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(The Canadian Press/Bombardier)

Moving freight key to a driver-less future

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In four previous posts, here, here, here and here, I've discussed how the rapidly developing automation of passenger road vehicles could pave the way for revolutions in the motorized movement of people. This could occur principally through the emergence of fleets of autonomous taxicabs (ATs) providing service that would be sufficiently convenient and inexpensive as to replace most individual automobile ownership and urban transit.

Driverless vehicles could also allow revolutions in the way goods are moved. There are three main considerations: (i) movement of goods now moved in personal automobiles; (ii) other movement of goods in urban areas; and (iii) other movement of goods between urban areas.

Much movement of things occurs in personal automobiles, and a surprising share of energy used for the movement of goods is expended for this movement. One study of the transportation energy involved in moving breakfast cereal from field to table found that 80 per cent of the total energy consumed was expended for the shopping trip. In both the rather different transport situations of the U.S. and the U.K., shopping is a major purpose of travel by car. People who use their cars for business purposes often have additional reasons to value the goods-carrying capacity of personal automobiles. If ATs were to substitute for personal automobiles, goods carrying arrangements would be essential.

One possibility was mentioned in the first post in this series: an AT user with a lot of baggage could hire two linked ATs that would travel together to the user's destination. Another possibility would be to have a standardized 'stuff locker' that fits in any AT and can moved by hand or moved automatically to and from stationary lockers. ATs could move items in this way without carrying passengers, as taxicabs are used today to carry small packages.

Autonomous local delivery vehicles (ALDVs) could do the same thing, carrying many containers. Such vehicles could substitute for mail and courier services if destinations were equipped to receive the standard containers. Larger items and amounts could be so delivered in appropriately-sized containers, refrigerated when necessary. However, much business delivery – e.g., for construction materials – may require human supervision for many more years.

For reasons of energy supply and local and global pollution, ALDVs may well move to electric traction. As with ATs, fleet management of ALDVs could facilitate electrification.

Heavy-duty vehicles, e.g., trucks with trailers, can be automated as readily as smaller vehicles, but their path to electrification would well be different. The primary advantage of automation for heavy duty vehicles could be facilitation of platooning on expressways. Trucks could be marshalled automatically into platoons providing energy savings of about a third compared with single trucks.

Battery powering of heavy duty vehicles may not be expedient. To match the range provided by the diesel fuel tank of a typical long-distance heavy-duty truck, which when full weighs about a tonne, a heavy-duty battery-powered electric-drive truck would have to carry almost 30 tonnes of battery, which is much more than the average payload of heavy-duty trucks. Put another way, a heavy-duty electric-drive truck would require one-to-two tonnes of battery per hour of operation.

A more feasible route to providing electric propulsion of heavy-duty trucks is to provide power while in motion, as streetcars and trolleybuses receive power. This is not a new concept. Electric trolley trucks were on German roads more than a hundred years ago. Today, they are used in mines and for other off-road uses. Trials of on-road trolley truck operation are under way in Germany, Sweden and the United States.

A possible scenario for much freight movement across the 500 kilometres between Toronto and Montreal could involve fully automated, electrically propelled, heavy-duty trucks. Such a truck leaves a loading bay in Toronto under battery power, travels 10 kilometres to Highway 401, and then raises its pantograph to allow direct powering of its electric motors from a pair of wires strung over one lane. As soon as possible during the trip along Highway 401 and Autoroute 20 to Montreal, the truck is marshalled automatically into a platoon of, say, four vehicles travelling a few metres apart. At Montreal, the truck disengages from the platoon, exits the expressway, and travels the 10 kilometres to its final destination under battery power.

Energy consumption for the 500-kilometre trip would be about a quarter of that used by one of today's trucks. The electricity could be generated without use of fossil fuels. Energy consumption would still be higher than if the freight were sent by rail, even counting that used by trucks to and from the ends of the rail trip, and very much higher than if the rail line between Toronto and Montreal were electrified. However, trucks' advantages of reliability, security, and overall speed could be achieved at lower financial cost, because of reduced energy and labour costs, and lower environmental and resource cost.

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.*