Transforming Chaos into Clarity: The Promises and Challenges of Digital Credentialing

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Higher education serves as a critical vehicle for upward mobility and equal opportunity in the U.S. labor market. First, it provides opportunities for workers to develop critical skills and competencies, and more generally pursue goals for self-improvement throughout their lives. Second, higher education provides a process for obtaining credentials, which play a critical role in differentiating workers in the labor market by providing signals that represent their skills, competencies, and accomplishments. In an ideal world, credentials would be tightly coupled with the skills and competencies that a student obtains from an educational experience. In reality, traditional academic credentials function more like roughly hewn proxies for ability, whose signaling power must be supplemented by other information. This tends to entrench social stratification rather than transform it.

This shortcoming of traditional credentials is evidenced by the disparities in employment along race and class lines that continue to persist even after the massive expansion in higher education opportunities in the United States in the decades after World War II. For example, a recent study revealed that black college graduates have faced unemployment rates more than double those of their white peers since 2008 (Jones and Schmitt 2014). Some of these disparities can be explained by the stubborn persistence of implicit bias in our hiring practices, whereby subtle cognitive biases shape our impressions of people from backgrounds different from our own. Other research has indicated that poorer students also get lower returns on investment from state-school education (Soria et al. 2013). The authors argue that this is mostly due to differences in social capital accrued through expensive college socialization activities, such as sororities and fraternities, which serve as a valuable network for sourcing employment opportunities post-graduation. These trends are magnified by the more fundamental challenge of figuring out how to make more objective and fair decisions about who is the best person for the job.

The stated objectives for assessments and credentials often include a desire to overcome human biases with more "objective" measures of a person's skills, qualifications, or character. However, results have generally fallen short, either by replicating existing inequalities or by overemphasizing skills that are easy to measure in a standardized way. A persistent challenge has been to develop assessments that are both meaningful and accurate. At best, educational assessments tend to be roughly hewn proxies for complex social structures and experiences. For example, the SATs are intended to measure objective qualifications regarding one's critical thinking and cognitive abilities; however, studies have shown that standardized assessments such as the SAT are a more accurate indicator of class and race than intelligence or future potential (Herrnstein and Murray 2010). Similarly, the college degrees with the strongest signaling power tend to come from elite private schools, whose student populations tend to be comprised disproportionately of the economically privileged.

In response to these challenges, people have begun to call for a fundamental rethinking of how we train and credentialize the future workforce. In the rest of this paper, we will explore the challenges and opportunities related to some of these efforts. First, we discuss the emerging challenges associated with credentialing given the increasingly diverse landscape of higher education. We then explore the specific risks and affordances related to two distinctive approaches to capturing meaningful signals from this "unbundled" (and increasingly digitized) landscape of higher education: first, unbundling credentials from the university degree, and second, moving beyond credentials to more direct data-based evaluations. Based on this discussion, we offer a few guiding principles for future development of an ideal infrastructure for managing credentials.

The Chaotic Landscape of Unbundled Credentials

The 21st century workplace is much more transient than it was 50 or 60 years ago. During the post-war era, it was normal for large firms to invest in training and professional development for a young recruit, expecting the investment to pay off over the long (often lifelong) course of the recruit's career in the firm. Yet today, the burden of professional development has largely shifted from the firm to individual workers, who are expected to continuously reskill as they move from job to job over the course of their careers.

These occupational changes are less and less about voluntary transitions to better-paying jobs. Rather, they reflect the growing uncertainty around how best to invest in talent development in such a rapidly evolving economy. As Auguste and Mariani (2015) have pointed out, too many Americans are "stuck" without a clear way of translating their skills and credentials into real professional opportunity. When hard-working Americans are laid off during times of economic hardship, it is increasingly difficult for them to discern the best way to "skill up," i.e., gain the skills they need to find their next job in tomorrow's economy. This heightens the need for educational opportunities well beyond the traditional university pathway, as people need cost-effective ways to continue developing new skills and competencies throughout their careers. They also need to be able to demonstrate their skills, competencies, and achievements to potential employers in a way that helps them find a job.

As a result, options for customized "lifelong learning" experiences— professional boot camps, online courses, and corporate training, to name a few—are increasing. Less formally, vibrant communities of practice have emerged on online platforms such as Stack Overflow, GitHub, and YouTube, yielding an immense amount of informal learning support for everything from software engineering to Arabic calligraphy. While this changing landscape provides promising new opportunities for lifelong learning, it's also quite confusing. Unbundling the education

system could increase the agility of our workforce, but it also makes it hard for students and workers to choose the best option for achieving their goals.

Moreover, the most successful technology-driven alternative education programs thus far have increased opportunities for a relatively small group of well-educated people with high socioeconomic status. Last year, the U.S. Department of Education announced that 36 million Americans were considered "low-skill" adults, meaning that they lack the basic literacy, numeracy, and problem-solving skills necessary to engage in gainful employment (U.S. Dept. of Education 2015). It remains a challenge to figure out ways of deploying new technology and pedagogical formats that can better address the needs of this grossly underserved population.

Another challenge learners face is the limited ability to transfer skills and accomplishments from one job or profession to a new employer or domain. In addition, there is an increasing awareness that we may be paying attention to the wrong skills altogether. For example, companies are reporting the need for more creativity and ability to collaborate, but assessment and credentialing systems focus on easily measurable skills or content knowledge, which are rarely good predictors for workplace success.

The more accurately and specifically credentials reflect new competencies learned in these emerging educational settings, the better study programs can be matched to employment opportunities. But new credentials, even if they are accurate, face trust problems: Students don't know if it is worth investing time and effort in new educational experiences, and employers don't know how to compare them to other, more traditional credentials. The ambiguity around the value of new forms of credentials tends to produce suboptimal results for workers seeking to use them as entry points into better-paying jobs.

Digital technology offers some interesting new opportunities for lifelong learning and credentialing. It allows us to design systems in which skills, competencies, and accomplishments are captured more granularly across many different contexts, are associated with an individual's online identity, and can be easily shared. In an ideal world, evidence of skills could be developed through interaction with peers, structured classes, or in the workplace and would include a broader variety of skills, including the ability to think creatively and work collaboratively. Such a system would enable the curation and presentation of more nuanced snapshots of learner competencies to various audiences, including potential employers, mentors, peers, and collaborators.

This is the direction in which many entrepreneurial and innovative learners are already moving, but the systems to support new approaches for more learners are still missing. We need better signals, but we also need better systems to create and manage those signals. In the following pages, we discuss two emerging trends that call into question fundamental assumptions about how we evaluate and credentialize this expanded set of educational experiences and professional development activities. We analyze opportunities that these practices offer to advance equal opportunity by rethinking signaling practices in the labor market, as well as the risks and challenges we see in designing these systems moving forward.

Trend 1: Expanding credentials beyond the degree

As the education system becomes increasingly unbundled, we are seeing a similar diversification of credentials. Some of the new credentials are issued by institutions that already have a history of issuing traditional degrees. For example, MIT recently started issuing certificates of completion for some of their online courses, which taken

together provide access to the MITx MicroMaster program that will lead to a traditional MIT degree. Other credentials are offered by non-accredited organizations, for example General Assembly, which only recently started offering certificates for its range of modular technology and design courses. Another example is online course platform Udacity, which partners with technology companies, such as Google or AT&T, to design certificates for courses that provide pathways into jobs. On the other end of the spectrum are organizations like Portland State University, which now issues digital badges for students who participate in academic programs that focus on creativity and collaboration.

For these new types of credentials, digital or not, the main challenge is to establish trust. Only if these credentials "count" for something will they be able to attract potential students. Trust can be created through different strategies: by leveraging the reputation of an existing higher-education institution, such as MIT; by connecting a credential to the reputation of a well-known employer, such as Google, which commits to recruiting applicants with a particular credential from online course provider Udacity; or by trying to position new credentials as innovative complements to formal education, such as in the case of General Assembly's courses.

However, establishing trust is hard. While the examples above demonstrate a few successful strategies, most alternative credentials have very low signaling value. They may be included in a job application to demonstrate an applicant's motivation to invest in further training, but they rarely serve as replacements for traditional credentials. In the case of digital badges for professional boot camps or mid-career intensive programs, there are no easy mechanisms to transfer them into official school transcripts. Digital technologies have the potential to allow for new strategies to gather data and establish trust and reputation based on evidence rather than existing reputation of partners. By recording information about which credentials correlate with employment and job success, students can make more informed decisions about education programs and employers can monitor the acceptance of new credentials by other companies.

The application process, which includes writing a letter of interest, preparing a CV, and sharing relevant information during an interview, allows job applicants to represent their professional experience to a potential employer. However, as the higher education landscape grows increasingly varied, it becomes a bigger challenge for individuals to tell a coherent story about what skills and experiences they have developed across various platforms and programs. In addition, different audiences may need different representations of skills and accomplishments; the criteria for evaluating a restaurant manager are quite different from those for new airline pilots.

Platforms such as LinkedIn, Bayt.com, or Xing.com aim to facilitate this process by becoming management platforms for professional identities. These platforms retain a high level of control by ingesting and centrally managing the analysis of an individual's professional data. This data analysis feeds into recruitment tools that platforms then sell to human resource professionals to support the recruitment of new employees. Most closed platforms keep the way they evaluate user data a secret, which makes it challenging to know what factors contribute to users' reputation. As proprietary platforms gain more and more users, they develop a strong gravitational pull of network effects, which makes it challenging for users to opt out if they have concerns about how their data is being analyzed to produce a reputation or status.

Open credential systems would place greater control in the hands of the individual and enable the development of third-party services for validation and evaluation, without the risk of platform centralization. For open systems to emerge, we need better access to the underlying sources of data that fuel them. Most current credentialing systems retain information at the level of the issuing institution. In the case of university transcripts, graduates

are typically required to pay a fee to access the record of their academic achievements. In the case of corporate learning, much of the data and certification is locked away in corporate databases and cannot be shared easily with others. Digitizing credentials would provide a good first step toward making them easier to share, transfer to third parties, and manage, but digitization is not enough. These digital credentials need to be accessible and transferable in order to be useful.

Open digital credential systems would enable the development of an entirely new set of ways to identify meaningful signals in the labor market. Meta-credentials could represent a particular combination of skills and other achievements. When credentials are digital and open, it makes it easier to knit together a more complete and detailed profile of a learner's experiences and competencies. Digital credentials can also contain richer types of information, such as videos or testimonials, and they can link to additional evidence on the web. They could even update dynamically, for example by representing the number of times a software developer's source code has been downloaded, which could serve as an indicator of the quality of the code. Finally, current credential systems make verification and authentication burdensome and unreliable, and degree fraud is rampant in some parts of the world. Digital tools could more easily validate a credential's integrity (ensuring that it wasn't tampered with) and authenticity (confirming that it was in fact awarded by a particular issuer to a particular recipient).

With traditional degrees or cumulative grades, much of the process that led to the degree is abstracted and lost. Digital credentials enable the documentation of more fine-grained sets of experiences, providing not only more complex information to potential employers but also guidance for other learners who want to evaluate the quality of a given learning experience. The more fine-grained these signals get, the less they look like "credentials," per se, and the more they look like a corpus of data that can be processed in novel ways to yield insights into workers' abilities and potential.

Trend 2: Moving beyond credentials with big data

In recent years, there has been a surge in interest surrounding the potential use of "big data" to increase the efficiency and accuracy of recruitment and hiring decisions. The term big data refers to very large data sets and the processes used to analyze them, which have the ability to reveal certain patterns, trends, and associations that otherwise are not readily apparent. Over the last couple of years there have been a growing number of companies which use big data to build platforms and tools intended to help recruiters identify promising candidates for jobs ranging from software engineering to corporate management.

In order to conduct this type of analysis, companies harvest data from a wide range of digital platforms where communities of practice convene to share their expertise and seek out advice.[i] Such resources foster a rich digitized environment for peer-to-peer learning to take place between learners with varying levels of expertise. In addition to serving as a valuable learning resource, these sites generate a large amount of data about what types of projects people are working on, the skills they are developing, and the level of expertise they have in a given domain. Given the open nature of these sites, the data generated from them is often public, making it possible for third parties to gather and integrate it into data-based predictive models.

[i] For example, on sites like Stack Overflow anyone can post a question regarding a problem they are struggling to solve. The question is typically answered within minutes of being posted. As a query receives more and more responses, the community up-votes those they find most helpful, thus making it easier for others to find the most relevant and accurate guidance related to the topic.

One appeal of big data is that it is ostensibly "hypothesis-free," meaning that we could avoid implicit bias in decision-making by finding new, data-based proxies for evaluating talent. Proponents of big data argue that, by allowing insights to emerge from the data, they can uncover a new perspective on what trends and patterns are most relevant when sifting through the talent pool for a new employee. Their aim is to expand, or altogether replace, clunky university degrees with more refined credentials that give us a much more detailed picture of a learner's abilities.

However, other researchers have challenged the notion that big data practices provide a fairer or more objective basis for decision-making. Scholars like Boyd and Crawford (2012), Gillespie (2012), and Sweeney (2013) are exploring the ways that deep-seated biases are hidden behind the promise of "neutral data." At the heart of this research is the recognition that big data analysis remains essentially a process of interpretation, one that is prone to the same biases and limitations we encountered in prior protocols for decision-making.

For example, big data models are developed using "learning algorithms," which identify patterns and trends from a set of "training data," meaning the example data that they're fed in order to build predictive models of reality. If the training data contain discrepancies that are present in the real world (i.e., disproportionate percentage of CTOs are white men who are fans of Lord of the Rings), the algorithm is likely to integrate those biases into its model (i.e., predict that other white, male Lord of the Rings fans are good candidates for CTO positions). Another common misconception is that if attributes associated with protected classes—race, gender, sexuality—are struck from the data, biases associated with them will not carry over. However, these protected attributes are often double-encoded in the data, meaning that they are latent in the included attributes and are therefore considered in the model regardless. Without taking thoughtful precautions to understand and minimize such biases, big data recruitment companies will simply amplify them.

This is not to say that these methods are altogether bad. The question is how these emerging practices compare to existing methods of talent evaluation and recruitment. To answer this, it's important to understand a few key distinctions between status quo credentialing regimes and practices based on big data.

First, big data recruitment platforms enable the evaluation of "passive" candidates, or people who have not actively submitted a resume or application for a job. When a recruiter identifies a promising applicant in this way, the recruiter will then reach out to the candidate to invite them for an interview. Passive recruitment is most popular in industries where there is a high demand and limited supply of skilled labor, such as software engineering. Hypothetically speaking, if these practices were limited to fields where the demand for talent is greater than the supply, then there would be little reason for concern: Passive recruitment would simply enable employers to competitively compete for scarce resources. However, if these practices seep into other fields (as they are beginning to do, particularly for low-wage, low-skill jobs such as truck driving and retail work), then this becomes a bigger issue.

The key difference between active and passive recruitment lies in how a candidate's profile is constructed at the top of the recruitment funnel. Traditionally, candidates have played an active role in detailing their experiences and qualifications via their resume or CV. However, these emerging data practices take that process out of the hands of the individual worker and automate it with the help of algorithms and data scrapers. The benefit of this approach is that it helps recruiters identify promising candidates who may not respond to a job posting because they are not actively looking for a job; the downside is that it limits the ability of learners to "pitch" for jobs they might want. A further problem with this approach is that evaluations are made on the basis of information

compiled from a wide range of sources, without the explicit knowledge or consent of the individual worker/learner. If inaccurate information becomes associated with one's profile, there are currently no processes in place to audit and edit that information.

The opacity of these methods also makes it challenging for us to assess how fair and accurate they are. Big data recruitment offers a new set of possibilities for reimagining the way we gather signals for talent and competency in the labor market, and it provides new means for us to capture insights about our interests and skills outside the paradigm of educational credentials. However, without better avenues for integrating the consent and participation of workers in this process, we run the risk of replicating and, worse, obfuscating deep-seated biases and inequalities that are redundantly encoded in the digital breadcrumbs we leave online.

Characteristics of Ideal Credentials Infrastructure

In light of these trends, we've developed a list of key features we'd like to see integrated into an ideal digital credentials infrastructure:

- **Learner control:** An ideal infrastructure for credentials management would place the learner, not third-party companies or educational institutions, at the center of the process and in control of her professional and educational identity.
- **Portability:** Learners/workers need the ability to share and translate their credentials from one context to another and to represent them in different combinations for different audiences.
- **Verifiability:** We need better ways of verifying the source and authenticity of new credentials. This is a fundamental aspect of increasing trust in novel forms of credentials and assessments based on big data.

There is an increasingly diverse set of experiences and data that workers can use to document their interests and abilities. An ideal credentials infrastructure would be able to support different types of media, including videos, audio, and portfolios, and allow expansion to new formats and programs in the future. Up to now, evaluating a digital credential has proven difficult, both for the individual holder of the credential and for external evaluators. It is relatively easy to issue, share, and display a new digital credential, but it requires additional effort to evaluate what it really stands for. The above features would enable us to draw out the most relevant contextual data necessary for evaluating the meaning and value of different credentials.

The Blockchain: Laying the Foundation for the Future

At the MIT Media Lab, we have begun experimenting with technologies that could provide the foundation necessary for building out a credentialing infrastructure that embodies many of the characteristics listed above. Digital credentialing systems have the potential to put a lot more control in the hands of the recipients of the credentials. However, they also carry the risk of increasing tendencies toward platform monopoly, either in the hands of existing institutions or new intermediaries, such as LinkedIn and new big data recruitment platforms. A step in the right direction would be an open issuer system that allows credential holders access to their data and credentials through APIs rather than the registrar's office.

However, we favor a more decentralized approach, in which credential holders are free to establish and manage their own credentials without requiring permission from issuers or intermediaries. Intermediaries could focus on providing value-add services, but should not act as middlemen or gatekeepers between issuer, recipient, and employer. In this scenario, a marketplace of third parties could offer certificate verification services, competing on quality and price, as opposed to a winner-takes-all scenario in which one organization could establish a verification monopoly. Such a system would also give learners the opportunity to actively opt in to providing additional information about informal work they've done. Such a system wouldn't prohibit third-party data collectors from gathering information on implicit professional activity, but it would provide a compelling alternative version of a learner's profile, one verified and approved by the individual learner in a canonical record.

In order to move toward decentralized certification systems, we have two recommendations: First, the development of a flexible standard for digital credentials, building on existing efforts such as the open badges specification; and second, moving to blockchain-based solutions to issue credentials and record data about how they are used.

For the Media Lab Digital Certificates project, we are testing and implementing both aspects of this proposed solution. The blockchain is the underlying technology that makes decentralized cryptocurrencies such as Bitcoin function in an open, decentralized manner (Nakamoto 2008). At its essence, a blockchain can be understood as a distributed ledger to record transactions and ownership. What makes it special is that it is durable, time-stamped, transparent, and decentralized. Those characteristics are useful for managing a wide array of data beyond financial transactions.

Issuing a certificate on a blockchain is fairly simple. First, we create a digital file that contains basic information such as the name of the recipient, the identity of the issuer (i.e. MIT, Udacity, etc.), the data of issue, etc. The contents of that certificate are then cryptographically signed using a private key to which only the issuer has access, and that signature is appended to the certificate itself. Next we create a hash, which is a short string of numbers and letters that can be used to verify that nobody has tampered with the content of the certificate. And finally we use our private key again to create a record on the Bitcoin blockchain that states we issued a certain certificate to a certain person on a certain date. Once that information is recorded in the blockchain, it is possible to verify to whom and by whom a certificate has been issued and validate authenticity of the certificate's content.

This kind of platform provides many of the desirable features we are looking for in a digital credentials management system. As we've discussed, evaluating a digital credential can be difficult, both at the level of the individual holder of the credential, and also regarding the credential's acceptance in the market. It is relatively easy to issue, share, and display a new digital credential, but it requires additional effort to evaluate what it really stands for. One solution (conceptually outlined in Evans and Goudzwaard 2015) would be to track data about how credentials are used in a central place.

By recording who accepts a digital credential, and for what purpose, it becomes possible to build up a reputation over time. If a university accepts a particular credential for transfer credit, or an employer starts hiring people based on a combination of credentials, this information can be recorded in a shared repository. The hard work of evaluating the credential would only have to be done once, by one (or a few) trusted organizations, but would increase knowledge about a particular credential for the entire network. Instead of tracking the individual, our blockchain-based system would track credentials and the ways in which institutions interact with them. Furthermore, this system would fundamentally shift the stewardship model for storing and sharing such

credentials from large institutions such as universities to individual learners. Public key cryptography and cryptographic hash functions ensure our ability to verify the provenance and ownership of credentials, as well as ensure that the content of those credentials isn't inappropriately modified or attributed to the wrong person.

Currently, the Media Lab is piloting this project internally to distribute credentials to valued members of the community who are not enrolled in a traditional degree program in the university. However, the goal is to expand this work to enable the development of the next generation data infrastructure we need in order to support the rapidly evolving landscape of higher education and workforce development for the future economy.

References

Auguste, Bryon and Tyra Mariani. 2015. "We Need to 'Rewire' the Labor Market." April 30, *New America Foundation*. Retrieved August 18 (https://context.newamerica.org/we-need-to-re-wire-e2ea173d6b31#.cblav8dk9).

Boyd, Danah, and Kate Crawford. 2012. "Critical Question for Big Data: Provocations for a Cultural, Technological, and Scholarly Phenomenon." *Information, Communication & Society,* 15(5): 662-679. Retrieved August 18, 2016 (http://www.tandfonline.com/doi/abs/10.1080/1369118X.2012.678878#.V2hpgOYrLow).

Gillespie, Tarlton. 2012. "The Relevance of Algorithms." *Forthcoming in Media Technologies*. Cambridge, MA: MIT Press. Retrieved June 20, 2016 (http://www.tarletongillespie.org/essays/Gillespie%20-%20The%20Relevance%20of%20Algorithms.pdf).

Herrnstein, Richard J. and Charles Murray. 2010. *Bell curve: Intelligence and class structure in American life*. New York, NY: Simon and Schuster,

Jones, Janelle and John Schmitt. 2014. "A College Degree is No Guarantee." *Center for Economic and Policy Research (CEPR)*. Retrieved August 19, 2016 (http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.637.6591&rep=rep1&type=pdf).

Nakamoto, Satoshi. 2008. "Bitcoin: A peer-to-peer electronic cash system." Retrieved August 19, 2016 (http://www.cryptovest.co.uk/resources/Bitcoin%20paper%20Original.pdf).

Soria, Krista M., Michael J. Stebleton and Ronald L. Huesman. 2013. "Class counts: Exploring differences in academic and social integration between working-class and middle/upper-class students at large, public research universities." *Journal of College Student Retention: Research, Theory & Practice,* 15(2): 215-242.

Sweeney, Latanya. 2013. "Discrimination in online ad delivery." *Queue,* 11(3): 10. Retrieved August 18, 2016 (http://delivery.acm.org/10.1145/2470000/2460278/p10-sweeney.pdf?ip=38.108.251.162&id=2460278&acc=OPEN&key=4D4702B0C3E38B35%2E4D4702B0C3E38B35%2E4D4702B0C3E38B35%2E6D218144511F3437&CFID=657242880&CFTOKEN=45394682&__acm__=1471551471_26c26ced4c11d9caa23726c27efd39e4).

Office of Career, Technical, and Adult Education. 2015. *Making Skills Everyone's Business: A Call to Transform Adult Learning in the United States*. Washington, DC: United States Department of Education. Retrieved August 18, 2016 (http://www2.ed.gov/about/offices/list/ovae/pi/AdultEd/making-skills.pdf).