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Telematics Industry Insights by Michael L. Sena

THE DISPATCHER

IN THIS ISSUE

4TH ANNUAL PRINCETON SMARTDRIVINGCAR SUMMIT

17 DECEMBER 2020 – 15 APRIL 2021

This year's summit was originally scheduled to be held in May. It is now be a virtual event spread over a number of weeks. See the program and register at:

https://orfe.princeton.edu/conferences/sdc/

*The focus of the **4th Annual Princeton SmartDrivingCar Summit** will address the challenges of commercialization and the delivery of tangible value to communities. Conference organizer Professor Alain L. Kornhauser says: "We've made enormous progress with the technology. We're doing the investment, however this investment delivers value only if is commercialized, made available and used by consumers in large numbers to deliver value that is commensurate with the magnitude of the investment made to-date."*

THE DISPATCHER

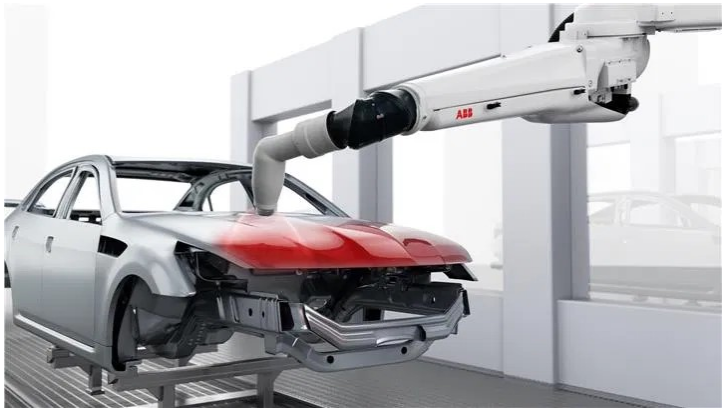
Telematics Industry Insights by Michael L. Sena
April 2021 – Volume 8, Issue 6

A Closer, Critical Look at Operational Design Domain

*NASA's Mars Rover **Perseverance** being lowered to the surface of the planet on the 18th of February 2021 by the rocket propelled sky crane.*

OPERATIONAL DESIGN DOMAIN (ODD). The term refers to where and under which conditions an automated vehicle should be able to function in order to successfully complete a task for which it has been designed. To take a topical example, the *Mars Rover* (clearly a very highly automated vehicle) was designed by NASA to explore the Planet Mars. Maybe it wouldn't do so well on Mercury, another ODD, due to the heat, or on Uranus where the surface is gaseous. It would definitely be totally useless for getting around the streets of Rome.

When I first heard the term ODD I thought it sounded like a very good general robotics expression. Every robot is designed to be programmed to perform a specific task within a defined area under certain conditions. The car painting robot pictured here paints cars in the enclosure designed for the task. It doesn't do graffiti along highways or produce copies of Rembrandt's paintings. ODD could also be used to describe where and under which conditions just about anything functions, including humans and any other form of life. Humans are made to operate on Planet Earth, but only on the land portion and not for extended periods of time where it's exceptionally cold, like the North and South Poles. However, human inventiveness has allowed us to make all of the planet our ODD oyster.



As I said at the start, the term ODD was invented to pertain to motor vehicles and specifically to vehicles that don't have drivers or who have so-called 'safety drivers' who are available to take over the driving task if the automated vehicle's systems fail. Its first use—at least the one that I could find—was in a documents written by the SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) International Standard J3016.[1]

1. SAE J 3016-2016 (SAE J3016-2016) – Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. The Operational Design Domain is "the specific conditions under which a given driving automation system or feature thereof is designed to function, including, but not limited to, driving modes."

I didn't give the term much thought because the people developing cars that drive themselves are mostly working in their own patch, either close to where they have their offices (Pittsburgh, PA for AURORA) or in a place where they don't have to worry about recalcitrant weather, unruly pedestrians or ancient road patterns (Chandler, Arizona for Waymo). Then in early February, I was an active participant in one of the *PRINCETON 2021 SMARTDRIVINGCARS SUMMIT* panel discussions titled *Safe Enough in the Operational Design Domain*. Among the panelists were Dan Smith from Waymo and Nat Beuse from AURORA, along with Christopher Hart, formerly with the *U.S. NATIONAL TRANSPORTATION RESEARCH BOARD* (and a college classmate of mine) and Marjory Blumenthal from RAND CORPORATION as the moderator.

Waymo's ODD patch is Chandler, Arizona where it drives its Chrysler Pacificas in both self-driving and driverless mode.

After the panelists had given their thoughts about how driverless cars would improve safety, I asked a question: "What are the specific conditions presented by different operational design domains that relate to how safe a driverless car can be? Waymo is testing in Chandler, Arizona and has collected a large amount of data about the area in which it is operating. What level of effort will be required to move from that operational design domain, where Waymo has shown that its driverless car can function safely, to a new ODD, for example Stockholm?" And I added: "Since every place is different, we would assume that it will take time to adapt the vehicle's systems to accommodate these differences."

I was very surprised by the response I received from AURORA's Nat Beuse. He said that he didn't agree with my statement that every place is different. Every place fits into a certain category, he said. He wasn't aware of any taxonomy of driverless car ODDs that had been done, but he was sure there would be a limited number and that adaptations of software in a vehicle to adapt to a new ODD would be relatively quick and straightforward. One of the panelists suggested that creating a taxonomy of operational design domains would be a worthwhile endeavor and maybe I should take it on. It was at that moment I was struck with a sense of *déjà vu*. "They're doing it again," I thought.

Don't criticize what you can't understand

I had the same feeling after this exchange in the SDC panel discussion as I had the first time I sat in on a meeting of the group working on a standard for navigable map data. It was late in 1992 in Hildesheim, Germany at the offices of BOSCH CARTOGRAPHIC SERVICES (which later bought TELE ATLAS and took its name). I would

be part of that group, ISO TC204/Working Group 3, for the next four years attending meetings held all around the world. Everything we were doing was based on a completely new paradigm for giving people directions while they were driving their cars. Unlike the systems I had seen coming out of Japan or the system developed by a U.S. company called Etak, the European and U.S. members of the group from BOSCH, PHILIPS and NAVTEQ, were working on a turn-by-turn approach that was based on spoken directions with graphics used to reinforce those instructions. Map displays were something that came later. Something was happening, but I didn't know what was. I thought they had the key to the door, and if I just watched and listened hard enough, I would learn what was behind that door. By the time I realized that the door their key would open wasn't where I thought it should go, the paradigm had been fixed. Since then, navigation systems bark instructions at a driver as if the driver were a robot. (You can read about how I believe navigation systems should work here.)

Maybe that was always the idea, to develop a system that would one day serve to guide a robotic driver instead of a human. Now we are there, on the threshold of robotic cars that drive themselves. According to the people who are developing these driverless vehicles, we are ready to shift the paradigm once again. Instead of driving in a specific place with a name (say, Scranton, PA) located in a political jurisdiction in a particular country, in places where people live, work, recreate and move around, driverless cars will be functioning in *operational design domains* where place is irrelevant, except for the person being chauffeured. For the robot, one place is like any other with the same taxonomic designation. Maybe it snows in one ODD once every fifty years (in Houston, Texas for example) instead of every winter. Isn't it as simple as summarizing these differences in a few descriptive phrases in a catalog of ODD taxonomies?

Rather than reacting to Nat Beuse's comment, I relinquished the microphone. The discussion continued, but my mind was elsewhere. Is it possible that the differences between places are essentially inconsequential to a robot that is just concerned with staying in its lane, stopping at red lights and not hitting jaywalking pedestrians? All of my experience, including my training as both an architect and urban planner, told me that a place is more than just the sum of its parts. A city with a rectangular street grid running north and south, east and west can house several million

NHTSA on ODD

In its Automated Driving Systems 2.0: A Vision for Safety, NHTSA explains how the concept of Operational Design Domain should be applied.

"Entities are encouraged to define and document the ODD for each Automated Driving System (ADS) available on their vehicle(s) as tested or deployed for use on public roadways, as well as document the process and procedure for assessment, testing, and validation of ADS functionality with the prescribed ODD. The ODD should describe the specific conditions under which a given ADS or feature is intended to function. The ODD is the definition of where (such as what roadway types and speeds) and when (under what conditions, such as day/night, weather limits, etc.) and ADS is designed to operate.

"The ODD would include the following information at a minimum to define each ADS's capability limits/boundaries:

- *Roadway types (interstate, local, etc.) on which the ADS is intended to operate safety;*
- *Geographic area (city, mountain, desert, etc.);*
- *Speed range;*
- *Environmental conditions in which the ADS will operate (weather, day, etc.); and,*
- *Other domain constraints.*

"An ADS is responsible for object and event detection and response while it is engaged and operating in its defined ODD. It should be able to address foreseeable encounters, including emergency vehicles, temporary work zones, and police manually directing traffic. ADS shall have behavioral competencies, such as keeping vehicle in lane, obeying traffic laws, following road etiquette and responding to hazards. Based on the ODD, an ADAS should be able to address applicable pre-crash scenarios."

people or several thousand; it can contain the world's tallest office buildings or no office buildings at all; it can be a place that is one day filled with people and another day a place where a person can be totally alone. It could be Chandler, AZ, Milton Keynes, UK, or Kyoto, Japan.

There are times when traffic disappears from even the busiest city's streets and a person can be alone with his thoughts.

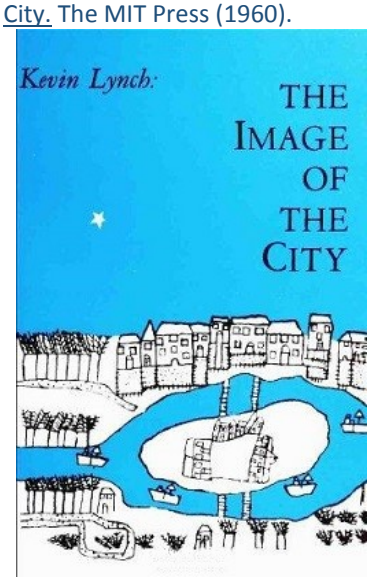
I decided to take the first step toward developing a taxonomy of operational design domains for highly automated vehicles, including vehicles that are completely driverless. For this purpose, 'domain' is defined as 'a region distinctively marked by physical features'.[2] The SAE definition of ODD refers to "conditions", not physical features. The intention was probably to take into account non-physical features such as time of day or weather, rules-of-the-road and regulations, as further explained in NHTSA's *A Vision for Safety*. Nevertheless, the places where vehicles are driving have to be the focus of the developent of an ODD taxonomy. Tokyo is not London; an Autobahn is not an Interstate in New York. We need to determine which physical features in combination with non-physical features actually matter during the driving task, and how different combinations of both types of features potentially affect what a driver (human or robot) will do—and expect the car he/it is driving to support. As I studied the SAE description of ODD, I began to feel that it has not given adequate attention to the full complexity of what a 'domain' actually is in practice.

Deep-, Surface-, Temporal- and Infra-structure

Where do I start? I looked at my shelves filled with books on urban design and town planning, texts on the evolution of different forms of movement patterns, treatises on what makes a city livable, textbooks on transport planning, proposals for utopias. I've kept them all despite my own urges—and my wife's urging—to leave them behind on one of my many moves. "I'm looking for the basics, information on the foundation principles for why places look the way they do rather than all places looking the same," I thought. One book caught my eye: The Image of the City by Kevin Lynch.[3] The book is the result of a five-year research study aided by a grant from the ROCKEFELLER FOUNDATION that Lynch

2. The word 'domain' is derived from Latin *dominium* meaning 'property' and *dominus* meaning 'lord'.

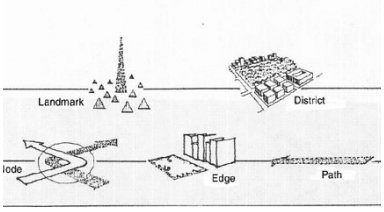
3. Lynch, Kevin. The Image of the City. The MIT Press (1960).



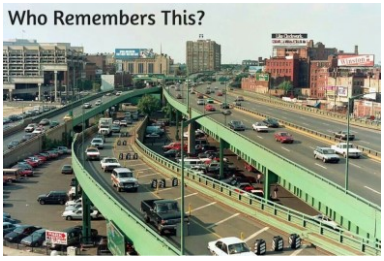
Lynch was born and raised in Chicago, matriculated at both YALE and RPI with the intention of studying architecture and engineering, but left each university after short stays. He spent a year and a half working with Frank Lloyd Wright and then three years serving in the Army Corps of Engineers in the Philippines during World War Two. When he returned, he finished his studies in city planning at MIT. Two years later, he was teaching there and by 1963 he was a fully tenured professor.

carried out with his MIT colleague Gyorgy Kepes (who founded the *CENTER FOR ADVANCED VISUAL STUDIES AT MIT* in 1968).

Lynch and Kepes studied three cities: Boston, Jersey City and Los Angeles. In the 50s, Boston and LA were polar opposites, and cities like Jersey City and Hoboken, nuzzled along the Hudson River across from the Great Metropolis, were entry and exit points to and from the continent. They interviewed the residents of these cities, asking them about their images of their city. They asked those whom they interviewed to produce mental maps, that is, maps created from memory. They discovered that people in all three urban areas used similar elements to construct their mental maps: paths, edges, districts, nodes and landmarks. Boston stimulated the largest number of these elements, while Jersey City inspired the fewest.



This exercise revealed the importance of a city's '**deep structure**' for wayfinding and what Lynch called a city's *imagability*. Boston's water edges along both the Charles River and Massachusetts Bay, Beacon Hill topped by the State House, the large open space in the city's center called Boston Common, the entire area of Back Bay with its regular pattern of streets, all figured prominently in the mental images of residents. Neither LA nor Jersey City had similar strong *imagability*. While I did not grow up in Boston, I lived across the river in Cambridge and I worked in Boston for eighteen years. I could have drawn a similar mental map. But—and this is a big BUT—this mental map was not what I used when I was driving in Boston. During the period when I lived there, between 1973 and 1990, the Central Artery (pictured right) and the Massachusetts Turnpike were the principal organizers of vehicular traffic. The elevated artery is now gone, replaced by an below-grade roadway covered over by a parklike landscape.

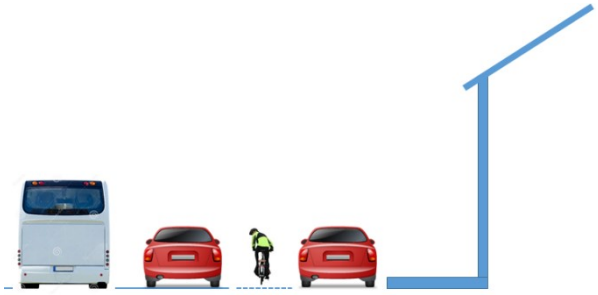


Boston' Central Artery with the North End to the right at the entrance to the Callahan Tunnel leading to Logan Airport. I remember it all too well.

Rome's seven hills, Amsterdam's canals and the towers in Bologna are important for imaging the city and for humans to orient themselves, but they have little or no impact on the actual driving task. Deep structure features that do matter are steeply-angled streets that can be icy in winter or slippery in the autumn when they are covered with wet leaves, or canal edges that have no barriers to prevent a car from accidently sliding into the water. In rural areas, rolling terrain can be a problem when, on a two-lane road, a driver cannot see that a car is passing on the other side of the hill. Tight curves on mountain roads are a major problem in all types of weather. There are countless other examples.

What about **infrastructure**? How important is the road pattern? Is it easier or more difficult to maneuvre a vehicle on the grid pattern of Manhattan or Barcelona, versus on the random street structure of Bologna, Italy (shown right) or in the City of London? Do bridges or tunnels make the driving more stressful (assuming the driver is not acrophobic or claustrophobic)? Human drivers have the big and small pictures in their heads simultaneously: Where am I going and what's happening around me? But the driving task is related only to a reasonably small area around the vehicle, and that area depends on the speed at which the car is moving and what is happening on both sides, in front and behind the vehicle. Let's look at an example to illustrate this point.

Driving in Stockholm's Östermalm used to be relatively comfortable back in the 1980s. The district has a regular grid pattern, the streets are wide and there was little traffic congestion back then. Gradually, the city's traffic engineers began to add features to the roads, like dedicated bus lanes and designated bicycle lanes. It's called 'fiddling'. Buses stop along the curbs, but the bus lanes could be either to the left or the right of the car lanes. The car lane could be congested, but the bike lane might be open so you have to be constantly aware of what is happening on your blind side. A double-parked delivery truck or someone opening a parked car door that blocks a bike lane can cause the bicyclist to suddenly move into the traffic lane. Driving through the city of Bologna has the same problems, but they happen within tighter spaces.[4] Pedestrians, cyclists, parked cars and delivery trucks are mixed on all of the city's streets.



4. During six months I was working with a client in Bologna, Italy on a telematics system implementation. When we performed end-to-end testing, we started and ended our tests in Bologna. I loved the food, but really did not like driving in the city. Too many things were happening at the same time, all requiring my undivided attention. More modern cities, those built after the invention of the motor car, have tried to engineer away all the distractions, but as the example of Stockholm shows, what one engineer can give, a politician playing city planner can take away with the stroke of a pen.

Surface structure is what causes the most difficult problems for both human and robot drivers. Surface structure is a combination of traffic control systems and signs, regulations that are written into the country's or city's transport laws, and traditions and cultural practices that people who drive long enough in an area learn. It is the 'Pittsburgh left turn', when the first car at a red light jumps to make the turn, blocking opposing cars going straight ahead, or the 'Boston roundabout maneuver', in which the driver entering the roundabout looks right, ignoring cars already in the roundabout. "If I don't see you, you're not there." Unsignaled

This is a perfect spot for a Pittsburgh left turn.

pedestrian crossings cause major problems to drivers who are new to a country or a city. Having grown up and lived in places where cars always had the right-of-way at intersections, I never got used to walking into a zebra crossing in London during the year I lived there. I didn't move until the oncoming cars stopped.

Returning to Stockholm for another example of the potential conflict between driving and surface structure, the current head of the traffic department made a unilateral decision a few years ago to put up signs under every *One-way Do Not Enter* sign in the city stating that the one-way did not apply to bicyclists. This was, of course, interpreted as a free pass for electric scooters and mopeds. The decision was criticized by residents and motorists alike, and the national traffic agency declared it was illegal. Stockholm ignored the agency. Those signs are still there one year later, and cyclists have not gotten better at stopping at intersections to give pedestrians the right-of-way or stopping at stop signs and red lights.

Sensor systems fixed to vehicles are supposed to recognize signs, and databases loaded into the vehicles should include all of the regulations that apply to a place with exceptions to regulations based on time of year, time of day, day of week. The place can be a particular street (e.g., restrictions on studded tires apply to specific streets in Stockholm) or a section of a city (e.g., so-called Environmental Zones in many European cities do not allow cars or trucks that are more than a certain number of years old or have diesel engines) or the entire city or county or state or country. The 'place' can be a road classification, but classification alone does not make it part of the same physical domain. In Europe, a European (E) road can be anything from a dirt path in the north of Finland to a ferry crossing to a multi-lane divided highway. It is not enough to simply state that an E-road is the ODD. There are also differences between countries. There are different speed limits, different rules for allowing merging vehicles to enter the highway, different rules for using the breakdown lanes, different rules for giving way to emergency vehicles.

A driverless car's instruction database must include the surface structure of the place where the car is driving, and the vehicle's systems must be able to turn that knowledge into instructions about how to drive in all situations. If the local practices cannot be codified prior to driving in the area, then the car will have to gain the knowledge through practice, very much like a new driver learns the practices through driving.

The **temporal structure** of a place is also a very important determinant of whether a road that might have been safe to drive on yesterday is not safe to drive on today. In places where thirty-to-one hundred centimeters of snow can fall overnight, covering roads and road signs, a driverless car before the snowfall is a parked car afterwards. In my neck of the woods, dawn and dusk in the spring and autumn are times when I need to be extra alert for a moose that weighs more than my car suddenly crossing the road. In the center of a town where we have a vacation apartment one section of one street is closed to vehicular traffic in one direction between midnight and 6 a.m. I have never found out why that is the case, but I suppose if I tested the law, there might be a policeman waiting to give me a ticket.

Why did the moose cross the road?

We're not in Kansas anymore, Toto

So what's the verdict? What really matters for driving cars, and are the same things important for cars driven by robots? Human drivers who know where they are going and know how to get there have an image of their journey in their head and they can concentrate on the driving task. If they don't know where they are going and have a navigation system operating or a human navigator in the car, they can also concentrate on the driving task, which in cities includes stopping at stop signs and red lights, yielding to pedestrians crossing the street and watching out for opening car doors, swerving bicyclists, unleashed dogs and everything else that gets in the way of driving. In rural areas, the driving task includes keeping an eye out for a moose or deer or wild pig dashing in front of the car or looking out for cars passing on two-lane, undivided roads around curves or hidden behind a hill.

Robot drivers always have a navigation function playing in the background. They have to know the end point of the journey, but once they do, the maneuvers they make are automatic—until what their sensors 'see' does not match what their navigation program tells them to do. The hard part for a robot-driven car is the same as for human-driven car: simultaneously making the mental connections among all four variables, deep structure, surface structure, temporal structure and infrastructure. Humans have two more variables, their mental and physical states, and it is often these two variables that are the cause of errors of omission and comission when accidents occur. But if there is one thing that distinguishes humans from robots it is our ability to do and think about several things at once.

If we are going to define places where a robot is allowed to take full control or even partial control of a vehicle, then the definition of those places must take all four physical variables into account. I submit that creating hard boundaries to what has been given the name 'Operational Design Domain' is essential, but this is not only difficult but impossible. There are two reasons for this. First, as I believe I have explained, there is not a one-to-one relationship between the boundaries of the variables. The conditions along a U.S. Interstate highway change within a state when the road enters an urban area, and they change when the road crosses a state boundary. The rules for one neighborhood in a city, such as the length of free parking or the maximum stay in a parking space, will be different from those of another neighborhood.

Keep in mind that one of the reasons for defining an ODD is that the vehicle 'knows' where it can operate. If it leaves its ODD for whatever reason, it must stop operating or hand over control to someone or something. There must be boundaries to the ODD, and they must be hard and fixed, otherwise they are not 'domains'. Cars drive on roads.[5]

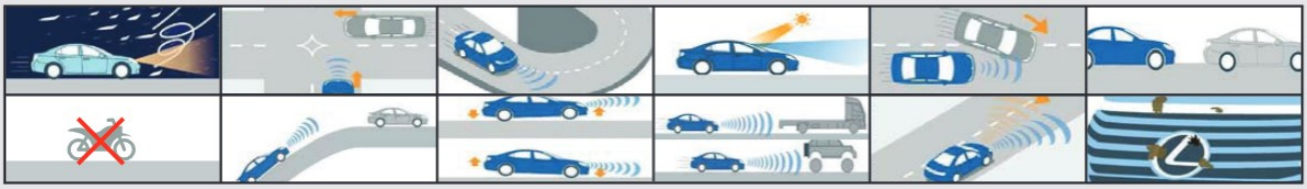
The second reason it is impossible to fix a hard and fast physical boundary to an ODD is related to why system developers and OEMs want ODDs in the first place. It is so they can limit their liability. Once they have established their ODD, they will do precisely what they have done with their ADAS systems, that is, limit their liabilities by defining all the reasons why their systems may malfunction even when and where they should be functioning. The table below lists about a quarter of the exceptions that *Lexus* takes for its Pre-Collision System. The section starts by stating: *"Pre-Collision System is premised on safe driving by the driver. It is not a system that will avoid collisions*

5. UN R157 for Automated Lane Keeping Systems is a textbook example of the difficulty of providing a definition of an ODD that can be applied for a specific and limited function. In its Definitions section, it repeats the definition included in the SAE document ("*Operational Design Domain (ODD) of the automated lane keeping system defines the specific operating conditions (e.g. environmental, geographic, time-of-day, traffic, infrastructure, speed range, weather and other conditions) within the boundaries fixed by this regulation under which the automated lane keeping system is designed to operate without any intervention by the driver.*")

However, in practice, the actual ODD for ALKS is defined in limited terms: *"ALKS can be activated under certain conditions on roads where pedestrians and cyclists are prohibited and which, by design, are equipped with a physical separation that divides the traffic moving in opposite directions and prevent traffic from cutting across the path of the vehicle. In a first step, the original text of this Regulation limits the operational speed to 60 km/h maximum and passenger cars (M1 vehicles)."*

There is a huge difference between these two definitions.

VEHICLE DETECTION MAY NOT OPERATE IN THE FOLLOWING CONDITIONS:



1. When visibility to the front is poor due to bad weather (rain, snow, fog, dust raised by wind, sandstorm, blizzard, etc.)
2. When there is a sudden appearance in the forward direction of the vehicle
3. When driving around locations with sharp curves or undulations or for a period of time after turning due to camera recognition
4. When there is intense light from the front such as strong sunlight or high beams of a vehicle going the opposite direction
5. When a preceding vehicle cuts in front of you suddenly, abruptly steers, accelerates or decelerates, or is offset compared to your vehicle
6. When very close to the vehicle in front (distance of approximately 6.5 feet or less) or coming close to a preceding vehicle after making a lane change
7. Motorcycle or bicycle may not be detected
8. When driving on an up or down slope and not able to recognize a preceding vehicle
9. When vehicle angle or stance changes dramatically due to load, changes to suspension, tire pressure, etc.
10. If the rear-most surface of the preceding vehicle is small, low or irregularly high
11. When the camera or laser faces the wrong direction due to damage or misalignment
12. When something is on the sensor such as bugs, dirt, ice, etc.

under all conditions." The *LEXUS Pre-Collision System* excuses itself if a bug blocks one of its sensors (see point 12).

If a bug flies into my eye while I am driving and I slam my car into the car ahead that has stopped for a red light, and that car crashes into and kills a pedestrian crossing the street, the dead person's next of kin cannot sue the bug, or more likely, the bug's next of kin because I have already killed the bug. They will sue me, and I will not be able to say I wandered out of my operational design domain and onto a street where I should not have been operating because there were bugs there.

What do I think of the whole Operational Design Domain idea? For a single function, like Automated Lane Keeping (ALK), it's essential to define in the most explicit terms exactly where, when and how the function may be used. If any one of the prerequisites is not met, the function must not be allowed to start, or if it is operating it must be deactivated. No excuses. No exceptions. UN R157 has defined an ODD for ALK which should serve as a model for such a definition. (See article on UN R157 in this issue.)

For driverless car operation, where there is no one sitting in the driver's seat ready to take back control from the robot, I think an ODD is a cop-out, a way for the developers of driverless systems and the OEMs that install those systems to avoid taking full responsibility for the eventual problems caused by those systems. Humans who pass their driver's license tests have the right to drive anywhere, and they are held accountable for knowing and abiding by all the rules and regulations that apply. Other drivers depend on them doing so. Having it any other way would simply lead to confusion and uncertainty. It is difficult enough to determine culpability today when accidents occur; adding a determination of whether a vehicle was or was not driving where and when it should, and taking into account all the exceptions the developers of driverless systems want to apply, will only add another layer of difficulty.

Every driverless car should take the same tests that we take, and if it passes, it should have the same rights and responsibilities as we humans do. No excuses. No exceptions.

Dispatch Central

Geely decides to leave Volvo Cars alone

GEELY AUTO AND VOLVO CARS will not merge after all. In the July 2020 issue of *THE DISPATCHER*, under the title *The Plan to Merge Geely Auto and Volvo Cars: Is it time to say Zài-jiàn to Volvo Cars?* I discussed the decision of ZHEJIANG GEELY HOLDING GROUP, the parent to the two companies, to study the advantages of merging the two into a single corporate entity with its headquarters in China. The plan for the study was announced in February of the same year. The goal of the potential merger was 'to accelerate financial and technological synergies between the two'. *VOLVO, POLESTAR, GEELY* and *LYNK & CO* would become brands within a global automotive group worth around $30 billion with well over 2 cars million in combined annual sales.

A joint working group was created to prepare a report on whether to proceed and how to do so. When the work started, a joint statement by GEELY AUTO and VOLVO CARS said that the hope was that a combined group "would have the scale, knowledge and resources to be a leader in the ongoing transformation of the automotive industry". The new company would initially be listed on the HONG KONG STOCK EXCHANGE and eventually on the STOCKHOLM EXCHANGE.

On July 21st, a month after my readers had opened the envelopes to pull out their July 2020 issue, GEELY AUTO and VOLVO CARS announced that their merger study was "temporarily put on hold due to GEELY AUTO's plans to list the company on a stock exchange in China". Along with most of the others following this issue, I was taken aback by GEELY's apparent lack of forethought in moving forward with one action while not appreciating that it would have an impact on another. GEELY AUTO had asked for and received approval from its board to list new renminbi[6] shares on Shanghai's STAR board, and while this was ongoing, there could be no discussions about mergers or transactions related to other companies. The plan was that talks and studies would resume when the new listing was behind GEELY AUTO.

On the 24th of February 2021, GEELY issued a statement that the two companies would remain separate,

6. *Renminbi* is the name of the currency while *yuan* is the name of the primary unit of *renminbi*. This is analogous to the difference between *sterling* and *pound* when discussing the official currency of the UK, the *pound sterling*.

standalone entities. The main reason given for this decision was that they could not come up with a fair valuation for VOLVO CARS that was acceptable to both GEELY investors and VOLVO CARS. GEELY investors of course wanted a low-ball valuation. Both Sweden's government and VOLVO's labor unions would have kicked up a fuss if GEELY management had gone along with a low valuation. The Chinese company already got the family jewels at a bargain basement price; now they wanted to move the company and everything it represented to China without paying the premium the Swedish investors felt they deserved to be paid.

"I firmly believe that this is the best combination, the best way forward for our companies," VOLVO CARS CEO Håkan Samuelsson said after the merger was nixed. "Having evaluated different options to realize value, we concluded jointly that a collaboration model between two standalone companies is the best way to secure continued growth and at the same time achieve technological synergies in many areas. We welcome the opportunity of further and deeper collaboration with GEELY AUTO."

So, at least for now, the two companies will retain their independent corporate structures. That leaves the door open for a separate stock market listing for VOLVO CARS, which was tried a few years ago and dropped because GEELY's Chairman, Li Shufu, wanted a valuation for VOLVO that was higher than potential investors were willing to pay. BLOOMBERG valued VOLVO in December 2020 in a range of $8.1 and $11.6 billion. Li Shufu had been hoping for something in the vicinity of $30 when the plug on the stock listing was pulled. Samuelsson said when asked whether the abandoned merger meant that a stock listing could now be considered, "There are no such plans." Plans can change. I believe there was another factor that weighed on the decision and that is GEELY AUTO's decision to become a contract producer for other companies, as evidenced by its agreement with FOXCONN.[7] GEELY has plenty of excess capacity at the moment, and filling it with VOLVO's production would simply empty VOLVO's factories.

Although they will not be merging, they will be doing more cooperating. It was announced that VOLVO CARS and GEELY AUTO will combine their power train operations into a new, standalone company that will produce internal combustion engines, transmissions, and next-generation dual-motor hybrid systems. The powertrains will be used by both companies as well as other manufacturers. The new business unit is expected to be operational this year. I can hear the champagne corks popping in Göteborg.

Not April Fool's Day

It wasn't April Fool's Day when I read the news. I double checked. It was the 19th of March when AUTOMOTIVE NEWS wrote the following: "China's Zhejiang Geely Holding Group Co. plans to roll out electric vehicles under a new marque with different branding and sales strategies, people familiar with the matter said, as it looks to take on its main electric vehicle rival Tesla Inc. with higher-end vehicles.

(Ed: I wonder if Tesla looks at Geely as its main rival.)

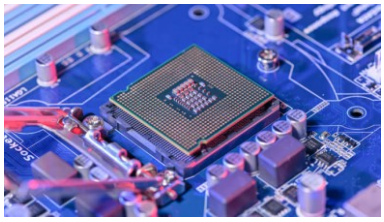
"The (new) brand, positioned in the premium segment and named "Zeekr," will be housed under Geely's to-be-launched EV entity Lingling Technologies, according to three people, who declined to be named as the plan is not yet public. Reuters reported the plans for Lingling last month.

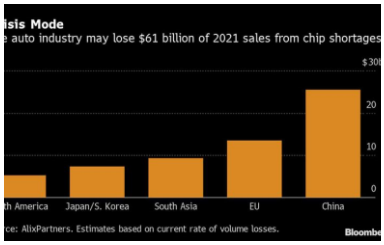
(Ed. Zeekr? Lingling? I had to make a third check with the calendar.)

"Geely, the owner of Volvo Cars and 9.7 percent of Daimler, will roll out models under the new marque based on its open-source EV chassis, announced in September and called Sustainable Experience Architecture (SEA), the sources said."

7. On the 13th of January 2021, ZHEJIANG GEELY HOLDING GROUP (GEELY HOLDING) and FOXCONN TECHNOLOGY GROUP (FOXCONN) signed a strategic cooperative agreement and will establish a joint venture company to provide OEM and customized consulting services relating to whole vehicles, parts, intelligent drive systems, automotive ecosystem platforms to global automotive enterprises and ridesharing companies.

What do you do when the chips are down?





IT'S BEEN IMPOSSIBLE to miss the news about supplies of microchips to the automotive industry running low and running out. The result of the extreme shortage has been idle production lines due to key components not being produced, delivered and installed in vehicles. Carmakers are expected to miss out on $61 billion of sales this year alone, according to a report by ALIXPARTNERS based on current rates of volume losses. GENERAL MOTORS expects the chip shortage will cut its earnings by $1.5-to-$2 billion this year. FORD MOTOR said the situation could lower its earnings by $1-to-$2.5 billion in 2021. HONDA MOTOR and NISSAN MOTOR combined expect to sell 250,000 fewer cars through March due to the shortage. VW won't build 100,000 cars. Research firm IHS MARKIT anticipates 672,000 fewer vehicles will be produced in the first quarter of 2021 due to the semiconductor shortage, including 250,000 units in China (see chart in sidebar).

How has this happened? It seems the answer is that it was the result of both good and bad planning, how the semiconductor and automotive industries are now structured, and where the automobile industry is on the advanced technology curve. It began with the COVID-19 pandemic. Let's start with how things looked before the pandemic knocked everything out of whack. Car companies have gradually increased the number of electronics devices in their cars, becoming part of the international buyer group of devices that include microchips competing with all the other buyers. However, car companies have not competed on equal footing with the larger volume buyers because the car business is low margin and relatively low volume compared to consumer electronics. The annual smartphone market alone is more than one billion devices, compared with less than 100 million cars. Car companies are used to pushing their suppliers for ever-lower prices, but chip manufacturers don't have to play their game. So car companies and the tier ones and tier twos who supply the devices are relatively low on the priority list of semiconductor manufacturers.

Given this lower priority and in order to keep prices of chips in car electronics low, the car companies and their suppliers have lagged behind in using the most advanced designs. This has meant that as the semiconductor business has moved to higher capacity for faster and more advanced chips, the

amount of capacity devoted to the lower end has been reduced. In spite of all of this, the situation pre-pandemic was stable.

When COVID-19 struck, the first reaction from the car industry was to hit the brakes on production. They canceled their contracts with suppliers who, in turn, cancelled their contracts with chip makers. They did this as more people were buying electronics devices to work from and recreate in their homes. Demand for electronics skyrocketed. Added to this is the fact that smartphones using 5G technology that enable more sophisticated applications use about 40% more semiconductors than 4G devices. When car makers figured out that people were not only not going to stop buying cars but might be buying more of them, they called their production line staff back to work. Unfortunately, by that time the chip suppliers had moved on and the car companies and their suppliers found themselves at the bottom of their priority lists.

Why didn't the car companies and the likes of BOSCH and CONTINENTAL just pull chips from stock? For the same reason Western companies couldn't just pull face masks and other protective equipment out of their storage cabinets: just-in-time deliveries. JIT is great when the supply chain is greased and running and when buyers and suppliers can adjust to changes in the marketplace. It does not work when pandemics hit and the entire supply chain is disrupted. Oddly, in Japan, the land where JIT was perfected into an art, Toyota Motor is faring better than most auto manufacturers claiming it has a four-month stockpile of chips.

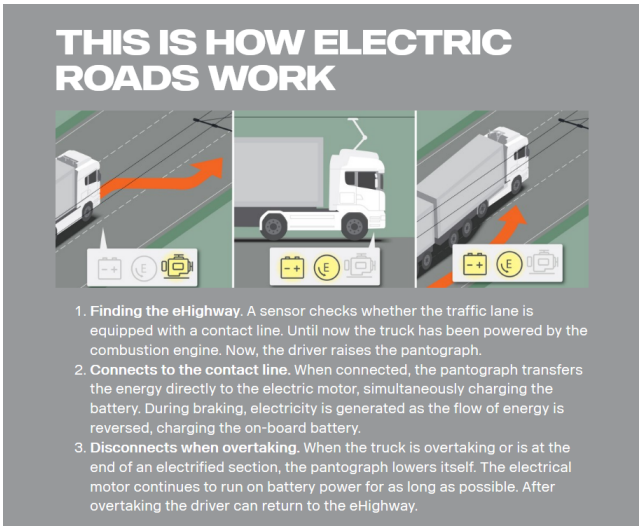
There's another problem that is the result of how the microchip industry has evolved. More and more chip designers, like NVIDIA, NXP, INFINEON and RENESAS ELECTRONICS, have gone fabless. That means they are relying on so-called foundries, such as TSMC (TAIWAN SEMICONDUCTOR MANUFACTURING CO.), UNITED MICROELECTRONICS CORP. and GLOBALFOUNDRIES INC. and chip assemblers like ASE TECHNOLOGY to serve as their fabricators. These foundries and assemblers were not expanding fast enough to meet the big spike in consumer devices caused by the pandemic. They are trying hard to catch up, but it will take time.

How long before everything is back to normal? No one is making any predictions. And just to make the lining on the dark cloud a little darker, all the latest and greatest technology that is needed for self-driving and driverless functions will not be unaffected by these shortages. If you are a car manufacturer, do you make the

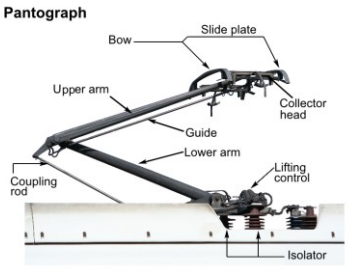
decision to produce cars with less technology to keep your factories humming and cash flow flowing, or keep your production lines idle until the chips show up? GM reported in *Automotive News* on the 15th of March that "due to the global semiconductor chip shortage it is building certain 2021 light-duty full-size pickup trucks without a fuel management module." That will hurt those vehicles' fuel economy performance. The alternative was worse for GM.

Electrifying Roads: Part Two

In the February 2018 issue of *The Dispatcher*, in the article *Hot Roads: An Electrifying Experience*, I wrote about ways to deliver electricity to a vehicle, either from overhead cables or from an in-road charging system. *Scania*, a brand in VW's Traton Group, has been at the forefront of testing electrified roads while, in parallel, investing in vehicle electrification. Belt and suspenders (braces).



One of the road electrification methods involves overhead electric wires and a *pantograph* fitted to the top of the tractor. This is what has been used with electric trains, trolleys and trolley buses for decades. The main difference with Scania's design is that there is a battery on-board which is being charged when the pantograph is in contact with the electric wires at the same time as energy from the wires is being delivered directly to the truck's electric motors.



Claes Erixon, Scania's Executive Vice-President of Research and Development, says the company sees electric roads as one of several promising technologies that can make long-haul transport a sustainable future. "*Vehicle electrification is developing quickly and with its environmental, social and cost benefits, it will play an important role in the shift to a fossil-free transport system*," he says.

Someone has to build those overhead electricity supply wires, and it is not likely to be truck companies. In Sweden, the government is taking this issue very seriously. In October 2020, it gave *Trafikverket* (Swedish Transport Administration) the assignment to plan for the construction of electrified roads along the most highly trafficked roads in Sweden. The goal of this is that this new infrastructure should be economically self-supporting and contribute to the reduction of greenhouse gases by 50% compared to the 2018 levels. It is expected that Trafikverket would report on and describe a plan based on the assumption that 2,000 kilometers of the busiest roads on the country's road network would be electrified by 2030, and a further 1,000 kilometers would be added at the latest by 2035. Finally, the report should include a description of how a lower and higher level of ambition would affect goal fulfillment. The government gave Trafikverket until the 1st of February 2021 to complete the report. In a country where similar types of assignments to public authorities drag out over several years, three months to perform this study indicates either the urgency which the politicians have assigned to it, or their lack of seriousness. I choose to believe that it is the former and not the latter.

Right on schedule, on the 1st of February 2021, *Trafikverket* published its report: *Government Assignment – Analyze conditions and plan for an expansion of electric roads*. The result is most probably not what the politicians expected or wanted to read:

"The results from the analysis show that the freight transport by road that is judged to have the greatest benefit from an electric road concept is the so-called long-distance traffic with major energy needs in combination with not having to stop to recharge. The rapid development of batteries has contributed to the vehicle fleet that was previously forecast to use an electric road being judged to be significantly smaller compared with just a few years ago. The assessment is that the proportion of heavy traffic that is expected to use the electric road has gone from between 60-80% to a maximum of 25% by 2040 with an expanded electric road system."

Those responsible for the report recommend that the government slows down. "There is a risk that we invest in a technique that is not market-sustainable," says Magnus Lindgren, senior expert at *Trafikverket*.[8] Whether this recommendation will be taken by the politicians or ignored as much as they have ignored recommendations by the same agency on high-speed rail remains to be seen.

8. https://www.di.se/nyheter/trafikverket-avvakta-med-att-bygga-elvagar-risk-att-man-satsar-pa-fel-teknik/

New UNECE Regulation for Automated Lane Keeping

UN Regulation No. 157 Adopted

ON THE 22ND of January 2021, the ***Uniform provisions concerning the approval of vehicles with regard to Automated Lane Keeping Systems (ALKS)*** came into force as an annex to the *1958 Geneva Agreement*.[9] The Regulation was adopted in June 2020, and at the time of adoption there were fifty-four contracting parties (countries) that had agreed to incorporate ALKS into their local traffic rules.

The stated intention of the Regulation is to establish a set of uniform requirements that can be used for determining through a pre-approval (known as 'type approval') process if an Automated Lane Keeping System should be allowed on the road. UNECE's WORLD FORUM FOR HARMONIZATION OF VEHICLE REGULATIONS (WP.29) views this as a significant milestone because it is the first binding international regulation for automated driving systems as defined in ECE/TRANS/WP.29/1140,[10] that is, those systems that move beyond Advanced Driver Assistance Systems (ADAS).

What is an Automated Lane Keeping System? The UK CENTRE FOR CONNECTED & AUTONOMOUS VEHICLES (CCAV) offers the following definition: "A system for low-speed application which is activated by the driver and which keeps the vehicle within its lane for a travelling speed of 60 kilometers per hour or less by controlling the lateral and longitudinal movements of the vehicle for extended periods of time without the need for driver input."[11] *UN R157* goes further, stating in its definition that ALKS "can be activated under certain conditions on roads where pedestrians and cyclists are prohibited and which, by design, are equipped with a physical separation that divides the traffic moving in opposite directions and prevent traffic from cutting across the path of the vehicle." The Regulation also specifies 60 kph as the operational speed limit.

What the Regulation states

The Regulation defines the requirements which, if met, provide the basis for a vehicle manufacturer to be granted

9. *Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts*, done at Geneva on 20 March 1958 (original version);

Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, done at Geneva on 5 October 1995 (Revision 2)

Agreement concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations, done at Geneva on 14 September 2017 (Revision 3) - https://unece.org/DAM/trans/doc/2019/wp29/ECE-TRANS-WP29-2019-34-rev.1e.pdf

10. *Reference document with definitions of Automated Driving under WP.29 and the General Principles for developing a UN Regulation on automated vehicles*. (23 April 2018)

11. https://www.motoringresearch.com/advice/what-automated-lane-keeping-system-alks/

type approval of its ALKS. The Regulation also describes the accompanying documents that must be submitted along with the application for approval. In addition, the manufacturer must provide a design document that shows how the ALKS is linked to other vehicle systems or by which it directly controls output variables.

There are five categories of requirements, all of which must be met:

- System Safety and Fail-safe Response
- Human Machine Interface/Operator Information
- Object and Event Detection and Response
- Data Storage System for Automated Driving
- Cybersecurity and Software Updates

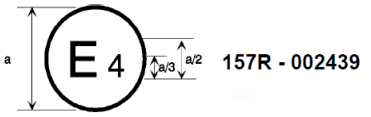
System Safety and Fail-safe Response

When the ALKS is activated, it must perform the driving task instead of the driver. That means it should manage all situations, including failures, and it must not endanger the safety of the vehicle occupants or any road users. Above all, it must comply with all traffic rules. It is the manufacturer's responsibility to take measures to guard against "reasonably foreseeable misuse" by the driver and tampering of the sytem. Most importantly, it must be possible for the driver to take back control of the vehicle at any time.

Human Machine Interface/Operator Information

The HMI should be designed with the purpose of preventing misunderstandings or misuse by the driver. Most importantly, the system must have a driver availability recognition systems. This system must be able to detect if the driver is present in the driving position, if the seat belt is fastened and if the driver is available to take over the driving task. If the driver is not in the driver's seat for more than one second or if the seatbelt is unbuckled, a so-called 'transmission demand' is activated. A transmission demand is "a logical and intuitive procedure to transfer the Dynamic Driving Task (DDT) from the system (automated control) to the human driver (manual control)". To put this in simple terms, TESLA's AutoPilot system would not pass muster.

The Regulation specifically requires that on-board displays used by the driver for other activities than driving when ALK is activated shall be automatically suspended as soon as the system issues a transition demand.



The approval mark should be affixed to a vehicle in a conspicuous place. This mark states that the vehicle has been approved for ALKS in the Netherlands (E4) pursuant to UN Regulation No. 157 under approval No 002439. The approval number indicates that the approval was granted in accordance with the requirements of UN Regulation No. 157 in its original form.

Object and Event Detection and Response

This section specifies that the ALKS vehicle must be equipped with a 'sensing system' that can, at a minimum, determine the road geometry ahead, lane markings and the 'traffic dynamics'. Traffic dynamics include:

- Across the full width of its own traffic lane, the full width of the traffic lanes immediately to its left and to its right, up to the limit of the forward detection range;
- Along the full length of the vehicle and up to the limit of the lateral detection range.

A key component of Object and Event Detection and Response is the strategies employed by the manufacturer of the ALKS to detect and compensate for environmental conditions that reduce the detection range. For example, it could ensure that under certain environment conditions the ALKS cannot be enabled, or the speed at which it is operational is reduced and the system disabled if the lower speed is exceeded.

Data Storage System for Automated Driving (DSSAD)

ALKS-equipped vehicles must have a DSSAD that records an entry for each of the following occurrences:

- Activation of the system;
- Deactivation of the system (e.g. override on the steering wheel);
- Transition Demand by the system (e.g. planned, unplanned etc.);
- Reduction or suppression of driver input;
- Emergency Manoeuvre;
- Involved in a detected collision;
- Minimum Risk Manoeuvre engagement by the system;
- Failures.

DSSAD data shall be available "subject to requirements of national and regional law."

Cybersecurity and Software Updates

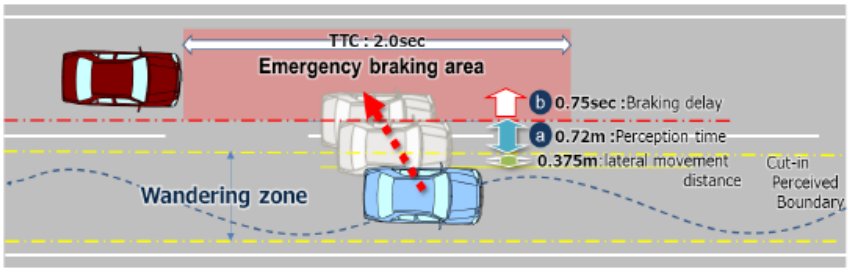
The Regulation refers specifically to the two recently passed UN Regulations, 155 and 156:

"The effectiveness of the system shall not be adversely affected by cyber-attacks, cyber threats and vulnerabilities. The effectiveness of the security measures shall be demonstrated by compliance with UN Regulation No. 155. If the system permits software

updates, the effectiveness of the software update procedures and processes shall be demonstrated by compliance with UN Regulation No. 156."

You need to read all sixty-four pages—no skimming

The first one-third of the document is comprised of a detailed description of the Regulation. The other two-thirds include five annexes, the longest one, Annex 4, is thirty pages. This annex describes the special requirements to be applied to the safety aspects of electronic control systems and their audit. Within this Annex is Appendix 3 that provides detailed guidance on *traffic critical scenarios* under which ALKS shall avoid a collision. Traffic critical scenarios of ALKS are divided into preventable and unpreventable scenarios. The threshold for preventable/unpreventable is based on the simulated performance of a skilled and attentive human driver. It is expected that some of the "unpreventable" scenarios by human standards may actually be preventable by the ALKS system. This section is worth reading just on its own.



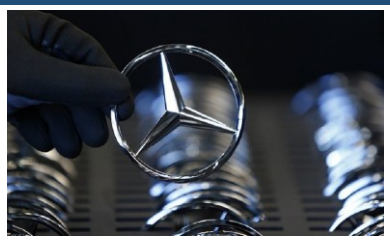
Here is one of the diagrams in Annex 4, Appendix 3 illustrating a driver model for a cut-in scenario.

Annex 5 provides test scenarios to assess the performance of the system. There are clearly-defined tests for lane keeping, avoiding a collision with a road user or an object blocking the lane, following a lead vehicle, lane change of another vehicle into the lane of the ALKS-vehicle, avoiding a stationary object after a lane change of the lead vehicle and field of view test. Imagine if vehicles on the road today being sold with promises that their systems were capable of automated lane keeping actually had to pass these tests before they could be operated.[12] Imagine if the authorities that allowed these vehicles to operate were held accountable for not having regulations such as UN Regulation No.157 in place.

Chuckle if you will, but this was one of the most pleasurable business-related reading experiences I have had. Not only does it cover its intended subject perfectly, but it is well structured and professionally written. It is timely and essential, and must be implemented everywhere with urgency. Congratulations to the team that developed it and the organization behind it.

12. https://www.roadandtrack.com/news/a35878363/teslas-full-self-driving-beta-is-just-laughably-bad-and-potentially-dangerous/

Musings of a Dispatcher: The Book of Mercedes



This article is about the journey Daimler AG has taken and where it is now going. It is questioning whether it will build motorcars or electric skateboard covers with Chinese partners. It has entered and is now gradually exiting mobility services. It has led ADAS and navigation developments, and is now trying to lead electrification. Now its management is proposing to Daimler's board that it be allowed to split itself in two.

IN THE BEGINNING, Gottlieb Daimler and Karl Benz created their respective motorcars. At the time, Earth was an inhospitable place for these new inventions. Horses and steam trains ruled. Herr Benz founded BENZ & CIE in 1883, and Herr Daimler with Wilhelm Maybach founded DAIMLER MOTOREN GESELLSCHAFT in 1890. Gradually, roads were built. The pneumatic tire made car travel more comfortable. Men were trained to maintain the cars. Oil companies provided the fuel and the places to fill the cars' tanks with it. By the time the two companies merged to form DAIMLER-BENZ AKTIENGESELLSCHAFT in 1926, horses were on the way to being replaced by motor cars and DAIMLER-BENZ was on its way to becoming the motor car company that has been in business longer than any other.

Not long after DAIMLER-BENZ was established, during the Great Depression, it adapted to the economic situation by building a smaller car, the Mercedes-Benz 170, that cost 4,400 Reich marks, a quarter of the price of the company's next lowest-priced model. During World War II it also adapted, shifting its production to military vehicles. Near the end of the war, almost half of its labor force was comprised of prisoners of war. After the War, along with many of Germany's major companies, it admitted its complicity with the Nazi regime and worked to pay retribution to the former forced laborers. It rebuilt and, since then it has endured. Over the years, the company acquired other companies, invested in various ventures and even made itself part of an unsuccessful merger with CHRYSLER CORPORATION. But it feels like there is a sense of tiredness among the old guard. It is about to divide itself into two companies, one that makes cars and another that makes trucks and buses. *Quo vadis, Daimler?*

But first, it's time for full disclosure

To start with, I once owned a *MERCEDES-BENZ* automobile. It was a 1964 190. My first father-in-law (I have had two) sold us his car for $1 after I returned with his daughter to the U.S. following one year of living and working in London. The move to London had been intended to be permanent, like the marriage, so gratitude was reflected in the asking price. The colors of the car were symbolic. It

was white, like an albatross, and its red leather interior epitomized the money bleeding from our pockets to keep it running. I shared ownership for only a year. Although its memory has faded, I do remember thinking at the time we were lucky it was not a diesel. They were stinkpots back then.

Second, I worked as an advisor to DAIMLER's long-term research group around the turn of the Millennium. It was a short and limited assignment. There was a report on the importance of China as a market versus a source of inexpensive labor, and participation in a workshop on navigation and driver assistance. Third, during a period of two-and-a-half years when I was responsible for the European business for a U.S.-based telematics services company, I spent a great deal of time in Sindelfingen, Böblingen and Stuttgart where DAIMLER has its headquarters and production facilities. I learned to know and appreciate the way decisions are made and executed in this company where its history and traditions are always present. On one occasion, when I reported with obvious pride that I had spent the afternoon following our meetings the day before at the Mercedes-Benz Museum, the manager of the group replied: "You'll have to go back this afternoon to see what you missed."

An aerial view of the Mercedes-Benz-Werk in Sindelfingen, Germany Sindelfingen, Germany

They say that breaking up is hard to do

The first breakup was the one DAIMLER-BENZ made with CHRYSLER CORPORATION. That was in 2007. In 1998, DAIMLER-BENZ had paid $40 billion for CHRYSLER. When it decided that CHRYSLER was no longer worth keeping, it sold 80.1% of its shares to CERBERUS CAPITAL MANAGEMENT, a private equity firm, for just $6 billion. It took its new name, DAIMLER AG. The Benz family members were not amused by the slight they felt when their name was wiped off the slate. They lobbied at a shareholder meeting to keep 'Benz' in the name. They managed to rescue it in the name of the car division: Mercedes-Benz.

On February 3rd 2021, the second breakup was announced by Ola Källenius, the Swede who took over the job from Dieter Zetsche May 22nd 2019. Källenius is the first non-German to hold the position of CEO at Daimler/Daimler-Benz. Källenius had been with DAIMLER-BENZ/DAIMLERCHRYSLER/DAIMLER since 1993, having joined as a management trainee. He's worked his way up the ladder and was appointed to the management board in 2015 where he was responsible for research and development of Mercedes-Benz cars. His educational background is finance, accounting and management. He is not an engineer.

Ola Källenius, CEO of Daimler AG making a point

This breakup will be a big one, assuming that it is approved at a shareholder meeting during the third quarter of 2021. The proposal that has been made by the board is for DAIMLER AG to be divided into two independent companies. One would be MERCEDES-BENZ Car Company. The other would be DAIMLER TRUCKS comprised of trucks, buses and other transportation solutions and services.

The spin being put on this breakup sounds familiar. I experienced it first-hand in 1998 when AB VOLVO was making the case for selling off VOLVO CARS. It was Leif Johansson who was the Chief Execution Officer for VOLVO at the time. His plan was to sell off the profitable but small car division in order to use the cash to make VOLVO the biggest producer of commercial vehicles. He talked at the time about how the development paths for cars and trucks were so very different, that the synergies of having them both in one company were minimal. He sold the car division to FORD for $6.45 billion. Today, AB VOLVO is the second largest manufacturer of heavy trucks, after DAIMLER, but it has hardly become the dominant player that Johansson had envisioned. VOLVO CARS languished under FORD and fetched only $1.8 billion eleven years later when it was sold to GEELY. Since then it has fared better, rising in sales from a quarter of a million when it was sold to over 700,000 in 2020.

Be careful what you wish for, Ola

Källenius has also talked about the differences today between cars and trucks in his explanations of why he wants to split up DAIMLER. He sees the two companies taking different paths toward electrification, with cars being focused much more on battery development while trucks need to develop other alternatives, such as hydrogen fuel cells.

"Given this context, we believe they will be able to operate most effectively as independent entities, equipped with strong net liquidity and free from the constraints of a conglomerate structure," said Källenius.[13]

Manfred Bischoff, chairman of DAIMLER's Supervisory Board, backs up Källenius's claim. He says that the split-up will give each company more independence to pursue their different markets and also make them *"more attractive for investors, and keep pace with a rapidly evolving business landscape"*.

If 'more attractive' means 'cheaper', then the separate companies will, of course, have a wider range of possible investors from

13. https://www.industryweek.com/leadership/growth-strategies/article/21154286/daimler-to-split-mercedesbenz-from-truck-business

which to choose. However, different investors have different objectives. Investment money today is coming principally from China, and, as we have seen, their money arrives with a lot of strings. VOLVO CARS had a relatively long honeymoon with GEELY, but it almost saw itself subsumed into GEELY AUTO with its headquarters moved to China. POLESTAR started life as a trademark then a brand then a wholly-owned subsidiary of VOLVO CARS. But GEELY now owns 50% of it and all POLESTAR manufacturing is in China.

DAIMLER's car division is already deeply involved with Chinese companies, including GEELY in its SMART joint venture. GEELY has a 9.7% capital share in DAIMLER AG. Where will those shares be placed when the split occurs?

DAIMLER AG is currently the second largest company in Germany measured by annual revenue. VW is first. BMW is fourth. Three of the top four companies in Germany make cars and trucks and buses. Allianz is big because it sells car insurance. Through its wholly-owned subsidiary, TRATON GROUP, VW owns SCANIA (Swedish) and MAN (German), both of which are big in buses as well as trucks. A divided DAIMLER will still be big, but not in VW's or possibly even BMW's league.

Largest German Companies	Revenue (€ billion)
Volkswagen	233
Daimler AG	166
Allianz	107
BMW	97
Siemens	83
Robert Bosch	78
Uniper	77
Deutsch Telekom	75

What is odd is that while DAIMLER believes it will gain greater economic traction for its car and truck/bus divisions by separating them from one another, the company its car division is lusting to emulate, TESLA, is readying its DAIMLER truck-beater for an introduction (see sidebar).[14] TESLA is doing everything DAIMLER-BENZ, VW, GM, FORD, VOLVO, RENAULT and FIAT did to get big: make all types of vehicles and cross-fertilize the different products with innovation obtained from multiple industries.

14. Tesla's big-rig was introduced in 2017, and production was going to start in 2019. Tesla is getting bigger by thinking bigger. It was Chicago architect, Daniel Burnham, who said: "Make no little plans; they have no magic to stir men's blood and probably themselves will not be realized." This was the creed that Gottlieb Daimler and Karl Benz lived by. What would they think of plans to make the company they created smaller?

I suppose it made sense for DAIMLER to call in a foreigner to do the dirty work of breaking up one of Germany's iconic companies. The board can take credit for the decision to appoint Källenius if all goes well, and they can blame him for destroying what the two founders and all those German engineers had created if it doesn't. If the VOLVO breakup is an example of how the people of Germany will feel about DAIMLER's management if one or the other of the two resulting companies winds up in the hands of a foreign entity that sucks out all of the know-how that had been built up over a century and uses it to enrich the fortunes of another country, those responsible for it will not be remembered fondly.

About Michael L. Sena

Michael Sena, through his writing, speaking and client work, attempts to bring clarity to an often opaque world of vehicle telematics. He has not just studied the technologies and analyzed the services, he has developed and implemented them. He has shaped visions and followed through to delivering them. What drives him—why he does what he does—is his desire to move the industry forward: to see accident statistics fall because of safety improvements related to advanced driver assistance systems; to see congestion on all roads reduced because of better traffic information and improved route selection; to see global emissions from transport eliminated because of designing the most fuel efficient vehicles.

This newsletter touches on the principal themes of the industry, highlighting what, how and why developments are occurring so that you can develop your own strategies for the future.

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