THE GLOBE AND MAIL

Report on Business

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Published on Monday, December 31, 2012

http://www.theglobeandmail.com/report-on-business/economy/economy-lab/why-driverless-cars-will-trump-transit-rivals/article6769279/comments/

Why driverless cars will trump transit rivals

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Globe and Mail

Personal rapid transit vehicles at London's Heathrow airport.
(Lee Durant /ULTra PRT - www.ultraprt.com)

In three previous posts, here, here and here, I've suggested that driverless cars will be on our roads during the next decade or so and they will be used mainly to provide autonomous taxicab (AT) services for about one third of the cost of present cabs. The results could be massive shrinkages of the auto industry and transit systems as we know them. Far fewer automobiles would be sold, but there would be more on the road at any one time. This post discusses the implications of such vehicle automation for energy use and related matters.

With widespread use of driverless cars – mostly as ATs – there could be more vehicles on the road because ATs will substitute for most, and perhaps eventually all, private automobile use as well as much use of buses and other conventional transit. Moreover, ATs will serve users who cannot drive or use transit, including young people and the elderly. As well, ATs will spend less time parked than today's automobiles, and more of the day on or moving between assignments, contributing to the increase in the number of vehicles on the road. An offsetting factor will be some growth in car sharing by strangers – in the form of sharing of part or all of trips by AT – but likely not enough to compensate completely for the factors contributing to an increase in traffic.

(Autonomous freight vehicles, small and large, could also be on the roads, in similar or greater numbers than present freight vehicles. I'll be covering automated road freight movement in the final post in this series.)

More movement of cars will not necessarily result in more fuel use. Driverless cars will be smaller and lighter on average because they will need fewer safety features and driver controls and because the capacity of particular ATs will likely be matched to the trip requirements. As well as using less energy for these reasons, they will be operated in such a way as to use less energy. This will happen through attainment of more even speeds as a result of better traffic management and vehicle operation. The energy savings could well be more than enough to offset any growth in traffic.

Reducing oil consumption for transportation would still be an imperative, whether for supply or environmental reasons, or both. If petroleum products continue to provide the main fuel for transportation, a major gap between potential demand for and world supply of oil seems likely to emerge within a decade or two, even with heroic efforts to improve the efficiency of fuel use. A shift from internal combustion engines to electric motors as the source of traction seems the best direction to take, because of the relative ease of producing electrical energy sustainably and then distributing it.

Operators of fleets of ATs could be in a better position to switch to electric traction than individual owners of driven or driverless cars, for several reasons:

-- Because taxicabs travel five or more times as much per day on average as individually owned cars, fleet operators are relatively more concerned with vehicles' operating characteristics and costs. For urban travel, electric vehicles can have substantially lower operating costs because they use less fuel, and cheaper fuel, and because the simplicity of electric vehicles results in lower maintenance costs. Thus, electric vehicles could be relatively more appealing.

-- The main challenge in using a battery electric vehicle is accommodating its short range. A fleet operator could deploy enough electric vehicles to ensure that a sufficient number to meet demand is always available even though many may be unavailable because their batteries are being charged. An AT with a battery approaching depletion would automatically seek a charging station between hires. Connection, charging, and disconnection would also be automatic. Fleet operators may choose to invest in fast-charging stations and fewer vehicles, or vice versa, according to circumstances. Individual owners could not make that trade-off.

-- Fleet operators could achieve what would in effect be very fast charging through battery exchange, which could also be achieved automatically. As well as very fast charging, batteries for battery exchange could be charged during off-peak periods, reducing fuel costs.

If possible, electric traction should be powered by connection to the grid while in motion – as are electric trolley buses and streetcars – rather than by on-board batteries. This avoids the high financial cost of batteries, the energy cost of moving energy into and out of a battery (about 25 per cent), and the energy cost of carrying the weight of batteries (a cost that varies considerably with topography and driving characteristics).

My concern to move towards widespread grid-connected electric traction led me to favour development of a concept known as Personal Rapid Transit (PRT), discussed in an earlier post. PRT usually comprises fully automated, one- to six-person, electrically powered vehicles (pods) on reserved guideways providing direct origin-to-destination service on demand. PRT is usually envisioned as powered directly from the grid, although in at least one early implementation – at London's Heathrow Airport – the pods are battery powered.

The remarkable progress with driverless cars during the past few years, and revelations of their extraordinary potential to transform motorized movement of people and freight, have caused me to change my focus. The challenges in implementing PRT are its novelty and the cost of the infrastructure, chiefly guideways.

The initial cost of a PRT system appears to be about $15-million per kilometre. This is low compared, for example, with light-rail, which seems to average about $35-million per kilometre in the U.S. and can cost much more (Toronto's mostly tunnelled Eglinton-Scarborough Crosstown LRT line is costing more than $250-million per kilometre). The PRT cost is nevertheless high enough to require what may be regarded as substantial investment in infrastructure even for a relatively small system, e.g., $300-million for a 20-km system. Resistance to spending even this amount – low for a transit investment – would be reinforced by the novelty of PRT, which could make for a risky venture.

An AT service could deliver much of the service provided by PRT, at perhaps about the same cost to users, chiefly because passengers would stay in the same low-capacity vehicle during speedy, mostly non-stop trips from origin to destination. An AT service would have the added advantages that travel could be literally door to door, and there would be no new public infrastructure cost because existing roads would likely be sufficient.

AT services, requiring less infrastructure, would thus be less disruptive than PRT and, accordingly, could be more successful.

If, when AT services are established, a need for a new road is recognized, this could be a guideway perhaps elevated that provided for powering of ATs with electric traction from the grid while in motion. To the extent such guideways were available, ATs' batteries could be smaller. The cost of ATs would be lower as would their energy requirements. Guideways might be constructed to achieve these benefits and, over time, might thus replace many roads as we known them. PRT would evolve from AT services.

Guideways that provided power to ATs and other small driverless vehicles could be of special value on expressways used for longer journeys. As well as reducing vehicle weight and energy costs, powering from the grid would avoid the need to stop for battery charging or replacement.

Such guideways might also be constructed where roads are needed but none exist, as in industrializing countries.

Richard Gilbert is a Toronto-based consultant on energy and transportation. These five posts are adapted from his contribution to International Handbook on Megaprojects *to be published during 2013, a draft of which is available on request to mail@richardgilbert.ca.*