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The implications of the sharing economy for transport

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ABSTRACT

The sharing economy has gained a lot of attention in recent years. Despite the substantial growth in shared services, its impact overall on transport is unclear. This paper analyses the literature on sharing in transport and includes government and consultant reports, websites and academic journals. The drivers of ride-sharing, car-sharing, car-pooling and freight-sharing are largely economic and convenience related for participants. Trust, technology platforms and the trend to avoid ownership of assets are facilitating factors in its growth. Over-regulation, inconsistent quality of service and the need for recommendation are potential barriers. The transport journals in particular are relatively slow to research this topic with more focusing on bike-sharing than other modes of vehicle sharing. The paper discusses the impact of sharing on transport suggesting it is likely to be part of a solution to transport problems and congestion perhaps in combination with other developments such as driverless vehicles. It also warns of the dangers of over-regulation and under-regulation. The future will require holistic transport strategies that consider sharing options and will require government departments to work cooperatively.

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Sharing economy; drivers; facilitators; review; technology

Introduction

Recent years have seen increased coverage in the media related to the sharing economy. A study by PWC (2016) for the European Commission shows that the sharing economy activity in Europe is accelerating rapidly, generating revenues of €3.6 billion and facilitating €28 billion of transactions in 2015. In the U.K. alone, activity is predicted to increase at over 30% per year over the next 10 years, generating £18 billion of revenue and facilitating £140 billion in transactions each year by 2025. Similar growth predictions have been put forward for Australia also (), although some recognise that Australia is lagging behind in this area (Huffpost, 2016). High profile examples in the sharing space include Airbnb and Uber. Accommodation has been the biggest revenue contributor, but in many countries, this has been surpassed by ride-sharing (Deloitte, 2016). Peer-to-peer transport is predicted to remain the largest sector of the U.K. sharing economy in terms of revenues, with urban ride-sharing apps and parking sharing platforms growing at over 35% per year (PWC, 2016).

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The sharing economy is an umbrella term that covers the sharing of consumption through online platforms (Hamari, Sjöklint, & Ukkonen, 2016). The term is closely linked to the concept of collaborative consumption (CC) that is concerned with the consumption of goods and services through activities such as renting, swapping or trading. Barnes and Mattsson (2016, p. 200) define CC as “The use of online marketplaces and social networking technologies to facilitate peer-to-peer sharing of resources (such as space, money, goods, skills and services) between individuals, who may be both suppliers and consumers”. CC is viewed as a subset of the sharing economy and is mediated by information technologies (Hamari et al., 2015; Shaheen & Chan, 2015). There is likely to be growth in the variety of models that involve aspects of sharing over the next few years. Although ride-sharing and in particular Uber has gained significant media attention and public debate, there is a lack of research on how the broader sharing economy and CC will impact on transport.

For transport planners and government transport departments, it is important to understand sharing economy developments in order to assess their potential impact on public transport demand and road use. Governments invest heavily in transport infrastructure that once implemented becomes a long-term part of the urban form. Hence, developments that may impact on future demand should be researched and monitored. For potential consumers, it is relevant because it increases travel mode choice and may impact on vehicle ownership decisions. Although the sharing economy has implications for transport policy, there are a number of unanswered research questions such as: How will the sharing economy affect private car use and demand for public transport? What are the barriers to the development of the sharing economy impacting on transport? What will be the developments in the sharing economy that policy developers need to be aware of to plan transport infrastructure for the future?

The literature on transport and the sharing economy has focused on particular applications such as taxi apps and regulation (Harding, Kandlikar, & Gulati, 2016), business models and ride-sharing (Cohen & Kietzmann, 2014), the barriers to ride-sharing (Furuhata et al., 2013) and the benefits of meeting points in ride-sharing systems where people can be picked up and dropped off (Stiglic, Agatz, Savelsbergh, & Gradisar, 2015). This focus on aspects of applications misses the wider implications of the sharing economy for transport planning and policy which is the aim of this paper.

Definitions of the various forms of sharing in transport are problematic because the terms are often loosely used in both the academic and practitioner literature, the rapid evolution of the area and the conceptual overlaps between the modes of transport. A report by the U.S. Department of Transportation (Shared Mobility, 2016) divides the types of sharing according to whether they are self-service, for hire or require membership. Despite the difficulties in developing a rigorous set of definitions while at the same time maintaining a link with popular definitions in the press, we use the following terms:

Ride-sharing: Typically for hire services where a participant orders a ride using an online/mobile platform. The criticism of this definition is that typically a passenger travels alone and so actual ride-sharing does not take place, except in the case of UberPOOL where other passengers may be picked up on a trip. However, sharing can also refer to the sharing of the driver’s private vehicle with a passenger in a more open taxi-like system (Amey, Attanucci, & Mishalani, 2011). The platform for these systems also relies on the sharing of feedback on the drivers. There is a wealth of literature that places ride-

sharing or ride-sourcing companies such as Uber in the sharing economy, and while we acknowledge conceptual limitations in this terminology, we use the term ride-sharing to form a link with the wider press and dialogue on the issues.

Car-pooling: This a sharing approach that is typically a not for hire arrangement but rather an agreement between people to share a journey. This could involve regular trips or a longer one-off trip. Some sharing of the expenses could take place but it is not typically a commercial arrangement.

Car-sharing: This involves the sharing of the vehicle on a for hire basis. It can either be run by major companies where vehicles are used by members or it can be individuals who “share” their car or van for a fee.

Freight-sharing: Forms of sharing that are possible in the freight sector. It can involve, for example sharing of freight space or people delivering goods on a journey they would be undertaking.

This paper aims to provide a research review with the objective of answering the research questions presented above. The review conceptually synthesises knowledge on the sharing economy and transport. It takes a qualitative approach because there are relatively few papers published on the topic in journals and the nature of writing varies considerably from magazines, blogs, websites and consultant reports to academic conference and journal papers. A quantitative meta-analysis would not be appropriate since the sample of work used is heterogeneous (Cooper & Hedges, 1994; Redman, Friman, Gärling, & Hartig, 2013). The searching for relevant sources took two main approaches. Firstly, the sources were identified using search engines to obtain consultant and government reports, magazine articles, relevant websites and research centre reports. We included these sources because we wished to avoid relying solely on academic peer-reviewed articles that mostly include statistically significant studies. Also, the topic is of considerable interest to governments and so their perspectives need to be included. However, studies that did not focus on the sharing economy in relation to transport were not included and reports that were not in English were excluded.

Secondly, online journal databases were used to target peer-reviewed academic research. Keywords used in the search process are shown in Table 1. The inclusion of an article into the analysis was dependent upon the article focusing primarily on some aspect of the sharing economy and transport. Those articles that concentrated solely on the sharing economy with no mention of transport were not included. The identification of articles within the journal list involved keyword searches. Articles that appeared to fit into the desired category were verified by firstly reading the abstract and then the entire article to extract the main findings and emphasis of the article. Some of the articles that were initially identified via the title or keywords were discarded in this process if either

Table 1. Keywords used in the literature search

Concept	Keywords (Included hyphens, no hyphen, initials, scheme and firm names)
Sharing economy	Sharing economy, Peer to peer economy, CC
Freight-sharing	Freight-sharing, B2B collaboration transport
Ride-sharing	Ride-sharing, Firm names such as Uber, Lyft
Car-pooling	Car-pooling, scheme names such as BlaBlaCar
Car-sharing	Car-sharing, car club, firms names such as Zipcar
Other phrases	Multi-model transport, future of transport, gig-economy, sharing transport, transport network companies (TNCs), lift sharing

the abstract or the article itself did not primarily focus on the sharing economy and transport. This process yielded 124 articles for the content analysis.

The article analysis method involved a grounded approach that examined the main conceptual emphasis of each article and its stated aims (Urquhart, 2012). The purpose of the grounded approach was to develop a conceptual classification from the literature rather than impose a classification framework on to it. Independently, the researchers developed their classifications from the literature. The content of each article was analysed by examining the title, abstract, keywords, stated aims of the article and a conceptual review of its full content. The authors then brought their independent classifications together and through a matching process and the resolution of inconsistencies reduced these to one classification framework involving the drivers, facilitators and barriers.

The structure of the paper is as follows. Firstly, the paper examines the sharing economy concept from multiple perspectives. The impact of the sharing economy in transport is then examined in terms of the drivers, facilitators and barriers. Implications for policy-making in the government are then discussed followed by recommendations for future research.

The sharing economy

The term sharing economy is used to describe a broad phenomenon of the sharing of consumption through online platforms that are challenging conventional business models. It has been referred to by other terms such as CC, trust economy and peer-to-peer economy (PWC, 2016). Start-ups in this area are viewed as a development from social media platforms such as Facebook, Trip Advisor and Pinterest where people share ideas, information and insights (Cusumano, 2014). They can grow rapidly because of the dynamics of networks.

The sharing economy is predicted to grow to \$335 billion by 2025. Uber is expanding rapidly and operates in over 500 cities already in most regions of the world. The 16–34 age group are the greatest Uber adopters. This age group makes up almost three-quarters of Uber's U.S. user base, with only a small minority being from the 45–64 age group (Global-webindex, 2017). In 2016, the ride service Lyft increased its rides from 53 million in 2015 to 160 million. Sidecar is a relatively new entrant in this space with a small percentage of market share in the U.S.A. (Businessinsider, 2016).

The Uber concept is being mirrored in the freight sector. A number of companies are developing smart apps that provide a comprehensive all-in-one solution for freight shippers and carriers. They provide "fast, automated load matching based on location and equipment; turn-by-turn route planning and shipment tracking; algorithm-based instant pricing; and seamless proof-of-delivery, billing and payment" (Trucking Apps, 2016). These apps are examples of innovations developed for consumers that can be used as solutions for business too. The approach could help small firms compete with larger firms with spare capacity becoming more visible and unlocked. In time, it may mean that just one or two apps in this area exist and will have high visibility. Firms with fleets of trucks may decide to reduce the number of trucks they own and use such apps when capacity is stretched. Freight-sharing has the potential to reduce the number of trucks on roads with commensurate reductions in traffic congestion and pollution.

While individuals have traditionally often seen ownership as the most desirable way to have access to products, increasing numbers of consumers are paying to temporarily access or share products and services rather than buy or own them (Scaraboto, 2015). Sharing can take a number of forms:

- Purchase a service – pay for a ride (ride-sharing).
- Exchange a service (car-pooling).
- Renting – a vehicle can be rented rather than purchased (car-sharing).
- Lending – a vehicle can be borrowed or loaned (car-sharing).
- Subscribing – people can become members of a car-sharing scheme (car-sharing).
- Donating – people can give free rides in their vehicle (car-pooling).

Sharing platforms are electronic marketplaces that match people together: those providing a service with those with a demand for the service (Cohen & Kietzmann, 2014). Hence, these are information-based systems and it is the information where the true value lies. For example, location sharing services that allow users to check-in using GPS-enabled devices create a lot of data that can be used to determine behaviour and travel patterns (Chen & Schintler, 2015). Much of the data being generated as yet is not being exploited. Some sharing models existed long before the Internet, car-pooling being one example as it made use of bulletin boards and word of mouth, but they have been taken to another level due to the immediacy and convenience of information and communication technology (ICT). Sharing economy start-ups are characterised by the “servitisation” trend. Rather than relying just on selling products, firms can expand their potential markets by renting access to products. For example, Daimler and BMW, following on from Zipcar, are offering transport as a service instead of selling vehicles (Cusumano, 2015).

Drivers of the sharing economy in transport

In this section, we examine the drivers of sharing in transport. We do this by examining the academic literature, reports by consultancies, websites and blogs, and government reports. The sharing economy in transport is divided into ride-sharing, freight-sharing, car-pooling and car-sharing and further analysed according to those involved (Table 2). Subsequent sections examine the facilitators and barriers to sharing in the transport sector.

One of the main drivers reported in the literature are economic in nature, for ride-sharing for example participants find it a cost-effective way of travelling since it has created greater competition with the taxi industry and hence prices are often reported to be lower than conventional taxis, typically around 20% cheaper (Business Travel, 2016). Greater choice and its convenience (availability) are significant factors in use as well as the feeling of fun compared with engaging with traditional taxi firms (Deloitte, 2015). A Deloitte study (Deloitte, 2016) found that people wasted an extra three minutes waiting for a taxi, with most Uber passengers picked up in about four and a half minutes as opposed to eight minutes with a taxi. The report also found Uber has reduced the risks associated with ride-sharing because both passengers and drivers have profiles that can be checked before pick-up. There are stringent rules for people

Table 2. The drivers of sharing related to transport

Model	Party	Drivers	Transport implications?
Ride-sharing	Participant	Affordability – reduced costs Owning feels like a burden Convenience – faster Choice Better for environment More fun than engaging with traditional companies	Government regulation required to protect consumers
	Provider	Income Independent – self-employed Lack of conventional employment opportunities	Potentially more vehicles offering service drives down prices
	Government	Less traffic congestion Less spent on road infrastructure	Government needs to develop position on relationship with ride-sharing companies
Freight-sharing	Participants	Reduce costs Convenience – save time Alternative to owning	Collaboration can reduce number of trucks on the road
Car-pooling	Participants	Builds community Better for environment Reduced costs	Reduces congestion and demand for parking.
Car-sharing	Participant	Affordability Owning feels like a burden Less expensive than to own	May impact on reducing car ownership rates in cities
	Provider	Profitable Taps into trend of not owning	Vehicle manufacturers change to “mobility access providers”

becoming Uber drivers, and there is a number of vehicle and personal requirements that people have to meet. The provider (car driver) does it for the income generated and because they are independent business owners, although reports of earnings per hour vary significantly. It is also possible that people take this option because of a lack of conventional business opportunities. Governments may see such services as reducing traffic congestion and spending on road infrastructure (Eggers & Macmillan, 2013).

Car-pooling lets you share a journey and the associated costs with everyone taking the journey. When two or more people, not belonging to the same household, share the use of a privately owned car for a trip (or part of a trip), and the passengers contribute to the driver's expenses, they are car-pooling. Car-pooling has been around for decades but technology and social media have made it easier to connect people to these schemes. As with any sharing scheme, the number of participants contributes to the success of the scheme. Although building the number of participants in car-pooling schemes is a challenge (Nielsen, Hovmøller, Blyth, & Sovacool, 2015), the effects of participation on road traffic could be significant. Conner-Simons (2016) models the effect of car-pooling on taxi rides in New York and predicts a possible reduction of taxi traffic by as much as 75%. Reductions in emissions, reduced fares and efficient routes can be obtained by using existing large taxi fleets as car-pooling services (Zhang et al., 2016).

Car-pooling services are typically more successful in densely populated urban areas where there is a critical mass of users. Different member demographics have been shown to exist between car-pool members and car-share members. Car-pool members are often blue collar workers, need to travel when other transport is not available and have tighter financial constraints than members of car-share schemes (Brimont, Demailly, Saujot, & Sartor, 2016). Although car-pooling is popular for short journeys, BlaBlaCar has become popular as a long distance, peer-to-peer car-pooling service. BlaBlaCar is the

world's largest long distance car-pooling initiative. It was initially thought of in 2003 and started in 2006. It now employs over 600 people and runs in 22 countries and has 35 million members. It has been valued at USD\$1.6 billion. BlaBlaCar's model revolves around drivers who want to fill empty seats in their car for a longer journey. Members register and create a profile and the profile is rated as the member makes journeys and is assessed by the passenger. People with more journeys become "ambassadors" or highly trusted members.

Car-pooling is driven by cost savings but also by other factors such as environmental implications since it results in fewer cars on the road because of higher occupancy in each vehicle. Some also suggest that car-pooling builds community structures since people are cooperating rather than being individualistic (Belk, 2014).

Technological advances have revolutionised traditional car-pooling by matching riders with drivers in real time. Despite the rapidly growing market of dynamic ride-sharing services, the impact of this service on travellers' behaviour is relatively unexplored (Viti & Croman, 2013). Car-pooling of the dynamic variety could make a significant difference to vehicle miles travelled if enough people adopted it in a locality. Deakin, Trapenberg Frick, and Shively (2011) conducted a study of the potential of dynamic car-pooling and found that 20% of commuters to the UC Berkeley campus would be interested in replacing their drive-alone trip with dynamic car-pooling.

Factors that contribute to car-pooling decisions have been reported in the literature, but it is still unclear how these apply in different social contexts (Neoh, Chipulu, & Marshall, 2017). As opposed to car-sharing, car-pooling requires participants to travel together and the driver usually owns the vehicle. Sharing space and social engagement have been reported as both positive and negative motivations for participation in car-pooling schemes (Nielsen et al., 2015). Social tie strength, trust and obligations have been found to influence car-pooling more than age or mobile engagement (Dickinson et al., 2017) which indicates that people of all ages and technical skill levels can participate in these schemes. Casual car-pooling, an informal car-pooling scheme run without the aid of technology, operates in some U.S. cities. A survey of users in the San Francisco Bay area showed that motivations to use the car-pooling service were the same as those often given for other types of car-pooling: convenience, time savings and monetary savings (Shaheen, Chan, & Gaynor, 2016). The introduction of technology to car-pooling schemes increases the likelihood of finding a suitable ride; it also has the potential to match the interests of car-poolers from crowdsourced data (Berlengerio, Ghaddar, Guidotti, Pascale, & Sassi, 2017). Connecting people with similar interests can make the journey more enjoyable, build trust and create social ties needed to maintain participation in collaborative travel.

Freights apps integrate time-consuming legacy processes, such as the process of calling freight brokers. Smart trucking app developers believe they can undercut fees charged by traditional freight brokers and in addition offer more comprehensive solutions. The benefits on the carrier side would involve lower operating costs, higher revenues and better fuel efficiency and asset utilisation.

The benefits on the shipper side include larger app-based marketplaces that should provide small shippers more access to on-demand capacity, at price points that they can more easily manage. Large shippers should be better able to manage freight surges. In the supply chain, freight apps should increase visibility and transparency for stakeholders. New load-matching apps will unlock the excess capacity now hidden due to

logistics inefficiencies and origin/destination imbalances. Companies with large private fleets might be able to reduce the number of vehicles they own, since they could use the service when needed. Also, private fleets could sell their excess capacity into the market when their truck utilisation is down (Ridebidz, 2017). Courier network services have the potential to impact the package and food delivery industry, as well as the broader transport network (Shared Mobility, 2016).

Road transport is typically dominated by large operators, and SMEs struggle to survive. The Uber concept that has succeeded so well for personal transport is being mirrored in the freight sector. A number of firms are developing smart apps that provide a comprehensive all-in-one solution for freight shippers and carriers. They provide “fast, automated load matching based on location and equipment; turn-by-turn route planning and shipment tracking; algorithm-based instant pricing; and seamless proof-of-delivery, billing and payment” (Meketon & Rennicke, 2016). These apps are examples of innovations developed for consumers that can be used as solutions for business too. The approach could help small firms compete with larger firms with spare capacity becoming more visible and unlocked. In time, it may mean that just one or two apps in this area exist and will have high visibility. Firms with fleets of trucks may decide to reduce the number of trucks they own and use such apps when capacity is stretched. Freight-sharing and optimal load balancing have the potential to reduce the number of trucks on roads with commensurate reductions in traffic congestion and pollution.

Freight apps integrate time-consuming legacy processes, such as the process of calling freight brokers. Developers of smartphone apps believe they can undercut fees charged by traditional freight brokers and in addition offer more comprehensive solutions. Growth in shipping versions of e-marketplaces, and platform access using mobile apps, will enable coordination of entire shipment routes and provide choice among carriers, hubs, depots and warehouses allowing the most efficient use of capacity. The owner of a single truck will be able to compete with companies owning hundreds of vehicles (Elliott, Schmah, & Tipping, 2017). The benefits on the carrier side would involve lower operating costs, higher revenues and better fuel efficiency and asset utilisation.

The benefits on the shipper side include larger app-based marketplaces that should provide small shippers more access to on-demand capacity, at price points that they can more easily manage. Large shippers should be better able to manage freight surges. In the supply chain, freight apps should increase visibility and transparency for stakeholders. New load-matching apps will unlock the excess capacity now hidden due to logistics inefficiencies and origin/destination imbalances. Companies with large private fleets might be able to reduce the number of vehicles they own, since they could use the service when they needed. Also, private fleets could sell their excess capacity into the market when their truck utilisation is down (Meketon & Rennicke, 2016).

The car-sharing concept is where cars are shared, mainly in cities. Cars are reserved, picked up and dropped off. DriveNow charges a registration fee, but there is no monthly charge. The rates cover rental, fuel, battery charging, insurance, parking in authorised areas and maintenance of the vehicle. The mobile app for the service allows users to locate and reserve vehicles. Customers can check the car’s fuel gauge or the charge of the battery, when they are going on a long trip (DriveNow, 2017). The car-sharing idea appeals to those that find owning a burden, especially in city locations where parking is difficult. There are indications that the costs associated with car-sharing are reducing and so it is

becoming more affordable to urban consumers. This is somewhat offset by extensive competition and considerable retail taxes that may prove a challenge in achieving local sustainability goals (Schwieterman & Bieszczat, 2017).

Car-sharing can play a role in reducing vehicle ownership, perhaps allowing at least some users to not own a car or reduce the number of cars they own. This is thought to be significant since reduced car ownership may translate into lower average vehicle miles travelled (Circella et al., 2016). Vehicle ownership among members of urban car-sharing programmes is lower by between 10% and 14%, while the portion of transit, biking and walking trips are all higher (Mishra, Clewlow, Mokhtarian, & Widaman, 2015). In one study (Cervero & Tsai, 2004), 30% of the members of car-sharing programmes were willing to sell one or more of their vehicles, while other members delayed the purchase of an additional vehicle after using car-sharing for approximately two years.

Car-sharing may have implications for the use of public transport, but there are a few studies on this. If car-sharing reduces vehicle ownership, it may reduce vehicle miles travelled. If so it may increase the use of public transport) but could also have the opposite effect on the use of public transport. Le Vine et al. (2014) found for example that car-sharing is often used in place of public transport.

Facilitators of the sharing economy in transport

Facilitation refers to factors that support a change but are not the reason or cause for the change. Several of the facilitators are interrelated because they relate to conditions that revolve around changes to behaviour brought about by developments in technology and the Internet (Table 3). In particular, developments in collaboration, sharing online and social commerce have created conducive conditions for the sharing economy as people become more familiar with the concepts.

Web 2.0 developments have seen the increase in user-generated content and how information is created and consumed (Kaplan & Haenlein, 2010). Peer-to-peer platforms involve collaboration between users online (Hamari et al., 2015). Participation in these systems is influenced by a range of factors such as reputation, enjoyment and intrinsic and extrinsic motivation (Hamari et al., 2015; Wasko & Faraj, 2005). Social media support the interactions in social commerce where contributions from users are used in the buying and selling process. Online recommendations from friends and to a lesser extent others can be very persuasive in convincing someone to buy a product (Wang & Zhang, 2012). Social commerce derives its influence due to the large number of members that participate in social networks. Word of mouth is important in influencing the attitude and behaviour of the user (Liang & Turban, 2011). Trust is a critical feature of sharing models. Many people will only trust a company or product when it has been recommended by someone they trust. Ride-sharing for example depends upon people

Table 3. Facilitators and barriers for sharing in transport

Facilitators of sharing in transport	Barriers to sharing in transport
Trust	Over-regulation
Adequate regulation	Lack of trust until recommended by someone they trust
Technology platforms, easy to use	Set-up costs and lack of profit (risk)
Rethinking value of ownership	Long-held norms and values (independence, private space, status)

trusting the driver to complete a journey safely and so driver recommendations are particularly useful when making a decision on this mode of transport.

Mobile technologies are a big enabler of just in time information that is shared in personal networks (Wong, Peko, Sundaram, & Piramuthu, 2016). The immediacy enabled by mobile devices is critical in many situations related to transport (US DoT, 2016). The growth of phone market has resulted in a diverse market for smartphone applications that perform a specific task such as providing a ride (Harding et al., 2016). Mobile devices do have constraints though: limited energy supply, low data transfer rates, delayed input functionality and small displays (Parise, Guinan, & Kafka, 2016).

Barriers to sharing in transport

Transport in the sharing economy involves a level of service risk (Table 3). Even though recommendations can be used to make decisions, it is likely that overall the service experience will not be consistent. Generally, there will be an absence of trust until there is a recommendation by someone. Ride-sharing has been rejected by some governments, Australia for example did not initially support it, but this has now changed in most states (Uber Standoff, 2017). There are stringent rules in some countries for people becoming ride-sharing drivers that require a variety of vehicle and personal checks to be completed as well as fees and insurance levies to be paid. Drivers join transport network companies primarily to generate income and become independent business owners. It is also reported that a lack of opportunities, economic strain and need to supplement existing income are motivations to join labour platforms (Farrell & Greig, 2016). Concerns over the social welfare, labour rates and the potential for exploitation of drivers have been raised. Reports of earnings per hour vary significantly, and there is evidence to suggest that drivers become dissatisfied over time because of fare cuts, high costs, driver saturation and lack of driver support (Ince, 2017).

Too many regulations in ride-sharing could make it difficult and expensive for drivers to start this form of business (Cannon & Summers, 2014). Some argue that broader rules should be developed that would not stifle innovation. Until recently, regulators have largely applied established practices to the sharing economy. As many sharing economy practices are on the border of personal and commercial activities, a new legal framework is needed. A minimum set of legal requirements is needed that takes into account the specifics of innovative sharing economy practices and that allow for future developments (Ranchordás, 2015). It is suggested that the objectives of city governments and sharing economy companies are often aligned though and that ride-sharing companies need to be proactive in putting their case forward (Cannon & Summers, 2014).

Although ride-sharing has grown quickly, some argue that it has only had a minor impact on the usual forms of transport. To start with, it is typically confined to urban areas and higher educated young adults (Rayle, Shaheen, Chan, Dai, & Cervero, 2014). Also, it mainly may just be a substitute for single-occupant driving trips. Even worse, one study of millennials in California found that had they not used ride-sharing, they may have walked or biked although older people said they would have made the trip in their own car (Circella et al., 2016). How ride-sharing impacts on vehicle miles travelled may just come down to local context, the characteristics of the users, the land use features and the transport alternatives that are available (KQED, 2015). Newer services allow

multiple users to share a ride in the same vehicle. If this type of service became popular, a reduction in vehicle miles would result (Circella et al., 2016).

Barriers to the development of sharing in transport also relate to long-held norms and values that include the desire to maintain independence, the significance placed on maintaining private space and the level of status obtained through private car ownership.

Although car-pooling has a potentially large market, many real-time car-pooling programmes have failed. A key reason put forward is the lack of a critical mass of users. It is also suggested that dynamic car-pooling requires some dedicated drivers to pick-up unmet demand (Circella et al., 2016). Dedicated drivers would mean a reasonable level of service is maintained in peak and off peak periods.

Implications for transport planning

The paper has examined the concept of the sharing economy applied to transport. The drivers in this area are mainly economically focused, but convenience is also important. Facilitators include the applications that make the more sophisticated matching and information provision possible. In addition, people's familiarity and conditioning through sharing and collaborating online has meant that more people are predisposed to participating in sharing systems. Over-regulation and lack of trust are barriers to sharing systems in transport increasing. In this section, we examine the implications of the analysis for government transport planning.

How will the sharing economy affect traffic and demand for public transport? What are the barriers to the development of the sharing economy impacting on transport? What will be the developments in the sharing economy that policy developers need to be aware of to plan transport infrastructure for the future?

Although the revenue generated by sharing schemes is quite large overall, the impact on transport systems has so far been minor. This is especially true when vehicle miles travelled are considered, as some ride-sharing schemes are not really sharing vehicles as yet but replacing traditional taxi services. It has also been pointed out that ride-sharing may involve additional miles in the pick-up and drop-off process and be used in place of walking or public transport. Given this perspective and that car-sharing and car-pooling are typically small scale, it has led some to propose that the sharing economy is being hyped up by those that stand to gain the most from it, that is, the platform operators (Dredge & Gyimóthy, 2015). The hyping takes the form of sponsored reports by consultancies, lobbying of government by platform providers, website content and social media content.

There is no denying that sharing is making an impact on the taxi sector (Daily Telegraph, 2016), and it has been suggested that it could make a major impact on reducing traffic congestion when true sharing takes place (MIT, 2016). However, should governments take the view that sharing will make a major impact on the transport system? Considering only sharing, we suggest that the answer should be it has the potential to make a significant impact, especially when considered with other developments, although it is too difficult to predict how it will play out over the coming years as new technologies appear and people's behaviour changes. But, sharing should not be considered in isolation from other technology changes. In combination with driverless, electric vehicles and new modes of working and living, the sharing economy has the potential to significantly

alter the transport system. Some have argued that due to the merging of car- and ride-sharing enabled through driverless vehicles, it will be possible to get everyone where they need to be on time with as much as 80% fewer cars in circulation (Ratti, 2016). This would result in opportunities for place-making, reclaiming and reinvented parking and streets for a whole new spectrum of functions. Others have argued that there will be more travel as a result of induced demand because travel is easier and cheaper, offering a greater degree of individual and flexible mobility with more people able to make trips (older, younger, disabled) and with travel time being more productive and/or enjoyable (Sun, Olaru, Smith, Greaves, & Collins, 2016).

The exception could be in the freight area since applications can result in sharing of transport, in other words, one fully loaded vehicle rather than two half-loaded vehicles. This can have a significant impact on vehicle miles travelled.

Holistic transport solutions

There is a desperate need for integrated transport solutions, integrated in the sense of being holistic. Holistic systems approaches emphasise the system rather than its components. Transport problems will not be solved by the sharing economy just as building another lane on a freeway will not solve peak-hour congestion as demand typically rises to meet provision. Better solutions will involve government departments working together to improve the design of urban areas rather than a silo approach (Curtis & Low, 2016). For example, suburban areas without grocery shops and places to work necessitate car travel. If the need to travel far is diminished, then people can rely on public transport, walk or cycle as alternatives to the car. For some, a car may no longer be needed, or the number of cars per family can be reduced (Planning for Shared Mobility, 2016). Rather than a transport problem, the problem can be viewed as an urban design problem and any improvements in this area can have a major impact. In addition, researchers have pointed out that transport taboos such as the inequality in transport consumption are rarely addressed (Gössling & Cohen, 2014). They argue that highly mobile travellers, usually from high-income classes, travel the greatest distances, but the costs are shared across society as a whole. Also, the key issues related to climate change are often ignored in transport debates and high mobility patterns are linked to socio-cultural norms and embedded with individual identities. These taboos create a barrier to holistic transport solutions since they are typically not confronted.

Dangers of over-regulation

While regulation is required to protect the consumers, there are dangers associated with over-regulation and additional barriers to the sharing economy. Not least is the situation that can occur if there becomes a culture of over-regulation (Koopman, Mitchell, & Thierer, 2015). Transport is in critical need of innovation. New ideas, new schemes, new technologies and new business models can potentially make a big impact on transport solutions and conditions. In Australia, for example, Uber drivers have additional tax impositions that other small business owners do not, making the activity less competitive.

Future research

Future research could examine the key attributes for each form of the sharing economy that explain why people choose to participate in shared transport. Equally important is examining how public transport can be made an attractive option since the discussion of the sharing economy is not just a direct comparison between sharing modes of transport and private car use and ownership but between sharing options and public transport. People using forms of sharing could be surveyed to determine how they would have travelled had they not used sharing modes. Studies could be conducted on how governments see the sharing economy impacting on transport modes and demand. Various stakeholders could be canvassed for their views on the transition and impact that mobility as a service might have on transport. Finally, research on sharing in freight is very scant, and surveys and interviews could uncover critical features for its development and the likely benefits that will result from its growth.

Conclusions

This paper has examined the sharing economy conceptually by analysing the broad literature. Although ecological reasons are frequently assumed to be strong drivers of transport sharing modes, the literature emphasises the importance of economic and convenience benefits for participants. In other words, the drivers are more instrumental rather than altruistic. However, behaviour can and does change as can be seen by the growing interest in having access to mobility rather than owning vehicles. The burden and cost of ownership may be aspects that millennials seek to avoid. It is important for policy developers and planners to be aware of the drivers, facilitators and barriers and to continually revisit developments.

The sharing economy has made an impact on transport in just a few years. The extent of the impact varies from country to country, city to city and between demographic groups. Estimating how it will progress in the future is a difficult task and is not just simply a case of extrapolating from how it has developed so far. The concept of the duality of technology explains how use of a technology evolves through time. Users appropriate technology according to the benefits they perceive it will provide, and as they adopt and use a technology they find new uses for them. This growth in use of a technology leads to further technological developments and the cycle of change and development continues. In other words, what people accept or embrace today will be different to what is acceptable in the future.

Suggestions are made from the review for transportation authorities that draw upon key points in the literature.

- The sharing economy has produced different business models and will continue to evolve as technology develops and behaviour changes. These developments need to be integrated in transportation planning, balancing the need for modal choice and equality of service provision.
- Transport and planning authorities can work with commercial car-sharing providers to set up pilot schemes that can be monitored and evaluated.
- Investigate willingness of citizens to join car-sharing and car-pooling schemes in the local context and community.

- Raise awareness of car-sharing and car-pooling and provide inducements to join. For example:
 - Road lane restrictions for vehicles carrying less than two passengers in peak hours.
 - Car-sharing/car-pooling framed as creating independence and being cost-effective.
- Significant scope exists for collaboration in the freight sector, particularly in terms of load sharing. Determining the benefits, facilitators and barriers to collaborative commerce in the freight sector needs further investigation.

Transportation research with a focus on behavioural questions, sustainable transportation, emerging transportation technologies and mobility services are current “hot topics” and demonstrate the interrelations between engineering, social science, environmental issues and economics. All these areas are features of CC and sharing economies. The companies providing sharing services collect large amounts of data from participants to operate the service. If these companies made their data more accessible and shared their knowledge, on miles travelled, destinations, pick-up-points, insurance claims, goods carried, etc., it would allow more targeted research and improve policy development.

The expansion transport networks is essential in areas with growing populations, but increasing road and rail infrastructure is not always the answer to the problem of congestion. Community context and personal needs are factors that influence transportation choices, but few studies are focused on an Australian context. Personal travel and convenience are closely aligned with mobility options for both work and leisure activities. There is a need to investigate how to balance convenience and shared mobility options. This would require investigating disincentives for single-occupant vehicle travel, provision of more shared mobility options and development of urban areas containing work, home and leisure facilities that would reduce the need to travel outside the area.

As sharing concepts and practices become more mainstream, they afford new opportunities for business development. The barriers to their development such as government regulation and security issues may be viewed as a drag on the speed of their development, but behavioural attitudes can change relatively quickly if significant benefits appear to exist for the user. Changes in transport infrastructure on the other hand are costly, require long-term planning and are slow to change. Integrating collaborative mobility and the sharing ethos into transport can speed up change by adding resources, such as those transport network companies could provide that did not previously exist. Vehicles could be smaller and routes more flexible providing a variety or hybrid models of transport consisting of on-demand options operated by local authorities and private companies. Collaborative software and people’s willingness to use P2P services such as Uber could make this a reality more quickly than changes in the infrastructure needed to accommodate it.

Disclosure statement

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