Improving the Talent Marketplace through the Application of Web 3.0 Technologies

Background paper developed for March 7, 2018 forum

(Revised March 26, 2018)

U.S. CHAMBER OF COMMERCE FOUNDATION
Center for Education and Workforce

Introduction and Overview

The U.S. Chamber of Commerce Foundation (USCCF) and Lumina Foundation are working with employers, universities and colleges, technical standards organizations, technology vendors, and other stakeholders to explore how the convergence of Web 3.0 technologies can be used to create a more responsive, dynamic, and inclusive talent marketplace. An improved talent marketplace will help employers better source and grow talent, learners communicate their competencies and connect to employment, and universities and colleges improve how they address the needs of employers and learners by documenting and verifying learning. These Web 3.0 technologies include semantic web (SW) standards (e.g., Linked Data); distributed ledger technology (e.g., blockchain), artificial intelligence (AI), machine learning, and large-scale data analytics. Web 3.0 technology convergence is defined as the leveraging of two or more of these technologies in applications that strengthen connections and transform business processes between employers, universities and colleges, learners, and government.

Leading employers, universities and colleges, government agencies, and technology vendor partners are now undertaking promising initiatives that explore how one or more Web 3.0 technologies can address critical use cases within their respective domains (e.g., HR management, higher education). However, there has not been sufficient attention given to how these Web 3.0 technologies could be better used together to address critical use cases and applications that cut across these domains and have the potential to improve interoperability and drive innovation. Now is the time to identify and explore the most promising Web 3.0 technology convergence opportunities that can be supported by a more comprehensive and distributed public-private data and technology infrastructure.

To identify these opportunities, this collaboration between USCCF and Lumina Foundation will first review how leading stakeholders are beginning to explore and use Web 3.0 technologies on both the demand and supply sides of the talent marketplace and in government. From the demand side, this project will explore how employers and leading HR vendors are now using Web 3.0 technologies to improve the end-to-end talent sourcing process. From the supply side, or talent development side, the project will review how universities, colleges, and credentialing platform vendors are exploring how these same technologies can be used to improve how learners pursue careers, education, and credentialing opportunities. It will also review how universities, colleges, and technology vendors are using these advanced Web 3.0 technologies to improve the delivery of services to employers and learners. In addition, the project will review how federal and state governments are leveraging these technologies to improve government programs and services as well as data management and reporting systems.

Next, the project will use the resulting analysis to identify the most promising Web 3.0 technology convergence opportunities that have the greatest potential impacts on improving the talent marketplace, including improving interoperability across the public and private sectors.

To help in this effort, USCCF and Lumina Foundation are convening major stakeholders to frame a vision and guiding principles for exploring Web 3.0 technology convergence opportunities. At least four work groups will be organized to address convergence challenges and opportunities and discuss possible pilot projects, with additional work groups formed as needed. After the work groups complete their assignments, the partners will host a meeting with public and private data and technology experts on the implications for building a more comprehensive technology and data infrastructure.

This background paper will be used to frame and guide discussions with stakeholders during the project. The first draft of this paper was prepared for the initial stakeholder meeting. This revised paper was updated based on discussion and feedback at the first stakeholder meeting. The first section describes the goals and objectives of the project. The second section presents an overview of the preliminary review of leading stakeholder applications of Web 3.0 technologies, as well as opportunities for convergence and improving interoperability. The third section presents the project work groups and describes how the results from these work groups will be used to discuss implications for a decentralized public-private data and technology infrastructure. The final section proposes next steps.

Project Background and Purpose

In America, companies are struggling to close a skills gap that is negatively impacting their ability to compete and grow in a global economy. For companies, the ability to succeed in today's economy will increasingly depend on finding, onboarding, and retaining a skilled and competitive workforce that can drive growth and innovation. The skills gap is also negatively impacting students and workers. Recently credentialed students and experienced workers are struggling to communicate their competencies and credentials to find the best jobs and career advancement opportunities. In addition, education, training, and credentialing organizations such as universities, colleges, and certification bodies are finding it difficult to address rapidly changing employer needs and fill major skill gaps by preparing students and workers with the right competencies and credentials.

Since 2014 USCCF, through its Talent Pipeline Management™ (TPM™) initiative,[1] has been engaging the business community to leverage lessons learned from supply chain management to close the skills gap for their most critical and hard-to-fill job vacancies. The TPM approach encourages employers to play a stronger role in managing their talent supply chains by working with other employers to more clearly communicate or signal their competency, credentialing, and other hiring requirements for their most critical jobs and improve how they use this information to manage talent supply chains with education and training partners. The TPM initiative has highlighted how employers and their partners are leveraging technology tools and systems to improve how they

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[1] For more information on Talent Pipeline Management, see https://www.uschamberfoundation.org/talent-pipeline-management.

identify, source, on-board, develop, and retain talent in cooperation with sourcing partners including universities and colleges.

The TPM initiative has identified major challenges and opportunities in using leading information technologies to improve employer signaling of competency and credentialing requirements, improve competency alignment with major education and credentialing partners, and improve the integration and use of data from job applicants. USCCF recently announced the pilot-testing of a Job Registry to improve employer signaling for competency and credentialing requirements that can be better integrated with leading human resource technology systems including human resource information systems and applicant tracking systems.[2] USCCF is using the TPM initiative to explore other strategies in using technology to improve the end-to-end employer talent sourcing process including employer signaling, performance analytics, talent outreach and engagement, applicant screening, on-boarding, development, and retention.

Lumina Foundation has launched multiple initiatives to improve how information technologies can be used to increase the number of learners with high-quality credentials that lead to employment and further education. These initiatives include the launching of Credential Engine to promote transparency and improve search and discovery in the credentialing marketplace through the use of Web 3.0 Linked Data principles and technology applications, including a credential registry.

Lumina Foundation has also funded initiatives that promote the development and use of comprehensive student records that can better reflect what students know and can do from their university and college experiences. Lumina Foundation sponsored Connecting Credentials, which has explored data and technology challenges and opportunities in the credentialing marketplace and has convened stakeholders to explore the applications of leading technologies.

Together, USCCF and Lumina Foundation have identified the need to bring together initiatives on the demand side and supply side to explore how to improve interoperability between vendor systems and apply Web 3.0 technologies to create a more responsive, dynamic, and inclusive talent marketplace. The purpose of this project is to:

- Explore how the convergence of Web 3.0 technologies can be used to improve the talent marketplace;
- Identify where and how data interoperability and harmonization can be achieved between multiple vendor tools and systems used by employers, learners, and universities and colleges;
- Explore convergence and interoperability opportunities with a special focus on competencies and credentialing;
- Explore implications for a new public-private data and technology infrastructure; and

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[2] For more information on the Job Registry see https://www.uschamberfoundation.org/reports/clearer-signals-building-employer-led-job-registry-talent-pipeline-management.

- Develop a vision, guiding principles, and a roadmap including next steps for pilot-testing the most promising use cases and applications.
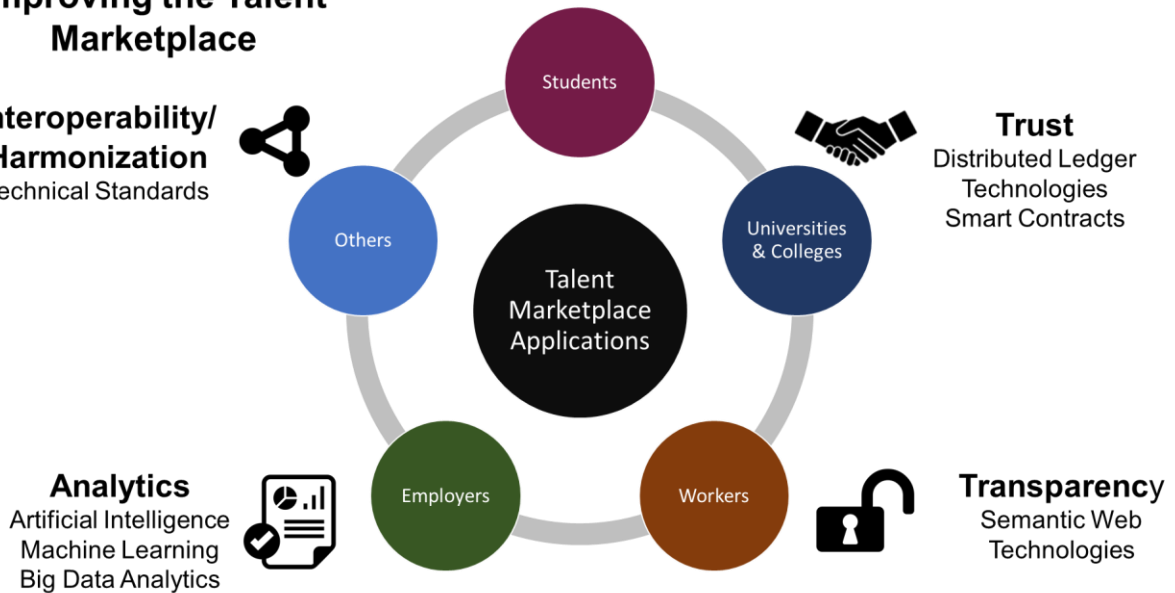
Convergence Opportunities for Web 3.0 Technology Applications in the Talent Marketplace

The project team has been reviewing Web 3.0 technology applications on both the demand and supply sides of the talent marketplace—and in government—to identify convergence opportunities that can drive breakthrough innovations in the talent marketplace. Some leading opportunities are highlighted below.

Semantic Web Convergence Opportunities

World Wide Web Consortium's (W3C) SW standards and related technologies, such as Linked Data, are increasingly being used to improve open Web search and discovery by employers, education and training providers, and credentialing organizations. On the demand side, search engines (e.g., Google), applicant tracking system (ATS) vendors, and job board vendors are leveraging Schema.org to improve the use of structured data in online job postings (e.g., JobPosting, Occupation). Similar standards have been developed by the HR Open Standards Consortium. USCCF's Job Registry project will build on these SW applications to improve how employers communicate competency and credentialing requirements that include the use of open competency frameworks, taxonomies, and ontologies.

On the supply side, Credential Engine is pioneering the use of SW standards to: (1) publish comparable information about credentials, credentialing organizations, quality

assurance organizations, and competency frameworks based on the Credential Transparency Description Language (CTDL); and (2) support the means to define machine-actionable relationships among them across the open Web.[3] Similar applications of SW standards could also be applied to how student and worker profiles are published and accessed on the open Web. Similarly, government agencies are exploring how to use SW standards to publish government statistics and related information as open Linked Data.[4]

Possible convergence opportunities for SW technologies with other Web 3.0 technologies include how:

- AI and machine learning technologies could leverage the power of SW technologies to provide more guided search and discovery including how employers identify and maintain connections with candidates in their talent networks; how universities and colleges identify opportunities to fill skills gaps; and, how students and workers find the best career, education, and credentialing opportunities.
- AI could be used to augment and enhance existing competencies and competency framework data.
- AI and machine learning technologies could utilize SW technologies to improve the alignment and comparison of employer competency requirements with the competencies expressed by universities and college programs and held by students and workers.
- AI and machine learning could also support the alignment and comparison of competencies between universities and colleges and other education, training and credentialing organizations, including corporations and the military.
- Distributed cryptographic ledger technologies could enable students and workers to better manage their online identities and professional profiles and to control what information they make public or share with employers and universities and colleges. They could also enable how students and workers indicate in their online profiles what information represents verifiable claims that can be easily confirmed through permissioned access to their personal information in distributed ledger networks.
- SW technologies, together with AI and distributed ledger technology, could be used to improve the sharing and analysis of trusted job candidate data throughout the end-to-end employer talent sourcing process from discovery to hire; and how they could be used together to improve performance analytics.

Distributed Ledger Convergence Opportunities

Distributed Ledger Technologies (DLT) are increasingly being used to cryptographically manage digital identities and other trusted, secure information about individuals,

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[3] For more information on Credential Engine see http://www.credentialengine.org/. For more information on the Credential Transparency Description Language (CTDL) and the Technical Advisory Committee see http://credreg.net/tac.

[4] For examples of federal efforts see David Wood (ed.) (2011) *Linking Government Data*, Springer: Springer, New York.

organizations, assets, and activities in the talent marketplace. In addition, they are being used to manage permissioned access to information which in the future could be enabled through DLT "smart contracts."

On the demand side, leading employers and HR technology vendors are exploring how to use DLT to implement the concept of self-sovereign digital identities with employees being able to better access, manage, and control information about themselves in company HR systems. Employers and HR technology vendors are exploring applications in talent sourcing, especially in conducting background checks and verification of work histories and credentialing, such as whether applicants have attained degrees, certificates, and certifications. They also are exploring applications in payroll processing and managing related compensation and benefit information, including health records.[5]

On the supply side, universities, colleges, and student record vendors are exploring the use of DLT to improve trust and verification of credentials as well as how students manage access and use of their information in applying for further education, employment, and benefits management. Governments throughout the world are exploring the use of DLT not only in education,[6] but across all government programs and services, including those relevant to the talent marketplace. The most common applications are in how federal and state governments manage and share trusted and secure information across government agencies and with third parties based on pre-defined conditions and, eventually, how DLT will allow individuals and organizations to gain greater access and control of their own information.[7] These applications have major implications for how government agencies and private sector data companies compile, manage, and use individual-level longitudinal information about work, education, and credentialing in the talent marketplace.

Possible convergence opportunities for DLT with other Web 3.0 technologies include how:

- SW technologies could provide students and workers with options in establishing digital identities and profiles on the open Web and make assertions that this information represents verifiable claims.
- SW technologies could be used to improve data standardization within and across distributed ledger networks and improve linkages to other off-chain data stores that enable more advanced applications of AI, machine learning, and data analytics.

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[5] Aliah D. Wright (2018) "Top 6 HR Technology Trends for 2018" Society for Human Resource Management, January 26, 2018; David Zielinski (2017), "Is HR Ready for Blockchain Technology?" Society for Human Resource Management November 21, 2017.

[6] Alexander Grech and Anthony Camilleri (2017), *Blockchain in Education*, Science for Policy Report, Joint Research Centre, European Commission, Luxembourg: Publication Office of the European Union.

[7] Steven Cheng, Matthias Daub, Axel Domeyer, Martin Lundqvist, (2017), "Using Blockchain to Improve Data Management in the Public Sector," Digital McKinsey, February, 2017, https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/using-blockchain-to-improve-data-management-in-the-public-sector; Jason Killmeyer, Mark White, Bruce Chew, "Will Blockchain Transform the Public Sector?: Blockchain Basics for Government," (2017), Deloitte Center for Government Insights, Deloitte University Press.

- Payroll processing applications could be leveraged to provide the additional information needed to verify work histories during the talent screening and verification process; reduce government reporting and regulatory burden (e.g., Unemployment Insurance); and provide the employment and earnings information for AI and data analytics tools to provide better guidance to students and workers and create better labor market information.
- AI and data analytics tools could be used to enhance the management and use of data managed through distributed ledger networks and smart contracts that provide permissioned access to individual-level data in ways that do not compromise privacy and security.

AI, Machine Learning, and Data Analytics Convergence Opportunities

AI, machine learning, and large-scale data analytics technologies are being used to automate routine tasks, improve decision-making, and redesign the customer experience in a wide variety of business processes in both the public and private sectors. On the demand side, employers and their HR vendors are using these technologies to revamp the end-to-end talent sourcing process.[8] These technologies are increasingly being used in performance analytics to determine which skills and career and educational backgrounds are most important in job performance and how this information can be used to predict which job candidates would be good hires. These technologies are also being used to improve outreach and recruitment in an employer's talent network and improve decision-making and connections in the talent screening and hiring process.

On the supply side, universities and colleges are exploring how to use these technologies to improve connections with current and future students and improve outreach, enrollment, education, and student services. Government is also using these technologies to improve services.[9]

Possible convergence opportunities for AI, machine learning, and data analytics technologies with other Web 3.0 technologies include how:

- AI and machine learning technologies could leverage the power of SW technologies to provide better search services for employers, learners, and universities and colleges in exploring opportunities in the talent marketplace.
- AI and machine learning technologies could utilize more structured competency data and competency frameworks, taxonomies, and ontologies to improve the development, comparison and analysis of competencies in job profiles, resumes, and credentials.

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[8] Allen Smith (2016), "Artificial Intelligence: The Future Is Now," Society for Human Resource Management, November 16, 2016; Roy Maurer (2018), "Technology Will Reshape Talent Acquisition in 2018" Society for Human Resource Management.

[9] William D. Eggers, David Schatsky, Dr. Peter Viechnicki (2017) "How Artificial Intelligence Could Transform Government," Deloitte Center for Government Insights; Emma Martinho-Truswell (2018) "How AI Could Help the Public Sector," Harvard Business Review, January 26 2018.

- DLT, including smart contracts, could help manage how AI, machine learning, and data analytics tools access and use individual-level data while protecting privacy and ensuring security.

Vision and Guiding Principles for Exploring Convergence Opportunities

This project is starting with a vision of an open applications marketplace where employers, students and workers, universities and colleges, and governments have access to a wide variety of affordable and effective vendor applications that are interoperable and designed to leverage a more comprehensive public-private data and technology infrastructure. This vision can best be realized through an open innovation network of major stakeholders and vendors on both the demand and supply sides of the talent marketplace and in government that embrace a common set of guiding principles.

Principle 1: Focus on High-Impact Stakeholder Use Cases. Stakeholders should focus on high-impact stakeholder use cases that strengthen connections and transform business processes between employers, universities and colleges, government, and learners. These high-impact use cases should have clear performance metrics that clearly define expected improvements in the talent marketplace.

Principle 2: Promote Web 3.0 Convergence. Stakeholders should leverage the benefits of two or more advanced Web 3.0 technologies such that the value of the results are greater than either technology used alone.

Principle 3: Foster Open Collaboration. Systems and applications should be developed through open collaboration among stakeholders and members of the technology ecosystem. This collaboration should start small with a focus on minimum viable demonstrations that could lead to breakthrough innovations.

Principle 4: Develop Open Technical Standards and Protocols. Systems and applications are built on open data and technology standards that promote interoperability and the effective sharing of information throughout the talent marketplace. This includes metadata standards that enable the application of SW and AI applications.

Principle 5: Utilize Open Competency Frameworks, Taxonomies, and Ontologies. Systems and applications utilize open competency resources that promote transparency and enable the application of SW and AI applications in improving the development and comparison of competencies in the talent marketplace.

Principle 6: Empower Individuals and Enable Self-Sovereign Identity and Data Management. Systems and applications should be designed to empower individuals in the talent marketplace. Systems and applications that contain

personal information enable self-sovereign management by the individuals whose data is stored in those applications. Users establish digital identities and have access and control of their identity attributes and other public and private information about them.

Principle 7: Facilitate Open Data Access in Public-Private Data Infrastructure. Enable users to make their information publicly available through multiple channels on the open Web, provide permissioned access to private information to conduct transactions, and provide greater access to de-identified individual-level information that can be used to improve guidance and transparency in the talent marketplace while protecting privacy and ensuring security.

Principle 8: Promote Ethical Practices. Stakeholders should develop and promote ethical standards and codes of conduct in managing access and use of data in the talent marketplace.

Organizing Work Groups

The project will organize at least four work groups to explore Web 3.0 application challenges and opportunities. This will be done in a two-step process:

- Step 1: Define High-Impact Stakeholder Use Cases. The first work group will involve employers and their talent sourcing partners in identifying the most important and highest impact use cases to address in exploring Web 3.0 convergence opportunities.
- Step 2: Enumerate and Address Technical Challenges. The other work groups will be organized after the first work group to address the technical challenges and issues presented by these critical stakeholder use cases. This will include work groups on data standardization, competency development and analysis, data management and other challenges presented by the stakeholder use cases.

These work groups will use at least two webinars to address challenges and opportunities and identify potential pilot projects. The project team will follow up with stakeholders to explore ideas generated in the webinars and develop a work group report that invites further input and feedback.

Work Group 1: Stakeholder Use Cases for Achieving Breakthrough Innovations

Objectives
- Identify the highest-impact stakeholder use cases where Web 3.0 technology convergence could improve interoperability and achieve breakthrough innovations in:
  - Employer signaling of hiring requirements including competencies and credentials;

- o Talent sourcing that includes recruitment, screening, verification, and hiring;
- o Learners pursuing careers, education, and credentialing opportunities;
- o Universities and colleges improving the delivery of services to employers and learners.
- Identify challenges and issues that should be addressed in the technical work groups.
- Identify performance metrics for evaluating the potential impacts of these use cases on improving the talent marketplace.

Possible Participants
- Employer HR professionals and universities and colleges.
- Other interested stakeholders, including technology vendors.

Background

As described above, employers, universities and colleges, government agencies, and technology vendor partners are now undertaking promising initiatives that explore how one or more Web 3.0 technologies can be used to address critical use cases within their respective domains (e.g., HR management, higher education). However, more attention must now be given to Web 3.0 convergence opportunities that can improve interoperability between the demand and supply sides of the talent marketplace and achieve breakthrough innovations.

This work group will review existing initiatives and identify the highest-impact stakeholder use cases where Web 3.0 technology convergence could achieve breakthrough innovations. The group will start by addressing:

- Employer Signaling: What are the major challenges and promising opportunities in improving employer signaling of hiring requirements? How can employers improve how they communicate competency and credentialing requirements? What are the challenges in doing that?
- Talent Sourcing: What are the major challenges and promising opportunities in improving the end-to-end talent sourcing process from talent outreach to candidate screening, verification, and hiring? What are the major issues in sharing and using candidate information throughout the process?
- Learners Pursuing Education and Career Opportunities: What are the major challenges and promising opportunities in improving how learners pursue education and career opportunities? What are the major issues in sharing and using individual learner information throughout the process?
- Universities and Colleges Improving Services to Employers and Learners: What are the major challenges and promising opportunities in improving university and college services to employers and learners? What are the major issues in sharing and using individual-level information in providing improved services?
- Ethical Considerations: What are the major ethical issues that should be considered in identifying and pursuing breakthrough opportunities in the application of Web 3.0 technologies and how individual-level information is accessed, managed, and used?

- Performance Metrics: How do we define performance metrics for these high-impact use cases to indicate expected improvements in the talent marketplace?

The work group may identify additional high-impact stakeholder use cases that do not fall within these two major categories. The work group report will be given to the technical work groups to start their work.

Work Group 2: Exploring Sustainable Data Standards Convergence

Objectives
- Identify stakeholder use cases that require additional data standardization and/or improve data standards harmonization.
- Develop plans and identify pilot projects for improving data standardization.

Possible Participants
- Technical standards organizations and technology vendors.
- Other interested stakeholders.

Background
One major challenge in improving interoperability and promoting the convergence of Web 3.0 technologies is the harmonization of data standards. This work group will explore opportunities to improve the harmonization of existing data standards and develop additional data standards needed to address the most critical stakeholder use cases involving the convergence of Web 3.0 technology applications.

Technical Standards Landscape
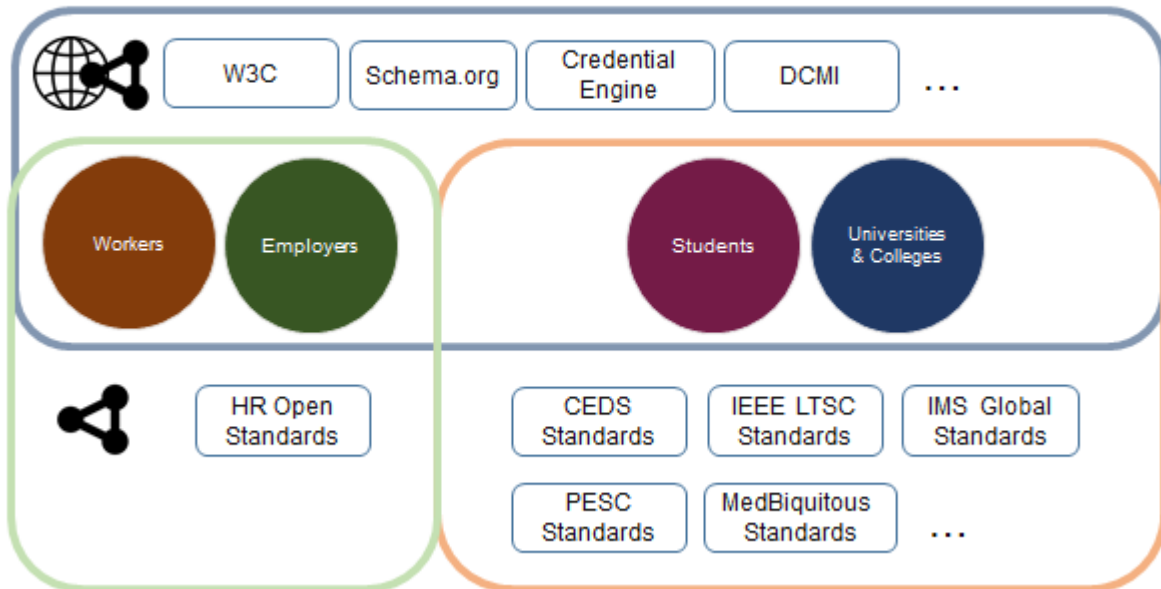
This work group will provide input to the existing Credential Data Ecosystem Mapping Team in how they can expand their scope to include the larger talent marketplace and address critical stakeholder use cases that promote the convergence of Web 3.0 technology applications.

The Credential Data Ecosystem Mapping Team is a voluntary group across North America-based organizations that manage international data standards. The Credential Data Ecosystem Mapping Team members include: Access4 Learning, Advanced Distributed Learning, Common Education Standards, Credential Engine, HR Open Standards Consortium, IMS Global, IEEE, Medbiquitous, and Postsecondary Electronic Standards Council. The team also has affiliates, including businesses that develop software and systems.

This group has developed a charter and mission, "To Ensure Interoperability of Data Standards Across Education, Training and Employment Sectors," and has agreed to crosswalk data standards that in the past have operated in silos. The voluntary group has currently limited the voluntary cross-walking to the credential ecosystem where there is growing demand for interoperability and Open Linked Data on the Web across supply and demand silos. Competency and credential data standards were identified as high-demand areas. So far, the group has mapped across a number of U.S.-based competency data standards and produced artifacts including a mapping Web page, abstract models, and an analysis of the mapping.

Some possible topics for this work group could include:

- How to improve data standardization in competencies and competency frameworks and related information needed by AI and data analytics applications.
- How to improve harmonization of data standards addressing job descriptions and job profiles including how they are used in online job postings and talent sourcing.
- How to improve harmonization and alignment of standards addressing resumes and comprehensive student records (e.g., transcripts) with a focus on use cases involved in publishing professional profiles on the open web and providing permissioned access in applying for jobs, further education and government programs (See Work Group 3).
- How to address standards in payroll applications that generate employment and earnings records that could be used in work history verification and public-private data systems.

Work Group 3: Developing and Analyzing Competencies

Objectives
- Identify stakeholder use cases that require improvements in how competencies are developed and analyzed.
- Develop plans and propose pilots of how SW and AI technologies can be used to improve the development and analysis of competency data.

Possible Participants
- Competency, SW, AI, machine learning, and natural language processing experts.
- Technical standards organizations and technology vendors.
- Employers, HR professionals, and other interested stakeholders.
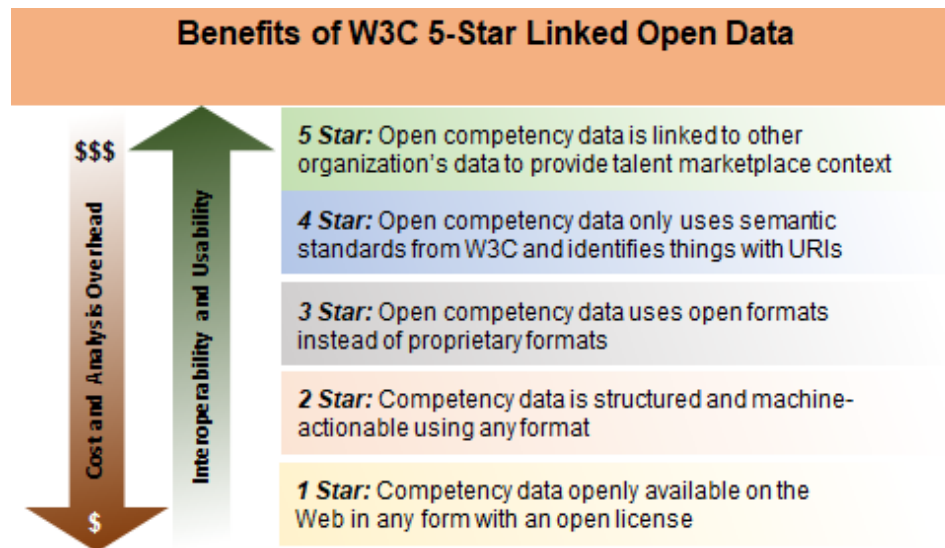
Background
Almost all major stakeholder use cases that have the potential to drive innovation in the talent marketplace require improved development and analysis of competency data. One of the major Web 3.0 technology convergence opportunities is using SW technologies, including Linked Data, to provide more structured competency data for AI and machine learning applications. This work group will discuss how SW and AI communities can better work together to improve how competency data is generated and used.

Most competency data is currently found in a wide variety of formats (e.g., text), documents, and datasets, including:

- Employer job descriptions and online job postings, applicant tracking systems, and related HR management systems.

- Credentials, including degrees, certificates, certifications, badges, and licenses.
- Assessments of academic, employability, and technical skills.
- Resumes and learner records including extended transcripts and portfolios.
- Corporate and military training and credentialing records.
- University and college student information systems, learning management systems, course catalogues, and course syllabus.
- Career and education guidance systems.
- Credential and domain frameworks such as the Degree Qualification Profile (DQP), European Qualifications Framework (EQF), and industry model competencies.
- Occupational information systems, such as O*NET.

Although there are many ongoing efforts to convert this competency data into more open and machine-actionable data, the development and comparison of competency lists and frameworks remains largely an expensive, time-intensive endeavor done by experts for very specific applications. These applications include the comparison of employer competency requirements to university and college program learning objectives, comparison of military and civilian credentials, and academic credit recommendations.

Benefits of W3C 5-Star Linked Open Data

5 Star: Open competency data is linked to other organization's data to provide talent marketplace context

4 Star: Open competency data only uses semantic standards from W3C and identifies things with URIs

3 Star: Open competency data uses open formats instead of proprietary formats

2 Star: Competency data is structured and machine-actionable using any format

1 Star: Competency data openly available on the Web in any form with an open license

However, there have been some promising data standardization and SW technology applications that have the potential to convert this competency data into more open and machine-actionable formats following the W3C Five Star Linked Open Data roadmap. This conversion of competency data could provide the necessary input for AI, machine learning, and natural language processing applications to do this work at the scale needed to drive innovation in the talent marketplace. In addition, there have been promising developments in AI, machine learning, and natural language processing in using this more structured data to not only improve the alignment of comparison of existing competency data but also augment existing competencies and

competency framework data through enriched terminology derived from the competencies and their context.

This work group will focus on identifying Web 3.0 convergence challenges and opportunities between these data standardization, SW, and AI applications that have the potential to provide a stronger foundation for a wide variety of pilot-test applications, including:

- Employer search and discovery of credentials and education and training programs to address changing competency requirements.
- Matching job competency requirements to competencies in credentials, applicant resumes, and learner records.
- Comparing and evaluating competencies in corporate training, prior learning assessment, and university and college programs for credit recommendations.
- Comparing competencies in military credentials and training programs to civilian credentials and education and training programs.
- Connecting competency information with related information on assessment (e.g., assessment rubrics).
- Generating competencies for university and college programs to match changing employer competency requirements.
- Generating real-time labor market information on changing employer competency requirements.

Work Group 4: New Architectures and Uses of Linked Individual-Level Data

Objectives
- Identify stakeholder use cases that have major implications for new trust architectures and protocols.
- Review existing and emerging trust architectures in relation to the use cases and identify key limitations and challenges.
- Identify pilot projects and key stakeholders capable of demonstrating new trust architectures that enable new uses of individual-level data.

Possible Participants
- Technology experts in distributed ledgers, secure multi-party computation, and cryptographic systems and protocols.
- Technology experts in SW and AI.
- Government data system experts.
- Technical standards organizations and education/employer technology vendors.
- Other interested stakeholders.

Background
One of the largest opportunities, as well as thorniest challenges, facing talent marketplace today is how emerging technologies will change access to, control over,

and use of sensitive individual-level data on education (e.g., student transcripts) and employment (e.g., employer payroll records).

Historically, the collection, management, and use of records about individual learning, credentials, employment, and wages have been fractured across employers, educational institutions, and government agencies, with a few trusted third-party intermediaries playing the role of neutral data aggregators. However, a variety of emerging technologies, policies, and legal structures are changing what is possible with these individual records. Distributed ledgers, smart contracts, and secure multi-party computation are technological keys that may unlock valuable use cases requiring the ethical and responsible use of personal records. These records could include personalized education, AI-assisted job search and matching, zero-cost and instantaneous employment verification, as well as automated qualification and enrollment in means-tested government programs. In addition, these use cases could provide dramatically better evidence on what publicly funded programs are effective means for transitioning people to employment.

However, these technologies remain at an early stage of development, with a number of nascent projects evolving rapidly and competing for attention. Questions remain as to the practicality of deploying distributed ledgers at scale, and to their relative advantages and disadvantages compared with more mature solutions. Further exploration and testing is still needed.

Moreover, dramatically expanding the use of individual education and employment records raises fundamental legal and ethical questions that often get overlooked at the peak of a technological hype cycle. While these emergent opportunities hold enormous promise, technology advancements alone provides no guarantee that distributed ledgers in education and employment will be more equitable in enhancing individual efficacy or expanding economic opportunity for all. This must be done in concert with deliberate, principle-based commitments by key stakeholders shaping the design and use of these new technologies in their institutional contexts.

To date, we have seen much of the innovation around individual records happen in a way that is disconnected from supportive and enabling efforts in data standardization, protocol alignment, and trust network development among key stakeholders. This inattention to complementarity and necessary convergence so early on in a technology's development may lead to choices in design and implementation that unintentionally constrain an important set of future uses.

This work group will explore emerging architectures for linked and verifiable individual records: what is feasible now, what may become possible in the near term, and what important constraints and limitations will need to be addressed. It will focus on identifying key design requirements and potential stakeholders for demonstration pilots that leverage the combined power of new trust architectures and SW technologies, and assess the ways in which they can enable the expanded use of AI and large-scale data analytics to increase opportunity.

Some of the key considerations of the group will include:

- What are the new architectures and protocols that hold the most promise in expanding access to linked individual data for major stakeholder use cases without compromising privacy and security?
- To what extent are current protocols used in public and private chains enabling and/or constraining important uses of the individual data for enabling search and discovery on the Web and AI power matching algorithms? What technology barriers and market incentives may be driving these constraints?
- What are leading practices in linking individual-level data across blockchain networks and other related data systems?
- What are the current legal and policy barriers and possible enabling frameworks for making some of the most promising applications possible?
- What are leading practices in multi-party computation that can be applied in the talent marketplace?
- What new research and development are needed at the intersection of distributed ledgers, SW, and AI?
- How can these new architectures and applications be pilot-tested among stakeholders and what is the minimum set of stakeholders for each identified use case?

Implications for a Public-Private Data and Technology Infrastructure

After the work groups complete their assignments, the project will conduct a meeting with public and private data and technology experts on implications for building a more comprehensive public-private technology and data infrastructure.

The private sector experts to be invited will include those who specialize in SW, DLT, AI, and machine learning, as well as experts on the design and use of distributed data systems. This group will include demand side and supply side vendors, private sector data aggregators, and real-time labor market information providers.

The public sector experts to be invited will include representatives from federal statistical agencies, national and state longitudinal data systems, and federal commissions on the future of education and workforce data systems. This could include participants from the Executive Office of the President (e.g., Office of American Innovation) and the U.S. Departments of Labor (e.g., Bureau of Labor Statistics), U.S. Department of Commerce (e.g., Census Bureau), and the U.S. Department of Education (e.g., National Center for Education Statistics), National Science Foundation, and National Academies (e.g., Committee on National Statistics). This could include participants from state workforce and education organizations, longitudinal data systems, as well as workforce and education policy groups addressing federal statistical systems and government data systems.

The meeting will first include a review of the proposed vision and guidelines for exploring Web 3.0 applications and results from the work groups and discuss implications for a more comprehensive public-private infrastructure. The meeting will then discuss major challenges and opportunities in moving forward and explore a roadmap for developing and pilot-testing key features of such a public-private infrastructure. The results from this meeting will be shared at the second stakeholder forum in which some of these public and private sector experts will be invited to share their views.

Summary and Next Steps

This background paper has described the goals and background of the project and summarized the preliminary review of Web 3.0 technology applications and opportunities for convergence. The paper has proposed a vision and set of guiding principles for exploring these convergence opportunities through four work groups and a meeting exploring implications for a public-private data infrastructure.

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