***Automated Hiring Platforms as Technological Intermediaries and Brokers***

## Introduction

For much of the hourly workforce—58% of the US workforce—the days of paper job applications are long gone. The thinking that an individual could walk over to the local store with a resume in hand and expect to win over the manager with a smile and firm handshake now belongs to a past era. The automation of the hiring process has introduced technological intermediaries in the form of automated hiring platforms who broker access to job applications and moderate the relationship between employers and potential employees. While these automated hiring platforms might have started life as tangible portals represented by the kiosks located in physical stores, most are now to be found online, with the internet as gateway.

Our survey of application policies revealed that the top 20 private employers in the US, as ranked in the Fortune 500, all require job applications to be submitted online (Appendix 1). Automated hiring platforms are thus an inescapable checkpoint for large swathes of the labor market, particularly those seeking hourly retail positions with large retail corporations. It is those same large retail chains that we observe leading the charge in adopting AHPs in the late 1990s and early 2000s because of their preoccupations of high turnover and loss prevention. Compared to smaller businesses with the same business concerns, these large corporations also had the available capital to invest in hiring technological innovations to link and centralize the operations of their numerous physical storefronts.

For example, to apply for an entry-level job at Target, Target's online application system first verifies your age, and then helps you narrow down available positions within a given zipcode. You choose a job category (e.g., sales, logistics) and then specific departments within

them (e.g., clothing, warehouse), each of which lists not only the duties involved but the skills required, attitudes desired, and rewards delivered. After your choices are ranked, you verify your identity—including Social Security Number—for the sake of background checks, agree (twice) that Target is a drug-free workplace, and establish your authorization to work in the US. Each new section builds on the last, and there is no option to go back and edit your work. Finally you're ready to enter in your work experience. If you've worked for Target before, or someone in their corporate family (e.g., Marshall's), you have the option of providing hyperlinks to that store and position. Everyone else must describe a previous job's duties in 32 characters or less, and then specify whether they are still working there, had voluntarily quit, or were involuntarily terminated or laid off.

Several screens devoted to scheduling follow, asking you to specify not only your preferred start data, but preferred shifts, and the hours (up to 40) you'd like to work. You are unable to select more than three preferred shifts. Availability is so important that it's entered twice, once visually—a clock—and once textually—as a pulldown menu. It's easiest to just check the box saying you're available any time and then input your digital signature. You must then input your desired pay, or check the box saying you're open to discussion. Then comes the personality assessment.

You're presented with a series of binary choices, and are instructed to pick the option that best represents you—though of course you're also wondering which choice best appeals to your prospective employer. "I prefer to avoid difficult tasks, in case I end up making mistakes" or "I have difficulty building social relationships"? "I am rarely the person people talk to about their personal problems" or "My friends say that I am disorganized"? In other automated hiring

platforms these are Likert scales or multiple choice items, but the anxiety of picking the least-bad, most job-ready personality item remains. After a few dozen of these—other vendors' tests include hundreds of items—you're asked whether you've qualified for certain government programs like SSDI in the past, in order to assess your qualification for various tax credits Target may receive for hiring you. And then you're done and you probably breathe a sigh of relief before you start anxiously awaiting that phone call or email. The whole system is wrapped in Target's colors and branding, but the brand name at the bottom of the screen indicates a third-party vendor who could potentially link your application to various other opaque, but mandatory, digital assessments: Equifax, best known for credit scoring.[1]

Clearly, it is not just a simple technological substitution that has occurred here, exchanging a paper application for its digital equivalent. Entirely new instruments of assessment are introduced on the front-end, with the applicant providing detailed information that will be used to assess their 'fit' for their prospective employer. And hints are repeatedly given that an entire network of backstage assessment is also underway as soon as you click 'Finish': Different criminal background checks for different jobs and industries, credit scoring, verification of previous work history or future qualification for tax credits. The job application itself has become much more than a mute instrument transmitting applicant data to reviewer's eyes. It is a platform hosting various third-party services for the hirer, measuring applicant qualities against hirer needs, screening applicants who don't qualify and delivering to the hirer those who do. For an applicant desperate for work, even though they have basically conducted their first job interview on their own, the system is opaque, invasive, and anxious. For a hirer desperate for

[1] It is, of course, illegal to request an applicant's credit score without their permission. But the scores themselves are based on a vast array of data sources that can be put to other uses.

qualified employees, a wealth of new data is revealed and, hopefully, the platform delivers exactly who they need, exactly where and when they're needed.

These are *automated hiring platforms* (AHPs): Systems for the digital solicitation, submission, and assessment of job applicants, built and maintained by a third-party vendor on behalf of the hirer. This paper explores the history of their design and uptake in the 1990s and early 2000s, and how these technological brokers restructure the labor market for hourly employment. Today, systems like these are becoming increasingly prevalent in sectors from trucking to healthcare, and start-ups in automated hiring and the broader 'workforce analytics' space are popular targets for venture capital (e.g., Sawers, 2017) and acquisitions (e.g., Kepes, 2017). They are built on recent advances in machine learning and artificial intelligence (Deveau, 2017), the latest research in behavioral economics and the raw power of cloud computing (KPMG, 2016). But they have their roots in the automation of hourly hiring during the first dotcom boom. By teasing out the discrepancies between corporate pitches, technological design, and historical use-cases, we can see precisely what these platforms are supposed to do and for whom, and how this brokerage system redesigns the flow of information between employers and job-seekers.

Conceptually, we describe AHPs as information brokers: Transmitting and computing signals from applicants to employers, on the latter's behalf. AHPs control the flow of information and the selection of relevant signals, creating an information asymmetry between employers and applicants. Our critical analysis of AHP design history and designer discourse supports four primary claims. First, we uncover a broad corporate desire for 'on-demand' labor, with technological intermediaries rating and assigning labor on capital's behalf, that precedes the

rise of Uber and similar gig platforms by more than a decade. This dream of on-demand labor is present in far more sectors than the still rather small gig economy. Second, and contrary to the claims of AHP designers, they are not actually automating *hiring* but *rejection*: Lower-rated applicants are culled, and a human is kept "in the loop" to assess higher-rated ones, though their job is deskilled. Third, AHPs fundamentally alter the flow of information between applicants and hirers: The control over what signals matter and how much they matter is entirely in the hands of the hirer, and the applicant may not even be aware of what attributes they're signaling, when, and where. Fourth, AHPs define 'fit' in terms of employers' previous choices, successes and failures. Finding patterns in noisy data is a fundamental principle of machine learning, but this runs directly against many AHP designers' claims to de-bias hiring by eliminating messy human decisions: If those decisions have been regularly biased in the past, AHPs will simply repeat them, faster. Garbage in, garbage out.

Our investigation combines conceptual and empirical tools from organizational studies and science and technological studies (STS) to map the effects of technological brokers in the labor market. In what follows, we first review the relevant literatures in brokerage theory, platform studies, and signaling theory. Then we describe our primary sources and our mixed methods approach to them. We present the history of AHPs, focusing on the rise of one particularly successful firm that promised to automate the hiring of hourly employees: Unicru. After outlining the changing capabilities of the technology involved, we are able to describe the purported benefits for enterprise customers and how AHPs tilt the labor market in their favor. By triangulating claims across primary sources, we are then able to compare these purported benefits against actual technological capabilities and advance the four primary claims described above. We conclude by describing the backlash to AHPs, particularly in online forums that help

applicants cheat them, and offering empirical and conceptual paths forward for future research, in audit studies and studies of technological brokers, respectively.

To explore the organizational impact of AHPs, we needed to drill down into what they are *for* (i.e., what promises they hold for enterprises in the future) and what they *do* (i.e., how they re-structure existing hiring relations in the present). The two are not necessarily equivalent. Unicru's sales pitch may not match up with its use case. And businesses may embrace a technology for one reason, but use it for another.

This sort of critical analysis requires archival triangulation: Using different sorts of sources to provide different perspectives on the same material or event, in order to corroborate and interrogate the claims of firms, designers, users, and observers in the press (particularly the often-celebratory tech press). Our archive focuses on the early years of AHP—the 1990s and early 2000s, the boom years of the information economy and the first years of the Web—so that we can track the development of these technologies and the firms producing them, the fears and dreams about AHPs in public and in the board room, and stories about their adoption. We first began with national newspaper archives, searching for specific keywords (e.g., online job applications, automated hiring). Then, once key players and technologies were nailed down, we narrowed our items of interest to particular technologies, designers, companies, patents, and adopting firms while simultaneously expanding our archives of interest: Trade presses in retail and hospitality discussing AHP adoption, business journals covering the growth of local firms building AHPs, journals for human resource professionals, press releases from AHP manufacturers announcing new technologies or new customers, financial statements from publicly traded firms, lawsuits and Equal Employment Opportunity Commission (EEOC)

investigations into technological bias, patents, advertising and training materials produced by AHP manufacturers for clients.

We supplemented these written materials with repeated assessments of contemporary AHP features. Bluntly: We applied to a lot of hourly jobs, screenshotting each stage of the process and later annotating the screenshots. This process helped us better understand the user experience, and helped us to highlight commonalities across AHPs. Ultimately, however, our own job applications were secondary materials in our investigation, impressionistic aides. They are the latest technologies, rather than the initial ones that built the market, and we did not systemically, rigorously test the results of the application process across multiple participants. Some thoughts on how to build such an audit study are offered in the Conclusion.

We then built a detailed timeline addressing which AHP features emerged where and when, how they were responded to, and how manufacturers and clients described them. This prepared the ground for a critical analysis addressing both the discourse of technological possibilities and the design of technologies for organizational realities, and the dialectical relationship between the two. Our general strategy of triangulation thus relies on two specific methods: Critical discourse analysis (CDA) and affordance critique.

CDA maps discussions of what AHPs are *for*. This is a qualitative method that explores how different parties describe and explain their social practices (Van Leeuwen, 2008). Written texts represent and recontextualize actors, action, time, space, legitimacy, and purpose. They provide a story for technological adoption, fitting new developments into existing frameworks about how firms can and should function and adjusting those frameworks as needed to embrace new facts on the ground. In annotating our archival sources, we were particularly interested in

how different actors described AHPs role in the labor market, in adjusting the relationship between hirers and applicants. In this way, we embrace the *critical* nature of CDA because we are interested in the description, interpretation, and legitimation of power relations and how those discursive dynamics change over time. Methodologically, we draw on one author's prior work (e.g., Greene and Shilton, 2017; Shilton and Greene, 2017) critically analyzing discussions about 'privacy' in mobile development in order to show how discursive practices influence technological practices and vice versa.

There is a roadblock here but it is not as significant as it may seem at first, given our goals and tools. The technologies in which we are interested are proprietary and we do not have access to their code. Nor do we have access to the internal company records that would indicate who was hired, when, how, with what results. Both AHPs and the firms that use them remain black boxes.

Particularly within debates around algorithmic bias, there is often a desire to find the single piece of code (or the single human value built into that code) that produces unequal outcomes for different groups. But algorithms—procedural instructions for digital behavior—are composed of multiple interacting systems that change over time, automatically adjusting for different users in different places. They are not stable empirical objects and access to their code or expertise in their design only goes so far in understanding their effects 'in the wild' (Seaver, 2014). Seaver demonstrates through his fieldwork with recommendation systems designers that there is rarely one 'algorithm' to point to that results in, say, a particular song playing at a particular moment on Pandora. Those results are personalized and their methods are constantly adjusted through experimentation on dozens of interlocking systems that are each pushed and

pulled by advertising networks, user inputs, and moderators. The output of a single song is the result of a particular technological ecology and achieving access to the 'raw' form of those systems ultimately cannot explain the system's logic—as many engineers will readily acknowledge. We have been here before, as Seaver argues, successfully explaining and critiquing pre-digital processes of rationalization and the social forms they take in the wild. Midcentury critics of technology and urban space, for example, did not hinge their investigations on a detailed explanation of the internal combustion engine. Instead they focused on how cars altered living and working patterns (e.g., Mumford, 2010 [1958]).

Specifically, we draw on technology studies' methodological approach to *affordances* to analyze what AHPs do and for whom. Originally grounded in environmental psychology (Gibson & Walker, 1984) to describe organisms' perception of their surroundings, technology studies have developed the idea to focus on the relationship between the design features, human perception of them, and the relationship between the two that defines what different users can or cannot do with a particular device (Schrock 2015). Rice et al (2017) situate affordances in organizational contexts as "organizational resources", where similar technological capacities are drawn on by substantively different organizations to reach formally similar goals. In a review of the literature, Nagy and Neff (2015) propose to re-define the term as 'imagined affordances', to emphasize how the expectations of designers and users regarding what a technology does are concretized into the technology itself, with varying levels of fixity depending on the openness of the design and the power differentials between designer and user. Viewed in this way, our methodological distinction between AHP design and AHP discourse is largely a formal one. In practice, the two are inextricably linked.

Even affordances that are not hard-coded into a design may become permanent fixtures of that design, from the user's perspective. There is no reason, for example, that most every AHP we encountered includes a personality questionnaire for the hourly workforce, automatically grading applicants' on various psychological and cultural measures and sorting out those that fall below a certain client-specified threshold. Nor do those questionnaires need to appear as binary choices, like they did in the Target application above. But sorting out customer and management-friendly personalities is a priority for one set of users—clients-hirers—and so another set of users—applicants—comes to identify online job applications with the anxiety of picking between two ambiguous descriptions of your psychology. This dynamic was brought into sharp relief by Overholt's 2002 *Fast Company* profile of AHP designer Unicru, where dozens of headshots of Blockbuster employees (a major client) and Unicru psychologists were overlaid with True or False personality items. One thing AHPs afford is thus the automated measurement, rating, and selection of applicant personality profiles. As platforms, AHPs host a variety of affordances, tailored to client needs.

Our critique of affordances relies heavily on written materials where AHP designers speak to their employees, investors, and clients (e.g., training materials, financial statements), as well as discussions among current or potential enterprise clients (e.g., the trade press for hospitality industries or human resource professionals) and our own AHP walk-throughs. It is here that we begin to see how AHP functionality differs for hirers and applicants. The former have far more information available to them, and far greater control over what sort of signals are selected from which cues and why. This should not be surprising given that the enterprises are AHP designers' ultimate customer, but it is (perhaps unsurprisingly) missing from popular press coverage and press releases announcing new technologies. This is our basis for describing AHPs

as a new class of technological brokers—the *tertius bifrons*, or two-faced third—increasingly common in the contemporary labor market. In this way we begin, empirically and conceptually, to unite longstanding concerns in management studies and organizational behavior regarding the flow of information through organizations and those seeking entry to them with media and technology studies' critique of the tools and techniques which transmit and shape that information.

**AHP History**

Our focus here is on the emergence of automated hiring platforms for the US hourly workforce and how these technological brokers shift power relations and information flows in the labor market, but the affordances of these platforms emerge over time, in a series of related technologies, across the very specific political-economic backdrop of the 1990s and early 2000s. The rise of the Web made the internet accessible and useful to non-specialists, and thus removed much of the friction around both soliciting job applications and applying to them: Jobseekers could skip the commute to hirers and rapidly apply to multiple jobs quickly, while hirers could now advertise more widely, cheaply, and in a way that networked their applications with various vetting mechanisms such as background checks and credit checks. These dynamics first played out in the salaried, technical end of the labor market with relatively unsophisticated search and display mechanisms before spreading to the rest of the workforce—with lower levels of technological literacy and access to personal computers and the internet—and to more centralized, powerful, and networked AHPs. These recruitment and assessment technologies develop during the increasingly tight labor market of the dotcom boom, when employers competition is high for qualified employees. AHPs help re-settle this dynamic in favor of

employers, though certain political dynamics, namely the creation of the Work Opportunity Tax Credit, also drive adoption.

In this section, we track AHP affordances as they first emerged in the 1990s and 2000s, the political-economic context for their adoption, the growth of the businesses selling them, and reactions to them from hirers, applicants, and the press. Our focus is on Unicru, the first and most powerful AHP producer for the hourly workforce, who beat competitors to market, drove adoption by large employers, and developed core platform features that we can see in wider adoption today.

*Job Boards and Experimental Software*

The first major feature-set, in the early 1990s, was job boards: Simple postings of job openings, focused on salaried professionals in the tech sector, the people who had the skills and means to get online at the time. In this period, and up until its full privatization in 1995, the US internet was still largely accessed through universities and research centers, though personal use flourished at these access terminals and commercial networks were growing. The World Wide Web—a graphical overlay for exploring linked sites—did not emerge until 1993, with the release of the Mosaic Web browser, and did not become widely popular until the commercial release of Netscape in December 1994 (Greenstein, 2015). This meant that internet users—relatively skilled and affluent hobbyists—in this first period were not navigating between a series of purpose-built websites with graphical interfaces, but were instead largely visiting text-based Bulletin Board Services (BBSes) that ranged from small, community operations to larger commercial ones like CompuServe, whose presentation recalls today's chat rooms (Driscoll, 2016; Marschall, 2002). Alongside discussions of software and science fiction, job boards began

to appear. Writing in the LA Times, Bucy (1991) reviews the pricing and features of a number of local—LA Online—and national—ECHO—standalone job boards, as well as job boards posted on larger BBSes like CompuServe and Prodigy. The business model here is the same as classified ads—employers seeking programmers pay a fee to the host to post a listing—but the novelty is the disintermediation, "bypass[ing] the mails and provid[ing] a direct link between the employer and applicant."

At this pre-Web stage, there is a good deal of business model experimentation among vendors. Companies such as Spinnaker Software Corp. and Data-Tech Distributors, Inc. would sell CD-ROMs to jobseekers, preloaded with databases of employers—obviously unable to be continuously updated—as well as purpose-built software to edit applicant materials and pre-fill forms for specific sectors, like the federal government. Bulkeley (1992) quotes the executive director of the Professional Association of Resume Writers, shocked at these developments: "The idea that a computer can properly express and elicit the correct information seems not in the realm of reality." The Online Career Center continued with the classified ads model but also charged applicants $6 to input a resume to their closed system, advertising its services to employers as a way to sift through the unemployed masses generated by the early-1990s recession (Matas, 1993). Career/Net marketed itself to college students—who often had internet access on campus—and promised to load resumes onto CDs and distribute them to employers (Halverson 1994).

*Resumes and the New Classified Sections*

With the opening of the Web, a host of new businesses sprang up to compete with newspapers for classified ads while still retaining the same basic fee-for-placement business

model (Barboza, 1995). Internet service providers like Prodigy—a joint collaboration between CBS, IBM, and Sears Roebuck, previously operating as a BBS—would offer job boards to reel in high-value subscribers. Large purchasers of newspaper space would also start their own independent websites, like Bernard Hodes Advertising did with Career Mosaic. And newspapers themselves began to act defensively: The *LA Times*, the *New York Times*, and *Washington Post* collaborated on careerpath.com. Some of these provide physical mailing addresses for materials, others fax numbers and email addresses. Contemporary reporters commented on how putting these ads online deliberately limited their audience to early adopters: "[B]y using them, employers can reach an audience that is generally well-educated and comfortable with technology."

Some new start-ups begin to do more than just digitize classified ads. Two of the names that would dominate the job posting space emerge here: Monster.com (founded in 1994 as The Monster Board) and CareerBuilder (founded in 1995 as NetStart, renamed in 1996). In 2000, Monster's chief operating officer noted that their early success was due to both first mover advantages—becoming a destination of choice because choices were limited—and a tight labor market, where employers wanted to get to skilled applicants as quickly as possible (Ceron, 2000). But Monster was not just for employers to post listings on, however. They also allowed jobseekers to publicly post their resume and charged employers for access to this database, which they could then search at will. CareerBuilder went even further. For $2000 per month, companies could post listings to CareerBuilder's database and review resumes posted by jobseekers. For a flat fee of $5000, clients could purchase the TeamBuilder software that allowed "non-technical" HR departments to design job listings that integrated seamlessly into their own website, and then create databases, scoring systems, and automatic forwarding trees (e.g., to

specific hiring managers for specific listings) that helped store and sort resumes received (Chandrasekaran, 1996). CareerBuilder told potential investors this would cut their hiring costs in half, while greatly expanding the pool of potential applicants and greatly reducing the time from first contact to offer (Selz, 1998).

Humans still reviewed every step of this process, but their work was sped up and networked. On the applicant's side, this prompted new jobseeking strategies. Because resumes would be discovered within a database through keyword searches, jobseekers had to be sure that their resume was cleanly typed—and thus legible to optical character recognition technologies—and that their documents prioritized a quickly-changing set of industry keywords (Oram, 1997; Olmstead, 1999).

*Decision Point Systems and the Kiosk*

Up until this point, online job applications and software for automatically processing them had been focused on salaried, professional jobs—particularly in the technology sector. This was in many ways a pragmatic decision. Proto-AHPs focused on those applicants who had internet access and the skill to use it, both because they could navigate the interface and because this acted as a signal of their education and wealth. Indeed, in 1997 only 36.6% of Americans owned a PC, only 26.6% owned the modem necessary to get online, and only 16.9% used email. But 75.9% of households making $75,000 and more owned a PC while 49.2% of that group used the internet; 63.2% of those with a B.A. or higher owned a PC while 38.4% of that group used the internet (McConnaughey et al, 1998).

But then, as now, hourly workers make up the plurality of the US workforce. And turnover is higher in lower-wage retail or food service sectors than it is in other, higher-wage

sectors. So any firm that could develop technological solutions for quickly evaluating candidate 'fit' in these sectors would access a large, untapped market. Retail security firm Decision Point Data recognized this opportunity in 1997 when they rebranded as Decision Point Systems. A major client had asked for assistance in evaluating applicants' risk for theft. So Decision Point retooled their Multipoint document-scanning platform—a wand connected to a fax machine—as HirePro, an automated hiring platform accessed through HirePoint kiosks installed in stores. HirePro combined a network of existing background check systems with whom Decision Point contracted with standard work history questions and a personality questionnaires meant to "pinpoint personality traits and characteristics desirable for frontline retail jobs such as sales clerks and cashiers" (Rafter, 2005). Decision Point's hometown paper *The Oregonian* interviewed venture capitalist Brian D. Ascher after his firm was part of a $16 million funding round for Decision Point:

> "No one is doing a full-service offering" in job-candidate screening, said Brian D. Ascher, an associate at Venrock, the venture capital arm of the Rockefeller family. "There are little dot-coms that want to help you attract candidates, but they don't help you evaluate them." Decision Point, Ascher said, is a "first mover." (Woodward, 2000)

In the Claimed Benefits section below, we will discuss in more detail exactly what Decision Point's AHP offered large employers like Home Depot or Blockbuster. But for now it is enough to describe HirePro's system and its increasing market domination from the late 1990s into the 2000s. The system was designed to appeal to large retailers processing lots of applications from working-class jobseekers for relatively standardized positions, and over time its features were refined in general while certain affordances were tailored more specifically for different firms and sectors. In its first year of operation, Decision Point processed 50,000 job applications through HirePro, according to press releases. This this rose to 100,000 in 1998, and

then 1.2 million in 1999 as they signed big clients like Sports Authority, Toys R US, Target, Blockbuster, MarMaxx, Pizza Hut, and Mervyn's. By 2000, there were 15,000 kiosks installed in the US—3000 at Blockbuster alone (Woodward, 2000). Competitors like Deploy solutions would occasionally land chains like Home Depot. Some large employers would design their own internal systems, with Mirage Resorts doing so in 1999 for a cost of around $600,000 (Gilbertson 1999). But Decision Point quickly became the market leader in automated hiring. In 2000, their homepage described HirePro as an "automated pre-employment hiring solution" that "turns all your manual processes into one streamlined automated process" and "attracts more applicants with less effort and lower costs."

Because working-class jobseekers were less likely to have home internet access in this period, Decision Point built HirePro into a system of kiosks that would be placed inside stores. The kiosk looks like a large telephone, with a small screen that displayed the various data fields and assessments and a keyboard for navigating them. The form factor was customized to fit client branding. In 2000, employers paid a monthly fee of between $200-$300 per kiosk, on top of set-up fees that ranged from $50,000 to $100,000 depending on the size of the installation base, plus monthly connection fees conditioned on how many employees were in the company and what services the employer requested (Brenneman, 2000a; Fest, 2000; Rafter, 2005). A large department store like Target would have two kiosks in the store and one in the manager's office (Brenneman, 2000a). Added affordances meant added time, and so kiosk applications (and later online applications running HirePro) took much longer to complete than paper applications. Satisfied clients described this as a feature rather than a bug, with Universal Studios' SVP of Human Resources saying in 2005 that compared to a paper application that took a half hour to complete, an AHP application that took two or three hours "weeded out people who weren't

serious about working at the park" (Rafter, 2005). Monthly connection fees paid not only for links to various background check databases but Data Point's active research into their client's metrics on existing employees. Initially, this value-add generated reports that, according to Data Point's home page in 2000, helped clients "easily track turnover, applicant volume, and increases in sales…mak[ing] each location accountable for maintaining consistent hiring practices." The dispersed outposts of large chains were thus made transparent to the central office who had ordered the Decision Point system in the first place. Eventually, in the next phase, this "closed-loop" system would use current employee performance to dictate how prospective employees are measured and rated, on the theory that newcomers should mimic present successes.

The applicant's process is similar to the Target procedure outlined above, though that feature set—particularly real-time integration with scheduling—took time to develop. Typically, early AHPs would request work history, references, a personality questionnaire, and identifying information (e.g., birth date, Social Security Number) that would be fed into a subset of the 40 independent service providers with whom Decision Point contracted for things like sector-specific background checks. Everything from the design of the kiosk to the questionnaire items were customized to specific clients; Good Guys electronics focused on drug and alcohol use in their assessment, where Target asked for reactions to employee theft or opinions on how many Americans cheated on their taxes (Richtel, 2000). Applicants inputted the data that would earlier have been collected, stored, and transmitted to central offices by clerical staff and Decision Point's Application Processing System took over the analysis. Between ten and twenty minutes after completion, the hiring manager at that location would receive a three-page fax or email summarizing work history and other data before giving a color-coded rating of the applicant: "The applications are labeled red zone (don't hire) and green zone (hire immediately). Yellow

zone issues warnings, such as an applicant does not follow rules, may not be honest and could be argumentative with customers" (Brenneman, 2000a). HirePro would suggest follow-up interview questions and areas of concern for hiring managers, based on jobseekers' responses to specific personality items or perhaps gaps in their work history. Decision Point called this side of the report Profiler.

Decision Point's clients in this early stage were typically large retail chains, with some food service. These large employers have the regular need for high volumes of new workers—with some industry sources estimating annual hourly turnover in retail and hospitality at upwards of 100%—the incentive to lower those turnover rates with "higher quality hires", and the capital required to implement this expensive new infrastructure. Centralized application systems also allowed them to route potential employees to openings in locations besides the one to which they applied. One reporter described this seamless transition from the perspective of a Home Depot location manager in Tempe: "If Anderson has openings in the garden department –as he will to handle Christmas tree and other holiday sales—he just punches in "Dept. 25" and the computer spits out a list of qualified applicants" (Gilbertson, 1999). Much contemporary reporting tied the uptake of these speedy sorting mechanisms to the tight labor market of the late 1990s and early 2000s: Boom times meant qualified applicants had more bargaining power in their choice of employer, and AHPs helped employers jump on those who fit before they moved on to another opportunity.

But there was another contextual reason for adoption, one that directly impacted the bottom line. In 1996, the federal government created the Work Opportunity Tax Credit—offering employer subsidies of up to $2400 per year for hiring and keeping on an applicant using certain

forms of welfare—and followed that up in 1998 with the Welfare-to-Work Tax Credit—offering up to $5000 per year for hiring and keeping on an applicant who previously been among the long-term unemployed. Verifying with the federal government whether applicants qualified could take up precious hours in human resources divisions. Decision Point promised to automate this process and, in so doing, help their software pay for itself. Investor Brian D. Ascher, who would go on to join Decision Point's board, said that the speedy recovery of these tax credits meant that retail clients would make back their investment within a year: "All of the benefits beyond that are basically gravy" (Woodward, 2000). Clients like Sports Authority openly admitted this was a primary reason behind adopting AHPs (Barth, 2000). The Equal Employment Opportunity Commission also argued that a post-9/11 concern with security and liability drove AHP adoption—though this concern varies from sector to sector (US EEOC, 2007).

During the kiosk moment, the view on AHPs from client firms and AHP manufacturers was typically rosy. There was, however, growing anxiety of automated hiring among the broader public. Particularly for higher-wage sectors, professional recruiters—perhaps nervous of being automated out of a job—argued that automated systems could not estimate 'cultural fit' in the same way as experienced humans (Boughton, 2000). For applicants, these systems and the rules governing them were opaque, with few visible opportunities to dispute the results. This was a particular problem for background check systems, where incidents of identity theft or just faulty data could effectively blacklist applicants from sectors like retail where employers subscribed and shared information through common databases in the name of loss prevention. In 1998, the *New York Times* ran a lengthy feature story by Susan Wells about incidents like this under the headline "No, Not *That* John Gotti: Errors in Web Background Checks Can Derail Job Seekers."

As the entire application process moved to the Web, and applicants lost even the physical kiosk that they could ask nearby employees about, the opacity deepened, as did the accompanying anxiety over whether anyone will read that application, how they will assess it, and if you would have the ability to represent your story in person (Freeman, 2002).

*Automated Hiring Goes Online, Matures as a Platform*

In 2000, Decision Point rebranded as Unicru "to forge its new identity as the one-stop site for job recruiting in malls, stores and online" (Brenneman, 2000a). They already had kiosks in 4000 stores in the US, around 12,000 individual units, but the name signaled a bigger vision for the company and AHPs generally: Moving the entry point for automated hiring from kiosks to the Web and in the process making hiring a more iterative process that constantly built from new information from outside databases and internal workforce analytics, seamlessly fitting the labor market to clients' staffing needs. Moving the HirePro system online meant that applicants would now access the total package of assessment screenings, work history requests, tax credit recovery and background checks either from Unicru's centralized job board or from enterprise websites that Unicru built for clients to their request, with their branding (Unicru, 2000). Moving the process online meant that Unicru also placed a premium on interoperability between their AHP and other systems that could assess clients' potential employees and measure their current employees in support of that assessment. Indeed this is what makes HirePro a *platform*: Its promise is more than a pre-packaged software fit for a specific end-user, it is an intermediary that hosts other software and constantly adjusts its feature set to manage the flow of information between parties. In the summer of 2003 alone, Unicru announced partnerships with

- DoubleStar, to integrate the latter's workforce analytics with Unicru's hiring analytics ;

- TimeManagement Corporation, to feed Unicru's hiring data directly into TimeManagement's scheduling software for restaurant chains;
- ChoicePoint, to integrate their suite of background check software into a set of customized screening tools for pharmacy chains
- HireCheck, to make XML-compliant interfaces that allowed smoother data sharing between background check systems and Unicru's assessment tools;
- PeopleReport to integrate their service industry workforce surveys into Unicru's assessment tools for that sector.

Some of these partnerships would develop into new features built into HirePro's bones—like XML integration—others would only be offered to specific sectors like pharmacies. They kept a ticker on their website that supposedly recorded how many applications they had processed in their history. On December 26, 2005, it stood at 44,382,722.

Moving HirePro online also helped open up the market for AHP's to small and medium businesses, beyond the large chains who had the investment capital to purchase a large order of kiosks and the foot traffic to attract wandering applicants (Brenneman, 2000b). This web-hosted software-as-a-service model also meant the AHP was more open to regular customization than when it came pre-loaded on a kiosk. So here you also see Unicru aggressively expanding its reach beyond retail and into food service, hospitality, trucking, and healthcare. In 2006, their 19% year-over-year increase in sales, a cash-flow positive $38 million that year, was borne largely of this focus on new clients outside retail—specifically 28 mid-sized firms with fewer than 5000 customers (Earnshaw, 2006). The rebranding and expansion onto the Web was also supposed to coincide with a push outside commercial firms and into libraries and unemployment

centers (Brenneman, 2000a). Perhaps because of the increasingly decentralized nature of US unemployment services after the Clinton administration—where policy is set in D.C. but the specifics ironed out in the states—this promise never materialized. However in a more centralized policy setting, a UK competitor—Electronic Data Systems—secured an eight-year, £470 million contract with the Blair government in 2000 to provide 9,000 Jobpoint Kiosks to 1,000 unemployment centers (House of Commons, 2001).

By integrating themselves further into clients' existing operations and using more and more measures on potential employees, Unicru began to accumulate an enormous amount of data. To make this data useful and valuable, they begin recruiting experts in industrial and personality psychology, artificial intelligence, machine learning—and prominently advertising their thought-leadership. For example, psychologist David Scarborough developed Unicru's personality assessments, promising that "Our system allows you to clone your best, most reliable people" (Overholt, 2002). Scarborough was also the lead author on a Unicru patent, filed in 2001 and approved in 2006, for an artificial intelligence system that iterated from existing employee data to generate new assessments for potential hires (Scarborough et al, 2006). He was also, as Chief Scientist, a leading Unicru representative in radio, TV, and newspapers and an expert witness for the AHP industry more generally. In 2001, Scarborough helped integrate machine techniques like neural networks into Unciru's workforce analytics (Meredith, 2001). And in 2006, he led the rollout for the 50-item Frontline Reliability Assessment, the new iteration of Unicru's personality measures, drawn from "the actual job results of 370,000 hourly workers in industries such as retail, grocery stores, and food service" (Frauenheim, 2006). This ongoing scientization of hiring helped Unicru assure its current clients—leading to a high renewal rate –- and recruit new ones, from Albertson's, to Macy's, to Rock Bottom, to Lowe's to Costco, ending

2005 with 60 clients total. Other large clients were won by acquiring smaller competitors like Guru and Xperius (Unicru, 2003a). They also expanded into the salaried and managerial workforce with their Total Workforce Acquisition Solution product, acquiring upmarket clients like Microsoft (Francis, 2004).

Of course, the post-bubble economic climate in the early 2000s differed from the high-flying dotcom years. But clients and vendors were convinced that AHPs were just as valuable in slack labor markets as tight ones. Clients in food service complained of being overwhelmed by the sheer number of applications for open positions (Crecca, 2004). And Adam Mertz, Unicru's senior manager for grocery workforce solutions, said

> It used to be that business was so brisk with the booming economy that the battle for hourly employees was fierce… Today, however, we're seeing 17 applicants for every job opening in the grocery industry, and convenience retailing is experiencing an equal flood of available workers. So, employers are in the driver seat and are now able to be more selective, which is a great opportunity to improve the quality of the hire. (Crecca, 2003)

Competitors like Recruitmax and Kenexa attempted to beat Unicru into new sectors, but largely failed because Unicru already owned the largest slice of employers—hourly—and had used that revenue to build up the data, research staff, and technology to refine their product for use elsewhere (Rafter, 2005). This success, through shifting economic conditions and multiple sectors and wage scales, led to rumors of an IPO in 2005 or 2006 (Francis, 2004; Earnshaw, 2006). But they ended being acquired instead, for $177.8 million by 'human capital management' firm Kronos, a leader in workforce analytics who got their start making automated time clocks that employees could not cheat. Unicru would form the basis of their new 'talent management division', building technical solutions for moving employees into and out of firms, integrating with the flow of client data through the 'workforce management' and 'human

resource management' divisions that management employees within firms (Kronos Incorporated, 2006). In their 2006 shareholder report, Kronos predicted that this new division would not match workforce management's earnings for some time, framing the Unicru acquisition as more of a value-add integration with existing infrastructure and intellectual property. Unicru was re-named 'Kronos Workforce Acquisition' and their software reframed as 'on-demand infrastructure' for hiring.

Around this time, fears around automated hiring and potential bias—particularly within psychological assessments—began to move out of op-ed pages and into the courthouse. In 2005, the Seventh Circuit Court of Appeals ruled against Rent-a-Center's use of the Minnesota Multiphasic Personality Instrument in hiring, finding it a compulsory medical examination that violated the Americans with Disabilities Act (Seegull & Caputo, 2006). In 2007, the Equal Employment Opportunity Commission sued Kroger—and Kronos, its vendor—after a hearing- and speech-impaired applicant filed discrimination charges after failing a Customer Service Assessment. The case has been tied up in court since then, as Kronos resists EEOC subpoenas that would reveal its trade secrets. That year, 304 discrimination charges were filed with the EEOC against firms using pre-employment tests (EEOC, 2007). In 2011, CVS settled out of court with the Rhode Island chapter of the ACLU, agreeing to remove certain items from its personality assessment that the ACLU argued targeted individuals with certain affective disorders (ACLU Rhode Island, 2011). And in 2012, the EEOC opened an investigation into Kroger, PetSmart, and Kronos, on behalf of a plaintiff rejected from a series of jobs for, he argues, automated assessments that drew on the Five Factor personality traits model and automated to a compulsory medical examination that discriminated against certain intellectual disabilities (Bal, 2014; Weber & Dwoskin, 2014).

## Claimed Benefits

We have reviewed the early stages of AHPs from job boards to resume nets to kiosks to networked websites, and seen the structural factors, often contradictory, that clients and manufacturers argue drove their adoption—both tight and slack labor markets, poverty policy via tax credits. A number of affordances emerged in this growth period, hosted on different AHPs according to client demand: Input fields for work history and references, assessments of personality and skill, scheduling, interview guidance for hirers, verification of eligibility for tax credits, and integration with a host of data brokers offering background check services and risk assessments. AHPs pick up an enormous amount of cues from applicants and translate them to useful signals for employers, molding the labor market to fit the needs of hirers. Considered in aggregate, what do these different affordances offer employers? We identified five primary benefits, claimed by both AHP designers like Unicru and their clients: loss prevention, reduced bias in hiring, reduced time spent hiring, increased retention rates, and seamless fit between employer needs and staff on hand. The master theme is of the reduction of *friction* in the labor market, by *fragmenting* workers into discrete skills and dispositions (i.e., human capital) that can be seamlessly placed into businesses. In this section, we review these claimed benefits. In the next, we critically analyze them, revealing the contradictions within them and how AHPs offer one thing but often do another.

### *Loss Prevention*

Reducing theft—often euphemistically called 'shrink'—of store stock is a major concern for retailers, who formed many of the early AHP customers, with one industry study finding it responsible for $42 billion in losses in the US in 2013 (Wilson, 2014). AHPs offer loss

prevention through more precise employee selection. This proceeds through two routes. On the one hand, AHPs promise to reduce theft by eliminating from the applicant pool anyone convicted of shoplifting or something similar, or who had previously been fired from a similar job for theft, even if they were not charged with a crime. The former would draw from arrest and conviction records, while the latter would draw from employee records shared among members of the industry. For example, the press release announcing Unicru's partnership with the data broker ChoicePoint listed the following databases to which pharmacy clients can potentially link their AHP installation:

- Esteem(R): National, contributory theft database that helps reduce employee theft by identifying individuals within this list of legally shareable data on employee and shoplifter theft contributed by members, as well as public record information on theft-related convictions. Esteem also includes job candidate Social Security number verification.
- ChoicePoint National Criminal File: A comprehensive file search, which includes over 77 million criminal conviction records from multiple criminal record sources.
- Health & Human Services List of Excluded Individuals: Ideal for pharmacy-related positions, this is a Department of Health & Human Services medical database which lists convictions for program-related fraud, patient abuse and related actions.
- County Criminal Check: Checks for job applicants with criminal backgrounds within any identified county (Unicru, 2003b).

On the other hand, automated psychological assessments promise to weed out applicants with thieving tendencies even if they had never stolen company stock or been accused of doing so in the past and had their name entered into a particular background check database. For example, Unicru built a "dependability assessment" for Universal Studios Hollywood that would "rule out individuals inclined to steal or skip work" (Rafter, 2005). The theme park's SVP of HR said that turnover was cut by between 20 and 30% in the first year of use and that they process fewer applications overall now because "Word spreads; the wrong element isn't applying anymore." So there is also, this executive argues, an indirect effect here where potential thieves are scared off

of even applying in the first place. Both of the more direct measures for loss prevention—database checks for past incidents, psychological tests for future ones—essentially build a blacklist of risky jobseekers who may not know they have been blacklisted—especially when the assessment is based not on prior deeds but on psychological disposition.

*Reduced Bias in Hiring*

AHPs designers and clients also claim that automation weeds out bias in hiring, replacing messy human decisions with a rules-based system that applies to the same metrics to everyone. This is benefit both in terms of increasing efficiency and reducing liability for discrimination suits. Machines, the pitch goes, are not only more rigorous and consistent than humans, but they can't be swayed by membership in old boys' networks. Sean Magennis, scientist with HR assessment firm Thomas International, said about Unciru's Smart Assessment and similar tools: ""From a diversity perspective, artificial intelligence can be very beneficial because it's blind to things like color, age, sexual orientation" (Meredith, 2001).

Part of the job of Unicru's scientists was not only to build these systems, but to evangelize them and their advances beyond human decision making. In 2004, industrial-organizational psychologist Steven Hunt (CITE) wrote an op-ed in the *Wall Street Journal* to do exactly this, coaching not just employers but applicants to, as the headline put it, "Cultivate a New Appreciation for Online Screening Tools." He notes that good design is key, but in general "unlike evaluations made by people, evaluations made by machines aren't influenced by idiosyncratic and largely irrelevant facts, such as whether you look like the hiring manager, went to the 'right school' or come from the same home time as the chief executive officer." Indeed, he notes that applicants should take the existence of these tests as signs that employers take staffing

seriously, before giving a series of tips on how to frame your accomplishments and workstyle for the machine.

*Reduced Time Spent Hiring*

AHPs are also supposed to reduce the time clients spend on hiring, through four principle means: 1) applicants take the responsibility of entering data that would otherwise be done by managers or clerical staff 2) the first round of vetting is fully automated, occurring within minutes 3) subsequent rounds of vetting are de-skilled, with interview guides produced for hiring managers 4) applicants are routed to branches where they're most needed, instead of having paper applications filed away at a single brick-and-mortar location. Unicru's training brochures for clients call this "faster associate capture."

Reduced time spent hiring features strongly in client testimonials from retail and food service sectors, where high turnover means managers are often constantly hiring. The 2002 *Fast Company* feature on Unicru prominently featured such testimonials. Blockbuster COO Mike Roemer said that Unicru cut their time from initial interview to job offer from an average of two weeks to just three days, a big difference given they hired around one employee in each of their 4300 stores every month. The director of employee relations and staffing for The Sports Authority said something similar: Because managers did not need to administer the initial application in person anymore and because unqualified applicants were cut out after that first stage, the retail chain saved "nearly 20,000 hours of extra interviewing and data-entry time each year" (Overholt, 2002).

*Increased Retention*

Unicru commonly claimed—referring to their own private data—that they reduced clients' turnover rates between 20 and 30% in the first year of adoption by highlighting for clients those applicants who were the best fits for open positions, and thus more likely to take to their duties and less likely to quit. Trade magazine *Chain Leader* highlighted these benefits in reviewing Rock Bottom Restaurants' $400,000 investment in Unicru's AHP: Year-over-year, they found a 21-point improvement in turnover, from 111% in 2002 to 81 in 2003. This reduction in turnover goes hand in hand with an overall reduction in processing time. As the general manager of the Chicago Rock Bottom unit put it, "There is no unnecessary interviewing." (Crecca, 2004). Because the variables of interest are specified in advance and made relatively consistent across hiring locations through a centrally-purchased platform, clients say they are both able to consistently hire the 'right' people and avoid 'mis-hires.' Prior to partnering with Unicru, Rock Bottom said they mis-hired around 30% of applicants. After implementation, that fell to under 3%. The promise is one of transparency and predictability: The AHP is supposed to help define—by analyzing the data of successful employees—exactly what you want, and then uses that to inform selection measures so that when you hire someone, you know exactly what you're going to get.

*Seamless Fit Between Employer Needs and Staff on Hand*

Related to but distinct from the automated selection of employees who will stick around is the automated selection of employees with the particular skills needed for particular jobs at particular locations. We saw above the ease with which one Home Depot manager said they could use their AHP to request candidates who fit the exact needs of the Garden department. But there is more here. Early adopters were large employers with multiple locations. While AHPs

centralize and regulate the variables of interest in hiring across all locations, they also allow for a common hiring pool to be shared across locations so that hiring managers can route the right applicants with the right skills to the right opening.

Much of the client-side discussion around timing hiring in retail is centered on seasonality: Home Depot needs help in the Garden department before Christmas, Universal Studios needs more hands on deck to handle the summer crowds. This is routine and one of the earliest AHP promises was to more quickly process applicants in periods of high employer need. But AHPs promise to not only seamlessly fit applicants into known needs, but, especially after the move to the Web and the embrace of machine learning techniques, to analyze clients' existing employee data to predict and meet new needs of which the client might not be aware. Indeed, Kronos'—whose motto is The Experts in Managing the Workforce—2006 shareholder report positions the Unicru acquisition as providing exactly this type of service, by linking their hiring analytics with Kronos' deep trove of workforce analytics to "integrate employee selection strategy with actual labor performance, link labor planning with sourcing and hiring" (8).

*Reducing Friction, and Increasing Fragmentation*

The five major claimed benefits of AHPs—loss prevention, reduced bias in hiring, reduced time spent hiring, increased retention rates, and seamless fit between employer needs and staff on hand—can be summarized as a reduction of friction in the labor market and the increased fragmentation of jobseekers into discrete bundles of skills and dispositions, i.e., 'human capital.' Each depends on the other. Adamson (2009) argues that postwar economists re-discovered 'human capital' as a theoretical concern because of a need to sort and measure the productive capacities of populations both being integrated into new development projects—from

education to public health—or entering new forms of service work that depended on attitude and culture and less on physical labor. In many ways, Unicru, especially after its integration with Kronos, is the culmination of this project, building ever more fine-grained measures for applicants' personality, ability, and history and matching them to client needs. It is a new technology but not a fundamentally new way of looking at workers. After all, Marx noted that, "For capital, the worker is not a condition of production, only work is," (Marx, 1973: 498). Unicru's *Fast Company* profile captures this well: Blockbuster employee photos were overlaid with white text reading, for example, "T or F: I pay close attention when people talk to me." The object of interest is less the whole worker than their capacities for different tasks.

It is this breaking down of jobseekers into their constituent parts that allows for the smooth transition of those jobseekers from applying to interviewing to scheduling to managing, because once the data profile has been built, it can be moved along and activated and scrutinized in different ways at different stages. What is reduced is not just the time spent at any given stage but barriers to interoperability between stages.

## Conclusion

The rise of AHPs, which have the capacity to analyze existing employee data to predict future hiring needs, also represented the opportunity to streamline the workforce by creating labor pools of applicants who may only be called upon as needed. Thus, the introduction of AHPs, as part of the labor market, may be read as the beginning march of the gig or on-demand labor market. In fact, exploring the history of automated hiring and the relationships between vendors, employers, and jobseekers, reveals a corporate push for on-demand labor that is far broader and longer-lived than the contemporary, app-

driven gig economy. An examination of the history of automated platforms represented the opportunity to explore the ur-technology that ushered in such apps as Task Rabbit, Instacart, etc.

This paper explored the design history of online job applications and the infrastructure for automated hiring, particularly for hourly workers in the US, excavating how these technological intermediaries reconfigure the hiring process and the power relations between hirers and jobseekers. First, we examined the discrepancies between the promise and the reality of AHPs by focusing on one major actor in the automation of hiring and the design of automated hiring platforms: Unicru. Founded as Decision Point Systems in 1987, Unicru was acquired by workforce analytics giant Kronos in 2006. Drawing on a diverse set of archives that include financial disclosures, court cases, mainstream and trade press coverage, instruction manuals, and policy guidance from human resource professionals, we revealed important tensions and contradictions in the discourse around how AHPs are marketed and their true functions. For example, for most of the systems active in the AHP ecosystem, it is not necessarily hiring that is being automated, rather, it is the swift rejection of perceived risky job applicants. Thus, the AHP is first and foremost a culling mechanism; a sieve that sifts for malleable and dependable labor while discarding those considered not a "fit" for the job task or for the corporate culture based on quantifiable skills and attributes. While humans remain in the loop to make the final hiring decision, the pool of who is afforded the opportunity for an in-person interview is pre-selected. Applicants clear the initial screening hurdle by, responding to various assessments for skill and personality—with the correct answers set by the AHP on the hirer's behalf.

These lengthy questionnaires are the most obvious illustration of the information asymmetry between the job applicant and the private firm. The questionnaires, administered solely for the benefit of the prospective employer, calcify the power imbalance between the job applicant and the private firm. The imposed constraints of the AHP and the manner in which it pre-scripts interactions between the job

applicant, the job application, and the human manager, ensures that the private firm retains full control over all signaling mechanisms while the job applicant is limited in how and what she might signal to the employer as part of her application—or even in her knowledge of what signals are activated by her responses. Thus, signaling job 'fit' through AHPs becomes primarily a one-way interaction. Employers specify variables of interest and AHPs build mechanisms to capture them at the point of application and elsewhere (e.g., various background checks and commercial data brokers). Applicants supply the information (or have it taken from them) because they must, and only learn about the employer through duties and expectations listed in job ads.

Some features of AHPs, such as forced or one-way signaling, calls into question its acceptance as a benevolent digital broker that equally serves job applicants and employers alike. Forced signaling is a feature of AHPs because these systems are primarily sites for the measurement and curation of 'human capital," for the benefit of the employer. Systems like Unicru's HirePro represent the first attempt to, with the help of digital technology, fragment workers into discrete sets of skills and present to employers only the precise amount and type of workers they need, precisely when they need them. The goal is to remove all friction from the labor market. Unsurprisingly, humans chafe under this system, building robust online communities to game AHPs – particularly, the personality and skills assessments. But beyond individual resistance, the features of AHPs that our research reveals denote a greater need for auditing systems enabled to crack the "black box" and to ensure that AHPs do not serve as covert vehicles for employment discrimination.

Appendix 1. *Application policies for the 2017 Fortune 500 List of Top 20 Employers in the US*

| **Employer** | **Total Workforce** | **Online-Only Application System?** | **Comments** |
|---|---|---|---|
| Walmart | 2.3 million | Yes | From their application FAQs: “"We do not accept paper applications for hourly positions. We would recommend checking for computer access at your local library or workforce solution center." |
| Kroger | 443,000 | Yes | |
| IBM | 420,000 | Yes | |
| Home Depot | 406,000 | Yes | Helpline representative: “We do not offer paper job applications. All applications are required to be submitted online." |
| McDonald’s | 375,000 | Yes, but individual franchises may elect for separate policies | |
| Berkshire Hathaway | 367,700 | Yes, but subsidiaries may elect for separate policies | |
| Amazon | 341,400 | Yes | |
| FedEx | 335,800 | Yes | |
| UPS | 335,500 | Yes | From the FAQs: “"The process for external candidates must be done in UPSjobs.com." |
| Target | 323,000 | Yes | |
| Walgreens Boots Alliance | 300,000 | Yes | |
| General Electric | 295,000 | Yes | |
| Albertsons Co. | 274,000 | Yes | |
| Wells Fargo | 269,100 | Yes | From their guide to the application process: “The application process: |

| | | | |
|---|---|---|---|
| | | | - Fill out and submit the application.<br>- You will receive an email confirmation that we have received it.<br>- The recruiter or hiring manager will review your profile.<br>- We will contact you directly if your background matches our hiring needs" |
| AT&T | 268,500 | Yes | |
| PepsiCo | 264,000 | Yes | |
| Cognizant Technology Solutions | 260,200 | Yes | |
| Starbucks | 254,000 | Yes | |
| JP Morgan Chase | 243,400 | Yes | |
| Lowe's | 240,000 | Yes | From their Careers FAQ: "<br>"To apply for a job with Lowe's, please follow these steps:<br><br>- Search for jobs on careers.Lowes.com and click "Apply Now<br>- Create your profile / account (an email address is required)<br>- Complete the application" |

Employer workforce data from 2017 Fortune 500 list of largest employers, excluding Yum China Holdings, who are based in TX but whose workforce is almost entirely in China. This should be taken as a 'best estimate available' since some of the numbers include non-US employees (e.g., through other sources, we have found that Wal-Mart's US workforce is closer to 1.4m).

Assessment of whether applications were online-only drawn from analysis of employer websites and, if that was inconclusive, correspondence with their human resource departments. To comply with the ADA, each company MAY offer printed applications as a reasonable accommodation to disabled applicants, depending on the nature of the disability and the request. This research was done on the basis of able-bodied applicants, with conclusions drawn from posted policies and phone and online chats with company representatives.

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