Editorial

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1 Introduction

An array of megatrends has been identified worldwide such as urbanisation, globalisation, population growth, ageing population and increasing social disparities

(Hoppe et al., 2014). To address these at a global scale, the United Nations (UN) 2030 Agenda for Sustainable Development was adopted by all UN member states in 2015 identifying 17 sustainable development goals (UN, 2018a), where SDG11: Sustainable cities and communities has a prominent role. Thus, it becomes apparent that the urban dimension is at the core of those global objectives. This is undeniable since cities are increasingly the places where technological, behavioural and institutional transitions make a significant impact. Planning, managing and assessing urban projects are at the core of contemporary urban development. Within this context, mobility is one of the most influential factors.

The transport sector attracts enormous amounts of investment funds. For example, it has been projected that more than US $14 trillion will be invested in transport infrastructure projects worldwide between 2016 and 2025 (Smith et al., 2017). This is partly linked with the fivefold and twofold increase in passenger car ownership levels since 2000 in China and India respectively, with a similar situation faced by a number of countries in the Global South. At the same time, certain cities in the Global North are experiencing the 'peak car' phenomenon (Newman and Kenworthy, 2011) which may be due to urban sprawl accounting for US $1 trillion costs per year to the US economy (Litman, 2015).

Consequently, there is high interest about future mobility developments both by private and public stakeholders. Given that more than half of the global population already lives in cities and that 68% of the global population is anticipated to live in cities before 2050 (UN, 2018b), urban planning and management become critical factors. Yet, the transport sector still accounts for 14%–23% of the global green house gas (GHG) emissions (Smith et al., 2017; IPCC, 2018) linking it with climate change. As a result, a wide range of future urban challenges arise which include the following:

- air pollution
- digital divide
- equity
- green energy
- privacy and data management
- urban sprawl
- well-being.

Therefore, it is crucial to develop and evaluate improved accessibility options through innovative mobility solutions for the future.

Mobility provision strategies in smart cities should be defined by their ability to actively prioritise people over automobiles and old-fashioned 'predict and provide' practices by embracing innovation. As a result, smart cities should be promoting a new mobility ethos that is safe-guarding the environmental, economic and social sustainability of their local communities as part of a continuous effort looking to establish a user-friendly transport network that provides seamless connectivity for all. The latter builds up on Sheller and Urry's (2000) critical argument against a car-dictated transport system which in certain occasions accelerates the transformation of public spaces into flows of traffic, coercing, constraining and unfolding an unparalleled urban domination. Emerging urban mobility solutions attempt to decrease the excessive usage of the

conventional, fossil-fuelled, human-led, privately owned car due to its potentially adverse effects including traffic congestion, climate change, local air and noise pollution, road injuries or casualties, obesity and decline in physical activity, chronic diseases and loss of social engagement (Nikitas et al., 2016).

Connected and autonomous vehicles (CAVs) will radically change the use and perhaps the very meaning of automobiles, as we know them for a century now, mitigating some of these adverse effects. Most automobile manufacturers are already marketing vehicles with some automation features and working to develop more highly automated and self-driving vehicles (Wadud et al., 2016). CAVs will introduce eco-driving and energy-saving functions, enhanced safety and security standards, better road space allocation and traffic congestion management and revolutionise commuting making it more productive than ever. However, despite the massive hype about CAVs there are too many questions remaining unanswered before driverless vehicles can be the next mainstream standard of transport provision. This special issue aims at reviewing a range of these questions.

Equally, electric vehicles (EVs) can also help entering this new era. Yet, market diffusion of EVs is currently low (Donada and Perez, 2016). According to the European Environment Agency (2016) in 2015 electric passenger vehicles represented just 1.2% of all new cars sold in the EU. This led Biresselioglu et al. (2018) to conclude that there is little to no acceptance of EVs, and a lack of general understanding of their advantages and costs. There are three key reasons for that:

1 conventionally-fuelled vehicles remain a serious competition (Wells and Nieuwenhuis, 2012)

2 their limited range and the questionable charging infrastructure availability make EVs incompatible with many urban environments (Franke et al., 2012)

3 EVs can be equally polluting to internal combustion engine vehicles unless their electrification is based on renewable energy sources (Kougias et al., 2019; Nikitas et al., 2017a).

However, these attitudes can change after a positive experience (Wikström et al., 2015) and thus research and development (R&D) efforts, as the ones presented in this special issue, looking to make EVs genuinely mainstream should be focusing on solving these shortcomings.

Finally, shared use mobility looks to create a shift from the private car culture. This is a new mobility recipe meaning to maximise the utilisation levels of the finite mobility resources that a society can realistically afford to have by disengaging their usage from ownership-bound limitations (Nikitas et al., 2017a). Shared use mobility schemes present the option of vehicle fleets that can be ridden by their subscribers on an as-needed basis associated with usage criteria. Milakis et al. (2017) explicitly suggest that the synergistic effects between vehicle automation, electrification and mobility sharing can multiply the benefits associated with those three transport initiatives. Bringing these three together thus may re-define the identity of the car and to a certain degree aid in turning it into a medium for change and not a sustainability barrier.

Overall, there is a wide spectrum of transport strategies that could re-shape the urban futures of mobility networks by creating modal shift. This special issue examines ways that are not about changing people's travel behaviour patterns *per se* but are about

changing the 'car' itself. Re-inventing automobiles and their usage norms could be a way forward. This special issue therefore offers an overview of how car-centric innovation could transform automobiles, by exploiting the vast potential of vehicle automation, electromobility and shared use mechanisms, to a travel choice that has a more anthropocentric character. Therefore, this special issue provides a forum to aid automotive stakeholders and city authorities aiming at crafting more sustainable pathways to liveable urban futures.

2 The contributions of this special issue

This special issue features five original papers that discuss how the automobile could be re-introduced as a medium that will help urban mobility futures to be smarter and more liveable. Each of them adopts a different approach for describing the opportunities and challenges facilitating or hindering the transition to a much more diverse, intelligent and sustainable automotive era. This special issue therefore creates a new layer of interaction between practitioners and academics examining mobility futures.

The most polarising but perhaps robust mobility intervention that this special issue concentrates on refers to the rise of the autonomous vehicle (AV) and its fit to the high-tech future of transport service provision. CAVs are set to revolutionise the urban landscape by allowing machines to take over driving (Nikitas et al., 2017a). This will minimise the human error factor that has been the principle reason for traffic accidents (Thomas et al., 2013; Uchida et al., 2010) and their side-effects, including production losses and massive costs overburdening healthcare systems. Recent studies also predict that CAVs could provide benefits in terms of traffic congestion relief, road space management, time savings, environmental improvements, decreased noise nuisance and fewer layers of transport-related social exclusion (e.g., Fagnant and Kockelman, 2015; Fraedrich et al., 2018; Milakis et al., 2017; Nikitas, 2015; Nikitas and Nikitas, 2015; Nikitas et al., 2017b; Thomopoulos and Givoni, 2015).

However this is only one perspective on this fascinating contemporary development. Although the 'autonomous car' ignites the imagination and promises great offerings, yet the research and debate on this topic largely focus on the 'autonomous' and do not examine adequately the 'car' element. Autonomous transport can improve our current travel eco-system, but similarly it carries risks and can lead into a future mobility that exacerbates, rather than relieving, current deficiencies of our mobility systems, including its high carbon and high cost characteristics (Thomopoulos and Givoni, 2015). Full vehicle automation will likely be a game-changer, but as Milakis et al. (2015) suggested its pace of development and subsequent implications largely depend on technological evolution, policies and user attitudes.

Nikitas et al. argue that CAVs are an inescapable intervention for the future of urban mobility offering huge dividends for users and societies. However, the article also argues that the full-scale launch of CAVs, may not be as 'smooth' as it is commonly portrayed by stakeholders and media and could involve a lot of uncertainty, risks, shortcomings and even some fiascos; the pathway to 'change' could be uphill. The article provides a list of the opportunities and challenges associated with the uptake and use of CAVs and a critical examination of 11 myths referring to CAVs' development and adoption readiness. Nikitas et al. suggest that shifting to a new machine-led transport era will not be a one-dimensional technology-centric process but a complicated multi-layer paradigm shift

that needs: more time, political support and stakeholder coordination; continuous investment in vehicle, road and telecommunication infrastructure; new complementing legislative, moral and educational frameworks; suitable business models that could emphasise sharing; activities building trust and acceptance; preparedness to manage failures; piloting schemes and strategic expansion planning. If these issues are addressed then CAVs have a better chance to succeed without unnecessary complications in improving the travel eco-system of tomorrow.

Along similar lines, a major finding of this special issue, which is in correspondence with other literature in the field, is the lack of uniform definitions. Despite that automation levels as defined by the Society of Automobile Engineers (SAE) are typically used today (e.g., Cavazza et al.), there is an identified lack of uniform definitions highlighting the need for consensus about terminology use (e.g., through a relevant glossary). This would be particularly useful in the light of the increasing need for multidisciplinary research to inform management and practice about smart urban mobility. Moreover, Cavazza et al. identify a literature gap in management and business research regarding automated and autonomous car technologies. Their bibliometric analysis is a useful contribution in this evolving field and highlights the lack of relevant business models that are necessary for providing a platform for the eminent arrival of AVs.

This matter is also addressed by Proff et al. who attempted to provide a short or medium-term solution for car dealers. It is a fact that car dealers face market pressures in the Global North, not only due to the 'peak car' phenomenon but also due to the market penetration by new large players established worldwide in non-automotive markets. Nevertheless, car dealers possess strong sales networks and long experience of liaising with car users. Thus, the suggestion by Proff et al. to develop a new business model offering both car and home purchase options is interesting and needs to be further explored in line with the suggestion of Krommes and Schmidt (2017). Their paper focuses on a sample from Germany where car ownership and environmental awareness are considerably high. Yet, it seems that such business models solely promote car use which may be at the expense of emerging shared mobility options. Diverse futures have been suggested in the literature, particularly about public transport supporting AVs (Thomopoulos and Givoni, 2015), which could be incorporated to the suggestion by Proff et al. Their proposal could be particularly interesting for rural areas, which is certainly a field of future research given the 'peak car' trend in cities of the Global North.

Subsequently, Blankesteijn et al. review the innovation practices of three leading car manufacturers from different continents, namely from the USA, Asia and Europe. Open or closed R&D and innovation are key contemporary issues faced by practitioners across countries and industries. Smart urban mobility is one of the sectors where this is mostly evident due to the incremental move from a hardware to a software industry where data is becoming the core currency through ICT for transport (Thomopoulos et al., 2015). Yet, it remains to be explored whether car manufacturers and original equipment manufacturers (OEMs) will embrace the open innovation model advocated by Blankesteijn et al.

Interestingly, Blankesteijn et al. point out that established manufacturers may not apply a single approach, adopting multiple business models. This approach could accelerate innovation development as well as the adoption of new business models. In an attempt to measure such practices, the number of patents has been used as a metric of innovation and R&D across articles (Blankesteijn et al.; Clarke and Piterou),

demonstrating the close link of intellectual property (IP) and smart urban mobility. Whether this should be open or closed innovation however, remains to be seen through the pursuit of an appropriate balance regarding risk, cost and profit.

Clarke and Piterou highlight the vast number of opportunities available within the smart urban mobility field by focusing on the niche area of EV range extenders. Linked with the widespread user concern of EV range anxiety, their suggestion is to use a portable range extender. This suggestion could simultaneously address intertwined ethical and equity concerns about the use of EVs (Thomopoulos and Harrison, 2016). Similarly to Flamand (2016), they conducted both quantitative and qualitative analysis through patent and social network analysis, and offer useful insights about this option. Such an option may still promote car use but is fostering reduced emissions at the point of use and can increase overall positive outcomes (e.g., reduced air pollution, when combined with green energy use). In such, it addresses concerns surrounding the advancement of battery technology which is vital for EVs.

3 Lessons learnt and future research agenda

This special issue aims at discussing how future automotive technology could contribute in re-shaping urban mobility and to describe the pathway leading to this transition. Ultimately, this special issue does not conclude the debate about smart urban mobility futures. On the contrary, it generates new questions for both academics and practitioners through the literature reviewed and the solutions presented. Nonetheless, certain key issues arise which if followed up may lead to useful lessons learnt:

1 Re-forging drastically the identity of the car is a not so obvious way to help in delivering a more sustainable and smarter urban future, to some extent at least, even if this seems highly paradoxical in today's terms. If despite policy interventions, travel behaviour remains purely car-centric, exploiting the benefits of automation, connectivity, electromobility and shared use is a robust approach in reducing some of the adverse impacts of automobiles.

2 Existing business models need to be updated so that they become more innovative and collaborative. Collaboration between different actors of the automotive industry at diverse stages of the currently globalised supply chain is essential, even between actors from dissimilar industries. Public and private collaboration through public private partnership (PPP) and emerging business models is deemed essential.

3 Future product and service development approaches have no other option than to be user-centred. The digital divide and deriving equity concerns should form an integral part of relevant debates to ensure adequate acceptability levels. Monolithic state or industry led approaches cannot lead to success in such a complex and competitive context as smart urban mobility.

4 As a result, integrated policy and management practices are the way forward to ensure safe and healthy environments which do not foster counter-productive forms of innovation (Rode et al., 2017). Public transport and active transport should also be part of future mobility systems given their merits highlighted (e.g., through life cycle assessments).

5 Any future solution should incorporate innovative funding mechanisms, particularly ones which can be effective in the Global South. Thus, attention should be given not only on conventional North-South approaches, but also on South-South ones (e.g., through city twining).

As outlined in the literature, first, second and third order implications of intelligent transport solutions are observed (Milakis et al., 2017). However, it is evident that despite the vast range of new technologies available, a techno-fix cannot be a panacea (Thomopoulos and Givoni, 2015) since technology is only one of the several tools in the toolbox of mobility (Sochor and Nikitas, 2016). The growing challenges of connected vehicles pose a further concern related not only to privacy, but also to cyber-security challenges (Morris et al., 2018). A more holistic approach adopting a wide range of 'sticks and carrots' and embracing advanced education and information provision instruments is required to reach a smart urban mobility future (Haboucha et al., 2017). This can be supported by initially mapping current practice and by offering global collaborative platforms at urban and regional scale. All in all, changing mobility paradigms is a difficult process. The pathway for transitioning to a new mobility era could be very demanding and associated with uncertainty and resistance to innovation so building trust could be the key ingredient for success.

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References

Biresselioglu, M.E., Kaplan, M.D. and Yilmaz, B.K. (2018) 'Electric mobility in Europe: a comprehensive review of motivators and barriers in decision making processes', *Transportation Research Part A: Policy and Practice*, Vol. 109, pp.1–13.

Donada, C. and Perez, Y. (2016) 'Editorial: electromobility at the crossroads', *International Journal of Automotive Technology and Management*, Vol. 16, No. 1, pp.1–10.

European Environment Agency (2016) *Electric Vehicles in Europe* [online] https://www.eea.europa.eu/publications/electric-vehicles-in-europe (accessed 10 July 2017).

Fagnant, D.J. and Kockelman, K. (2015) 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations', *Transportation Research Part A: Policy and Practice*, Vol. 77, pp.167–181.

Flamand, M. (2016) 'Studying strategic choices of carmakers in the development of energy storage solutions: a patent analysis', *International Journal of Automotive Technology and Management*, Vol. 16, No. 2, pp.169–192.

Fraedrich, E., Heinrichs, D., Bahamonde Birke, F.J. and Cyganski, R. (2018) 'Autonomous driving, the built environment and policy implications', *Transportation Research Part A: Policy and Practice*, in press.

Franke, T., Neumann, I., Bühler, F., Cocron, P. and Krems, J.F. (2012) 'Experiencing range in an electric vehicle: understanding psychological barriers', *Applied Psychology*, Vol. 61, No. 3, pp.368–391.

Haboucha, C.J., Ishaq, R. and Shiftan, Y. (2017) 'User preferences regarding autonomous vehicles', *Transportation Research Part C: Emerging Technologies*, Vol. 78, pp.37–49.

Hoppe, M., Christ, A., Castro, A., Winter, M. and Seppänen, T.M. (2014) 'Transformation in transportation?', *European Journal of Futures Research*, Vol. 2, No. 1, pp.1–14.

Intergovernmental Panel on Climate Change (IPCC) (2018) *Global Warming of 1.5C* [online] http://www.ipcc.ch/report/sr15 (accessed 15 October 2018).

Kougias, I., Szabó, S., Nikitas, A. and Theodossiou, N. (2019) 'Sustainable energy modelling of non-interconnected Mediterranean islands', *Renewable Energy*, Vol. 133, pp.930–940.

Krommes, S. and Schmidt, F. (2017) 'Business model analysis of electric mobility products and services', *International Journal of Automotive Technology and Management*, Vol. 17, No. 3, pp.316–338.

Litman, T. (2015) 'Analysis of public policies that unintentionally encourage and subsidize urban sprawl', *New Climate Economy – Cities: Sprawl Subsidy Report*, Victoria Transport Policy Institute and LSE Cities, Vancouver [online] http://static.newclimateeconomy.report/wp-content/uploads/2015/03/public-policies-encourage-sprawl-nce-report.pdf (accessed 14 November 2018).

Milakis, D., Snelder, M., Van Arem, B., Van Wee, G.P. andHomem de Almeida Correia, G. (2015) *Development of Automated Vehicles in the Netherlands: Scenarios for 2030 and 2050*, Delft University of Technology, Delft, The Netherlands.

Milakis, D., Van Arem, B. and Van Wee, B. (2017) 'Policy and society related implications of automated driving: a review of literature and directions for future research', *Journal of Intelligent Transportation Systems*, Vol. 21, No. 4, pp.324–348.

Morris, D., Madzudzo, G. and Garcia-Perez, A. (2018) 'Cybersecurity and the auto industry: the growing challenges presented by connected cars', *International Journal of Automotive Technology and Management*, Vol. 18, No. 2, pp.105–118.

Newman, P. and Kenworthy, J.R. (2011) 'Peak car use: understanding the demise of automobile dependence', *World Transport Policy and Practice*, Vol. 17, No. 2, pp.31–42.

Nikitas A. (2015) 'Automated cars: a critical review of the potential advantages and disadvantages of driverless technologies', *First International Workshop on Smart Urban Mobility*, Edinburgh Napier University, Edinburgh, UK, November.

Nikitas, A. and Nikitas, G. (2015) 'Social dilemmas in vehicle automation', *The 2015 Royal Geographical Society (with IBG) Annual International Conference*, Special Transport Geography Research Group Session in The Spaces of Road Transport Automation, Exeter, UK, September.

Nikitas, A., Kougias, I., Alyavina, E. and Njoya T.E. (2017a) 'How can autonomous and connected vehicles, electromobility, BRT, hyperloop, shared use mobility and mobility-as-a-service shape transport futures for the context of smart cities?', *Urban Science*, Vol. 1, No. 4(36).

Nikitas, A., Njoya, T.E. and Dani, S. (2017b) 'Examining the myths around autonomous cars: what does the future hold?', *4th Smart Urban Policy Futures*, University of Greenwich, London, UK, July.

Nikitas, A., Wallgren, P. and Rexfelt, O. (2016) 'The paradox of public acceptance of bike sharing in Gothenburg', *Proceedings of the Institution of Civil Engineers-Engineering Sustainability*, Vol. 169, No. 3, pp.101–113.

Rode, P., Floater, G., Thomopoulos, N., Docherty, J., Schwinger, P., Mahendra, A. and Fang, W. (2017) 'Accessibility in cities: transport and urban form', in Meyer, G. and Shaheen, S. (Eds.): *Lecture Notes in Mobility*, Springer, Cham.

Sheller, M. and Urry, J. (2000) 'The city and the car', *International Journal of Urban and Regional Research*, Vol. 24, No. 4, pp.737–757.

Smith, J., Clayton, E. and Hanson, D. (2017) 'Building sustainable, inclusive transportation systems: a framework for the future', *PwC Strategy Report* [online] https://eu-smartcities.eu/sites/default/files/2017-09/Building-sustainable-inclusive-transportation-systems_0.pdf (accessed 14 September 2018).

Sochor, J. and Nikitas, A. (2016) 'Vulnerable users' perceptions of transport technologies', *Proceedings of the Institution of Civil Engineers: Urban Design and Planning*, Vol. 169, No. 3, pp.154–162.

Thomas, P., Morris, A., Talbot, R. and Fagerlind, H. (2013) 'Identifying the causes of road crashes in Europe', *Annals of Advances in Automotive Medicine*, Vol. 57, p.13.

Thomopoulos, N. and Givoni, M. (2015) 'The autonomous car – a blessing or a curse for the future of low carbon mobility? An exploration of likely vs. desirable outcomes', *European Journal of Futures Research*, Vol. 3, No. 1, p.14.

Thomopoulos, N. and Harrison, G. (2016) 'An ethical assessment of low carbon vehicles using cost benefit analysis', *International Journal of Automotive Technology and Management*, Vol. 16, No. 3, pp.227–247.

Thomopoulos, N., Givoni, M. and Rietveld, P. (2015) *ICT for Transport: Opportunities and Challenges*, Edward Elgar, Cheltenham.

Uchida, N., Kawakoshi, M., Tagawa, T., and Mochida, T. (2010) 'An investigation of factors contributing to major crash types in Japan based on naturalistic driving data', *IATSS Research*, Vol. 34, No. 1, pp.22–30.

United Nations (UN) (2018a) *Sustainable Development Goals*, New York [online] https://sustainabledevelopment.un.org/?menu=1300 (accessed 14 September 2018).

United Nations (UN) (2018b) *68% of the World Population Projected to Live in Urban Areas by 2050*, United Nations [online] https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html [accessed on 14/9/2018].

Wadud, Z., MacKenzie, D. and Leiby, P. (2016) 'Help or hindrance? The travel, energy and carbon impacts of highly automated vehicles', *Transportation Research Part A: Policy and Practice*, Vol. 86, pp.1–18.

Wells, P. and Nieuwenhuis, P. (2012) 'Transition failure: understanding continuity in the automotive industry', *Technological Forecasting and Social Change*, Vol. 79, No. 9, pp.1681–1692.

Wikström, M., Hansson, L. and Alvfors, P. (2015) 'An end has a start–investigating the usage of electric vehicles in commercial fleets', *Energy Procedia*, Vol. 75, pp.1932–1937.