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EXPLORATION OF THE CURRENT STATE AND DIRECTIONS IN THE EMERGING FIELD OF DYNAMIC RIDESHARING PLATFORMS

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ABSTRACT: *Automobility has advanced since the postwar decline of public transportation and its near universal replacement by single-occupant vehicles (SOVs) throughout much of the developed economies. Even so-called "transit friendly" economies of the Global South have seen shifts in their modes of transportation to systems that are predominantly SOV-based (Cervero, 2013). Intensive infrastructure expansion within emerging economies indicates that the SOV is being adopted at a rate similar to the developed economies of one hundred years ago. In Henry Ford's quote "With mobility comes freedom and progress" mobility becomes universally interpreted as "automobility". Grave concern is linked to the continuation of the SOV model and its consequences for an environment taxed by an ever-expanding transportation sector. A paradigm shift, however, in the SOV-driven model, has been detected coming not from transportation but the different domains of information and communication technologies (ICT). This review examined the current state and direction of dynamic ridesharing (DRS), an emerging technology driven by recent innovations in ICT over the last two decades (Siddiqi & Buliung, 2013). DRS matches drivers and riders in real-time using Internet and mobile technology, and are single-occurrence events organized on short notice (Amey, Attanucci, & Mishalani, 2011). We conclude with a case study of DRS from its roots in San Francisco, CA. The city provides a present-day template for emerging themes when DRS is introduced into the present-day urban transportation system.*

Keywords: *dynamic ridesharing, mobile communications, Uber, Lyft, SideCar, taxis*

INTRODUCTION

Apart from safety and amenity advancements, little has changed in personal mobility since the public transportation network was rendered secondary by postwar business interests. Much of that network became universally replaced with single occupancy vehicles (SOVs) (Snell, 1995). Automobility focused on technological advancements in amenities, fuel economy, and safety improvements and has been pervasive even within the so-called "transit friendly" developing countries of the Global South (Cervero, 2013). Intensive highway infrastructure expansion among the rising economies has signaled their intention to replicate the developed world's SOV model based on Henry Ford's motto "With mobility comes freedom and progress".

The year 2015 marks the 70th anniversary of a period of vast economic and social upheaval following World War Two. Change was stimulated by the mass migration of middle-income families from the central cities to the less expensive land of the suburbs and concomitant monumental investments in infrastructure and highways. During the automobility era, private vehicle ownership has been encouraged and welcomed as a facilitator of opportunities for those once confined to housing within walking distance to the nearest transit stop (Liepmann, 1944). This freedom has come at a cost in terms of global environmental climate change enabled partly by rising vehicle emissions, squandered resources, and productivity lost to SOVs idling in traffic. Among the major energy consuming sectors, transportation's share of total CO2 emissions is largest at 32.9% (Davis, Diegel, & Boundy, 2014, p. 11-15).

The information and communication revolution in technology has changed many aspects of society, particularly in the retail and financial sectors. Information technology has been slow in adapting to transportation systems. The arrival of Big Data, the massive volume of both structured and unstructured information collected by ubiquitous sensors as well as social media websites and global-positioning-system-enabled (GPS) mobile devices, has at last come to transportation (Miller, 2013). A paradigm shift in automobility in the developed and developing economies is still in its initial stages, but it is rapidly altering common perceptions of private vehicle ownership and use.

A major activity behind this paradigm shift is a variant of carpooling known as dynamic ridesharing (DRS). DRS is an emerging method of personal mobility based on the traditional concept of ridesharing. DRS matches drivers with riders in real-time using online technology platforms (Agatz, Erera, Savelsberg, & Wang, 2012). The

platforms provide matching services via smartphone applications that use information, communication, and location-aware technologies to match drivers with riders in real-time. Drivers do not work for a technology company providing matching services, but are instead independent contractors providing their vehicles to transport passengers (Hubpages, 2014). The DRS platforms also offer a method of payment using a smartphone, and in most cases peripheral services such as liability insurance and background investigation of drivers (made available to quell concerns about personal safety). The DRS companies earn income using a business model based on transactions called an administrative fee that is typically 20% of the charge for the ride (Hubpages, 2014). The remaining 80 %of the fare is deposited electronically in a bank account designated by the driver. The DRS platform sets the charge for the ride based on factors such as distance and whether the ride occurs during peak or off-peak hours.

DRS differs from traditional ridesharing since matches between drivers and riders are arranged in real-time using mobile technology, are single-occurrence events and organized on short notice usually within minutes before a ride (Amey, Attanucci, & Mishalani, 2011). Traditional ridesharing, such as carpools and pre-arranged shared vehicles, continue to be part of the transportation planner's toolbox. However, the toolbox has expanded with recent advancements in information and telecommunication technologies (ICT) that have allowed the evolution of DRS (Figure 1). DRS represents a break with tradition in its lack of connection to the major regulation, transportation planning, or engineering disciplines. Contemporary transportation demand management (TDM) strategies designed to reduce traffic demand and SOV usage were policies developed by transportation professionals such as traffic engineers and transportation planner. DRS has similarly desired outcomes; however, it was conceived out of the entirely different domain of information technology.

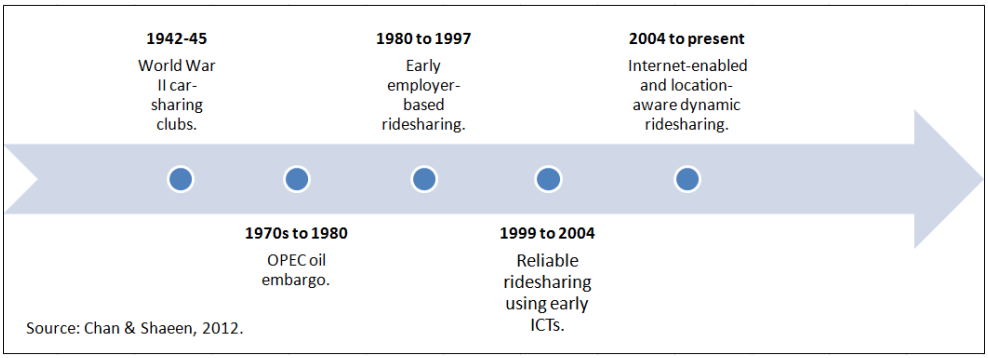

Figure 1. The evolution of ridesharing.

DRS proliferation has followed a predictable pattern established in San Francisco, CA, its city of origination. That pattern is one of a disruptive innovation (Christensen, 2003), occupying the newer value network of smartphone users, and ever poised to invade the older value network of the taxi and limousine industry. Consequently, DRS has pushed hard on the older taxi and limousine industry to the point where competitors are attempting to fend off market erosion with similar technology with hopes of surviving the current disruption (Christensen, 2003). Renewed interest in the concept of ridesharing must be understood not as a sustaining innovation but as disruptive, with potential to change all existing for-hire car markets. DRS focuses on the convergence between information and communication technologies, GPS-enabled internet and mobile devices (i.e., smartphones), and represents a new paradigm in transportation planning (Siddiqi & Buliung, 2013).

BACKGROUND

This review examined the emerging themes and changing aspects of the new DRS technology into the classic urban transportation system. It focused on the current state of the top three DRS platforms: UberX, Lyft, and SideCar. The platforms are the companies creating the software that operates on smartphones and websites, and allows drivers and riders to be matched in real-time. San Francisco was chosen as a case study because it the origination point of ICT-enabled DRS and can be used to explore general directions that DRS services take once they enter a market. San Francisco possessed a unique history regarding the traditional taxi industry. Despite its unique underlying history, San Francisco provides a basic formula for DRS adoption in cities across the world. On a

rudimentary level, each DRS platform offers a service matching riders with drivers using similar software and hardware. Additionally, each DRS service has similar policies for transaction processing, providing automobile insurance, and plans for future expansion. Variation occurs where each platform offers its own distinct brand of ridesharing that is often reflected in the social media of individual offerings. Although there is an apparent variation among cities and DRS platforms, there is a demonstrable pattern of DRS adoption that follows the San Francisco case history.

The technology companies responsible for the development of smartphone applications are at the heart of DRS. The leading platforms, UberX, Lyft, and SideCar, each represents a prominent position in the current state of DRS. Uber is the largest service offering the most choices in ridesharing spanning from luxury livery vehicles to basic sedans. In all cases vehicles are driver-owned independent contractors who set their own work schedules. Lyft is the next largest platform the primary competitor of Uber. In order to compete directly with Uber, Lyft has been branching into specialty services such as Lyft SUV, a service that provides larger vehicles, and Lyft Line, a service that uses a program to match multiple riders in a single vehicle along an optimized route (Lyft, 2015). In third position, SideCar competes by offering fares lower than the two giants. The DRS transport mode is developing quickly due to competition among the platforms and the rapidly changing nature of enabling technologies. Hence, any thorough cataloging of DRS platforms at this time will likely result in an outdated list (Deakin, Frick, & Shivley, 2011).

THE DYNAMIC RIDESHARING PLATFORMS

The sphere of DRS platforms is comprised of startups that have risen and fallen quickly due to the rapidly evolving nature of their technology. Additionally, the nascent business model of DRS is still unrecognized by many regulators at state and municipal levels. (Begley, 2014). Additional background on Uber, the parent of UberX was provided to give context. Background was also provided for Zimride, the earlier iteration of Lyft. The following sections give a brief overview of the histories and business models of the prominent platforms, Uber/UberX, Lyft, and SideCar, as of 2015.

Uber and UberX

The breakthrough enabling technology needed to make ridesharing real-time would be wedded to DRS at the 2008 Le Web Conference in Paris, a venue for European entrepreneurs. Startup technologists Garret Camp and Travis Kalanick, met at the conference and formed what was to become Uber, the present day behemoth of DRS platforms. Both had recently completed start up deals and were reflecting on what could be the next major disruptive innovation from Silicon Valley. Camp had suggested dealing with the well-known problem of requesting a taxi in San Francisco. A victim of mid-twentieth century deregulation and re-regulation, the taxi industry in San Francisco had become synonymous with some of the most unpleasant aspects of that city's life (Newsham, 2000). Camp and Kalanick devised a program, initially for their exclusive use that would circumvent the taxi problem by using smartphones. An app on the iPhone was developed to split the cost of a professional driver and a luxury black car to get around San Francisco on-demand (Arrington, 2010). Upon returning to San Francisco, the two began what could be called a "limo timeshare." They split the cost of a Mercedes S Class limousine, a driver, and parking space in a city garage. Either could use the app on his iPhone to summon the shared-limo without resorting to taxis to get around San Francisco. The developers soon realized that anyone with access to a smartphone and appropriate software could use such a system to circumvent the historical problem of getting around San Francisco by taxi. Hence, the final piece of the DRS puzzle, developing a mobile device app, was developed by Camp in March of 2009. At the same time, Kalanick prepared a prototype of the project that was tested in New York using several cars in January, 2010.

Uber was officially launched as UberCab on May 31, 2010 on iPhone and Android mobile devices in San Francisco. At its inception, UberCab offered only full-size luxury vehicles based on the company's original prototype that reflected private black luxury car services offered in Lower Manhattan. The name "UberCab" was shortly changed to "UberBlack" to conform to its black luxury car image. In December 2010, Kalanick became CEO of Uber (Uber Blog, 2010). The management change reflected a strategic transition from the successful launch to long term disruption strategy based on Kalanick's philosophy of DRS-driven industry change. In 2012, Kalanick threatened industry disruption in the form a full attack on the local taxi and car-for-hire industry with the launch of UberX, the platform's program of smaller non-luxury privately owned vehicles driven by non-professional drivers, and at prices competitive with regular city taxis (Flegenheimer, 2014). As will be shown in the case of San Francisco, industry disruption can be positive and bring improvements to customers in a region where taxis service

had become all but dysfunctional. The ease with which UberX had recruited drivers and immediately placed them on the street transporting passengers has be phenomenal and well documented. The lack of traditional car-for-hire regulatory restrictions has made UberX more accessible to both drivers and riders with its ease of driver enrollment and simplicity of passengers using smartphones to summon a ride. Unlike Uber Black, the smartphone application that summons a black luxury car at premium cost, UberX meets the more precise definition of DRS which is the short notice matching of riders and drivers in average, privately owned vehicles. Hence, Kalanick's UberX model offered more potential to disrupt the taxi industry with its simplified model (Brustein, 2013).

Lyft

In 2007, Logan Green, a recent University of California, Santa Barbara graduate, developed a web-based DRS service called Zimride.com to make trips to see friends in California (Bell, 2007). The use of websites on the Internet to match riders with drivers was not new in 2007, dating back as far back as the 1990s (Dailey, Loseff, & Meyers, 1999). A fundamental change came when Facebook released its application programming interface (API) to third-party developers. Green used this opportunity to incorporate the trust and reputation capabilities of Facebook that would make ride-matching closer to present-day DRS (Masabumi, et al. 2013). Leveraging the social networking capabilities of the website Facebook added two elements that were missing from ride-matching: overcoming the initial fear of getting into a vehicle with a total stranger and creating the critical mass of users necessary to provide regular and complete round-trip service (Bell, 2007).

Later in 2007, Green met John Zimmer, an analyst at Lehman Brothers in New York. Zimmer's graduate studies at Cornell University included transportation issues with a particular emphasis on solving the problem of underutilized road capacity, estimated to be about 80% daily. Zimmer saw this as an opportunity to fill those empty seats and make efficient use of road capacity. By the time of Lyft's launch in San Francisco during the summer of 2012, about 2000 seats per month were being filled on rides between San Francisco and Los Angeles for about $35.00 each way (Gustin, 2012). As CEO for Lyft, Zimmer has been instrumental in developing the platform's core philosophies. These beliefs included using enabling technology to change structural inefficiencies in transportation (Gustin, 2012) and focus on community-building to bring people together (Olanoff, 2012).

SideCar

SideCar, a DRS platform launched in San Francisco in June 2012, is third ranked among the national platforms operating today. Initially, SideCar differentiated itself in how it priced rides. SideCar began an innovative policy where the passenger set the price of the ride, which the company called donations, rather than fares. Instead of choosing a set price, the app asks the passenger to decide how much he/she feels the ride is worth. (Brustein, 2013). The passenger's price was honored as a valid fare regardless of whether it covered the cost of the driver's time and/or vehicle operation. The "donation" policy changed in 2013 and riders were required to pay minimum fares. This decision was made to compete with Uber and Lyft and encourage SideCar drivers to drive more regularly (Rodriguez, 2013). Like the two larger platforms, SideCar incorporates trust and reputation systems that allow drivers and riders to rate each other. Trust and reputation systems are an integral part of the sharing economy and in the case of DRS have a direct role in the operation of app-enabled ridesharing programs (Miller, 2013).

EXISTENTIAL ISSUES FACING THE DRS PLATFORMS

Insurance and DRS Platforms

Automobile insurance is handled similarly by each DRS service and is often a function of the state in which the platform operates. Platforms claim their insurance packages cover occupants of vehicles and injuries to persons and property outside of vehicles in the event of an accident during the entire DRS process. Platform-paid coverage generally begins from the moment the app is opened until it is shut off. Specifics depend on the platform, the jurisdiction being served, and any DRS-specific regulation that has been put in place at the state or municipal level. For example, Lyft states in its insurance overview that a driver has contingent liability insurance while his/her smartphone app is on waiting for a ride match. During the time defined by the California Public Utilities Commission (CPUC) as Period 1, up to $50,000 coverage per person is offered for bodily injury, up to $100,000 per accident for bodily injury, and up to $25,000 per accident for property damage. In addition, Lyft offers excess liability and uninsured/underinsured motorist coverage up to $1,000,000 per occurrence and contingent collision and comprehensive coverage of up to $50,000 per accident with a deductible of $2,500 (Lyft, 2014). UberX offers coverage in most states at levels similar to taxis and limousines in the cities of those states (Uber Blog, 2014).

Sidecar's driver liability for property damage and/or bodily injuries to passengers or third parties offers coverage at $1,000,000 per occurrence and is similar to Lyft and UberX, however, additional coverage for the "app on" period is only offered for the state of Washington.

The model of regulation that has been emulated by most DRS platforms is based on a decision made by the CPUC in San Francisco on September 2013 where the name Transportation Network Company (TNC) was created to define DRS platforms that used smartphones and Internet technology to match riders with drivers (CPUC, 2013). The CPUC also set mandatory rules on driver and criminal background searches for drivers registering with a TNC. Insurance was also made necessary by the CPUC, setting three "defined periods" to help clarify when insurance applies. Period One is "App open-waiting for match"; the driver is in his/her vehicle and turns on the app. Period Two is "Match is accepted- but the passenger is not yet picked up"; the driver is on his/her way to retrieve the passenger. Period Three is "Passenger in the vehicle and until the passenger safely exits vehicle" (Table 1). The CPUC wanted to make sure there were no insurance gaps when drivers were getting paid to give rides and achieved this with the legislation passed (G. Mathieux, personal communication, October 9, 2014).

Controversy still exists over TNCs and their role at airports. Despite a near universal laissez-faire acceptance of TNCs throughout California's cities and the rest of the United States, airports have stood vehemently opposed to TNC operations on airport property. Their hesitancy ostensibly stems from a concern about additional traffic congestion at airports. Some TNCs, such as Wingz, circumvent the airport issue since they do not use a smartphone app, but instead accept reservations for airport pickups and drop offs through their website only. The CPUC and the City of San Francisco recognize that web-based companies such as Wingz historically had customers reserve rides via the web. Thus, they are exempt from the Period One and Period Two phases of insurance coverage. The "hybrid" web-based TNCs are required to provide coverage for defined Period Three. Defined period three is when the passenger enters the vehicle and until he/she safely exits (G. Mathieux, personal communication, October 6, 2014). Discussions to allow TNCs at airports are ongoing.

Table 1: Defined periods when TNC covers insurance.

State of Mobile Device		Insurance coverage based on state of mobile device	Uber[1]	UberX	Lyft	Sidecar
Not logged on/not available	(app off)	Driver's personal auto insurance				
Logged on/available but not on trip	(app on)	Driver's personal auto insurance -PLUS- Contingent liability coverage (Also called "insurance gap" coverage[2]		X	X	X
Driver: - Accepts trip - During trip - Ends trip	(app on)	Commercial coverage when trip is accepted, while en route and carrying passengers, and when trip ends and passenger exits vehicle		X	X	X

[1] Drivers offering rides through UberBlack, UberSUV, and UberTaxi carry commercial insurance in at least the minimum required by local regulators.

[2] TNC providers contingent liability coverage if/when driver's personal auto insurer denies claim.

TNCs and the Taxi and Limousine Industry

Another major issue affecting the viability of modern DRS platforms, including those operating as TNCs, is their mixed and often contentious reception by municipalities and the taxi and limousine industry. When TNCs such as Uber, Lyft, and SideCar enter a market, municipalities find themselves in an awkward position of intermediary between the interests of influential labor and taxi industry lobbies and local citizens who see DRS as an environmentally progressive and cost effective alternative to the old taxi and limousine model. In most cases, the local taxi industry and its attendant labor groups resist the DRS platforms citing unfair advantage due to the lack of regulation. Some municipalities have raised the issue to the state level requiring a degree of regulation from the DRS platforms by classifying them as TNCs. TNC regulation typically includes mandatory motor vehicle and criminal background checks on drivers, safety inspections of vehicles, and minimal commercial insurance coverage.

DRS platforms operate in more than 90 cities in the United States. Only seven states, Delaware, Montana, Nevada, North Dakota, South Dakota, West Virginia, and Wyoming have not had a DRS platform enter any of their municipalities as of 2014. Noticeably absent from the list of DRS cities is Las Vegas, NV, a city whose taxi and limousine industry is unique. Taxi regulation in Las Vegas is by a state-appointed board of officials shielded from direct lobbying by the major TNCs (Shine, 2014). Las Vegas with its giant tourist industry, however, cannot be ignored, and how and if the TNCs manage a launch in this city can be another indication of how viable DRS is especially in cities that have strong political mechanisms in place to thwart acceptance.

The question of DRS's viability, however, seems close to being answered affirmatively as unlike Las Vegas, most municipalities have only been able to issue cease and desist orders to TNCs. Cease and desist orders are ignored summarily by the TNCs, who would rather pay fines than halt operations. Another tactic used to halt or slow down TNC market entrance is quick and temporary legislation that is contingent on a final vote off in the future. This approach often fails as well since in the interim TNCs have time to take their case to the public who is typically sympathetic. Hence, acceptance continues to evolve with all but eighteen states having some form of legislation pending (Jergler, 2014).

When a DRS platform enters a new market, it follows an established pattern based on its inception in San Francisco. At first there is intense interest by early adopters and the unemployed/underemployed who see a promising new transport mode and help to diffuse the innovation rapidly. The reaction of taxi and limousine companies to early DRS launches were initially benign. The newcomers were sometimes cast in the local press as outgrowths of the Great Recession of the late 2000s and its concomitant Sharing Economy (Fournier, et al., 2013). The DRS platforms' close association with technology was initially seen as a fad associated with young urban adults. With time and experience, however, taxi and limousine companies quickly learned that DRS platforms were well received by drivers and riders across the demographic spectrum. Current reaction to DRS arrival is now quite proactive usually beginning with press campaigns and appeals at the municipal level to reign in the unregulated competitors. Unfortunately, once the local citizens experience DRS it becomes difficult to reverse. The reason for this is the DRS platforms have been savvy in their use of promotions and media in inculcate themselves into the local culture. Also, allowing them to demonstrate their service has filled a void in many cities where clean, reliable, and pleasant taxi service has been missing.

Municipalities try to reach consensus among the DRS platforms and its constituency made up of primary stakeholders such as local citizens, labor unions, and taxi and limousine companies. Additionally, depending on the municipality, taxi medallion owners are a vocal group who stand to lose significant income. Taxi medallions are government-controlled taxi permits that increase in value based on economic regulation such as limited supply for the entire city. The provision and value of medallions become meaningless as the rate of DRS adoption increases (Badger, 2014). The concerns of medallion owners have yet to be resolved and promises to be a sticky future issue as it involves government taking or eminent domain arguments and possible compensation for the owners (PR Newswire, 2014). Further research into the status of medallions with regards to TNCs is required in order to find optimal solutions for this problem.

Cities in the United States began regulating taxi companies in the 1920s in order to deal with the chaos of independent drivers, upgrading of safety standards, and reduction of discriminatory practices (Dempsey, 1996). Part of that regulation was the institution of the medallion system. About fifty years later many taxi companies were deregulated along with other transport modes as per the business and ideological moods of that time. As will be shown in the case history of San Francisco, deregulation brought unsatisfactory results to most cities causing them to resume regulation or seek piecemeal fixes through ballot initiatives.

CASE STUDY: DYNAMIC RIDESHARING IN SAN FRANCISCO, CA

San Francisco is often the starting point for a contemporary technology story (e.g. Apple, Hewlett Packard, Xerox, eBay, etc). Hence, it would seem logical to credit the site and situation characteristics of the San Francisco Bay Area with the origination and growth of DRS since it is one of the world's preeminent research and development centers. Its proximity to major research universities and the technopole of Silicon Valley is credited with the origination of many elements of DRS technology. However, it will be shown that fundamental urban transportation issues lying outside San Francisco's role as technopole were in place several decades earlier (Castells, Hall, 1994). Dysfunctional management of the region's taxi industry forced innovation onto this, the first of the DRS cities. An environment for reform within the taxi industry was already in place before DRS arrived in the Bay Area. And when it did arrive its success was notable. San Franciscans tend to be early innovation adopters, and their

adoption of DRS was no exception as it filled a need for service in a city notable for its poor deployment of taxis. To understand the origination of ICT-enabled DRS in the Bay area, reflection on the last 35 years of attempted reform of the taxi industry in San Francisco will be instructive.

Background

In 1978, perceptions of unfairness and corruption within the taxi industry of San Francisco led to ballot initiative Proposition K (Newsham, 2000). Proposition K called for a system using taxi medallions as operating permits, to be issued by the City of San Francisco to persons paying an annual fee (San Francisco Municipal Transportation Agency, 2014). Persons possessing medallions are not a driver, but rather owners of medallions, who lease it to experienced taxi drivers in order to generate income. Under Proposition K, the city placed a limit on the number of medallions it authorized. By 2009, the next year of significant regulatory reform, the limit on the number of medallions authorized was 1,500 for a city of more than 800,000 people. The 1,500 medallion-limit represented a gradual increase over several decades intended to keep pace with demand. Suppressing the medallion limit, however, proved to be one of the contributing factors in public complaints regarding the difficulty of ordering a taxi (Said, 2014).

The 1978 system was designed to prevent speculators from bidding up the price of permits by awarding medallions only to individuals who would rent taxis from established companies at a set fee per shift. However, after several decades it was apparent that this system was not optimal for deployment of taxis throughout the city (Newsham, 2000). An attempt to reform Proposition K led to a successful 2007 vote on Proposition A giving the San Francisco Board of Supervisors the option of transferring regulatory jurisdiction from the Taxi Commission to the San Francisco Municipal Transportation Agency (SFMTA) (San Francisco Municipal Transportation Agency, 2014). In March, 2009, the Board of Supervisors exercised the option, and the SFMTA added the Taxi Commission to a consolidation with the San Francisco Municipal Railway and the Department of Parking and Traffic. Proposition A's significance to the taxi industry was that by placing the Taxi Commission under the auspices of the SFMTA, reforming Proposition K could be realized. The transfer of jurisdiction to the SFMTA also brought retirement and medical benefits to career taxi drivers. In the past, low incomes and meager benefits precluded a social safety net despite the many years of service per average driver (Lam, et al., 2006).

Since 1978 taxi drivers have been operating as independent contractors of the established taxi companies, e.g. Yellow Cab. Independent contractor status had worked to the benefit of the taxi companies that were insured income from the leasing of medallion-linked vehicles to drivers regardless of how often they were used during a shift. Companies also benefitted from the independent contractor relationship with drivers having been relieved of paying disability and social security taxes as well as being shielded from the threat of unionization (Newsham, 2000). Many drivers approved of the independent contractor status seeing it as a benefit freeing them from direct supervision and granting the ability to set one's work schedule (Newsham, 2000).

Unfortunately, passengers suffered most from this system. Upon examination of the 1978 and 2007 rules and regulation, passengers in San Francisco are never guaranteed service when they request a taxi. The entire system is skewed to the medallion and taxi company owners who earn set fees from drivers regardless of the hours and amount of passengers handled in a work shift. For example, when a request for a ride is transmitted to a particular taxi it is broadcast to all available drivers of that company, regardless of distance or whether their vehicle is occupied with a passenger. One hopes the request will be heard by drivers who are roaming and waiting for passengers. Ironically, this is the primary dysfunction of the system because drivers are operating independently and are under no obligation to accept a call for a ride. An available driver close by to the potential rider might be ending his/her shift and will opt to leave the request open where it may or may not be accepted by drivers who are farther away.

Thus, passengers in San Francisco had been deprived of reliable taxi service for many decades despite attempted ballot initiatives that were really aimed at reforms designed to favor medallion and taxi company owners. Hence, the San Francisco taxi problem sets the stage for the DRS innovators who understood the problem and applied the enabling technologies that would fill a void and bring reliable taxi service to passengers.

The Launch and Operation of Dynamic Ridesharing in San Francisco

ICT-enabled DRS was launched first in San Francisco, a city in need of taxi reform and possessing the requisite engineering and financial talent requiring a successful operation. Both major DRS providers, Uber and Lyft, launched service in San Francisco at approximately the same time. Concurrent with the launches of Uber and Lyft, San Francisco voters debated and eventually passed Proposition A, the law that would give the taxi industry yet another chance at reform. Ironically, as Proposition A was being voted into law a nascent DRS industry was

beginning with a positive public reception. Other DRS services entered the San Francisco market encouraged by the success of Uber, Lyft, and SideCar.

In the wake of the successful 2013 CPUC ruling in San Francisco, incidents have occurred which continue to test TNCs. For example, a few months after the CPUC made carrying insurance mandatory for each DRS, a six-year-old girl was struck and killed at a San Francisco intersection by an UberX driver on the evening of December 31, 2013 (Melendez, 2014). The UberX driver had been picking up and dropping off passengers that evening using the UberX app on his smartphone. Under the CPUC ruling Uber must cover both the driver and his passengers with $1 million liability insurance, however, Uber contends that coverage is only in effect while drivers are transporting riders with the app on (Table 1). According to Uber, when the pedestrian was struck, the driver did not have a passenger in his car and was not on his way to pick up passengers, thus he was not providing services to Uber at the time of the accident (Melendez, 2013). The case is still pending with both Uber and the driver fighting a wrongful death lawsuit filed against each of them (Williams & Alexander, 2014). The victim's lawyer stated that if a device such as a smartphone is turned on waiting for ride requests, in essence the driver is providing TNC service. Uber contends that although the device was turned on, it was only displaying a GPS map, and not information on potential rides.

The case of the six-year-old accident victim is being watched carefully as there is hope it will answer questions to some of the vagaries regarding insurance and TNCs. The CPUC ruling in 2013 states that the TNC coverers drivers who use their app to engage in sharing for up to $1 to $1.5 million in liability insurance once the passenger is in the car. The accident involving the child raises the question of whose insurance covers an accident. If it is not Uber's insurance providing coverage then is it the driver's personal insurance since he/she was not transporting passengers. At present, insurers offering personal automobile insurance view any conveyance for pay as a commercial use which would void a drivers insurance. Insurance providers are becoming increasingly aware of the proliferation of DRS platforms and warn that they will not honor policies of drivers using DRS apps (Property Casualty Insurers Association of America, 2014).

CONCLUSIONS

DRS is evolving quickly, and it is still too early to understand the impact of its disruption to the car-for-hire industry, transportation in general, and the physical environment. As a transportation demand management strategy, DRS promises to fill the unused seats in SOVs and by doing so increase lane capacity and level of service (Levosky & Greenberg, 2001). Its evolution from Internet to smartphone-based applications has been instrumental in its current successful proliferation throughout the United States and cities globally. Two fundamental issues, however, threaten DRS in its current smartphone-based iteration. Although much has already been worked out between the TNCs and insurance providers regarding the *insurance gap*, the time when a driver has his/her app on and is waiting for a ride match, questions still remain and are being addressed state-by-state. Apart from insurance, the other issue threatening DRS is its coexistence with local taxi and limousine companies. On this issue, stakeholders are divided three ways, with municipalities playing a mediator role attempting to bring consensus to all parties (Anderson, 2014).

If left unanswered, questions on insurance will discourage participants, particularly drivers who will expose themselves to legal and financial tribulations. As of 2014, TNC drivers have sufficient coverage, according to the DRS platforms discussed in this study. Drivers are still expected to carry personal automobile insurance which is supposed to cover all situations, including when they are driving for a TNC with their app off (Table 1). Unfortunately, personal insurers cancel their policies when they discover that the driver has been using the vehicle as an independent contractor for a TNC. The solution insurers and TNCs are currently working toward is affordable commercial insurance for casual DRS drivers with details yet to be determined (Property Casualty Insurers Association of America, 2014).

The adversarial relationship between the DRS platforms and the taxi and limousine industry threatens the continued evolution of platforms into regulated TNCs capable of providing inexpensive and reliable service. If the taxi industry prevails in restricting the number of vehicles a TNC is allowed to operate in each municipality, DRS will be nothing more than an alternative mode of transportation. The promise of reducing urban traffic and the subsequent environmental benefits that go with it will be diminished. The owners of taxi companies and medallions stand much to lose, and it is in their interest to prevent an all out disruption of their industry.

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