INNOVATION BRIEFING PAPER 1: AUTONOMOUS VEHICLES

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There can be no more disruptive technology to the global road freight industry than 'autonomous driving' or to give it its more usual term 'driverless vehicles'. Although in many people's minds, this type of technology is little more than science fiction, the fact that technology giants such as Google have invested heavily in developing the concept shows that it is perhaps closer to realisation than people think.

Whereas the headlines have mostly focused on cars, one of the world's largest manufacturers of trucks, Daimler, recently revealed its own plans. These included demonstrating a prototype which drove autonomously on an autobahn in Germany, successfully navigating a junction in real life driving conditions. This is part of its Future Truck 2025 strategy. Trucks will be equipped with Daimler's Highway Pilot assistance system which will allow them to navigate successfully at speeds up to 85kph.

However at this stage removing drivers from trucks is still a very long way off and will face huge challenges, not only from labour organisations, but also safety and regulatory bodies and even the wider population. A cursory look at the railway industry throws up some of the barriers faced. Although the technology has existed for many years for driverless trains or rapid transits, very few are in service. In theory, the highly controlled environment of a railway should lend itself ideally to the technologies. In fact, given the congestion which exists on many parts of a rail network and the expense of building new infrastructure, it would seem obvious that autonomous driving should have been adopted several years ago. At the very least plans should be in place to implement such technologies. However this is not the case and this perhaps hints at the problems such initiatives in the road freight sector will face.

It is for this reason that vehicle manufacturers such as Mercedes Benz (Daimler) are being very careful with the language they use, unwilling as they are to upset vested interests. For the foreseeable future the technology which they are developing will be to assist the driver rather than take over the driving. A comparison perhaps would be with airline pilots who use an autopilot once they have taken off, and only return controls to manual when they are about to land. This is despite the fact that at many airports some newer airliners are quite capable at landing themselves.

What are the driving forces behind driverless trucks?

Congestion

One of the foremost reasons for the investment in this technology is the potential increase in transport efficiency. With congestion forecast to rise substantially in the near future, there is a need to break the

link between economic growth and vehicle movements. German authorities predict that truck transport volume will increase by 39% by 2030 unless steps are taken. Construction of new roads is unpopular from an environmental perspective, and many countries in Europe just don't have the money available to make the sort of investment required. Major trunk road networks in Western Europe have barely grown in the past decade. Therefore it becomes essential to utilise existing road capacity more efficiently and new technologies can aid in this goal.

Costs

In many countries in Europe, it is estimated that around 45% of total cost for road freight operators is related to the driver. Eventually removing the driver (although no one is suggesting this is likely for many years) would obviously then have an enormous impact on road freight costs, profits and margins.

Another issue is the looming driver shortage crisis. Many people are increasingly unwilling to commit to a career as a driver given the hours away from home; the relative low pay and the conditions. This will eventually translate into higher costs for road operators and their customers. By taking away most of the stress from driving by leaving most of the important decisions to a computer, the working conditions will become more attractive. There may also be the opportunity for the role to become more value-adding as the driver will have the time and connectivity to undertake an enhanced role, perhaps in transport management activities.

Safety

The demand for absolute reliability is not so much a technical requirement, this can be archived by embedding some degree of redundancy in the vehicles if they go 'off-line' for a few seconds (although to put this in context 99.95% reliability would be just about acceptable). However public perceptions will demand that absolute reliability must be proven. Therefore, by definition, any operations involving autonomous vehicles 'in the wild' so to speak, will need to be as part of a much larger system. How long before this is a practical reality?

The technology

There have already been major developments in terms of assisting the driver. Daimler's Proximity Control Assist adapts the speed of the truck depending on traffic situations through an integral cruise control and braking function. Three-dimensional maps exist for a Predictive Powertrain Control system, and telematic products ranging from vehicle management and transport management to apps for the driver and operator have already been rolled out.

Future advances in technology will be in Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) initiatives which will build on the technologies already in place, adding in more cameras and sensors. Vehicle manufacturers at present believe that the driver will still be completely essential to the driving process in 2025. The technology is there to aid them rather than take over their job.

V2V and V2I connective technologies are not strictly essential to autonomous driving, although if used in conjunction will create more efficiencies. Vice versa, V2V and V2I technologies do not require autonomous vehicles.

Big Data

It is increasingly possible to 'harvest' a huge amount of data from the vehicles, both cars and trucks, which if analysed in a proper and timely way will result in efficiencies, mostly related to the avoidance of congestion. This data can be generated either by traffic authorities (such as municipalities or highway agencies); private companies, which provide information to users on speed of traffic or more recently mobile applications which allow individuals to log incidents as they observe them. The latter can theoretically mobilise thousands of drivers who act as monitors of traffic situations in areas which no other organisation could reach.

With vehicles having the capability to interact not only with other vehicles around them, but also with highway infrastructure, a huge amount more data will be generated.

Embedded sensors in everything from transport infrastructure through to smart devices on board the vehicles themselves will be generating huge volumes of data. This data has to be assimilated and processed, with the resulting conclusions fed back into the system. This places huge demands on the communications topology required to carry the data. It has to be reliable and virtually 'fail safe'.

Legislative barriers to autonomous driving

The US is leading the way in the development of autonomous vehicles, although other jurisdictions have not been slow to catch on. However three US states, Nevada, California and Florida have enacted legislation which allows these types of vehicles to be tested on their roads. In Europe, Spain, Italy, Finland and Greece have also passed some form of legislation.

There are three main challenges, in addition to the technology development, which will need to be overcome if driverless vehicles are to be widely accepted.

- Safety (see above)
- Data security (see above)
- Insurance liability

The last point may be the most difficult. If, for example, a driverless vehicle was involved in a collision with a pedestrian, who would be to blame? At present the case depends on whether the driver is in the right or wrong and in most cases a judgement would be derived by assessing the driver's decision-making or behaviour. However if a collision was caused by a software or sensor failure, a case could be made to hold the car manufacturer responsible, unless, for example, it could prove that the owner had failed to maintain the systems to the requisite standard.

Conclusion

Autonomous road vehicles are under development by almost all major manufacturers. Their ability to operate as part of a coherent logistics operation will depend on a number of factors. Leaving aside the inherent technology inboard the vehicle itself, consideration must be given to the operational environment in which it will function. This is a miasma of technical, legal and social rules.

There is little doubt that the technology which will allow autonomous vehicles will be in place in five years, although due to some of the reasons outlined above it is more likely to be 10 years before it becomes a reality. It will be much longer before legislators, vehicle manufacturers and road freight operators feel comfortable with removing the driver completely.

In summary, vehicle manufacturers believe that the efficiencies the technology will deliver will come in the form of:

- Reduced fuel consumption – the computer will drive the vehicle more fuel efficiently
- Reduced emissions – for the same reason
- 100% connectivity and location services which allow for ‘perfect’ route planning
- Diagnostic services which ensure correct maintenance and fewer breakdowns
- Emergency braking will ensure fewer accidents; gaps between vehicles will be adhered to.
- Routes can be re-planned around known areas of congestion.
- Accidents caused by human error (through tiredness, for example) will be considerably reduced.
- Communications can be shared with customers to provide visibility of delivery times, changing in line with the traffic situation.

Many of the vehicle manufacturers have developed their driverless vehicles to function within the constraints of prevailing transport infrastructures. In short this means the driverless technology 'augments' the driver rather than replacing them. It is fair to assume that this will be the first step in an evolutionary path towards complete autonomous operation. During this period we will probably see vehicles operate as just one component in a huge data generating transport system. As organisations learn to use and analyse the tsunami of data streams, they will be able to reap the potential efficiencies from both a cost and operational point of view.

The challenge for many transport operators will be how do they modify their existing information systems to manage a sensor rich environment. Rather than replacing or enhancing existing platforms, this will most likely require a fundamental redesign of their approach to their business.

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