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Docked and dockless public bike-sharing schemes: Research, practice, and discourse

Authors

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Introduction

Public bike-sharing may be one of the most successful examples of policy and technology transfer of our times. The concept has become a buzzword in cities across the world around, from Cape Town to Beijing to Melbourne (Shaheen et al. 2010). Any city that seeks to appear hip, vibrant, and cosmopolitan – qualities much sought after by the creative class (Stehlin 2015) – is compelled to provide at least one bike-sharing system. Planners, politicians, and media pundits keep touting the benefits of bike-sharing: reducing pollution, congestion, travel costs, and oil dependence, while improving liveability and public health (Fishman et al. 2013). While many bike-sharing schemes have been launched amid much fanfare, sometimes their popularity has waned. A number of schemes operate at a financial loss and depend on other profitable enterprises to cross-subsidise them and some have resulted in dumped and discarded bikes becoming an eyesore.

In this chapter, we explore several questions. What are the characteristics of a successful public bike-sharing program? What are the characteristics and dynamics of the riders that use these systems? Beyond users' own predilections and patterns, are there environmental characteristics that lead a system to succeed? These are important questions because installing or adopting public bike-sharing requires significant public and/or private investment along with modifications to the urban environment. Understanding which factors enhance or hinder public bike-sharing is critical in helping cities anticipate how the local population will react and decide whether such a scheme is viable, before contemplating what design and siting will work best.

Drawing on current knowledge, we first discuss docked bike-sharing systems. We examine the importance of user characteristics and behaviours, the local landscape, climate, cycling infrastructure, and land-use. We also touch on other factors, such as the legal environment and the characteristics of the bike-sharing scheme itself.

In the second part of this chapter we discuss the public discourse around dockless systems, a new generation of bike-sharing (Chan and Shaheen 2012). Different interest groups have had different reactions to the concept of 'docklessness'. We explore these reactions in some depth as they are tied to

broader discourses that preoccupy contemporary society, including the pervasive role of technology, the different pathways to sustainability, and late stage capitalism. The reactions to dockless bike-sharing schemes are likely to apply to e-scooters too- – another micro-mobility mode that operates based on a similar concept.

Docked bike-sharing schemes

User characteristics and behaviours

Urban planners might hope, when adopting a bike-sharing scheme, that cycling will replace (at least some) car-based commuting in their city. If a bicycle is made available for rent nearby, people may change their travel habits. However, research shows that only a minority of bikeshare users switch over from cars. So who, then, is likely to use shared bikes and for what purposes?

The most comprehensive and up-to-date reviews of studies in this area have been conducted by Ricci (2015) and Fishman (2016). Their findings show that, across most cities, bike-sharing attracts users with a particular profile: male, white, employed, and also younger, more affluent, and more educated than the general population (Beecham and Wood 2014). Female bike-share users are more safety-conscious. As with regular cycling, they typically avoid wide roads and prefer to ride along segregated cycle paths and in areas with calmer traffic. Women users are also more likely to cycle recreationally in groups, especially in the late evening (Zhao et al. 2015).

As in regular cycling, bike-sharing participation patterns are socioeconomically unequal. Inequality is reinforced by the requirement that users have a debit/credit card and by the geographical coverage of stations. These tend to be concentrated in CBDs and other affluent areas, or near transport hubs and universities. However, studies show that residents of less wealthy neighbourhoods do use bike-sharing when it is available in their areas (Ogilvie and Goodman 2012).

Consistently across studies, convenience emerges as the key motivator for those who use shared bikes (Fishman et al. 2013; Shaheen et al. 2014). Simply living near a docking station leads to higher use. Other reasons people use bike-sharing include health and fitness, travel time savings, enjoyment, and financial savings. Some users prefer bike-sharing to bicycle ownership due to concerns about theft (Fuller et al. 2011), maintenance and storage – for example, if they live in small apartments, as in

China or continental Europe (Tang et al. 2011; Molina-García et al. 2015). A few join merely because they like the design and image of the bicycles in their local scheme (Bachand-Marleau et al. 2012).

Work-related purposes dominate bike-sharing use everywhere. Annual members, in particular, tend to use share bikes for weekday commutes. Casual users are more likely to rent a bicycle for recreation during weekends. Men are more likely to use bike-sharing to commute. Recreational journeys over weekends and in parks are more common among female members. As expected, commuting dominates during peak times while non-work purposes (chiefly leisure) are more prevalent outside the peaks (Ricci 2015).

Overall, reported usage rates vary from three to eight trips/day/bicycle. But, sadly, in Australia bike-sharing produces only 0.7-1.2 trips per day per bicycle – much lower when disaggregated by gender (Ricci 2015). Potential users in Australian cities point to barriers such as: mandatory helmet laws; long distances between destinations; obstacles to instant access; lack of cycling infrastructure; competition with free-tram zones (Melbourne only), and road safety concerns (Fishman et al. 2014; Jain et al. 2018). These are major impediments to cycling in Australian cities in general (Butterworth and Pojani 2018).

The archetypal user of shared bikes is likely to be a cyclist anyway, which means bike-sharing does not lead to many abandoning driving (Ricci 2015). However, in Australia people switch from driving to bike-sharing more often than in other places (Fishman et al. 2014).[1] It might be that, in heavily car-dependent cities there is more latent demand for alternatives to driving than in cities that already exhibited sustainable travel patterns before bike-sharing was introduced. In many cities bike-sharing replaces walking and public transport use instead of driving (Murphy and Usher 2015). For example, in Melbourne and Brisbane, about 40-45% of bike-share users have switched from using public transport, and about 20-25% from walking (Fishman et al. 2014). This is especially the case in dense inner-city environments – where most stations are located. Here, bus and rail are used less because bike-sharing offers lower cost, faster travel and an opportunity to incorporate physical exercise into one's commute. In some cases, however, bus or rail use increases after the adoption of a bike-sharing scheme that provides better access to stations – especially in the urban periphery of sprawling North American

cities (Martin and Shaheen 2014). This suggests that strategically marketing bike-sharing in satellite towns and suburbs connected by rail to a central city or CBD could increase participation and support bicycle-rail integration (Goodman and Cheshire 2014).

Natural environment effect on bike-sharing

Two natural environment factors are known to affect participation: hilliness and weather. A hilly terrain is detrimental to system balance, as users avoid returning bicycles to stations on hilltops (Mateo-Babiano et al. 2016). Those stations (termed *sources*) end up being empty, while stations on flat terrain (termed *sinks*) are often full, so users cannot find a dock to return their bike. Services offering bonus minutes to return a bicycle uphill, such as Parisian bike-share operator Vélib, or incorporating e-bikeshares, like in China, can be vital to the program's success (Campbell et al. 2016). As for weather, optimal temperature ranges vary by climate zone. In continental climates, the range is as broad as 4-40°C while in subtropical climates the range is as narrow as 15-32°C (Brandenburg et al. 2007; Gebhart and Noland 2014). Case studies show that warm and dry weather encourages public bike-sharing use, while humidity, rain, and strong wind deter trips (Corcoran et al. 2014).

Again, the adoption of shared e-bikes could reduce some of the adverse effects of bad weather (Campbell et al. 2016). Other approaches, such as providing sheltered, shaded, or even heated or cooled cycling infrastructure, and consistent road ploughing during snowy months, could prove useful. Innovative concepts are being tested around the world (Böcker et al. 2013; Spencer et al. 2013; Tin et al. 2012; Dürr 2016; MVSA Architects n.d.).

Built environment effect on bike-sharing

The presence of high-quality bicycle infrastructure is crucial to participation in bike-sharing programs – and to cycling more generally. The length of segregated bicycle paths near each docking station strongly affects use (de Chardon et al. 2017). Without high-quality cycling infrastructure, expanding the system size does not necessarily increase participation. No 'network effect' is evident, although station density does improve the performance of programs. In addition to connecting stations, segregated bicycle paths must connect key land uses, such as central business districts, university and high-school campuses, high-density residential

clusters and the like. The distances between these vital land uses must be “cyclable”, otherwise, bike-sharing programs have little utilitarian value (riding to work and back, for example). They then end up being used mainly on weekends and for recreation in parks (Mateo-Babiano et al. 2016).

Legal environment effect on bike-sharing

The legal environment in which public bike-sharing programs operate must be factored in too. For example, laws that require cyclists to wear helmets discourage use (Fishman 2016). These laws add to the safety, but also to the inconvenience, for cyclists. In Australia, for example, the adoption of helmet laws in the 1990s lead to large declines in cycling rates, from which there has been little recovery (de Jong 2012). Helmet laws are a typical example of how cyclists are forced to bear the responsibility for their own safety, regardless of who is at fault. The Netherlands and Denmark have a law of “strict liability” to protect more vulnerable road users from more powerful road users. Under this law, in crashes involving cars and bicycles, the driver is liable by default. This arguably makes Dutch and Danish drivers much more cautious around cyclists. By contrast, under current Australian laws, if a car and bicycle collide, the cyclist bears the burden of proof.

System design characteristics

Public bike-sharing schemes’ design and subscription type can help or hinder performance. Cheap subscription prices are crucial for success. Most users take short trips during the free initial periods provided under most schemes and do not incur any charges other than for membership (Mateo-Babiano et al. 2016). However, not-for-profit operators tend to perform more poorly. Technological advances, such as seamless payments via apps, are adding to the attraction of bike-sharing programs.

Dockless bike-sharing schemes

Dockless systems present a different set of issues. A form of “smart” transport, dockless bike-sharing centres on technology. In an attempt to maximise flexibility and convenience for users, but also minimise investment and hard infrastructure, the schemes do not offer specific docking stations. Instead, prospective cyclists can reserve the nearest bicycle using a smartphone app, after which an individualised

map leads the user to the bicycle's location. The bicycles can be unlocked by scanning a QR code on their body. At the end of the trip, bicycles can be left in any designated parking area or an otherwise safe and legal spot where they do not obstruct pedestrians or other transport. Most schemes to date (e.g., oBike, Mobike, and ofo) have offered low rental fees or a few dollars per hour (plus an affordable annual membership fee).

Their simple premise notwithstanding, dockless schemes have run into difficulties from the outset. Instances of vandalism and obstruction have been recorded in cities in which dockless schemes have rolled out operations, including Melbourne, Munich, Taipei, London, Kuala Lumpur and even Amsterdam, the world's bicycle capital. Discarded public bicycles were reported to be strewn all over these cities; people were dumping them in rivers and lakes, on footpaths, bus stops, and private lawns. Singapore – oBike's birth country and arguably one of the most law-abiding – has not been immune from controversy either. In fact, one year into its first dockless scheme it had to resort to geofencing. (This is a technology that creates a virtual boundary around a bicycle to ensure it is parked in designated areas.) In Chinese cities, dockless bike-sharing – provided by Mobike and ofo – has been suffering the same fate.

To examine the public discourse around dockless systems, we applied a qualitative method. Through the library of The University of Queensland and Google, we collected 287 press articles on dockless bike-sharing schemes (see Richardson 2006). These appeared between 2017 and 2019 in nine major newspapers or planning portals, including *Sydney Morning Herald*, *The Australian*, *China Daily News*, *The Guardian*, *The Times*, *Financial Times*, *CityLab*, *Next Cities*, and *The New York Times*. We chose these outlets as they span the political spectrum and cover four global regions: North America, Europe, East Asia, and Australia.

We performed content analysis of the text of the articles in our database and extracted five major themes: (1) advocacy for urban cycling; (2) technology enthusiasm; (3) anti-technology sentiment; (4) support for the sharing economy; and (5) anti-capitalist views. These are summarised below, and supported through references to academic commentators as well. In our interpretation, cycling advocacy and anti-capitalist views have tended to dominate the press discourse. Enthusiasm for technological innovation and the sharing economy was more

prevalent during the early stages of dockless schemes, and more recently has tended to fade or reverse.

Cycling advocates

Cycling advocates have depicted dockless bike-sharing schemes as a welcome urban amenity. According to such views, insofar as it encourages cycling and provides first- and last-mile connectivity for commuters, dockless bike-sharing is extremely beneficial – in socio-economic, environmental, and liveability terms. Because it is flexible and does not require modifications to the urban infrastructure, docklessness allows start-up companies to enter the market quickly and thus promote sustainable mobility, render modal transition seamless, lower fuel consumption, and help abate traffic congestion. Where dockless schemes have led to instances of vandalism, this has been framed as a problem with local populations, which purportedly lack the civic culture to appreciate and accommodate bike-sharing. A large portion of the academic community shares the cycling advocacy perspective (see Zhang and Mi 2018; Shaheen et al. 2011).

Technology enthusiasts

Technology enthusiasts have framed dockless bike-sharing in a positive light too. They see it as another way to support the new 'Silicon Valley economy', based on digital start-ups and IT innovation. According to this view, new technological advances should be embraced because they can overcome the performance constraints of old technologies (see also Danneels 2004). A joint set of technologies, including Global Positioning Systems (GPS), deep-learning algorithms, and geo-fencing can be harnessed to optimise the management of shared bicycle fleets in a much more efficient manner than before. The 'big data' produced by the dockless systems, which captures every cycling trip in detail, will allow cities to form a much clearer picture of cycling patterns and urban space utilization than they could via partial surveys of individual cyclists. This would bestow more credibility upon planners' decisions regarding cycling infrastructure investments (see An et al. 2019).

The coupling of bike-sharing and IT promises to give birth to novel business models, supported through venture capital rather than the government largesse. These new models provide more opportunities for upscaling and global expansion. Also, the inventive nature of dockless schemes is thought to force incumbent cycling

(and other transport) providers to innovate in order to maintain a competitive edge, in the same way that app-based car sharing companies such as Uber and Lyft disrupted the traditional (and complacent) taxi market and business model (Laurell and Sandström 2018). Again, based on this viewpoint, some dockless bike-sharing schemes have failed to gain traction with the public because of the latter's short-sightedness and technological conservatism.

Luddites

By contrast to cycling advocates and technology enthusiasts, technology haters or Luddites cast dockless bike-sharing as a disruptor whose adoption is not necessarily in the public's best interest. They charge that the fact that we can adopt a new technology or have the ability to shift from one travel mode to another does not imply that we should. All new transportation technologies have a "dark side" and, as such, require scrutiny, public criticism, and government control.

At a basic level, detractors note that one does not need high tech to perform as simple a task as riding a bicycle. Turning cycling into a digital venture only serves to further immerse people into virtual space and thus lose touch with embodied reality. Traditionally, cycling was meant to promote the exact opposite: get people out of the unnatural environment of car interiors and strengthen their connection to cities and nature.

Moreover, Luddites cite unanticipated technological weaknesses exposed during the implementation of dockless schemes. For example, the new fleets may not be optimised to quickly react to user demand across time and space, leading to inefficient bike redistribution and high operating costs during station rebalancing (see Pal and Zhang 2017). Dockless schemes are accused of gambling on user behaviour (via tech algorithms) to handle the bicycle parking problem; these gambles have resulted in bicycle oversupply in cities, and a shortage of parking space, rather than public enjoyment of cycling.

As with all digital mobility platforms, there is concern that bike-sharing companies may be harvesting and commodifying massive databases of cyclists' characteristics and behaviour, which may be used to increase private profits and strengthen surveillance capitalism in a process that is not transparent nor accessible

to the public. Turning user data into a tradable asset is akin to handing over civic resources to business interests, free of charge.

A final line of attack is the loss of urban identity that comes from technological replicas. A similar design of dockless bicycles (sturdy to prevent wear-and-tear and brightly coloured to prevent theft) is eroding the uniqueness of individual cities, and with it, place attachment.

Sharing-economy supporters

While lacking a standardized definition, the sharing economy has accumulated numerous advocates and participants (Rauch and Schleicher 2015). Supporters regard the sharing economy as a way to disaggregate existing consumption patterns and equalise consumption or goods and services within the bounds of a capitalist, profit-driven system (Spinney and Lin 2018). In essence, the idea of "sharing" presumes exchanges which do not involve money but are motivated by generosity and care for others (Slee 2017, p.2). In the context of docked or dockless public bicycles owned by a company, sharing is cast as value-added to existing platforms, as it minimises waste, surplus, or idling, and allows for more intensive and equitable utilisation of the assets (i.e., the bicycle fleet).

In economic terms, dockless bike-sharing ventures are also praised for aiding the local economies and providing much needed local employment for tech-savvy youth. This is supposed to increase urban revenues through taxation and increased consumption. In this view, all that is needed for success is government goodwill, collaboration, and openness to new economic principles; the invisible hand of the market will take care of the rest. As such, dockless bike-sharing schemes do not attempt to achieve radical socio-economic transformations but rather entrench existing ones (Spinney and Lin 2018).

Anti-capitalists

Critiques by anti-capitalists centre on the commercial nature of dockless bike-sharing operations. To this group, dockless bike-sharing creeps into, and consumes, public space for private gain. In a 'winner takes all' international race, a major surplus of dockless bicycles has flooded public spaces. This set of accounts paints a chaotic picture of discarded or poorly parked vehicles invading and littering the city. Dockless bicycles intrude on streets, pathways, green spaces, and become a

general nuisance, a barrier to access, and even a safety hazard (see Lan et al. 2017). The situation is presented as a ‘tragedy of commons’ scenario.

The higher bicycle redistribution costs in dockless systems (due to casual parking, often in unsuitable places) are thought to cancel out any efficiency gains (see also Pal and Zhang 2017). Another concern is the monopolistic nature of sharing platforms. While no dockless public bike-sharing scheme has turned into a monopoly operation, critics point to the trajectory of other platforms such as Uber or Airbnb which have come to dominate the taxi and hotel market respectively. They have tended to follow the general motto of digital disruptors (‘move fast and break things’), entering and capturing unregulated markets, and later seeking to strike bargains with local authorities once any negative impacts or externalities become evident (Millar et al. 2018; Ma et al. 2018). Anti-capitalists point out that private mobility companies which become too large, or succeed in gaining the support of social elites, are more difficult to regulate or ban (Cohen and Kietzmann 2014).

Primarily, the blame for this situation is laid at the door of private companies motivated by profit. But local governments are criticised too, for making hasty decisions to licence dockless bike-sharing companies without first pondering the consequences carefully. In a neoliberal planning environment, governments, like private companies, are regarded as guided by short-term financial interests rather than long-term sustainability goals (see Ma et al. 2018). Ultimately, a lack of collaborative, bottom-up governance is identified as the culprit by this group of commentators.

Conclusion

Clearly, many of the key ingredients for the success of bike-sharing programs are the same as the ingredients needed to make cycling, in general, “irresistible” (Pucher and Buehler 2008; Pojani et al. 2017). For these programs to work, cities must adopt aggressive pro-bicycle programs, while reining in longstanding pro-driving policies (see chapter 13). Many remedies have been put in place to cope with urbanisation – one of which is encouraging more people to commute using bicycles. While modestly reducing driving and taking away some passengers from buses, trains and trams, bike-sharing helps increase bicycle use in a city. It also raises drivers’ awareness of cyclists on the road, which helps to make urban cycling safer. As a highly visible

mode of transport, and generally one with a positive image, it promotes and normalises cycling behaviour for all.

It is unlikely the demise of some dockless schemes has killed the bike-sharing concept. New companies are likely to step into the market to fill the void that dockless schemes undoubtedly leave behind – despite the criticism they attract – seeing as the cycling market in most cities is hardly saturated. In most places, docked schemes continue operation. Docking stations appear to be a key ingredient for bike-sharing schemes to succeed. International experience with the grand experiment of dockless bike-sharing – which is far too prone to vandalism – has demonstrated the world is not ready for it yet. This concept is, perhaps, ahead of its time. Or, indeed its time may never come. However, cities worldwide can and should do much more to promote cycling – whether through public bike-sharing or privately-owned bicycles.

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Notes

[1] For example, 19% of Melbourne's bike-share users switched over from cars, while the figure is 21% for Brisbane bike-share users (Mateo-Babiano et al. 2016), while the figure is only 2% in London and Montreal. The Australia-based findings rely on a data from an online survey of over 800 annual members of two bike-share programs based in Brisbane and Melbourne (Fishman et al. 2014).