

UNDERSTANDING THE EMERGING SKILLSTECH LANDSCAPE

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

Sean R. Gallagher | Amanda Welsh | Emilee Trieckel | Chris Houston



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EXECUTIVE SUMMARY

Identifying and analyzing the skills held by employees and job candidates is becoming a top priority in talent management - and in today's rapidly changing economy, the focus on skills as the key unit of analysis is increasingly a major organizing principle for work itself. The same technological developments that are reshaping the workplace and accelerating the pace of skills change are also creating new opportunities for employers and others to better interpret and manage skills. As a result, a growing wave of startup companies, global enterprise software firms, nonprofit organizations, and others are investing in the development of skills taxonomies and new technologies that are driving innovation in skills management.

The explosion of providers of “skillstech” tools (many leveraging AI and machine learning) and the ongoing dialogue about skills frameworks in the policy world and among employers can be confusing to navigate. The analysis that follows – based on more than a year of secondary research and primary interviews and demonstrations with skillstech providers and other industry leaders – defines this landscape, discusses how it is evolving, and identifies key issues for interested stakeholders to consider.

Ultimately, we arrive at the key conclusions and recommendations summarized on the following page.



KEY TAKEAWAYS



1. The creation of one universal skills taxonomy appears to be an unrealistic scenario. Instead, organizations in the skills solutions market are focused on developing tools that are contextual and adaptable. Industry- and occupation-specific taxonomies are expected to be especially important.



2. Many organizations are increasingly thinking of skills as multi-dimensional – shifting the dialogue beyond simple and static keywords to instead focus on skill clusters, proficiency, and validation.



3. It is early in the still evolving skillstech landscape. The development of this market is expected to include new entrants, potential consolidation, and continued work to integrate with other HR systems.



4. Establishing an architecture for skills portability and data consistency can benefit all stakeholders.



5. The growing application of AI and machine learning to talent and skills demands greater attention to ethical and responsible use and ensuring high quality data.

ASSOCIATED CONSIDERATIONS

- Employer desire for proprietary skills inventories
- Needs of specific industry verticals / occupations
- Potential of AI and machine learning to keep pace with skills shifts vs. canonical recommendations of human experts
- Value of crosswalks and standards given the need to integrate proprietary taxonomies

- Importance of skills *clustering* and the need to situate skills within a broader context
- Agreeing on and capturing *proficiency* levels associated with skills
- Skill *validation* as an emerging horizon and market opportunity
- Potential development of new business models, and implications for education providers and others based on these dynamics

- Convergence of human capital as a strategic employer asset and the growing capabilities of AI as drivers of increased attention and investment in skillstech
- Entrance of new startups, established software titans, and potential market consolidation
- Need to integrate “best-of-breed” skills solutions with a host of HR and other corporate systems

- Collaboration among stakeholders in service of building an “open skills” ecosystem that benefits workers/learners and economic development, potentially through open standards
- Tension between open vision and employers’ and skillstech providers’ potential incentives to invest in proprietary frameworks
- Coordinating across parties to make skills records verifiable, comparable, and portable

- Potential for greater regulation at multiple levels of jurisdiction
- Adjusting models to address potential bias issues
- Need for high quality and high volume skills data to train models
- Special sensitivity required when considering data privacy and individuals control and curation of records in the talent domain

INTRODUCTION

In today's economy, the strategic dialogue among managers, human resources leaders, and even CEOs is increasingly focused on *skills*. There is an established body of evidence that skills are central to economic opportunity – and it is undeniable that we are in a moment of rapid change with respect to skills demands in the workforce.¹ A growing number of employers are focused on prioritizing skills over credentials in the embrace of skills-based hiring as a means to identify new sources of talent and to achieve a more rigorous and equitable hiring process.² In addition, businesses are growing their investments in upskilling and reskilling to sustain competitiveness, support digital transformation, build a more diverse workforce, and retain employees in the post-COVID-19 environment.³ These recent developments affirm the World Economic Forum's assertion a few years ago that skills are “the new currency” in the labor market.⁴

If skills are indeed the new currency driving the future of work, then the documentation, matching, and assessment of workers' skills relative to employer needs are paramount. As a result, many organizations and initiatives are developing skills frameworks and taxonomies that can serve as a reference point and lingua franca in the world of skills. Perhaps more significantly, a number of technology and service providers have sprung up to offer solutions to catalog, identify, match, and interpret skills. The work of these organizations – which includes both startups and mature technology companies – also aligns with the interests of employability-focused higher education institutions, and workforce development-oriented policymakers, who are also increasingly focusing on “skills” as a key unit of analysis and planning. Like employers, these groups are interested in the emergence of innovative new data sources, technologies, and tools to address employment-related challenges and opportunities.

The energy created by these new developments suggests optimism for increased efficiency and equity in human capital management. However, as is true with any nascent trend in the early adoption stage, there is uncertainty and even confusion about the proliferation of frameworks and skills-related technological developments. Visions of a standardized, unified perspective on skills are competing with the reality of employers' unique needs and proprietary interests - with “skillstech” platforms attempting to bridge the interests of companies, governments, educators, and others.

What are skills? Who defines them? How can we use them? How can we assess and validate them? These are useful questions to consider as we untangle the potential of this new world of skills frameworks and “skillstech.”

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1. Matt Sigelman, Bledi Taska, Layla O'Kane, Julia Nitschke, Rainer Strack, Jens Baier, Frank Breitling, and Ádám Kotsis, *Shifting Skills, Moving Targets, and Remaking the Workday* (Boston Consulting Group, May 23, 2022), <https://www.bcg.com/publications/2022/shifting-skills-moving-targets-remaking-workforce>.
 2. 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>; 1EdTech Foundation, *Digital Credentials & Competency Frameworks: Exploring employer readiness and use in talent management* (1EdTech Foundation, November, 2021), https://www.imsiglobal.org/sites/default/files/wellspring/Wellspring_IL_Employer_Research.pdf.
 3. Sean R. Gallagher and Michael Ferrari, *Employers' Post-COVID Business Strategy for Talent: A view from the C-Suite* (Northeastern University, December 2021) https://cps.northeastern.edu/wp-content/uploads/2022/01/NUReport_CFHETS_EmployersPost-Covid_12-22-2021.pdf.
 4. Centre for the New Economy and Society, *Strategies for the New Economy: Skills as the Currency of the Labour Market* (World Economic Forum, January 2019) https://www3.weforum.org/docs/WEF_2019_Strategies_for_the_New_Economy_Skills.pdf.

ABOUT THIS ANALYSIS AND METHODOLOGY

The objective of this report is to review the landscape of players driving the management of skills taxonomies and the emerging “skillstech” movement, as well as identifying key trends in this ecosystem. After establishing context, we analyze trends in this emerging territory and conclude with guidance for key stakeholders interested in these new skills-related developments.

This analysis is grounded in both secondary research and more than 15 qualitative interviews and demonstrations with organizations supporting skills-based talent management. Research questions were framed to elicit front-line insights on the skills environment and software product offerings, as well as perspectives on market trends. Descriptions of selected participating organizations interviewed, which include a representative set of startups, non-profits, established tech providers, and others, can be found in Appendix A.⁵ The growth of skillstech solutions is driving the development of a rapidly growing ecosystem with scores of firms and other players operating in it: while the interviews our team conducted were highly informative, by design this sample represents only a portion of the overall larger marketplace. Additionally, our focus in this analysis was on skills taxonomies, and identifying and analyzing skills-focused products and services that support HR management and decision-making. We viewed these types of organizations and solutions as distinct from the numerous learning content providers and other HR services companies that have skills frameworks or features that are intertwined with their proprietary products.

Our intention is that the information in this report can be used by employers as they consider how to invest in skills-based talent management; by education providers to understand how to provide better skills-related outcomes for students; by policymakers to understand how to support and leverage the potential of skills-based approaches; and by technology firms offering skills-based solutions.

5. Note: Some individuals and organizations participated anonymously.



The Skills Challenge and Opportunity



THE TECHNOLOGIZATION OF THE WORKPLACE AND THE PACE OF SKILLS CHANGE ARE CREATING NEW URGENCY

In the United States in 2023, there are more than 11 million job openings, which represents an all-time high, even in a slowing economy.⁶ Employers are having a difficult time filling many roles. In fact, a survey conducted by international staffing company ManpowerGroup found that nearly 4 in 5 employers globally (77%) report talent shortages – a 17-year high.⁷ Not surprisingly, this state of affairs has led many to consider why filling open roles is so hard. Approximately a decade ago, the popular idea of a “skills gap” emerged, describing the mismatch between the skills and experiences that jobs require and the qualifications of job seekers.⁸

A 2022 report from the Burning Glass Institute based on an analysis of more than 15 million job postings found that 37% of the top 20 skills within the average job had changed since 2016 and that 22% of the referenced skills were entirely new.¹⁰

While experts have debated the causes for this gap – attributing it to misplaced employer expectations or the failure of education systems⁹ – one issue that is unquestionably a factor is the pace of change in today’s work environment. New skills are emerging at a faster pace while *current* skills are becoming outdated more rapidly. Sean Hinton, founder and CEO of SkyHive, points to the example of the cloud computing market, where major architecture updates and shifts in skills demand are occurring on average every 4.5 months: “the pace at which jobs need to be redefined is in months, not years,” according to Hinton.

Although technological developments – in particular the growth of mobile and cloud computing, data analytics, machine learning and AI, and automation and robotics – are creating new skill demands for tech-related roles, even non-technical roles are impacted, and changes are occurring across a wide range of industries and business functions.¹¹ The result is that the World Economic Forum’s Future of Jobs report found that for workers set to remain in their roles, the share of core skills that will change in the next five years is 40%, and 50% of all employees will need reskilling (up 4%).¹² On average, companies estimate that around 40% of workers will require reskilling for six months or less, and 94% of business leaders report that they expect employees to pick up new skills on the job, a sharp uptake from 65% in 2018.¹³

6. “Job Openings and Labor Turnover Summary,” US Bureau of Labor Statistics, March 2023, <https://www.bls.gov/news.release/jolts.nr0.htm>.

7. “The 2023 Global Talent Shortage,” ManpowerGroup, <https://go.manpowergroup.com/talent-shortage>.

8. Sarah A. Donovan, Adam Stoll, David H. Bradley, and Benjamin Collins, *Skills Gaps: A Review of Underlying Concepts and Evidence* (R47059, U.S. Congressional Research Service, March 31, 2022), <https://crsreports.congress.gov/product/pdf/R/R47059>

9. Matthew T. Hora. *Beyond the Skills Gap: Preparing College Students for Life and Work*. (Cambridge: Harvard Education Press, 2016).

10. Matt Sigelman et al, *Shifting Skills, Moving Targets*.

11. David Autor. “The Labor Market Impacts of Technological Change: From Unbridled Enthusiasm to Qualified Optimism to Vast Uncertainty.” NBER Working Paper 30074, National Bureau of Economic Research, Cambridge, MA, July 2022. https://www.nber.org/system/files/working_papers/w30074/w30074.pdf.

12. Saadia Zahidi, Vesselina Ratcheva, Guillaume Hingel, and Sophie Brown, *The Future of Jobs Report 2020* (World Economic Forum, October 2020), <https://www.weforum.org/reports/the-future-of-jobs-report-2020>.

13. Saadia Zahidi et al., *The Future of Jobs Report*.

These shifting needs and the shortening shelf-life of skills means that employers, facing the economic reality that it is often more cost-effective to reskill existing employees whenever possible, need to be able to conceive of work with specificity beyond simple and static notions of title or job category. Employers and the broader economy need a vocabulary that is granular enough to capture the changes happening around them. A focus on “skills” offers a way for employers to express and manage talent needs better, and to approach how work gets done differently.

WHAT IS A SKILL?

Most definitions of the term “skill” focus on competence or proficiency – the ability to do something well.¹⁴ Skills are typically developed through education, training, or experience.

While the definition of the term skill is fairly straightforward, there’s significant variation in the language used to express skills – the level of granularity, what “counts” as a skill, and the syntax of the language used to describe it. For example, some may be comfortable with denoting “project management” as a skill, while others argue this is too broad. Project management can be parsed into more granular, descriptive concepts such as “cost management,” “resource leveling,” and “stakeholder communication,” instead. Additionally, there can be disagreement around whether something constitutes a skill as opposed to related concepts such as knowledge or abilities. For some, knowledge is familiarity and understanding of a concept, whereas a skill involves applying that knowledge. For example, *knowledge* of the French language does not indicate proficiency in speaking French.¹⁵ Meanwhile, being resilient might be considered a skill while for others this is an *ability* – a personal trait someone possesses. The disagreement stems from the question: can resilience be taught and developed or is a person born with it? Finally, there is disagreement about how language should best be used to express a skill. In many taxonomies, skills are represented as single words, as in “Python” (a reference to the programming language) but some organizations promote using syntax for skill descriptors that, for example, pair a verb with every skill to give it more meaning. This raises questions like whether a technology name such as “Python” should count as a skill or rather is “Writing Python code” more useful and informative for skills intelligence?

These differences, while subjective, have led to significant variations in the number of skills that organizations consider meaningful to organize and track. LinkedIn, for example, has suggested that there are about 50,000 skills that are meaningful.¹⁶ In 2018, Workday launched its Skills Cloud with more than 2 million skills, which has been reduced to 47,000 official or “canonical” skills that continue to be revised and updated.¹⁷

14. Paul Attewell, “What Is Skill?” *Work and Occupations* 17, no. 4 (November 1990): 422-448, <https://motamem.org/wp-content/uploads/2018/09/What-Is-Skill-Paul-Attewell.pdf>.

15. Sarah et al., *Skills Gaps: A Review of Underlying Concepts*.

16. Paul Petrone, “The Skills Companies Need Most in 2019 – And How to Learn Them,” LinkedIn Learning Blog, December 31, 2018, <https://www.linkedin.com/business/learning/blog/top-skills-and-courses/the-skills-companies-need-most-in-2019-and-how-to-learn-them>.

17. Vinnie Mirchandani, “Analyst Cam: Workday Skills Cloud update,” Deal Architect Inc, October 28, 2021, https://dealarchitect.typepad.com/deal_architect/2021/10/analyst-cam-workday-skills-cloud-update.html.

By contrast, the Occupational Information Network (O*NET), a public source of occupational information maintained by the U.S. Department of Labor that prioritizes creating a framework that can be used across all types of employment, developed a list of only 35 basic and cross-functional skills.¹⁸ The following table, which illustrates the wide range of skills emphasized in selected skillstech providers' libraries, reflects the diversity of approaches and philosophies. On one hand, companies are often proud of the large number of skills that their libraries account for; in other cases organizations choose to emphasize a smaller number, reflecting the reduction to a core or "canonical" set of skills.

Figure 1. Wide ranges of skills referenced by various providers



A key question is to what extent this variation matters. One consensus emerging from our interviews with these providers and others was that the definition of what constitutes a skill, and raw counts of skills, are less important than how well employers are able to make use of skills-based approaches to meet their needs.

18. Peter Q. Blair, Tomas G. Castagnino, Erica L. Groshen, Papia Debroy, Byron Auguste, Shad Ahmed, Fernando Garcia Diaz, Christian Bonavida. "Searching for Stars: Work Experience as a Job Market Signal for Workers Without Bachelor's Degrees." NBER Working Paper 26844, National Bureau of Economic Research, Cambridge, MA, March 2020. https://www.nber.org/system/files/working_papers/w26844/w26844.pdf.

19. Carlos M. Gutierrez (chief marketing officer, Empath), in discussion with the authors, July 2022.

20. David Shaw (job skills & competency solutions subject matter expert, IBM) and Jeffrey Douglas (partner, IBM talent and transformation, IBM), in discussion with the authors, August 2022.

21. "Open Skills Taxonomy," Lightcast, <https://skills.lightcast.io/>.

22. Lisa Simon (senior economics, Revelio Labs), in discussion with the authors, July 2022.

23. "Talent Frameworks," TalentGuard, <https://www.talentguard.com/platform/talent-frameworks>.

24. Vinnie Mirchandani, Workday Skills Cloud update.

EMPLOYERS ARE BEGINNING TO PRIORITIZE SKILLS IN TALENT STRATEGY

Forward-looking research from Gartner has identified that better skills management is among the top three most important human resource (HR) technologies for 2023.²⁵ As skills take center stage, employers are seeking new solutions to support the deeper and more dynamic consideration of skills in three areas:

- **Workforce planning and management.** Strategic workforce planning is becoming a greater priority as the current state of the job market drives a need to better understand the supply and demand of talent and skills in an organization, including the identification of gaps. This is an area where new, more powerful ways to analyze data are especially useful. Workforce planning uses talent inventories to support “build, buy, or contract” decisions, succession planning, performance management – and the emerging world of “talent marketplaces” that enable internal mobility, job discovery, career development, and staffing projects through “gig work.”²⁶ Deloitte frames skills-based talent marketplaces as an agile response to the current business environment, where workers are matched to projects irrespective of reporting lines.²⁷ Workforce planning also extends into reading the external market and understanding the skills and talent supply emerging in a geographic region or demanded by an industry or occupation.
- **Recruiting and hiring.** Talent acquisition remains a major CEO- and board-level priority and a zone of intense competition. Importantly, “skills-based hiring” is one of the most significant trends in HR, with one-third of U.S. employers having made a strategic commitment to the approach, typically in the pursuit of focusing on skills over degrees.²⁸ Recent research from the Society for Human Resource Management (SHRM) found that 79% of HR professionals favor scores on skill assessments over traditional criteria in making hiring decisions.²⁹

25. Sam Grinter, Josie Xing, Hiten Sheth, Eser Rizaoglu, *HR Technology Planning Imperatives for 2023 and Beyond* (Stamford, CT: Gartner, February 22, 2023), <https://www.gartner.com/en/human-resources/trends/hr-technology-planning-imperatives>.

26. Josh Bersin, “The Mad Scramble to Lead the Talent Marketplace Market,” Josh Bersin, February 8, 2022, <https://joshbersin.com/2021/12/the-mad-scramble-to-lead-the-talent-marketplace-market/>.

27. Michael Griffiths, “The skills-based organization: fueling the 21st century enterprise with skills,” Deloitte, September 14, 2022, <https://www2.deloitte.com/us/en/blog/human-capital-blog/2021/skills-based-talent-strategies.html>.

28. Sean R. Gallagher, Employer Post-COVID survey.

29. “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>

- **Learning and development.** Especially in the post-COVID environment, businesses are growing their investments in upskilling and reskilling to sustain competitiveness, support digital transformation, build a more diverse workforce, and retain employees.³⁰ Learning that happens in the workplace is increasingly digital and occurs in shorter episodes of “micro-learning,” rather than being anchored in the construct of a formal “course” or day-long training experience.³¹ Operating at the skill level allows for tasks to be deconstructed more finely and better enables this more frequent, shorter style of “just-in-time learning.”

These use cases represent a few key examples of the new ways organizations seek to utilize skills data, and will continue to evolve as skillstech tools continue to mature and adoption grows.

30. Sean R. Gallagher, Employer Post-COVID survey.

31. Sean R. Gallagher, Rashid Mosley, and Tova Sanders, *The New Landscape for Workplace Learning: Employers and Workers Managing the Digital Transition*, (Northeastern University, October 2021), <https://cps.northeastern.edu/wp-content/uploads/2021/10/Workplace-Learning-Report-1.pdf>.



DATA AND TECHNOLOGY ARE INCREASINGLY DRIVING NEW SOLUTIONS

For many years, the typical process used by organizations to identify skills was to engage in a form of facilitated job analysis, often hiring consultants to create job to skill mappings. This work was time-intensive and expensive. Once skills mappings were created, they were difficult to maintain: managers resisted keeping them updated since they saw this work as an administrative task that did not contribute to the bottom line productivity; HR teams lost interest in chasing after stakeholders; or companies simply struggled to see the value of their investment and abandoned it. The concept of using skills was compelling, but the reality of doing so often fell short of a workable system.

The same technologies that are driving change in skills demand in the workplace are also enabling a data-driven, skills-based view of the world that has not been possible before.

Interestingly, the same technologies that are driving change in skills demand in the workplace are also enabling a data-driven, skills-based view of the world that has not been possible before. As more tasks are performed online, there is more behavior and real-time data to mine for skills insights. One skillstech provider explains, “Most companies are creating data 24 hours a day: working in (Microsoft) Teams, putting knowledge in databases, information about what they’ve been learning and developing.” Additionally, rich data can be extracted from activity occurring in business-to-business transactions. As ecosystems rely on third-party technology platforms to connect supply chains and orchestrate a range of customer services, they are creating a record of company behavior that offers the capability to create a more detailed and dynamic view of how much and what kind of activity is happening. Additionally, data is increasingly accessible through the emergence and popularity of job boards and professional networking sites like LinkedIn, providing even more valuable information on skills trends from user-generated content.

This digitization of information and behavior offers an unprecedented opportunity to forego manual mapping by organizations and consultants and instead benefit from tools that can process real-time, machine-readable information that is continuously updated. Skyhive’s Sean Hinton sums it up best: “Why would we spend a bunch of human time trying to define things that are already summarized through the real-time labor market?” The wealth of data and insights generated by state-of-the-art tools may help us finally deliver on the promise of a more granular view of work that is timely and dynamic, and accurately reflects what is actually going on.

Sources of Skills Data

The ability to collect more information and organize it automatically has only increased the value of skills data for employers. Internal sources of skills data include:

- **Internal personnel documents.** Organizations may utilize internal documents such as progress reports, performance reviews, completed work, memos, and more. These documents may live in an organization's intranet and with the aid of technology, the language is analyzed and parsed, and the skills are extracted.
- **Employee and manager reported skills.** Employees can also self-report what skills they believe themselves to possess. Similarly, managers can report on the skills of their team. Often aided by technology, this method offers the most direct view into a workforce’s skillset.

- **Data from Applicant Tracking Systems (ATS) and other HR platforms.** A subset of internal company data that is particularly rich in skill information can be found in the existing HR systems of a company. Resumes from prospective employees stored in an ATS, for example, are tailored to showcase skills. These prior skills are often combined with new skills that have been manually defined and maintained by managers and the HR team.

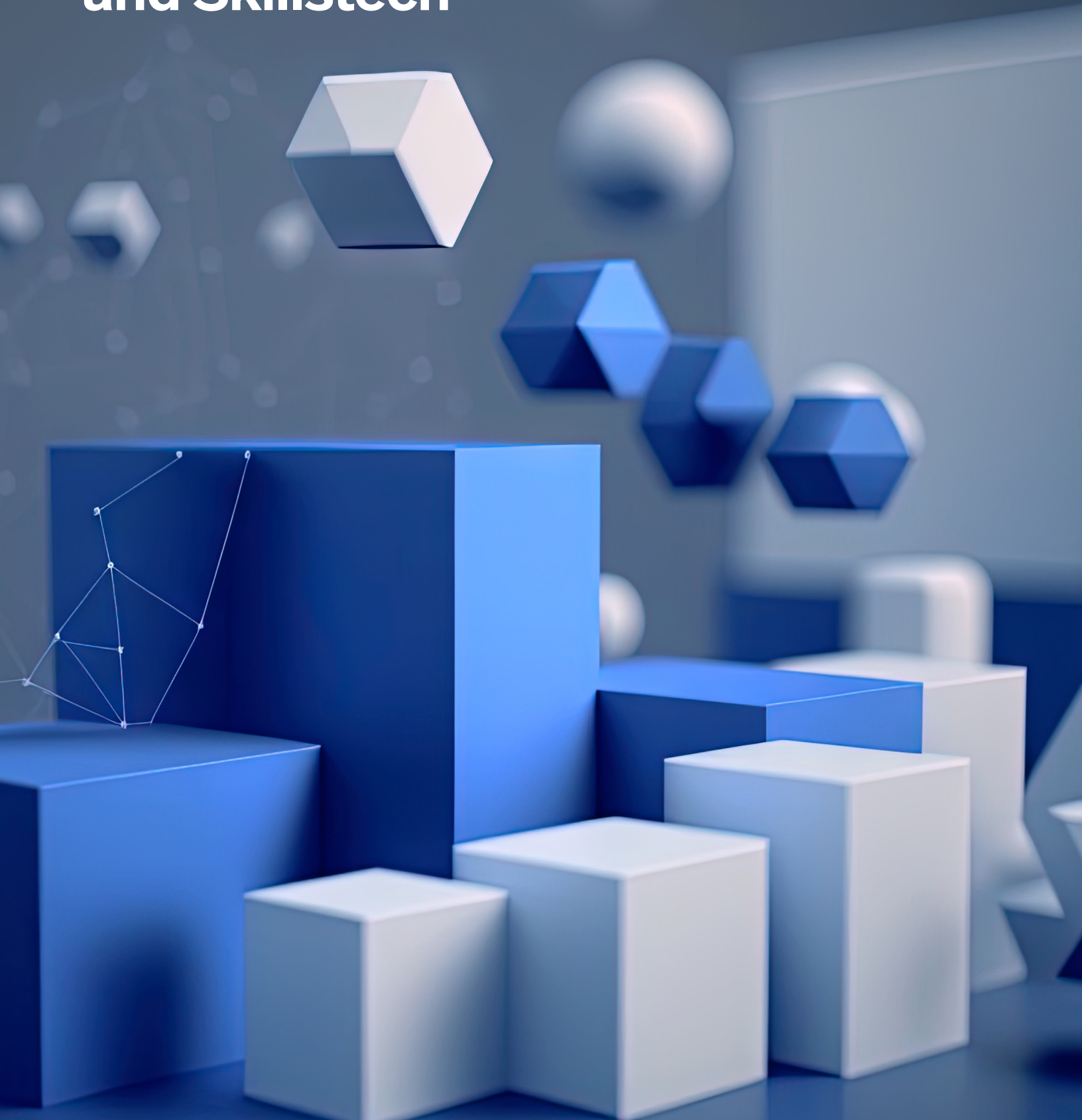
In addition, with the explosion of external data sources, new avenues are opening in the broader marketplace, outside of employer organizations themselves. Key external sources include:

- **Job websites.** As job websites have increased in popularity, they have collected a wealth of information that can be parsed for skills. Several companies regularly scrape job posting platforms for details and language from which a list of skills is extracted. One of the key values of this approach is that it can rapidly identify new skills cropping up in the marketplace as quickly as employers can articulate them.
- **Social profiles.** Just as aggregated listings of jobs online have opened a rich new source of job and skill information, so too has the proliferation of professional sites that facilitate networking. The most prominent of these is LinkedIn. A growing segment of gig worksites in which freelancers share profiles to secure work (especially in occupations such as software development, graphic design, and website development) also provide rich data and signals related to skills. Employees and freelancers post tremendous amounts of information in professional profiles that can be aggregated into a bird's eye view.
- **Macroeconomic data.** Published macroeconomic data offers information that is used by skillstech vendors to place a list of skills into an appropriate context for employers. Augmenting skills with macroeconomic data helps companies understand how jobs are being defined in different regions and industry sectors, and what the competition for skills looks like to anticipate skill shortages or abundance that they can include in corporate planning.
- **Training and assessment providers.** Education providers who deliver certification training in regulated industries and upskilling to professional learners also have a unique aggregated view of skill demand. Similarly, the use of assessment and performance tests among companies with greater than 100 employees has been increasing dramatically – information collected by these companies offers another view of what skills individuals have.³²

Various skills-oriented technology providers are often specializing in and focusing their primary value proposition on optimizing the use of one or two of the sources noted above. However, these vendors are also aware of and, in many cases, actively working to combine inputs from more than one source. Understanding the data sourcing strategy is key to understanding the solutions offered by different skillstech vendors.

32. Tomas Chamorro-Premuzic, "Ace the Assessment," *Harvard Business Review*, August 2015, <https://hbr.org/2015/07/ace-the-assessment>.

Skills Taxonomies and Skillstech



SKILLS TAXONOMIES: CREATING ORDER AMONG CHAOS

The explosion of useful skills data, while incredibly powerful, has also introduced a need for greater sophistication in how the data is organized. The volume and variation in data that can be parsed to identify skills has prompted the development of skills taxonomies in which inventoried skills are arranged into groups based on their similarities and relationships to create order in a potentially overwhelming lake of information. The nature of how a taxonomy is organized is very much a function of how a skill is defined and, given the variation already noted, there can be any number of reasonable ways to organize skills information.

However, much like the notion of creating a taxonomy for species revolutionized biology in the 19th century, work to create a skills taxonomy has typically been associated with the idea of creating a currency: a single taxonomy that is accepted and used by all players in the employment landscape. Foremost among work on this front is O*NET which was originally developed in the 1990s with funding from the US Department of Labor/Employment and Training Administration. O*NET currently contains a taxonomy of 923 occupations in the US, aligned to US government Standard Occupation Classifications (SOC) that form the backbone of most government reporting.³³ Through the O*NET database users can look up the specific knowledge, skills, abilities and other attributes that each occupation requires. Occupational experts and workers from across industries are surveyed in order to update the O*NET occupational descriptors database.

While O*NET offers a common language for the United States, the European Union has created ESCO, a multilingual classification of European Skills, Competences, Qualifications, and Occupations. Available in 25 languages, the system links skills, competencies, and qualifications to specific occupations.³⁴ A more recent effort from the World Economic Forum is the Reskilling Revolution initiative.³⁵ WEF's work is slightly different from the foundational databases created by ESCO and O*NET. Instead of creating its own taxonomy, it builds a composite of the others and is positioned to serve as a "universal adapter" for existing taxonomies.³⁶ The framework was released in January 2021 and includes skill definitions as well as categorizations – skill clusters and groupings at various levels of granularity.³⁷

In addition to government or NGO-sponsored activity, a number of commercial skills tech companies also focus on creating taxonomies. For example, Lightcast, a global leader in labor

33. "About O*NET," O*NET Resource Center, <https://www.onetcenter.org/overview.html>.

34. "ESCO Taxonomy: Classification of European Skills, Competencies, Qualifications and Occupations just released," European Centre for the Development of Vocational Training, European Union, November 4, 2013, <https://www.cedefop.europa.eu/en/news/esco-taxonomy-classification-european-skills-competences-qualifications-and-occupations-just#:~:text=ESCO%20is%20the%20multilingual%20classification,training%2C%20in%2025%20European%20languages>.

35. Ann E. Schulte, "Making Sense of Skills Using the Global Skills Taxonomy," *Career Convergence*, June 1, 2021, https://www.ncda.org/aww/NCDA/pt/sd/news_article/372260/_PARENT/CC_layout_details/false.

36. Ann E. Schulte, Making Sense of Skills.

37. Ann E. Schulte, Making Sense of Skills.

market analytics, has developed a skills taxonomy to create unity across the market.³⁸ Based on real-world data, Open Skills is a taxonomy of over 32,000 skills sourced from user collaboration and gathered across hundreds of millions of online job postings, profiles, and resumes – updated every two weeks. These skills are further organized into 32 skill categories, 400 subcategories, differentiated into 3 skill varieties: specialized, common and certifications.

Another approach among organizations has been to focus less on the actual skills themselves, and instead to define a common format system. These organizations argue that the foremost goal for the skills ecosystem is interoperability and that ultimately it does not matter if there are one or many taxonomies as long as they adhere to some standardization in how skills are represented. Consider universal product codes (UPCs), or barcodes. The information they encode may vary from company to company, but they all adhere to a common format that is utilized worldwide. In the same way, groups like the Open Skills Network (OSN), the T3 Innovation Network, and others are advocating for constructs such as Rich Skill Descriptors (RSD). A rich skill descriptor is essentially the definition of what information about a skill needs to be logged. The format typically includes a unique ID, skill name, skill statement, keywords, alignments to skills in other frameworks, and more. These build on data formatting standards (such as CTDL-ASN and CASE) that enable definitions published by skill authors to be referenceable for a variety of use cases, such as digital credentials, learning pathways and job profiles.³⁹

While the work of groups like O*NET, ESCO, OSN and T3 provide an authoritative response to how skills are defined, they also rely on active participation among a community of stakeholders to determine when and if changes should be allowed to the data element format or if new skills should be added to the “master” list that each group maintains. The burden and relative slowness of shared governance must be balanced against the benefit of having a single universally accepted view. Indeed, the reality appears to be that many skills-based vendors serving HR needs consider the currency taxonomies not as the end of the work but rather as the starting point. Input from one of the taxonomy creation organizations is then modified to meet the particular demands of a given client.

38. Open Skills Taxonomy, Lightcast.

39. “Rich Skill Descriptors,” Open Skills Network, <https://www.openskillsnetwork.org/rsd>.



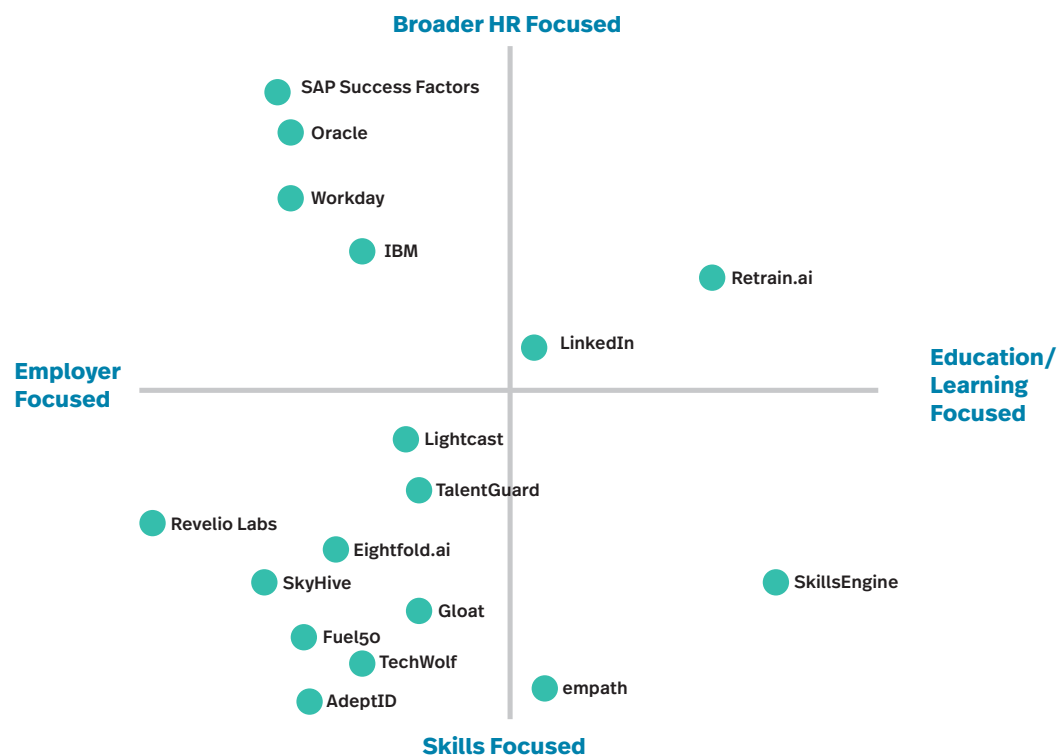
THE EMERGING LANDSCAPE OF “SKILLSTECH” PROVIDERS

The ecosystem of skills technology tools is growing quickly, bringing opportunity and perhaps confusion about the number of new and existing providers on the market – in particular what products they offer, who they serve and what their purpose is. The providers mentioned in the following analysis do not necessarily reflect every company offering skillstech solutions but instead serve as a representative sample for our analysis. Additionally, the following discussion does not seek to name every product offered by each organization.

While innovations related to the analysis and management of skills have been percolating for decades, there has been an increase in activity in the last 10 years, coinciding with many workplaces transitioning to software solutions for organizational management. Veteran provider Lightcast, through its predecessor organizations Burning Glass Technologies and EMSI, has been collecting skills data for more than 20 years. Beginning around 2010, other providers joined the market including but not limited to TalentGuard (2014), Fuel50 (2011), Gloat (2015), SkillsEngine (2015), and Eightfold.ai (2016). In the last five years, the number of providers has grown significantly with, for example, the launch of new startups – SkyHive, Revelio Labs, TechWolf, AdeptID, and Empath – as well as large human capital management software companies, job boards, and other enterprise technology companies such as Workday, SAP, LinkedIn, Oracle, and IBM launching their own tools.

When considering the landscape of providers, Figure 2 represents one of several possible ways to visualize organizations operating in skillstech in terms of two basic dimensions.

Figure 2. Selected providers in the skillstech landscape



Along the x-axis, providers are plotted based on whether the core focus of their skills solutions is on employers (on the left) versus education and learning (on the right). As reflected here, most of the providers in our analysis have an employer focus.

The y-axis reflects the degree to which providers have a broader HR focus, at the top of the graphic (consider the major ERP/HRIS providers who have added skills intelligence to their capabilities), versus if the focus of the organization and its products is skills-centric, at the bottom of the graphic. This illustrates the full spectrum of players in this market ranging from companies whose main focus is offering a broader HR suite or related services, to those that are often standalone companies or products focused principally on skillstech.

The purpose of this illustration is not to render judgment on if there is any “best” position in the landscape, but rather, to show differences in specialization and customer focus as just two descriptive dimensions across this wide range of companies. The exact placement of the companies is of course open to interpretation.

As the skillstech market evolves, we expect to see more enterprise HR platforms adding skills intelligence to their offerings; new start-up entrants focused on point solutions for skills; and more providers beginning to bridge the gap between employer-focused HR/talent solutions and learning by serving educational institutions and professionals.

Companies that actively compile market level information include SkyHive, Revelio Labs, AdeptID and Lightcast.

SkyHive helps many of the largest companies and governments in the world transition from job-based to skill-based and markets its “quantum labor analysis” methodology that continuously collects and analyzes millions of real-time labor market data points.⁴⁰ Based in Vancouver, BC, SkyHive was recognized by the World Economic Forum as a 2021 Technology Pioneer and in that same year raised \$40 million in Series B funding.⁴¹ In addition to providing labor market data, SkyHive offers a variety of individual career tools, including the Skills Passport which identifies an individual’s career pathway, helps find learning and development opportunities, and recommends job opportunities.⁴²

Startup company Revelio Labs collects, assembles and studies labor market and skills data to produce trend reports utilized by investment companies and corporate strategists. Founded in 2018, Revelio tracks headcounts, inflows and outflows at the occupation, location, seniority, education, gender, and ethnicity levels across companies.⁴³ Meanwhile, AdeptID helps organizations identify and match talent. With customers like Year Up and Multiverse, AdeptID works with workforce and training organizations to uncover underlying skills within talent pools and create personalized learning pathways, especially for underrepresented populations.

40. “Labor Market Intelligence,” SkyHive, <https://www.skyhive.ai/products/lmi>.

41. Iris Dorian, “SkyHive pockets \$40m Series B funding led by Eldridge,” *Venture Capital Journal*, October 20, 2021, <https://www.venturecapitaljournal.com/skyhive-pockets-40m-series-b/>.

42. “Skill Passport,” SkyHive, <https://www.skyhive.ai/products/skill-passport>.

43. Kyle Wiggers, “Revelio Labs raises cash to scrape the public web for HR insights,” *TechCrunch*, October 6, 2022, <https://techcrunch.com/2022/10/06/revelio-labs-raises-cash-to-scrape-the-public-web-for-hr-insights/>.

Lightcast, one of the largest providers of workforce data, was created through the merger of Burning Glass Technologies (founded in 1999) and EMSI (founded in 2000).⁴⁴ Lightcast's database of more than one billion job postings and career profiles covers more than 99% of the workforce, available by state, metropolitan-statistical-area, county, and zip code.⁴⁵

At the other end of this spectrum, nonprofit initiative SkillsEngine was founded to help postsecondary educators demonstrate curriculum-to-employer alignment at scale, while enabling a common skills language and knowledge-share across educators, employers and individual job-seekers.⁴⁶ Specific to educators, SkillsEngine enables skill validation directly with employers and assists education providers in aligning their curriculums with these requirements.

In between these companies, there are a host of providers who work with or augment basic skills data and connect it to practical uses for companies. These providers range from large full-stack platform companies like SAP and Workday to smaller companies with clear perspectives on how skills build into varied, existing HR applications.

Established in 2018 in Belgium, TechWolf is an API-first provider that extracts and interprets skills from unstructured data in order to help companies understand the skills of their workforces.⁴⁷ TechWolf utilizes AI to automatically monitor employee skills based on HR and their digital footprint to understand gaps in employee skills and future skill needs. TechWolf is compatible with a variety of HCM providers including Workday, Oracle, ADP, SAP SuccessFactors, and more.⁴⁸ Empath seeks to help companies identify what skills their employees have and optimize career pathways, recruitment, and retention. Empath offers organizations a company-wide skills inventory that includes skill proficiency levels by employee and job role.⁴⁹

TalentGuard, founded in 2014, markets its ability to give a clear, actionable view of a workforce's skills, roles, and pathways. Through its platform, TalentGuard unlocks insights on employee skills and potential so employers can effectively support upskilling, reskilling, career development, performance management, succession planning, and more. TalentGuard's Workforce Skills Intelligence Platform offers a library of skills across 3,000 job profiles and 19 core industries for customers to leverage and tailor to their organization. Through its Intelligent Role Studio, TalentGuard utilizes AI and machine learning to help develop and dynamically maintain a model of a company's career architecture to help better match people with roles, design career paths, and assess talent consistently.⁵⁰

44. Burning Glass Technologies, "Burning Glass Technologies and Emsi Announce Merger to Provide Deeper Labor Market Insights and Advance Workforce Development," *BusinessWire*, June 14, 2021, <https://www.businesswire.com/news/home/20210614005192/en/Burning-Glass-Technologies-and-Emsi-Announce-Merger-to-Provide-Deeper-Labor-Market-Insights-and-Advance-Workforce-Development>.

45. "Lightcast Data," Lightcast, <https://www.datocms-assets.com/62658/1656098194-about-lightcast-data.pdf>.

46. "About Us," SkillsEngine, <https://www.skillsengine.com/about>.

47. "How does TechWolf Work?" TechWolf, <https://techwolf.ai/how-does-it-work>.

48. "How does TechWolf Work?"

49. "Empath: Know the Skills of Every Employee," Empath, <https://www.empath.net/>.

50. "Intelligent Role Studio," TalentGuard, <https://www.talentguard.com/platform/intelligent-role-studio>.

Workday Skills Cloud and SAP SuccessFactors are two of the largest software providers that incorporate skillstech into their platforms. Workday, the cloud-based enterprise software management system, is considered the #1 human capital management provider, with about 13% of the market share and more than 9,500 customers, while SAP is in the #2 spot.⁵¹ In 2018, Workday launched Skills Cloud, a skills data ontology that breaks down the components of what makes up a skill and organizes these components by category. In 2022, Workday introduced skills interoperability – the process of normalizing skills data from external sources into the Workday platform.⁵²

In 2012, SAP acquired the human capital management company SuccessFactors, which ultimately became SAP SuccessFactors, offering a cloud-based Human Experience Management Suite with a variety of products covering talent management, HR analytics, workforce planning, HR and payroll management, and employee experience management.⁵³ Within this suite, employees have access to a framework of skills and competencies through the Talent Intelligence Hub which provides a searchable system of record for cataloging skills. Consisting of two main components, the Attributes Library stores a listing of all capabilities (skills, competencies, attributes) that are important to an organization while the Growth Portfolio manages which particular skills and competencies are assigned to individuals or job roles.⁵⁴ Capabilities are assessed via a performance form and each capability has a predetermined proficiency rating scale.

The descriptions above capture a number of the key players in the skillstech landscape – and one of a number of potential ways of describing their focus and products. In the following section, we turn our attention to the key issues in this landscape and conclusions of our analysis.

51. Josh Bersin, "Update From The Workday Innovation Summit: Lots Of Growth Ahead," Josh Bersin, April 17, 2022, <https://joshbersin.com/2022/04/update-from-the-workday-innovation-summit-lots-of-growth-ahead/>.

52. David Somers, "How Workday Is Delivering Next-Generation Skills Technology at Scale," Workday Blog, September 13, 2022, <https://blog.workday.com/en-us/2022/how-workday-delivering-next-generation-skills-technology-scale.html>.

53. "What are SAP SuccessFactors solutions?" SAP, <https://www.sap.com/uk/products/hcm/about-successfactors.html>.

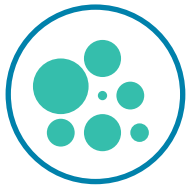
54. Jacqueline Prause, "SuccessConnect 2022: Together, We Can Change Work for Good," SAP News Center, September 16, 2022, <https://news.sap.com/2022/09/successconnect-2022-together-change-work-for-good/>.



Key Conclusions and Implications



In the preceding discussion, we have reviewed the case for employers' and others' growing focus on "skills," and described the current landscape of skills taxonomies and skills solutions providers with attention to how this space is evolving. In the analysis that follows, we present several thematic conclusions, recommendations, and considerations for the future that emerged from our research.



1. The creation of one universal skills taxonomy appears to be an unrealistic scenario. Instead, organizations in the skills solutions market are focused on developing tools that are contextual and adaptable. Industry- and occupation-specific taxonomies are expected to be especially important.

Given the investment by some government organizations in creating standards, it might be expected that many of the new startups in skillstech would be focused on producing their own skills frameworks that could be adopted as the industry standard. However, company leaders and other experts interviewed for this study almost universally dismiss the idea of developing a singular, authoritative skills taxonomy across all occupations. AdeptID co-founder and CEO Fernando Rodriguez-Villa aptly labels this quest "quixotic." Indeed, even government and nonprofit efforts recognize that, while their work is important to establish basic connective tissue, it is not sufficient to truly serve the complex, dynamic, and diverse needs of successfully operating companies. Jeroen Van Haute, co-founder and chief technology officer of TechWolf explains that "while trying to create one shared language for everyone, you ultimately create a language that is useful for almost no one."

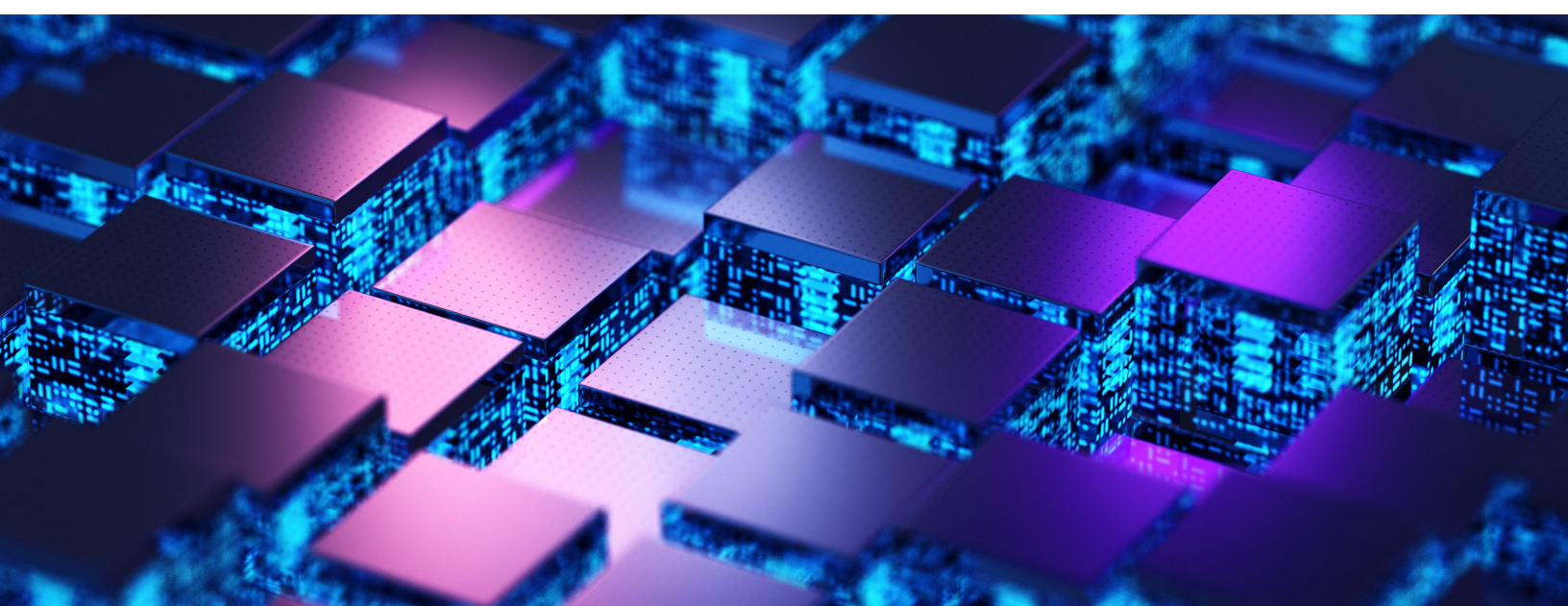
Instead, companies operating in the skillstech market often gear their products around a few key open frameworks and datasets as a starting point (with O*NET, Lightcast, and ESCO cited repeatedly in our research) and make modifications as needed in accordance with their customers' unique needs. As a result, many skillstech companies are building architectures that allow clients to incorporate data signals from a variety of internal and external inputs, optimized for their own needs – effectively creating a host of proprietary skill inventories.

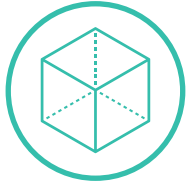
Another significant reason why one single skills taxonomy is proving unrealistic is the wide variation across industries and the lack of utility of a one-size-fits-all taxonomy relative to the special needs of individual industry verticals. For example, AdeptID noted that even though its skills taxonomy was used by a consulting company specializing in supporting factory owners, the downstream provider nonetheless employed data scientists and offered their own additional input into an ideal understanding of skills in that space. Consider engineering skills: while some skills are common across all engineering types, skills needed by an engineer programming robots for manufacturing are different from those needed by an engineer working on financial services software. One provider noted that while conducting research on skills, they found more than 100 different industry-specific skill libraries. This is particularly true for regulated industries where employees are required to maintain certain – often safety-related – skills that need to be tracked in very specific ways. Skillstech provider, TalentGuard, summed it up most succinctly, "there are too many industries for any one vendor to own a monopoly on profiles."

Finally, in addition to the push from end users, the dynamism of the market would suggest that consolidation around a single universal taxonomy is becoming increasingly unlikely. As noted earlier, one of the most significant challenges in developing a universal skills taxonomy – and perhaps a marked shift in just the last 5 years – is the pace of skills and job change. A group of authorities or a panel of experts cannot manually analyze information, come to a consensus, and publish a universal framework quickly enough to keep pace. Instead, machine learning models are being developed that enable the updating of skills data in real-time. The relative ease for any company to develop its own machine learning model makes it that much harder for a consensus leader to emerge.

As a result of these dynamics, it appears almost certain that adaptable solutions yielding many proprietary taxonomies are the future of skillstech. And, practicality aside, there is potential competitive advantage for both clients and skillstech providers that is driving the current state. Proprietary skills understanding allows providers to differentiate themselves. Employers see their own particular view of talent management as part of their competitive advantage. For example, their hiring practices encode a perspective, developed from experience with past hires, regarding which skills matter most to drive success. This perspective is not translatable from one company to the next and it may go against a company's own interests to want to broadcast their hard-earned learning broadly. Without dramatic changes in market incentives, this situation is likely to continue.

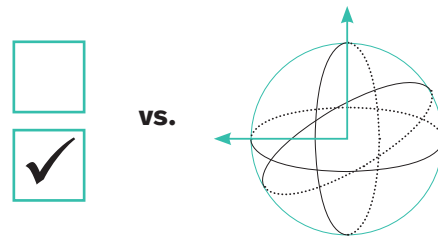
The high likelihood that multiple taxonomies will continue to exist means, in turn, that skillstech companies are prioritizing the development of tools that allow for crosswalks between published lists. As David Ludlow of SAP SuccessFactors calls out, “The question is still open as to how all these ontologies and taxonomies are going to come together.” As a counterpoint, however, some skillstech companies believe that startup firms and tools focused on specific industry verticals will remain viable and are most likely to emerge in the sectors and occupations that are seeing structural disruption and major shifts in skills needs. These include for example, the energy, automotive, finance, and telecommunications sectors, to name a few. Notably, this deeper focus on the skills, competencies, and bodies of knowledge needed to perform in specific industries and occupations is similar to the work of educational institutions, industry associations, and other groups that drive specialized credentials and assessments.





2. Many organizations are increasingly thinking of skills as multi-dimensional – shifting the dialogue beyond simple and static keywords to instead focus on skill clusters, proficiency, and validation.

Figure 3. Conceptual Illustration: Toward a Multi-dimensional View of Skills



Historically, the discussion in the marketplace about skills frameworks and taxonomies has revolved around simple, relatively static lists of skills – and the essentially binary idea that someone either has a skill or not. In practice, this appears too limited. Companies are finding a need to fill in data gaps. The grouping of skills into clusters is often required to capture the full scope of what is needed for a role, as well as infer what skills are present with an individual. Clustering is also a useful technique to make skills information truly understandable to end users. And finally, the presence of a skill in a profile may not reasonably imply that an employee possesses the level of skill mastery required.

Most taxonomies provide foundational skill definitions, but without additional context and detail, cannot fully benefit from the promise of skills-related technologies. Lightcast vice president of strategy, skills, and people analytics Mark Hanson argues that “a skill term does not mean anything in isolation; you need context – you have to attach it to a job, to learning, to other groups of skills – then that rich definition starts to emerge and provide value to what that skill term means.” Skills clustering – grouping skills and summarizing them with a cluster name – can help add rich dimensions to skills data. It also can aid end-users who may be overwhelmed by long lists of skills. TechWolf, for example, found its customers might say, “this is amazing but I actually get scared when I open the dashboard and see how many different skills we have.” As a result of this, TechWolf worked to form skill clusters, moving from thousands of skills to 200 or so skill groups that provided bigger building blocks for customers to grasp.

While creating clusters can deepen understanding of what skills actually refer to in a given context, clustering can also help fill in missing information for individual employees. Revelio Labs, for example, uses machine learning models to cluster skills based upon co-occurrence found from social media website profiles. Once they have built an understanding of what skills tend to appear together in a given role or what sets of skills tend to be associated with a certain educational path, they can create profiles of the skills an individual is likely to have. Similarly, Empath creates job profiles from direct signals in customer data and augments them by inferring what might be present for each specific employee given skill constellations known about other, similar employees. The

value of this approach, according to Empath, is that inference seems to be finding that people “have” more skills than they would otherwise think: while most people will claim to have roughly 4-5 skills, the actual number is often closer to 30. In addition to inferring missing content, Empath employs techniques to align similar but slightly different expressions of the same content. They use a “semantic topic vector” approach to determine if employees have skills even if the specific lexical items used to describe a skill, such as “cost management,” don’t exactly match the term used to encode it in the taxonomy, say “budget control” words in the skill name and description are not in the data that is being analyzed on the employee.

Beyond clustering, several skillstech providers agree that assigning proficiency levels to skills is valuable. However, this can be particularly hard. In fact, there is not yet agreement on even the number of levels of proficiency a skill should have – e.g. beginner, intermediate, advanced or beginner, advanced beginner, early intermediate, advanced intermediate and so on. That said, without proficiency levels, companies lack a holistic view of their workforces and are at risk of miscalculating talent decisions. For example, an individual with basic graphic design skills is significantly different from one at the expert level. Several technology providers who offer skillstech solutions have already undertaken the process of articulating proficiency levels and offer tools for organizations to help assess their employees in order to assign these levels. Considering deeper dimensions related to “skills” and moving toward frameworks and databases that can account for proficiency is an important direction.

Finally, skill validation represents another important dynamic in the world of skills technologies. One major issue with current skills solutions is that they often rely heavily on self-reported data, such as the information in individuals’ resumes, or lists of skills in professional profiles. Many providers and others in the ecosystem would value validation from trusted sources, which would also improve the reliability of algorithms and models. It is worth noting that educational institutions are traditionally the gatekeepers of meaningful proficiency validation for employers, and that traditional assessment processes could have a role to play. Further, with agreement on common standards, mechanisms for skill validation – including those related to digital credentials and learning and employment records – could also lead to entirely new business models from entities focused on this opportunity.



3. It is early in the still evolving skillstech landscape. The development of this market is expected to include new entrants, potential consolidation, and continued work to integrate with other HR systems.

Although the potential of identifying skills in talent management has obviously been around for many years, it is important to note that it is still quite early in the development of a “skillstech” market and dedicated set of tools and providers. At the same time, employers’ growing interest in organizing work and talent strategy around skills-driven applications suggests that this space will be fueled by a potential influx of venture capital and corporate R&D investment as well as continued

experimentation with new tools and techniques. The current groundswell of excitement in 2023 about machine learning and AI may lead many software companies and employers to realize that the talent and skills domain is an underleveraged area ripe for data mining and new insights. In addition, the evolution of the skillstech market is likely to be driven by – and is a key infrastructural piece for – new investor and regulatory mandates for human capital measurement and reporting.⁵⁵

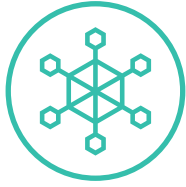
It seems reasonable to expect that large enterprise software providers as well as new startups will continue to enter the skillstech space. As is natural in most software markets, the acquisition of smaller firms by larger players is likely, with some consolidation in the adjacent HR technology, workforce, and corporate learning domains already occurring. But such an active flow of new offerings suggests that – much like the market isn’t coalescing around a single taxonomy – it will take some time before there are true category leading companies.

The lack of a single clear leading provider in skillstech is not new to professionals in the HR space. Many interviewed skillstech providers mentioned that sorting through and connecting with the jumble of HR systems that their employer clients have (in one example 20-30 different applications) is a major part of their work. Talent mobility, learning, external hiring, and other HR use cases can be very different – and employers can be expected to continue to purchase best-of-breed solutions for each. Given that, vendors who specialize in working with internal employee and skills data often operate under the expectation that part of their core competency is to consolidate and normalize data from siloed applications.

A skills-based view of work and corporate strategy cannot be isolated, and realizing the potential of skillstech requires integration with other enterprise systems. SkyHive’s Sean Hinton notes, “A few years ago HR went all-in on investing in applications, but the issue is these applications don’t speak to each other, and therefore cannot provide a unified talent architecture that commonly defines jobs and skills across the organization.” Since vendors are actively building their core competencies around this expectation, we can reasonably expect that this support for a best-of-breed strategy among clients will remain fairly stable for the near term.

As the skillstech ecosystem evolves, there is a longer term opportunity to think about the complementary solutions, standards, and architecture that make up a talent-related “stack” of tools and applications, as is the case in other business functions. AdeptID CEO and co-founder Fernando Rodriguez-Villa describes how they envision talent tools will evolve over time, “the way that the financial services tech stack and the advertising tech stack has over time migrated from being one all-in solution to category winners at different layers of the stack... we predict aspects of the talent industry will evolve in a similar way.” It is possible that skills-focused applications will provide the data elements that drive the development of a broader talent architecture: getting “skills” right creates a crucial foundation for a wide array of talent use cases.

55. Sean R. Gallagher, Curtis Odom, Emilee Trieckel, and Monica Borgida, *Human Capital Measurement and Reporting: The New Frontier in Talent Strategy and ESG* (Northeastern University, January 2023) <https://cps.northeastern.edu/wp-content/uploads/2023/01/Human-Capital-Measurement-and-Reporting.pdf>.



4. Establishing an architecture for skills portability and data consistency can benefit all stakeholders.

The emerging nature of “skillstech” as a category of solutions provides an opportunity for all stakeholders with an interest in this space – including technology companies, educational institutions, non-profits, government leaders, and others – to thoughtfully consider and begin to work together on how these technologies and skill models interface and connect to the bigger picture of talent and economic mobility. Such collaboration creates opportunities to support individuals as they move from job to job, and assures that different kinds of companies are all represented in how the technology develops. Certainly employers themselves stand to benefit greatly from a talent market that features greater skills portability: if workers came to the table with clearly defined, comparable, and shareable data on their skills, this could create tremendous efficiencies in the hiring process, training, and other areas related to talent and operations.

While employers and skillstech companies will continue to develop their own proprietary taxonomies, the idea of building a broader “open skills” ecosystem is an important aspirational goal given the scale of the skills challenge and the hundreds of millions of individuals in the talent marketplace in the U.S. The need to grapple with driving meaningful employment in a world facing continual and increasing disruption is one of the most profound demands of the 21st century. An important element of meeting this demand is developing ways in which workers' experience translates to new opportunities or is continuously expanded from one job to the next. To accomplish this, we need to both define mechanisms to track skill development over the course of a career as well as identify where a skill that applies in one domain may meaningfully be valuable in another, an application that is expected to become more important as technological disruption makes existing jobs obsolete. These two concepts together are captured in the notion of “skill portability.”⁵⁶ Nonprofit suppliers of public skill taxonomies have always held this as an objective. For individuals' skills to be verifiable, comparable, and portable, there must be greater coordination across all parties and agreement on basic standards. Many experts working in the related areas of digital credentialing and learning and employment records (LERs) share a vision of a learning ecosystem and talent marketplace that is driven by machine-readable verifiable skill attestations and endorsements, and where these records are controlled by the worker.

Importantly, there are non-profit organizations such as the U.S. Chamber of Commerce Foundation's T3 Innovation Network, Credential Engine, the Open Skills Network, 1EdTech, and others, who are developing some of the appropriate tools, open data standards and exchanges to address the public good of assuring skill portability for individuals. For example, Sarah DeMark, Interim Provost at Western Governors University and Interim Executive Director of the Open Skills Network (OSN) describes their efforts as being “focused on establishing a common skills syntax that can be leveraged across all of these different technologies and systems that are trying to piece together across hiring and education. There has to be a common language to make all of these communication points connect, and work, and be powerful.”

Another value of embracing some notion of open standards – and a key contribution offered by nonprofit and government groups – is ensuring stakeholder representation of employers with less

56. “Portability of Skills,” International Labour Office Governing Body, Committee on Employment and Social Policy, March 2007, https://www.ilo.org/wcmsp5/groups/public/@ed_norm/@relconf/documents/meetingdocument/wcms_gb_298_esp_3_en.pdf.

economic clout. Half of Americans are employed by small and midsize companies. However, a reality of the current skills solution marketplace is that the anchor clients of the commercial skills solutions providers are typically larger, Fortune 500 companies. The clear skew of who is funding development of skills-based applications means that large companies play an outsized role in defining the focus of that development.⁵⁷ The economics of a skills-based platform may be such that nonprofit and government groups need to step in to ensure input from potentially underrepresented stakeholders.

Finally, for all employers and the skillstech firms who support them, there is efficiency to be gained from leveraging a freely available open taxonomy. This reduces some of the initial investment in creating client-specific solutions, which is good for both the employer client and the skillstech provider. Happily, it also offers a minimum level of generalizability across all of the specific implementations. Our interviews suggest that there is enough value offered by the work of organizations promoting open standards that commercial providers will continue to take advantage of their work product. At the same time, we suspect that there will be continued tension with respect to how players in the skillstech ecosystem balance the needs of private companies with the public good.



5. The growing application of AI and machine learning to talent and skills demands greater attention to ethical and responsible use and ensuring high quality data.

Artificial intelligence (AI) is not new, but it is now spilling over into the public sphere with tools such as ChatGPT and Dall-E being in the media and attracting greater attention, adding new energy to the idea of applying AI in the talent domain. The use of these new types of tools presents great opportunities for HR leaders, but can also bring unintended consequences. As such, scrutiny is necessary, in particular around ensuring ethical and responsible AI use.

Recently, New York City adopted a law making the use of automated employment decision tools (ADETs) unlawful unless certain requirements intended to reduce bias are met.⁵⁸ While uncertain, it can be expected that other jurisdictions will adopt similar policies as research continues to find that AI products can be inherently biased unless otherwise mitigated.⁵⁹ Fernando Rodriguez-Villa of AdeptID explains that, “any time you’re training a model based on historical outcomes, you have to be wary of perpetuating bias that’s inherent in those outcomes. We’ve been looking at that carefully from the start. We have a three-layer approach to applying AI ethically which involves mitigating bias, managing systematicity (correlated errors) and handling governance.” Most of the skillstech organizations we interviewed leverage AI and machine learning to some extent and are building sensitivity to the potential pitfalls of AI into their data sourcing, model management or system design.

57. Theo Francis, “Why You Probably Work for a Giant Company, in 20 Charts,” *Wall Street Journal*, April 6, 2017, <https://www.wsj.com/graphics/big-companies-get-bigger/>.

58. Sharon Perley Masling, Leora Grushka, and Carolyn M. Corcoran, “NYC Postpones Enforcement of AI Bias Law Until April 2023 and Revises Proposed Rules,” Morgan Lewis Law Firm, January 9, 2023, <https://www.morganlewis.com/pubs/2023/01/nyc-postpones-enforcement-of-ai-bias-law-until-april-2023-and-revises-proposed-rules/>.

59. James Manyika, Jake Silberg, and Brittany Presten, “What Do We Do About the Biases in AI?” *Harvard Business Review*, October 25, 2019, <https://hbr.org/2019/10/what-do-we-do-about-the-biases-in-ai>.

At their simplest level, AI models find patterns in data. Some take unorganized data and organize it into groups – e.g. that certain skills are often found in people doing a specific job; other models are trained with known input-output patterns so that they can evaluate novel input and predict the corresponding output, e.g. employees with a given set of skills will do well in a given job. Given that they are fundamentally data processors, it becomes apparent that the power of AI is very much a function of the quality of the data it has to work with. Problems with data quality are first among the culprits of biased results in skillstech. For example, Revelio Labs knows that skills data in social media portals like LinkedIn represents “white collar” industries better than others. To combat this, Revelio Labs corrects for sampling bias by reweighting the data to be representative of the entire workforce. They also actively collect source data from industries under-represented in online profiles, such as job postings. Another concern is using data that encodes outdated patterns, resulting in models perpetuating the outdated patterns. Many skillstech firms are attuned to these issues and are actively combating them.

It is also interesting to note that the example of the New York City law indirectly identifies another concern about bias. The law was revised to ultimately define automated employment decision tools (AEDTs) as any process “derived from machine learning, statistical modeling, data analytics, or artificial intelligence, that issues simplified output, including a score, classification, or recommendation, that is used to *substantially assist or replace discretionary decision making*.”⁶⁰ The idea that human discretion is an important component in talent management and one that should not be lost is also reflected in how many skillstech companies have designed their systems. Rather than train a biased model and then remove the bias later, some companies have designed their systems to allow customers full control over the data at all points in the process. These are just some examples of how skillstech companies are being thoughtful about the use of AI. In addition to bias-related concerns with AI and its underlying data, some experts feel that there is simply not yet enough of a volume of skills data to train AI models, which are only as good as the data they are trained on. This is an important consideration as this space continues to grow.

Finally, although not a new topic, data privacy is another consideration which has achieved fresh urgency given the rapid growth of AI, especially in its application to talent strategy. There are concerns about the amount of data that AI can collect on a candidate while analyzing their video interviews, assessments, resumes, LinkedIn profiles, or other public social media profiles. In the European Union, which a number of years ago passed the General Data Protection Regulation (GDPR), companies are also required to tell individuals what personal information is being collected and stored, and how it is being used.⁶¹ Offering individuals the opportunity to curate their own data is another way to assure some level of oversight by human beings, in line with the concerns addressed in the NYC law. Of course, these types of concerns and opportunities related to personal information and AI are not unique to human capital data and the HR landscape – but the application of AI to this domain does require special attention and sensitivity.

60. Sharon Perley Masling et al., “NYC AI Bias Law”

61. Peter Church, “AI & the GDPR: Regulating the minds of machines,” Linklaters, <https://www.linklaters.com/en/insights/blogs/digilinks/ai-and-the-gdpr-regulating-the-minds-of-machines/>.

CONCLUSION

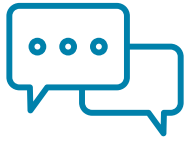
It is an exciting time in the skills landscape, with the development of many new tools, datasets, and companies. Many new players are driving new opportunities and established players are evolving their offerings based on clear market feedback. The result is an ecosystem that is not yet fully defined but also one that is rich with opportunity for users, providers and public policy makers alike. We hope that this report has offered insight on the key trends and themes in the evolving skillstech landscape that will encourage greater adoption as well as stronger focus and alignment on how skillstech continues to evolve.

Panning back, we want to emphasize that the adoption of “skillstech” is still in an early stage. As employers consider skills-based talent management, many of the providers offering skills-based solutions caution that embracing skills in workforce decisions is like embracing any other shift: it should be conceived of as a change management problem. Michael Bettersworth, CEO of SkillsEngine and Senior Vice Chancellor of Texas State Technical College, cautions, the “most critical thing is not the technology, it’s the culture.” Similarly, Jason Tyszko, with the US Chamber of Commerce Foundation, says this about the human aspect of change, “if you give frameworks to companies they might not use them – you have to do the human change management piece first - to become users of the frameworks and integrate them into jobs.”

And as with any change, the more successful companies will have a clear understanding of the outcomes they want to drive. Within companies, there should be a strong alignment between personal motivations and corporate objectives. Within the corporate talent function, focusing on “skills” is a trendy topic – especially when considering the opportunities for technological innovation. However, solutions providers and other experts that we interviewed consistently emphasized the importance of carefully linking skills- and skillstech to broader business objectives, rather than focusing on skills for the sake of it. Employees may have concerns about data collection and use that are best addressed by clear definitions of the value proposition for them.

Very practically, a key part of our inquiry into skillstech involved exploring how easy or difficult it might be for employers to “get started” with these diverse technologies and approaches. Many skillstech providers described how they manage client engagements by mapping internal job titles and definitions to those in their own taxonomy. Linda Ginac from TalentGuard explains, “There are systems like ours that are loaded with current jobs and skills data that allow you to begin right away with minimal effort. But if your organization prefers to start from scratch, a list of your organizations’ job titles can get you off the ground.” This accessible approach should offer assurance to interested companies that the bar to engage is not out of reach.

The comfort that skillstech providers appear to have in successfully serving employer clients across a wide range of sizes, industries, and levels of readiness (from simple to more advanced) speaks to the sophisticated data management tools that these firms have created and are continuing to develop. The time to address the challenges and harness the opportunities of skillstech is upon us!



KEY QUESTIONS FOR STAKEHOLDERS TO CONSIDER

Employers

- How would a focus on "skills" benefit the business and help us to achieve our short-term goals and longer-term vision – and is there a strong enough business case for a shift toward a skills strategy?
- Within our talent strategy, how broad or narrow is our vision for where skillstech might apply – e.g. in workforce planning versus talent acquisition or training?
- Independent of technology capabilities, is my organization prepared to make the cultural shift to a focus on skills?
- What is the current state of our talent-related artifacts and skills data: is it accessible or organized enough to be analyzed?
- How unique are the skills dynamics and needs of our industry – including potential regulatory compliance requirements?

Educational Institutions

- How does our curriculum and course outcomes map to widely accepted skills taxonomies?
- Do we have systems in place to track skills changes in the workplace and “tune” our curriculum to new developments in the job market?
- What future role might we be able to play in evaluating skills proficiency or validating skills developed elsewhere?
- How might we utilize new skills technologies to help students better articulate and communicate their acquired skills to employers?
- Are our systems of record prepared for a more skills-centric future – for example, can our prior learning assessment (PLA) processes account for using external skills data and artifacts?

Policymakers

- How might efforts to build universal skills taxonomies be refocused on the needs of specific industries and occupations?
- What can we do to better assist organizations using skills to balance their individual needs with public good needs?
- How can we motivate and empower key stakeholders to better collaborate in order to address shifting skills demands?
- What can be done to represent the interests of individual workers in employer-driven skills initiatives, including the potential enablement of portable skills records controlled by the individual?
- To what extent can our policies encourage attention to skills-related data privacy, and addressing potential issues related to algorithmic bias?
- What is our role in ensuring that all stakeholders, not just large organizations, have a voice in the development of shared skills systems?

Technology Firms

- What are our strategic assumptions about how the “skillstech” sector will evolve, relative to HR technology in general?
- What new business models does the growth of skillstech present, and how should this be balanced with the demands of the broader ecosystem?
- To what extent, and how, can we contribute to the development of shared standards and collaboration with technology sector peers?
- How do we think about skills data management vis-a-vis integrating sources and allowing use of information from multiple sources?
- How can HR Tech better align with Ed Tech in the developing skills ecosystem that spans these sectors?

APPENDIX A. INTERVIEW PARTICIPANTS AND ACKNOWLEDGEMENTS

Interview Participants

Michael Bettersworth, SkillsEngine
Sergey Bukharov, SkyHive
Anthony Campagnano, TalentGuard
Melissa Clark, Open Skills Network
Brian DeAngelis, AdeptID
Sarah DeMark, Open Skills Network
Rita Detrick, Solutions for Information Design (SOLID)
Jeff Douglas, IBM
Pamela Frugoli, U.S. Employment and Training Administration
Linda Ginac, TalentGuard
Carlos Gutierrez, Empath
Carlos M. Gutierrez, Empath
Mark Hanson, Lightcast
Sean Hinton, SkyHive
David Ludlow, SAP
Mohan Reddy, SkyHive
Lauren Runco, Solutions for Information Design (SOLID)
Fernando Rodriguez-Villa, AdeptID
David Shaw, IBM
Lisa Simon, Revelio Labs
Kacey Thorne, Open Skills Network
Jason Tsyzko, T3
Jeroen Van Haute, TechWolf

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Report Design

The Design Wonder LLC

APPENDIX B. COMPANY/PRODUCT PROFILES

Descriptions and key aspects of the skillstech providers interviewed as part of this study. These descriptions focus specifically on the skills technology and may not reference additional products these providers offer.

AdeptID – Boston, MA

Inclusive talent intelligence for organizations and applications

AdeptID uses machine learning to identify and support hidden talent in the workforce. Through their API model, AdeptID makes it easy for any application to match talent to in-demand jobs and training by surfacing underlying, transferable skills earned in seemingly different roles.

Key Aspects

- API-first
- Public benefit corporation
- Looks beyond job titles at underlying skills
- Models trained on observed employment outcomes

Empath – Washington, D.C.

Tomorrow's Workforce. Today.

Empath's machine learning technology identifies the skills of every employee in your organization. The skills of a workforce are identified by inferring (with a high level of accuracy) from information that already exists within the company. A complete picture of employee skill levels is developed allowing managers to make skills-based decisions.

Key Aspects

- Skills matching to current and future roles and training opportunities
- Proficiency level identification
- Compatible with any skills framework

IBM Talent Frameworks – Armonk, NY

Let powerful frameworks do the work for you

Ready-to-use job taxonomy and skills library with industry-specific job descriptions and responsibilities, core competencies and behavioral-based proficiency statements.

Key Aspects

- Provides job profiles which consist of 12-15 competencies, made up of skill name, description, proficiency measurements
- 2,700+ Skill/Competencies covering 16 industries
- Technical and non-technical competencies

Lightcast – Moscow, ID **Making a job market that works for everyone**

Provides labor market insights covering more than 99% of the workforce that is delivered to partners through access to software, consulting or API. Offers a variety of tools for education institutions, employers, government entities and real estate.

Key Aspects

- Open Skills – open-source taxonomy updated every two weeks
- Includes the Lightcast Occupation Taxonomy covering 2,000 occupations
- Skillabi tool helps translate academic curriculum into skills

Revelio Labs – New York, NY **Indexing the world's human capital**

Revelio Labs absorbs and standardizes hundreds of millions of public employment records to create the world's first universal HR database, allowing us to understand the workforce dynamics and trends of any company.

Key Aspects

- AI powered software
- Data updated monthly
- Provides a comprehensive, current understanding of workforce trends

SAP SuccessFactors HXM Suite – San Francisco, CA

SAP SuccessFactors solutions are cloud-based HCM software applications that support core HR and payroll, talent management, HR analytics and workforce planning, and employee experience management.

Key Aspects

- Talent Intelligence Hub provides a searchable system of record for cataloging employee skills.
- Growth Portfolio stores an individual's skills and competencies to match against job and career opportunities.

SkillsEngine – Austin, TX **Create, translate, organize and align skills**

A nonprofit initiative of the Center for Employability Outcomes at the Texas State Technical College, SkillsEngine utilizes their patented algorithms and living library of 20k+ skills competencies to enable alignment and common fluency across educators, employers, and workforce development interests. SkillsEngine's technology solutions cultivate a skills-first culture and advance better learning and employment outcomes.

Key Aspects

- Supports skills-based hiring, employee upskilling and reskilling, and employer-validated training
- Facilitates collaboration, knowledge-share and a common lexicon for users
- Offers an open skills platform to aid users in skills-based output, including AI-driven skills translation, job post generation, and interview question support tools

SkyHive – Vancouver, BC **Unleashing Human Potential**

We are on a mission to reskill the world. By marrying economic theory with workforce modeling and human analytics, we help companies, communities, and countries transition from job-based to skill-based at pace and scale.

Key Aspects

- Utilizes Quantum Labor Analysis
- Automates the talent architecture across multiple existing HR systems
- Recognized leader in ethical AI practices
- Identifies future talent needs
- Target learning recommendations

TalentGuard – Austin, TX **AI Workforce Skills Intelligence Platform for the Modern Workplace**

TalentGuard's Workforce Skills Intelligence Platform unifies data, software and ecosystem to unlock complete visibility of skills, the intelligence to make data-led talent decisions and the ability to develop the highest potential in your workforce.

Key Aspects

- Gain access to dynamic job and skills data to support your job architecture.
- Robust platform of talent management offerings to support skill-based talent practices.
- Applies ethical AI model and mitigates biased skill verification.

TechWolf – Belgium **Know the skills of your workforce. Finally.**

TechWolf puts organizations on the fast track to becoming skill-based. TechWolf's Skill Engine™ connects existing systems via an API-first approach to get an instant, up-to-date, and unbiased view of skills and skill gaps in an organization.

Key Aspects

- A total view of skills are surfaced through:
- Inferring skills providing skill data
 - Structuring skills providing a skills framework
 - Distributing skills by connecting to applications

