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Pre-Automation: Insourcing and Automating the Gig Economy

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Abstract

This paper examines a strategic configuration in the technology, logistics, and robotics industries that we call "pre-automation": when emerging platform monopolies employ large, outsourced labor forces while simultaneously investing in developing the tools to replace these workers with in-house machines of their own design. In line with socioeconomic studies of imagined futures, we elaborate pre-automation as a strategic investment associated with a firm's ambitions for platform monopoly, and consider Uber, Amazon Flex and Amazon Delivery Services Partnership Program drivers as paradigmatic cases. We attempt detection of firms' pre-automation strategies through analysis of patenting, hiring, funding and acquisition activity and highlight features of certain forms of gig work that lay the infrastructural foundations for future automation. We argue that certain forms of platform labor may be viewed dynamically as an intermediate arrangement that stages outsourced tasks for subsequent insourcing through automated technologies, and discuss the implications of this configuration for existing theories of outsourcing and technology-driven job displacement.

Keywords: gig labor; platform capitalism; outsourcing; automation; imagined futures.

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1 Introduction

In October 2014, Amazon purchased a warehouse in central Manhattan on Thirty-Fourth Street. Two months later, it rolled out its Prime Now service, which was soon available across New York City. Work was coordinated via platform. Delivery workers met at the warehouse to pick up ordered goods and deliver them within two hours of ordering. Although New York City housed highly skilled bicycle couriers and drivers who could expertly navigate the city streets, Amazon employed those who were simply willing to walk. Following this proof of concept, Amazon rolled out Prime Now to other boroughs in New York City and then to other major US cities, followed by the Amazon Flex gig-based personal vehicle delivery platform in 2015 and franchisee-based Delivery Service Partnership Program in 2018. By late 2019, reportedly over 3 billion packages, representing approximately half of Amazon's total, were delivered through these platform-based channels (Statt, 2019).

Yet there is a parallel story alongside this explosive growth of an increasingly pervasive, rapid, and outsourced last-mile delivery service. Amazon applied for its first three aerial drone delivery patents in the spring of 2014 (Kimchi et al., 2014; Navot, Beckman, et al., 2014; Navot, Kimchi, et al., 2014). During the same period when the logistics application for Prime Now was being coded, the New York City warehouse was being purchased, and the delivery service initiated in August through December of that year, Amazon filed for 30 additional patents for aerial drones, including supporting a drone's ability to carry packages, recharge on the fly, avoid obstacles and maintain ballast. The company began to lobby the FAA and local agencies for permission to deploy aerial drones in the crowded New York City airspace, gaining experimental approval in March of 2015 and petitioning for full approval in August of 2019.[1] Thus, at the same time that Amazon was investing in the construction of new contract labor networks, the firm was busy developing the aerial drone technologies and regulatory relaxation to replace the very workers it was newly employing on the streets. By 2019, CEO Jeff Bezos promised that Amazon drone delivery would be available by the end of the year, fulfilling corporate investment begun over five years earlier.

Amazon is not alone. Uber Technologies was founded in San Francisco in 2009, and soon embarked on a politically explosive expansion around the globe. The service allowed car-owners to co-ordinate with those who needed rides via an algorithmically managed smartphone app, driving strangers around for a charge. The system posed a disruptive challenge to regulated taxi industries, and helped augur the much-discussed growth of platform-based, algorithmically-managed gig labor as a new modality of contingent work (Berg & Johnston, 2019; Hall & Krueger, 2018; Rosenblat, 2018). At the same time that Uber began to invest in legal and lobbying costs order to secure the political and regulatory foundations for its gig-labor ride-hailing model, the firm also began investing in the development of a fleet of autonomous vehicles: self-driving cars. By early 2015, Uber hired away fifty researchers from Carnegie Mellon University to focus on autonomous vehicle development (Lowensohn, 2015). The US Patent Office records nineteen filed patents related to autonomous vehicles from Uber in 2015 and over fifty in 2016. Upon IPO the company disclosed an increase of funding to these initiatives of 39% between 2016 and 2017, and an additional 25% the following year.

These two cases highlight an unexplored link between two sides of the platform gig econ-

1. https://www.faa.gov/news/updates/?newsId=82225; https://www.federalregister.gov/documents/2019/08/08/2019-17010/petition-for-exemption-summary-of-petition-received-amazon-prime-air. On August 31, 2020, the *New York Times* reported the FAA's issuance of a part 135 air carrier certificate to Amazon for its drone delivery service.

omy: platform coordination of labor, on the one hand, and expansion of automation techniques for said labor on the other.[2] Far from being two separate stories, we argue that the two go hand in hand. This paper unpacks this connection by analyzing an organizational configuration that we call "*pre-automation*." We define pre-automation as *the coincident, strategic effort to scale a workforce and monopolize a distribution network via platform while simultaneously investing in its automated replacement*. While "lean platforms" (Srnicek, 2017)[3] amass ever-larger networks of externalized gig or contract labor forces to scale platform services, we demonstrate that these same firms may simultaneously and concertedly invest in the technologies to replace gig workers with machines of the company's own design. They do so by developing capabilities to automate core services in-house through technologies such as self-driving vehicles and drone-based delivery.

Despite the prominence of automation in the investor-facing strategic communications of firms such as Uber and Amazon, the literatures on gig-labor and platform capitalism have yet to seriously grapple with the existence or implications of this strategic configuration. To be sure, scholars have theorized how platform firms use technology to disrupt the business models of incumbent competitors (Srnicek, 2017), highlighted the role of automated technology as a means of algorithmically controlling the workforce (Brayne & Christin, 2020; Cutolo & Kenney, 2019; Kellogg et al., 2019; Rosenblat, 2018), or documented more generally how automation projects inevitably rely on (often invisible) human labor to step in for what machines cannot do (Gray & Suri, 2019; Sachs, 2020; Shestakofsky, 2017; Shestakofsky & Kelkar, 2020). But the orientation toward automated insourcing of a platform's own presumably core services, and the implications this holds for work, have not been addressed.

Drawing attention to pre-automated work arrangements pushes us to consider platform work and its connections with outsourcing and automation in a more dynamic manner. Viewed statically, platform labor appears as an increasingly expansive model of contingent work that is here to stay (Gray & Suri, 2019; Katz & Krueger, 2016; Ravenelle, 2019; Vallas & Schor, 2020). For the aspiring platform monopoly firms we study, however, we suggest that the current configuration of gig-labor represents neither the strategic end goal nor the imagined "future of work." Rather, it represents a presumed intermediate stage in a larger dynamic of firm-driven industrial transformation, one in which outsourced gig workers are enlisted to construct platforms' market dominance by taking on risk, trial running the system, and staging tasks for subsequent insourcing via automation. This dynamic perspective helps reconcile claims about the monopolistic dominance of platforms that support their astronomically high valuations, with the reality of perennial unprofitability and consistently low margins at companies like Uber or Amazon in their current forms (Molla, 2019).

It is *not* our goal in this paper to make predictions about the future course of platform automation.[4] Rather, our aim is to theorize and document pre-automation as *an imagined future* (Beckert, 2016; Jasanoff & Kim, 2015) which nevertheless shapes *current* arrangements

2. There are many layers of automation in gig economy systems: here we focus on gig-worker replacement.

3. Srnicek's concept of the "lean platform" describes an orientation toward capturing market share instead of producing a sustainable model for profit: scholars of platform monopoly capitalism emphasize that platforms thrive through becoming the dominant player in the market, creating effects that perpetuate and cyclically strengthen the platforms' economic position (Cutolo & Kenney, 2019). The pre-automation configuration describes how platform work that builds out this economically advantageous position is staged for later profitable automation.

4. We agree with the litany of studies of technology in the workplace that argue that humans cannot be fully automated away (Autor, 2015; Brayne & Christin, 2020; Davenport & Kirby, 2016; Ekbia & Nardi, 2017; Gray & Suri, 2019; Kling, 1991; Levy, 2015; Mindell, 2015).

of labor and technology. Studies of capitalism have argued that stories about the future — including wildly unrealistic ones — help to mobilize resources and coordinate projects (Beckert, 2016; Hirschman, 1977). Actors' imagined or projected conceptualizations of the future carry significant social and material weight in present-day decision-making independent of their actual realization (Borup et al., 2006; Brown et al., 2017; Deuten & Rip, 2000; Jasanoff & Kim, 2015), with Beckert arguing that "expectations motivate real decisions that have distributional consequences and may thus become the object of interest struggles among actors in economic fields" (Beckert, 2016, pp. 11–12). Understanding firm-level investments and decisions in the present, therefore, means grappling with anticipatory visions of the future. Intentions to automate core platform functions represent one such premise upon which contemporary labor is organized, capital is invested, particular forms of innovation are incentivized and an infrastructural monopoly is constructed.

We caution that not all "gig-work" platforms are oriented toward automation in the manner we describe, and that not all automation involves a strategic, endogenous component oriented toward market capture. We agree with scholars of the gig economy who argue against generalizing across distinct kinds of platform-enabled work under a single banner (Vallas & Schor, 2020). The two cases we describe, Amazon parcel delivery and Uber taxi services, are both dispersed mobility platforms characterized by complex yet relatively non-customized tasks. These features make them particularly likely targets of platform automation projects.

Our aims in this paper are primarily theoretical. We lay out the concept of pre-automation as a strategic configuration, marshalling available evidence about firm investments, timing of strategic initiatives, and manifestations in labor force data, and focusing on core cases of Uber driving and Amazon delivery services. We theorize the role of platform workers as infrastructural laborers in the pre-automation dynamic, and draw on interviews with workers to investigate their engagement with this process. Overall, this intervention aims to provoke an alternative perspective on the intersection of gig-work, outsourcing and automation in the era of platform monopoly capitalism.

2 Background and Conceptual Development

Sociologists and researchers in proximate fields have produced a growing number of synthetic accounts of how platform-coordinated "gig work" is transforming markets, work, employment, and firms, including an interest in workplace surveillance and its evasion (Levy, 2015; Zuboff, 2018), or the experience of gig workers (Gray & Suri, 2019; Kunda et al., 2002; Neff, 2012; Occhiuto, 2017; Rosenblat, 2018; Schwartz, 2018). Studies of "micro-entrepreneurship" attend to issues such as time-management or flexibility at work, and the use of information technologies to manage these sensibilities (Appelbaum et al., 2006; Mazmanian et al., 2013; Occhiuto, 2017). Meanwhile, economists debate basic questions regarding the scale and consequences of the platform economy, largely due to the difficulty in detecting gig workers through available survey data (Abraham et al., 2018; Collins et al., 2019; Hall & Krueger, 2018; Kalleberg, 2011; Kässi & Lehdonvirta, 2018; Koustas, 2019; Taylor, 2017). Scholars also differ on the extent to which platform-mediated gig work should be conceived of as distinct from other more traditional modes of contract and on-call work (Bernhardt et al., 2016). Applied legal scholarship meanwhile has focused on employment misclassification, and contestation over platform firms' efforts to define their role as intermediary brokers rather than as employers (Dubal, 2017). Overall, existing scholarship treats platform work as an emerging phenomenon investigable in its own right, but does not fully consider observed practices as developments within the larger

arc of platform capitalism (Srnicek, 2017; Zuboff, 2018). Such a focus suggests the need for further consideration of the connections between automation, outsourcing, and gig labor in the strategic projects of aspiring platform monopoly firms.

2.1 Automation from the Inside

Scholars of labor have long considered how machines as engines of capital can deskill workers, reduce employment costs, and heighten profit margins (Brynjolfsson & McAfee, 2011; Kristal & Cohen, 2017; Marx, 2010/1867). For instance, Marxist and neo-Marxist theories of capital's role in labor displacement view firms as adopting newly available technological tools to displace or control the labor process (e.g. Braverman, 1974; see also Kling, 1991). As such, existing accounts of automation typically assume that automating technologies are external to the firm, brought in through a complex process of integration that may or may not align with local political arrangements of tools and skills (Bailey & Leonardi, 2015; Barley, 1996).

Where the pre-automation dynamic differs from traditional conceptions of automation is with respect to both the causal ordering and assumed exogeneity of job-replacing tools. Firms deploying a pre-automation strategy marshal labor to set the stage for their own future automation. In this sense, gig job creation, automation, and job destruction are in-house, endogenous processes, central to the firms' imagined futures as platform monopolists. This same endogeneity means that labor-displacing automation is also a more iterative, protracted process. Adopting a pre-automation strategy, firms may hope to avoid well-known pitfalls of automation, such as a large, one-time capital investment in equipment and skills training, or taking on risk associated with the influx of machinery and shifts in employment relations. The pre-automated work arrangement offers the opportunity to scale services rapidly with lower risk to the firm, and to trial run a service at scale to generate logistics data that inform developing machinery.

The key fulcrum (and scope condition) of this model is the platform monopoly structure. By platform monopoly, we mean a captive distribution system that relies on large network externalities, and is undergirded by culturally-embedded consumer expectations and embodied habits (such as the expectation that one can press a button on one's mobile phone, and a car should appear on the street corner, or a package should appear on one's doorstep). Scholars of platform capitalism describe the rise of this business formation as a significant shift in the political economy of U.S. consumer markets (Srnicek, 2017). Much like the railroad networks of the late nineteenth century (Chandler, 1977), the prospect of capturing monopoly profits underwrites an enormous amount of capital investment aimed at rapidly scaling platforms and consolidating a dominant market position prior to any competitors.[5]

Because the potential rents to be generated from a monopolized, vertically integrated distribution system are so substantial, companies may be willing to devote immense resources (and sustain enormous short- and medium-term losses) in order to scale a platform network. In other words, capturing the externalities upon which the network depends presents the possibility for considerable future return on investment. These investments include not only development of basic service technology (apps and websites), but also the discounting incentives necessary to attract providers and customers, the institutional transformation efforts (political lobbying) necessary to sustain and monopolize the network (Fligstein, 2001) and the research and

5. By the middle of the twentieth century, big vertically integrated corporate enterprises with substantial capital to invest in automating technologies were normalized (Galbraith, 1967). To some extent this dynamic hunt for new monopolistic networks is at odds with older currents of Marxian political economy which equate monopolism with stagnation and lack of innovation (Baran & Sweezy, 1966).

development which will eventually allow the firm to capture a greater share of the rents from the network by displacing high-marginal cost gig providers with low-marginal cost insourced technology. Indeed it is perhaps only with the rise of platform monopolies as a business model that it makes plausible sense for a firm to develop a workforce and invest in an infrastructural network that it intends to self-disrupt as soon as possible.

In some cases the promise of automated technology plays a role in firms' efforts to solidify a platform's dominant market position. For instance, network externalities for ride-hailing and other localized gig services are known to be asymptotic and unstable due to the ease with which providers can switch between competing apps. This results in low barriers to entry for competing platforms. In contrast, captive automated vehicles cannot defect to a different platform. Hence Uber founder and first CEO's Travis Kalanick's 2016 assertion that winning the race to roll out automated vehicles was "existential" for Uber's viability as a business (Chafkin, 2016). Rather than see gig workers as compensating for automated technologies' incompleteness ex post (Gray & Suri, 2019), we argue that the deployment of gig labor is a purposive staging effort aimed at building an automated system while scaling a service, shifting the regulatory marketplace, generating capital, and enabling platform monopoly.

2.2 Outsourcing First, Then Insourcing

The pre-automation concept also points to an underappreciated function of outsourcing in twenty-first century platform capitalism. Outsourcing typically refers to the externalization of task functions which had once been performed internally. According to Dey, Houseman and Polivka (2010), firms outsource their internal functions for various reasons, including: 1) vertical disintegration and the emergence of complex forms of networked production; 2) removal of back-office functions to low-cost environments; 3) transformation of employment relationships by contracting on-site services to third-party contract firms (including temporary workers), which allows firms to reduce employee benefit expenses, circumvent pay compression norms, and displace unionized workforces; 4) changing managerial conceptions, which emphasize flexibility, focusing on core competencies, and reducing firms' internal administrative burdens (Dey et al., 2010). Economic sociologists generally agree that this form of outsourcing has become more prevalent in the U.S. economy since the 1970s, reversing a prior century-long trend toward ever-more internalized bureaucratic administration (Abraham, 1990; Bernhardt et al., 2016; Davis-Blake & Broschak, 2009; DiTomaso, 2001; Weil, 2014). On a structural level, the number of distinct business entities has grown at a significantly faster rate than the overall workforce (Meyer, 2001, p. 464), resulting in more external contracting and external coordination. At an organizational level, outsourcing appears as part and parcel of broader transformations in corporate bureaucracies and the rise of precarious employment relationships (Cappelli, 1999; Kalleberg, 2011; Weil, 2014). This transformation has the effect of offloading risk from firms onto individual contingent workers and/or the smaller sub-contractors who employ them (Irani, 2015; Neff, 2012; Weil, 2014).[6]

The rapid growth of algorithmically-managed platform "gig" work appears to represent the culmination of outsourcing and contracting trends *in extremis*. But while outsourcing had traditionally been viewed as primarily affecting firms' auxiliary activities and inputs,[7] contem-

6. These are conceptually distinct insofar as outsourcing refers to the boundaries of firms, whereas contract work refers to employment relations between firms and workers. For instance, a firm could outsource a task to a supplier whose workers themselves are traditional full-time employees.

7. Gray and Suri (2019) argue that by the 1990's, firms classified various forms of work as "core competencies"

porary platforms go a step further in *externalizing provision of the firm's core task functions*. For example, rather than hiring a third-party transportation services firm to supply a pool of taxis and drivers, platform ride-sharing companies use a web-based app to separately contract each discrete job with an individual worker-contractor, positioned as a "micro-entrepreneur."

Platforms also offer a novel business motive for outsourcing. Although firms pursuing pre-automation aim ultimately to reduce marginal labor costs by replacing human service providers with firm-owned automated technologies, they are at least initially primarily interested in building up market power, which takes the circuitous route of outsourcing labor. As we elaborate, outsourced gig-labor is useful to the company in this early phase to externalize costs and risks associated with scaling the platform network: scaling which justifies costly concurrent investments in automation. We therefore add to Dey et al.'s list of outsourcing rationales: *Outsourcing as a staging opportunity for bringing automatable work in-house*.

Locating automation efforts internally to the firm and observing this rationale for outsourcing suggests skepticism of the assumption that current forms of platform-mediated gig labor represent some kind of stasis point or end-strategy for platform firms. Gig work is an emerging and dynamic phenomenon, and among its dynamisms we must consider current observed practices as developments within the larger arc of platform capitalism. As we describe below, reconstruction of key firms' investments reveals that current forms of algorithmically-managed gig work are conceived as a prelude to an automated distribution network in which today's gig workers are rendered redundant through the firm's development and deployment of in-house technology. For this reason, we look beyond the current organization and experience of gig work to consider how companies strategically deploy a particular form of labor externalization to pave the way for monopolized, automated, imagined distribution systems. In our view, what is most novel about platform-mediated outsourcing is not the precarious or technologically-imbricated form of labor (this also accompanied industrialization: see Gray & Suri, 2019); but the role that this externalized workforce plays in facilitating an expansionist business strategy specific to platform monopoly capitalism (Srnicek, 2017).

3 Pre-Automation in Action: Two Case Studies

3.1 Example #1: Amazon Prime Air, Flex, and DSP

The timeline in Figure 1 maps the scaling of the outsourced gig workforce associated with Amazon delivery including Prime Now, Flex, and the Delivery Services Partnership program, alongside a parallel effort within the company to develop the core automation techniques for worker replacement. In the absence of data on internal deliberations, we reconstruct firms' strategic orientation from public patent records (compare to Delfanti & Frey, 2020), investment and acquisition histories recorded on an industry-standard database (www.crunchbase.com), and records of series-specific funding rounds, lobbying activities, and other general announcements available in the technology press.[8] The left side of the timeline shows the expansion and evolu-

versus auxiliary at will in order to protect their ability to selectively outsource, as in Vizcaino v. Microsoft Corp., 120 F.3d 1006 (9th Cir. 1997).

8. We were unable to interview or visit employees of these firms, which are famously closed to outsiders, and therefore could not access direct statements of corporate strategy. However, interviews with elite members of each organization were unlikely to shine much insight upon business practices as such individuals are practiced at controlled conversation with outsiders. We therefore worked through indirect means to access necessary information, relying on trace data in public records to piece together strategic direction.

tion of Amazon's last-mile delivery system into an increasingly captive platform-based model, while the right side documents concurrent investment in research, development, or acquisitions associated with a fully automated version of the same service (Figure 1). While a company the size of Amazon may often undertake multiple simultaneous and unrelated ventures, we argue that these parallel and intertwined corporate activities suggest a pre-automated strategy in action.

Amazon's Last-Mile Programs	Year	Amazon's R&D and acquisitions
	2013	December: CEO announces drone delivery development on *60 Minutes*
Summer: Prime Now program idea October: Amazon buys warehouse space on 34th street in Manhattan December: Prime Now service begins in NYC	**2014**	CEO begins Prime Air internal dvision Spring: Amazon applies for first drone delivery patents July-December: 30 patents filed for drone delivery technologies over 6 months
Prime Now expands across Manhattan September: Begins Flex platform for driving delivery services	**2015**	94 patents for autonomous aerial vehicles filed.
California classifies Prime Now drivers as employees	**2016**	95 patents for autonomous aerial vehicles; 16 submitted for autonomous vehicles.
Flex rolled out to 11 US cities	**2017**	Acquires Dispatch.AI and Scout robot (founded in 2014) Begins Amazon Vehicles division Additional 95 patents submitted for drone delivery; 12 for autonomous vehicles.
Amazon begins Delivery Services Partnership Program (DSP) in Q2	**2018**	December: Announces drone delivery "within months"
Amazon incentivizes employees to start their own DSP franchise	**2019**	Senior VP placed in charge of both DSP and autonomous vehicle division

Figure 1: Parallel timelines for development of automated services and Prime Now, Flex, and DSP. Sources: LexisNexus, US Patent Database, TechCrunch, WSJ

The idea for the two-hour Prime Now delivery service emerged in the summer of 2014 (Kantor & Streitfeld, 2015), mere months after Jeff Bezos announced in an interview on 60 Minutes that the company was working on drone delivery technologies.[9] Within weeks of initiating its dedicated drone delivery unit, Amazon purchased a warehouse in central Manhattan to stage the deployment of Prime Now's rapid delivery service. Amazon repeated this pattern in September 2015 with Flex, a client-side platform to meet demand for same-day delivery outside of Manhattan, where individuals signed up to deliver packages by car within a given metropolitan area. Throughout 2017, while Amazon expanded Flex to eleven US cities and advertised for new drivers, the company also purchased Dispatch.AI and its mobile delivery robot, Scout, founded a subsidiary called Amazon Vehicles, and began patenting in autonomous vehicle and delivery services for last-mile deliveries.

In the latter half of 2018, Amazon rolled out its delivery services partnership program (DSP), relying on an exclusive franchisee network of micro-entrepreneurial small businesses to deliver packages. Instead of signing up to drive via Flex, an individual could found a small business that employs other drivers and bears the capital costs for a fleet of 10-40 vans. Like

9. https://www.cbsnews.com/news/amazons-jeff-bezos-looks-to-the-future/. Accessed December 3, 2020.

Uber, which provides financing for individuals to lease vehicles for the ride share program, DSP also provides incentives for van leasing and back-office support for these local delivery startups. Deliveries are coordinated algorithmically, via an Amazon smartphone app used by every driver, thus ensuring Amazon manages the delivery logistics and retains control of the data while avoiding the burdens of workforce management and vehicle maintenance. Rollout of this service also coincided with fresh investment in autonomous vehicles and trucks for last mile delivery services. The DSP and Amazon's automated vehicle delivery programs were not separate initiatives: by 2019, the same executive, Senior Vice President Dave Clark, was running both programs, and Amazon was offering its employees financial incentives to quit and start their own DSP franchise (Berger, 2019).

Examining patents filed by Amazon during this period reveals that these announcements reflected a series of sustained investments into this technology. Automation efforts in the Prime Air drone division began on a small scale in 2014 while the Prime Now service rolled out in Manhattan, growing steadily over time with individual and small team hires. Although they purchased a few small robotic delivery companies, the company largely scaled up their in-house automation division through strategic hires directed at developing automated last mile delivery internally. Patent data not only reveals *what* a company is working on but also *who* is working on these problems: associating LinkedIn profiles with patentor names indicates that individuals who joined Prime Air and Amazon Vehicles were hired from other Seattle-based technology companies such as Intel or Microsoft, or west coast aerospace such as Boeing or the Jet Propulsion Laboratory; they moved on from their time at Amazon to robotics, logistics, or automation-oriented companies, perhaps due to the expertise they developed at Amazon. We also observed that many of the project teams associated with Prime Air contributed early patents as anchor tenants for the new automated vehicles unit, officially founded in 2017 but with an earlier patenting record. Taken together, all automated delivery service patenting grew to approximately 7% of approved patents throughout the Prime Now and Flex roll-out period of 2014–2017 (Figure 2).

Patents serve many purposes within a corporation, but it is suggestive to read this evidence of steady growth of investment in automation in the context of Amazon's experimentation with a variety of in-house and out-of-house delivery options throughout the 2010's. For instance, Amazon attempted to work through UPS and USPS exclusively instead of via FedEx, purchased their own fleet of airplanes (in a different, prior iteration of "Prime Air"), and experimented with their own delivery vans and long-haul trucks. In the public press these configurations were framed as an attempt to "solve the problem of last mile delivery," as if this problem were merely technical and logistical. The preferred solution to this problem involved altering the relational architecture of the market (Fligstein, 2001) by progressively cutting out third party delivery firms. The expansion of Flex, Prime Now, and later DSP as well as parallel investments in drone and automated delivery together aim to "solve" Amazon's problem of last mile delivery with logistics applications owned by the company.[10] Amazon already operated heavily automated warehouses and possessed the expertise in robotics, logistics, and flexible work arrangements — in addition to the substantial capital — necessary for investment in research and development. Prime Now and Flex, in their initial articulation and pre-automated arrangements, therefore drew on existing trends toward automation, contract labor, and logistics within the company to initiate a form of industry capture.

Investment in developing these technologies also took place alongside an explosive growth

10. A form of "closure by redefinition of the problem" (Pinch & Bijker, 1987).

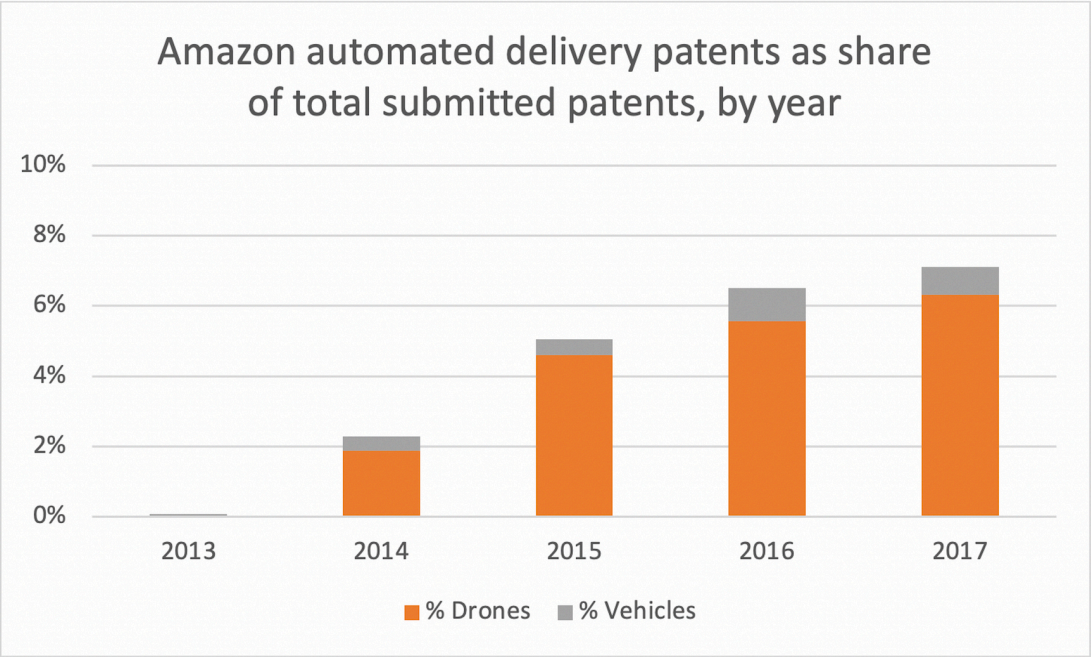

Figure 2: Automated delivery patents as share of total Amazon patents submitted, by year

of workers in this sector. The impact of Prime Now and Flex is difficult to discern due to the low visibility of workers in public records, but DSP "startups" are sub-contracted franchise establishments with statutory employees, making the impact of Amazon's DSP program discernable in industry data. We therefore drew on the Quarterly Census of Employment and Wages (QCEW) from the Bureau of Labor Statistics[11] to plot trends (2015–2019 Q2) in the number of establishments, total employment, and average weekly wages in the delivery-driving industry. Before 2017, we witnessed steadily increasing consolidation and centralization in the delivery services industry as existing companies scaled up to deliver growing numbers of packages for e-commerce behemoths like Amazon. The reversal of this trend in the number of delivery establishments just after the DSP launch in the third quarter of 2018 is striking (Figure 3). The QCEW data show a net estimated increase of approximately 1,500 establishments from the launch of DSP in late 2018 through the first quarter of 2020. Not all of these are Amazon partners, of course, although the change is comparable to the 1,300 startup businesses which Amazon claims to have spawned through the second quarter of 2020.[12] The total number of persons employed as delivery drivers was already on the rise before the introduction of DSP due to the secular growth of e-commerce, but the DSP rollout may have accelerated this trend based on the third quarter uptick in 2018. The number of delivery drivers doubled to over 100,000 by Q2-2019 (Figure 4). The introduction of the DSP program therefore tells a story of initial consolidation in an employment market, then rapid expansion of an employment opportunity alongside a distribution network. We suggest that such simultaneous scaling of a platform, labor capture via gig work, and investment in automation technologies are complementary activities in a pre-automation strategy.

11. https://www.bls.gov/cew/downloadable-data-files.htm

12. http://www.aboutamazon.com/news/transportation/two-years-of-empowering-entrepreneurs-with-more-to-come

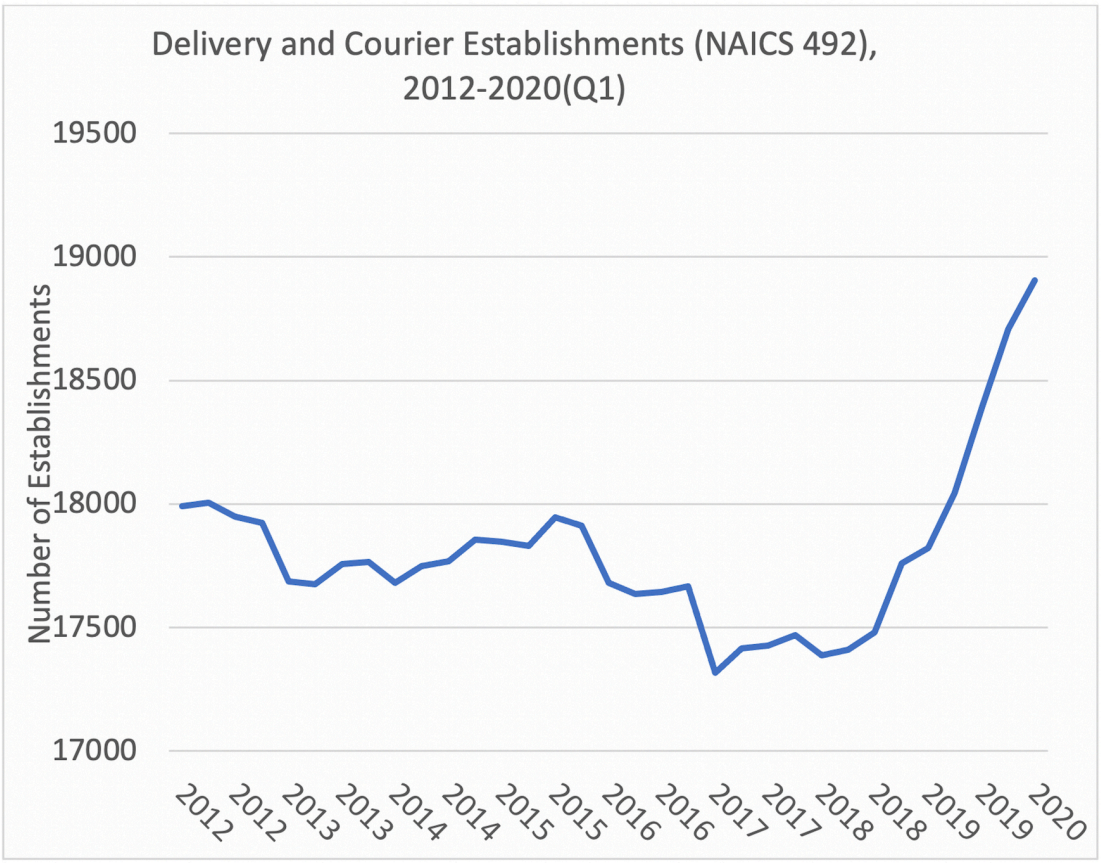

Figure 3: Trend in total number of parcel delivery establishments nationally, 2012–2020. Data come from Quarterly Census of Employment and Wages. Consolidation reverses in mid-2018, with the launch of Amazon DSP franchise program.

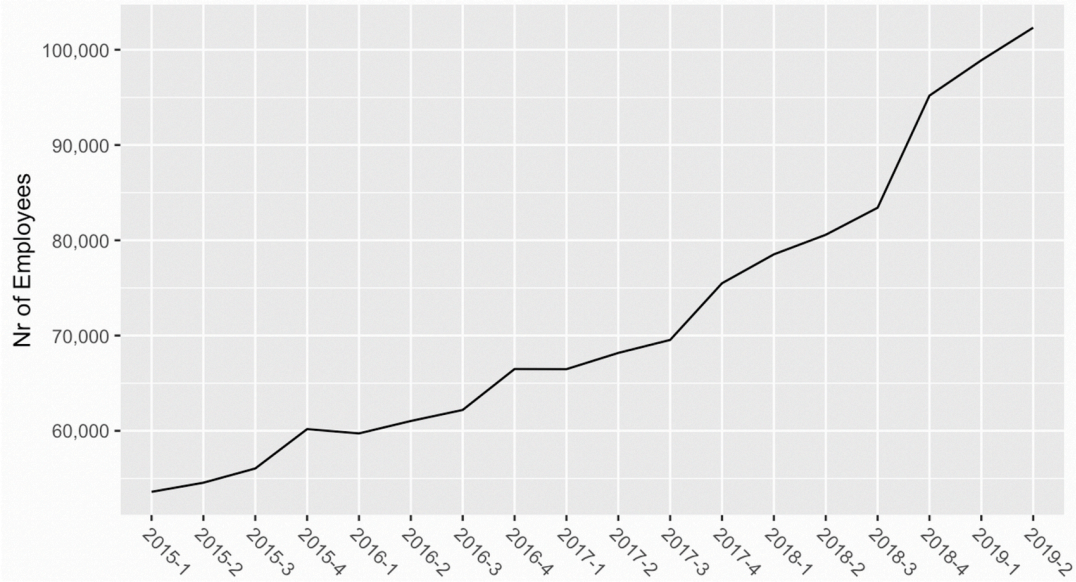

Figure 4: Trend in total number of statutory employees in parcel delivery industry nationally, 2015–2019. Data from Quarterly Census of Employment and Wages, 2015–2019.

3.2 Example #2: Uber Technologies

Amazon already possessed considerable capital at the outset of its automated delivery development and had the resources to initiate concerted research efforts in automation at the same time as introducing and scaling a new gig service. Uber, meanwhile, took an *acquisitive approach*, displaying a strategic pattern of growth and corporate acquisitions that guaranteed both employee expertise and the transfer of existing patents.[13] Despite its founder's early professed interest in producing self-driving vehicles, for the first few years of the company's existence the company made no direct investments in developing this technology. By 2014 the startup had enough initial success and access to capital to invest strategically in the acquisition of automating talent and expertise. In early 2015, the company hired fifty autonomous vehicle researchers from Carnegie Mellon University, followed by the purchase of Otto the following year. This included experts and patents filed from 2013 onward about lidar (light detection and ranging), sensing technologies essential for an automated vehicle to detect and analyze distance from obstacles and other vehicles. As efforts on the gig economy platform scale, investments in automation scale too, with research and development growing accordingly (Figure 5). Uber's patent holdings demonstrate considerable commitment to this project: by 2017, over 40% of their total approved, purchased and acquired patents were dedicated to autonomous vehicles, including half of all patents filed in 2017 (Figure 2). We observed that the acquired groups generated a stable patenting infrastructure for Uber's ongoing efforts and were still visible as

13. Pre-automating companies do not necessarily need to make space internally for simultaneous development of automated technologies. Lyft, for instance, followed up on their CEO's public discussion of automated vehicles in 2012 with an official partnership with Ford's automated vehicle unit, much like the partnerships Uber and Amazon announced with external firms at the close of 2020. Hybrid arrangements are also possible, with Amazon's acquisition of Zoox in summer 2020 following Uber's acquisition-oriented strategy. Future work should examine strategies companies deploy to maintain their core gig-economy business while scaling the automating aspect of their service as finances permit.

enduring clusters several years later, with LinkedIn profiles revealing little firm attrition.

Uber service expansion	Year	Uber automation efforts
Uber expands to Europe Taxi drivers strike in France, app banned in Germany, California cities sue	**2013**	
Uber-pooling introduced Public outrage over surge pricing	**2014**	May: CEO publicly describes intention to introduce self-driving vehicles
Enters agreements with cities for passenger data sharing Adds 50,000 drivers	**2015**	January: hires 50 roboticists from CMU; self driving car tests begin in Pittsburgh 18 autonomous vehicle patents filed in 2015
Waymo-Google-Uber battle over autonomous vehicle patents	**2016**	Acquires Otto, self-driving truck company, and patents dating back to 2013 September: begins automated vehicle tests in San Francisco $230 million reported investment in self-driving vehicle research. 51 patents approved patents submitted
CEO steps aside, promises "Steve Jobs moment" Drivers agitate toward unionization and benefits	**2017**	$384 million invested in self-driving vehicles; 75 approved patents submitted. Website up for Advanced Technologies Group (self-driving vehicles unit) Funding from Toyota in corporate round

Figure 5: Parallel timelines for Uber service roll-out alongside car automation efforts. Sources: LexisNexis, US Patent Database, Crunchbase.com, Uber Technologies Inc. S-1 Registration Statement.

If Amazon's pre-automation narrative is one of vertical integration and industry capture, Uber's is a story about acquisition and investment. Although its CEO stated interest in self-driving cars earlier, Uber began its automated efforts once the platform had suitably expanded and investment levels were high. It was late to acquire its first self-driving car patents (by then, companies like Microsoft, Google, Apple, Ford and Toyota had already invested millions) and records of successive years of patenting are largely due to its strategic acquisitions of people, companies, and patent holdings (Figure 6).[14] Uber's IPO documentation filed in early 2019 lists approximately 30% R&D investment oriented toward self-driving vehicles between 2016–2018, with $457 million dedicated in 2018 alone, supporting its claim that "autonomous vehicles will be an important part of our offering over the long term" (Uber Technologies, 2019, p. 33). Including the cost of acquisitions, it is estimated that Uber spent nearly $1 billion on research and development of automated vehicles from 2015–2020 (Harris, 2019). Consider-

14. Uber's patent acquisition strategies, including the creation of the corporate entity Apparate, became more widely known following a high profile lawsuit with Google Waymo over the 2013–4 patents.

able shareholder capital is therefore bet on the assumption that an eventual automated system will eliminate or at least reduce the marginal labor costs of human-driven service delivery, with patent capture providing additional revenue along the way.[15]

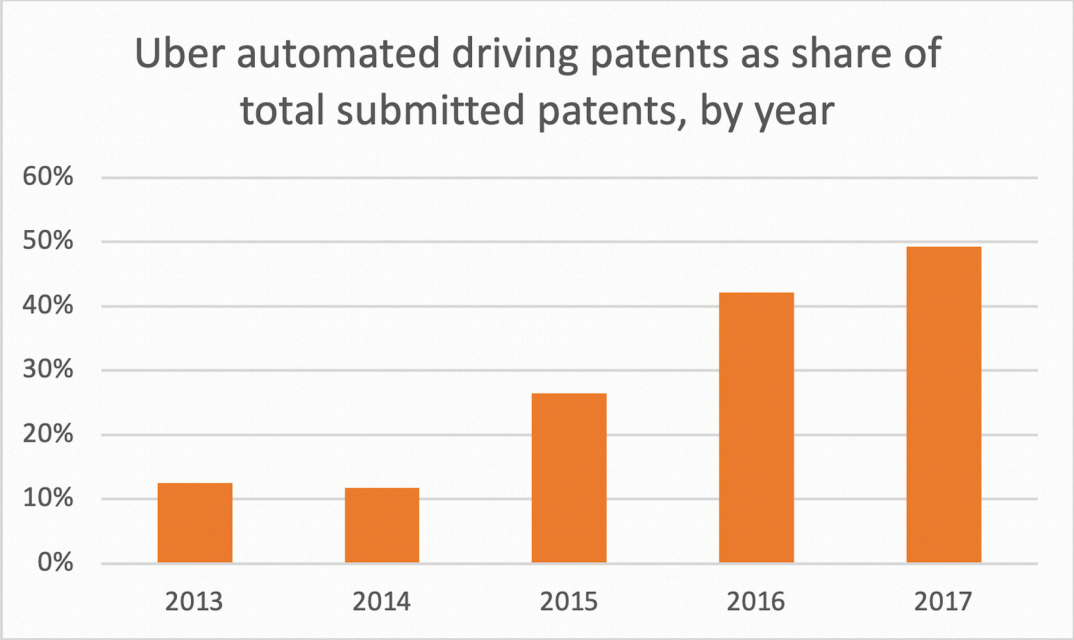

Figure 6: Automated delivery patents as share of total Uber patents, by year submitted. All 2013–2014 patents were acquired.

Such data suggests that Uber's excessive valuation during this period was not only premised on its global expansion, but also upon its ability to eventually automate and insource its core "sharing" service: driving. Self-driving cars were seen as expensive to develop relative to low prospective revenue in early direct-to-consumer sales, requiring the kind of capital for research and development that could only be offset by such established companies. Uber's strategy aimed to guarantee prospective sales not by selling cars to consumers, but by introducing automated vehicles to *cities* as a mode of taxi transport. Although exaggerated promissory narratives about future technological plans are often used for strategic purposes to raise capital, we note that Uber's own 2016 internal projections for AV taxi rollout ranged from between 13,000-75,000 cars by 2019.[16] In the meanwhile, their "disrupting" online sharing platform dismantled the existing taxi infrastructure in those cities, paving the way for the hoped-for, eventual

15. Compare to Viscelli on automated trucking (Viscelli, 2018). Additionally, a recent paper by Delfanti and Frey argues that Amazon patents demonstrate a more synergistic human-robot future, whereby human labor is assisted through machinic devices (2020). This may be the case in warehouse work, but our study points in a different direction, wherein this synergism is an intermediate stage toward the intended full mechanization of work. As these assistive patents describe and circumscribe human labor in increasingly mechanical terms, they stage such labor for eventual takeover. Reading patents as evidence of sociotechnical imaginaries, successive staged futures are made visible in documentation of anticipatory technologies, themselves anticipated in stepwise fashion (compare to Messeri & Vertesi, 2015).

16. These internal presentations later became public in the context of an intellectual property lawsuit. See p. 22 in https://www.documentcloud.org/documents/5765440-2275-4-Uber-Bratic-Report-EXCELLENT.html. Accessed December 20, 2020.

insertion of the company's own automated vehicles.

As with last-mile delivery, suggestive traces of this pre-automation strategy are apparent in labor market data for the taxi industry. Unlike the DSP, these companies do not encourage individuals to start their own businesses, so the numbers of new drivers who work exclusively for ride-sharing services are difficult to quantify. Instead, we looked at mean weekly wages at the industry level, where we noted a staggering increase. Between 2015–2019 average wages in the taxi and limo sector rise from around $500 weekly to a peak of nearly $1700 per week (Figure 7). We postulate that these increases were not driven by the dwindling number of traditional taxi drivers, but rather reflect the *rapid compositional replacement* of taxi drivers with an influx of tech workers who are developing the applications for ride-sharing and the automated technologies for driver replacement. Such wages are not out of place in computer or information technology sectors, but as these employees apply their skills to other industries in an effort to "disrupt" markets, they may leave similar empirically observable residue in wage trend data.[17]

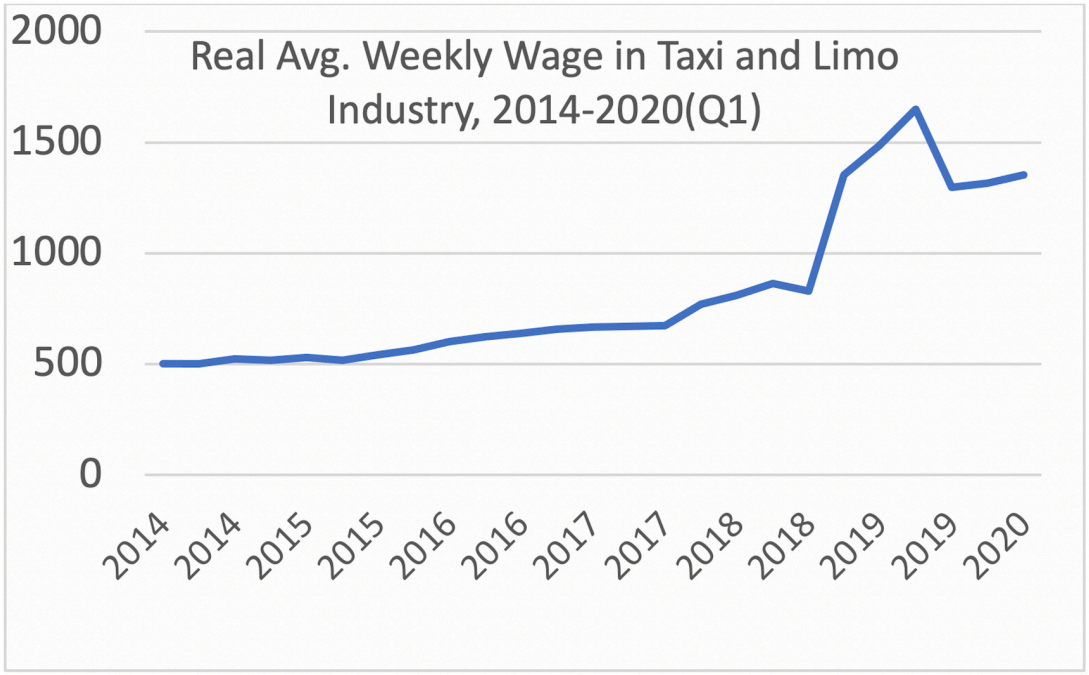

Figure 7: Trend in real average weekly wage among employees in the taxi and limousine industry, 2014–2020. Data from Quarterly Census of Employment and Wages, 2015–2020. Tripling of wages suggests influx of high-salaried technology jobs, a potential signal of a pre-automated strategy in action.

4 What Do Pre-Automated Workforces Do?

Above we provided snapshots of pre-automation processes in action as associated with the development and strategic configuration of two prominent aspiring platform monopoly firms. Here we elaborate specific theorized functions of workers within these pre-automated platforms as distinct from other types of platform gig work and as oriented toward monopolization efforts. From this perspective, platform gig workers can be seen as *infrastructural laborers*

17. Unfortunately, occupation-by-industry tabulations are not available in the QCEW.

rather than just outsourced service providers responsible for revenue generation. We propose that preautomated laborers build out the infrastructure for aspiring platform monopolies in three key ways: (1) scale the network and establish consumer demand; (2) take on corporate risks as individualized risks under the frame of micro-entrepreneurship; and (3) trial-run logistics for tasks that are intended to return in-house in automated form. Given only indirect data, we offer the following as speculative propositions, which we complement with data from forty-one structured interviews with contract employees of pre-automating firms (20 with Amazon workers, 21 with Uber or Lyft drivers).[18]

Scale the System. We theorize that the first-order infrastructural function that pre-automated workers perform on behalf of the aspiring firm is helping to scale the network. Scale is the watchword of platform economics, especially for "lean platforms" which emphasize network construction and coordination (Srnicek, 2017). Through independent registrations, workers build platform service-delivery into city- or nation-wide infrastructure: the increase in human-powered service providers visible in Figure 3 and Figure 4 provide evidence of such growth. As the system grows, so does the user base and demand from those users. With every Flex delivery, Flex drivers help Amazon gain one more customer who is accustomed to having access to same-day package or grocery delivery. As the system scales, too, both customers and gig workers argue for the rollback of regulation that impedes continued service delivery. Legal battles over such propositions are well documented in the press; on Facebook groups dedicated to drivers, we noted considerable pushback against regulation or unionization of gig jobs as drivers feared this would lead to job loss. Infrastructural laborers may therefore themselves serve as frontline deregulators for automated services. Scaling the network helps to establish the captive consumer demand and the network externalities that both support and justify firms' enormous investments in automated technologies to replace such labor. The priority of network scaling at low cost is synergistic with such firms' reticence to classify workers as employees, thereby reducing overhead.

Take on Corporate Risk. We theorize that pre-automation externalizes the *cost* of expanding the network onto gig workers, as well as the *risks* of soon to be obsolete capital investments, through leveraging the contractual relationship common to gig work. By suggesting individuals invest in a vehicle to drive for Uber or purchase a small fleet of vans to deliver for Amazon, companies offload the capital investments associated with growth and scale onto micro-workers, while ensuring they do not sink money into soon-to-be-replaced technologies. The gig workers we spoke to described a variety of these investments, from smartphones to vehicles, as well as the creative techniques they used to maintain profitability despite investment risk: for instance, by planning when to complete their required hours of driving or, in the case of one PhD-holding driver we spoke to, maintaining complex spreadsheets to decide which jobs were profitable enough to accept. We posit that requiring gig workers to invest in and manage these technologies under the framework of "being your own boss" allows the platform firm to focus their own investments in the technologies that will allow them to capture the full poten-

18. We recruited delivery drivers and couriers via flier and Craigslist postings in Queens, Manhattan and in Central New Jersey; advertised on a national website that helps low-income workers manage their benefits; and joined Facebook groups for Amazon Flex Drivers. We therefore spoke to individuals located across the United States but primarily in lower SES conditions. Interviews took between 20-60 minutes and interviewees were remunerated for their time. Anonymity was preserved at all levels of the process: in Amazon's case, at least, the repercussions for those who speak to outsiders about their work are reportedly swift and decisive. Transcribed responses were compared with respect to specific questions, and we also developed and applied an open inductive coding schema based on responses. Complete analysis of findings are under development in a separate paper; we report only on findings relevant to industry automation here.

tial rents of that network in an automated future. Meanwhile independent drivers and small business contractors construct the network on their behalf.

Train, Trial and Taskify. We theorize that pre-automated platform workers may help pave the way for task automation by trial running a scriptable and predictable system. Prior studies of work with algorithms demonstrates the role of human labor in training machines to recognize elements in a dataset (Gray & Suri, 2019; Roberts, 2019; Sachs, 2020); scholars identify how this work is dynamic and shifting because as the algorithms learn from behavior, data becomes more structured (Kellogg et al., 2019; Seaver, 2019). Certainly workers using these platforms transit task-level data to the firm, including patterns associated with demand, delivery routes, obstacles, and timings, providing ample data to refine or improve a model. Yet tasks are also made routinizable and optimizable and therefore automatable through an engineering view of the problem of driving or delivery. Workers we spoke to reported constant system upgrades where they could sense the presence of engineers attempting to script or "improve" their work. For instance, an Amazon Flex driver described new numbering schemes for packages that made sense to a machine but were impractical and difficult to decode as they organized packages in their cars to deliver in their neighborhood. Workers like these often recorded completing the task recommended by the app while following their own methods instead, and used such stories about the non-driving related aspects of their work to assert that it was impossible for a machine to do the job (Stark, 1980). While prior scholarship frames such algorithmic efforts and resistances in the context of employers' attempts to control the labor process (e.g. Levy, 2015; Rosenblat, 2018), we suggest these developments may ultimately be oriented toward making platform workers' tasks compatible with the development needs of engineers (Stark, 1980), therefore better enabling eventual automation.

Casting certain forms of gig work as infrastructural labor can help to distinguish pre-automated arrangements from other studied forms of platform labor. For instance, Gray and Suri (2019) describe the hidden human work in seemingly-automated platforms as "ghost work," explaining its rise and precarity as endemic to the inherent and historically persistent difficulties associated with replacing human labor with machines: what they identify as "the paradox of automation's last mile." The insertion of human laborers in a system rollout recalls a common design technique in engineering, "the Wizard of Oz" technique, in which usability experts trial-run systems using people to understand how users might react to such a system were it to be implemented (Dahlbäck et al., 1993; Kelley, 2018; Wang et al., 2017).[19] In contrast, pre-automated arrangements are not a response to technical limitations, but rather a strategic and purposive arrangement of people and machines that capitalizes upon the infrastructural efforts of highly visible human workers on the front lines to develop the automated service "behind the curtain." Precarity arises as workers are poised to lay the infrastructural, social and economic foundation for their own eventual automation. This also clarifies which companies are emphatically not automating their core functions. For instance, TaskRabbit, Fiverr, or AirBnB invest in algorithms to produce matches between clients and workers, but the services that gig workers on the platform provide are not (yet) being actively scripted or prepared for automation: owners and guests are even rated on their interactional qualities. Not all gig work is pre-automated: pre-automation techniques form only one variety of a broad taxonomy of platform coordinated labor (Vallas & Schor, 2020).

The arm's length relationship offered by outsourcing produces a divergence in narratives

19. The name refers to a scene in American children's author L. Frank Baum's book in which protagonist Dorothy discovers that what appears to be a "great and powerful wizard" is really a small man behind a curtain pulling a puppet's strings.

about the future of such work among gig workers themselves. Our interviews suggest that gig workers are largely marshaled into the automation project unwittingly, and even dissociate themselves from their future at the company with automated cars driving alongside them. We discovered this dissociation when, after several detailed questions about their jobs and daily routines, we asked, "Do you worry about self-driving cars?" The majority of the respondents paused and changed their tone, answering as if we were asking them if they wanted to own such a vehicle themselves. "Self-driving cars? I'm not worried about that," said one, launching into a discussion of the vehicles' safety records as if they were thinking about buying one. Another expressed a similar interest, saying, "it's always good to try new things." Respondents also answered in the position of a customer or driver who might be "in one of those"' and not in the position of job loss. Only two of our respondents identified pre-automative goals, explaining in expletive-laden terms that their parent companies were "greedy" and uncaring about people. Notably, unstable earnings and schedules were the norm for many of the workers we spoke to, who framed gig work as something they expected would be temporary before they were forced to find other work. Concerned with a need to make today's ends meet, these respondents framed the possibility of automation as yet another economic future that would not include them, using phrases like "times are changing" and "anything could change at any moment" that underlined their sense of precarity.

Workers' relative inattentiveness to the spectre of task automation stands in contrast to prior research which finds that gig workers are highly attuned to other aspects of platform firms' strategies, particularly with respect to algorithmic management (Rosenblat, 2018). We posit that workers' distance from and skepticism of the firm's automation narrative may therefore be a product of the very arm's length relationship that firms adopt in their efforts toward automation. It may also explain why prior studies that focus on gig workers have avoided the connection between automation and firm monopoly strategy: the workers don't see it (both intentionally and unintentionally) or, in line with research in the sociologies of the future, they contest its very possibility (Beckert, 2016; Brown et al., 2017).

5 Conclusion

This article has identified an alternative way to think about the platform economy, premised on the detection of strategies that suggest new implications for our understanding of the dynamics of automation, outsourcing, and labor displacement. Of course, the use of low-wage labor to midwife automation projects is endemic across Silicon Valley. We suggest that in the development of certain platforms at least, gig labor is not merely attractive as a reaction to technical challenges associated with the inevitable limits of automation. Rather, we tell a story about a purposive deployment of human workers to scale a platform network as part of a business model that attempts to realize a platform monopoly's full rent-generating potential. Evidence for the mechanics remain suggestive; we therefore offer pre-automation as a topic for further elaboration by sociologists and historians of this period in the expansion of the platform economy, especially as firm-internal documentation becomes available for analysis.

In developing this account, we have sought to take the promissory narratives of automation's apostles seriously without taking them literally as empirical predictions. We agree with scholars in technology studies who cast doubt on the viability of techno-utopian visions and suggest that the receding horizon of automation's cutting edge will continue to require armies of human workers (Gray & Suri, 2019; Shestakofsky, 2017; Viscelli, 2018). Indeed, both of the corporate projects sketched in the timelines above have faced significant delay and even di-

version. With investor confidence riled by claims of harassment, toxicity, and a patent lawsuit, Uber brought in a new CEO who avowed drivers as core to their business and expressed an interest in hybrid autonomy. Shortly before this article went to press, both Uber and Amazon partially divested themselves of their automated divisions, citing a more protracted development process than expected. Of course, economic sociologists document how companies make dynamic choices between futures-in-the-balance when they find themselves in moments of economic uncertainty, not due to the inability to deliver on technologies associated with future claims (Beckert & Bronk, 2018; Kaplan & Orlikowski, 2013). We should therefore expect to see the economic destabilization due to Covid19 to prompt pre-automating companies to keep their strategic options open, as in Amazon's November 2020 decision to outsource their drone development ("Amazon Lays off Dozens of Employees at Drone Programme," 2020), Uber's December 2020 sale of its pre-automated vehicle division while maintaining a 23% stake and board seat for their CEO (Bursztynsky, 2020), and even Amazon's fresh step into the self-driving vehicles market with a fleet produced by acquired company Zoox. Such developments are consistent with a large literature that documents both firms' responses to uncertainty and the near universality with which automation efforts are messy, non-linear, and even deflected (Barley, 1996; Burawoy, 1979; Kellogg, 2009; Kling, 1991; Lei, forthcoming; Sellen & Harper, 2003; Volkoff et al., 2007).

Nonetheless, we believe that identifying pre-automation as a strategic configuration helps to highlight key developmental features of platform monopoly capitalism. First, pre-automated work arrangements point to a distinctive rationale for outsourcing within key segments of the platform economy. In contrast to prior literature that highlights the efforts to progressively externalize auxiliary task functions, we argue that pre-automating companies deploy gig- and sub-contractual relationships to perform the infrastructural work of scaling and capturing monopolistic platform networks, as a staging ground for eventually "insourcing" core functions in future automated form. This, in turn, suggests an expanded view of contingency and risk in platform gig work beyond the short-term precarities that arise from volatility of customer demand. Aspiring platform monopolies also foist onto largely unsuspecting gig workers the risk of scaling and developing the service network, including capital investment costs for equipment (cars, delivery vans, etc.) which they expect to soon render obsolete with their automated service. Pre-automated outsourcing therefore not only produces precarious work with unstable pay: it also produces precarious micro-entrepreneurial roles whose viability may be fleeting. This may require a shift in strategy for those arguing on behalf of platform workers' labor rights.

Second, we suggest renewed attention to processes of in-house automation. Such attention demonstrates how platform companies scale toward monopolization through strategic investments and acquisitions that bring the tools for eventual infrastructural development and market capture in-house. The externalization of the automatable labor force combined with the invisibility of internal research and development efforts produce a sensibility toward impending automation as if it appears externally from nowhere, instead of seeing such technologies as gradually produced, the purposive result of years of labor and capital investment by the very same companies that eventually hope to adopt them. Such a view can also shift the conversation about "control" from a managerial to an engineering concern as the technical professions attempt to identify scriptable solutions to problems of service delivery (i.e. Stark, 1980). Future scholarship might also address the "strategic ambiguity" (Padgett & Ansell, 1993) that pre-automating companies must maintain as they simultaneously straddle such disparate sectors as

engineering and logistics, on the one hand, and driving or delivery service on the other.[20]

Finally, pre-automation might usefully shift our conversation from "the future of work" to "the futures of work." We have argued that pre-automation suggests a more dynamic view of gig labor than studies of the future of work that assume a transition to a new, steady-state phase (Briken et al., 2017; Wilkinson & Barry, 2020). This dynamism is not limited to a single arc. For instance, Cutolo and Kenney's (2019) observation that the risk to entrepreneurs grows as platforms themselves grow and mature suggests that pre-automated systems are in a race against the clock to achieve a monopoly in a market and to insource service delivery before their outsourced human workers leave. Platform workers, too, can create and participate in forums for information sharing and develop an identity around their job, and develop an occupational community (Irani & Silberman, 2013; Rosenblat, 2018; Schwartz, 2018). Futures shift, too, with shifts in underlying economic conditions. Even if imagined futures seldom come to fruition as imagined, taking corporate strategy, promissory narratives and anticipatory discourse seriously suggests how a potential strategy oriented toward automation can exert significant structuring effects within the platform economy today.

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20. This adds to the "institutional chameleon" character that Vallas and Schor (2020) articulate as pre-automating companies must maintain multiple identities for different audiences.

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