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The Automation Highway:
What are the more practical implications of self-driving vehicles?

by Richard Gilbert

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The movement of people and freight by road appears to be heading for truly revolutionary changes. The main agent of change is rapid progress towards widespread deployment of autonomous road vehicles (ARVs), also known as driverless or self-drive vehicles. As well as bringing about remarkable transformations in how people and freight are moved, this deployment could also have profound impacts on several related matters including patterns of vehicle ownership, automotive industries, and – not the least – infrastructure planning and provision.

Google is setting the pace. Its test ARVs have travelled well over 500,000 kilometres without incident. The company anticipates that ARVs could become a consumer item before 2020. See Google's March 2012 video at http://www.youtube.com/watch?v=cdgQpa1pUUE for an indication of progress. Many automakers are not far behind, although they tend to be more conservative in their estimations of the pace of deployment. Some say that full automation will not happen: vehicles will always have to provide for the possibility of human intervention.

Technology is presently running ahead of liability law. Several states in the U.S. and some other jurisdictions (none in Canada) allow or will soon allow ARVs on their roads for test purposes, but each must have an operator who can take over at any time. The operator would be liable in the event of a crash. If roads were used exclusively by true ARVs, only owners – who might not even be in the vehicle – and manufacturers could be held liable.

Today, it seems that over 90 percent of crashes result from driver error. The systems controlling ARVs would make many fewer errors. Thus, ARVs could put automakers in a position they might not like. Instead of being responsible for a small minority of a large number of crashes, they would be responsible for the majority of a much smaller number of crashes.

For reasons to do with liability automakers could be reluctant to sell true ARVs to individual consumers. There could be less reluctance to sell to fleet owners – including taxicab and car sharing operations –

who could be in a better position to accept some responsibility. Indeed, autonomous taxicabs (ATs) could become the predominant type of ARV.

You would summon an AT on your cell phone, indicating destination, number of people travelling, and amount of baggage. An AT of appropriate size would arrive within a minute or two, with the trip being charged to the cell phone account according to the time taken and distance travelled. Estimates of the costs to AT users suggest they would be mostly lower than the costs of using transit or personal automobile use.

It's the likely low costs of AT use that would cause a revolution. Why own a car when for less cost you can have door-to-door service without ownership and parking hassles? Why take a bus when summoning an AT would provide much more comfortable and speedier service for less cost?

With widespread use of ATs, transit systems could become limited to providing service only to high-density areas, where ATs could not provide the capacity. The number of vehicles on the road at any one time could be higher than now, but the number sold could be very much lower. The typical automobile is on the road for an average of less than two hours a day. An AT could be on the road for half the day or more. There would be massive reductions in parking requirements.

Even though there could be more vehicles on the road, less roadway may be required. ARVs would be able to move while much closer to vehicles ahead and alongside than is safe when vehicles have drivers. Moreover, with ATs matched to load, and less need for safety features, vehicles could be much smaller on average. With full deployment of true ARVs, the capacity of existing roads could increase by a factor of four or more. Even a doubling of effective capacity would have dramatic effects on infrastructure requirements.

The truly dramatic impacts on infrastructure requirements would come with automation of heavy-duty vehicles. Pavement damage is roughly proportional to the cube of the axle weight. Thus, the damage caused by a truck's ten-tonne axle weight is about 1,000 times that caused by a car's one-tone axle weight. Reducing truck size by half would reduce pavement damage by about a factor of eight. Without operators, smaller trucks could readily be used. Infrastructure costs could plunge dramatically.

Road-vehicle automation could also result in modest increases in infrastructure requirements. Although most of the 'intelligence' of modern automated systems is in the vehicle, vehicle-to-infrastructure (V2I) communication can enhance performance. Equipping infrastructure with appropriate communication devices would be a cost. This cost could be offset by, for example, less need for traffic signals. With full deployment of ARVs, movement through intersections could be managed through vehicle-to-vehicle (V2V) communication.

Road vehicle automation may not be entirely bad news for businesses with a stake in infrastructure provision. It's possible that automation could facilitate electrification. The lower fuel and maintenance costs of electric vehicles could appeal to owners of intensively used fleets of ATs more than to individual consumers. Moreover, users of electric ATs would not have to experience range anxiety. An electric AT

with a battery nearing depletion would take itself out of service and find a charging station. Companies providing charging infrastructure could thrive as a result of the boost to electrification.

Battery powering of heavy-duty vehicles is likely to be less practicable than for light-duty vehicles. A loaded truck could deplete as much as two tonnes of battery an hour, eating into payload capacity. Powering from overhead catenaries while in motion is an answer, as is being explored by truck makers in Germany and Sweden. Although trucks with operators can be powered in this way, automation could provide for more reliable transitions from overhead to battery powering and for the efficient assembly and disassembly of conveys of trucks that could optimize catenary use. Automation could thus also boost electrification of heavy-duty vehicles. Companies providing infrastructure for powering while in motion could thrive.

The implications of road vehicle automation are extraordinary. People in transportation and infrastructure businesses are having an understandably hard time coming to terms with what might be ahead. How ARVs could revolutionize the ways we move people and freight during the next few decades should be examined with great care.

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