BERYLLS INSIGHTS

TRUCKING 2030 – BOOSTING PRODUCTIVITY & SAFETY WITH AUTONOMOUS TRUCKS
For more than a decade, autonomous driving has fueled thoughts about the future of mobility and disruptive business models in the automotive industry. It was tech giant Google with its self-driving car project started in 2009, who originally initiated the hype around autonomous vehicles. In 2016 the project was spun-off under the name Waymo, and in October 2020 – after millions of kilometers of successful testing – Waymo One was launched and became the first robotaxi service available to the general public, albeit only in Phoenix, Arizona.

While self-driving shuttles and robotaxis were the most frequent early prototypes and use cases of autonomous driving, heavy-duty trucks were initially considered only a niche category of the self-driving industry. However, today the consensus is that the path to profitability is much clearer for trucks than for robotaxis due to the lower complexity and better unit economics of long-haul applications on highways. Unsurprisingly, autonomous trucking has by now attracted billions of dollars of venture capital and created several very promising startups.
FROM ADVANCED DRIVER ASSISTANCE TO AUTOMATED DRIVING

In the meantime, the incumbent OEMs have followed a path of gradual enhancement of advanced driver assistance systems (ADAS) rather than seeking the disruptive approach. Features like blind spot and lane departure warning as well as automatic emergency braking are state-of-the-art in European heavy-duty trucks today. These systems act independently of the driver to avoid or mitigate accidents. Additional active systems like lane keeping and change support as well as adaptive cruise control with integrated stop-and-go function have been launched to increase not only safety, but also driver comfort.

The classification SAE International J3016 – first defined in 2014 – categorizes the respective vehicle features from Level 0 to Level 5. All current systems are driver support features up to Level 2, meaning that the driver is still driving whenever these features are engaged, even if his feet are off the pedal and his hands are off the steering wheel. He must constantly supervise and be ready to brake or steer as needed to maintain safety. Automated driving starts at Level 3, where a driver still must be seated in the driver’s seat even when they are no longer actually driving the truck under defined conditions.

It is common sense that conditional automation (SAE Level 3) is no game changer for commercial truck operations, as the driver must still take over driving when requested by the system. There is also little appetite to increase the driver comfort further. Instead, the ultimate goal is to eliminate the driver and thereby reduce the operating cost of the truck by up to 30%. Driverless trucks will be a transport system with unprecedented efficiency and safety. In order to reach the next level, truck OEMs need to achieve what can be seen as a quantum leap. That explains why they have increased funding considerably in recent years and started to team up with the disruptive players from the Silicon Valley, which are targeting SAE Level 4 and Level 5 directly.
Waymo is again one of the major players in autonomous driving for trucks. Testing of Waymo’s self-driving technology on class 8 tractor-trailers began in 2017, and in March 2020 the trucking division Waymo Via was officially launched. Waymo has adapted the so-called Waymo Driver technology to the requirements of heavy-duty trucks – Waymo would rather equip vehicles with their self-driving technology than operate autonomous truck services. In October 2020, Waymo announced a global strategic partnership with Daimler Truck to integrate the Waymo Driver into a fleet of Freightliner Cascadia semi-trailer trucks.

The second biggest player in autonomous trucking measured by total funding is Aurora Innovation. Located in the neighborhood of Waymo, Aurora was founded in 2017 by the former CTO of Google’s self-driving cars unit, Chris Urmson. His co-founders were Sterling Anderson, former director of Tesla Autopilot, and J. Andrew Bagnell, former head of Uber’s autonomy team. In December 2020, Uber invested 400 million dollars in Aurora in a corporate funding round while Aurora acquired Uber’s Advanced Technology Group (ATG). Since 2019 Aurora is focusing on the heavy-duty truck segment and announced a strategic partnership with PACCAR in January 2021 to deploy the Aurora Driver on class 8 Kenworth and Peterbilt trucks.

Number three in terms of funding is TuSimple of San Diego, California. Founded already in 2015, TuSimple has completed 11 funding rounds with truck manufacturers Navistar and Traton Group being among the investors. Their autonomous freight network runs 50 heavy-duty vehicles for customers like UPS and U.S. Express, connecting hubs in Phoenix and Tucson, Arizona with El Paso, Dallas and Houston, Texas. Unlike Waymo and Aurora, TuSimple follows an ecosystem approach including terminals and autonomous operations monitoring. Since February 2021, their self-driving technology has been the first to be tested in Europe in cooperation with Swedish truck manufacturer Scania (a brand of Traton).

There are two more players in autonomous trucking with total funding exceeding 100 million dollars each: Embark in San Francisco, hauling commercial loads on SAE Level 4 autonomous trucks between the Los Angeles area and Arizona, as well as Plus in Cupertino, being the first to have founded a joint venture with a Chinese truck OEM (FAW Jiefang).

There is a race for the global pole position and a battle over talent in the autonomous trucking industry. But not only the tech players are under pressure to perform. Even more so are the incumbent OEMs, striving to be first-to-market to underline their technology leadership, but also facing a future as commodity suppliers if they cannot transform their business models quickly enough and continue to control the relationship with their truck customers.

“If we don’t get autonomous driving done, we will be out of business.”
– Truck Dealer
AUTONOMOUS TRUCKS ARE COMING

There is one certainty: Autonomous trucks are coming. The open questions are when they will arrive on European roads, what autonomy level they will have, which applications will be technically and economically feasible and how deeply the technology will be integrated into the current vehicle concepts. The latter question also decides about the future winners and losers along the value chain.

We have conducted the expert survey “Trucking 2030” to find valid answers to the above questions. The result is a fairly clear and robust picture of the most disruptive element in the transformation of the truck industry over the next decade: driverless trucks.

Trucking experts agree, regulation and technological maturity will be the key success factors of autonomous driving. 94% of the respondents of our survey consider the legal framework to be very important. Consistent and international standards are required, since long-haul trucking crosses national borders. The maturity of the technology is attributed highest importance by 73% of the experts. Flawless functionalities are a precondition for the adoption of autonomous vehicles by truck operators as well as the essential acceptance by the general public. Europe tends to be more risk-averse regarding the use of new technologies compared to the United States. There is a great opportunity to boost both productivity and safety of truck transport.
INTO THE TROUGH OF DISILLUSIONMENT?

According to the July 2020 release of the Gartner hype cycle for automotive technologies, SAE Level 4 autonomous driving is currently on the way into the so-called trough of disillusionment. This typically corresponds with the realization that a new technology takes longer and delivers less benefit than expected during the hype phase.

Does this also apply to autonomous trucking? We don’t see it that way for several good reasons: (1) The massive shortage of drivers – which will get worse with the ongoing demographic shift – requires autonomous trucks rather sooner than later. (2) Trucking is the backbone of any economy, which means that in contrast to robotaxis, self-driving trucks are far from “nice to have”. (3) The promise of higher productivity will help autonomous trucks break through commercially. (4) The benefits of autonomous trucking are also seen in the advanced positioning as technology leaders. (5) Computers can perform monotonous, repetitive tasks like driving on a highway without getting tired, distracted or impatient. The promise of higher safety will help autonomous trucks become socially accepted.
LEVELS OF AUTOMATION: 4 WINS

Autonomous trucking is a “must have”, the question is not if, but how. As mentioned before, SAE Level 3 does not provide sufficient benefits for truck operators, because it does not allow the omission of the driver which is the key to a significant cost reduction. On the other hand, SAE Level 5 – i.e. automated driving that works everywhere and in all conditions – is likely too high a challenge from a technical point of view, considering the near endless variety of complex environments.

The pragmatic approach in between is SAE Level 4: Automated driving features that do not need the driver to take over. However, they can drive the vehicle only under limited conditions and will not operate until those are met. Practically speaking, truck operation with Level 4 is limited to certain routes, the so-called operational design domains (ODD). And in the worst case, e.g. if there is an obstacle on the road or the visibility gets too low, the vehicle stops just like a responsible driver would.

All the current prototype applications mentioned above are operating on SAE Level 4. There largely is consensus that autonomous trucking will become available in series production on this level: 73% of the experts interviewed during our survey agreed that Level 4 is sufficient for autonomous truck operation on public roads. Only a minority said that Level 5 was required for the breakthrough of autonomous trucking. Some respondents even doubt that Level 5 will ever be achieved, one called it “utopia by definition”. Many just focus on viable driverless use cases without taking care of the SAE classification too much.

Our conclusion: autonomous trucking will be widely commercialized on SAE Level 4; the market will not have to wait for the ultimate goal of full automation on SAE Level 5 to come true.
With autonomous vehicles, the road network for trucks must be rebuilt – not physically, but in terms of a stepwise extension of the operational design domain. The respondents of our survey unanimously named hub-to-hub applications as the starting point of the autonomous truck network of the future.

To begin, specialized transfer hubs will be established in locations that allow easy access. Later existing depots will be added to the network in order to avoid the change of trailers on the way to the destination. Long-haul is the use case that 73% of our interviewees consider suitable for autonomous trucking. Although spot business is more complex than regular hub-to-hub transport, a clear majority expects that it will be feasible in the future.

Only slightly fewer experts (67% of the respondents) believe in automated trucks for regional distribution. In fact, with the network getting denser, the distances getting shorter and the hubs getting smaller, the system will approach an area of decreasing margins. At some point, the additional effort will exceed the additional benefit of driverless operation. It also has to be taken into account that in many use cases the driver spends a large portion of his time on tasks other than driving, e.g., loading and unloading. Not least because of that, autonomous trucks in urban delivery and construction make sense for less than half of the respondents.
Autonomous trucking will require new operating concepts. Besides the truck and the virtual driver, there will be a third potential profit pool in future business models: the control center. Land traffic controllers will have to supervise the autonomous fleets and eventually take care of troubleshooting and remote driving whenever a problem occurs. Remote technicians will have to fix breakdowns with the help of tele-diagnosis tools. All these backend services must be established in parallel to the launch of autonomous trucks.

Another field of action is the automation within the yard. Does autonomous trucking end at the gate or at the dock of the transfer hub? Will the tractors used in hub-to-hub applications do the job end-to-end or handover to manual operation at some point? There is still a lot of room for process optimization. Specialized tech players like Outrider of Golden, Colorado are working on automated yard operations for logistics hubs. And Swedish startup Einride has launched a fully electric autonomous vehicle connecting a logistics hub with an external warehouse.

At the end of the day, the success of driverless trucking technology will most probably not be limited by the technical feasibility, but by the economic viability of the respective use cases. In the years to come, there must be more focus on the underlying operational concepts and business models.
When are SAE Level 4 autonomous trucks going to go into commercial operation in Europe? The majority of the experts who participated in the “Trucking 2030” survey expects that customer testing will begin until 2025. And before the end of the decade, series production of autonomous trucks is going to start.

Our respondents believe that in 2030 already 10% of all newly sold trucks will be ready for automated operation. There is quite a big spread in the sample regarding that question, though. One third is even more optimistic and expects penetration rates of 15% and above; another third is more cautious and considers 5% realistic. So, the exact course of market penetration is still somewhat fuzzy, but there is large consensus that the diffusion of the technology will be quick once it is available, due to the massive TCO advantage. Autonomous trucking is a game changer, and hub-to-hub transport is its killer application.

SAE Level 5 for trucks is expected to be available for customer testing before 2030, but not yet in series production. Coming back to the controversial discussion above, many experts see the crucial next step in the omission of the driver cabin, and not in abolishing the limits of the operational design domains. In other words: there is no need to go everywhere, but there is further savings potential.

Autonomous trucks can not only be driverless but can have no driver cabin at all well within ten years from today. This does not only reduce the product cost, it also creates new possibilities for optimized aerodynamics. And it makes the packaging of batteries and hydrogen tanks much easier on future zero emission tractors. Based on our survey results, we assume that before 2035 trucks without cabin will be in series production at large scale.
TRUCKS WITHOUT CAB... SURE?

Yes, the majority of the respondents believe that in the long run driverless trucks will be offered with and without driver cabin. 79% agreed to the hypothesis, that truck OEMs will offer both options in the future. Preference for either one depends on the trade-off between flexibility for different applications and dedication for a certain operating concept. If mixed operation is required or the respective network is only partially automated, a driver cabin is indispensable. But on highly frequented hub-to-hub destinations dedicated trucks will no longer be expensive part-time machines with integrated bedroom. They will simply produce ton kilometers at maximum availability and minimum cost.

In order to make this issue 100% waterproof, we have added two more explicit hypotheses to the questionnaire: could a driver cabin be necessary because of technical redundancy or customer acceptance? Both statements were clearly rejected by the trucking experts; only 22% and 25%, respectively, supported them. So, the incumbent OEMs better prepare for this scenario, because otherwise it is very likely that some innovative new players will fill the gap.
FUTURE TRUCK VALUE CHAIN:
WHO WILL SUPPLY WHOM?

Autonomous trucking will reduce TCO considerably and therefore create a strong competitive advantage for those who can provide it. So who will benefit most from it? Truck experts see tech players in the lead. 91% of respondents agree that autonomy is their door opener into the truck business. 75% believe that suppliers will be able to increase their share of value creation with autonomous driving. Only 64% assume that incumbent truck OEMs will be able to strengthen their position in the industry. Consequently, the statement that autonomous driving technology will always be OEM captive in the future is supported by a meager 33%. It seems like trucks risk becoming a commodity and their manufacturers are in danger to lose access to important fleet operators.

The tech players have a structural advantage in this game because their virtual drivers are vehicle agnostic. If they follow an approach like TuSimple and run the autonomous network themselves, truck OEMs become their suppliers. It seems rather unlikely that manufacturers will be able to apply and offer different virtual drivers across their product portfolio. In mixed fleets this might become a problem. Daimler’s decision to partner with Waymo despite their earlier engagement at Torc Robotics is a fallback option – and maybe an important sales channel in the near future. This example illustrates how much the technology race is also about market power.

Another conceivable scenario is the formation of firm partnerships between OEMs and tech players. Participation in the startup funding is an indicator for such a development. The Top 5 would then have their captive autonomous driving technology, whereas smaller truck OEMs would need to rely on external sourcing of white label solutions.

I don’t believe that the truck OEMs will make it on their own.
– Tier 1 Supplier

Finally, another potential battleground is who will operate autonomous trucks in the future. It is not necessarily the truck operators of today who are in the best position to capture that part of the value chain. For the 1PLs autonomous trucks are quite far from core business and most of the 2PLs are small and mid-sized companies lacking the expertise to operate high-tech. Some of the big 3PLs running structured logistics networks are already in a good starting position today. But also the truck manufacturers themselves – potentially through their fleet management subsidiaries – could run autonomous trucks and offer transport-as-a-service.
Autonomous trucking is the most disruptive element of the transformation that is lying ahead of the truck industry. Tech players challenge the technological leadership of incumbent OEMs and with it also their business model. Technically, autonomous trucking can only be 100% connected, and, looking at the timeline, it is likely close to 100% electric. There has never been more complexity and need for robust strategic decisions in the history of this industry.

We have identified a major need for action for all players along the value chain:

- **Focus on the development of SAE Level 4 for suitable driverless applications** – the market will not wait for SAE Level 5 to start commercial autonomous operations
- **Partner with tech companies** and related tier 1 suppliers to form a **long-term strategic cooperation** for autonomous trucking
- **Define your go-to-market strategy** and make sure that you firmly control the customer interface – whoever that final customer will be in the future world of autonomous truck networks
- **Review your future product portfolio** and include variants without driver cabin as well as product features supporting yard automation
- **Develop and implement operational concepts** for hub-to-hub applications in the first step – once on the road, further use cases will follow
- **Start building the control center and backend services** in time, create and implement business models like transport-as-a-service
- **Leverage the benefits** of autonomous trucking by creating a seamless integration with freight exchange and transport management platforms

Autonomous trucks are no longer science fiction. They are on the road already and they will spread quickly after some final hurdles have been taken. Trucking is one of the last industries that will be disrupted by tech players – and the disruption is adding complexity. Managing that complexity is the key to future success.

Are you prepared for Trucking 2030?
Berylls Strategy Advisors is a top management consulting firm specialized in the automotive industry, with offices in Detroit, in Munich and Berlin, in China, in Great Britain, in South Korea and in Switzerland. Our strategy advisors and associated expert network collaborate with automotive manufacturers, automotive suppliers, engineering services providers, outfitters and investors to find answers to the automotive industry’s key challenges. Our main focus is on innovation and growth strategies, support for mergers and acquisitions, organizational development and transformation and profit improvement measures across the entire value chain. In addition, together with our clients, experts at Berylls Digital Ventures develop solutions for digitizing and transforming the business models of OEMs, suppliers, engineering services providers and mobility providers. Longstanding experience, well-founded knowledge, innovative solutions, as well as an entrepreneurial mindset distinguish Berylls consulting teams. Through partnerships with experts, Berylls can draw on in-depth technology expertise, a comprehensive understanding of the market, and powerful networks in order to develop workable solutions.

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