Potential approval procedures

Although the subsystems of autonomous vehicles can be tested, their functional safety as an overall system ultimately has to be tested and validated. Test drives on real streets and in real environmental conditions are the ideal scenario, but this is not an option given the driving distances (several billion kilometres) and time required, and they need to be supplemented with alternative methods such as scenario-based approaches, test rigs and testing areas. There is not yet a clear picture of the new, potentially serious risks that may arise. These, alongside proving sufficient reliability, are the subject of ongoing research.

The questions of when autonomous vehicles will be mature enough to be approved for road transport and how the process should be organised (in particular for fully automated vehicles) remain largely unresolved: a paradigm favoured in the USA stipulates that vehicles like this should be tested on roads as far as possible and that manufacturers must ensure that key requirements are met, but then take on the remaining risk themselves ('self-certification'). Other countries such as Germany do not consider road testing to be sufficient, and require vehicles to be tested against representative data-based scenarios that are developed by key players from science, industry and public authorities and agreed as binding. The latter group is ultimately responsible for deciding on approval ('stamp approach'). Harmonisation and standardisation efforts are required and take place on an international level.

Imprint

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Autonomous mobility requires overall assessment

Potential users and the general public seem to have an ambivalent attitude. The only thing that seems to be widely agreed upon is the fact that autonomous passenger and goods transport vehicles should be viewed and developed as part of an innovative, collective mobility concept under which the traditional boundaries between different mobility providers disappear. The integrative SBB app that has been announced is a step in this direction, although it does not (yet) include self-driving vehicles. It is also clear that as well as purely technical aspects, assessment of these vehicles should also take into account social, ethical, regulatory, economic and environmental issues.

SATW supports raising awareness

The general public and the political arena seem to be largely uninformed and uneducated about such vehicles. Wide-ranging debate regarding expectations, consequences and reservations and is therefore required, involving all of the key players. This will ensure that they gain a sound base of knowledge, as well as an awareness of the opportunities, risks, and potential problem areas. However, the best way to actually do this remains largely unresolved.

SATW stands ready to contribute. It has created a topical platform "autonomous mobility" with the general aim of establishing a sound, broad knowledge base, informing and educating the public, identifying opportunities and problem areas, and initiating activities where required. This factsheet is a result. Innovation forums were also contributed to the Swiss Green Economy Symposium 2019 and 2020. This produced an interesting picture of the general mood: critical questions were asked about the need to develop highly automated vehicles, and opinions were divided regarding whether this was just hype or would soon be a reality. Surprisingly, Switzerland was not expected to play a pioneering role, despite the country already having experience with self-driven public transport minibuses and a particular culture of discussion and decision-making. However, Switzerland is well placed to develop integrated transport concepts, as well as to gain SMEs involved in subsystem and system integration development.

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Factsheet "Autonomous Mobility"

The future aim of highly and fully automated vehicles with corresponding drive systems is to free drivers from often tedious tasks, eliminate them as a source of danger, and make more efficient use of infrastructure. They require an almost unimaginably high level of digitalisation, artificial intelligence usage and innovative networking to enable extremely complex systems to emerge. Tim Cook, the CEO of Apple, has therefore described autonomous vehicles as "the mother of all artificial intelligence applications".

Hype, or soon a reality?

Autonomous vehicles are currently at an early stage of development, planning or even testing. Details of initial authorisations and commercial availability are still far off: sceptics dismiss this as just hype, proponents talk about it soon becoming a reality. This is supported by billions in investment from large countries such as the USA, China and Germany, as well as gigantic technology and service conglomerates such as Alphabet-Waymo, Uber and leading automobile manufacturers. A realistic timeframe seems to be 20 years until highly automated vehicles penetrate the market, with at least 40 years for fully automated versions. Autonomous shuttles, taxi fleets, computer-guided lorry convoys and traffic on the outskirts of major cities will most likely lead the charge.

According to Waymo, by mid-2019 autonomous vehicles had already covered around 10 million miles on American public roads (in sparsely populated states with good weather conditions). Taxi services using self-driving vehicles have already been set up in Singapore, Las Vegas and Boston, whilst Switzerland has experience with small, self-driving buses in Sion, Marly, Geneva and Neuhausen. Of course, the current generation of vehicles is not going to be rapidly replaced with autonomous versions – this is likely to take decades, and poses an often-underestimated challenge in many respects.

New mobility concepts

The development of autonomous vehicles creates high expectations for individual users, as well as for society and the economy as a whole (as part of innovative mobility concepts). A key benefit is increased road safety with fewer accidents and victims and thus lower costs – with the significant result that some people have hailed the rapid implementation of autonomous driving as ethically commendable and have begun to dream of 'zero risk'. A further benefit is the fact that groups such as the disabled, elderly or children who are excluded from traditional individual mobility solutions can also become individually mobile. These often overestimated benefits are offset by serious concerns such as the stress caused by blind faith in systems that could fail or that users do not understand, loss of self-control, glaring cyber risks, danger of additional traffic, or reduction of public transport. There are also fears that driving will become less enjoyable.

Autonomous driving levels in Switzerland

	Level 3	Level 4	Level 5
Technical description	**Limited automation:** The vehicle is able to take over the entire task of driving in certain situations with lasting effect, without the driver needing to monitor this driving. If the system reaches its limits, the driver must take back control of driving once prompted to do so by the vehicle.	**High level of automation:** As for level 3, but if the system reaches its limits, the vehicle independently returns itself to a state of minimum risk. The vehicle is equipped with a steering wheel and pedals, unless it is a district-limited vehicle.	**Full automation:** The vehicle is able to take over the entire task of driving in all situations with lasting effect. This includes mixed traffic, bad weather conditions, poor road infrastructure and unusual traffic situations. No drivers, steering wheel or pedals are required.
Technical challenges			
Mapping a highly complex environment in real time	– A multitude of sensors to detect the surroundings, special conditions (construction sites, water, snowy and dry areas) and non-motorised road traffic – Mixed traffic – Identifying different traffic signs and rules – Amalgamating, interpreting and protecting large quantities of data	As for level 3, plus: – Reliable sensors in all weather conditions – Inadequate road markings or infrastructure – Implementing most road sections – Remote system monitoring	As for level 4, plus: – Implementing all road sections (side roads and mountain roads) – Route decisions in the event of traffic jams, diversions, flooding etc.
Optimisation	– Avoiding undefined responsibility – Data protection and security	– Highly precise, current map materials for routes – Networking infrastructure, vehicles and people	– Fallback scenario with central monitoring and control
Ageing	– Decreasing sensor sensitivity (ageing processes) and blurring of system boundaries – Software updates throughout the entire service life plus software maintenance if production is being discontinued		
Approval	– Clear, tiered approval requirements required (in particular AI applications, critical scenarios, validation) – Approval safeguarding via OTA (over-the-air) software updates		
Individual benefit			
Lower risk of human error	Applicable to a limited extent (humans not good at solely monitoring)	Increasingly applicable	Extremely applicable
Reduction in non-productive time	Only conditionally applicable	Applicable	Extremely applicable
Mobility for non-drivers	Not applicable	Not applicable	Extremely applicable
Societal benefit	– No changes to mobility behaviour (adapted vehicle sizes and car sharing), at most an increase in annual kilometres per head – Dependent on power type (electricity, hydrogen, methane)		
Lower emissions and energy requirements	Not applicable	Not applicable	Only conditionally applicable (laps in empty mode rather than parking)
Infrastructure		– Dedicated infrastructure for platoon driving – Costs relating to infrastructure upgrading and maintenance – Networking with public transport	As for level 4, plus: – Narrower streets and fewer, narrower parking spots
Risk to people inside and outside the vehicle			
Increased system complexity	Applicable	Increasingly applicable	Extremely applicable
Evidence of reliability	Necessary	Increasingly necessary	Extremely necessary
Danger of cyberattack	Only conditionally applicable	Applicable	Extremely applicable
New severe accidents	Applicable	Increasingly applicable	Extremely applicable
Social acceptance and perception in Switzerland	– Social acceptance is relatively good – Hesitance to purchase, as vehicles are expensive and the added value is still limited – Continuous development facilitates acceptance	– Social acceptance is relatively good – High costs to procure and run vehicles – Noticeable psychological inertia – Continuous development facilitates acceptance	– Ambivalent social acceptance – Psychological inertia is very noticeable but still difficult to assess
Approval in Switzerland: current situation and requirements	– Draft bill being prepared, significant delegation to regulatory authority – Clarification regarding if and the extent to which drivers can be released from their obligations regarding alertness and control on a regulatory level; primarily dependent on the minimum guaranteed pickup time	– Draft bill being prepared, delegation to regulatory authority – Drivers largely released from obligations regarding alertness and control on a regulatory level during compliant system use – Proof of sufficient reliability and safety for both the overall system and key individual elements – Rooting in draft bill, regulation or standards – Amendment to 'Vienna Convention' if required*	– Still largely unresolved on a legal level, but ISO standards are being prepared – Not covered by the current revision of the Road Traffic Act – No driver obligations – Sufficient proof of reliability and safety for both the highly complex overall system and key individual elements – Rooting in draft bill or standards – Amendment to 'Vienna Convention'*
Legal aspects for Switzerland	– Fault-based liability for vehicle driver with some discharge of control responsibility		– In the absence of a driver, there is no control responsibility
Liability in Switzerland	– Vehicle owner: strict liability in tort and liability insurance for damage caused by vehicle operation – Manufacturer/supplier product liability (recourse by owner or liability insurance provider)		
Timescale for Switzerland (estimate)			
Approval, individual sales		2020–2025	2025–2030
Commercial availability		2030–2035	2040–2050
Market penetration		2040 onwards	2060 onwards

The table on this double page provides a detailed overview of the current challenges on a technical, legal, environmental and social level, and shows some potential benefits. It focuses on vehicles for passenger transport with a high traffic share. It is clear that developing systems like this represents a huge technical challenge. Whether all of the current problems can be solved remains uncertain. The systems need to be extremely reliable in a dynamic, complex environment with, in some cases, extreme road and weather conditions, and be able to function safely for long periods.

* "Vienna Convention": Vienna Convention on Road Traffic, concluded in Vienna on 8 November 1968
(www.admin.ch/opc/de/classified-compilation/19680244/index.html)