of how an envelope may be implemented. At its simplest, this technology is a type of online distributed database used for tracking transactions. A transaction might be economic (in the case of cryptocurrencies) or it might be record-keeping (for example, the issuance of credentials). Distributed ledger technology's unique characteristics include that records in the database cannot be altered or deleted, that there are many copies of the database (in part to defend against an inadvertent or malicious actor altering or deleting a record), that it supports digital self-sovereignty, and that access to the database can be controlled through permissions.

The starting point for issuer access to this system architecture is a governance layer that recognizes trusted issuers while allowing public access to issue and read. The distributed ledger could record the issuance of a credential by an issuer or the revocation of the credential by the issuer at a later time if the credential is no longer valid. When the learner chooses to share their credentials, the consumers (typically academic institutions, employers, or others to whom the learner is applying) could use a variety of applications and management tools to receive the credentials and automatically verify the credentials against the issuer's issuance. That verification would complete the credential cycle of earning → issuing → managing → sharing → verifying.



The Letter

The "envelope" of a credential is the technology container and provides provenance information about the credential, such as who issued it and who earned it. The "letter" inside the envelope spells out the specific achievement.15 Information in the letter could include the type of credential (e.g., university degrees, professional licenses, badges, certificates), skill level (potentially indicated by passing an exam or the time spent in the classroom or in training), and other detailed information. Once the learner has completed the requirements to earn a credential, the issuer could issue the credential to the learner through a secure envelope.

In general, the letter is not limited to any particular fields or body of information. However, it may be helpful to standardize basic entries related to credentials while allowing for specifics to vary. The letter may also contain information beyond credentials earned from academic institutions or training providers. Examples include drivers' licenses or language proficiency certifications.

Currently, even within types of credentials that appear to be similar, there is great variation. For example, a bachelor's degree from a U.S. institution typically consists of four years of schooling, including both specialized and general coursework. It is issued in English (or sometimes Latin). The same degree from a European institution may be three years of specialized work, with the diploma issued in French, German, or Greek. In addition, diplomas issued by different institutions may represent different levels of specialization or rigor. It is important to be able to distinguish between the true similarities and differences between credentials.

15 The credential is composed of the envelope and the letter together.

Ontologies/Frameworks

The letter layer can use standardized ontologies to improve understanding of, and comparison across, credentials issued by different parties to different individuals. A deciding factor in the interoperability of learning records will be whether the thousands of independently operating entities can agree on common language. That is the reason for ontologies and open standards frameworks. The use of standardized ontologies will make the ILR information more useful to issuers, learners, and consumers. The ILR can be designed in such a way that using standards benefits issuers (because they provide more value to their learners/achievers) and consumers (because they get access to better job candidate matches) when they have followed common ontologies in their credentials, occupations, competencies, and job descriptions to common ontologies. Having common ways to describe key elements of credentials serves many purposes, including helping ILR consumers to search and filter content based on their requirements, subject to consent of the learner.

Making learner records interoperable requires at least three types of ontologies:

- Occupations and Job Descriptions
- Skills
- Credentials

Occupations and Jobs

A fundamental purpose of ILRs is to allow individuals to share, discuss, and automatically deliver information about their qualifications to potential employers. This exchange of information happens in the context of an occupation and its requirements. Occupations need common ontologies. For example, while the occupation of entry-level programmer might be called "programmer," "software engineer," or "system developer," it is important for interoperability to understand how the skills required by those occupational titles are similar or different.

A challenge in applying standard terminology to similar occupations is that job descriptions within those occupations differ. For example, while programmer jobs may be similar in their core tasks, they may differ in many details: different languages or toolsets, working from an office or from home, whether they are on call at night, or level of interaction they have with non-technical people. Similarly, a trauma nurse, intensive care nurse, and pediatric nurse may have many similar core characteristics but differ in important details. Thus, while occupational ontologies are useful for understanding and tracking occupations, additional detail is required for specific jobs and experiences and how they map to ILRs.

Occupational ontologies are already well established. The 2018 Standard Occupational Classification (SOC) system published by the U.S. Bureau of Labor Statistics is a standard used by federal agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data.[16] All workers are classified into one of 867 detailed occupations according to their occupational definition. To facilitate classification, detailed occupations are combined to form 459 broad occupations, 98 minor groups, and 23 major groups. Detailed occupations in the SOC with similar job duties, and in some cases skills, education, and/or training, are grouped together. Meanwhile, the Census uses a similar but slightly different categorization scheme.[17]

16 https://www.bls.gov/soc/

17 https://usa.ipums.org/usa-action/variables/occsoc#description_section

Outside of the United States, many organizations use the International Standard Classification of Occupations (ISCO) published by the International Labor Organization.[18] There are also non-governmental occupational ontologies published by private organizations.

Skills

For ILRs, skills are the atomic unit of credentialing. The specification of skills and skill ontologies can become very complex because of the variety of types, levels, and contexts that are relevant for describing skills. Some skills, such as arithmetic, welding, or language fluency, have common specifications and measurements. Others, such as leadership or empathy, are more difficult to specify or measure. Education and training providers use tests and exercises to assess learners' skills. Employers and professional and industry organizations manage their own exam processes to measure skills. Increasingly, groups are attempting to assess "social" or "human" skills which have typically resisted quantified measurement in the past.

One way to assess learners' fitness for specific jobs is to compare their skill sets against job requirements. In career planning, an ILR could allow learners (including workers looking for new jobs or expanded opportunities) to compare their skills to standard lists of occupational skill requirements. As they consider a new job, they can invest in learning the skills specific to that job, and when advocating for a promotion, they can use their ILR as evidence of their qualifications for the new role. For specific jobs, the learner and the employer can compare applicants' skills against the job's basic and more nuanced or granular requirements. Screening or hiring based on standardized skills may partially reduce the impact of implicit biases in the hiring process.

Ideally, each issuer of a credential would be able to map the credential to a standard skill ontology. Additionally, each employer would be able to map the job's requirements to the same ontology and/or to a crosswalk to another ontology. Then the employer and potential employee would have a standard language to assess the employee's readiness to perform the job.

Many skill and skill/occupation ontologies already exist. Private firms, trade associations, professional associations, unions, and state regulators often maintain their own lists of skills. The most commonly used mapping of skills to occupations in the United States is the Department of Labor's O*NET.19 O*NET lists the skills required for performing occupational tasks and the level of skill required. It provides an ontology, data infrastructure, and definitions of competencies representing knowledge, skills, abilities, tools, technologies, and detailed work tasks across more than 900 occupations. This enables rich ways of differentiating among skills; for example, fine motor control may be important for a machine tool operator and a surgeon, but the two jobs would require a worker to be able to perform those skills at different levels. Similarly, using computers is important for cashiers and operating system programmers, but the level of skill required is different for each of these occupations.

In addition to government-developed and foundation-supported skills ontologies, a wide variety of private organizations have developed skills ontologies. These organizations use big data analytics on current job listings in an effort to be

18 https://www.ilo.org/public/english/bureau/stat/isco/
19 https://www.onetonline.org/

more agile and adaptable than standard survey or expert-based ontologies, but they may exhibit biases due to fashion (or hype) or unrepresentative data. In the past year, several companies with privately developed taxonomies have chosen to make them freely and openly available to the public in order to support greater skills data interoperability. While significant hurdles remain in aligning and translating between the varieties of skills ontologies currently available, progress in artificial intelligence may make matching skills across ontologies feasible at scale in a way that was not possible in the past.

Credentials

In the past, fewer types of credentials existed. Credential descriptions therefore were relatively straightforward for commonly issued credentials. Secondary and post-secondary institutions issue high school diplomas, associate's degrees, bachelor's degrees, master's degrees, and doctorate degrees in different subjects. Training programs offer certificates. Some sectors, such as education, law, and medicine, require specific certification or licensure including state- or specialty-managed exams and licenses.

Over time, the number and type of credentials has grown exponentially in response to our rapidly changing economy. The lines have blurred between different types of credentials and which organizations issue them. Further complicating matters is that education and training providers offer skill attainment programs that sound similar but issue different types of credentials. This calls for an ontology of credentials to apply a level of sense-making to the rich and complex variety of credentials and achievement recognitions being issued in today's world of lifelong learning.

Although occupational and skill ontologies have existed for some time, ontologies for describing types of credentials are a newer phenomenon. Ontologies of this nature can provide a common language for how credentials, credentialing organizations, quality assurance, occupational relevance, competencies, and many other characteristics are described.

Recommendations

The potential audience for ILRs in the United States is enormous, as noted earlier, and driving adoption across an audience this large and diverse is difficult. While no strategy can ensure widespread adoption, long odds can be made shorter by testing ILR ideas for defined segments in limited, defined-scope pilots. Several contributors to this white paper already are creating the building blocks of what could become a true ILR ecosystem. The path to such an ecosystem may not be linear, but rather iterative and collaborative, in the same spirit as this white paper.

To further the work already occurring to build an ILR ecosystem, the AWPAB Data Transparency Working Group provides three recommendations. The working group recommends creating an ILR inventory convening an expert group to develop a project plan, and championing fast-track prototyping, as described below.

These recommendations support moving this work forward in a collaborative environment.

Recommendation 1: Create an ILR Inventory (October 30, 2019)

Pilots frequently focus narrowly to encompass a set of stakeholders whose hiring and training are already primed to lean on ILRs. That said, the contributors to this paper recognize that scaling and partnering to build an ecosystem depends, first, upon a full understanding of the wide range of relevant existing pilots and stakeholders. To that end, the NCAW should create and maintain a public inventory of pilot projects that are currently underway or planned for the near future. The Appendix to this paper starts this inventory with examples of pilot programs involving this paper's contributors.

Recommendation 2: Convene an Expert Group who will Develop a Project Plan (December 5, 2019)

The NCAW should convene a working group to develop a project plan focused on clarifying stakeholders' roles and incentives to both consume and issue credentials through ILRs. The participants should have expertise in policy, governance, and technologies as they relate to ILRs and designing projects that reflect best practice in using enterprise scale solutions to transform culture and operations.

The project plan should be completed by the next AWPAB meeting (currently scheduled for December 5, 2019) and explicitly outline:

- The minimum features and content required in an ILR minimum viable product (MVP) and minimum viable ecosystem (MVE);
- The required resources — in the form of vision, human capital, and technological infrastructure;
- Objectives and key results associated with subsequent milestones;
- Specific context (e.g., nursing or electrician or trucking) for the project;
- The value added or unique benefit of the project in context of other existing or planned projects;
- A cadence for review of progress;
- Potential funding sources;
- A framework for executing contingency plans if needed;
- Specific goals and measures for assessing the success of the project.

Achieving adoption of ILRs at a broad scale in the United States is an admirable and audacious task. Achieving 20% adoption of ILRs across the American economy is a grand task — but achieving 20% adoption among individuals within a specific occupation and the training programs and employers with which they are affiliated is more manageable, can generate momentum toward adoption in adjacent roles, and can provide useful lessons for adjacent sectors and beyond. Partnering with issuers of a particular occupational credential who agree to issue their credentials in the manner described above and large employers who are actively hiring agree to consume the ILRs in hiring decisions can allow us to set focused milestones for adoption (e.g., 25% of credentials issued by training providers into individually controlled ILRs and employers representing 25% of hiring in an occupation).

Table 5 lists proposed project participants.

Table 5 | Proposed Participants in Interoperable Learning Record Project

ILR MVP Ecosystem Role	Functional Roles to Convene
Employers	Senior HR Executives
	Senior IT Executives
	Society for Human Resource Management
Education and Training	Academic Program Directors
	Registrars
	Workforce Training Providers
	Chief Learning Officers
	Chief Information Officers
	Learners
Public Sector	National Council for the American Worker
	Government and professional licensure organizations
	K-12 school systems
	State Workforce Agencies
	U.S. Department of Education
	Foundations

Recommendation 3: Champion Fast-Track Prototyping (2nd Quarter 2020)

The ILR ecosystem is emerging, very active, and on the cusp of rapid expansion. The first two recommendations note the need to assess the field more fully and outline common paths to new projects. Such planning is critical, but it should not delay additional prototyping if stakeholders are eager and poised to move forward.

In addition to taking action on the first two recommendations, the NCAW should champion partnership among stakeholders in the ILR ecosystem to quickly bring an ILR MVP to market. These partners may be from the set of experts who advised the current paper, or may be from the broader universe of potential collaborators.
The goal is to bring a solution to market by Q2 2020 to demonstrate in a tangible way the art of the possible with respect to ILRs and to begin realizing the benefits to American employers and learners as outlined in this paper.

This is eminently doable. Many software platforms and technology standards organizations are actively developing features and capabilities that enable ILRs and have come together to work out cross-platform standards and protocols that can support ILRs. These same industry partners can and should accelerate their efforts to deploy ILRs in the field as soon as this fall so that the standards processes can be informed by field testing and market experience. These ILR MVPs should be simple, requiring no more than two software platforms coordinating their ILR deployment with their customers in a specific geography.

MVP testing of ILRs relies not only on a minimum viable coalition of industry partners, but also willing networks of schools, colleges, and/or employers. Fortunately, a variety of school systems, college networks, employer networks, and state agency partners have worked to set themselves up as high-potential ILR testbeds. The AWPAB may be able to play a helpful convening role for willing industry stakeholders to identify and connect with these high potential testbeds to accelerate the timeline for ILR testing in the field.

Additionally, early ILR projects may require R&D funds to support the necessary innovations to bring them to market. Schools will require staff time commitments, and networks may need early project coordination support and hands-on technical assistance. The AWPAB should encourage Department of Education, Department of Labor, and other federal agencies to support ILRs through innovation grants. Because of both philanthropy and private interest in seeing ILRs come to market, federal grants that require partner matching funds could maximally leverage federal funding to seed multiple pilot in multiple communities.

Conclusion

American learners deserve a way to translate education, training, and work experience into records of transferable skills that will provide them opportunities at higher wage occupations. Employers deserve to have a way to communicate to potential applicants what skills and abilities they require to fill a position. ILRs that use open standards can bridge education, training, and employment, helping individuals understand their own abilities, apply their skills, and advance in their careers. Today we have the technologies, protocols, and ontologies to develop ILRs that realize the potential of empowering America's workers with transparent, relevant, equitable, private, secure, portable, shareable, interoperable, and verifiable evidence of their achievements. These recommendations accelerate the development of ILRs to more quickly identify the policy and governance frameworks needed for a connected learn and work ecosystem.

Appendix: ILR-Related Projects and Initiatives

The following list of ILR-related projects and initiatives is meant to represent some but by no means all efforts currently underway. Several of this report's contributors compiled this list based on their proprietary knowledge and interests to showcase a few existing activities and tools. Appearing on this list is in no way an endorsement by the American Workforce Policy Advisory Board's Data Transparency working group as to scope, direction, or quality.

American Association of Collegiate Registrars and Admissions Offices (AACRAO)[20]

The American Association of Collegiate Registrars and Admissions Offices and the Association of Student Affairs Professionals partnered on a national pilot project between 2015-2017 to develop models for a more comprehensive student record. After the success of the pilot, the associations moved to the second stage of this work on the development and adoption of Comprehensive Learner Records in American higher education. This work has focused on the development and implementation of a single learner record across a broad number of American colleges and universities. The Comprehensive Learner records seek to capture, record, and communicate learning when and where it happens in a student's college experience. This includes learning outcomes from courses, programs, and degrees, as well as experience outside the classroom. There are several emerging technologies that have demonstrated their ability to show the institution's learning framework and some of these also provide a deeper exploration of the information and evidence of what that learning means or how it was attained and validated.

As Phase II of the project progresses, it is focused on scaling up the adoption of CLRs among colleges and universities, the content of competency-based transcripts/records, the integration and use of data to create CLRs, and track student progress toward competencies and learning outcomes. The scaling is being done by working with higher education systems and networks, as well as workshops for single institutions interested in creating and implementing a CLR. Working with the Competency-Based Education Network (C-BEN) and IMS Global, the content of competency-based education (CBE) transcripts/records is being standardized and socialized among those institutions who offer CBE courses and programs. Data integration work has already produced a white paper that delineates the challenges and potential solutions. Degree audit system processes are being documented to provide resources for institutions seeking to track student progress toward learning outcomes/competencies.

20 https://www.aacrao.org/signature-initiatives/comprehensive-learner-record

Credential Engine[21]

Credential Registry

Credential Engine is a 501(c)(3) organization based in Washington, D.C. whose mission is to bring transparency to all credentials in the marketplace. Credential Engine has built a cloud-based Credential Registry, which is designed to house common, searchable, and comparable information about all credentials — from diplomas, badges, and certificates to licenses, certifications and degrees of all types and levels. By using this Registry, students, credentialing bodies, employers, and more will have access to critical credentialing data needed to make decisions about both education and career.

Credential Transparency Description Language

The Credential Transparency Description Language (CTDL), which describes credentials and credential providers, and Credential Transparency Description Language - Achievement Standards Network (CTDL-ASN), which describes competencies, are open-source schema (type of mini-language people and systems can use to understand each other even if their data comes from different sources) that together provide standard specifications for describing, searching, discovering, and comparing credentials on the Web. Creation and use of these languages are founded in the recognition that the easiest, most efficient way to ensure transparency of credentials is for all organizations that provide credentials to describe those credentials on their websites using a common language. CTDL is a schema that anyone can use to share information about credentialing data. CTDL not only provides a common and unified way of describing information in the Credential Registry, it also is an open language that can be used on the Web. This feature makes it easier for students, businesses, researchers, and automated systems to discover, understand, and compare information about credentials from a variety of sources. CTDL is used in the Credential Registry. CTDL's more than 400 terms allow credentialing bodies of all types, from institutions of higher education to licensing boards, to describe their organization and credentials in a common way.

CTDL is accessible on the open web and is harmonized with Schema.org as the standard for describing, searching, and comparing credentials on the Internet, such that all credential data posted to the web will be able to be more easily and efficiently discovered by search engines as well as used to populate the Credential Registry. CTDL is openly available through a Creative Commons Attribution 4.0 International License. It is also consistent with certain federal policies and programs on open data and the use of standards, including the Open Data Policy, Office of Management and Budget (OMB) Circulars A-119 and A-130, and the Federal and Defense Standardization Programs. Credential Engine harmonizes with widely used international standards for the web such as Open Badges. Credential Engine also works in partnership with international standards bodies such as PESC, IMS Global, and the HR Open Standards Consortium to improve standards and data interoperability.

See also the "Guide to Key Initiatives for the Connected Learn and Work Ecosystem."[22]

21 https://credentialengine.org/

22 https://credentialengine.org/a-guide-to-key-initiatives-for-the-connected-learn-and-work-ecosystem/

edX

edX is a nonprofit online education platform founded in 2012 by Harvard University and MIT, with more than 22 million learners and 140 institutional partners offering more than 2,600 online courses. In order to help learners more easily pursue education and employment opportunities, edX created a secure, transferrable learner record (TLR). Learners on edX.org who have earned at least one course completion certificate for a course that is part of a multi-course program can opt to share a link to their TLR with any other person, university, or employer. The TLR link is directly accessed by learners with login credentials on edX.org from their profile or program progress page. For courses on edX.org that are associated with Master's degree programs, such as edX's MicroMasters® programs, edX streamlines the credit application process for Master's degree programs by sending a secure TLR link to the university on behalf of the learner.

A learner's record contains information about the courses completed, grades received and date of certification. Future iterations of the TLR will likely contain additional attributes such as learning objectives, competencies and skills acquired, and associated professional certifications, credit hour and continue education units.

Indiana

e-Transcript Program

Begun in 2005, the now mandated Indiana e-Transcript Program has resulted in a statewide, common high school transcript that each high school is capable of sending as a data file compliant with national, open consensus standards, the Postsecondary Electronic Standards Council (PESC) XML e-transcript schema. Fields are being added that describe student achievements and competencies beyond those in a conventional academic transcript: project-based, work-based, and service-based learning experiences; industry certifications; and apprenticeships.

Comprehensive Learner Record

The Indiana e-Transcript Program is now being seamlessly extended to postsecondary education, in conjunction with the AACRAO/NASPA Comprehensive Learner Record (CLR) Phase II project. A convening on September 16, 2019, involving all public institutions, will begin crafting a strategy for implementing a statewide, interoperable CLR that will build on, but go beyond, the conventional academic transcript to incorporate the particular student's achievements and competencies. The CLR will also link electronically, through the Credential Registry, to information about the credential the learner has earned, revealing, among other things, the generic competencies all credential earners should have mastered.

Scale-Up of Credential Engine

The first state to scale-up Credential Engine, Indiana now has all certificate and degree programs at all levels from all public two- and four-year institutions on the Credential Registry, over 3,000 in all. Much information is available on each credential, including tuition and fees, while data on how much graduates earn one, five, and ten years after graduation should be added by September 2019. Competencies for all community college associate degrees have already been added to the Registry, while competencies for other programs will be added in the future.

Competency Alignment

Indiana's emphasis on competencies (the 30-hour Statewide Transfer General Education Core and 19 statewide 2+2 articulation agreements are based on competencies) is intended to ensure alignment of competencies cultivated in education and non-traditional training programs with competencies sought by employers. This focus on alignment is embodied in other statewide initiatives, such as **NextLevel Jobs**, **Skillful Indiana**, and the state's engagement with the **U.S. Chamber of Commerce Foundation's T3 Innovation Network** and the **JDX** initiative, all of which provide an employer perspective on desired competencies in Indiana's workforce.

National Science Foundation Convergence Accelerator

Credential Engine, in partnership with Indiana Commission for Higher Education (ICHE), was awarded a National Science Foundation (NSF) Convergence Accelerator short-term Phase I grant on September 10, 2019. This project will focus solely on Indiana and aims to develop a strategy for an integrated coordination of key statewide initiatives to provide transparency and interoperability, with adherence to voluntary open or consensus standards. Early next year, Credential Engine/ICHE should be positioned to apply for a Phase II grant to execute the strategy not only in Indiana, but throughout the 12-state Midwestern Higher Education Compact (MHEC).

Markle Foundation: Skillful[23]

Skillful, a non-profit initiative of the Markle Foundation, is dedicated to enabling all Americans — particularly those without a four-year college degree — to secure good jobs in a changing economy. In partnership with Microsoft and others, Skillful is developing skills-based training and employment practices in collaboration with state governments, local employers, educators, and workforce development organizations. A skills-based approach to hiring reduces bias and creates a more equitable job market that "screens in" for skills and clarifies credential requirements. Skillful and its partners are working to create a labor market in which skills are valued, and people can more easily access the information and education they need to keep pace with technology's impact on work.

23 https://www.markle.org/rework-america/skillful

The Skillful model focuses on driving change in five areas through the use of technology, data, partnerships, and new practices:

- Facilitating widespread adoption of high-quality skills-based employment practices.
- Aligning educational programs to employment needs by informing and driving collaboration through industry-specific approaches.
- Driving increased transparency and data around educational outcomes to make it easier for job seekers to understand the value of different training.
- Encouraging widespread understanding of the multiple pathways to success that are available in the digital economy.
- Creating a system of effective, evidence-based coaching to help job seekers successfully achieve career growth and opportunities for good-paying jobs in high-growth industries.

MIT: Digital Credentials

MIT is one of nine leading universities forming the Digital Credentials collaboration in order to create a trusted, distributed, and shared infrastructure standard for issuing, storing, displaying, and verifying academic credentials.[24]

National Association of State Workforce Agencies

The National Association of State Workforce Agencies (NASWA) is the national organization representing all 50 state workforce agencies, D.C., and the U.S. territories. These agencies deliver training, employment, career, and business services, in addition to administering the unemployment insurance, veteran reemployment, and labor market information programs. NASWA provides policy expertise, shares promising practices, and promotes state innovation and leadership in workforce development.

National Science Foundation Convergence Accelerator

Notification was just received that NASWA in partnership with BrightHive and the W.E. Upjohn Institute for Employment Research, was recommended for a National Science Foundation Convergence Accelerator short-term Phase I grant. The team will collaborate with other partners and experts to launch the NLx Data Hub, a cloud-hosted warehouse of job vacancy information from the National Labor Exchange (NLx). The resulting research and derived data products will contribute to the design of career planning tools for employers, job seekers, learners, transitioning service members, and military spouses, as well as their career counselors in the public workforce system. Early next year, NASWA should be positioned to apply for a Phase II grant to develop and deploy prototypes of such tools.

Workforce Information Technology Support Center

The Workforce Information Technology Support Center, or Workforce ITSC, is a federally-funded initiative supporting states as they work to implement integrated technology solutions. Workforce ITSC aims to improve effectiveness in the WIOA system with a three-pronged approach: (1) sharing resources through online tools, (2) delivering learning services, and (3) coordinating technical assistance. Resources and recommendations disseminated to state WIOA agencies will encourage data and technology strategies that are modern, innovative, program-driven, and user-centric. The Workforce ITSC Solutions Marketplace could be a natural destination for prototypes generated by Recommendation 3, and Workforce ITSC staff can help convene stakeholders for user testing and training initiatives.

24 https://digitalcredentials.mit.edu

Navy Research and Development and Training Transformation

In 2013, the Navy launched a major initiative (Sailor 2025) to improve and modernize its IT systems with several personal initiatives to include two key goals: ensuring 1) its training, education, and maintenance systems are well linked and managed and 2) those systems are appropriately matching Navy Occupations to civilian occupations and their corresponding credentials. The latter requires that KSAOs (Knowledge, Skills, Abilities, and Other Characteristics) and credentials acquired in the military are transparent and have the ability to be continuously updated and refined. The Navy trains sailors to prepare for work (on ships, submarines, bases, and supply sites) using many tools it has developed: KSAOs, curriculum, assessments, and credentials that qualify sailors for specific tasks. These tools in turn are linked to an array of technical and nontechnical manuals, work process schedules, job task analysis, engineering drawings, parts lists, and maintenance plans designed to help sailors carry out their tasks. The systems and processes for these are currently cumbersome, difficult to manage, and dated.

The Navy is partnering with Credential Engine based on the recognition that the Navy may be able to use the Credential Transparency Description Language as a typology to update its internal systems and publish its linked credentials to the Credential Registry.

The partnership is:

1. Completing a gap analysis between the ctdl and Navy Task Classification Taxonomy;
2. Mapping the CTDL to Navy specs that support data linked to various components of its training artifacts;
3. Linking the CTDL with all Navy KSAOs in its linked data classification and curriculum (e.g., “courses”); and
4. Connecting the CTDL to KSAOs in the Navy’s maintenance task analysis.

This R&D work is guided by a Cooperative Research and Development Agreement (CRADA) signed by the Navy’s Research & Development Unit. If this work succeeds in aligning to competency and credentialing systems, Credential Engine may be able to incorporate Navy-linked credentials into the Credential Registry; the Navy can update its internal systems using a common credentialing language; civilian organizations can better understand Navy-linked credentials; and veterans leaving the service can transition more easily into civilian jobs.

OpenCLR Lab: IMS Global, Amazon Web Services, Public Consulting Group, and the Broward County Public School System

Too many Broward County Public School (BCPS) students continue to struggle to complete their high school program of studies and successfully transition to post-secondary and workforce success due to failure to evidence mastery of Algebra 1 and English 10 skills. Computational thinking and related skills are increasingly acquired through non-traditional settings such as Code.org.

New competency-based, blended learning approaches have demonstrated success in both remediation and acceleration. Open technical standards enable these new learning models to exist at the scale of the Internet across systems while preserving private data access control. The IMS Global Comprehensive Learner Record (CLR) draft candidate specification provides a blueprint for implementing this approach at the scale of the Internet. This project, as part of the OpenCLR Lab, will explore the intersection of key technical and policy issues to create a national demonstration model.

Public Consulting Group (PCG), Amazon Web Services (AWS), and IMS Global, in partnership with BCPS seek to demonstrate, document, and share how personalized, competency-based, blended learning can leverage the draft IMS Global CLR specification to support BCPS graduates as they transition into post-secondary degree completion, industry certifications, NCAA athletics, and other professional licensure fields.

U.S. Chamber of Commerce Foundation

Job Data Exchange (JDX)[25]

Employer signaling challenges can be resolved by creating a Job Data Exchange (JDX) that uses advanced, open data infrastructure and provides human resource managers guidance on job description data, a resource library, and job description data repository for developing, benchmarking, and improving job descriptions and postings. The Exchange will do this by promoting the use of open data standards and tools to normalize competencies and credentialing language across employers. Advanced technologies can be used to ensure the improved job description data is made available in real time, at low to no cost to credential providers. This work can also make HR managers and others responsible for talent sourcing aware of other efforts such as Credential Engine, frameworks, and assessment tools. Furthermore, the JDX can integrate the use of digital, competency-based learner records into the talent sourcing process. This approach will support more advanced artificial intelligence and machine learning applications in improving job matching.

The U.S. Chamber of Commerce Foundation is leveraging participants in the Talent Pipeline Management project that brings together employers, employer collaboratives, education providers, and HR technology service providers. Stakeholders are engaging in the development of the prototype, to be used by employers and their selected HR providers to distribute improved job description information including competency and credentialing requirements to talent sourcing partners and students and job- seekers. In February 2019, the initiative announced seven pilot partner teams across six states and the District of Columbia that will

25 https://www.uschamberfoundation.org/workforce-development/JDX

participate in co-designing and pilot-testing the JDX tools and resources. Pilot partner teams are comprised of education and training providers, employers, HR professionals, and HR technology vendors representing the industries of healthcare, defense, utilities, energy, and manufacturing. An advisory committee has also been formed to provide recommendations and feedback on the design, data integration, pilot, evaluation, adoption, and future use of the JDX.

T3 Innovation Network[26]

The T3 Innovation Network is a voluntary open innovation network formed in 2018 and is composed of over 250 public and private partners, led by the US Chamber of Commerce Foundation. The goal of the network is to build an open, public-private data and technology infrastructure for a more equitable talent marketplace. Now in its second phase, it has launched 10 coordinated projects organized into four areas of focus:

Open Data Standards: Promote technical standard harmonization and interoperability to support competency data exchange, worker/learner records, and digital identities and its use by government entities.

- PPI: Data Standards Harmonization
- PP4: Public-Private Standards Development and Use by Government

Comprehensive Learner and Worker Records: Identify gaps in and develop public-private standards for employment records, earnings records, and learner records. Explore and promote adoption of enhanced public-private standards by federal and state entities.

- PP2: Employment and Earnings Record Standards
- PP3: Learner Record Standards

Open, Shared Competency Infrastructure: Develop guidance and tools to author, curate, translate, and distribute open and shared competency and skill statements across all stakeholders in the talent marketplace.

- PP5: Competency Data Exchange
- PP6: Competency Analysis and Translation
- PP7: Learning Outcomes Exchange
- PP8: Public-Private Use of Open Competency Data

Linked, Individual Level Data: Design protocols for empowering individual workers and learners with their data through new and emerging self-sovereignty technologies, such as distributed ledger and block chain.

- PP9: Data Collaboratives for Individual-Level Data
- PP10: Empowering the American Student and Worker

26 https://www.uschamberfoundation.org/t3-innovation/pilot-projects

U.S. Department of Education Blockchain Action Network[27]

The Office of Educational Technology has initiated the Education Blockchain Action Network: a shared, community-driven, action-oriented space for conversation, community curation, and open source project development. Educators, administrators, parents, students, and technology developers are invited to work collectively to learn, influence, and equitably shape the ways in which these new technologies affect our shared future. As blockchain technologies and their associated networks evolve, this network will feature a diverse range of projects — those the community has highlighted as having the greatest potential to impact the national educational landscape.

27 https://tech.ed.gov/blockchain/