

# Connecting Credentials

*BUILDING LEARNING-BASED CREDENTIALING SYSTEMS*

## **Applying Demand and Supply Signals**

**Work Group Report**

**November 2017**

## Forward

Connecting Credentials is a collaborative effort of more than 120 national organizations and more than 3,000 stakeholders to make credentials easier to understand, use and interconnect. Credentials include degrees, certificates, diplomas, professional and industry certifications, licenses, and micro-credentials such as digital badges. Credentials connect people to jobs, education programs and career pathways.

In April 2017, Connecting Credentials convened five workgroups of diverse leaders in credentialing reform to tackle particularly challenging aspects of achieving the vision of a learner-centered credentialing ecosystem articulated in the 2016 [From National Dialogue to Collective Action: Building Learning-Based Credentialing Systems](#). The workgroups were asked to recommend actionable steps that should be taken to address the credentialing needs and priorities of diverse learners, especially adults with no recognized postsecondary education, in the complex and highly dynamic credentialing marketplace. With this equity focus, they addressed the following questions:

- **Building Trust in the Quality of Credentials:** How can we increase the quality, quantity and pay-off of credentials for all students, especially for those with no other postsecondary credentials?
- **Equipping Adult Learners to Attain Market-Valued Postsecondary Credentials:** How do we equip and empower adults with no postsecondary credential to navigate, persist and succeed in selecting and attaining postsecondary credentials that lead to educational and economic advancement?
- **Aligning Demand and Supply Signals:** What should be done to better align diverse credentialing processes and products with emerging employer hiring practices so that job applicants are evaluated based on what they know and can do, rather than who they know and where they went to school?
- **Improving Learner Mobility:** How can we improve credential stackability and portability, especially for adults with little or no prior postsecondary education?
- **Making All Learning Count:** How can we reliably and consistently recognize learning that takes place in informal and workplace settings?

This report and those of the other four work groups can be found at [www.connectingcredentials.org](http://www.connectingcredentials.org). Each workgroup started with the recognition that the predicted disruptions in our learning and credentialing systems already have begun to transform these systems. More diverse learners with different needs and priorities are engaging in postsecondary learning than ever before. The speed of change in the clusters of competencies required at work is accelerating. The proliferation of learning and credentialing options, including substantial expansion of work-based learning, continues unabated, leaving credential seekers confused about what credential and pathway to pursue and credential providers and their quality assurers trying to adjust to this changed environment.

Together, the workgroups contributed to our understanding of the interconnectedness and systemic nature of these challenges, identified leading-edge policies and practices to address these challenges and provided useful guidance for moving forward on multiple fronts.

## Introduction

Academic and professional credentials are signals. Credentials provide information about the human capital of the credential holder. Job seekers use credentials to communicate their qualifications for employment. Employers use credentials to evaluate job applicants. The way credentials and credential requirements are used to sort job applicants, in particular, can exclude people without the resources and connections necessary to obtain the right credentials.

Ideally, from the employer perspective, a credential's quality as a signal is based on the degree to which it accurately predicts or correlates with the human capital expectation of the employer, what we call the "demand side." Similarly, a credential's reputation is formed based on the experience of an employer with individuals who have earned that credential, or, absent direct experience, the reputation of the "supply-side" organization issuing it, and possibly an assessment of the criteria required to earn it.

The figure below shows the hiring process. While traditional hiring practices such as reliance on individual referral and the reputation of the credentialing program are still commonplace, a growing number of employers are broadening and changing worker sourcing practices at the wide part of the funnel to address current problems: persistent skill shortages, the weakening quality of traditional supply-side signals, the cost of bad hires, and the increasingly specialized nature of technical skills required in some positions. These new approaches are more proactive in seeking out and engaging potential applicants in a much broader talent pool. They also are driven by employers' more explicit understanding and articulation of the competencies required in the positions for which they are recruiting. Technology is playing a core role in enabling this competency- or skills-based approach to hiring, one consequence of which is a potential reduction in continuing influence of traditional signals that reduce access to economic opportunity, such as what educational institution a candidate attended or who the candidate knows.

The growing practice of competency-based hiring provides a unique opportunity to level the playing field for how candidates are discovered and evaluated in the job market. For that opportunity to be realized, however, we must enhance supply-side credentialing processes and products so that they align with emerging employer practices in ways that help individuals realize economic opportunity. We also need employers to test the efficacy of competency based hiring along with research that provides evidence on the actual ROI to the employer.

We must increase transparency for employers and learners: to make all potential applicants visible to employers; to make all jobs and their requirements visible to job seekers; and to make pathways to credentials and credential providers visible to learners and employers. Those who lack social and financial capital often lack access to platforms and tools to help them become visible in the marketplace and access sources of job seeking information.

# ALIGNING SUPPLY & DEMAND

How might we better align credentialing processes with emerging employer hiring practices so that job applicants are evaluated based on **what they know and can do**, rather than **who they know and where they went to school**?



Education Design Lab

The work group created the figure above to differentiate the phases of the hiring process and consider examples of emerging practices. We focused our discussions on the wide-end of the funnel as that is where technology is creating the biggest pain point for employers and the biggest opportunity for new solutions in expanding access. It is where technology is expanding talent pools and enabling a larger number of online job applications, which have to be filtered to identify potentially qualified workers.

## Aligning Supply and Demand: Key Trends

Today's credentialing ecosystem is complex and in transition. An increasingly diverse set of actors is issuing an array of credentials across a range of increasingly dynamic occupational fields. Employers are more open to new sources of attestations of job seekers' skills, but continue to use degrees as proxies for a broad range of skills. Credential providers are beginning to use new formats for recognizing and communicating skills. Skills-based hiring and credentialing on the rise, but their potential for competencies to form a new "lingua franca" for hiring and mobility is not inevitable. To identify opportunities for proactive alignment, we identified and analyzed key trends on the demand side and the supply side.

### Key Trends on the Demand Side

**The rules of indicators, evidence, and discovery in skills-based hiring have changed.** Employers are looking for more information/evidence of skills (such as assessments), and increasingly using predictive analytics to determine who will be a top performer vs. an average performer. For example, PAIRIN is working with the Colorado Workforce Development Council on a predictive analytics model for 20 top jobs across 4 industries in the state by testing employees in those jobs and then creating a model to de-risk hires from alternative programs.

**Recruitment is increasingly technology-driven, from online postings and more proactive applicant recruitment that generate high volumes of candidates to applicant tracking systems that sort and filter based on data.** We believe this trend has profound consequences for the content and format of credentials (e.g., machine readable data and validated standards-based competency taxonomy), as well as how credentials and by extension credential issuers establish their value as quality signals.

**Although by no means uniform or always systematic in their approach, employers are increasingly explicit about the skills their positions require, and more open to different kinds of credentials and credentialing organizations as certifiers of those to ensure the job applicants' skills have been achieved.** IBM, for example, has issued 500,000 "badges" or micro-credentials to employees and external learners who want to build "competency stacks" in fast changing areas such as cloud computing. As employers develop competency maps related to job roles and career trajectories, with jobs conceptualized as skill profiles, the need for a common competency-based language is critical to enable alignment across supply and demand.

**The emerging skill profiles of employment candidates that employers seek include a mix of what variously are called employability, mobility, soft", 21<sup>st</sup> century, or liberal arts, (critical thinking, problem-solving, communication) and occupational "hard" skills (specific technical, product, process knowledge).** The perception that hard skills are more amenable to credentialing for competency-based

hiring is evident in the types of industries and professions that are early adopters. That said, both sides of the skills spectrum are in scope for improving quality signals of competency.

**Employers are being proactive and reaching further “upstream” to identify talent for high growth sectors.** They are doing this by: scanning the environment of the overall talent pool, including passive candidate searching and public evidence of candidate skills; and going to sources of talent (education and training providers) to both mold those programs and create tailored recruiting relationships.

**Employers are increasingly questioning the predictive validity of many types of credentials, embracing “trust and assess,” processes in which they require credentials and then directly assess key skills as part of their hiring process.** The use of pre-hire assessment is trending upwards among major employers, aided by new technology platforms and assessment developers to differentiate among job applicants, many of whom already have required or preferred credentials. This trend holds for small and medium businesses that employ up 90% of the workforce, although at a slower pace.

**The gig economy and project-based environment is creating more dynamic employment relationships.** It means workers will work with multiple employers and teams of people. It requires workers, as independent contractors, to continually update their skill/experience and reputation profiles as they network with employers and colleagues. It recognizes that industry contractor communities, like GitHub, DevEx or Behance, will gain importance as market makers.

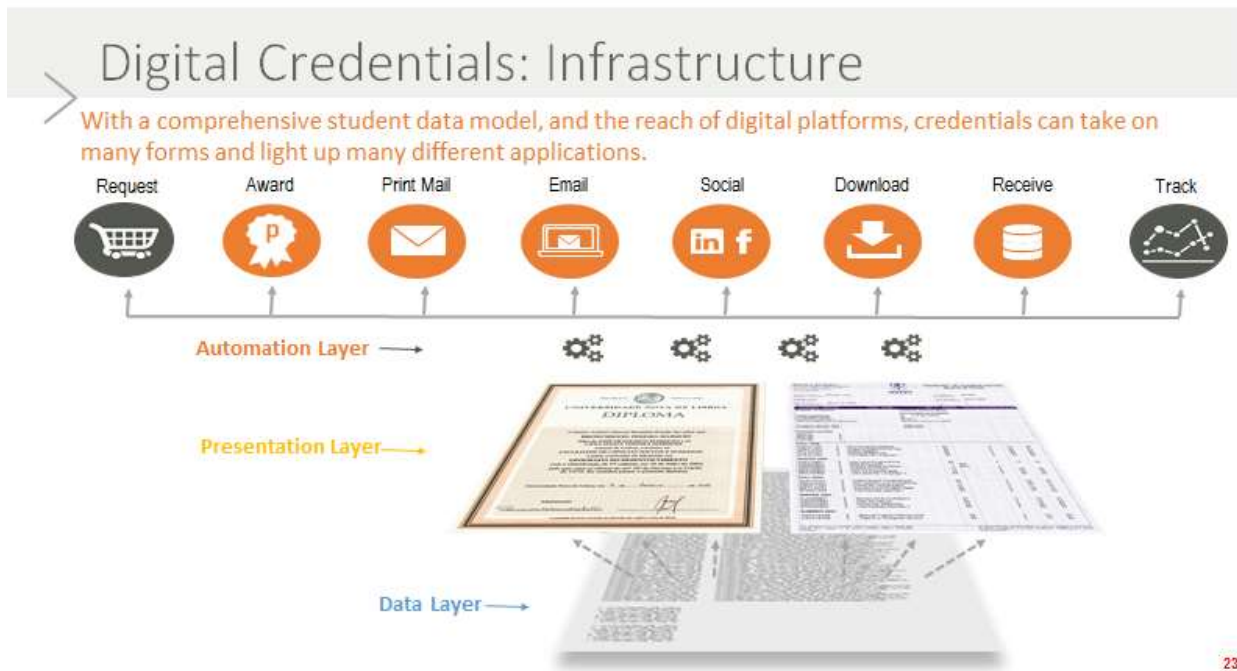
## Key Trends on the Supply Side

**Open standards for digital credentials are being developed so that stakeholders can discover and connect data about what a learner knows and is able to do regardless of where the data reside.** The Credentialing Ecosystem Mapping Team made up of leading technical standards organizations spanning K-12, higher education, medical education, military training, and workforce development<sup>1</sup> have joined together in an initiative to align their standards in order to provide better competency and credential transparency and portability. This new collaboration among standards organizations will facilitate the transfer of competency data across the continuum of learning and employment. See Appendix 2 for information on the various standards developed by these organizations for describing credentials and related entities such as competency frameworks.

---

<sup>1</sup> The organizations involved in this effort include: Competency And Skills System (CASS); Common Education Data Standards (CEDS); Credential Engine; HR Open Standards Consortium; IEEE Learning Technology Standards Committee; IMS Global Learning Consortium; MedBiquitous; and Postsecondary Electronic Standards Council (PESC) Through this work, the Credentialing Ecosystem Mapping Team, aims to empower students, veterans, and employees to be more effective in controlling education and career trajectories, enable clear data exchange between education, training, and HR systems, and provide individuals with a singular, lifelong credential and competency-based learning record. The goal of standards is to express information on credentials, competencies, academic achievements or deficiencies and job qualifications in a common language to enable comparisons. But today, these systems often operate in silos. For example, the credential and competency information from a college system does not transfer to business systems and competency information from military occupations does not transfer to colleges or private-sector employment.

As illustrated in the following figure developed by Parchment, interoperability of data files provides the basis for generating different formats for presenting this data (including drill down options and evidence of competency) for different users in different contexts. Various digital platforms can deliver this data through different applications. For example, a collaboration of IMS, University of Wisconsin Extension



and Portfolium is creating an “Achievement Record Store,” or achievement record manager using web-based technology based on standards for linking data from various sources to make learner’s achievement records searchable by, and connectable to, employer search engines.

**Postsecondary educational institutions are beginning to credential informal learning.** Under the broad label “Comprehensive Student Records,” (CSR) new forms of academic transcripts are communicating learning outcomes from co-curricular activities (e.g., organization leadership), as well as replacing the rubric of credits and grades with mastery and competencies. CSRs are helping students understand and communicate what they know and are able to do and helping faculty gain a broader view of student learning. Other providers are issuing digital micro-credentials such as badges to document informal learning.

**Postsecondary educational institutions are unbundling/disaggregating degrees and modularizing programs of study to increase adaptability and relevance to learner and employer needs.** Some institutions are using certificates to validate smaller blocks of learning than degrees while others are and/or using digital badges and other micro-credentials for this purpose. In addition, education and training providers are embedding opportunities for students to gain certifications as part of their programs of study.

**An increased focus on competency attainment has led to a proliferation of competency and credentialing frameworks.** While frameworks are being developed by industry groups and credential issuers to enable more relevant credentials, the proliferation of unaligned frameworks is creating further confusion in the credentialing marketplace.

**Credential issuers are increasingly supporting and testing new models for matching their learners' verified competencies electronically to job descriptions and hiring requirements.** For example, the National Network/BurningGlass initiative uses data to improve the clarity of requirements listed in job openings and a resume generating tool developed by the National Network of Business and Industry Associations translates a "named credential" into the key knowledge, skills and abilities that credential represents . . . a direct translation from supply to demand. The U.S. Chamber of Commerce Foundation also is exploring and piloting a Talent Pipeline Management Job Registry Service to improve employer communication of hiring requirements, especially competency and credentialing requirements, and how these requirements can be used by credential issuers to close the skills gap. Credential Engine is also promoting employer and credential issuer applications that can improve transparency in the credentialing marketplace.

**More and more colleges are working collaboratively with employers to align curricula and credentials with industry requirements.** They are aligning and "stacking" workforce and academic credentials in visible credentialing pathways for students that lead to employment and further learning. A growing strategy for doing this is embedding industry certifications in programs of study. A Lumina Foundation [study](#) found this practice is especially prevalent in credit-bearing certificate and associate and applied associate degree programs in community and technical colleges; and in credit-bearing and non-credit certificate programs in four-year institutions.

These trends foreshadow a very different future from the essentially closed loop, and frankly, inefficient, hiring landscape that exists today. But we are at an important juncture in the evolution of competency-based hiring. Will emerging practices expand the use of proprietary or open standards? Will the proliferation of multiple languages and competency frameworks continue or will a consensus approach emerge? Will emerging practices evolve in a way that expands access and opportunity, or in a way that exacerbates inequality? Regardless, new practices will be digital and employers will use a much richer range of non-degree credentials to identify skills and signal requirements; but how accessible will those pathways be to learners if most hiring still occurs via network connections and internships, and blue chip brands recruit first at elite schools? If we can "open" these networks, how might any learner gain understanding to position his/her career-facing "digital footprint" to access them?

## Design Principles

If we hope to realize the potential of new credentials in the hiring process, we need to be intentional about the further evolution of these trends. Those of us innovating in the credentialing space have the responsibility to make our systems, rubrics, tools and policies interoperable so that individual students and job seekers aren't left with the full burden of navigating the complexities of the emerging credentialing marketplace. We need to identify the interests and potential intersecting points of value of new credentialing practices for employers, issuers, learners, validators, and policymakers recognizing that there are many profiles in each category.



For this reason, the work group held a design session in which members and other invited participants projected the hiring and credentialing trends forward and articulated a set of design criteria that could guide us toward a desirable future state. These design criteria tell us “what must be true” in the hiring ecosystem to realize the potential of this work group’s goal: How might someone be hired based on what they know and are able to do, rather than on who they know or where they went to school?

**Equity should be a primary design consideration for any tool or practice created to align supply and demand.** Clear signals on the hiring side and clear visibility of “open pathway” maps and entry points on the credentialing side are critical to show the “non-networked” learner how to access opportunities based on competencies.<sup>2</sup> We focus on equity but recognize this goal cannot be achieved without the sustained involvement of employers.

**Employers or intermediaries with access to real-time demand signals, not educators, should lead the articulation of employer-valued competencies.** As it becomes clearer that employers want more competency-based and granular information than the resume and transcript provide, we see more learning institutions testing their own sub-degree digital credentials to demonstrate career-readiness. We encourage them not to operate on their own, but to look to employers, industry associations, and intermediaries (e.g. companies such as Portfolium, Skillsmart, Burning Glass, and non-profits), who are beginning to play the translator/connector role. These organizations can stay abreast of rapidly changing employer needs and help send clear signals to institutions and candidates.

**The learning provider’s role is helping the learner develop, articulate and display competencies and learning evidence in ways that will be visible to and searchable by employers.** Learning at the postsecondary level has to be visibly mapped and aligned to employment goals (recognizing that learning serves other goals as well). Learning providers need to help their students to make their knowledge, skills and experiences visible to employers using employers’ language because employers will not take the time to translate educational experiences or the value of competencies or skills they don’t recognize.

**Informal learning needs to be captured and/or assessed in ways that allow employers to assign value to it.** Employers increasingly refer to the resume and the traditional transcript as “blunt instruments” in the hiring process. They are asking for ways to prioritize, trust and verify learning that happens outside a traditional classroom (co-curricular, work-based, community) and numerous efforts are underway to capture such learning in comprehensive student records and badges. In the candidate filtering stage, employers are looking for more than evidence of participation, they want ways to quickly judge mastery of skills, e.g. critical thinking or project management, without having to look at a portfolio.

**Technology must support interoperability between supply and demand in the hiring ecosystem.** The further development and adoption of technical standards to enable interoperability is a necessary first step. This will require the alignment and harmonization of technical standards related to descriptors of credentials and competencies from both the supply and demand sides and is being addressed by the afore-mentioned interorganizational Credentialing Ecosystem Mapping Team. The next step is helping

---

<sup>2</sup> We use the term *pathway* to describe a series of either courses or competencies recommended for a learner to be prepared for a particular role or career. *Open* refers to that pathway being easily discoverable by the learner.

individual institutions enhance their capacity to use these standards to make their learners' evidence and new credentials machine readable. The third step and what some call the "learning layer," requires the syncing up of semantics, or competency frameworks, so that digital evidence can be categorized, translated or assessed. Interoperability is a key hurdle. The work group spent significant time discussing whether artificial intelligence can, over time, solve for the proliferation of competency frameworks by translating the underlying sub-competencies that employers might be looking for.

## Recommendations for Alignment

From these design criteria, the workgroup built out the following recommendations that could move stakeholders toward a clearer understanding of the benefits of an aligned ecosystem and proof points to light the way:

- 1. We ask employers to participate in a series of pilots that test the efficacy of tools and practices that could help employers better signal their competency needs to learners and the providers who prepare them, and to help learning providers respond to these signals.**

These pilots will need to be designed in ways that *speak to employer interests*. Employers care most about: increasing their diverse talent pools, saving on hiring costs and/ or improved talent performance and retention. Support for and dissemination of early successes where employers have those results will help drive adoption. They also need to be designed in ways that *demonstrate the utility of voluntary adoption of shared data standards*. Now that shared data standards have been developed, it is time to demonstrate their utility for linking real-time supply and demand side data systems in ways that educators can use to keep their curricula relevant and responsive to continually changing labor market requirements.

We propose pilots on:

- **Search tools that help employers find candidates using competency-based keywords and that are transparent to the learner.** Ideally, groups of learners are in the same pilots testing the visibility of their competencies.
- **Pathway finder tools** that begin to show us how learners or incumbent employees can "stack" multiple digital credentials to build the competencies employers seek. These experiments should test open feedback loops, whereby employers endorse or recommend credential stacks that successful candidates have earned. One example in this vein is that Northeastern University has announced it will offer credit for certain IBM stacks in data analytics graduate programs.
- **Voluntary adoption of technical standards.** This would involve one or more educational institutions, committed employers and product companies working on both the supply and demand side that agree to use IMS Global's CASE and digital credential standards to match supply and demand signals using keywords from both systems.

**2. Ecosystem advocates should collaborate to gain a better understanding of how competency search criteria used by employers might evolve as useful alignment signals.**

Might employers be willing to dynamically publish their top keywords to a national index? The workgroup discussed how “keyword hiring” could become more prevalent as employers are better able to isolate competencies that predict success and then only pull applicants through the funnel who meet certain search word criteria. In coming decades, artificial intelligence may render defined search unnecessary, but publicly highlighting competencies as a changing index of the valued workplace needs will always be important. In the meantime, competency maps, blueprints, and guides from employer associations have begun to provide pathway information for students and curriculum translation guidance for institutions. (Efforts such as Credential Engine and an employer-led Job Registry being developed by the U.S. Chamber of Commerce Foundation will provide building blocks for this and other experiments.)

**3. Funders should invest in the development of consistent ways of assessing 21st century skills so that employers can assign value to them.**

The constant for all careers in an increasingly complex, dynamic and networked world is what we often call “21<sup>st</sup> century skills” or “mobility” skills. These are the competencies, such as collaboration, communication, creative problem solving, empathy, and critical thinking, that transcend technical know-how and signal to an employer that a candidate “knows how to learn.” Work to define these skills has resulted in a proliferation of frameworks with no consistency in articulation measurable performance expectations. Some employers are asking for consistency in how these skills are measured and calibrated in credentials so that they more easily can use them to search for and prioritize candidates, rather than having to understand each learning institution’s offerings and level of rigor. While formal common assessments may be hard to sell across institutions, pilot micro-credential teams from 8 universities working with Education Design Lab determined that they could agree on competency statements, sub-competencies and learning outcomes across very diverse institutions.

**4. Employers, learning institutions and funders should collaborate in the development and refinement of quality micro-credentials.**

Advocates argue, and employers agree, micro-credentials have the potential to significantly benefit less-advantaged students who might excel in 21<sup>st</sup> century skills but don’t have the networks to get to the interview stage. We recommend support for a series of pilot projects to test the efficacy of micro-credentials as an equitable hiring tool. Further, based on what is learned through these pilots, we recommend the development of quality standards for micro-credentials to promote their portability, rigor, consistency and machine readability.

**5. Funders should support the mapping of incentives for key players that may be needed to foster adoption of a more open and equitable sourcing and hiring system.**

Such a mapping would help identify the interests of learners, employers, accreditors, validators and institutions to engage in this work, recognizing that there are many profiles in each category. We recommend that this mapping look at the motivations of the diverse players in each group, including workers in the gig economy and industry contractor communities.

**6. Learning institutions, policymakers and learners should partner to gain a better understanding of how learners will use the “the resume of the future” and how to encourage learners to feel personal agency for how they represent themselves digitally to potential employers over their careers.**

The lifelong learning record is the searchable digital scan capturing cumulative evidence associated with a learner’s experience. Our work group discussed whether students should “own” their records, and it was decided that it was more important that they “own” their footprint or the organization of their records and understand how and why to use it to their advantage, in the same way that they might try to understand and improve their credit score. We recommend pilots in which learning institutions and funders use tools with different types of students to understand how they perceive the shift from the analog resume to the digital footprint. This will help learning institutions define practices and roles for themselves to promote student agency as well as policy considerations around privacy and marketing concerns. IMS Global has identified a roadmap for the lifelong learning record, they have termed a “personal achievements record” (see Appendix 2).

## **Conclusion and Next Steps**

In summary, it is clear that we can paint future scenarios for a digital credential world that pose both utopian and dystopian possibilities for learners. How do we best influence those potential future states? Our recommendation is to design with the learner and the employer in mind at the same time. Learners appear to have very limited knowledge of how the online recruiting and hiring trends described above will begin to impact their career preparation process. Most employers will follow the shortest path for hiring to meet their varied business needs, so designing solutions that start from this assumption will be critical.

Key next steps include experiments to test tools that help employers send clear signals, such as up-to-date competency needs and preferred pathways to achieve those competencies. We must also help learners see and understand the language employers use to select candidates. Finally, the whole ecosystem would be served if we could begin to educate learners on how the whole concept of their paper resume will quickly evolve toward a “digital footprint,” where their learning evidence and credentials from a range of providers will live in cyberspace. The opportunity is to shape it and enhance that record as one adds experiences and competencies throughout one’s life.

The work group recognized that topics such as sharing student records with employers and pre-hiring assessments are fraught with legal and policy considerations. With limited expertise on our committee, we simply did not feel qualified to make recommendations in this area.

The co-chairs would like to thank the workgroup for its spirited and thoughtful response to our topic. It should be stated that the enthusiasm about the potential for competency-based hiring was palpable and the expertise our group brought helped us see even further into the future of possibilities.

## APPENDIX I

### Work Group Participants\*

#### **Co-chairs**

Kathleen deLaski, Education Design Lab

Matt Pittinsky, Parchment

#### **Staff**

Evelyn Ganzglass, Connecting Credentials

#### **Members**

Kimberly Admire, Innovate+Educate

Alexander Alonso, SHRM

Kim Bartkus, HR Open Standards

Jamai Blivin, Innovate+Educate

Mimi Collins, National Association of Colleges and Employers

Ryan Craig, University Ventures

Emily DeRocco, National Network of Business & Industry Associations

Yuanxia Ding, Opportunity @ Work

Karen Elzey, Business-Higher Education Forum

Jonathan Finkelstein, Credly

Sean Gallagher, Northeastern University

Melanie Gottlieb, AACRAO

Jason Green, Skills Smart

Danny King, Accredible

Edwin Koc, National Association of Colleges and Employers

Mark Leuba, IMS Global

Dane Linn, BRT

Chris Pauley, Consultant

Derek Redelman, USA Funds

Mike Reilly, ACCRAO

Ahmad Shawwal, U Virginia

Bob Sheets, Credential Engine

Michael Simpson, Pairin

Audrey Theis, Key Links, Connecting Credentials

### **Participants in the July 13 Design Session**

Naomi Boyer, Polk State College

Andrea Deau, U of Wisconsin, Extension

Kathleen deLaski, Education Design Lab

Emily DeRocco, National Network of Business & Industry Associations

Deborah Everhart, Learning Objects

Evelyn Ganzglass, Connecting Credentials

Jeff Grann, Capella University

JoEllen Shendy, University of Maryland University College

Sarah Kiley, Parchment

Pat Leonard, Credly

Mark Leuba, IMS Global

Adam Markowitz, Portfolium

*\* Participation in workgroup deliberations doesn't imply that the individuals listed or their organizations necessarily endorse any or all of the workgroup recommendations.*

## APPENDIX 2

### US-Based Standards for Describing Credentials and Competencies

Below is a list of a United States-based organizations offering information models that have a role with standards for describing credentials and related entities such as competency frameworks. These organizations are currently participating with the Credentialing Ecosystem Mapping Team to map these information models. This effort is facilitated by Credential Engine and Postsecondary Electronic Standards Council (PESC). The Team is now identifying overseas-based organizations offering information models to include with the mapping efforts and may also identify additional US-based models over time.

In addition to the standards in the list related to credentials and competencies, the organizations identified in the chart may have additional standards available.

Standards	Description
<p>Advanced Distributed Learning</p> <p>The Competency and Skills System (CASS)</p> <p><a href="http://docs.cassproject.org/index.html">http://docs.cassproject.org/index.html</a></p>	<p>The CASS Project publishes its schema for all to use. These schemas are versioned and the CASS library provides upgrade paths to move information forward as community ideas evolve. The CASS Project and its collaborators maintain these schema.</p> <p>CASS is open-source software that enables users and other systems to define, store, manage, and access objects called competencies that are organized into structured collections called frameworks, and to report, store, and retrieve assertions about the competencies held by an individual (or team). General information about the CASS project is available on the CASS project website. Code, schema definitions, and API definitions are available from the CASS GitHub site.</p> <p>CASS uses and promotes linked data and open data and has mechanisms in place to facilitate public machine-readable access to competency data. CASS selectively includes encryption mechanisms to identify users anonymously, provide data integrity and nonrepudiation, and protect Personally Identifiable Information. This use of encryption to protect rights allows researchers to use CASS data without the need to maintain relationships of trust with providers of sensitive data.</p>
<p>Common Education Data Standards</p> <p><a href="https://ceds.ed.gov/">https://ceds.ed.gov/</a></p>	<p>Common Education Data Standards (CEDS) is an education data management initiative whose purpose is to streamline the understanding of data within and across P-20W institutions and sectors. The CEDS</p>

Standards	Description
	<p>initiative includes a common vocabulary, data models that reflect that vocabulary, tools to help education stakeholders understand and use education data, and assembly of metadata from other education data initiatives, and a community of education stakeholders who discuss the uses of CEDS and the development of the standards.</p>
<p>Credential Engine™</p> <p>Credential Transparency Description Language (CTDL)</p> <p><a href="http://credreg.net">http://credreg.net</a></p>	<p>The Credential Transparency Description Language (CTDL) is a vocabulary comprised of terms that are useful in making assertions about a Credential and its relationships to other entities. The word "vocabulary" is used here to refer specifically to a set of terms, a set in which the members are properties, classes, concept schemes, and/or data types.</p> <p>The CTDL is modeled as a directed graph using the W3C's Resource Description Language [RDF] for describing data on the Web. RDF extends the linking structure of the Web to use URIs to name the relationship between things as well as the two ends of the link (this is usually referred to as a "triple"). Using this simple model, RDF allows structured and semi-structured data to be mixed, exposed, and shared across different applications.</p> <p>In a sense, the CTDL is like a dictionary comprised of nouns (classes) and verbs (properties) that allow us to make simple statements, which, in aggregate, enable rich description of credential-related resources including credentialing organizations and specific subclasses of credential such as degrees, certificates, certifications, and digital badges. Credentials are related (linked) to other entities in the credentialing ecosystem such as assessments (Assessment), learning opportunities (LearningOpportunityProfile), and a myriad of conceptual frameworks such as competencies (Competency), assessment rubrics, and conceptual entities including formal classifications of occupations and instructional programs. The CTDL provides the terms to assert relationships among all of these entities.</p>
<p>Credential Engine™</p> <p>CTDL Achievement Standards Network</p>	<p>In order to describe competency frameworks in as interoperable a manner as possible, Credential Engine will build on an existing description language called Achievement Standards Network Description Language (ASN-DL) that was developed by the U.S. National Science Foundation (NSF) between 1999-2013 for the description of logically related sets of</p>



Standards	Description
<p>Description Language (ASN-DL)</p> <p><a href="http://credreg.net">http://credreg.net</a></p>	<p>knowledge, skill and ability assertions. The ASN-DL is designed using the W3C's Resource Description Framework (RDF) for describing Linked Data on the open Web. The CTDL-ASN Profile adopts in full the set of properties and classes defined in the ASN-DL and will be judiciously extending that set through property and class refinements as well as the addition of new properties and classes defined in CE's own Credential Transparency Description Language (CTDL).</p> <p>The ASN Description Language (ASN-DL) is made up of two fundamental entities: (1) the Standards Document—a competency framework as a whole, and (2) the Statement—the individual assertions of knowledge, skill, and abilities of which a Standards Document is comprised. These two entities—documents and statements—are modeled in terms of an entity-relationship model (ER) and embodied as a directed graph using W3C's Resource Description Language (RDF). An extensible set of structural and semantic relationships between the ASN's primary competency framework entities—the standards document entity and its atomic statement entities—have been defined.</p>
<p>Ed-fi</p> <p>Ed-Fi Data Standard</p> <p><a href="https://www.ed-fi.org/">https://www.ed-fi.org/</a></p>	<p>The Ed-Fi Data Standard is a set of rules that allow (previously disconnected) educational data systems to connect. Any educational technology that's powered by Ed-Fi—whether a student information system, a rostering tool, assessment software, etc.—can connect with any other.</p> <p>The Ed-Fi Data Standard is the set of rules for the collection, management, and organization of educational data that allows multiple systems to share their information in a seamless, actionable way.</p>
<p>IMS Global</p> <p>Extended Transcript (eT) standard,</p> <p><a href="https://www.imsglobal.org/activity/extended-transcript">https://www.imsglobal.org/activity/extended-transcript</a></p>	<p>Extended Transcript (eT) standard, is an implementation of the Comprehensive Student Record (CSR) that supports the development and management of standard-formed digital achievements records of competencies, courses, career-ready skills, experiential and co-curricular achievements. Extended Transcripts are created and controlled by the institution (“learning organization”) and can relate to a specific learning path or program such as a degree, certificate, micro-credential or independent. skills and competencies. Extended Transcripts are related to an Open Badge to support a learner’s public sharing and eT can also store badges in its achievements record structure. This capability forms</p>

Standards	Description
	<p>the foundation of an institutional network of open standard-formed achievements available for employment search, academic transfer and the learner’s personal achievement records, an unalterable, electronically verifiable copy of the credentials which the learner manages. University of Maryland University College completed a successful pilot of the eT design in 2016 and University of Wisconsin Extension is preparing for a pilot in 2017.</p>
<p>IMS Global  Competencies &amp; Academic Standards Exchange™ (CASE)  <a href="https://www.imsglobal.org/activity/case">https://www.imsglobal.org/activity/case</a></p>	<p>An important digital curriculum standard developed by IMS Global's members is the <a href="#">Competency and Achievement Standards Exchange (CASE)</a> which supports the ability to publish an institution’s course or competency-based curriculum in digital form, including assessment rubrics, and link the elements to other published entities like job descriptions or competency definitions published as frameworks or individual employment offerings. The CASE standard is integrated with the IMS Extended Transcript standard and can be the basis for connecting employer requirements to institution’s curriculum and provide a technology enabled pathway from education to the workplace. Projects are underway to implement CASE. Both standards support and complement the concept of a Credential Engine that holds reference versions of an organization's’ credential offerings. CASE supports the institutions’ local management of these records.</p>
<p>IMS Global  Open Badges v2.0  <a href="https://www.imsglobal.org/activity/digital-credentials-and-badges">https://www.imsglobal.org/activity/digital-credentials-and-badges</a></p>	<p>The Open Badges standard, originally developed by Mozilla, is now overseen by IMS Global and has undergone a significant upgrade to version 2.0. To ensure learners can display their badges on any compliant platform, IMS provides a certification service for suppliers to verify their badges adhere to the standard. Therefore, a student (or faculty) receiving a badge can share it with employers from any compliant platform. Previously, badge interoperability was not tested and certified, resulting in badges being “captive” to specific technology providers due to non-standard implementations. This certification enables the open badges and digital credentials ecosystem.</p>
<p>IMS Global  Personal Achievements Record (PAR)</p>	<p>The Personal Achievements Record (PAR) is the emerging vision for the portable lifelong learning record. Open Badges Infrastructure defines a “Backpack” as a cloud-based service to hold a learner’s badges for their management and sharing. The expanded version of the Backpack concept is PAR and includes the learner’s verifiable, unalterable eTranscripts, Learning Pathways and related digital evidence of learning. With Open</p>

Standards	Description
<a href="https://www.imsglobal.org/">https://www.imsglobal.org/</a>	Badges, Learning Pathways and eTranscripts, the PAR represents capstone of IMS' digital credentials program.
HR Open Standards  <a href="http://hropenstandards.org/">http://hropenstandards.org/</a>	<p>Founded in 1999, the HR Open Standards Consortium is the only independent, non-profit, volunteer-led organization dedicated to the development and promotion of a standard suite of specifications to enable human resource related data exchanges. HR Open Standards offers free, current, global HR data vocabularies in a transparent, collaborative, consensus-based environment open to all HR professionals and organizations.</p> <p>Integrate simply with external vendors and internal systems. Our specifications provide a common vocabulary enabling disparate systems to speak the same language and interoperate successfully.'</p>
MedBiquitous  ANSI/MEDBIQ CF.10.1-2012, Competency Framework  <a href="https://medbiq.org/competency_framework">https://medbiq.org/competency_framework</a>	<p>The MedBiquitous Competency Framework, ANSI /MEDBIQ CF.10.1-2012, is a technical standard for representing competency frameworks in XML. Organizations that publish competency frameworks can do so in this standard format, making it easier to integrate competency frameworks into educational technologies like curriculum management systems. The standard allows medical schools and other health professions schools to connect their curriculum, learning resources, and assessment data back to a common set of competencies, ultimately enabling competency-based views of the curriculum and of learner performance.</p>
MedBiquitous  ANSI/MEDBIQ PF.10.1-2015, Performance Framework  <a href="https://medbiq.org/performance_framework">https://medbiq.org/performance_framework</a>	<p>Competency-based learning and assessment are increasingly being applied within health professions education at all levels across the continuum. An important component of competency-based learning is performance level, an expected level of performance related to a competency. In the US, the Accreditation Council for Graduate Medical Education (ACGME) has developed Milestones for each of the 26 specialties in its purview. In undergraduate medical education, several medical schools, including the University of California, San Francisco, are implementing milestones related to the developmental achievement of competence. In Nursing and other health professions, levels of performance are associated with the assessment and development of competence. Standards are essential to make performance data portable and easily understood across the</p>

Standards	Description
<p>MedBiquitous</p> <p>ANSI/MEDBIQ EA.10.1-2017, Educational Achievement</p> <p><a href="https://medbiq.org/educational_achievement">https://medbiq.org/educational_achievement</a></p>	<p>continuum of a learner’s career. The Performance Framework is one step towards making that possible. It is designed to work in concert with other competency-related specifications, including the Competency Framework.</p> <p>The Educational Achievement standard provide a consistent format and structure for data concerning learners’ educational achievement. Educational Achievement allows systems to document learner competency and makes that data portable. This data is helpful to those considering the learner at transition points on the continuum. In addition, such information would be helpful to learners reviewing their professional development.</p> <p>These specifications intentionally exclude the following from their scope:</p> <ul style="list-style-type: none"> <li>• Credentials awarded as a result of achievements, including degrees, certifications, and licenses.</li> <li>• Continuing education.</li> <li>• Activities completed as part of a maintenance of certification or continuous certification process that are not assessments carried forth from prior GME training.</li> </ul> <p>Credential, CE, and certification activities are addressed by the Healthcare Professional Profile and Activity Report.</p>
<p>MedBiquitous</p> <p>ANSI/MEDBIQ PP.10.1-2008, Healthcare Professional Profile</p> <p><a href="https://medbiq.org/professional_profile">https://medbiq.org/professional_profile</a></p>	<p>The Healthcare Professional Profile provides a standard XML format for profile data on healthcare professionals, making it easier to exchange and compile profile data across organizations. This in turn allows for faster credentialing of professionals and faster availability of accurate data to the public.</p> <p>Standardizing the format of professional profile data has many benefits:</p> <ul style="list-style-type: none"> <li>Faster and more accurate updating of credentials data.</li> <li>Faster delivery of credentials data to regulatory bodies, healthcare institutions, and the public.</li> <li>Easier compilation and integration of data from primary sources.</li> <li>Faster development of information systems for credentials data.</li> </ul> <p>Because data is accurate and easy to exchange, it’s easier for regulatory bodies and health care institutions to catch fraudulent practitioners and recognize those claiming the highest levels of qualifications.</p>
<p>Postsecondary Electronic Standards Council (PESC)</p>	<p>Established in 1997 at the National Center for Higher Education, PESC operates as an international 501(c)(3) non-profit, community-based, umbrella association headquartered in Washington, D.C. PESC is an open standards-development and open-standards setting body with independent funding by membership dues and sponsorships, enabling provision of PESC approved standards and technical information free of charge.</p>

Standards	Description
<p>Academic College Transcript</p> <p><a href="http://www.pesc.org/pesc-approved-standards.html">http://www.pesc.org/pesc-approved-standards.html</a></p>	
<p>PESC</p> <p>Academic ePortfolio</p> <p><a href="http://www.pesc.org/pesc-approved-standards.html">http://www.pesc.org/pesc-approved-standards.html</a></p>	<p>ePortfolios today are being used for enhancing teaching and learning, for counseling and advising students, for building individual learning plans, for career development purposes, for Faculty RTP reviews and for institutions to collect certain data about student learning that can often be utilized for accreditation, management and promotional purposes.</p> <p>At its basic core, ePortfolio software allows users to simply build an electronic collection of content elements – often including rich media - that are typically referred to as artifacts. ePortfolio software also allows its users to reflect on and share their artifacts with friends, colleagues, teachers and prospective employers, with the administrative controls for sharing artifacts given to the creator of his or her Portfolio.</p>
<p>PESC</p> <p>Academic High School Transcript</p> <p><a href="http://www.pesc.org/pesc-approved-standards.html">http://www.pesc.org/pesc-approved-standards.html</a></p>	<p>The electronic exchange of student transcripts refers to a technology-based method of exchanging transcripts between postsecondary institutions and other constituents, including students, alumni, graduate schools, high schools and employers. This data delivery option is a value-added solution for both senders (registrars) and receivers (admissions), and represents a marked improvement to the traditional paper and postage delivery method.</p>
<p>PESC</p> <p>Common Credential</p>	<p>The Academic Credential and Experiential Learning schema is designed for:</p> <ul style="list-style-type: none"> <li>• Credential records for both traditional academic learning and extra- and co-curricular experience</li> <li>• Learning record data exchange and mobilization</li> <li>• Records for credential artifact generation and presentation</li> </ul>

Standards	Description
<a href="http://www.pesc.org/pesc-approved-standards.html">http://www.pesc.org/pesc-approved-standards.html</a>	<ul style="list-style-type: none"> <li>• Expression of the contents of the program as learning outcomes and learning reflection</li> <li>• Learning outcome proficiency assessment</li> <li>• Learning outcome mapping to alternative systems such as HR system, Higher Ed student records system.</li> <li>• Both PreK, K-12 and Work Force eco-systems as well as Higher Education</li> </ul> <p>The schema includes the components of Academic Program, Academic Session, and College Transcript Course and it is structured to support the needs of both academic and experiential learning records. It also serves the purpose of data transmission using the Transcript Request and Response standard. The schema supports credential artifact generation and presentation.</p>
<p>PESC</p> <p>Data Transport Specification</p> <a href="http://www.pesc.org/pesc-approved-standards.html">http://www.pesc.org/pesc-approved-standards.html</a>	<p>The Data Transport Standard (DTS) is a specification for a web service architecture that enables entities to send and respond to any type of request (transaction, inquiry, report) utilizing standard web service protocols. DTS is a culmination of different specifications and defines how to use them together. DTS is a result of a PESC initiative to create a standard method to exchange data within the Higher Education community, regardless of the business process. It is a recommended replacement for POP3/SMTP (e-mail) and an industry wide solution for real-time or immediate requests. DTS offers a solution for transport and may coexist or replace FTP.</p>
<p>Schema.org</p> <a href="http://schema.org/">http://schema.org/</a>	<p>Schema.org is a collaborative, community activity with a mission to create, maintain, and promote schemas for structured data on the Internet, on web pages, in email messages, and beyond.</p> <p>Schema.org vocabulary can be used with many different encodings, including RDFa, Microdata and JSON-LD. These vocabularies cover entities, relationships between entities and actions, and can easily be extended through a well-documented extension model. Over 10 million sites use Schema.org to markup their web pages and email messages. Many applications from Google, Microsoft, Pinterest, Yandex and others already use these vocabularies to power rich, extensible experiences.</p>

<b>Standards</b>	<b>Description</b>
	<p>Founded by Google, Microsoft, Yahoo and Yandex, Schema.org vocabularies are developed by an open community process, using the public-schemaorg@w3.org mailing list and through GitHub.</p> <p>A shared vocabulary makes it easier for webmasters and developers to decide on a schema and get the maximum benefit for their efforts. It is in this spirit that the founders, together with the larger community have come together - to provide a shared collection of schemas.</p>