Smart trains with no driver

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Credit: AI-generated image (disclaimer)

Everyone's talking about autonomous cars, wondering if they'll soon be whizzing along our roads. This hype surprises me, because many vehicles in other transport systems have been moving about driverless for years, or even decades. In industrial environments and harbours, automated transport systems have been in place for over 60 years. And most of the metros are highly automated. These systems just haven't received much media attention, maybe because they pose fewer ethical and regulatory

challenges than autonomous cars.

Setting targets for trains

It's astonishing that autonomous trains in public transport have – as far as I can see – rarely been the subject of discussion until now. But that, too, is changing, and just recently a substantial increase in automation was announced at a major railway fair. The French railways want to make key technological advances over the next five years to bring prototype driverless trains into operation. In Australia, remotely controlled and partially autonomous freight trains have been operating for some months. In Switzerland too, the Swiss Federal Railways (SBB) and the Südostbahn AG (SOB) have tested automation technologies without passengers.

It's still difficult to evaluate the benefits of autonomous cars, whereas the benefits of driverless solutions in railways are quite clear. And it's not just about the costs you save; I see the greatest advantage in the regularity of operations – for the performance and timing of operations will vary very little. What's more, these trains can be better controlled: timetable changes, for instance, can be implemented more swiftly and reliably.

More regularity means improved punctuality. If operations run more smoothly, there are fewer delays, and if they do occur, they can be resolved more quickly.

Any delay is loss

If time is money, then any delay means a loss. In fact, a key concept in transport systems is infrastructure capacity i.e. how many vehicles you can move in one time unit. In railways, delays and unplanned events

consume a lot of capacity. One way to improve capacity would be to build more bridges, tunnels and railway lines. But that's expensive. With an autonomous system you can increase the capacity more flexibly and more cheaply. And if more trains run more on time, then everyone benefits – the economy, the train operators, and the passengers, of course.

Fine-tuning required

So, there are good reasons to automate trains, and the remaining challenges are mostly technical. Individual components have already been proven to work; trains can safely move and stop even if there's no driver actively steering. It's already possible to run a driverless train via signals which are sent to the infrastructure and carried out there.

The difficulty lies in the complex interaction of the various components. When a train is running, multiple subsystems need to interact, monitoring the status of the railway track, the position of other trains and the physical integrity of the train, and determining the space required to brake safely. If any subsystem cannot judge the situation accurately, it will perform defensively: the train will then slow down or stop, and transport performance drops. ETH is currently engaged on various research projects with the Swiss railways to help achieve reliable, performant traffic management systems. We are seeking, for instance, to optimise flow through bottlenecks.

Not just a utopian dream

How many of you have spoken to a train driver lately? In fact, passengers would hardly notice any difference if there were no driver in the cab. The railway system as a whole would be more regular, and there would be more trains available. People would be able to interact directly

with the transport system, and move about as much as they wanted, when they wanted. Does that all sound too utopian? Let's not forget – there are already some highly automated driverless vehicles that move a great deal of people worldwide in an unconventional dimension: we call them elevators.

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