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AUTHOR: *PhD. Gian Andrea Giacobone*

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Driverless transition: the value of autonomous mobility for sustainable urban development

PhD. Gian Andrea Giacobone
University of Ferrara / Italy.

Abstract
In the last two centuries, contemporary cities have been progressively changing their urban landscapes according to the functional necessities of the auto-centered transport system but, over the years, that model of consumption has contributed negatively to the environmental degradation of public spaces. Nevertheless, with the advent of autonomous vehicles, urban planners have new opportunities of rethinking urban mobility in a new and sustainable way by completely reshaping transport infrastructures and reorganizing land uses for the future development of more accessible and livable cities. In fact, autonomous vehicles are expected to transform the use and experience of the vehicle itself but also change the overall infrastructure design, which, in turn, will have a great impact on urban planning, location choices, and land use organization. For these reasons, this contribution sheds lights on the urban transition to autonomous transport by reporting the main advantages – in terms of safety, social and economic inclusion, freeing of public space and sustainability of the urban environment – that the new technology is able to offer to urban planners for improving the quality of the existing mobility systems. Moreover, the paper highlights the benefits of autonomous vehicles by describing briefly an ongoing research experiment that is testing the use of driverless cars in the real world. Considering this, the manuscript gives urban planners a new perspective capable of adapting spatial planning and land-use organization to future and uncertain challenges related to the implementation of autonomous vehicles in the existing urban context. In particular, the opportunity of assessing the impact of those vehicles on the existing cities will prepare urban planners to play a strategic role in defining a common urban development policy framework for helping European cities to evolve in perfect symbiosis with the new and disruptive driverless technology.

Since the nineteenth century, the history of everyday urban transportation is clearly represented by the auto-centered transport system. The automobile and its supporting infrastructures have dominated the landscape of our contemporary cities, shaping, at the same time, every aspect of urban development according to the functional needs of vehicle transport (Freund and Martin, 1993). Over the years, the auto-centered phenomenon has offered to people great advantages in terms of privacy and freedom, though its individualized mode of consumption has contributed to a progressive environmental degradation in the urban public space, such as smog, vehicle accidents and traffic congestion (Sheller and Urry, 2000). However, during the last twenty years, the automotive industry has created new opportunities in redefining the existing auto-centered transport model in order to conceive and develop a safer and more sustainable urban infrastructure, capable of ending the negative effects caused by the existing transport system (Riggs, Appleyard and Johnson, 2020). Nowadays, the automotive industry has initiated many research studies that rethink the use of the auto-centered system by developing a new vehicle typology equipped with sophisticated technological features – named Advanced Driving Assistant Systems (ADAS). This

technology transforms conventional cars into autonomous vehicles (AVs), also called automated or self-driving vehicles (Fregnant and Kockelman, 2015). This new technology allows the AVs both to drive themselves in the existing roads with high driving precision and to navigate many types of roadways and environmental contexts with almost no direct human input (Lipson and Kurman, 2016) (Fig.1).
The upcoming advent of this disruptive technology has made it clear that AVs will become increasingly prevalent and more integrated into our urban society, and they will significantly affect urban mobility conditions in the future contemporary cities (Milakis, van Arem and van Wee, 2017). In particular, most of the changes are expected to transform the use and the experience of the vehicle itself but also to modify the entire infrastructure design, which, in turn, will have a great impact on urban development, location choices, and land-use organization (Gavanas, 2019). For this reason, in order to consider the possible impacts of AVs in the near future, urban planners have to start thinking about transportation infrastructure in a different way, because spatial planning and the organization of land use will need to adapt to new and uncertain challenges related to the implementation of AVs in our urban spaces. Reflecting on the importance of this change, the European Commission has also started to consider AVs as an important implementation that promotes an intelligent transport system. Their innovative technology could contribute to the improvement of the overall quality of the current urban transport system in terms of safety, congestion and emissions (Papa and Ferreira, 2018), which were dictated by the previous auto-centered system. In fact, AVs present many potential advantages that can help the European Commission to strengthen its e orts to achieve speci c targets for sustainable development by fostering smart, accessible and inclusive urban mobility in all the European cities (Gavanas, 2019). In this context, urban planners will have the chance to evaluate the potential contribution of these new vehicles to the economic, social and environmental pillars of urban sustainability (Purvis, Mao and Robinson, 2019) and play a strategic role to plan a common policy framework of urban planning for helping European cities evolve in perfect symbiosis with the new technology. An important advantage of AVs is primarily related to road safety. The ADAS technology is able to reconfigure tasks and responsibilities of the drivers because they can prevent human error (Giacobone, 2018) – usually related to the brain's cognitive limitations in attention (Drive, 2001) – and consequently reduce road accidents, including protecting the lives of vulnerable categories such as pedestrians or cyclists. The advantages of ADAS technology are also addressed in changing the availability and quality of transportation experience because the automation of skill-based control makes urban travelling more comfortable and efficient than human guidance through smoother braking and finer speed adjustment (Cummings, 2014). This can affect both the value of time and the perceived cost for the travelers because

Fig.1 / Waymo's self-driving car operating without human oversight. The interface is designed to build trust with passengers. Source / Waymo, website

Fig.2 / Ringspeed's vision of the future of driverless cars as a living space on wheels. Source / Ringspeed, website.

they can easily replace the task of driving with other activities (Meyer et al., 2017), transforming the vehicle itself into a third living space conceived for conviviality and socialization (Lewin, 2017) (Fig.2).

Considering this, another benefit of AVs is associated with inclusion because it makes the vehicle accessible for everyone, including the fragile people who cannot drive conventional vehicles, such as people with permanent or temporary disabilities, the elderly and underage travelers. In economic terms, AVs also promote the inclusion of people who cannot afford the costs of car ownership and use Mobility as a Service (MaaS) by enhancing shared mobility, new public mobility services (Pickford and Chung, 2019) (Fig.3) and, hence, reducing the overall cost of personal and public transportation (Heinrichs, 2016). From an urban planning perspective, inclusion enables mobility infrastructure to better service the less accessible urban areas around a country, facilitating, at the same time, the everyday commuting without forcing people to abandon small towns for reaching more dense and lively cities (Zhong et al., 2020). These aspects become very important for urbanization because they enable people to have more options where to live or work (Lipson and Kurman, 2016), and, hence, they can reduce the phenomenon of urban depopulation in those cities located in the too-distant surrounding countryside and currently seem isolated and segregated from the available transport infrastructure of a given country. Again, another advantage of AV for urban planning lies in the precision of driving because it increases the efficiency of urban transportation in many aspects. The energy-saving strategy, called platooning, can save fuel and reduce both emissions

Fig.3 / Reanult's concept of an autonomous vehicle specifically designed for the future of shared mobility. Source / Reanult, website.

Fig.4 / Voyage's autonomous vehicle testing a shared mobility service in public roads involving a retirement community in Florida. Source: Voyage, website.

and air pollution (Davila, 2013), while efficient driving can significantly reduce urban congestion due to the ability of AVs to coordinate travel behaviors and operate with relatively higher occupancy rates than traditional vehicles (Hawkins and Nurul Habib, 2018). This phenomenon inevitably leads to the freeing of public space, giving new opportunities for urban planners to restore the degradation of the urban environment. Indeed, the latter may be dedicated to increasing green areas and open-air recreational spaces to enrich the pedestrian environment, especially in the historical centers of European cities, which were designed before the widespread use of auto-centered transport. The same effect can also be achieved by the AVs' ability to reduce the hidden cost of searching for on-street parking, as the activity itself negatively impact the sustainability of the urban environment through congestions, accidents, fuel consumption, air pollution and human livability degradation (Soup, 2006). Moreover, the capacity of AVs to drive themselves even after dropping off their passengers can change the approach for the parking space management, because, in a context where the AVs are shared or integrated into public service, the parking lots of conventional vehicles can be drastically reduced and even eliminated in high dense districts due to the flexibility of AVs in the use of urban space. In this case, urban planners have the opportunity to use free space to regenerate urban spaces and reorganize land use, especially dedicated to the pedestrian environment, and to decrease the auto-centered system in favor of more sustainable and walkable urban spaces that can foster the use of the body, promote physical activity and hence contribute to making a city

healthier, livable and safe (Dorato, 2020).
One significant example that highlights the benefits of the AVs is the public experiment conducted by Voyage, a software company that aims to create a shared transport service for people who cannot drive because of the limitations of old age (Cameron, 2018) (Fig.4). The company is testing its fleet of AVs in the real world, specifically involving a retirement community in Florida.
The AVs' service allows the elderly to remain connected to other areas of the city in a completely safe condition and without owning a private car. In this case, the vehicles' density and traffic congestion can be controlled and reduced at a minimum, giving the parking areas the chance of being transformed into other walkable spaces by creating a calmer and safer neighborhood for all the community. Moreover, since people maintain their freedom, they cannot feel isolated from other urban places anymore. On the contrary, they are stimulated to move more frequently, and at the same time, increasing the social relations without abandoning their living places. The experiment is still in progress. It presents many opportunities for urban planners to collect and assess data for future planning strategies addressed to improving the efficiency and sustainability of the existing cities and their mobility infrastructures.
To conclude, the complex phenomenon of driverless mobility expects to come up with new opportunities capable of changing both the use of conventional vehicles and the current transportation system. The new concept also is expected to change the accessibility of many urban areas of future cities. This is because driverless technology can have a great impact on urban development due to its ability to innovate the efficiency and the quality of transport infrastructures and to reorganize land use for fostering sustainability, livability in future human-scale cities. Considering this, in the coming years, urban planners should focus on understanding the impact of AVs in the urban space and take advantage of the potential benefits offered by the autonomous system to prepare themselves for new urban challenges, finding, at the same time, innovative solutions to arrest the negative effects of the auto-centered system, in favor of a more sustainable and smart urban development.

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Fig.5 / Examples of ear-market public transportation busses that could be used to brand Gjirokastra