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Tackling road congestion – What might it look like in the future under a collaborative and connected mobility model?

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ABSTRACT

Traffic congestion continues to be the bane of many metropolitan areas and has exercised the minds of experts for at least the last 60 years. With the advent of smart (intelligent) mobility, aligned with digital disruption and future connected and collaborative transport including extensions to autonomous vehicles, the question of whether we have a new window of opportunity to tame congestion is now high on the list of possibilities. It is however very unclear what the future will look like in respect of congestion on the roads, especially if we rely on 'smart' technology and continue to reject reform of road user charging and new opportunities to fund the sharing model. This paper looks at a number of themes as a way of highlighting possibilities and challenges and promotes a position that congestion may not be reduced, especially without a significant switch to the sharing economy and relinquishing of private car ownership; the urgent need for government to define the institutional setting within which smart mobility can deliver reductions in congestion; and the crucial role that road pricing reform must play to ensure that those who benefit (suppliers and travellers) contribute to pay for the infrastructure (in particular) that they gain benefit from.

1. Introduction

The growing interest in smart[1] cities and the role of digital-based technology in driving new agendas for how our cities will perform in the near and far future has opened up commentary on what this might mean for curbing road traffic congestion. Will, for example, autonomous vehicles (at levels 3 and 4 in particular[2]) contribute to reducing if not eliminating or better manage traffic congestion, and when might this occur? How might a move to a sharing culture with less private car ownership affect levels of congestion even without autonomous cars? What will all this mean for future investment in infrastructure, especially major highways, and might the design of such roads change in recognition of the safety outcomes associated with computer-controlled cars that can travel in platoons? Will lanes be narrower,[3] with possibly autonomous intersection management? Under the sharing model, car-based movements might start to take on the feel of conventional bus public transport, albeit with smaller vehicles, offering improved public transport-like services that can stretch throughout suburbia under a point to point initiative, or as a first and last mile (almost seamless) connection with conventional line-haul high capacity public transport. These speculative assertions are eroding daily as we come to grips with the real possibilities of technology-enhanced mobility opportunities, driverless or otherwise. What this will mean for the changing landscape of service provision under the adage 'the customer comes first', and the implications for the governance of cities, are rapidly becoming priority agenda items.

With a focus on what this might mean for future levels of traffic congestion, this paper looks closely at a number of themes that might throw up clues as to the implications for future congestion and what conditions are likely to have to be in place to support taming traffic congestion. We have selected four themes: smart mobility, governance reform, ownership of information, and road pricing reform. In one sense the arguments presented below are speculative (although almost daily we acquire further factual evidence); but then so is the future. To recognise that the digitally disrupted future and its interface with autonomous vehicle technology may have significant downsides, once

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[1] See Lyons (2017) for a review and critique of the meaning and value of the word 'smart'.

[2] A Level 3 autonomous system is capable of monitoring the driving environment around them, allowing vehicles to make decision themselves. Cars with on board computers that can handle tasks like indicating, braking and steering at the same time are classed as Level 4 systems. A Level 4 car is officially driverless in certain environments and can drive safely on its own even if a driver chooses not to intervene when asked. See https://en.wikipedia.org/wiki/Autonomous_car.

[3] Although this may require no lane access by heavy vehicles.

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we start to understand behavioural response, must be given a greater focus. Importantly, we need to be clear from the outset that mobility as a service (MaaS), the popular interpretation of future collaborative and connected mobility services, must be considered under both the presence and absence of autonomous vehicles as well as the extent to which we can change society to adopt a sharing culture. These are the critical elements that have to be in place or not in judging the opportunity to change the way transport services are provided and the success of any initiatives (see also Cavoli et al., 2017 for an excellent review of the literature and Cohen et al., 2017, also Stathopoulos and Sener, 2017)).

This paper is as much about uncertain futures as it is about identifying research themes that will need to be given great attention if we are to gain greater confidence in the likely impact that these exciting initiatives might have on levels of congestion. There is one outcome that we feel reasonably confident about however – congestion is likely to become less random and somewhat more predictable, but it is unlikely to disappear. Much of the criticism of historical and current traffic congestion is related to its great variability and uncertainty every time one travels, and the growing incidence of accidents and breakdowns as a contributing influence.

1.1. Smart shared mobility and potential implications for levels of congestion

The transition to smarter mobility that is taking place, referred to as Smart Transition, typically involves greater car sharing (facilitated by apps) and less owning of cars by private individuals, as well as the future role of (electric) autonomous vehicles. It has an underlying mandate to redefine and commit to a Collaborative and Connected Society (CCS) whereby the mode is far less important that the service levels that satisfy customer needs. While we will always need reflective and effective governance frameworks to ensure deliver of CCS, we have an opportunity to finally break the stranglehold that outmoded mode-specific regulatory models have had on the provision of transport services.[4] Why should we continue with mode-specific contracts, often associated in the public transport sphere with public monopolies or provided by competition for the market (i.e., competitive tendering – see Hensher, 2017), all supported with provider-side subsidies? This includes the limitations imposed on the over-specification of network service levels (and the predominance of timetables for conventional public transport). The car-based systems associated with taxis are now being broken by the arrival of new service models such as Uber and Lyft, although they are essentially mode-specific (though covering an increasingly expanding mix of intermediate modes, many of which are being defined for the first time). Fundamentally, we increasingly see many variants on the conventional wisdom that are tantamount to delivery models that cannot operate under outdated regulations. Smart Transition is the context in which we have to contemplate that anything goes as long as it has a sensible customer outcome, and one might hope an acceptance by government as the custodian of societal interests through a reformed governance (and funding) model.

The current interest is in how this all relates to the future of road congestion reduction, something that is claimed to be a major benefit of an era of intelligent mobility. This appears to be premised on one crucial consideration, the success in moving society to a regime of collaboration and connectivity, initially without autonomous vehicles, but subsequently with such vehicles. Collaboration is often associated with the sharing economy which can take at least two paths – shared and pooled (see Wong et al., 2017), or without others, for a particular 'point to point' or 'point via another point to point' trip. It is far from clear how much of the congestion challenge can be resolved through greater sharing of private cars (no matter whether they are autonomous or not), increasing occupancy, assuming a constant number of person trips. However, sharing of private cars could lead to increased trips overall through a higher number of trips per vehicle, and to greater congestion if the number of trips overall goes up.

A very specific issue being raised within the new reform agenda is what all of this might mean for the number of cars on the road and the amount car usage (vehicle kilometres travelled). The limited evidence on smart transition (predominantly associated with smart apps, opportunities to ride hail and dispose of a car), is simultaneously creating the promise of a system that can reduce demand (congestion), but at the same time fulfilling previously unmet demand and creating new demand (e.g., Truong et al., 2017). Smart transition moves society to a rentier model (Docherty et al., 2017) where the incentive for the mobility service provider is to generate as much mobility as possible (i.e., trips and kilometres) to maximise returns on capital (Karlsson et al., 2016).

What little evidence there is at present, based on simulated scenarios of futures, is informative, but can it be relied on? Two studies are of particular interest, one from the ITF/OECD, and one from University of California Davis (Clewlow and Mishra, 2017). These studies say nothing about the impact of autonomous cars or indeed any renewed future role of public transport (except on demand buses)– they primarily focus on shared cars with a driver, the latter likely to be the basis of car travel for at least the next 20 years.

The ITF/OECD (2017) study modelled the impact of replacing all car and bus trips in a city with mobility provided through fleets of shared vehicles. The study found that if all individually-owned private cars were removed from the city with shared vehicles only, there would be a substantial reduction in the number of vehicles required to service overall mobility demand, and greater equity of service across the city as a whole. However, the findings suggested an increase in vehicle kilometres driven of 6.4 percent per day. Once the assumption of perfect conditions breaks down, and 50 percent of private cars are assumed to remain, the performance of the system deteriorates further, with up to 90.9% more kilometres being driven per day. This does not sound like a congestion buster? Even more congestion on our roads; although the congestion levels may be more predictable (non-random) with improved reliability, and maybe a lower value of travel time savings and reliability willingness to pay.[5]

ITF/OECD (2017) also undertook a simulation study, using mobility and network data from Lisbon, Portugal and examined scenarios where shared mobility is delivered by a fleet of six-seat vehicles (shared taxis) that offer on-demand, door-to-door shared rides in conjunction with a fleet of eight-person and 16-person mini-buses (taxi-buses) that serve pop-up stops on demand and provide transfer-free rides. Rail and subway services are assumed to keep operating in the current pattern. They tested scenarios where car owners could use their car for one, two or three days each working week, which corresponds to having 20 percent, 40 percent, and 60 percent of trips currently made by private car continuing to be made by that same mode.[6] Allowing for 60 percent of the private cars[7]

[4] Interestingly, New South Wales, Australia made a start with this is the 2014 Passenger transport Act where linking of specific vehicles of modes was removed.

[5] The study only forecasts a minor increase in travel times by having distributors and local streets absorb much of this increase—thereby ignoring the road hierarchy and bringing associated externalities.

[6] A related issue and cautionary evidence is what happened when Athens allowed vehicles to be driven every other day (odd and even registration plates), albeit for pollution control. The outcome was an increase in the number of vehicles as households moved to buy more vehicles so they had a permitted vehicle for each day or they went for one of the exempted vehicles. It is not easy to stop people once they have a car, so reducing the number of vehicles overall has to be where we start.

[7] The study found that if conventional cars were replaced with driverless cars that take either a single passenger at a time or several passengers together, as long as half of travel is still carried out by conventional cars, total vehicle miles travelled will increase from 30 to 90 percent, suggesting that even widespread sharing of driverless cars would mean greater congestion for a long time.