

The ripple effect of automated driving

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Extended abstract

In the beginning of the twenty-first century there are signs of saturation in car ownership and use, often referred to as ‘peak car’ (see Millard - Ball and Schipper, 2011). The reasons behind this trend are not entirely clear, but explanations relate to the economic crisis, urbanization trends, ICT, and status (see the special issue in Transport Reviews – Goodwin and van Dender, 2013). The car has not radically evolved with respect to neither its basic technology nor its social representation and connection to broader societal changes. Dennis and Urry (2009) note that the main car technology has remained largely unchanged throughout the twentieth century, basically involving an internal combustion engine, four wheels and a steering wheel. Newman and Kenworthy (2011) identify current technological limits of the car (in addition to a growth of anti-sprawl/pro-urbanism culture) as one of the reasons behind peak car travel.

It seems though that parallel to the appearance of the peak car travel phenomenon, car industry started developing a new wave of technologies (intelligent transportation systems (ITS) and ultimately fully automated and connected vehicles) that signalize potential evolution towards a major disruption in mobility and automobility in particular. It is unclear whether these technologies will transform future mobility. However, we can infer estimations by answering the following two questions (a) which are the potential changes and subsequent implications for mobility and society associated with introduction of automated driving, and (b) to what extent are these changes synchronized with broader concurrent societal transformations (e.g., the digital and sharing economy, the livability and environmental awareness movement and the connectivity, networking and personalized consumption trends) that could enhance the disruptive dynamic of such mobility technology? In this paper, we focus on the first question aiming to explore potential effects of automated driving relevant for policy and society. To the best of our knowledge literature does not systematically conceptualize the effects of vehicle automation. Most papers published so far focus on traffic implications (capacity, capacity drop, stability and shockwaves), while papers that focus more on wider impacts do not present a respective conceptualization. This paper aims to fill this gap by proposing a conceptualization of policy and society related implications of automated driving inspired by the ripple effect model.

We use the ‘ripple effect’ to model the potential disruptive nature of automated driving technology and the sequential effects that this change might bring to traffic, travel cost, travel choices, location choices, transport infrastructures, vehicle ownership, safety for users and non-users, energy consumption, emissions, health, economy and social equity. A ‘ripple effect’ (2015) represents the “*continuing and spreading results of an event or an action*” like the incremental expansion of ripples across water when an object is thrown into it. The ‘ripple effect’ has been extensively

used in economics, psychology, computer science (and more recently in supply chain management and scientometrics) to model sequentially spreading effects of events such as changes in regional housing prices after a ‘shock’ in local housing market, psychological and life course effects from exposure to events such as September 11th terrorist attacks, effects in work group dynamics from group emotional contagion and moods transfer, effects on software stability after a change in source code for maintenance reasons, citation chain reactions of a Nobel Prize, disruptions in supply chain after major events such as natural disasters or infrastructure failures or even the impacts of Neolithic revolution on incomes across the world today.

Figure 1 presents the ripple effect of automated driving. Driving automation is placed right in the center of the figure representing the change in mobility technology, while sequential implications over time appear in outer ripples. The first ripple includes short-term implications of automated driving with respect to traffic, travel cost and travel choices. The second ripple includes medium-term implications of automated driving with respect to location choices, vehicle ownership and transport infrastructures. The third ripple contains the long-term wider societal implications (i.e. energy consumption, emissions, congestion, health, economy, social equity, and safety) from the introduction of automated vehicles. Such implications result cumulatively from the previous ripple effects, while interactions among those impacts are possible, as in every ripple. The magnitude of the ripple effect is expected to be analogous to the level of vehicle automation and the respective penetration rate. For example, we might expect implications to extend up to the first ripple for low penetration rate of level 2 (partial automation) and up to the third ripple for high penetration rate of level 4 (full automation).

The ripple effect model offers a holistic system-wide conceptualization of the policy and society related implications of automated driving. This paper gives an overview of this model. A detailed analysis of the implications of automated driving within each of the three ripples of this model (short term, medium-term, long-term) will be presented in the full paper.

References

- Goodwin, P. and van Dender, K., “Peak Car” - Themes and Issues. *Transport Reviews* 33, pp. 243–254, 2013.
- Millard-Ball, A. and Schipper, L., Are We Reaching Peak Travel? Trends in Passenger Transport in Eight Industrialized Countries. *Transport Reviews* 31, pp. 357-378, 2011.
- Newman, P., Kenworthy, J., “Peak Car Use”: Understanding the Demise of Automobile Dependence. *World Transport Policy & Practice* 17, pp. 31–42, 2011.
- “ripple effect, n.”, *Oxford Dictionaries Online*, Oxford University Press, available at <http://www.oxforddictionaries.com/> (accessed 24.2.2015)

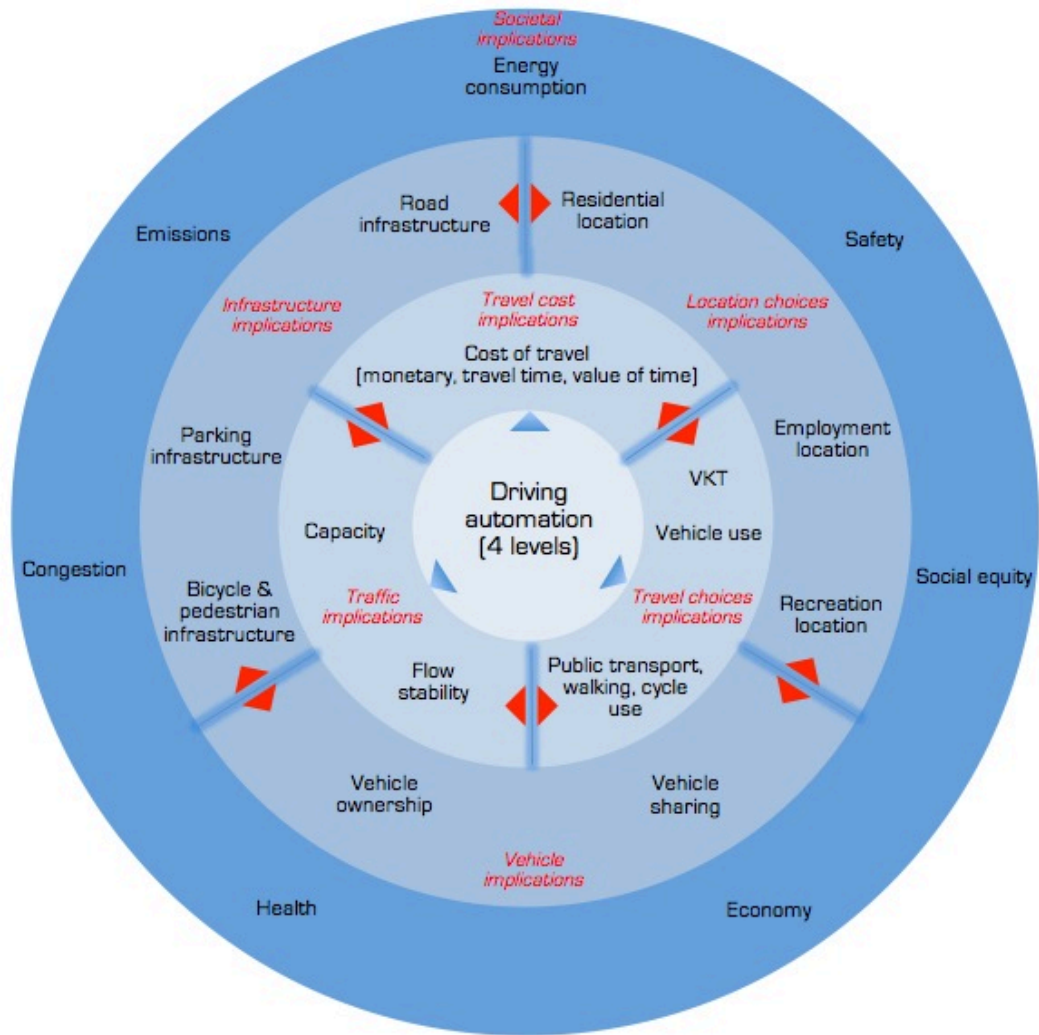


Figure 1: The ripple effect of automated driving.