FEBRUARY 2020

LANDSCAPE ANALYSIS

WHITE PAPER

U.S. CHAMBER OF COMMERCE FOUNDATION

The research included in this report was made possible through funding by Walmart. The findings, conclusions, and recommendations presented in this report are those of the U.S. Chamber of Commerce Foundation alone, and do not necessarily reflect the opinions of Walmart.

Whiteboard Advisors

Whiteboard Advisors is a mission-driven communications, research, and consulting firm passionate about developing and implementing strategies that help changemaking organizations and entrepreneurs make an impact. Our team's diverse—and often divergent—perspectives are rooted in an unmatched understanding of education practice, policy, and the future of work.

U.S. CHAMBER OF COMMERCE FOUNDATION

The U.S. Chamber of Commerce Foundation is dedicated to strengthening America's long-term competitiveness. We educate the public on the conditions necessary for business and communities to thrive, how business positively impacts communities, and emerging issues and creative solutions that will shape the future.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

American employers are feeling the pain of acute skills gaps, driven by a tight labor market and technology's influence on a rapidly evolving world of work. But while employers are struggling to identify, attract, and retain workers, individuals often see the skills that they do have overlooked by hiring and promotion processes that rely on college degrees and other proxies for talent and weren't built to track, communicate, measure, or quantify today's most in-demand skills.

The result is a talent marketplace that is broken, limiting both economic opportunity for individuals and economic growth for companies. A recent study from Opportunity@Work estimates that 35 million Americans with a high school diploma but no four-year degree actually have a skills profile that employers are looking for, and that could lead to a new job with a 50 percent pay raise. The challenge comes in connecting these often-overlooked individuals—and their skills—with the employers that need them. If efforts to do this at scale succeed, the result will be a more inclusive and responsive talent marketplace. It could unlock both individual opportunity and corporate growth.

The challenge stems, in part, from a troubling communication gap: our education and employment systems don't speak the same language or communicate effectively. Employers can't share what they need and individuals can't share what they can do in a way the other understands. Against that backdrop, the burden of charting a path to economic opportunity often falls on individuals, who are poorly equipped to do that.

The challenge of education-employer interoperability is compounded by a lack of technical infrastructure that would allow this communication to happen. It's a challenge other sectors have faced and have overcome. For example, using a credit card requires a massive network of players—merchants, banks, hardware providers, and other intermediaries—that must all digitally "talk" to and trust one another in order to seamlessly turn the physical interaction of paying someone into a digital transaction. A similarly complex interoperable network is needed for opportunity seekers to share what they know and can do with employers. But the challenge in the talent marketplace is, in many ways, even more profound. Financial networks, after all, deal in currency that has a recognized form and value. In contrast, the systems that will support a talent communication ecosystem have the added challenge of defining and sharing something much more amorphous: skills.

Fortunately, a growing number of organizations and initiatives are focusing on closing the communication gap. But as they've grown in number, the challenge of differentiating between and among players, their overlapping solutions, and the complex relationships among them likewise grows. This paper aims to demystify that landscape and how the major initiatives, including three led by the U.S. Chamber of Commerce Foundation, fit together.

Specifically, it unpacks the work being done in five critical areas:

- **Navigating Credentials and Opportunities:** Creating better data and tools for opportunity seekers to understand the workforce value of specific skills and credentials.
- **Communicating and Authenticating Skills:** Enabling opportunity seekers to share what they know and can do more clearly and in a way that employers recognize and trust.
- **Communicating Skill Needs:** Helping employers identify, describe, and share the discrete competencies required for open roles within their organization.
- **Understanding Skills that Matter:** Creating the processes for employers to understand what skills matter for roles at their organization and to communicate where gaps exist.
- **Improving or Creating Technical Infrastructure:** Developing the shared standards and technical infrastructure to facilitate better communication.

Vast improvements in each of these areas are necessary to unlock their collective potential to transform the way we think about, measure, and communicate skills. It's simply not enough to recognize the role important competencies should play in hiring, or even to develop a common understanding of what skills are. We have to build the technical infrastructure that actually allows employers, educational providers, and individuals to speak clearly to one another.

To meet this need, the U.S. Chamber of Commerce Foundation has pioneered three key initiatives: Talent Pipeline Management® (TPM), the Job Data Exchange™ (JDX), and the T3 Innovation Network™. Together, these initiatives are designed to provide a Rosetta Stone for the talent ecosystem, translating both supply and demand signals into a common language and broadcasting these signals to relevant actors throughout the supply chain in near-real time. They also provide the foundation for other innovations necessary to create a more dynamic and inclusive talent market.

Just as the financial infrastructure that facilitates credit card payments is largely invisible to the end user, these initiatives are, in many cases, enabling tools that will create a more seamless way of connecting talent to employers and individuals to opportunity.

This landscape analysis is intended for a broad audience, including organizations that are currently leading or participating in signaling efforts or initiatives related to or covered in this report. This report is also intended for education, workforce, and employer partners and stakeholders that are impacted by—and will benefit from—the solutions and new signaling infrastructure that is emerging for the talent marketplace. Policymakers, state and federal public agencies, and philanthropic organizations will also find this to be a useful resource for navigating the current state of signaling in the talent marketplace as well as understanding the opportunities, gaps, and investment opportunities therein. Lastly, members of the media covering education, training, and employment will gain important insights into a wide-variety of new and emerging innovations impacting signaling in and across those sectors.

Those who care about creating a more equitable labor market based on skills rather than inefficient proxies must first be clear about what players in the sector are doing, what they hope to accomplish, and who they need to bring along in the process. This paper is designed to build that common understanding.

PREFACE

The challenge of connecting individuals with opportunity and employers with talent is neither new nor easy to solve. During Industrialization, the U.S. education system dramatically transformed to meet emerging workforce needs. As jobs changed in the decades following, employers, policymakers, and educators continued to invest in new kinds of training through community college systems, workforce development programs, and industry-recognized credentials. But despite these efforts, the pace of change in employer needs continues to outpace changes in workforce preparation, and the disconnect between the skills supplied and those demanded remains.

It is a challenge made more difficult by our dynamic, rapidly evolving global economy. Today, an estimated seven million jobs remain open and the lack of qualified workers to fill them threatens to stunt economic growth.[1] An overwhelming 92 percent of American executives say that American workers don't have the skills they need, and 45 percent say their companies are missing out on growth as a result.[2] Likewise, workers recognize that their jobs are transforming, with nearly three in four saying their jobs will change in the future and a similar number saying they have already had to learn new skills to do their jobs.[3]

But beyond these often-discussed skills gaps, another disconnect is looming over the labor market: a communication gap. We lack objective standards for skills, as well as the language and data to describe the skills workers have and those employers want. In other words, our education and employment ecosystem is starved of reliable signals.

- **Opportunity seekers** face a maze of options, are unsure what training or education programs will help them find good jobs in their geographic area, and are unable to effectively demonstrate skills (including ones learned on the job) that aren't packaged into a recognized credential;
- **Education, training, and credentialing providers** seek to help individuals meet their economic aspirations but are hindered by long and limited feedback loops that prevent them from seeing whether their curriculum, certification, or other credential is keeping pace with employer needs and, therefore, creating value for students; and
- **Employers** lack the data, technology, and related tools to accurately evaluate prospective workers and validate their skills, so they instead resort to inefficient proxies that lead to increased costs in finding, hiring, and upskilling their workforce.

Ecosystem Player	Description and Needs	Metrics that Matter
Opportunity Seekers	Students, employees, or unemployed individuals looking for a new role or job and guidance on what they need to know and be able to do in order to find and keep a good job, and how to obtain those skills.	• Employment • Salary • Upward career mobility • Return on investment (ROI) of training and education programs
Employers	Private-sector companies, the military, and other government agencies looking to hire the talent they need, upskill their workforce to stay relevant, and upskill workers to help them find their next role.	• Improved time to hire • Improved retention • Lower training costs • Larger, more diverse talent pipeline • Improved overall bottom line
Education, Training, and Credentialing Providers	Traditional higher education; workforce agencies and their partners; shorter-form programs (e.g., bootcamps, bridge programs); and industry certification organizations.	• Completion rates • Salary of graduates • Net promoter scores or other indicators of satisfaction • Adoption of tool or standard • Increased student demand

Figure 1: Talent Marketplace Ecosystem

Individuals, educational institutions, employers, credentialing bodies, and workforce training programs struggle to talk to one another about the competencies learners need to be successful and how they can credibly demonstrate those competencies to employers. "Job seekers, employers, and educators are out of sync with each other," says Jason Tyszko, vice president of the Center for Education and Workforce at the U.S. Chamber of Commerce Foundation. "Innovation in this space abounds, but gaps persist."[4]

This communication gap is perhaps most obvious in the tension between employers and higher education: 96 percent of college chief academic officers are confident that their institutions are preparing graduates for the workplace,[5] but only 11 percent of business leaders believe that recent graduates are prepared for work.[6] Education, training, and credentialing providers, meanwhile, wish that employers would more clearly define the competencies they seek. And without clear signals about either the quality of programs or the competencies that matter most to local employers, opportunity seekers are forced to choose a training or education program with limited information about its relevance or likely return on investment.

A lack of consistent terminology adds another layer of confusion to the communication gap. For example, some people use terms like "skill" and "competency" interchangeably, while others differentiate between skills as a discrete activity and competencies as a combination of skills, knowledge, and behaviors. Despite the use of the term "skill," "skills-based hiring" also includes hiring based on other attributes, behaviors, aptitudes, or knowledge. The same is true for the term "skills gaps." For the purposes of this paper, we use "skills" as shorthand for everything a person knows and can do, and "credential" to indicate any validated demonstration of skills, knowledge, or abilities (including badges, degrees, and industry certifications).

As a growing number of organizations and initiatives focus on closing the skills communication gap, it becomes challenging to differentiate between the groups and clarify the problems they are working to solve. Overlapping solutions and complex relationships between players create confusion for stakeholders, policymakers, and funders. Evaluating the landscape to identify the highest points of leverage, therefore, requires an examination of not just who is doing what within the ecosystem, but also who is doing what well.

Against that backdrop, a cadre of forward-thinking stakeholders sees a series of opportunities:

- How do we identify the efforts that are actually bringing education and workforce together?
- How do we help employers find and cultivate talent in new ways that are both more efficient and more inclusive?
- How can we convene and connect partners across the education-and-employment pipeline to improve communication?
- How do we better determine what jobs, competencies, and credentials are in demand and communicate that to opportunity seekers?
- What technology or data standards need to exist to enable improvements in how competencies are recognized, shared, and verified across the entire ecosystem?

The value of this effort is clear: it will not only help match the right opportunity seeker with the right employer, but also empower opportunity seekers with the information they need to choose education and training that leads to good careers and personal fulfillment.

THE CHALLENGE

Today, a communication gap exists all along the talent supply chain. Employers post job descriptions that use inconsistent terms to describe the qualifications they're seeking, call for a laundry list of skills and credentials, or fail to identify the competencies that will actually set job candidates up for success. And labor market intermediaries and service providers convene employers through advisory groups but have mixed results in obtaining reliable information on employer hiring needs. These hazy demand signals are then interpreted by policymakers, local workforce boards, and educational institutions as they create education and training programs, as well as by individual learners choosing what education or training path to pursue.

This means that learners may be acquiring the competencies and credentials they believe matter and that education, training, and credentialing providers may be designing programs to teach them, but all parties are responding to signals that have been diluted or distorted. And, to compound the challenge, it may have taken so long for the signal to travel down the chain that, by the time it reaches the learner, employer needs have changed. As a result, supply and demand are mismatched: learners have competencies they cannot sell in the labor market, and employers are unable to fill open positions.

But unclear signals aren't limited to the demand side. Even when a learner has the skills employers seek, it can be hard to easily and accurately share them with employers. Lacking shared competency frameworks or trusted measures of skill, employers fall back on well-known but imperfect proxies like degrees as ways to sort candidates. Only half of employers say that a degree is a "fairly reliable representation" of a candidate's skills and knowledge, yet 44% of employers have increased educational requirements for jobs in the past five years.[7] Employers are then disappointed when their hiring processes fail to distinguish the best candidates or when their "qualified" talent pools are too narrow for the number of jobs they seek to fill.

Adding to the challenge, individuals frequently lack easy access to their own learning records or do not receive recognition for experiences and knowledge obtained outside of the classroom, including those gained through military service, self-directed learning, or other experiences. And business as a whole has missed opportunities to credential learning that takes place on the job, says Sae Schatz, director of the Advanced Distributed Learning Initiative.[8] Even when learning is memorialized, with over 738,000 distinct credentials in the United States, according to Credential Engine's recent count,[9] it is challenging for employers to understand what each of them entails.

As a result, the communication gap is growing.

To simplify and organize the landscape, we have organized the challenges that individuals face in connecting with opportunity and that employers face in recruiting talent into five rough categories (Figure 2). These categories are made up of a wide range of intermediaries offering solutions (products and services) as well as frameworks, schemas, and other structures that help organize, collect, and share information. And while the communication gap is most acute between the supply and demand sides, it exists throughout the system.

In some cases, organizations fall into more than one category. For example, while companies generally fall on the demand side, they also play a role in helping workers obtain skills through workforce training programs.

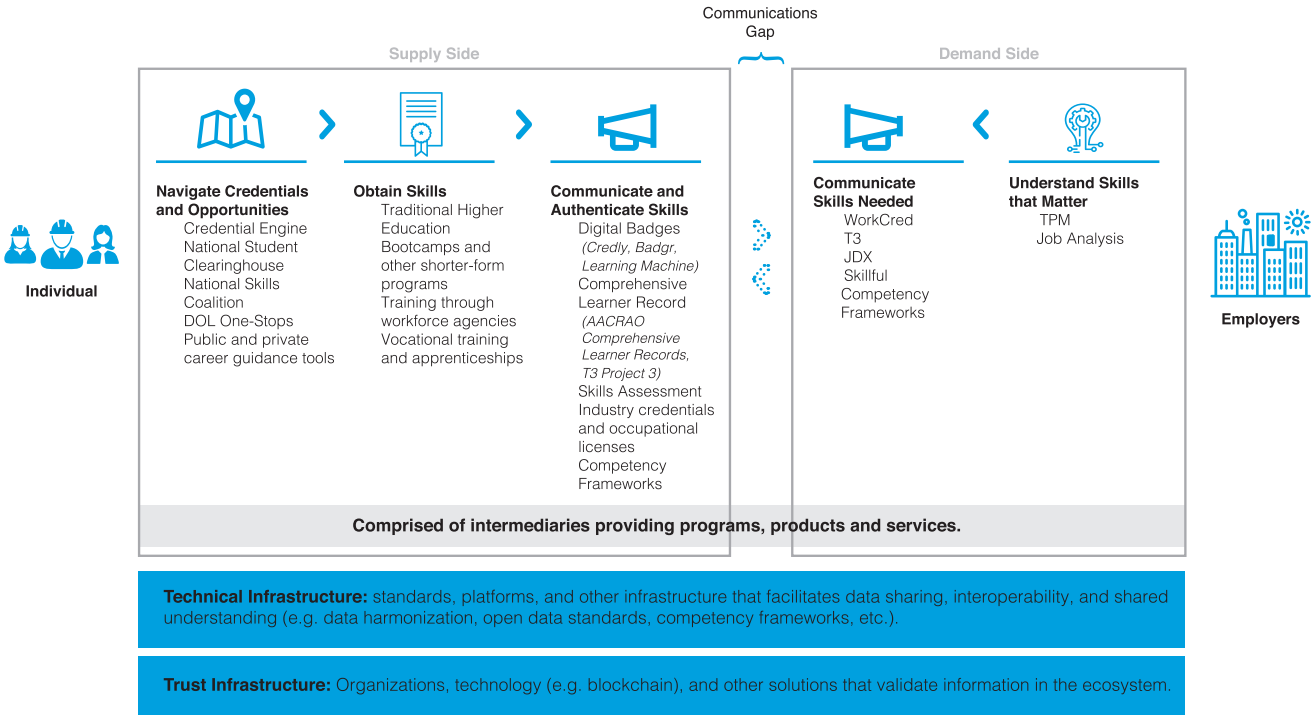

Figure 2: Flow of Information in the Current Ecosystem

Closing the communication gap will require both technical and human solutions, along with active participation from all members of the education and employment ecosystem. This includes not only providers of products or programs, but also the intermediaries that work to create the preconditions for success (e.g. organizations like Jobs for the Future (JFF) that facilitate cross-sector collaboration). At a basic level, however, it will require shifts in practice and investment in new tools and standards across all points of the education-and-employment ecosystem, including efforts around:

- **Navigating Credentials and Opportunities:** Opportunity seekers need improved data (including both employment and earnings data) to understand the value of individual credentials and their alignment to workforce needs and to make informed decisions about their educational path.
- **Communicating and Authenticating Skills:** Opportunity seekers need to be able to share what they know and can do in a way that employers recognize and trust. This requires collecting all of their learning activities in a sharable record (i.e., connecting military experience, training or education programs, and professional certifications), being able to articulate the skills that are embedded in each experience, and then communicating these skills to employers in a format that their HR IT systems will understand.
- **Communicating Skills Needed:** Employers need tools to identify the discrete competencies required for open roles within their organization and describe and share those needs with opportunity seekers in a way that makes it easier for job seekers to compare job expectations and allows for aggregation of workforce needs.
- **Understanding Skills that Matter:** Employers need improved processes and tools to facilitate workforce planning within and across sectors, including data collection and measurement to facilitate skills-based hiring and improve talent pipeline management (e.g., by identifying education and training providers that prepare students with the skills employers seek). Workforce agencies need an accurate understanding of skills gaps and surpluses in industries to connect local talent with high-quality, effective training options.

- **Improving (or Creating) Data and Technical Infrastructure:** All players need data standards and a better data and technical infrastructure that will facilitate the transmission of competencies in a machine-readable and easily parsed form, and enable tools that connect data across sectors and systems. This will dramatically improve the exchange of information between education, training, and credentialing providers; opportunity seekers; and applicant tracking systems (ATS) and other IT systems used by HR departments.

Of course, none of these can happen in a silo. All of the work above assumes the existence of data systems and an trust infrastructure that enable these changes to occur. It also acknowledges the deeply interdependent—and constantly changing—nature of the education and employment landscape. Making what may seem like a minor shift in approach often require significant changes in another part of the ecosystem.

This is not to say the communication gap is the only challenge: both the supply and demand side are constantly reacting to a range of factors. The cost of education, macroeconomic pressures, policy incentives, and even popular culture can impact how both individuals and employers choose to spend their time and money, and what skills they acquire (or don't) as a result.

OVERVIEW OF U.S. CHAMBER OF COMMERCE FOUNDATION INITIATIVES

To begin to facilitate these shifts, the U.S. Chamber of Commerce Foundation has pioneered three key initiatives: Talent Pipeline Management (TPM), the Job Data Exchange (JDX), and the T3 Innovation Network. Together, these initiatives act as a Rosetta Stone for the talent ecosystem, translating both supply and demand signals into a common language and broadcasting these signals to relevant actors throughout the supply chain in near-real time. Additionally, they provide the foundation for other innovations necessary to create a more dynamic and inclusive talent market.

Talent Pipeline Management (TPM)

Almost every good or service on the market today flows through a supply chain consisting of disparate actors who make, move, or message parts of the final product before a vendor sells it to an end consumer. The labor market is no exception. When supply chains are unstructured, though, each actor defaults to focusing only on the activities within his or her purview, which means information is lost, consumer demands are misunderstood, and the final product suffers.

"You need a new tool to solve this problem," says Tyszko, vice president at the Foundation.[10] TPM applies a supply chain management framework to local labor markets, building channels that decode and communicate signals between stakeholders throughout the ecosystem. It guides labor markets through the process of building a demand-driven supply chain by identifying the granular competencies employers are looking for, identifying the local education and training systems that are doing a good job of teaching those competencies, and partnering with providers to build learning programs that emphasize high-demand competencies.

TPM is both a way of thinking about and approaching talent management, as well as a set of practices that are supported by the TPM Academy™. The in-person TPM Academy targets business-facing organizations to help them build capacity for TPM implementation. After a six-module training process, participants are equipped to facilitate the TPM process with one or more group(s) of employers, including understanding how to collect and analyze rigorous data from employers and use the data to improve employer practices (e.g., hiring in terms of distinct competencies, not just credentials). This sets up the rest of the supply chain to focus on building competencies, which amplifies the returns of education and training.

The approach is also streamlining system-level workforce initiatives. For example, it used to take the Kentucky Chamber of Commerce between eight and 12 hours to collect job descriptions for analysis, decipher them to find common competencies, and write a common job description for the region, according to Beth Davisson, executive director of the Kentucky Chamber Workforce Center.[11] TPM dramatically simplifies this process.[12]

Job Data Exchange (JDX)

The Job Data Exchange™, or JDX, is a set of free, open-source data resources that employers and their HR technology partners can use to break down job openings into discrete competencies—instead of broad occupational descriptions—and communicate those competencies through a common blueprint for job postings used by all employers.

By creating a job data standard to organize and structure data about jobs, JDX makes it possible for job seekers; education, training, and credentialing providers; and policymakers to accurately compare the competencies required for different jobs, pinpoint individual or system-level skills gaps, and seek out targeted training options. When employers describe competency demands using different languages, information inevitably gets lost in translation. JDX's decoding and analysis tools ensure that employer signals are accurate and clear before TPM broadcasts those signals down the supply chain.

Developed by the U.S. Chamber of Commerce Foundation with support from Google.org, JPMorgan Chase & Co., Lumina Foundation, Schmidt Futures, and Walmart, JDX tools help employers improve their job descriptions and postings to make informed decisions about the language they use and the signals they send to talent sourcing providers.

T3 Innovation Network

After skill demands have been identified, decoded, and communicated, learners need a way to message their skills back to employers that aligns with demand signals. Historically, both sides have relied on educational institutions to act as the skill transponder for learners. However, this approach often requires learners to pursue overly broad and inefficient credentials and dramatically undervalues learning that takes place outside the classroom, including on the job or in the military.

Established through a collaboration between the U.S. Chamber of Commerce Foundation, the Lumina Foundation, Google, the Bill and Melinda Gates Foundation, ETS, Walmart, and Microsoft, the T3 Network tackles this problem by assembling a network of organizations from across sectors to build a data infrastructure that measures, records, and tracks learning throughout a worker's life—no matter where it takes place.

Comprised of more than 400 organizations, including businesses, postsecondary institutions, technical standards organizations, and human resource departments and their technology vendors, the T3 Network is working to build bridges between the data systems that track learners' skills. Enabled by technologies like artificial intelligence (AI) and blockchain, the interoperable data standards will create an open and decentralized ecosystem that streamlines skill and credentialing data from employers, universities and colleges, training providers, learners, and government sources into a single, unified learner record.

The T3 Network is empowering employers to understand the distinct skills that opportunity seekers have accumulated, regardless of where those skills were learned. And it is equipping individuals with a validated record of their skills in a language that employers understand.

Recognizing the importance of data harmonization and interoperability, the T3 Network partners are also working to promote the adoption of open data standards that will improve the flow of data across the education and employment ecosystem. In addition to improving labor market insights, this holds the potential to increase transparency for consumers, providing valuable information about opportunities and likely ROI for training or education programs garnered from aggregated individual outcomes data.

WHERE WE ARE: LANDSCAPE PLAYERS

Of course, the U.S. Chamber of Commerce Foundation is not alone in working to create a more efficient and equitable market for talent. Their work intersects with—and increasingly enables—the efforts of other ecosystem players to improve the current systems for connecting talent to opportunity.

To date, both the supply side and the demand side have taken steps to create a consistent lexicon to describe skills. But communicating skills is still a game of telephone, prone to error and misunderstanding, particularly since it lacks effective feedback loops to help identify potential errors. And the likelihood of crossed signals grows as the set of skills and experiences that people bring to the workforce and that employers seek grow more diverse and complex.

The sections below categorize notable players in the education-and-employment ecosystem within the five categories outlined above. More information on each of these players can be found in Appendix 2.

Navigating Credentials and Opportunities

For workers looking to obtain skills and credentials that unlock economic opportunity, identifying a relevant program of study or certification is the first hurdle. Today, a widening array of programs, from institutions of higher education to bootcamps to industry certifications and "bridge" programs, is emerging to allow individuals to obtain the skills and knowledge they need when they need them. This fragmented market makes it harder for individuals to choose a path and for employers to understand what different credentials mean.

Employers are beginning to enter this space as well, providing tools to help their employees choose pathways that will help them achieve their long-term goals. Amazon's Career Choice program and McDonald's' "Where You Want to Be" campaign, created in partnership with the Council for Adult and Experiential Learning, both help guide current employees toward the educational and other experiences that will help them achieve their career aspirations.

			Supply Side			Demand Side	
Organization	**Notable Funders/Partners**	**Primary Focus**	**Navigating Credentials**	**Obtaining Skills**	**Communicating & Authenticating Skills**	**Communicating Skills**	**Understanding Skills That Matter**
Competency Catalyst	University System of Georgia, BrightHive Inc., Eduworks, Credential Engine	Translating education into competencies	✓				
Connecting Credentials: A Beta Credentials Framework	Lumina Foundation, Common Employability Skills Framework	Promoting shared language for credentials	✓			✓	
Credential Engine	Lumina Foundation, JPMorgan Chase, ECMC, Microsoft, the National Science Foundation, the Northrop Grumman Foundation, the Siegel Family Endowment, Walmart.org, Workcred, George Washington University's Institute of Public Policy, Southern Illinois University Carbondale's Center for Workforce Development	Promoting credential transparency, shared language	✓		✓		
Data for the American Dream	Schmidt Futures; Colorado Workforce Development Council; Michigan Department of Technology, Management & Budget; New Jersey Department of Labor	Helping workers access jobs data	✓				
National Skills Coalition	National Association of Manufacturers, United States Census Bureau	Providing insights on non-degree credentials and other pathways to skills acquisition	✓				
National Student Clearinghouse		Providing better data on student outcomes	✓				
Skillful Governor's Coaching Corps	Colorado Governor John Hickenlooper, Indiana Governor Eric J. Holcomb	Training for coaches to help them connect workers to jobs	✓	✓			
The Right Signals Initiative	Lumina Foundation, American Association of Community Colleges, Corporation for a Skilled Workforce, Mississippi Gulf Coast College, Lone Star College	Connecting degree programs with stackable credentials	✓		✓		
Workcred	American National Standards Institute	Developing and sharing credentials	✓			✓	

Figure 3: Notable Players: Navigating Credentials and Opportunities

Skill Development

Traditional colleges and universities have often struggled to keep pace with the changing needs of employers. But many are now creating programs to better connect students and employers. New York's Monroe Community College created an Economic Development and Innovative Workforce Services division to foster partnerships between the college and local businesses and organizations. Northern Virginia Community College and George Mason University are partnering with Amazon Web Services to create a cloud computing degree program, hoping to build up a local talent base in one of the tech industry's fastest-growing, most talent-starved specialties. And other colleges are beginning to identify promising local industries so they can create programs built around their demands.[13]

Many institutions are also pursuing competency-based education (CBE), which awards credit based on demonstrated learning rather than credit hours or other time-based measures, and exploring ways of embedding other badges, certifications, or credentials within their degree programs to help students articulate their skills to employers. But it is not enough to offer CBE; institutions must also help individuals articulate the competencies they've obtained and share them with employers in a digital, scalable way. This may mean connecting higher education competency frameworks to HR systems, allowing these systems to better understand the context in which skills were developed and more accurately identify what an applicant knows and can do.

There are also organizations that help higher education understand the needs of employers and build the skills and competencies that employers require. For example, Education Design Lab has created 21st-Century Skills Badges that institutions can embed within existing curricula or offer to students as standalone, self-directed learning opportunities.[14] However, these organizations need more and better data to deliver on their full potential.

Higher education isn't the only skill provider. Workforce agency programs, trade unions, apprenticeships, and short-form programs, as well as employer-provided training, military-based learning, and individuals' life experiences also help workers gain the skills they need.

Industry certifications can provide a path for opportunity seekers to either enter a new field or command a higher salary within their current field.[15] Some industry credentials can boost an individual's salary by as much as 20 percent.[16] These groups, similarly to higher education, play an integral role in helping individuals memorialize and share their abilities.

			Supply Side			Demand Side	
Organization	**Notable Funders/Partners**	**Primary Focus**	**Navigating Credentials**	**Obtaining Skills**	**Communicating & Authenticating Skills**	**Communicating Skills**	**Understanding Skills That Matter**
ACE College Credit Recommendation Service	Microsoft, Jiffy Lube, Walt Disney, Starbucks, NASA	Evaluating and providing credit for non-traditional learning	○	○	✓	○	○
Association of American Colleges and Universities (AAC&U) VALUE Institute		Developing frameworks for assessing student learning	○	○	✓	○	○
Competency-Based Education Network	Western Governors University, Texas A&M - Commerce, Miami Dade College	Promoting competency-based education	○	✓	✓	○	○
Education Design Lab	UNCF, U.S. Department of Education, Georgetown University, George Mason University, Western Governors University, Miami Dade College, Dell Foundation, Lumina Foundation	Developing badges for skills valued by employers	○	✓	✓	✓	✓
IMS Global Competencies and Academic Standards Exchange		Comparing competencies	○	○	✓	○	○
National Institute for Learning Outcomes Assessment	Association of American Colleges and Universities, VSA Analytics	Promoting outcomes-based assessments	○	○	✓	○	○

Figure 4: Notable Players: Skill Development

Skill Communication and Authentication

Today, most individuals seeking additional education do so to get or keep a job, which puts increased importance on their ability to translate their new competencies into career opportunities.[17] Doing so means having a way to articulate skills in context and memorialize them in a valid and secure way. Current tools for communicating competencies include comprehensive learner record initiatives, digital badges, and a plethora of skills assessments and exams. These range from high-stakes assessments that lead to a professional certification to skills assessments on platforms like LinkedIn Learning.

These new models provide the data—and metadata—that HRIT systems rely on to sort and filter individuals during the hiring process, making them an important part of the education value chain.

			Supply Side			Demand Side	
Approach	**Notable Organizations, Initiatives, or Partnerships**	**Primary Focus**	**Navigating Credentials**	**Obtaining Skills**	**Communicating & Authenticating Skills**	**Communicating Skills**	**Understanding Skills That Matter**
Blockchain for Student Records	Arizona State University, Massachusetts Institute of Technology	Communicating competencies	✓		✓		
Co-Curricular Transcripts	NASPA, American College Personnel Association	Recording and communicating competencies	✓		✓		
Competency Mapping and Assessment	SkillsEngine	Communicating competencies			✓		
Comprehensive Learner Records	Lumina Foundation, American Council on Education, Credly, Working Transcript, NASPA, AACRAO, Comprehensive Learner Records Project, IMS Global, PIVOT Project, U.S. Department of Defense, Advanced Distributed Learning Initiative	Recording and communicating competencies	✓		✓		
Degree Qualifications Profile	Lumina Foundation	Communicating competencies			✓		
Digital Badges	Mozilla Foundation, IMS Global, IBM, Purdue University, Digital Promise, Credly, Badgr, Learning Machine	Communicating competencies		✓	✓		
Industry Certifications		Communicating competencies		✓	✓		
Velocity Network Foundation	National Student Clearinghouse, Velocity Career Labs, Cornerstone, HireRight, Korn Ferry, SAP, Randstad, Upwork	Communicating competencies			✓		

Figure 5: Notable Players: Communicating & Authenticating Skills

Skill Identification

As the types of jobs and the skills needed to do them become more complex with the adoption of new technology, companies will need to be strategic about how they identify skills they need, how they communicate those skills in job descriptions, and how they source talent, both externally and through internal promotion.

Job analysis has long been the framework from which all other HR practices stem, laying out the knowledge, skills, abilities, and other characteristics required for success in a position. But while hiring managers are happy to make a laundry list of desired attributes, only about a third of companies report tracking whether or not their hiring practices help them find good employees[18] This means that the vast majority of companies likely don't know which skills are most important, much less how to source candidates with those skills.

Historically, the process of breaking down job openings into distinct competencies has been time-intensive and expensive. Many firms cannot afford the investment or are deterred by scale—they know their singular efforts will not impact the overall talent pool. And, even when employers do understand the skills they need, they often lack insight into which local providers are best suited to teach those topics, or they don't trust external signals or frameworks as valid and reliable indicators of competency.

This is one challenge that TPM aims to solve. By more clearly articulating the skills required for success on the job, and removing historic proxies like credentials, companies can improve the likelihood of getting the right applicants and, as a result, will be more likely to find strong candidates who can be quickly hired and onboarded. Investments in upskilling and training programs will also improve when they are based on a deep understanding of the skills employers currently need and will need in the future.

Other tools that both employers and higher ed institutions use to understand the skills that matter are included below:

			Supply Side			Demand Side	
Organization	**Notable Funders/Partners**	**Primary Focus**	**Navigating Credentials**	**Obtaining Skills**	**Communicating & Authenticating Skills**	**Communicating Skills**	**Understanding Skills That Matter**
Burning Glass Technologies	North Illinois University, University of South Florida	Providing labor market/data insights	✓			✓	
Emsi	Western Governors University	Providing labor market/data insights	✓			✓	
O*NET	U.S. Department of Labor	Providing labor market/data insights					✓

Figure 6: Tools for Understanding Skills that Matter

Skill Communication and Amplification

Once companies understand both their current and future needs, they need to communicate those needs with would-be employees and education, training, and credentialing providers. Shifts in technology, including the expansion of AI and machine learning, are giving rise to new opportunities in aggregating and communicating this skill demand.

Similar to skill communication from the supply side, which relies on a shared language for describing competencies, demand-side initiatives rely on a shared language in order to consolidate expectations about skills and create a clearer market for the supply side to target.

Both TPM and JDX work to solve this problem by amplifying signals of skill demand.

			Supply Side			Demand Side	
Organization	**Notable Funders/Partners**	**Primary Focus**	**Navigating Credentials**	**Obtaining Skills**	**Communicating & Authenticating Skills**	**Communicating Skills**	**Understanding Skills That Matter**
National Labor Exchange	National Science Foundation, BrightHive, W.E. Upjohn Institute for Employment Research, National Association of State Workforce Agencies, DirectEmployers Association	Developing career planning tools, job bank	✓			✓	
Opportunity@Work		Connecting workers to jobs, reducing degree requirements in hiring	✓			✓	✓
Skillful	Markle Foundation	Connecting workers to jobs, skills-based hiring				✓	✓

Figure 7: Tools for Communicating Skills

Technology and Trust Infrastructure

Undergirding all of the components above is the need for basic infrastructure, including a common way of describing skills and a commonly-accepted way of deciding what fields to include for data entry, what to call them, and what data should go in each (also known as a common schema). The work of Credential Engine is perhaps the most well-known example on the supply side; its Credential Transparency Description Language (CTDL) provides an interoperable standard for memorializing the components of a credential or work experience (including the skills and competencies it includes) in a digital format.

Other initiatives also exist to facilitate easier translation of competencies. For example, the Advanced Distributed Learning Initiative (originally in the U.S. Department of Defense) promotes employee education and training, ensures interoperability, and encourages collaboration across government agencies.[19]

On the supply side, data standards and adoption of standards like CTDL hold the potential to create the infrastructure necessary to improve communication, which in turn gives stakeholders the data for measurement and program improvement. The same is true for JDX and other infrastructure on the demand side.

Standards play an invisible but important part in most digital interactions. The reason tools like Kayak can pull flight data from multiple sources and present it in one place is because airlines publish their information to the web in a standard format. The price of a flight is always labeled in the same way, regardless if it's Delta or United. Similarly, as more employers, HRIT companies, credentialing bodies, and others begin using the shared schemas of JDX and CTDL, players across the education and employment ecosystem will have access to more and cleaner data and will be able to use that data more effectively.

Of course, CTDL and JDX are not alone. Other data standards organizations also play an important role in ensuring data from educational, HR, and other sources is entered into systems in ways that can easily be shared. HR Open Standards, Common Education Data Standards (CEDS), IEEE, and other data standards all help create the consistency that allows data to be connected and used in new and meaningful ways.

Several organizations, including the U.S. Department of Education, the T3 Innovation Network, and the National Student Clearinghouse are convening players to explore the use of blockchain technology within this space, to offer greater individual ownership of records as well as improvements in trust and verification.

The improved data and interoperability created through new infrastructure, in turn, permit the use of new technologies that allow employers to use artificial intelligence and machine learning to quickly scan hundreds of resumes for desired talents and competencies. Dozens of "sourcing automation" companies such as HiredScore can customize algorithms to match employers' requirements. But these enabling tools are only as good as the data they have—a problem known across the tech world as "garbage in, garbage out."

				Supply Side			Demand Side	
Organization	**Initiative(s)**	**Notable Funders/ Partners**	**Primary Focus**	**Navigating Credentials**	**Obtaining Skills**	**Communicating & Authenticating Skills**	**Communicating Skills**	**Understanding Skills That Matter**
American National Standards Institute			Developing voluntary standards and assessments	○	○	✓	○	✓
Common Education Data Standards		T3 Network, IMS Global	Developing voluntary standards and tools	○	○	✓	○	○
Credential Engine	Credential Transparency Description Language	World Wide Web Consortium	Describing credentials using a shared language	○	○	✓	○	○
HR Open Standards Consortium		T3 Network	Promoting adoption of data exchange standards	○	○	✓	○	✓
IEEE	Learning Technology Standards Committee	T3 Network, Advanced Distributed Learning Initiative, IMS Global Learning Consortium	Developing technical standards and recommendations	○	○	✓	○	○
IMS Global	Badge certification	T3 Network, IBM, Purdue University, Digital Promise, Common Education Data Standards	Communicating competencies	○	○	✓	○	✓
MedBiquitous		T3 Network	Developing open standards	○	✓	✓	○	○
Mozilla Foundation	Open Badges standard		Communicating competencies	○	○	✓	○	○
Postsecondary Electronic Standards Council		T3 Network, Credential Engine, EMREX, EWP, HR-Open Standards, IMS, Stanford University, The National Center for Higher Education	Developing open standards	○	○	✓	✓	○
Schema.org		T3 Network, World Wide Web Consortium	Developing data schemas	○	○	✓	○	○
World Wide Web Consortium		T3 Network	Developing open standards	○	○	✓	○	○

Figure 8: Notable Players: Building a Technology and Trust Infrastructure

WHERE WE'RE GOING: A NEW PARADIGM OF TALENT MANAGEMENT

TPM, JDX, and the T3 Network all emerged to address the same problem: employers, opportunity seekers, and educators are talking past each other when it comes to talent development—and all sides are coming up short.

All three initiatives focus on closing the communication gap by developing and promoting tools for data collection and sharing, and they are deeply interconnected with the other skill communications initiatives outlined in this report. In many ways, none of these initiatives can have real impact and deliver value on their own, yet each is an essential part of a whole skills communication system.

For example, Credential Engine's CTDL and AACRAO's comprehensive learner records must be interoperable with HR systems (like applicant tracking systems) for credential earners to truly benefit from their use. Taken together, these initiatives build toward an ideal future state where more widely available and transparent data allow for seamless communication, clear measurement of outcomes, and a virtuous circle of improvement.

Better data created by the adoption of consistent schema for credentials and job descriptions (CTDL and JDX, respectively) will provide the high-quality raw material to power machine learning algorithms and other technologies that will help us make sense of the supply and demand of skills. Taken together, they enable the shift to a future where skills sit at the center of education and training, hiring, and talent development.

New feedback loops and processes (shown in purple in Figure 9) will improve the signals across the system:

- **Employers** will connect talent processes to business needs and outcomes, identifying what skills they truly need and the talent providers or other sources that lead to quality hires and signaling this clearly through job postings;
- **Education, training, and credentialing providers** will receive signals directly from employers, getting feedback not only on the new skills that employers need, but also on the extent to which their existing programs are adequately preparing students; and
- **Opportunity seekers** will have the data to navigate the sea of opportunities and pick a program or provider. They will have the tools to communicate their skills effectively and to continue collecting verified recognitions of what they know and can do throughout their career, creating a record that can open doors to future employment.

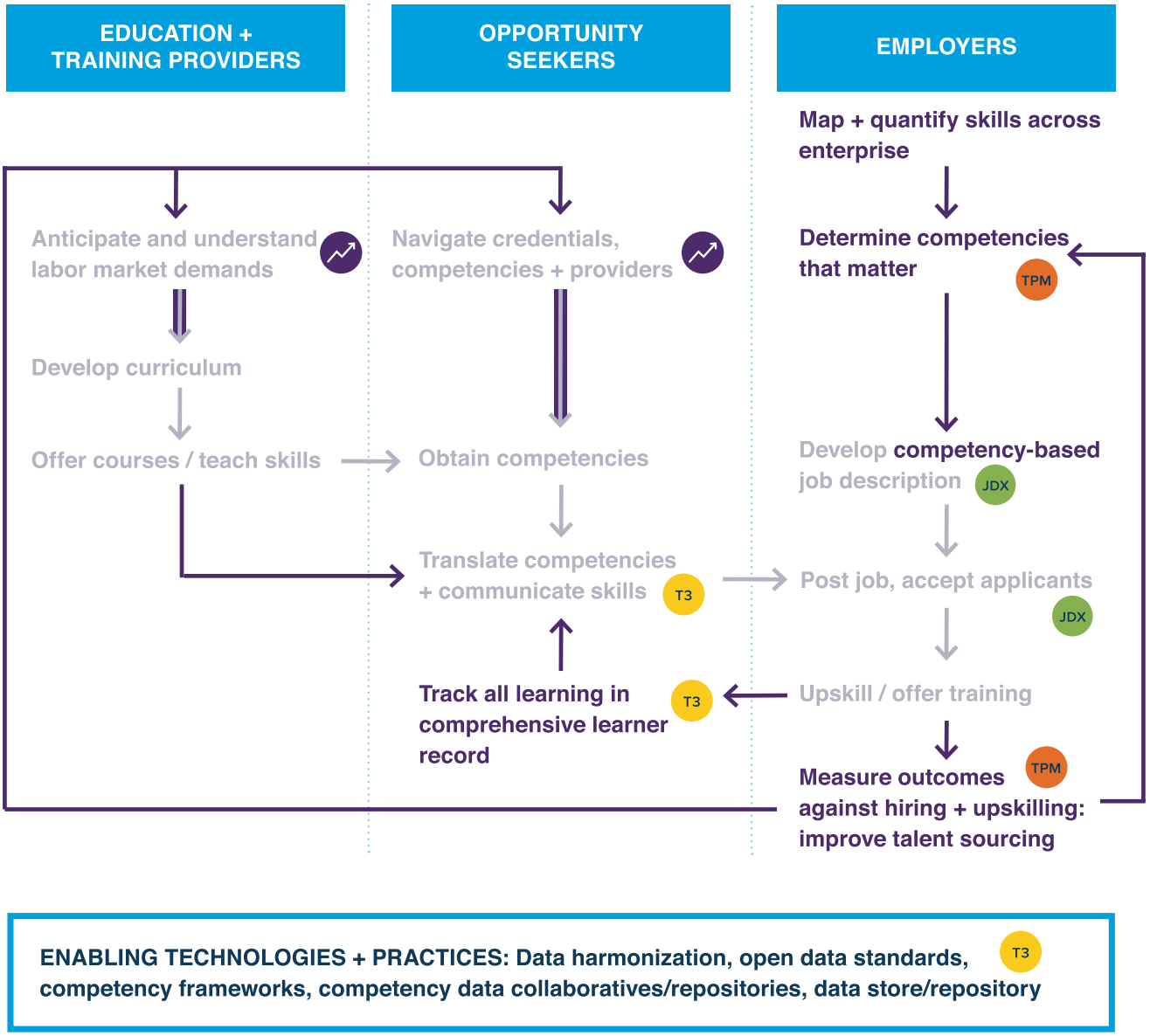

Figure 9: Improving Signals Across the Ecosystem

In some cases, improving the flow of data allows for the creation of completely new steps in the process (e.g., employer determinations of competencies that matter); in others (e.g., navigating credentials, competencies, and providers), it turns existing steps that amount to a guessing game into more educated decisions.

Consider the dramatically different experiences of an opportunity seeker.

As described earlier, in the current paradigm, a learner chooses a field of study based on whatever faint signals she can glean about the value of that credential—often relying on the brand reputation of an institution or a recommendation from a family member or friend rather than on real labor market outcomes.[20]

She then gains skills from a curriculum created by educators who have *attempted* to align it to workforce needs—but have no way to confirm it does. She shares those skills with employers via digital badges, degrees, or other credentials that may or may not be machine readable or easily parsed by IT systems, and she likely doesn't get credit for on-the-job learning or skills and abilities developed outside of the classroom. The exact terms she uses to describe her skills may or may not match the list of terms an employer has fed into its ATS, which means her resume has a high chance of never being read by an actual human.

In the new paradigm, the basic infrastructure initiatives create better, cleaner data and allow for improved measurement of workforce outcomes. Our opportunity seeker can choose an education path or provider with a better understanding of its likely value for employment or prosperity. She can memorialize all of her skills in a comprehensive record that is easy for her to access and modify but also machine readable, verified, and able to be parsed by an ATS. Her future employer gets a fuller picture of her knowledge, skills, and attributes, which can help inform the employer's internal strategy and talent management process.

Of course, getting to this future state requires substantial work to connect applications, platforms, and data across a wide range of locations and players. But other domains show that it's possible.

Most individuals use some kind of non-cash payment (e.g., credit cards, Apple Pay, Venmo) in their daily lives, but few understand the complex financial and technical infrastructure that ensures that those transactions process seamlessly. Every time you swipe a credit card, information must flow from a seller to a chip reader to the credit card issuer, and through several third-party apps in between, before your money goes into the seller's bank account. But each transfer of information happens so seamlessly that, from the customer's perspective, it seems simple: you can use a credit card issued by one of many companies at nearly any merchant using any currency, and the same amount of money will come out of your bank account. Each player operates separately, using their own infrastructure and languages, but they have built connections that allow everyone along the chain to instantly validate that a piece of plastic or a bar code links to a real credit line.

Making the shift to a skills-based paradigm will require the development of a similarly complex system with layers of technical and trust infrastructure that allow disparate systems to work together. It will take reaching the simplicity on the far side of this complexity to get to a user experience that is seamless (or nearly seamless), and therefore more likely to be adopted.

But unlike financial infrastructure—which transfers currency with known, commonly accepted attributes and value—the education-to-employment infrastructure deals in skills, which are far harder than money to define, measure, and compare. The technical layers of the ecosystem, all of which must "talk" to one another fluently in order to reach the ideal future state, are significantly more complex than the overly simplified flow chart in Fig. 2. Each player in the ecosystem, from employers to the talent sourcing providers (e.g., education and training programs) to the individuals themselves, must go through a multi-step process of collecting the data, translating it into skills, and sharing those skills with others in the system. On the employer side, ATS or other HR Information Systems (HRIS) must be able to take in and make sense of data about individuals' skills. This will likely require some type of connection to the competency frameworks used by institutions of higher education to denote what a person knows and can do as a result of obtaining a credential.

The resulting web of interactions between and among players may be more accurately envisioned as a set of layered, concentric systems. Only when information can flow effectively both throughout a system (e.g., each circle) and across systems will our economy truly unlock the potential of all individuals.

JDX
Job Data Exchange

Future State

Platforms and Applications
Utilize data resources, the JobSchema+ package, and open data tools to develop and share high quality, linked, and dynamic job descriptions and postings that improve internal hiring practices and external labor market information.

Translation, Recommendation, and Validation Tools
Enable platforms and applications to complete robust job descriptions and postings efficiently by translating skills and competencies, as well as validating the output.

Data Resources
Access data resources from diverse stakeholders (e.g., industry associations and government) to make skills and competency data available and usable for inclusion in job descriptions and postings.

JDX Data Collaborative
Use improved jobs data provided by public/private data collaboratives to enable new talent analytics for today's talent marketplace.

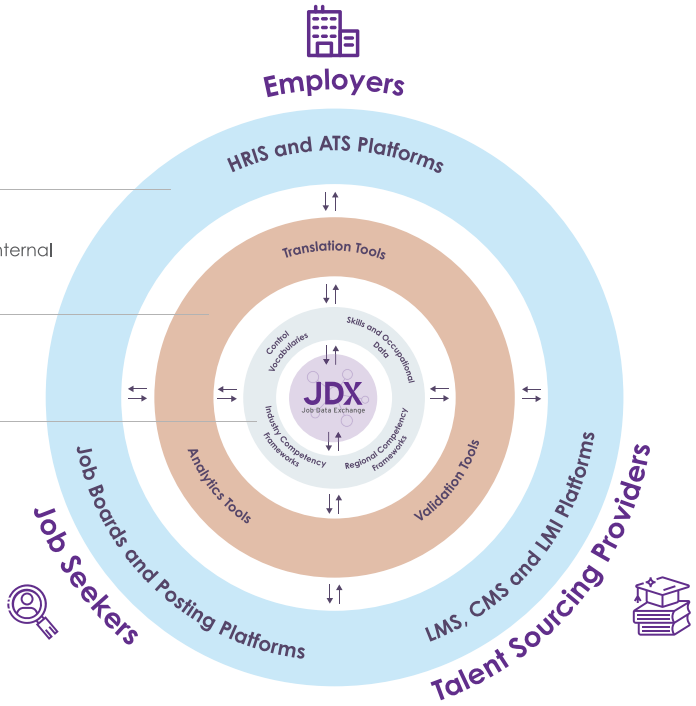

Figure 10: The Future State of the Talent Marketplace

CASE STUDY: IMPROVING SIGNALS FOR JOB SEEKERS WITH UPSKILL HOUSTON

In Houston, Texas, there are almost one million jobs that offer growth opportunities and are open to workers with two or fewer years of college, but the city is facing a significant skills gap across several industries.[21] In 2014, the Greater Houston Partnership created UpSkill Houston, which then used TPM to identify potential partners to help build stronger talent pipelines in the city.

UpSkill Houston has benefited workers in multiple industries, including:

- **Petrochemical manufacturing:** Enrollment in local community colleges to study petrochemicals has increased by 105 percent in five years, from 8,300 to over 17,000. The industry has also raised over $1 million for new scholarships for students in petrochemical programs at community colleges.
- **Construction:** Several companies have created Women in Construction programs to help address the severe gender imbalance in the industry. One company reported that 80 percent of the women it enrolled graduated, and those graduates are still working in the industry today.
- **Military:** NextOp, an organization that provides training and mentorship for veterans and returning service members to work in Houston's regional economy, has helped over 1,000 people find jobs in three years. It also works to increase awareness of technical careers among teenagers and currently has partnerships with local school districts that collectively serve over 150,000 students.

For employers, improved signals from the supply side mean fewer false negatives during the hiring process. Increasingly sophisticated algorithms can identify good candidates with increased precision, opening the door to new pools of talent.

CASE STUDY: CLOSING ENERGY INDUSTRY SKILLS GAPS, POWERED BY DTE ENERGY

The two occupations projected to grow the fastest in the U.S. by 2026 are both in the energy sector. During this same time, at least 50 percent of workers in this sector will become eligible for retirement.[22] As these trends converged, DTE Energy recognized that, to meet its talent needs, it would need help from industry partners, education providers and others statewide in order to substantially increase the number of qualified workers locally.

DTE Energy assembled a group of local stakeholders that faced the same talent shortage and wanted to create more robust career pathways into energy jobs. These stakeholders used the TPM framework to identify the most important qualifications for a job in the energy sector and develop educational programs to train people to meet those qualifications. They then convinced the Michigan Department of Education to approve and implement a new career cluster related to energy in order to help guide school districts in developing career and technical programs that prepare students for careers in the energy sector.[23]

As a result of this work, industry employers have more graduates with the skills needed to fill the growing number of jobs, and educational providers have a clear sense of what skills employers are prioritizing. After the energy career cluster was approved, DTE Energy also began working with Henry Ford College on the Power and Trades Pathways program, which trains high school graduates in one of six career paths that lead directly to paid apprenticeships in the energy sector.

Change Management for a Skills-Based Paradigm

The shift to a skills-based ecosystem requires human and technical solutions. In addition to substantial technical and product changes, there must also be changes in the way individuals work throughout the system. Without both of these components working together, neither will be successful. Technical solutions must be designed in such a way that they are likely to be used, and they must be integrated with human-side change management processes.

In addition to the extensive technical work that needs to happen to build the layered ecosystem we have been discussing, work is needed to build support for making these changes on the user side and safeguards must be put in place to help individuals use these new tools and data ethically and responsibly.

- **Communicating Value:** Recruiting early adopters will depend on effectively communicating the value of skills-based hiring, as it relates to either the social good (improving social mobility and increasing opportunity for individuals) or other metrics that matter (for employers, cost and time to hire, for example).
- **Closing Gaps to Improve Implementation:** Adoption—or at least adoption at scale—will depend on ease of use. If skills-based hiring tools require HR teams to spend more time on data entry because the systems are not interoperable and require everything to be keyed in from scratch, they will be less likely to use these tools. Improving the ways tools work together will also improve the user experience.
- **Nudging with Norms:** Creating a shared expectation for putting skills at the center of the education and employment ecosystem, and creating shared accountability for developing and communicating those skills, can also bolster adoption across all players.
- **Thoughtful Data Governance and Technical Development:** While data holds the promise to create a system based on skills and merit rather than on proxies, relying heavily on data and technology also opens the door to regulatory risks, privacy concerns, and threats of algorithmic bias. Full implementation will involve a sector-wide understanding of where data access is unintentionally limited versus where data limitations are important for protecting the privacy of individuals. This work will also likely require capacity-building efforts to ensure that employees handling data (whether from talent sourcing providers, workforce boards, or human resources teams) have the training to use it effectively and responsibly.

CONCLUSION

For too long, employers, opportunity seekers, and educators have talked past each other, creating inefficiencies in how talent is developed, sourced, hired, and upskilled. Awareness of the skills communication gap is increasing, and dozens of organizations and initiatives—including TPM, JDX, and the T3 Network—have started working to close it.

Significant work is still needed, both to create and scale the technologies and platforms to enable this shift to a skills-based paradigm and to create the human change management structures necessary to implement it. Appendix 1 offers some examples of additional questions that will need to be addressed as this work progresses to ensure that the initiatives of the U.S. Chamber of Commerce Foundation and others achieve both scale and sustainability, as well as—to the extent possible—avoid unintended consequences.

Of course, given the complexity of the problem and urgency of the need, system participants should not let the perfect be the enemy of the good. Like so many transformations, the shift to a new paradigm will be gradual, then sudden. But along the way, we must stop to assess our work, correct course when necessary, and draw in more partners. Doing so is essential to ensuring that the new paradigm actually increases equity, economic mobility, and growth.

It is hard work, but work worth doing, and other sectors have proven that it can be done. If successful, this work will transform how opportunity seekers, employers, and other ecosystem players find and communicate with one another, creating a more efficient and dynamic labor market—one that finally achieves the goal of connecting diverse talent to opportunities and employers to diverse talent.

APPENDIX 1:

Areas for the Chamber's Additional Consideration

While all parties agree that connecting the links in the education-to-employment chain is essential, many questions remain. These questions can be loosely divided into three categories: employers, data tools, and policy and finance.

EMPLOYERS

- How do employers ensure they're amplifying the right signals? Does TPM risk creating more barriers by identifying characteristics that are correlated with—but not determinants of—success?
- What steps should companies and organizing entities be taking now to demonstrate ROI so that, whenever the next economic downturn occurs and labor supply grows, they do not fall back on prior hiring habits and proxies?
- What is TPM's role in helping to facilitate cross-sector partnerships with employers and education, training, and credentialing providers?

DATA TOOLS

- How can JDX align large data sets and integrate them with private-sector tools to allow for greater scale?
- What processes must be developed to securely exchange data and link records with consistent analysis and privacy-preserving aggregation?

POLICY AND FINANCE

- As it grows, how will the T3 Network handle data privacy, equity, and the competing desires of open-source versus centralization?
- How can training on the TPM supply chain approach be scaled across geographies without reduced efficacy?
- How can the U.S. Chamber of Commerce Foundation engage a broader federation of state and local chambers? Who are the right additional partners to include?
- How do we future-proof existing initiatives and identify the groups best positioned to promote their success in the future?
- What policy changes will be needed to enable talent analytics across the education and employment ecosystem?
- How can initiatives like TPM, JDX, and the T3 Network catalyze additional investment or innovation to better align metrics and incentives to address other issues such as talent finance?
- Which entities are responsible for security/privacy within the larger infrastructure?

APPENDIX 2: LANDSCAPE PLAYERS

Navigating Credentials and Opportunities

Organizations and programs that help learners understand the value of often-disconnected credentials include:

- **Competency Catalyst:** a project led by the University System of Georgia, BrightHive Inc., Eduworks, and Credential Engine to map and link educational content to specific competencies. In 2018, it was selected as one of ten winners in the U.S. Department of Education's Reimagining Higher Education Ecosystem Challenge.[24] The creators of Competency Catalyst envision that the technology will ultimately help educators align curriculum to competencies and credentials and make it easier for students to see what they will learn by following a given educational pathway.

- **Connecting Credentials: A Beta Credentials Framework:** a framework developed for the Lumina Foundation by the Corporation for a Skilled Workforce and the Center for Law and Social Policy that uses competencies as the base for comparing various credentials. Competencies are broken into two domains, knowledge and skills, and skills can be further divided into specialized skills, personal skills, and social skills. From there, there are eight levels of increasing achievement that a learner can reach. Those levels do not imply any prescribed sequence of learning; learners may acquire competencies in any order. The framework aligns with the Common Employability Skills Framework and the Lumina Foundation's Degree Qualifications Profile and Tuning Initiative.[25] The project began in 2016 and culminated in a Connecting Credentials Action Plan in 2018.[26]

- **Credential Engine:** a non-profit working to create credential transparency, increase credential literacy, and empower individuals to make more informed decisions about credentials and their value. Credential Engine also offers a centralized Credential Registry to house up-to-date information about credentials, a Credential Transparency Description Language (CTDL, discussed more under Creating Infrastructure and Trust Frameworks) to enable credential comparability, and a platform to support customized applications to search and retrieve information about credentials. Founded in 2016, Credential Engine grew out of the Credential Transparency Initiative, a research effort led by the George Washington University's Institute of Public Policy, Workcred, and Southern Illinois University Carbondale's Center for Workforce Development. That effort was also supported by the Lumina Foundation, JPMorgan Chase, ECMC, Microsoft, the National Science Foundation, the Northrop Grumman Foundation, the Siegel Family Endowment, and Walmart.org.[27] In November 2019, 15 postsecondary education organizations signed a joint statement of support for credential transparency.[28]

- **Data for the American Dream (D4AD):** a grantmaking initiative to help make education and employment data more accessible so that opportunity seekers can make more informed decisions. In September 2019, D4AD announced its first three grantees: the Colorado Workforce Development Council; the Michigan Department of Technology, Management & Budget; and the New Jersey Department of Labor.[29] Schmidt Futures is the lead funder of D4AD's RFP process.[30]

- **National Skills Coalition:** a Washington, D.C.-based nonprofit comprising more than 28,000 members from the ranks of business, labor, community colleges, community-based organizations, and the public workforce system. Founded in 1998 as The Workforce Alliance, it pushes to show that "investments in skills work."[31] The coalition is working on building robust quality assurance systems for non-degree credentials (NDCs) such as industry certifications, apprenticeship certificates, and occupational licenses. As of 2016, 27 percent of adults had a NDC, with 18 percent having licenses, 8 percent having postsecondary certificates, and 6 percent having certifications.[32] That year, NSC also partnered with the National Association of Manufacturers and the United States Census Bureau to collect and analyze data on pathways from education to the workforce. That work includes developing common reporting formats for certification providers and non-credit courses, matching data from credit and non-credit courses, and matching education and employment data.[33]

- **National Student Clearinghouse:** a Virginia-based nonprofit founded in 1993 by the higher education community. It runs a national student data resource "to better understand student pathways and outcomes in order to help students succeed." It also runs a research center that works with higher education institutions, states, school districts, high schools, and educational organizations to inform practitioners and policymakers about student educational pathways.[34]
- **Skillful Governor's Coaching Corps (SGCC):** a state-level program that provides training and professional development for career coaches to better equip them to connect people to effective training opportunities and quality jobs. The SGCC coaching corps was launched in 2017 in Colorado with Governor John Hickenlooper; two years later, it was expanded to Indiana, working closely with Governor Eric J. Holcomb.[35]
- **The Right Signals Initiative:** an effort to recognize high-quality credentials, whether they are degrees, certificates, certifications, badges, or apprenticeships. Twenty-seven colleges are participating in the initiative by using Lumina's beta Credential Framework (described in "Navigating Credentials and Opportunities") in some fashion. The parameters were broad—participating colleges were asked to link at least one nontraditional credential with a degree or certificate using the framework. For example, Mississippi Gulf Coast College decided to use the framework to map all of its general education courses, while Lone Star College decided to require the use of the framework in any new program development. Some institutions reported that using the framework helped them develop stronger industry relationships or expand their awarding of credit for prior learning.[36]
- **Workcred:** a nonprofit affiliate of the American National Standards Institute (ANSI) that works to improve the credentialing system. Its work includes thought leadership and research around workforce needs and credentials; helping stakeholders understand credentials and their value; connecting industry leaders, education leaders, and credentialing organizations to share information about credentials; and helping employers assess their needs and build high-quality credentialing programs.[37]

Developing Competencies

Efforts to promote and develop competency-based education (CBE) and similar programs include:

- **ACE's College Credit Recommendation Service:** a service that evaluates employer-based learning, among other types of learning that take place outside the classroom, and recommends the amount of credit that institutions should award based on that learning. That process clears the way for students to receive academic credit for corporate learning. Employers that have used the service include Microsoft, Jiffy Lube, Walt Disney, Starbucks, and NASA.[38]
- **Association of American Colleges and Universities (AAC&U) VALUE Institute:** In 2009, the Association of American Colleges & Universities (AAC&U) released rubrics that institutions and other organizations could use to assess student learning called Valid Assessment of Learning in Undergraduate Education (VALUE). There are rubrics for sixteen Essential Learning Outcomes, as determined by employers and faculty, and they have collectively been accessed by over 70,000 individuals from nearly 6,000 unique institutions. The VALUE Institute allows institutions or other organizations to upload samples of student work to be scored by VALUE Institute faculty, providing external validation of an institution's assessments.[39]
- **Competency-Based Education Network (C-BEN):** a network that aims to increase demand for CBE, build capacity among institutions to offer CBE programs, and remove legal and policy barriers to implementation. C-BEN began in 2014 with 17 institutions and two public university systems, and it now counts 30 institutions and four public systems as members of the network. These institutions either currently offer or are working to offer programs that use outcomes-based assessments. C-BEN also offers consulting services for institutions and other organizations interested in developing CBE programs.[40]

- **Education Design Lab:** an organization that helps develop student-centered solutions that solve problems for institutions, foundations, entrepreneurs, and non-profits. One of those solutions is 21st-century skills badges, which the Lab has co-designed with school administrators, faculty, students, and employers. The skills that are represented on these badges include collaboration, intercultural fluency, resilience, and critical thinking. Each skill has four sub-competencies, and learners must demonstrate each sub-competency through a performance-based assessment in order to be awarded the relevant badge.[41] Institutions can embed these badges within their curricula or offer them to students as standalone, self-directed learning opportunities.
- **IMS Global Competencies and Academic Standards Exchange:** a framework for exchanging information about competencies, whether that information is in the form of documents, items, associations between and across standards, or rubrics.[42]
- **National Institute for Learning Outcomes Assessment (NILOA):** an organization that works to document and promote the use of outcomes-based assessments in education programs. It houses an assignment library and toolkit that can help demonstrate what an effective assessment looks like and how to design one. NILOA also has a Transparency Framework that is intended to be a resource for institutions looking to make what students have learned clearer and more visible. In addition, NILOA offers an Excellence in Assessment designation to institutions in partnership with the Association of American Colleges and Universities and VSA Analytics.[43]

Communicating and Authenticating Skills

Individuals and talent sourcing providers are communicating skills in a variety of ways:

- **Blockchain for Student Records:**
  - » Arizona State University (ASU) and the Massachusetts Institute of Technology have begun using blockchain to transmit student records. Blockchain formats for student records are desirable because they are secure, verifiable, and able to be shared with employers, graduate schools, and other interested parties. ASU is also using the blockchain records to coordinate with local community colleges and identify students who transferred from community colleges to ASU and have since earned enough credits to receive an associate's degree from the community college.[44]
- **Co-Curricular Transcripts:**
  - » Co-curricular transcripts allow students to display extracurricular activities and other learning outside the classroom alongside their academic transcripts, providing a more holistic picture of what they know and have accomplished. Co-curricular transcripts can be verified by school officials in a similar fashion as academic transcripts.[45] NASPA has worked on broader recognition of student learning since at least 2004, when it published "Learning Reconsidered: A Campus-Wide Focus on the Student Experience" with the American College Personnel Association.[46]
- **Competency Mapping and Assessment:**
  - » Mapping competencies against an existing curriculum is often a highly manual process that is more art than science. While companies like SkillsEngine are working to automate this, the nuance of what a particular competency looks like in one academic context versus another makes it challenging to do this without a human touch.
    - – Memorializing and sharing these competency frameworks in a way that can be communicated with other players in the ecosystem, through either a shared data schema or another open standard, will be necessary to communicate competencies clearly to employers.

  - » Skills assessment includes a broad range of uses, from competency-based learning to credit for prior learning to a high-stakes assessment leading to a professional certification.

- **Comprehensive Learner Records:**
  - » Learners accumulate marketable skills outside the classroom, but they lack a way to track and demonstrate those skills. Comprehensive Learner Records (CLRs) are standardized, portable, and verifiable transcripts that convey a more complete set of information about learners' skills and competencies than a traditional academic transcript. For example, instead of including only academic coursework, CLRs can contain information about non-traditional and extracurricular learning opportunities and show evidence of performance through badges. CLRs allow individuals to share a more holistic picture of their knowledge with hiring managers, graduate schools, and others, and those recipients also benefit from having more information on which to evaluate an individual. In the future, CLRs could also potentially provide interoperable records of individuals' work experiences.[47]
  - » In 2019 with the support of the Lumina Foundation, the American Council on Education (ACE) and Credly created and implemented a Working Transcript to validate learning and issue modular digital badges to hundreds of thousands of students. This Working Transcript includes both academic credit recommendations and workplace competencies that have been validated by expert evaluation teams. Students holding ACE credentials on Credly's Acclaim platform are connected with both higher education institutions and employers.
  - » In 2015, the Lumina Foundation gave NASPA and the American Association of Collegiate Registrars and Admissions Officers (AACRAO) $1.7 million to pilot CLR models. Two years later, Lumina provided an additional $1.2 million to continue developing CLRs and implement them at institutions of higher education. NASPA and AACRAO created a readiness assessment for institutions interested in CLRs and offered workshops and an online toolkit for institutions that formally joined the Comprehensive Learner Records Project.[48]
  - » IMS Global's PIVOT Project offers resources and demonstrations to K-12 schools and districts to encourage them to adopt comprehensive learner records and ease the transition to digital records.[49]
  - » The U.S. Chamber Foundation's T3 project also aims to support CLRs by solving for some of the technical challenges in connecting various demonstrations of learning.
    - – For example, Pilot Project 1 (PP1), mapping and harmonizing data standards, convened a data standards work group to determine what is needed for ongoing mapping and exchange of data standards. This would allow more and better information about the talent marketplace to be shared.
    - – PP2, improving the quality of employment outcomes data, worked to develop standards for public and private data on earnings and employment that could help streamline employment verification and government programs.
    - – PP3, documenting all learning as data, identified common data standards for comprehensive learner records and promoted adoption by federal, state, and private reporting systems.
    - – PP4, promoting data standard adoption in the public and private sectors, sought to work with federal and state agencies to promote the use of public-private data standards.[50]
  - » In the public sector, the Advanced Distributed Learning Initiative (a federal program) announced that it will award contract(s) for fiscal year 2020 to vendor(s) that will research universal learner records and develop an operational prototype.[51]

- **Degree Qualifications Profile (DQP):**
  - » DQP is a framework designed by the Lumina Foundation that specifies what students should know in order to receive an associate's, bachelor's, or master's degree, regardless of field. The framework emphasizes student performance and learning, not credit hours or number of courses, and divides student learning outcomes into five overlapping categories: specialized knowledge, broad and integrative knowledge, intellectual skills, applied and collaborative learning, and civic and global learning. DQP can be used in a variety of ways, including to align student outcomes with departmental objectives, help students understand how a given curricular path coheres, streamline paths for transfer students, help accreditors set consistent learning outcomes they expect institutions to achieve, and help connect school-based and out-of-school learning. Lumina reports that over 400 institutions have used the DQP in some way.[52]

- **Digital Badges:**
  - » Digital badges allow individuals to demonstrate skills that they have acquired, whether in a classroom or in other settings, in a portable and verifiable format. Badges can be acquired in millions of combinations and are sometimes stackable toward a more advanced badge, a degree, or other credentials. They can therefore be used to paint a more complete and granular picture of an individual's skills, beyond those that can be validated via assessments.[53]
  - » Digital badge providers are increasingly allowing learners to put their badges on a blockchain for greater validity and security.
  - » Providers in this space include Badgr, Credly, and Learning Machine (which is part of the BlockCerts initiative).

- **Industry Certifications:**
  - » In some cases, industry certifications are the best, clearest indication of a particular skill. This is particularly true in fields such as project management (PMP) or accounting (CPA). For instance, a PMP certification can lead to a salary increase of up to 20%.[54]

- **Velocity Network Foundation:**
  - » In January 2020, National Student Clearinghouse, Velocity Career Labs, and 14 other organizations launched the Velocity Network Foundation, which will support the use of blockchain to manage and share credentials. The partners' vision is to create an "Internet of Careers" in which individuals own and control their credentials and, when they share them with employers, employers can access verified data on individuals' credentials.[55]

Understanding and Responding to Labor Market Demands

Education, training, and credentialing providers leverage data from public and proprietary sources to inform program and curriculum development, including:

- **Burning Glass Technologies**: a company that analyzes data on the labor market and skills gaps, using AI to aggregate and sort millions of job postings each day from over 40,000 online sources, and develops products for education providers that track local labor market demand and help providers align coursework to employers' needs.[56] For example, Northern Illinois University used Burning Glass to help educate its graduate students about labor market options and help them develop paths to their desired careers.[57] And the University of South Florida hired Burning Glass to provide data to inform a curriculum review, which led to changes such as the history department revamping its curriculum to emphasize skills students need in the workforce rather than only teaching skills that are valued in academia.[58]

- **Emsi:** a consulting and labor market analytics company that aims to better connect education and employers. The Idaho-based company claims its labor market data, which comes from government sources, job postings, and online resumes and profiles, represents 99% of the workforce. In higher education, Emsi helps institutions tailor their programs of study to labor market data, engage with employers, and connect students to programs and careers. The value proposition is that, at a time when students and parents are increasingly questioning whether college is worth the investment, colleges can use Emsi's data to make their programs more relevant and valuable for students. Emsi recently partnered with Western Governors University to map the competencies taught by education providers to the skills that are highly valued in the labor market. Emsi reviewed millions of job postings to identify common skills sought by employers in high-demand fields and then mapped the skills taught in WGU courses to those that employers seek.[59]

- **O*NET:** a program to define and collect data on occupations in order to better understand how the world of work is changing. The O*NET database contains descriptors for 974 occupations, and it is continually updated and free to access. O*NET also provides several applications that use the data, including customizable occupation reports, crosswalks from between occupations, and career exploration tools for students and workers. O*NET is sponsored by the U.S. Department of Labor's Employment and Training Administration and administered by the North Carolina Department of Commerce, with the help of several project partners.[60]

Communicating Labor Market Demands

Other efforts to support a shared language or improve skill communication and amplification include:

- **National Labor Exchange (NLx):** a public-private partnership that aggregates and distributes job postings from over 25,000 corporate websites and state job banks.[61] The goal is to share postings more widely, not to create a single job bank. NLx was created in 2007 as a partnership between the National Association of State Workforce Agencies (NASWA) and DirectEmployers Association. It now has partnerships with workforce agencies in every state, the District of Columbia, Puerto Rico, and Guam to allow employers and opportunity seekers to access NLx's services for free.

    - In 2019, NASWA received a grant from the National Science Foundation to develop (with help from BrightHive and the W.E. Upjohn Institute for Employment Research) tools for opportunity seekers that utilize NLx data.[62] Specifically, the NLx Data Hub will be a cloud-based repository for jobs data that will be used to create career planning tools for opportunity seekers, employers, career counselors, and other stakeholders.[63]

- **Opportunity@Work**: an organization that helps people who do not have bachelor's degrees find jobs and works to promote a more inclusive labor market. Opportunity@Work encourages employers to remove superfluous degree requirements in their hiring processes and works with them to identify opportunities for workers without degrees to demonstrate their skills.[64] The organization is also publishing research and resources to help employers recruit workers without college degrees and developing an Opportunity Marketplace that helps match these workers to jobs. The marketplace will launch in Washington, DC, and San Diego, California, in 2020 with an initial focus on filling entry-level tech positions.[65]

- **Skillful:** a non-profit regional initiative of the Markle Foundation that aims to help people, especially those without a four-year degree, find good jobs. It currently operates in Colorado and Indiana and operates with a similar aim to TPM and JDX in those states, partnering with state governments, educators, workforce development organizations, and local employers to reframe the local labor market in terms of skills. Skillful also promotes cross-state collaboration through its Skillful State Network, which counts 28 governors as members.[66]

Creating Infrastructure and Trust Frameworks

- **American National Standards Institute (ANSI)**: a private, not-for-profit membership organization that was founded in 1918 to strengthen the United States' global competitiveness. It promotes the development of voluntary standards and assessment systems and has accredited over 11,500 American National Standards to date.[67] ANSI has also founded four foundations to increase awareness of standards by consumers, the business community, and institutions of higher education.

- **Common Education Data Standards (CEDS):** an initiative to develop shared language and data tools that will help education institutions and other stakeholders use and talk about education data in similar ways[68] CEDS makes its source code for the data elements available through its Open Source Community, allowing any community member to make contributions or suggestions. In 2012, CEDS released standards for assessment systems that it developed with IMS and several other partners.[69]

- **Credential Transparency Description Language (CTDL):** a schema created by Credential Engine for describing information about credentials. It is structured like a dictionary, with different types of terms that can be aggregated into detailed descriptions of credentials and related resources. CTDL is open for anyone to use and has five advisory committees that are responsible for growing and maintaining it. It is based on the W3C guiding principles, including providing links to related resources, appropriate documentation, and uniform resource identifiers.[70]

- **HR Open Standards Consortium:** a non-profit organization, founded in 1999, that promotes the adoption of data exchange standards that enable human resources departments to share data. The standards are developed in response to specific industry needs and are voted on by the full consortium prior to adoption, and the consortium encourages organizations of all sizes to have a voice in their development.[71] Current workgroups focus on topics including employer and earning records, payroll, employee benefits, and recruiting. HR Open Standards also awards individual certificates to indicate expertise with the data exchange standards and product certificates to indicate implementation of the standards.[72]

- **IEEE:** a professional organization that promotes technological innovation,[73] including by creating a Learning Technology Standards Committee (LTSC). The LTSC develops technical standards and recommendations, and it coordinates with other standards organizations and initiatives (including the Advanced Distributed Learning Initiative and IMS Global Learning Consortium) to help ensure that ed tech products are interoperable.[74] Current workgroups focus on learning environments that incorporate augmented reality, child and student data governance, mobile learning, and federated machine learning, among other topics.[75]

- **IMS Global:** Issuers of digital badges can have their badges certified by IMS Global as interoperable. Examples of badges that IMS Global has certified include IBM's Data Science Program badges, Digital Promise's Educator Professional Development badges, and badges from Purdue University's chemistry department for skills such as pipetting.[76]

    - Mozilla Foundation: In 2011, the Mozilla Foundation created the Open Badges standard using funding from the MacArthur Foundation.[77] Its goal was to help learners demonstrate skills mastery outside of the traditional higher education setting and earn shareable digital "micro-credentials." These micro-credentials are consistent and interoperable, allowing learners to communicate their skills to a variety of audiences.

    - In 2017, the IMS Global Learning Consortium took over the management of the Open Badges technical specification.[78] In addition, Mozilla announced in August 2018 that it would transfer its Backpack, a mechanism to store and display digital badges, to Badgr.[79]

- **MedBiquitous**: an organization that develops data standards and technology guidelines for the health professions, creates a community around those resources, and makes the resources open for the industry to access. The goal is to create a stronger infrastructure that uses technology to connect different players within the industry, make the learning experience more streamlined, improve patient care, and reduce the paperwork burden within the field.[80] The MedBiquitous standards are competency-based, and 800,000 doctors have used the standards as part of their credentialing.[81]

- **Postsecondary Electronic Standards Council (PESC):** a nonprofit membership organization that was established in 1997 at The National Center for Higher Education to promote the development and adoption of open standards in education.[82] It has several subgroups of PESC members, including one that collects, stores, and shares data on competencies and credentials.[83] (That subgroup is also a member of the T3 Innovation Network.)

    - In 2017, PESC's Academic Credentialing and Experiential Learning Task Force partnered with Credential Engine, EMREX, EWP, HR-Open Standards, and IMS to work on a credential mapping effort to improve interoperability.[84]

    - That same year, the task force released a Common Credential for Certificates, Degrees and Diplomas, which was produced by Stanford University as part of the Comprehensive Learner Records Project.[85]

    - PESC also administers EdExchange, a secure platform for exchanging standards-based data and documentation that is currently being piloted by seven participants.[86]

- **Schema.org:** a loose community that works to create and maintain data schemas. These schemas provide language that can be used on webpages in ways that give search engines more context to aggregate results.[87] It was co-founded by a Google executive and a Microsoft executive and is currently managed by a steering committee that includes representatives of Google, Microsoft, W3C, and Yahoo.[88]

- **World Wide Web Consortium (W3C):** an organization that convenes stakeholders to develop standards to promote the long-term health of the Web. (While the World Wide Web is often used to mean the Internet, the World Wide Web refers specifically to the information available online rather than the infrastructure.[89]) W3C's standards are centered around an open web platform on which app developers can create content, and they are designed with speed, fairness, public accountability, and quality in mind. They are continually tested for interoperability and are free to download.[90]

ENDNOTES

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

2 https://www.adeccousa.com/employers/resources/skills-gap-in-the-american-workforce/

3 https://research.udemy.com/wp-content/uploads/2018/11/FINAL-Udemy_2018_Skills_Gap_Report_Complete-1.pdf

4 Interview with Jason Tyszko, Nov. 15, 2019.

5 2019 Inside Higher Ed Survey of Chief Academic Officers, https://www.insidehighered.com/news/survey/2019-inside-higher-ed-survey-chief-academic-officers, p. 11.

6 Gallup-Lumina Study on Post-Secondary Education, Feb. 25, 2014, https://www.gallup.com/services/176759/america-needs-know-higher-education-redesign.aspx, p. 25.

7 https://www.northeastern.edu/cfhets/wp-content/uploads/2018/12/Educational_Credentials_Come_of_Age_2018.pdf

8 Interview with Sae Schatz, Nov. 20, 2019.

9 https://credentialengine.org/2019/09/25/analysis-of-u-s-education-and-training-landscape-identifies-over-738000-unique-credentials/

10 Interview with Jason Tyszko, Nov. 15, 2019.

11 Interview with Beth Davisson, Nov. 20, 2019.

12 https://www.uschamberfoundation.org/sites/default/files/JDX_FAQs_January%202019.pdf.

13 Jamai Blivin and Ben Wallerstein, *Shift Happens: The Entrepreneurs, Wonks, and Investors Revolutionizing the Learning-to-Employment Landscape*, https://innovate-educate.org/wp-content/uploads/2017/04/Shift-Happens-Whitepaper-F10.pdf, p. 29.

14 https://eddesignlab.org/the-labs-21st-century-skills-badges/

15 https://www.burning-glass.com/research-project/certifications/

16 https://money.cnn.com/2017/01/12/technology/project-management-linkedin/index.html

17 https://www.stradaeducation.org/report/why-higher-ed/

18 https://hbr.org/2019/05/recruiting#your-approach-to-hiring-is-all-wrong

19 https://adlnet.gov/research/baa/; https://adlnet.gov/assets/uploads/2020-adl-baa-ulr.pdf

20 https://www.stradaeducation.org/report/major-influence/

21 https://www.forwardontalent.org/stories/greaterhoustonpartnership/

22 https://www.forwardontalent.org/stories/dte-energy/

23 https://www.aeseducation.com/states/michigan/career-clusters

24 https://credentialengine.org/2018/10/18/press-release-credential-engine-brighthive-inc-and-university-system-of-georgia-among-winners-of-u-s-department-of-education-challenge/

25 http://connectingcredentials.org/wp-content/uploads/2015/05/ConnectingCredentials-4-29-30.pdf

26 http://connectingcredentials.org/about-us/; http://connectingcredentials.org/framework/

27 https://credentialengine.org/about/

28 https://www.aacrao.org/docs/default-source/signature-initiative-docs/clr/press-release_major-postsecondary-education-organizations-commit-to-credential-transparency_191104.pdf

29 http://d4ad.com

30 http://d4ad.com/faq/

31 https://www.nationalskillscoalition.org/about

[32] https://www.nationalskillscoalition.org/resources/publications/file/9.18-NSC_QNDC-paper_web.pdf

[33] https://credentialengine.org/wp-content/uploads/2019/01/A-Guide-to-Key-Initiatives-for-the-Connected-Learn-and-Work-Ecosystem_FINAL_190314.pdf

[34] https://www.studentclearinghouse.org/about/

[35] https://www.skillful.com/career-coaches

[36] https://www.aacc.nche.edu/programs/workforce-economic-development/right-signals-initiative-2/; https://www.aacc.nche.edu/wp-content/uploads/2017/09/AACC_LuminaReportFINAL.pdf

[37] https://www.workcred.org/Programs-and-Services/Default.aspx; https://www.workcred.org/Partnerships.aspx

[38] https://www.acenet.edu/Programs-Services/Pages/Credit-Transcripts/Benefits-of-Learning-Evaluation.aspx

[39] https://www.aacu.org/value; https://www.aacu.org/VALUEInstitute

[40] https://www.cbenetwork.org/about/

[41] https://eddesignlab.org/the-labs-21st-century-skills-badges/; https://ntyyvuebz51lkxul3puxw5nw-wpengine.netdna-ssl.com/wp-content/uploads/2019/08/badge_menu_v14_tl.pdf

[42] https://www.imsglobal.org/activity/case

[43] https://www.learningoutcomesassessment.org/about/; https://www.learningoutcomesassessment.org/ourwork/; https://www.learningoutcomesassessment.org/ourwork/transparency-framework/

[44] https://www.insidehighered.com/news/2019/07/09/arizona-state-tackling-college-completion-blockchain; http://news.mit.edu/2017/mit-debuts-secure-digital-diploma-using-bitcoin-blockchain-technology-1017

[45] https://www.naspa.org/blog/the-value-of-a-co-curricular-transcript

[46] https://www.naspa.org/images/uploads/main/Learning_Reconsidered_Report.pdf

[47] https://www.imsglobal.org/activity/comprehensive-learner-record; https://www.imsglobal.org/introduction-extended-transcript-et

[48] https://www.aacrao.org/signature-initiatives/comprehensive-learner-record

[49] https://www.imsglobal.org/initiative/advancing-digital-credentials-and-competency-based-learning

[50] https://www.uschamberfoundation.org/sites/default/files/T3Phase1_Report_FINAL_0.pdf

[51] https://adlnet.gov/research/baa/; https://adlnet.gov/assets/uploads/2020-adl-baa-ulr.pdf

[52] https://www.luminafoundation.org/files/resources/dqp.pdf

[53] https://www.hastac.org/initiatives/digital-badges; https://library.educause.edu/resources/2019/7/7-things-you-should-know-about-digital-badges

[54] https://money.cnn.com/2017/01/12/technology/project-management-linkedin/index.html

[55] https://www.forbes.com/sites/michaeltnietzel/2020/01/28/the-velocity-network-foundation-using-blockchain-to-control-your-own-career-credentials/

[56] https://www.burning-glass.com/solutions/education/

[57] https://www.burning-glass.com/case-studies/labor-insight-case-study-northern-illinois-university/

[58] https://www.burning-glass.com/case-studies/labor-insight-case-study-usf/

[59] https://www.economicmodeling.com/higher-education/; https://www.economicmodeling.com/2019/07/24/wgu-creates-value-by-mapping-curriculum-to-skills/

[60] https://www.onetcenter.org/overview.html

[61] https://www.naswa.org/national-labor-exchange/what-is-the-national-labor-exchange

[62] https://directemployers.org/2019/09/25/naswa-receives-national-science-foundation-award-grant/

63 http://www.imsglobal.org/sites/default/files/articles/ILR_White_Paper_FINAL_EBOOK.pdf

64 https://next50.urban.org/article/helping-anyone-who-can-do-job-get-job-conversation-byron-auguste

65 https://www.opportunityatwork.org/our-initiatives/;
https://www.opportunityatwork.org/our-initiatives/opportunity-marketplace/

66 https://www.skillful.com/sites/default/files/2019-10/Skillful%20Primer-2018-10-09.pdf

67 https://www.ansi.org/about_ansi/introduction/introduction?menuid=1

68 https://ceds.ed.gov/whatIsCEDS.aspx

69 https://ceds.ed.gov/aif.aspx

70 https://credreg.net/ctdl/handbook#introduction;
https://credentialengine.org/wp-content/uploads/2018/11/CTDL_Fact_Sheet.pdf

71 https://hropenstandards.org/about-us/

72 https://hropenstandards.org/hr-open-standards-individual-certificate/;
https://hropenstandards.org/hr-open-standards-product-certification/

73 https://www.ieee.org/about/vision-mission.html

74 https://sagroups.ieee.org/ltsc/about-ieee-learning-technology-standards-committee-ltsc/

75 https://sagroups.ieee.org/ltsc/meetings/

76 https://www.imsglobal.org/initiative/advancing-digital-credentials-and-competency-based-learning

77 https://openbadges.org/about/

78 https://openbadges.org/about/

79 https://medium.com/read-write-participate/the-mozilla-backpack-is-transitioning-to-badgr-c080e68d5603

80 https://www.medbiq.org/about_us/

81 https://www.medbiq.org/bring_competency_data_together;
https://www.medbiq.org/track_achievements_and_credentials

82 https://www.pesc.org/about-us.html

83 https://www.pesc.org/competencies---credentials.html

84 https://nebula.wsimg.com/8a44ac6fb21cd05333ad38e0d01436c3?AccessKeyId=4CF7FAE11697F99C9E6B&disposition=0&alloworigin=1

85 https://www.pesc.org/competencies---credentials.html;
https://nebula.wsimg.com/7169eb2d3db35263c2d608c899860ab5?AccessKeyId=4CF7FAE11697F99C9E6B&disposition=0&alloworigin=1

86 https://www.pesc.org/edexchange.html

87 https://schema.org/docs/gs.html

88 https://schema.org/docs/about.html

89 https://www.geeksforgeeks.org/whats-difference-internet-web/

90 https://www.w3.org/Consortium/;
https://www.w3.org/standards/about.html

U.S. CHAMBER OF COMMERCE FOUNDATION

uschamberfoundation.org/workforce-development