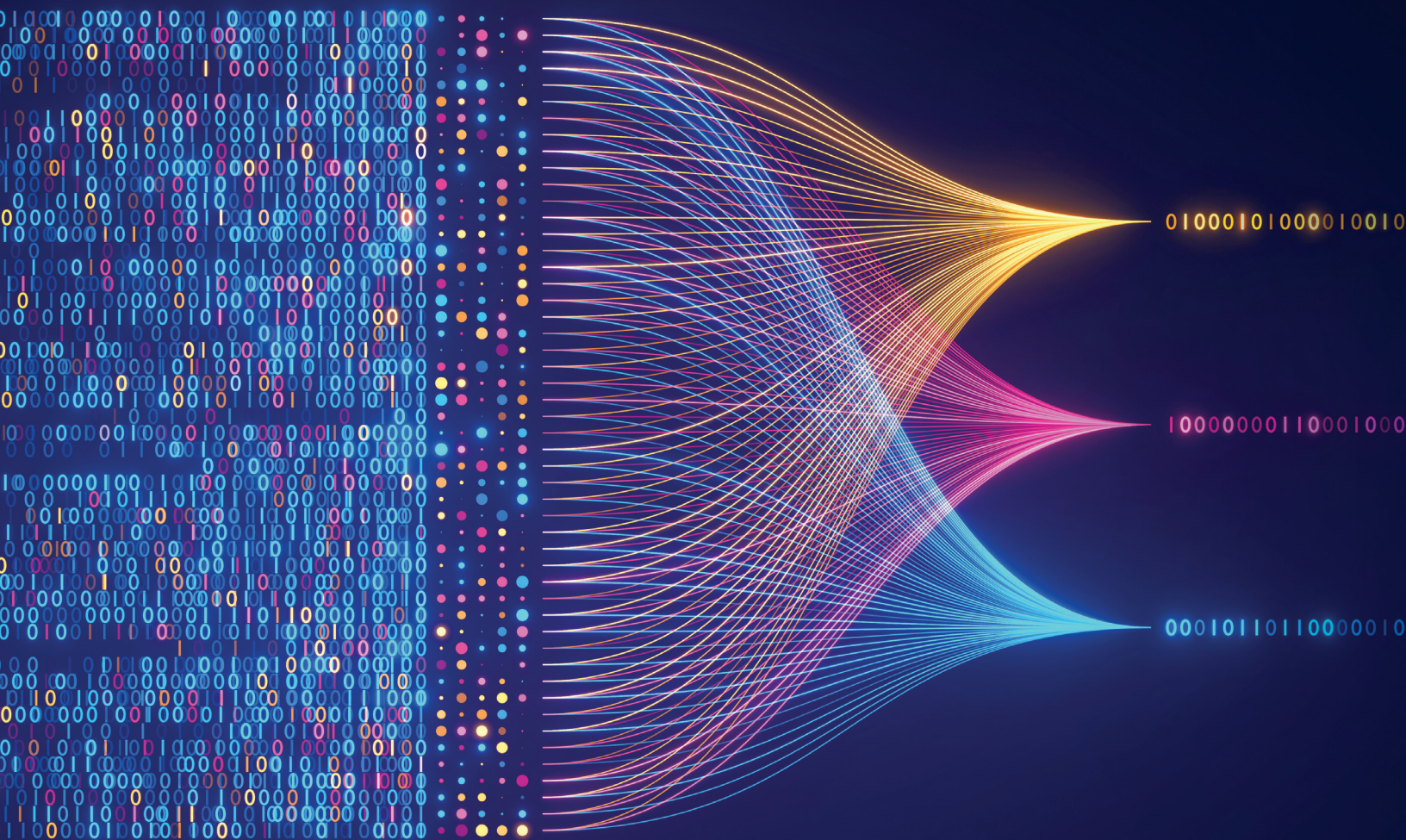# DIGITAL CREDENTIALS AND TALENT ACQUISITION TECH: CLOSING THE DATA GAP BETWEEN LEARNING AND HIRING

March 2023

Northeastern University
Center for the Future of Higher Education and Talent Strategy

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EXECUTIVE SUMMARY

KEY FINDINGS	IMPLICATIONS AND RECOMMENDATIONS

1. Most talent acquisition systems are not yet prepared to accept new types of non-degree credentials or richer skills data: they remain geared around basic educational information and unstructured data such as PDF attachments.

- The ability of talent acquisition systems to interpret and manage digital credentials is less mature than leaders in the education ecosystem might have assumed

- HR leaders should declare and define their hiring needs and engage technology partners to ensure digital credential and skills functionality is prioritized in product roadmaps

- Credential issuers also need to play a role in continuing to grow general awareness of the benefits of these educational innovations

2. Job candidates' applications and resumes often pass through multiple software systems and intermediaries, which can introduce inconsistencies and data loss.

- More consistent adoption of data interoperability standards will increase the likelihood that data provided by candidates is preserved: for the full benefit of standards to be realized, they need to be widely adopted by leading industry participants

- The purchasers of HR technology – employers and talent leaders as enterprise users – are the essential drivers for standards adoption

- The growth and importance of intermediary systems and services that sit between credential earners/job candidates and employers and their talent acquisition systems should be closely monitored

3. Most systems do not authenticate educational credentials by default, and largely do not support digital credential verification.

- Better credential verification does not appear to be a primary use case for digital credential adoption among most HR leaders, while interest in verification and building a future where individuals own their own learning records is growing

KEY FINDINGS

IMPLICATIONS AND RECOMMENDATIONS

4. Technology providers confirm growing customer interest in supporting skills-based hiring practices.

- The growing demand for skills-based hiring will be the most significant factor in influencing and elevating how talent acquisition technologies treat and interface with digital credentials and skills information

- Larger corporations who have the resources to pilot and invest in new hiring technologies will drive innovation in this area and in turn enable small- and mid-sized businesses to benefit beyond certain large employers prioritizing this today

- Skills assessments play a key role in skills-based hiring and yet digital credentials may diminish their need, as these credentials can be designed to provide rich skill-related metadata about candidates

5. Capabilities vary — but progress is expected — in how talent acquisition systems manage skills data.

- Which intermediary providers are used and how they process data from applicants has significant influence on the information employers receive

- Adoption of skills-related technologies and taxonomies will need to be coordinated among providers in order to keep the information exchange smooth and unbiased

- "Skills" continue to be a key unit of analysis among employers, which may bode well for digital credentials, which are designed to relay rich skill data – and yet, its possible credentials altogether may be bypassed in favor of simply documenting verified skills

6. Talent acquisition technology firms see positive benefits in leveraging AI: many are actively implementing it and others are building the use cases for increased investment.

- The rapid pace of developments in AI and the impact on hiring-related technology and educational credentials remains important to monitor, while it is still early

- More detailed skills data and quality profile information on candidates is needed to fully realize the potential of AI in talent management and educational credentialing

- Caution is warranted in considering AI as a decision-maker in the hiring process, versus a tool to augment it: there is healthy skepticism of AI, but beneficial talent acquisition use cases are expected to continue to emerge

INTRODUCTION

Over the last decade, innovations in the education sector and changes in the economic landscape have driven growing interest and demand for new types of educational credentials, particularly as alternatives to expensive and long-to-complete traditional degrees.

In the early 2010s, the Open Badges standard was developed, paving the way for digital credentialing infrastructure and creating a vision of learning that is more portable, verifiable, and shorter-form.[1] This was soon followed by the arrival of massively open online course (MOOC) platforms such as Coursera and edX, which partnered with major universities and quickly anchored their business models in low-cost online certificates and other credentials. Silicon Valley start-ups such as Udacity introduced the "nanodegree," while the Massachusetts Institute of Technology (MIT) created the "MicroMasters." In parallel, hundreds of community colleges and four-year universities ramped up their non-credit and for-credit certificate offerings, including embedding industry certifications into their curriculum and creating short-form bootcamp programs and credentials. The arrival of the COVID-19 pandemic in 2020 then dramatically catalyzed demand for these types of offerings as millions of Americans and their employers embraced online learning and professional development.

Today, the vast expansion in the supply of credentials and the demand for them is apparent. The number of educational and professional credentials available in the United States has been growing significantly. There are now more than 1 million unique credentials of all types available, including approximately 350,000 degrees and certificates from postsecondary institutions, and nearly 660,000 credentials from non-academic providers, including various badges, course completion certificates, certifications, and licenses.[2] The total number of open badges awarded worldwide has grown from 24 million in 2018 to 75 million in 2022, directly reflecting students' and professionals' pursuit of these offerings.[3] Strada Education Network's polling has highlighted that non-degree credentials, skills-oriented programs, and individual courses are the top preference of adults interested in enrolling in education and training in the near future.[4]

Crucially, despite the increased supply of educational credentials and growing educational consumer demand, relatively little is known about employers' understanding and ability to use and interpret new types of credentials in the hiring process.[5] The value of educational credentials in the marketplace is in large part driven by their ability to qualify candidates for jobs – making how employers' hiring processes handle educational credentials an important area of inquiry.

In fact, this fundamental intersection point between the worlds of work and education has a number of gaps in understanding even with respect to "traditional" educational credentials –

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1. "History," Open Badges, 1EdTech Consortium, https://openbadges.org/about/history.
2. Credential Engine, Counting U.S. Postsecondary and Secondary Credentials (Washington, DC: Credential Engine, 2022) https://credentialengine.org/wp-content/uploads/2022/12/CountingCredentials_2022-1.pdf.
3. "Badge Count 2022," 1EdTech Consortium, https://content.1edtech.org/badge-count-2022/findings.
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5. Mitchell L. Stevens et al., An Applied Science to Support Working Learners (Stanford, CA: Stanford Graduate School of Education, January 2022) https://workinglearners.stanford.edu/wp-content/uploads/2022/08/SUGSE-Working-Learners-Report-2022-v07-FINAL.pdf.

the degrees and paper-based diplomas that have existed for centuries. The continuing digital transformation of these longstanding credentialing processes alongside the emergence of new types of digital credentials and technological innovations referred to collectively as learning and employment records (LERs)[6] include comprehensive learner records (as formalized in the 1EdTech CLR Standard)[7], Open Badges and the recent World Wide Web Consortium (W3C) recommendation for the general exchange of various verifiable credentials necessitates a better understanding of how prepared employers are to make use of these innovations. The demand-side adoption (by employers) of these educational innovations is mediated through the human resources (HR) talent acquisition systems at the point recruiting and hiring decisions are made.

Recognizing the need to better understand employers' readiness to make use of digital credentials and competency-related data in hiring, in 2021, Northeastern University's Center for the Future of Higher Education and Talent Strategy conducted a national survey of 750 HR leaders in partnership with the 1EdTech Foundation as part of the Wellspring Initiative.[8] This research confirmed talent leaders' interest in and the growing adoption of competency frameworks, digital credentials, and skills-based hiring practices – but found that technical integration between HR systems is a significant potential barrier. Half (51%) of respondents reported that "data-rich learning and achievement records would challenge our current systems and processes," while at the same time, 54% felt that their hiring systems were ready to incorporate digital credentials. This new research tests that claim. The adoption of digital credentials by employers hinges on the integration of new supporting features into HR technology products.[9]

As a result, the purpose of *this* analysis conducted across 2022 and early 2023 is to deeply explore how existing HR technologies treat educational credentials and skills data. These systems deserve more detailed exploration as employers' talent processes continue to rapidly digitize – and against the backdrop of growing interest in skills-based hiring.[10] Where our own past research with employers has provided a high-level starting point related to general employer awareness and perceptions, this analysis is more technical in nature and focused on exploring the digital recruiting and hiring process through the software tools in common use.

6. A white paper from the American Workforce Policy Advisory Board Digital Infrastructure Working Group, Learning and Employment Records Progress and the path forward (American Workforce Policy Advisory Board, September 2020) https://www.commerce.gov/sites/default/files/2020-09/LERwhitepaper09222020.pdf.

7. "Comprehensive Learner Record," 1EdTech, 1EdTech Consortium, https://www.1edtech.org/initiatives/digital-credentials/clr.

8. 1EdTech Foundation, Digital Credentials & Competency Frameworks: Exploring employer readiness and use in talent management (1EdTech Foundation, Nov. 2021), https://www.imsglobal.org/sites/default/files/wellspring/Wellspring_II_Employer_Research.pdf.

9. Anthony F. Camilleri, Brandon Muramatsu, and Philipp Schmidt, Credentials to Employment: The Last Mile (Digital Credentials Consortium Report, September 30, 2022), https://digitalcredentials.mit.edu/docs/Credentials-to-Employment-The-Last-Mile.pdf.

10. "New SHRM Research Makes the Case for Skills-Based Hiring," SHRM, August 15, 2022, https://www.shrm.org/about-shrm/press-room/press-releases/pages/new-shrm-research-makes-the-case-for-skills-based-hiring.aspx

METHODOLOGY

Our inquiry into better understanding how recruiting- and hiring-oriented HR technology systems treat educational credentials is grounded in primary qualitative research: principally the engagement of a representative sample of software providers, through interviews and product demos. Following extensive secondary research on trends and key players in the HR technology ecosystem, we conducted deep conversations with a sample of 7 HR technology firms representing a range of large and small applicant tracking ("ATS") and HRIS/ERP systems, as well as data intermediaries connecting candidates with employers, and middleware companies (listed in the Appendix). The focus of this analysis was not on proprietary product details or specific company strategies, but rather, to broadly understand product functionality and trends in the market based on the perspectives of participants, including the evolving demands of employer customers and product roadmaps. Based on various estimates, the participating providers represent more than 40% of the U.S. applicant tracking system market – yet it is also important to note that this is a highly fragmented market with hundreds of small technology players. To our knowledge, this research is a first-of-its-kind undertaking, particularly given our unique educationally oriented lens.

In addition, these formal interviews were complemented by a technical analysis of publicly available application programming interfaces (APIs) and documentation for five HR technology products, with a focus on data objects that support recruiting such as the "Candidate," "Position Opening (Job Post)," and "Application" use cases. A field-level analysis was conducted to identify what fields are in common and what fields are outliers compared to the other products. We also analyzed API support for assessment and background check integrations.

Although by design this inquiry represents just a snapshot of the overall market, because of the breadth of perspectives, we are confident in the conclusions that can be derived from this sample of products, software documentation, and expert perspectives. The ultimate goal presented in the findings and conclusions that follow is to paint a clearer picture of how these key HR technology systems treat and manage credentials and skills – in service of advancing the roadmap for digital credentialing infrastructure; informing the strategies of participants in the market; and closing the gap between the educational technology and HR technology communities.

BACKGROUND ON THE EVOLVING HIRING TECHNOLOGY LANDSCAPE

According to leading industry analyst Josh Bersin, more than 40% of the U.S. workforce changes jobs every year, creating a more than $250 billion market for recruitment, advertisement, assessment, and interviewing – with software and platform products accounting for more than $5 billion of this spending.[11] Applicant tracking systems (ATS), are key to these processes, providing tracking, posting, and automation services for the requisition-to-hire process. The needs of the talent acquisition function have evolved beyond basic ATS software, to include products including AI-based recruitment tools, skills assessments, candidate relationship management, onboarding, and even internal talent marketplaces.[12] Additionally, market share has increasingly shifted from older legacy systems to newer start-up platforms.[13]

Talent acquisition systems offer a variety of functions and data fields to collect candidate background information, often customizable to each employer-customer's needs. These systems are integrated with and exist alongside broader human resource management platforms that automate and manage basic HR functions. Referred to alternately as an HRMS (human resource management system), HRIS (human resources information system), HCM (human capital management), or ERP (enterprise resource management system), these systems also maintain a record of all employees, and manage payroll, benefits administration, and compliance.[14] Additional software components are integrated to create a "tech stack" – a combination of platforms, applications and pieces of software that provide additional functionality. These integrated applications are often connected to the core systems through application program interfaces (APIs). Alongside these systems, job boards such as Indeed and CareerBuilder – and professional networking sites like LinkedIn – are playing a growing role in connecting job seekers and employers in the matching of talent.

These software applications and their workflows are crucial in mediating the connection between job-seekers and employers – including the collection and sharing of data related to skills, educational credentials, and professional experience. As a result, what these systems include by default and their potential capabilities are the focus of our investigation.

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11. Josh Bersin, HR Technology Market 2019: Disruption Ahead (Josh Bersin, 2019), https://oliver-dev.s3.amazonaws.com/2019/01/27/12/54/25/916/Tech_Disruptions.pdf.

12. Lauren Shufran, "Talent acquisition technologies in 2022: the Gartner Market Guide," Gem, October 4, 2022, https://www.gem.com/blog/talent-acquisition-technologies-gartner-market-guide.

13. Josh Bersin, HR Technology Market 2019.

14. "What is HRIS?," ADP, https://www.adp.com/resources/articles-and-insights/articles/w/what-is-hris.aspx.

Findings and
Key Themes

1. Most talent acquisition systems are not yet prepared to accept new types of non-degree credentials or richer skills data: they remain geared around basic educational information and unstructured data such as PDF attachments.

The key goal of this study was to better understand and document how talent acquisition systems treat educational credentials – with an eye toward new types of digital credentials and skills-related data. Part of the value proposition of digital credentials is that they can include added metadata about candidates' skills and abilities, and that through using the right mechanisms, they can be securely verified and analyzed by recruiting systems. However, this depends on the ability of those who are receiving and interpreting digital credentials – namely, employers during the hiring process – to be able to make use of these features and data.

Credential issuers (such as colleges and universities, professional associations, and employers) and the infrastructure providers that support them have perhaps assumed that armed with this new functionality, candidates can collect their digital credentials from multiple institutional sources, curate those that are most applicable and offer them to employers as proof of qualification for a position. Our prior research hypothesized that these structures and added data may not fit into existing workflows and business processes – and that HR tech systems can be either a limiting factor or an enabler for realizing the benefits of digital credentials.

Our findings suggest an underdeveloped market in terms of talent acquisition systems' treatment of digital credentials and skills data. At a conceptual level, many recruiting systems and web-based application forms are oriented toward one broad category for candidates' educational background – typically, with a basic orientation to college degrees. Some systems and recruiting processes do allow for the specification of certifications and licenses as a special category of requested non-degree credential, since certain occupations demand these credential types as a firm requirement (or "knock out" criterion) connected directly to the definition of the job.

The majority of companies that we interviewed reported that their customers were typically not yet requesting digital credential support as a priority. Often, systems can be modified to handle inbound digital credential data, but this requires investment in customization. As might be expected, HR tech providers are organizing their functionality around the types of qualifications and criteria that clients include in their job descriptions – which typically do not include specific non-degree credentials. Andrew Cunsolo, senior director of product management at Jobvite, reports, "None of our systems will accept a digital badge or certificate, etc. – we're pretty much accepting a resume, as this is what the employers want. We support other attachments, but those are mostly files. From what I've seen, that's generally common across almost every major ATS provider." At the same time, he notes that the field is engaging in R&D to advance toward more of a structured data model, "hopefully with some employer demand some of us will make those investments, but right now it's very low," says Cunsolo.

Some technology leaders attribute the gap between the potential of digital credentials and the reality of what HR systems today can process to the fact that HR technology and educational technology companies are not aligning their activities and strategies. Rick Barfoot, chief operating officer at Joynd, an HR systems integrator, states, "It's always struck me as odd that these two ecosystems exist in parallel – and it's urgent to figure out how edtech plays into the recruiting

systems. Keep in mind the recruiting system space is highly fragmented – almost no one has more than a 20% market share. Practically, we're talking about dozens of vendors in that other 80% – and of all the ones we work with, the vast majority have a very unsophisticated data model when it comes to educational information, metadata, badging, and skills." Barfoot further notes that, "in cases where it is structured, this is within a local data model and taxonomy rather than an industry standard."

Most recruiting and hiring platforms are also oriented around including candidates' resume documents (e.g. a PDF or Word document) as an attachment, within data integrations including APIs. In most systems, where possible, data from the resume is parsed into a proprietary structure – a specialized process that produces inconsistent results across providers.

What data can be extracted – such as name, contact information, education, experience, and awards – is then often stored in a database. When the data is retrieved through an API, the data package associated with the candidate typically includes data the candidate entered in the application; the parsed resume data that could be extracted; and an attached document or PDF of the resume. On the receiving end of this information, the parsed data can be searched, processed, and utilized in filtering and categorization processes, while the attachment (e.g., the resume PDF) is generally accessed as a static object by a recruiter on a screen within the browser. This process perhaps uses the best commonly available techniques when first introduced, but may be increasingly thought of today as a "make do" solution in an era where structured linked data and verifiable credentials are available to enable a more effective and precise approach.

Although most systems do not handle digital credentials today, many HR technology companies report that digital credentials and processing richer skills data are on their future product roadmaps – but that this is not yet a top priority for most customers, although many noted that some large and progressive customers are requesting digital credential support. In this sense, there is wide agreement that this type of functionality represents the future. As Jobvite's Andrew Cunsolo explains, "We have one very large customer that's pushing the digital credentials – so strategically that's what we're doing with that one customer, and doing in a general way so that other customers could adopt in the future. That will help to seed the market and begin a very slow adoption, but at some point, maybe 5 or 10 years, enough of the vendors, employers, and institutions will be producing and consuming digital credentials, and enough people with a wallet will have their digital credentials – it'll be a hockey stick adoption curve: but we're on the bottom of the stick right now."
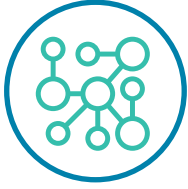
2. Job candidates' applications and resumes often pass through multiple software systems and intermediaries, which can introduce inconsistencies and data loss.

Research and analysis on HR technologies that support the talent acquisition life cycle would be incomplete without the discussion of system integrations and the potential for pitfalls, as this ecosystem grows and is augmented by integrations, intermediaries, and various third parties. Being able to accurately communicate job and candidate data through those intermediaries is imperative when the goal is to match the right talent to the right positions. This is not a new challenge, but as we know, methods of communication have changed over the years, especially with the shift to digital and an emphasis on data.
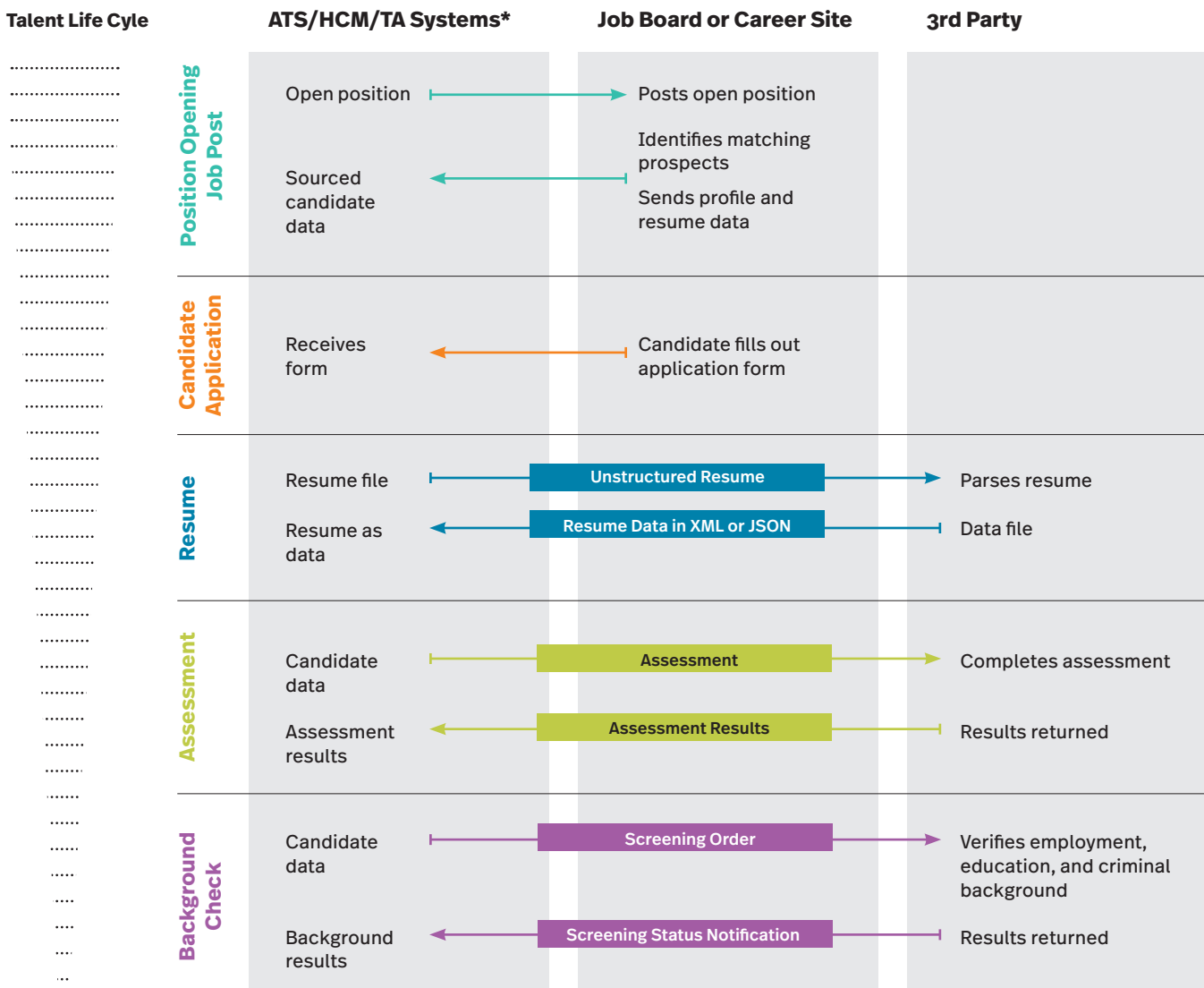
Like many areas of business, the human resources function is going through a significant digital transformation that is bringing greater automation and more data-driven decision-making. An earlier significant HR transformation involved the shift away from faxing physical copies of resumes to attaching digital versions, such as PDFs or Word documents. The Portable Document Format (PDF) is itself a technical standard, and entire business processes have grown around it. However, while the PDF format is digital, it is not considered structured, immediately machine-readable data in a modern sense.

Most recruiting systems have the capability to parse resumes, which, for context, is the process of extracting text from various file types and organizing them into a structured data format. Through additional research, we found that this technology is usually built on two steps: the first is optical character recognition (OCR), and the second is the categorization and classification of data into related keys and tags, e.g. personal information and skills. Once converted into a data file structure, the data can be easily exchanged or stored in a database allowing it to be machine-readable and further processed. There are various data models used between different HR technology products and partners – each potentially with different data elements and field names, such as referring to a licensing organization as Issuing Authority versus Institution. While some resume parser technologies can achieve high levels of accuracy, it can be difficult, and therefore lead to inaccuracies, for software to interpret language and information from an unstructured source. Language is ambiguous and varied; dates can be written in many different formats; and there is no current single, universal format for resumes. Ultimately, the unstructured nature of resumes and the semantic mapping of data points can lead to data loss due to the potential for leftover, unmapped elements or data discord.

Our analysis of integrations, APIs, and in particular the three most common business objects – *candidate, position opening and application* – finds that many data formats in use today are derived from an earlier industry standard. However, adherence to the standards (published by the HR Open Standards Consortium) has not been consistent within the industry, with many implementers customizing the original base specification – resulting in what is now effectively proprietary interfaces, and therefore no longer standard or widely interoperable across many products.

A key conclusion we've drawn from the analysis of talent acquisition data flows is that educational credential information provided by the applicant can readily be lost in translation between the software systems at multiple points of data hand-off. The same is true for skills that may be claimed by the candidate in the resume or online application, if during data parsing and reconstruction between systems there is not a text match or known synonyms to the job posting. This can result in otherwise qualified candidates being filtered out or not visible to recruiters or hiring managers due in part to the effects of low-fidelity, unstructured data. The diagram that follows attempts to describe the main data flows, data packages, and integrations most common among HR technology providers based on our analysis (not all scenarios are articulated in this diagram).

Figure 1. Common Talent Acquisition Technology Data Flows

Talent Life Cyle		ATS/HCM/TA Systems*	Job Board or Career Site	3rd Party
	Position Opening Job Post	Open position	Posts open position	
		Sourced candidate data	Identifies matching prospects / Sends profile and resume data	
	Candidate Application	Receives form	Candidate fills out application form	
	Resume	Resume file	Unstructured Resume	Parses resume
		Resume as data	Resume Data in XML or JSON	Data file
	Assessment	Candidate data	Assessment	Completes assessment
		Assessment results	Assessment Results	Results returned
	Background Check	Candidate data	Screening Order	Verifies employment, education, and criminal background
		Background results	Screening Status Notification	Results returned

* Applicant Tracking Systems (ATS), Human Capital Management (HCM), Recruiting or Talent Acquisition System

We found that integrated systems typically exchange candidate data augmented with a copy of the resume (often as a PDF document) as an attachment. Some job seekers will enter additional profile information or re-enter information when applying for a job, while some only provide a resume, which can be parsed out into structured candidate fields. The digital copy of the resume is primarily for recruiters and sourcers to reference since not everything within the resume has been parsed (or parsed correctly) into machine-readable data fields.

Education as an industry has also changed over the years and is itself also still in the process of digital transformation. Support for newer education and professional credentials has not been implemented, as a whole, in many talent acquisition technologies, meaning candidate data may not always be accurately communicated to those who can benefit from the information the most.
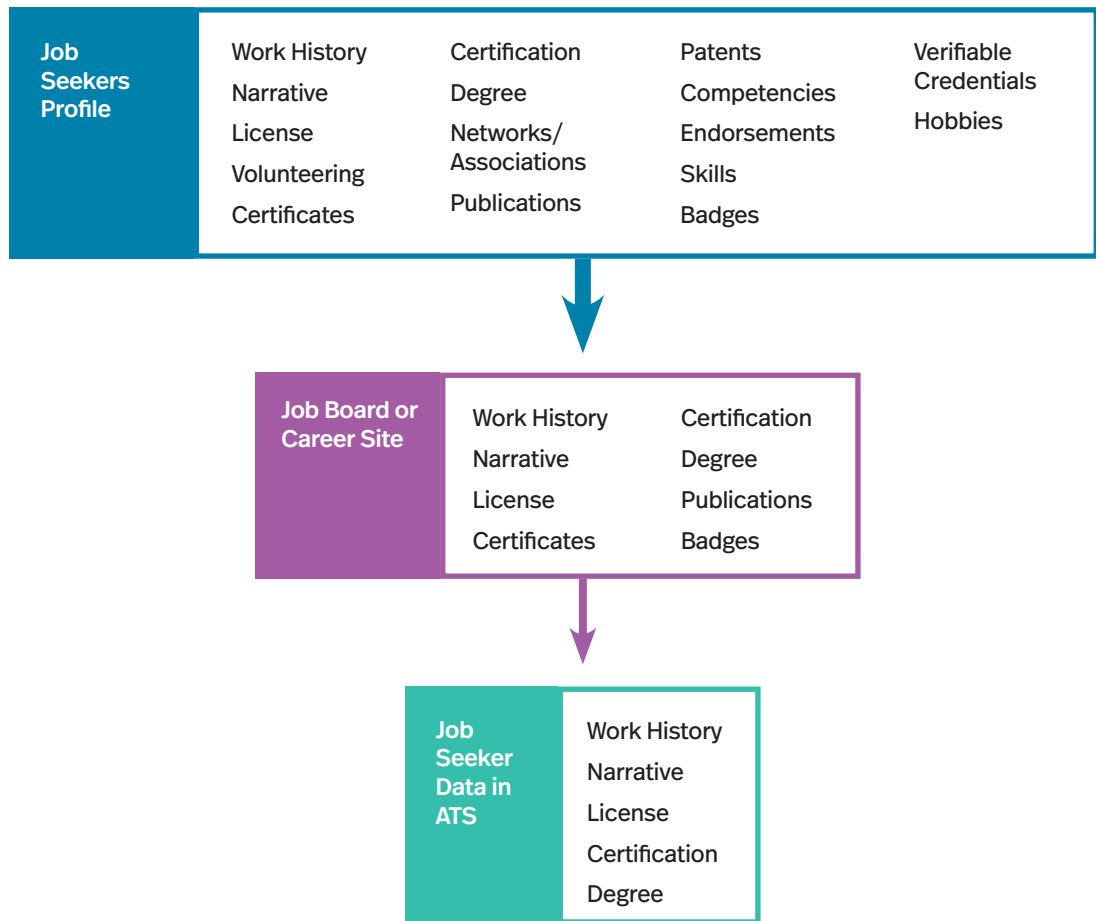
Skills, Intermediaries, and a Common Language

Around half of the HR technology products evaluated include at least minimal skills fields and functionality in their platform and data model. Of those that have skill functionality, most only allow for a simple list of self-identified skills, with no ability for the reviewer to verify the skills. As referenced earlier, none of the analyzed APIs support digital credentials explicitly – although some APIs allow for customer-defined fields which may be used to store a credential link. Within this sample of APIs, none offer credential verification or integration to credential providers for automated verification. Most do support selected *license* and *certification* specific data fields such as an expiration date. The job candidate's *awards* and *achievements* are rarely defined by specific fields within the APIs, but most allow for attachments that can be used to represent the award, achievement, diploma, or certificate. In this case, the attachment is not structured data and must be manually viewed, inspected, and interpreted by a human in order to process and verify the information provided. While it appears that many of these systems and platforms have similar data models and exchanges – in some cases based upon the older HR Open standard as mentioned earlier – a drift away from the standardized format has occurred as integrations become increasingly customized.

Most ATSs and some job boards have their own resume parser application, while there are also many third-party vendors who specialize in this process. Across the ecosystem, there appear to be several inconsistencies with how and what is parsed and categorized which can lead to data fidelity loss and potential bias. Each proprietary platform has its own unique data model designed to support its customers. Without standard payloads, as candidate information is sent from system to system, there is a risk of data mismatch, which can ultimately lead to a decline in data fidelity.

The growing importance of "intermediary" platforms – such as Indeed, LinkedIn, and ZipRecruiter – that operate between the job seeker and the employer and their HR systems is a key trend identified in our research. These intermediary players are adding great value but naturally often introduce an added layer of data exchange and reduction. In addition, the scale and reach that some of these organizations have achieved has led to their proprietary APIs being widely adopted as de facto standards, since employers' recruiting processes need to plug into these third-party systems. This has led to multiple de facto standards in the market, requiring a product to potentially support two, three, or more sets of integrations for the same basic function, each a little different. The specific data that the applicant tracking system (ATS) is able to handle becomes the lowest common denominator.

The following graphic provides a simple illustration of how a candidate's attributes, achievements, or profile information may get lost in the transition from their unstructured resume or profile on an intermediary platform, depending on what the specific fields within the ATS are able to accept. This conceptual figure based on our analysis implies that there are many elements of the job seeker's profile and capabilities that may not make it downstream to employers' talent acquisition systems.

Figure 2. Candidate Data Losing Fidelity as Data Flows Between Multiple Systems

Job Seekers Profile	Work History	Certification	Patents	Verifiable Credentials
	Narrative	Degree	Competencies	Hobbies
	License	Networks/ Associations	Endorsements	
	Volunteering	Publications	Skills	
	Certificates		Badges	

Job Board or Career Site	Work History	Certification
	Narrative	Degree
	License	Publications
	Certificates	Badges

Job Seeker Data in ATS	Work History
	Narrative
	License
	Certification
	Degree

In the current landscape, the presence of additional services and technology platforms that support recruiting and hiring can lead to inconsistency in how information is processed and exacerbates the potential data loss. As one HR technology expert expressed, "It is hugely important for everyone to speak the same language." In the present environment, an applicant submitting the same credentials through multiple intermediaries will potentially – and in some cases even likely – be represented to hiring managers differently, depending on data loss or distortion. This is a situation that obviously would benefit from the HR technology sector's increased adherence to mutually agreed-upon data standards.

3. Most systems do not authenticate educational credentials by default, and largely do not support digital credential verification.

One of the potential benefits of digital credentials is the ability to verify or validate the authenticity of the credential, the authority of the issuer, and potentially the information within it, such as items of evidence. The Open Badge standard and other verifiable credential standards provide for this verification, which can be implemented by using cryptographic methods or through an API. Yet, it appears that most talent acquisition systems are not yet verifying credentials in this way – that is, there is often no "out of the box" product functionality or automation to verify the authenticity of a candidate's credential claim.

However, it is important to note that even if many systems lack automated digital credential verification, they are often customizable to add the necessary functionality – but this can require substantial costs and time. According to one talent acquisition technology executive, "There's no digital (credential) verification – none of that is passed through as an automated response. That being said, the system is configurable in a way that clients can do that."

Similarly, Chris Kim of Workday describes how its system and ecosystem treat the option of verification, with a connection to its product philosophy: "There are multiple ways where additional data can be stored in Workday. A customer can directly bring in data from another vendor, utilize a system integration to do verification between multiple systems or leverage an official skills partnership program that allows providers to deliver turnkey solutions that reconcile skills data as well as the associated certification or digital credential."

His colleague, VP of product management, David Wachtel, adds "the theme is we don't build predefined workflows for those things – but there is open accessibility through web services and APIs that enable companies and partners to build in these capabilities. That's the only way it scales – there are just so many use cases."

In addition, interviewed executives confirm that credential verification is not especially high on their employer clients' list of business challenges and functionality demands. That said, many systems do integrate directly with traditional background screening companies, which can include conventional educational credential verification alongside employment and criminal record background checks.

Today's talent acquisition systems and hiring processes do at times include candidates' self-attesting their credentials in cases where this evidence is required or ideal early in the application process. For example, if a candidate needs to provide evidence of a legally required license or certification, systems build in the ability or mandate the attachment of PDF versions of *credentials* (e.g. a copy of a diploma or license) much like they handle the attachment of a PDF resume. Examples of this include jobs in nursing or truck driving – both referenced by study participants – where the qualifying credential is legally necessary and therefore must be prioritized and verified at the start as a condition of building the applicant pool. In this case, candidates can attach or link to a copy of their credential – but the verification itself is not an automated procedure.

By contrast, consider the case of a candidate applying for a role with a job description stating that a bachelor's degree is "required." This is more often an expression of hiring manager or employer preference than a true necessity. At the moment of application and among potentially hundreds

of candidates at the top of the hiring funnel, there is likely not an immediate need to invest energy in verifying the candidate's claim that they hold this degree. The degree, alongside professional experience, would be verified toward the end of the hiring process when the candidate is a finalist – through a routine educational background verification that may be outsourced or conducted in-house by the hiring organization. This later verification activity also takes place within a context where the candidate has little incentive to and faces great risk in falsifying their qualifications. Perhaps due to this disincentive, the incidence of falsification has not risen to a level of concern for talent leaders.

4. Technology providers confirm growing customer interest in supporting skills-based hiring practices.

Skills-based hiring is the practice of evaluating prospective job candidates based directly on their skills, often as an alternative to traditional educational credentials. While in recent decades many employers have relied on postsecondary credentials as a proxy for skills, the lack of detailed information provided by these credentials and a tight talent market has pushed employers to find alternative methods for identifying strong candidates. Analysis of job descriptions,[15] survey data from the Society for Human Resource Management (SHRM),[16] and many other sources – including our own research with HR leaders in 2021 – confirm growing interest in skills-based hiring.

Our engagement with HR technology providers confirmed a growing customer interest in how technology platforms can support these innovations in hiring practices.

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15. Joseph Fuller, Christina Langer, and Matt Sigelman, "Skills-Based Hiring is on the Rise," Harvard Business Review, February 11, 2022, https://hbr.org/2022/02/skills-based-hiring-is-on-the-rise.

16. "New SHRM Research Makes the Case for Skills-Based Hiring," SHRM.

Employers care about these skills-related capabilities for multiple reasons including to improve talent acquisition, deliver a personalized recruiting process and expand diversity in recruiting. On diversity, Chris Kim of Workday explains, "There are traditional HR practices that can impact underrepresented people groups more than others. By focusing on skills-based hiring, organizations are able to uplift the recruiting experience while also delivering results to the organization. This is done with more efficient and effective hiring that also provides more inclusive recruiting by focusing more on the skills that a person has rather than traditional measures alone like job titles or educational background."

Technology providers explained several clients are choosing to turn on available features that support skills-based hiring. Workday's David Wachtel notes, "The uptake of skills capabilities is exploding, and growing tremendously in the number of customers who are turning those things on. Some of the skills capabilities customers are going live with the fastest include the ability for candidates to add skills and for our system to recommend skills to candidates." LinkedIn finds that around 40% of hiring professionals on their platform (up 20% year-over-year) are using skills data to find talent, and that hiring managers are 60% more likely to find successful hires than those not relying on skills as part of their hiring process.[17] In response to this trend, LinkedIn has taken measures to integrate skills-based hiring into its platform by allowing hirers to search and filter for candidates who match their skill requirements – alongside other more traditional filtering criteria like professional experience or educational degrees.

Pre-screening and skills assessment offer another way in which employers can identify relevant skills in job candidates. Job site Indeed offers "free and easy-to-use skills tests" to help narrow candidates.[18] These tests screen a mix of hard skills – like accounting, food safety, or billing – and soft, or durable, skills – like reliability and accountability, and range in length or complexity. The skills tests were designed by a team of industry/organization psychologists and other experts and are not editable or customizable. Indeed notes the use of these assessments can reduce an employer's time to hire by 12% on average.[19] Recent research conducted by the Society for Human Resource Management (SHRM) highlights the growing use of skills assessments, finding that more than half of the surveyed employers said they'd use pre-hire skill assessments to ascertain applicants' abilities, with 1 in 4 planning to expand the use in the next five years. They also found that skills assessment scores are just as or more important than traditional criteria such as minimum years of experience and degrees. In fact, about a third of employers responded that if a candidate lacks the experience requirements but has scored well on the assessment, the candidate would "very likely" make it on a list of final candidates.[20]

Implementing functionality that supports skills-based hiring in HR technologies can be complicated. Ananth Kasturiraman from Indeed highlights the number of additional factors involved in the screening process, explaining, "It's not enough for employers to adopt skills

17. Jack Kelly, "LinkedIn Commits To Skills-Based Hiring To Help Both Job Seekers And Companies In Need Of Workers In A Hot Job Market," Forbes, March 29, 2022, https://www.forbes.com/sites/jackkelly/2022/03/29/linkedin-endorses-skills-based-hiring-to-help-both-job-seekers-and-companies-in-need-of-workers-in-a-hot-job-market/?sh=17ea8a4910e2.
18. Indeed for Employers, "Free and easy-to-use skills tests," Indeed, https://www.indeed.com/hire/screening/assessments-library?co=US.
19. Indeed for Employers, "Using Indeed Assessments to Administer Candidate Skills Tests," Indeed, https://www.indeed.com/hire/resources/howtohub/how-to-use-indeed-assessments#source.
20. Kathryn Moody, "Skill assessment usage is growing, SHRM survey says," HR Dive, August 17, 2022, https://www.hrdive.com/news/skill-assessment-usage-is-growing-shrm-survey-says/629871/#:~:text=Skill%20assessments%20may%20become%20a,years%2C%20the%20association%20announced%20Aug.

taxonomies that translate existing job descriptions and profiles into a common language of skills. While that is critical, they also have to think about 'how do I stop requiring degrees? Introduce assessments? Adapt my interview processes? There's a whole family of things tied to skills-based hiring that aren't just this narrow question." Skills-based hiring is certainly a growing trend that will likely lead to a more careful review of the entire screening process.

5. Capabilities vary — but progress is expected — in how talent acquisition systems manage skills data.

As skills-based hiring gains popularity, there is a growing need for organizations to capture and maintain skills data. Skills taxonomies – hierarchical systems that catalog, organize, and define skills – provide needed structure and management that in turn helps facilitate the identification and matching of qualified candidates and supports the sourcing and upskilling of internal candidates. Moreover, taxonomies support credentials by helping organizations make sense of in-bound skills data and relate it back to support the hiring process. An open standard published by 1EdTech is Competencies and Academic Standards Exchange (CASE), which enables the open sharing of skills frameworks and taxonomies over the web.

Many providers feature skills in their platforms or data models but the picture of capabilities is mixed. About half of the talent acquisition technology products included some level of 'skill' in their platform and data model. Basic skill functionality would include the ability to enter a skill name or select one or more skills from a drop-down list, allowing the job seeker to include self-identified skills in addition to providing their resume. Additional metadata may also be available such as years of experience in the skill. At this basic level, skills are generally simple lists that lack categories, hierarchies, or linkages.

Discussions with technology providers found that skills taxonomies are an area of client interest and on many firms' roadmaps but have yet to be widely implemented. In general, firms agree that skills taxonomies will be utilized in the future but are currently not in systems. Moreover, there is no clear industry norm for designing skill taxonomies and instead most companies use basic internal data models to house skill information. One example of third-party data is labor market analytics company Lightcast, which reports having an open-source library of 32,000+ skills gathered from

hundreds of millions of online job postings, profiles, and resumes – updated every two weeks.[21] Their tool "SkillsMatch" leverages the company's large skill framework to help users create a personal skills inventory.[22] Lightcast is one of a number of players in this space (which is itself the subject of a parallel research investigation at Northeastern University), and through Lightcast's open API, users get direct access to datasets and the ability to create custom data displays and applications.[23]

An idealized implementation of a skill model and taxonomy within the HR tech platform would need to include a sophisticated data model. It would be expected to assign skills a unique identifier and include additional metadata to further describe the skill and distinguish it from other related ones. Moreover, the framework may be linkable in a way that creates relationships between skills and external frameworks of skills, competencies, and qualifications, or even job profiles and job codes – and ideally, shareable broadly across the web inside of credentials. In this respect, job boards tend to operate at a basic level, whereas larger HCM platforms often have more complex functionality in translating skills and skills inference capability. How, if at all, HR technology systems process and relay skills data is important to maximizing the value of increasingly popular digital credentials. While the wide adoption of skills frameworks appears still on the future horizon, the depth of capabilities varies among providers. Ultimately, most talent acquisition software is not yet equipped to intake and manage rich skills data that accompanies digital credentials.
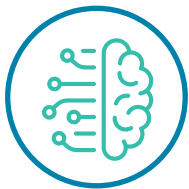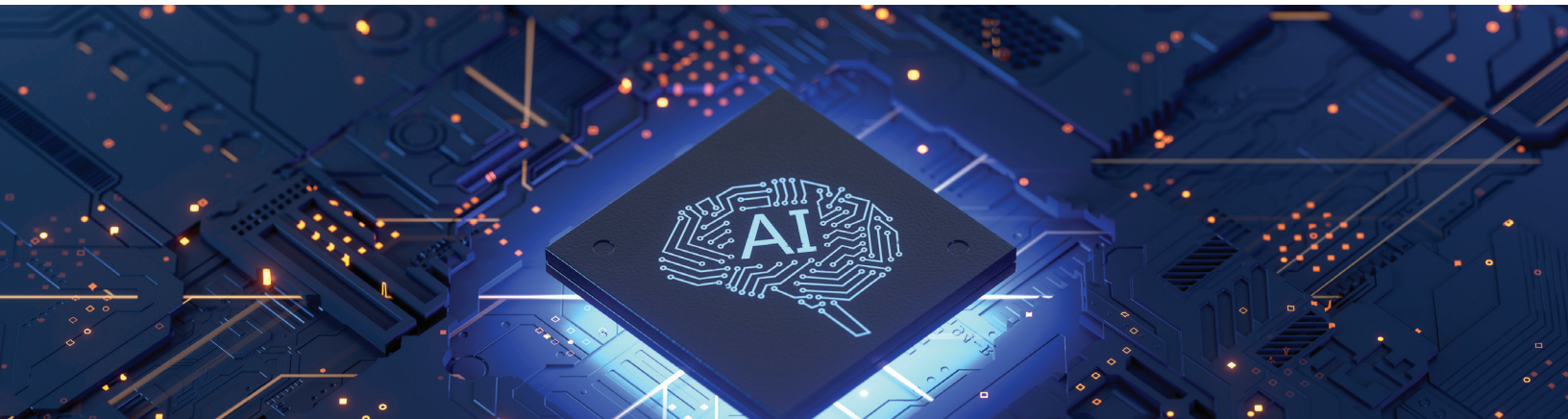
6. Talent acquisition technology firms see positive benefits in leveraging AI: many are actively implementing it and others are building the use cases for increased investment.

One important area of inquiry in our interviews and demonstrations was exploring the extent to which HR technology players are implementing AI and machine learning in their systems, and exploring the algorithmic matching of candidates and their credentials to job openings. The structured and linked data in digital credentials is well-tuned to sophisticated machine processing.

21. Lightcast, "Open Skills Taxonomy," Lightcast.io, https://lightcast.io/open-skills
22. Lightcast, "SkillsMatch," Lightcast.io, https://lightcast.io/solutions/education/skillsmatch
23. Lightcast, "Lightcast Data API," Lightcast.io, https://lightcast.io/solutions/api

The deployment of AI is recognized as presenting an opportunity for talent acquisition technology firms and their employer clients – but it is also viewed as an area of potential concern due to the fact that algorithms can introduce and amplify bias; can create ethical issues; and are often not auditable.[24]

Most participating firms reported a positive view of AI and most have implemented some form of AI in their systems. However, in many cases, leveraging AI and machine learning in a significant way remains on the horizon (a component of near-term product roadmaps) more than a widely implemented reality today. Many interviewed experts note that the effective use of AI in hiring hinges on more detailed skills data and quality profile information on candidates – and it is important to note that the need for more data to fully leverage AI also applies to talent management and cataloging the skills of existing employees. In describing AI as an area of investment for SAP, David Ludlow, group vice president for solution strategy, explains: "If you have better profiles at the individual level and at the job level, it provides a much more confident set of data on both sides. Imagine a future where it also includes the behavior and personality level derived by the results of assessments and psychometric testing, where it's a richer source of data is available to determine who might be successful in a specific role from an overall perspective. Then this gets very interesting."

Digital credentials can capture substantial amounts of rich information about the achievement being represented, including granular details. While not limited to education, credentials can include things like every learning outcome demonstrated in a course or program; every test taken; both academic and "durable" skills; and professional development and work experiences. As AI progresses, there will be increasing amounts of data being consumed by AI, including the rich sets of data provided by digital credentials. It is worth noting that the core research for this study took place in 2022 – and that the recent release of tools such as ChatGPT is leading to a surge of new interest in the business world in AI applications, which may lead to an even greater level of priority for talent acquisition technology firms' product roadmaps.

AI is being used to augment the recruiting and hiring process, but interviewed firms feel caution about its use in decision-making today, and emphasize that it is a tool to augment the hiring process, not control it. According to Jobvite's Andrew Cunsolo, "Using AI to make hiring decisions for people is a bad idea at this point – the data available to it is flawed or missing or assumed... But having AI comb millions of records to make connections, and then surfacing that information to a hiring manager or recruiter to help them make a decision – that's exciting. AI discovering people who are successful on a job have these skills, credentials, etc. – and here are similar people with similar skills/credentials in your pool."

In our interviews and other research, we found there is a healthy skepticism of black box solutions or the expectation for AI as a magical solution to everything. The use of AI in talent acquisition is still early, and it is good to be risk-averse with this powerful technology. We expect that very beneficial use cases will emerge for its application as more experience is realized across the industry and there may well be abuses that come to light to guide ethical implementations. In the meantime, cautious and transparent practices are called for.

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24. Miranda Bogen, "All the Ways Hiring Algorithms Can Introduce Bias," Harvard Business Review, May 8, 2019, https://hbr.org/2019/05/all-the-ways-hiring-algorithms-can-introduce-bias.

Recommendations
and Implications

The preceding analysis provided a first detailed look at the intersection of educational credentialing and talent acquisition systems. Our principal conclusion is that the current ability of talent acquisition systems to make use of the features and functionality embedded within digital credentials and to import richer skills data is limited and relatively immature – even more so than hypothesized.

As a result, stakeholders with an interest in the emerging digital credentialing and skills ecosystem (including educational credential issuers, edtech companies, some industry leaders, and policymakers) must be aware that there is still a significant gap to close before credential earners and employers can benefit at a greater scale from the potential of these educational technology innovations.

From the perspective of *credential issuers and earners*, there is a need to build greater awareness among employers and the HR technology firms that support their talent acquisition activities, about the momentum for and potential benefits of digital credentials. The early investments by the education and training sectors over the last decade – in developing and refining digital credentials as a stronger way to communicate a person's knowledge and skills – have today positioned this community to better understand and respond to the opportunities and challenges of the talent market and its technology providers.

In the space that follows, we outline the key implications and recommendations resulting from our findings.

1   **The lack of current support for digital credentialing and richer skills data in many talent acquisition systems means that employers are currently losing out on realizing the full benefit of potential innovations that can be central to skills-based hiring strategies.** In order to accelerate closing the gap, HR leaders should declare and define their hiring needs and related business processes, and engage their talent acquisition technology partners to prioritize implementing this functionality within tech companies' product roadmaps. Rick Barfoot, chief operating officer of HR integration company Joynd, describes it in the following terms: "The actual friction is with the recruiting systems vendors themselves – the challenge is to have the employers recognize this is a superior way of hiring, all the way down to competencies and skills, at a more minute level than just sticking to qualifications or degrees and diplomas. Some of them need to put pressure on their existing vendors, or vendors they're looking at. I think it's going to take big employers that hire tens of thousands of people to push their vendors into providing that level of detail."

In addition, credential issuers such as colleges and universities – and the edtech community that supports them – can play a greater role in building awareness about new credential offerings and digital capabilities and in the needed illustration of why digital credentials can be a better, more equitable way to hire. Ideally this will take the form of in-field demonstration pilots, the results of which can be widely communicated to the HR community.

The development and adoption of standards is also crucial – which is a common theme in the recommendations resulting from this research. Standards will enable the seamless exchange of digital credentials and increase the overall ease of implementation. Industry and professional

associations can play a pivotal role in adoption by publishing their certification requirements in open skills frameworks and then supporting the value of verifiable digital credentials in their industry.

A parallel and constructive trend is happening with the development and early emergence of open digital wallets that support a learner-worker's ability to manage and share their credentials independently from a commercial provider, laying the groundwork for a virtual talent network not tethered to a particular product but controlled by the learner and worker sharing verifiable credentials. This important innovation depends upon the use of open standards to enable the free flow of an individual's verifiable credentials. The design intention of many is to make this network free and based on open standards also makes access to these capabilities more likely for small and mid-sized companies who together are the engine of economic vitality in the United States and many countries worldwide. Secure credential storage and personal digital wallet products, essentially LER apps, could fill a void in the current app-less credential exchange environment.

(2) **The reality of candidate data and artifacts passing through multiple software systems and intermediaries often leading to data loss is another case for greater HR industry adoption of agreed-upon standards, and the importance of a strong community to ensure that these standards are up to date.** Industry's more consistent adoption of data interoperability standards for common use cases will drive a greater likelihood that data provided by candidates is preserved – including digital credentials, skills, and other profile information which today can be lost during data handoffs, resulting in qualified candidates potentially being bypassed if their resume content doesn't exactly match with algorithmic search terms.

The growth in the use of various intermediary systems (such as job boards) is also worth closely monitoring by the edtech and HR tech communities, as the scale of many of these players and the channel that they represent is significant – touching hundreds of millions of professionals. To the extent that third-party sites are becoming major platforms and repositories for skills and credential information – and even skill assessment – there is a potentially disruptive force asserting itself into the recruiting and hiring process, including the space between educational institutions and hiring employers. The existence – even prevalence – of a few very large platforms creates a possible imbalance where the learner-worker is not the agent of their advancement, but rather, the product.

Networks based on open standards can potentially help to level the playing field while still providing ample opportunity for innovative platforms to offer users a worthwhile and effective experience. The HR Tech ecosystem's adoption of a more rigorous posture for data exchange through data interoperability standards can ultimately lower the barriers to entry for new innovations such as digital credentials. There is a historic parallel in the education sector, where in 2012 a standard known as Learning Tools Interoperability (LTI) was released to simplify how learning related applications and tools plug into otherwise monolithic learning management systems – historically a very complex and time consuming effort. In part due to these efforts, there are hundreds of low cost and free products available for use by teachers and school administrators based on LTI.

The availability of a standard is of minimal benefit unless it is taken up and widely adopted by the industry participants. The purchasers of technology – the employers and talent leaders as enterprise users – are the essential drivers for standards adoption. They must be aware of the benefits to them and their industry and require their technology providers to adopt the standard

and ideally be certified by a third party for confirmation. For example, products that pass 1EdTech certification are listed in its [Trusted Apps Directory](). Learning and employment records that include educational credentials should be held to a similarly high expectation to avoid the possibility of data loss or distortion.

Relatedly, 1EdTech and HR Open are collaborating on a next generation resume standard called the Learning and Employment Record Resume Standard (LER-RS) for release in 2023. Among its many beneficial features, the LER-RS will incorporate Open Badges 3.0 and CLR Standard 2.0 as officially defined contents in the new resume.

③ Talent acquisition systems' lack of automated credential verification appears to largely reflect a lack of need, enthusiasm, or awareness on the part of employer HR customers, coupled with the older technologies in predominant use. Verification is a secondary benefit of digital credentials – one that has perhaps at times received outsized attention from edtech entrepreneurs and others. The greater value is digital credentials' ability to represent an authoritative claim of knowledge, skills, and achievements as attested by a reputable issuer such as an accredited college or university. It is also worth reflecting on the revenue incentives that colleges and universities historically have enjoyed to maintain ownership over educational credential verification – but many organizations have decided to take the path of learner empowerment over the income streams associated with degree verification or transcript mailing services.

Although credential verification may not be at the top of the list of digital credential value propositions, there is still a strong case for this technological innovation to enable greater efficiency in hiring – once this functionality becomes integrated into more talent acquisition systems. Indeed, many players in the ecosystem are looking in this direction – with an emphasis on individuals' ownership of their learning records and taking the middleman out of the equation. According to David Ludlow, group VP for strategy at SAP SuccessFactors, "We're starting to see technology provide a more agnostic perspective to have a verified credential or validation of a credential… The key thing is to put this into the hands of the individual – leading to the ability to hire someone much more confidently, and at the same time reduce the cost of all these external validations/ verifications, and university verification services." His colleague, Alex Chudnovsky, vice president of solution strategy at SAP, notes that today's process is already inefficient for traditional and static credentials such as the episodic degree – not to mention the growing importance of capturing skills development over a career. "In the current process of consent giving, all the intermediaries – it's very inefficient. And validating lifelong skills development and training changes is even more valuable compared to just your graduation date." As lifelong learning and continuous professional development become more popular, it is even more important to have better systems of record that capture the often smaller-grained knowledge and skill-based achievements while maintaining the feature of authenticity.

④ The growing demand for skills-based hiring appears to be the use case that will most significantly influence and elevate how talent acquisition technologies treat and interface with digital credentials and skills information. The qualitative reports from interviewed HR technology executives – whose platforms serve millions of employer customers – are yet more evidence that this trend is gaining momentum.

For small- and mid-sized businesses, the adoption of these new innovations will in part rely on larger corporations who can more easily invest in the work of piloting and testing skills-based

technology tools. It is expected that eventually these tools and functionalities will reach the full range of employers, providing an avenue for small- and mid-sized businesses to compete for talent alongside large corporations. Here again, open standards can be a leveling agent that can serve as a unifying vehicle for the growing market of technology start-ups and their products and services that can plug into the legacy talent acquisition system ecosystem through the adoption of a common language. Through intentional actions of the collective industry, it is possible for the transition to more skills-based hiring more efficient and equitable for businesses of all sizes.

The focus on skills assessments and many talent acquisition technology platforms' investing in support for this growing product area is particularly notable for higher education and many other credential issuers, as pre-hire testing of skills and capabilities may diminish the value of traditional credentials such as degrees. Yet, on the flip side, employers' emphasis on pre-hire assessments may also open the door for education providers and industry to collaborate more directly on authoring assessments and the related curriculum. Further, a verifiable digital credential with rich metadata and evidence can reasonably be a substitute for additional employer-developed skill assessments, providing a signal of competency that employers can trust.

⑤ **The varying capabilities that talent acquisition systems have to handle and analyze skills data means that in the future, a person's chances to make it through an increasingly algorithmically-driven screening process may rely as much on which intermediary systems, if any, are being used — and how those systems' skills data handling aligns.** As one talent acquisition technology executive notes, "there is concern that there won't be agreement between these systems: everyone wants to own the taxonomy, or own the system of record." Uncoordinated adoption of skills-related technologies and taxonomies may hinder the seamless use of skills data among systems, including job boards, ATSs, and employers, resulting in negative consequences for job applicants. Open-skill frameworks may be a solution to mismatched capabilities because it provides an accessible blueprint for talent acquisition systems to adopt.

In addition, the relatively recent upsurge of interest in "skills" as key units of analysis for employers in place of degrees may be good news for digital credentials, which are designed to incorporate much more detailed information about the learner-workers' knowledge, skills and abilities than is available in legacy forms of credentials. However, the influx of skills-as-currency may have implications for some credential issuers. While digital credentials are in fact designed to showcase rich skill data, its possible credentials altogether may be bypassed in favor of simply listing verified skills.

Looking to the marketplace, there are certainly pilots and pockets of innovation happening, which may help to resolve the lack of definitive skill data, in particular with the use of digital learning records. In particular, the US Chamber of Commerce Foundations' T3 Innovation Network sponsors a volunteer community of practice on the subjects of learning and employment records and skills frameworks. The Open Skills Network (OSN) is another notable contributor to the shared definition of skills through the use of "rich skill descriptors," a formalized way to describe skills. In collaboration with OSN, Western Governors' University first contributed this concept and libraries of skills for free use and reciprocal contributions. Credential Engine is a registry where education providers can list the credentials they offer along with the associated skills. Together, along with the previously mentioned CASE standard for publishing open skills frameworks, there has been substantial progress that can be leveraged by AI entrepreneurs.

6 **It is early in the application of AI: the emerging use cases and its significant potential benefits and risks call for continued monitoring and a commitment to transparency.** Given the rapid pace of developments in AI, this territory is especially important to monitor – and there is a very wide range of ways that technology companies are beginning to deploy AI in recruiting and hiring platforms. Examples are readily available in various firms' product descriptions and marketing materials, with new, sometimes experimental, features arriving often. For example, Jobvite utilizes AI to extract top-matching candidates from their candidate relationship management system, while Workday uses AI and machine learning to infer skills in the hiring process, among many similar examples.[25]

A potential area of promise for AI is the identification/recognition of skill adjacency and the ability to weigh or evaluate an individual's potential to learn a skill through implicit associations with other skills or experiences. Ultimately, the implementation of AI hinges on better quality data. It is also important to proactively mitigate and manage bias. Bias is inherent in all technological systems, but even more so in the use of AI as it decreases the need for human intervention.

One way to provide richer skills data while also mitigating bias is through the use of LERs (Learning and Employment Records), which can document employment history and learning wherever they occur, such as in the workplace, through an educational experience, military training, and more. If an LER can also store proof of skills – such as results from a skills-based assessment, or if the claimed skills can be verifiably endorsed by others in the field – this skills data could be exposed to talent searchers and AI. This mix of detailed and verified data decreases the possibility of incorrect inferences made by AI. As automation in the hiring process grows, it is important to keep in mind that at its heart, hiring remains a very human-centric connection between job seeker and employer.

CONCLUSION

We hope that this analysis – a first detailed look "under the hood" of talent acquisition systems through an education-oriented lens – clearly highlights both the opportunities and the gaps to close in realizing the potential of digital credentials within the evolving talent marketplace. As both the demand for digital credentials and the need for new talent strategies and solutions grows, key actors including credential issuers, talent acquisition technology providers, policymakers, and employers have the opportunity to work more collaboratively. Our hope is that the ongoing work in this area will lead to more precise, efficient, and equitable hiring processes, enabled by the full power of better data and technology.

25. Jobvite, "Engage, Nurture, & Convert Candidates at Scale," Jobvite, https://www.jobvite.com/capabilities/recruitment-marketing/?; Workday, "AI and Machine Learning in HR," Workday, https://www.workday.com/en-us/pages/feature-stories/ai-machine-learning-hr.html

APPENDIX

Interview Participants
Rick Barfoot, Joynd
Nick Cosgrove, ZipRecruiter
Alex Chudnovksy, SAP
Andrew Cunsolo, Jobvite
Ananth Kasturiraman, Indeed
Chris Kim, Workday
David Ludlow, SAP
David Wachtel, Workday
Anonymous Participant, Talent Acquisition Technology Firm

In addition to the core insights contributed by the participants above, we also appreciate the review, comments, and ideas contributed by Dr. Michelle Prince (MPrince Consulting) and Dr. Stephen Rando (Northeastern University) in the development of this report.

Publicly Available API and Integration Documentation Researched

Indeed Candidate Application JSON file and XML Job Feed
- https://developer.indeed.com/docs/indeed-apply/example-json-post-file/
- https://developer.indeed.com/docs/indeed-apply/enterprise-ats/

SAP Success Factors APIs
- https://api.sap.com/api/ECSkillsManagement/resource
- https://api.sap.com/api/RCMCandidate/schema
- https://api.sap.com/api/RCMCandidate/resource

Workday REST APIs
- https://community.workday.com/sites/default/files/file-hosting/restapi/index.html
- https://community.workday.com/sites/default/files/file-hosting/restapi/index.html#recruiting/v3/prospects

ZipRecruiter Job Apply JSON file
- https://www.ziprecruiter.com/partner/documentation/#fields.

Other API Documentation
- https://docs.merge.dev/ats/candidates/
- https://api.lightcast.io/apis/skills