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THE JUNE 2024 ISSUE IN BRIEF

IF YOU HAD \$300 billion to invest, where would you put it? Reflect on that question for a moment. Would you dedicate it to manufacturing technology, like tools to make graphic processors that run faster and more energy efficiently, or producing steel with no carbon dioxide emissions? Would you earmark it for mitigating the effects of too much CO₂ in the atmosphere? Would you devote it all to finding cures for cancer and Alzheimer's disease? Would you wish to invest your money in order to receive the highest financial return, or would you prefer to be a philanthropist and help others with donations to good causes? I chose the sum of \$300 billion because that is the amount of money which has been estimated to be the amount invested so far in developing a solution for driverless mobility, and, so far, those who have invested for a financial return have seen little to show for their outlays. At the 6th annual *PRINCETON SMARTDRIVINGCARS SUMMIT* held during the last two days in May, we discussed why the lack of a clear purpose for driverless vehicles has prevented profits from materializing for investors, and how an alternative, more philanthropical approach, could both deliver a financial return to investors and significant social and economic benefits to society. Reciprocal altruism has gotten us humans pretty far along in our evolutionary journey, and we need to keep that in mind in all of our endeavors.

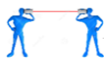
At this time next year, there should be a real MOVES pilot project in a real community, not just a simulation. That is the goal. If there is a 7th *PRINCETON SMARTDRIVINGCARS SUMMIT*, it should be a celebration of the achievement of that goal, but the real purpose of having a gathering is for participants to roll up their sleeves and discuss problems that have been identified during the previous year and ways to make improvements. There will be other venues to talk about driverless freight applications, driverless vehicle standards development, safety, and insurance, and we should do all we can to support developments in all areas. However, if the mission of *SMARTDRIVINGCARS* – at least as I understood it – is to be fulfilled, it is with delivering rides to the large number of people who need a ride but who cannot afford one.

Feature: Standardization and Regulation

Feature Articles



The real case for driverless mobility



Vehicle-related telecommunications



Automotive artificial intelligence



The business of delivering transport systems



People and transport – the effects of how and where we live, work, and recreate on our requirements for transport



Standardization and regulation of transport systems

Making Automated Driving Systems Roadworthy

STEADY PROGRESS IS being achieved by industry and regulators on making automated driving systems (ADS) roadworthy. I am referring to driver aids, not driver replacements. Some ADS functions, like automated lane keeping, allow hands-free driving when specified operational design domain conditions are met, but most ADS functions perform their duties in the background while the driver drives. Unfortunately, what has been receiving the attention of the media, and therefore the public, is the failure of driverless replacement systems from GM CRUISE, ALPHABET WAYMO, and TESLA. It is time for the automotive industry to retake the automated driving systems narrative and communicate its progress and priorities to both consumers and regulators.

My intention for this article is to assist in establishing the content of the narrative, and will address four areas:

1. Status of *UN Regulation No. 157: Uniform provisions concerning the approval of vehicles regarding Automated Lane Keeping Systems (ALKS)* and its most recent updates.
2. Liability implications of ALKS and other automated driving systems.
3. Testing and evaluation of automated driving systems outside the regulation framework, such as with the *New Car Assessment Program (NCAP)* and the *INSURANCE INSTITUTE OF HIGHWAY SAFETY (IIHS)*.
4. Expectations for Automated Emergency Braking systems—which are already mandatory in the EU and have recently been mandated for the U.S. by NHTSA—may exceed the performance capabilities of current technology. What are the implications of the mismatch?

UN Regulation No. 157 update

This newsletter has provided extensive coverage of the process leading up to the establishment of *UN Regulation No. 157* and the requirements for meeting its provisions. I refer you to the April 2021 and May 2022 issues for background.¹ The following is a summary of *UN R157 Regulation for Automated Lane Keeping Systems*:²

ALKS controls the lateral and longitudinal movement of the vehicle for extended periods without further driver command. ALKS is a system whereby the activated system is in primary control of the vehicle.

This Regulation is the first regulatory step for an automated driving system (as defined in ECE/TRANS/WP.29/1140) in traffic and it therefore provides innovative provisions aimed at addressing the complexity related to the evaluation of the system safety. It contains administrative provisions suitable for type approval, technical requirements, audit and reporting provisions and testing provisions.

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. This Regulation includes general requirements regarding the system safety and the failsafe response.

When the ALKS is activated, it shall perform the driving task instead of the driver, i.e. manage all situations including failures, and shall not endanger the safety of the vehicle occupants or any other road users. There is, however, always the possibility for the driver to override the system, at any time. The Regulation also lays down requirements on how the driving task shall be safely handed over from the ALKS to the driver including the capability for the system to come to a stop in case the driver does not reply appropriately. Finally, the Regulation includes requirements on the Human-Machine Interface (HMI) to prevent misunderstanding or misuse by the driver. The Regulation for instance requires that on-board displays used by the driver for other activities than driving when the ALKS is activated, shall be automatically suspended as soon as the system issues a transition demand.

These measures are without prejudice to driver behaviour rules on how to use these systems in the Contracting Parties as currently being

¹ The-Dispatcher_April-2021.pdf (michaellsena.com);

The-Dispatcher_May_2022.pdf (michaellsena.com)

² <https://unece.org/sites/default/files/2022-05/ECE-TRANS-WP.29-2022-59r1e.pdf>

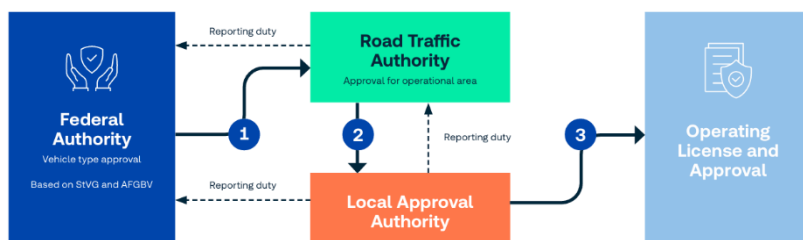
discussed by the Global Forum for Road Traffic Safety (WP.1) at the time of drafting the original version of this UN Regulation.

ALKS is not mandatory, but Type Approval for it is

In 2021, forty-two countries adopted the *UN R157 Regulation* and agreed to uniform type approval requirements. (Note that the U.S., Canada, China, do not follow the type approval process, but have their own requirements, some of which are based on UNECE promulgated regulations.) Manufacturers selling vehicles in those countries where type approval applies must comply with performance-based requirements for type approval, technical topics, audits, and documentation, as well as proving ground tests and real-world conditions.³ In addition to UN R157, the ALKS system must also be compliant with other UNECE regulations concerning cybersecurity (UN R155) and software updates (UN R156).

Unlike most type approval requirements, a vehicle does not require ALKS to obtain type approval. It is voluntary on the part of a vehicle manufacturer. However, if a vehicle manufacturer wishes to install ALKS on a new vehicle and intends to sell it in any of the countries that require UN-based type approval, it must comply with the *UN R157*, as well as with *UN R155* and *UN R156*.

What is important to understand – and given the questions I have received and what I have seen written in various news sources, it is not well understood – is that while type approval can be performed once for all countries where type approval applies, each country where cars with ALKS will be sold must provide the preconditions for the vehicle to perform according to the requirements.



For example, Germany drafted a law that "clarifies that the operation of motor vehicles using highly and fully automated driving functions is permitted within the scope of the

³ <https://www.tuvsud.com/en/industries/mobility-and-automotive/automotive-and-oem/autonomous-driving/compliance-with-new-automated-lane-keeping-system-regulation>

intended use".⁴ (See sidebar) It states that the automated driving function should only be used to control the vehicle if the vehicle driver observes specially regulated obligations to immediately resume vehicle control. Each country is going to have to decide if its current laws provide the preconditions for ALKS, or whether it needs to do what Germany has done and modify its laws.

There is also a need to ensure that systems have proper information about speed limits and road types. Initially, ALKS was approved for a maximum speed of 60 km/h, and operational only on roads where pedestrians are prohibited and which, by design, are equipped with a physical separation that divides the traffic moving in opposite directions.

What about countries which do not comply with UNECE regulations, like the U.S.? The U.S. NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION (NHTSA), which is responsible for developing and enforcing the *Federal Motor Vehicle Safety Standards (FMVSS)*, has not incorporated the requirements as defined in *UN R157* into its FMVSS. In 2020, NHTSA proposed a Framework for Automated Driving System Safety, which would have integrated ADS requirements into FMVSS. This has not yet been acted upon. That means there are no federal requirements regulating the performance of ALKS or any other automated driving systems. NHTSA has left it up to each state to either enable or, through inaction, allow cars to be driven without the human driver being in control of the vehicle and completely attentive at all times. I will return to this in the section on liability.

NHTSA has not completely abrogated its responsibility for overseeing the potential safety hazards of vehicles equipped with ADS. It has recommended that companies putting ADS-equipped systems in their vehicles publish a *Voluntary Safety Self-Assessment (VSSA)*⁵ with a "holistic view on AV safety" with twelve different safety-related areas. It recommends that companies follow *Cybersecurity Best Practices for the Safety of Modern Vehicles*⁶ that refers to industry standard

⁴ The Dispatcher May 2022 (page 5).

⁵ <https://www.nhtsa.gov/document/automated-driving-systems-20-voluntary-guidance>

⁶ <https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-09/cybersecurity-best-practices-safety-modern-vehicles-2022-tag.pdf>

German Road Traffic Act and AFGBV

In July 2021, the German Road Traffic Act (StVG) was adopted and updated. Several sections for highly automated driving functions were added to §1. It described the series approval of highly automated vehicles, the possibility of approving highly automated test vehicles, the use in specified operating areas, and subsequently activatable driving functions. However, the StVG must be implemented by specific ordinances.

Following the adoption of the StVG, with regard to highly automated driving functions, work began on the associated ordinance. However, this was not final until June 2022. The "Autonomous Vehicles Approval and Operation Ordinance" (AFGBV) thus came into force on July 01, 2022.

The AFGBV regulates the approval and operation of highly automated vehicles in operating areas requiring approval in Germany. It creates a legal basis for the approval of highly automated vehicles according to SAE Level 4.

Source: file:///C:/Users/Default.LAPTOP-4PUR6QNQ/Documents/Newsletter%20-%20The%20Dispatcher/Monthly%20Issues/2024/June_2024/twvsud-automated-driving-legal-status.pdf

ISO/SAE 21434.⁷ It requires that companies follow the *Standing General Order on Crash Reporting*. Finally, according to *Title 49 of the Code of Federal Regulations (CFR) Part 555 – Temporary Exemption from Motor Vehicle Safety and Bumper Standards*,⁸ NHTSA may grant exemptions from mandatory standards for up to 2,500 vehicle sales per year per manufacturer. This exemption cap affects the sale and deployment of automated vehicles that do not have a driver's seat with a steering wheel.

Extension of UN R157 began immediately

Two proposals were submitted by Germany for modifying and extending the requirements of *UN R157* even before the initial requirement was passed. These were to increase the maximum speed from 60 km/h to 130 km/h, and to permit a lane changing function. These proposals were intended to be independent of each other so that one or the other could pass, or both could be accepted.

Amendments to *UN R157* were reviewed, adopted, and came into force as of January 2023. Key features of the UNECE regulations for ALKS and its 01 series of amendments are:

- *ALKS regulation is applicable for all vehicles with ALKS of class M and N and allows now a maximum effective speed up to 130km/h (before the amendment in January 2023, the regulation was limited to M1 class vehicles and a maximum speed of 60 km/h).*⁹
- *It also enables lane changes through the Automated Lane Keeping System (ALKS) and the possibility for use of vehicle combinations.*
- *The ALKS can control the lateral and longitudinal movements of the vehicle on highway-like roads.*
- *Drivers no longer need to keep their hands on the steering wheel or otherwise prove attentiveness (although numerous*

⁷ This specifies engineering requirements for cybersecurity risk management regarding concept, product development, production, operation, maintenance and decommissioning of electrical and electronic (E/E) systems in road vehicles, including their components and interfaces.

⁸ https://www.nhtsa.gov/sites/nhtsa.gov/files/2023-04/Second-Amended-SGO-2021-01_2023-04-05_2.pdf

⁹ Category M – Power-driven vehicles having at least four wheels and used for the carriage of passengers; Category N – Power-driven vehicles having at least four wheels and used for the carriage of goods.

provisions in the regulation refer to the monitoring of driver behaviour).

- *Drivers should be able to take back control within a defined period of time if prompted to do so by the lane keeping system.*

According to the UNECE in its 22 June 2022 press statement, the amendment stipulates the obligation for the automated driving system to comply with local traffic rules. It also includes provisions to ensure smooth driving and to limit traffic congestion. The Data Storage System for Automated Driving (DSSAD), a kind of “black box” that is required to be part of the ALKS and which records, among other information, when the automated driving system is activated, will be required to also record lane changes initiated by the system.

As of January 2023, ALKS type approval requirements have been updated to reflect *01 Amendments*. If the vehicle manufacturer has prepared ALKS to enable the functionality allowed in the *01 Amendments* through software updates (i.e., it is not necessary to install sub-systems that need to be component type approved) and comply with *UN R155* and *UN R156*, then vehicles that were type approved before January 2023 should be upgradeable to the *01 Amendments* without further type approvals.

Liability implications of ADS

Who pays the fines and who pays for the damages when the human driver is not driving? These are the most crucial questions that need to be answered before ADS can truly start to become mass market functions. As it turns out, the former is more difficult to address, and there is not going to be a global policy framework for either of them.

It was two years ago that I contacted MERCEDES-BENZ to request a clarification of their statements about assuming legal responsibility for their ALKS system when it was activated. Alexandros Mitropoulos, Spokesperson *Autonomous Driving, Technology Communications* for MERCEDES-BENZ AG replied. At the time, vehicles with the ALKS system enabled would only be sold in Germany where changes were made to its laws to allow for driverless, hands-off functionality. In summary, Mitropoulos said that "MERCEDES-BENZ assumes full product liability for the safe performance of its ALKS in Germany. It can only be activated on selected roads in

Germany, the 13,191 km (8,100 miles) of *Autobahn* highways, and the liability laws of Germany apply. If the ALKS fails when it is activated, M-B's product liability insurance applies. M-B is NOT taking out personal liability insurance or any other insurance product to cover personal injury or property damage. It is using the 'existing, traditional liability regime' for accidents if they occur while ALKS is active."

I explained in the May '22 issue what Germany had to do to allow ALKS by any manufacturer to be activated. Other countries in Europe, such as Austria, have adapted their laws to allow testing of ADS. The UK appears to be the next country in Europe to attempt to adapt its laws so that consumer products like the M-B Drive Pilot (i.e., not test systems) can be sold to consumers. An Automated Vehicles Bill was submitted to the House of Lords following the King's first speech in November 2023. It passed the House of Lords in February and has been making its way through the House of Commons. As of the 24th of April, it is in the Reporting Stage. The bill is intended to "regulate the use of automated vehicles on roads and in other public places, and to make other provision in relation to vehicle automation".¹⁰ In summary, the Bill says that "while the vehicle is driving itself, a company rather than an individual will be responsible for the way it drives".

The sticking point in Europe seems to be traffic violations: Who pays when the car is driving and it breaks a traffic law? There is no point in claiming that it will not happen because it will, especially now that the maximum speed has been increased to 130 km/h. There could be a construction zone with a lower speed limit that the vehicle's sensor systems miss, or a temporary no passing zone that neither the on-board nor off-board systems has noted. Is the car company really going to pay these fines, and how will the entire process work to ensure that the fines are paid on time?

When it comes to tort law, the U.S. is at the top of the heap

In the U.S., lawyers specializing in tort cases have been licking their chops in expectation of ADS finally reaching consumers, and both car companies' legal counsels and regulators have been wringing their hands over how to prevent

¹⁰ [230190.pdf \(parliament.uk\)](#)

what seems to be an inevitable flood of lawsuits over who bears responsibility for any wrongdoing. And then there are the law professors who are pointing the way for the tort lawyers – who really would not know where to start to look for the juiciest cases without clear direction. Bryant Walker Smith of the University of South Carolina¹¹ and William Widen of the University of Miami¹² are two law professors that have been most often sought out by journalists looking for provender for us technology grazers. Pete Bigelow, a journalist for *AUTOMOTIVE NEWS* got them both for his gloomy article on the prospects for M-B's *Drive Pilot* making it out of the corral and into the American plains.¹³

MERCEDES-BENZ with its *Drive Pilot* is the canary in the coal mine because it is currently the only system that is designed for hands-free operation according to UN R157. Other systems, like TESLA's *FSD*, specifically state that drivers must keep their hands on the wheel. M-B is intending (or already has started) to sell *Drive Pilot* in the two states where it has been authorized to do so, California and Nevada. In its English language manual for the U.S., it states the following:

- *Stay alert: observe notes and messages, take control of the vehicle when requested to do so.*
- *Take control of the vehicle if irregularities are detected on the vehicle or in the traffic situation.*
- *Drive Pilot does not release you from public use obligations. The legal requirements for the country you are driving in always apply.*

M-B is saying the same thing about using *Drive Pilot* in the U.S. as it has said about using it in Europe, which is the existing laws and regulations are sufficient to determine their liability for crashes and incidents that may occur when the systems is engaged. However, Smith and Widen question this assumption. They claim that new rules and laws are needed to make it crystal clear whether motorists or automakers will be held accountable for every possible violation, from speeding to a crash, when the system is in *Drive Pilot* mode.



¹¹ Q&A with Bryant Walker Smith, USC Associate Law Professor – College of Engineering and Computing | University of South Carolina

¹² Highly Automated Vehicles & Discrimination Against Low-Income Persons by William H. Widen :: SSRN

¹³ Bigelow, Pete. *AUTOMOTIVE NEWS*. Mercedes-Benz addresses Level 3 legalities; lawyers say uncertainty lingers. (June 29, 2023).

"In a lot of states, the human person has the overall authority," said Smith. "But in others that expressly state the vehicle is driving, then legally that ticket may go to the company." He went further: "If a vehicle with *Drive Pilot* engaged strikes and kills a pedestrian, the human motorist using the system as directed would not have the legal culpability to be charged with a crime. At the same time, it is not clear MERCEDES-BENZ would be charged with manslaughter either."

Smith and Widen say that MERCEDES-BENZ has not stated whether a driver may engage in activities like reading or watching TV while the car is in *Drive Pilot* mode. M-B told the *AUTOMOTIVE NEWS* article's author that it would provide "a more detailed tech update that clarifies those ambiguities when the *Drive Pilot* launch is closer. Widen is not reassured by this position. "Without legal clarity, then the whole line about relaxing and taking your time back is nothing but air," he said. "Motorists should not expect the company's assurances to either supersede state laws or exonerate them with courts," Widen said. "They (motorists) should wait to use such automated driving systems until laws clarify their role in the driving process. The law is simply not clear on these points, and it should be clear."

If Tesla can do it, why can't we?

Every time a TESLA driver has an accident when the car is in FSD mode, TESLA simply claims that it is the driver's fault. "Look at the manual," it says. "The driver has to be in total control." M-B's manual says the car will drive itself, but the driver must be aware of all conditions that could call for the driver taking back driving responsibility. There is a huge difference between these two conditions, and it does not favor MERCEDES-BENZ.

Non-regulatory testing of ADS

In March of this year, the INSURANCE INSTITUTE FOR HIGHWAY SAFETY (IIHS) issued a report titled *Safeguards for Partial Driving Automation Test Protocol and Rating Guidelines – Version 1 (March 2024)*.¹⁴

¹⁴ https://www.iihs.org/media/d01ff4e0-50ba-4199-8e0f-c1ef8c3b18e1/q1-Ovw/Ratings/Protocols/current/automation_safeguards_test_and_rating_protocol_V1.pdf

IIHS is an independent, nonprofit scientific and educational organization dedicated to reducing deaths, injuries, and property damage from motor vehicle crashes through research and evaluation and through education of consumers, policymakers, and safety professionals. It was founded in 1959 by three major insurance associations representing 80% of the U.S. auto insurance market. At first, the Institute's purpose was to support highway safety efforts by others. A decade later, IIHS was reinvented as an independent research organization. William Haddon Jr., M.D., who served as the nation's first federal highway safety chief, oversaw this transition after becoming president of IIHS in 1969. By then, he already was leading the transformation of the highway safety field from one focused solely on crash prevention to one using a modern, scientific approach to identify a full range of options for reducing crash losses. (Source: IIHS)

The protocol and guidelines describe the test and rating procedures used for the IIHS Safeguards for partial driving automation vehicle ratings program. According to IIHS, this program evaluates the user safeguards that vehicles with partial driving automation systems employ to help drivers use the technology appropriately. *"The systems eligible for testing are those that can simultaneously support control of the vehicle's longitudinal motion with adaptive cruise control (ACC) and control of its lateral motion with sustained lane centering under highway driving conditions."* IIHS further clarifies this by saying the tested systems are not advanced driver assistance systems (ADAS), and not automated driving systems like ALKS. IIHS defines ADAS, such as automatic emergency braking, blind spot detection, and lane departure prevention systems, as safety features, explained Joe Young, a spokesperson for IIHS in an interview with *THE VERGE*.¹⁵ *"Partial automated systems use sensors and cameras to relieve drivers of some of the responsibility of operating the vehicle. They include features like adaptive cruise control, lane-keeping assistance, and automated lane changing. Some even allow drivers to remove their hands from the steering wheel under certain conditions."*

The Test Protocol states that the systems it will assess are SAE International 2021 Level 2 systems.¹⁶ I have made it clear that I do not like these classifications and do not use

¹⁵ <https://www.theverge.com/2024/3/12/24098394/iihs-partial-automated-test-rank-ford-gm-tesla>

¹⁶ <https://www.sae.org/blog/sae-j3016-update>

them. However, if anyone does use them, and bases their work on the definitions stated in the SAE documents, which is what IIHS says it is doing, then the definitions should be meticulously followed. With Level 2, there needs to be a licensed driver behind the wheel giving the driving task his or her full attention. The vehicle has semi-automated systems for steering, speed control, and braking, and the driver may be able to remove his or her hands from the steering wheel, but a monitoring system ensures that the driver is paying attention to the driving task and disables the system if the driver's eyes are not focused on the road ahead.

IIHS is in the business of testing and rating the performance of vehicles according to tests it devises itself. It is not in the business of using requirements and testing procedures established by others, such as NHTSA's *U.S. Federal Motor Vehicle Safety Standards* or UNECE Regulations.¹⁷ There are no references to either one of these organizations in the *Safeguards for Partial Driving Automation Test Protocol and Rating Guidelines*. There are also no references to another testing and rating organization, the NEW CAR ASSESSMENT PROGRAMS (NCAP), or to competitors, AAA or *CONSUMER REPORTS*.¹⁸ References listed in the Guidelines include the *SAE International Taxonomy* and its own research.

IIHS declares that industry has work to do

On the 12th of March, IIHS released the results of tests it made on a selected group of fourteen vehicles using its *Guidelines*. According to results of the tests, out of the fourteen tested, only one (Lexus Teammate with Advanced Drive in the 2022-24 *Lexus LS*) earned an 'acceptable' rating, two were rated 'marginal', and eleven were rated 'poor'. Full results can be found in the IIHS document listed.¹⁹ Weighting principles for the rating of each of the IIHS

¹⁷ An early president of IIHS, Dr. William Haddon, Jr., was the first Administrator of the National Highway Safety Bureau, which became NHTSA. He resigned from HHSB in 1969 and shortly after became President of IIHS where he remained until his death in 1985. As administrator of the NHTSA, Dr. Haddon was responsible for setting the first *Federal Motor Vehicle Safety Standards*.

¹⁸ <https://www.consumerreports.org/cars/car-safety/the-car-safety-features-you-want-right-now-a3127130097/>

¹⁹ <https://www.iihs.org/ratings/partial-automation-safeguards>

requirements are shown in the table below taken from the Guidelines.



In the introduction to its rating results, IIHS says the following: "*Partial driving automation is a convenience feature that is meant to make long drives easier. There is no evidence that it makes driving safer, and, in fact, it can create new risks by making it easier for the driver's attention to wander. For this reason, it is essential that all partial driving automation systems incorporate robust safeguards.*"

If it is indeed true that these systems create new risks for drivers, then why in the name of sanity do regulators allow them to be added to vehicles that will be sold to the public? If it is not true, if the tests are flawed, or if the results are incorrectly interpreted, then how could IIHS continue to operate? Why aren't the regulators shutting them down, or why are car companies, who are having their reputations besmirched, not suing them for liable?

Consumers are in the middle. On the one hand, they are being bombarded with information from organizations like IIHS, NCAP, *CONSUMER REPORTS*, and every Tom, Dick, and Harry with a blog purporting to be an expert on car safety. On the other hand, there are cars for sale that have been judged to be roadworthy by government regulators. Car companies must comply with the type approval requirements, or the equivalents like *FMVSS*, in order to sell their cars. They do not have to pass NCAP, IIHS, or *CONSUMER REPORTS* tests, which are mostly more stringent than the official regulations and cover areas that are not included in the regulations.

I believe we can all agree that all cars, regardless of price or place of origin, should not endanger the lives of those who drive them, those who are passengers in them, or those who occupy space in the vicinity of these vehicles, like pedestrians and cyclists. The simple fact that we have so many experts, both officially designated and self-proclaimed, who

WEIGHTING PRINCIPLES FOR OVERALL RATINGS

Table 1
Weighting principles for partial automation safeguards

	Good	Acceptable	Marginal	Poor
Driver monitoring	0	5	15	30
Attention reminders	0	5	15	30
Emergency escalation and countermeasures	0	5	15	30
Automated lane change	0	n/a	n/a	5
ACC auto-resume	0	1	3	5
Cooperative steering	0	3	6	10
Safety features	0	10	30	50
Total score	0-9	10-29	30-49	> 49

Note. n/a = not applicable.

are not in agreement on what constitutes safe-driving cars, is extremely problematic.

Automatic Emergency Braking systems mandated

Automated Emergency Braking (AEB) systems are an important ADS function. The EU made them mandatory within the EUROPEAN UNION for new type-approved models from May 2022, and for all new vehicles as of May 2024. The U.S. NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION (NHTSA) announced in April 2024 that AEB is being added to the *Federal Motor Vehicle Safety Standards* as FMVSS No. 127, and will be required on all vehicles, including passenger cars and trucks, by 2029.²⁰ I will discuss questions about how AEB currently functions and what improvements are needed to make it completely roadworthy.

As of mid-2022, the EU made Automated Emergency Braking, Emergency Lane Keeping Assist, Drowsiness and Distraction Recognition, and Intelligent Speed Assistance mandatory for all newly manufactured vehicle models (Regulation (EU) 2019/2144). As it is specified for type approval, the AEB system begins with Forward Collision Avoidance, with flashing lights, buzzing alarm, and a shaking steering wheel to encourage the driver to brake. At the same time, it pre-charges the braking system to respond quickly if the driver does not act, or act strongly enough. Then, it brakes.

The EU regulation is based on UNECE UN Regulation No 131 and UN R152: *Uniform provisions concerning the approval of motor vehicles with regard to the Advanced Emergency Braking Systems (AEBS)*. The scope of this Regulation is to "avoid or mitigate the severity of a rear-end in lane collision with a preceding vehicle and avoid or mitigate the severity of an impact with a pedestrian.

In the U.S., on the 29th of April 2024, NHTSA finalized a new *Federal Motor Vehicle Safety Standard, FMVSS No. 127*,²¹ that will make automatic emergency braking standard on all passenger cars and light trucks by September 2029. According

²⁰ FMVSS are developed and enforced by the National Highway Traffic Safety Administration (NHTSA) pursuant to statutory authorization in the form of the National Traffic and Motor Vehicle Safety Act of 1966, which is now codified at 49 U.S.C. ch. 301

²¹ https://www.nhtsa.gov/sites/nhtsa.gov/files/2024-04/final-rule-automatic-emergency-braking-systems-light-vehicles_web-version.pdf

to *NHTSA*'s statement, "The new standard requires all cars be able to come to a full stop and avoid contact with a vehicle in front of them up to 62 miles per hour (100 kilometers per hour) and that the systems must detect pedestrians in both daylight and darkness. In addition, the standard requires that the system apply the brakes automatically up to 90 mph when a collision with a lead vehicle is imminent, and up to 45 mph when a pedestrian is detected." So, up to 62 mph, the car must stop to avoid hitting a car or pedestrian, and it must function in both daylight and darkness, and it must apply the brakes when driving over 62 mph and up to 90 mph in order to try to avoid hitting cars, but it is not required to come to a complete stop. Why it does not state automatic braking must be activated for cars driving over 62 mph, rather than up to 90 mph, is not explained.

NHTSA and the EU both state that the purpose of AEB is to reduce the number of deaths and injuries that result from crashes in which drivers do not apply the brakes (because of inattentiveness or permanently or temporarily impaired driving capabilities) or fail to apply sufficient braking power to avoid or mitigate a crash, and to reduce the consequences of such crashes. According to *NHTSA*, in 2019, prior to the COVID-19 pandemic, there were nearly 2.2 million rear-end police-reported crashes involving light vehicles, which led to 1,798 deaths and 574,000 injuries. In addition, there were 6,272 pedestrian fatalities in motor vehicle crashes, representing 17% of all motor vehicle fatalities. In 2022 the number of pedestrian deaths rose to 7,522 and 17.7% of all fatalities. A further 76,000 pedestrians were injured in motor vehicle crashes. AEB will definitely reduce rear-end collisions and the resulting deaths and injuries. What is not so clear is whether it will reduce the number of pedestrian deaths, which are significantly higher than with rear-end collisions.

AAA's Greg Brannon, Director of Automotive Engineering, is doubtful. "You can't ignore the fact the majority of deaths happen at night, and the current systems don't work at night." The new Regulation states that the system must detect a person crossing a road, walking alongside a road, and being in stationary positions. Brannon said that his group's tests found that AEB systems with pedestrian detection performed inconsistently overall and were "completely ineffective" at night. They failed to brake for pedestrians at any

point during four separate nighttime tests. Why is that the case? If you are relying only on cameras, as many of the current systems are, they cannot see in the dark, said Brannon. Using infrared cameras and pairing cameras with radar and lidar would allow the systems to work in many poor-to-zero visibility situations.²²

The EU has set a low bar for performance but judged that it is better to mandate AEB for all cars, rather than leaving it to car companies to fit their high-end models and ignoring the rest. *NHTSA* has set a higher bar with a five-year period for implementation. *NHTSA* should make it clear that no fudges will be allowed and ensure that the systems which are installed meet the requirements, especially if they are going to allow cars to be driven with inattentive drivers.

Conclusions and recommendations

On the positive side of the ledger, ongoing standardization work at UNECE is proceeding according to the plans established by WP.1 Global Forum for Road Traffic Safety. *UN Regulations 155, 156, and 157* have established a good, strong foundation for future standards efforts, with vehicle-to-vehicle communication for merging into motorways next in line. Linkage between the UN Regulations and type approval processes allows for a smooth integration of requirements, testing methods for ensuring compliance, and regular follow-on inspections in those countries that follow the type approval process.

Concerning liability of ALKS and future automated driving systems, referencing a country's laws to the UN Regulations, as is the case in countries which follow the type approval process, provides much better tracking for liability purposes than what exists in the non-type approval countries, especially the U.S. Even though there could be a comparison made between having to establish enabling country legislation in the EU and providing a legal basis for operating in each U.S. State, there is a single, fixed set of requirements provided by *UN R157* for type approval countries, but no *FMVSS* requirements for ADS for the U.S. This is why TESLA's so-called FSD is not allowed in the EU, because it does not meet the *UN 157* requirements. Unless *NHTSA* writes an

²² <https://newsroom.aaa.com/2019/10/aaa-warns-pedestrian-detection-systems-dont-work-when-needed-most/>

agreed set of requirements into FMVSS (ideally, taking UN R157 directly), it will be a patchwork of 50 sets of requirements in the U.S., one for each State.

Non-governmental organization testing and rating of vehicle systems is problematical. Each organization creates its own guidelines and testing protocols without reference to official requirements and promotes its rankings to consumers. Automobile manufacturers must meet the type approval or equivalent requirements (e.g., FMVSS), but must also decide whether they will attempt to meet one or more of the NGOs' requirements as well. A uniform set of requirements, ideally applied globally, would provide the best assurance to car buyers that their cars are as safe as they can be.

As it turns out, I seem to be preaching to the choir with regard to NHTSA. In its introduction to its AEB Regulation, it acknowledges the limitations of NCAP, which it created, and states clearly that it is FMVSS which should take priority. It states:

"Voluntary measures are intended to supplement rather than substitute for the FMVSSs, which remain NHTSA's core method of ensuring that all motor vehicles can achieve an adequate level of safety performance. The NCAP program is designed to provide valuable safety-related information to consumers in a simple to understand way, but the agency believes that gaps in market penetration will continue to exist for the most highly effective AEB systems. NHTSA has also observed that, in the case of both electronic stability control and rear visibility, only approximately 70 percent of vehicles had these technologies during the time they were part of NCAP. Thus, while NCAP serves a vital safety purpose, only regulation can ensure that all vehicles are equipped with AEB that meet minimum performance requirements."

Establish the requirements for companies to put their products into the hands of consumers, evaluate them thoroughly before they are sold using uncorruptible testing agents, and then make regular checks to ensure there have been no changes to the systems after they have been put on the roads. Instead of having multiple organizations such as NCAP, AAA, or IIHS, performing tests and publishing results, deliver the results of the official tests to whoever wants to package them and distribute them to interested parties. The

structure for this is already in place, as the diagram from The Real Case for Driverless Mobility shows.

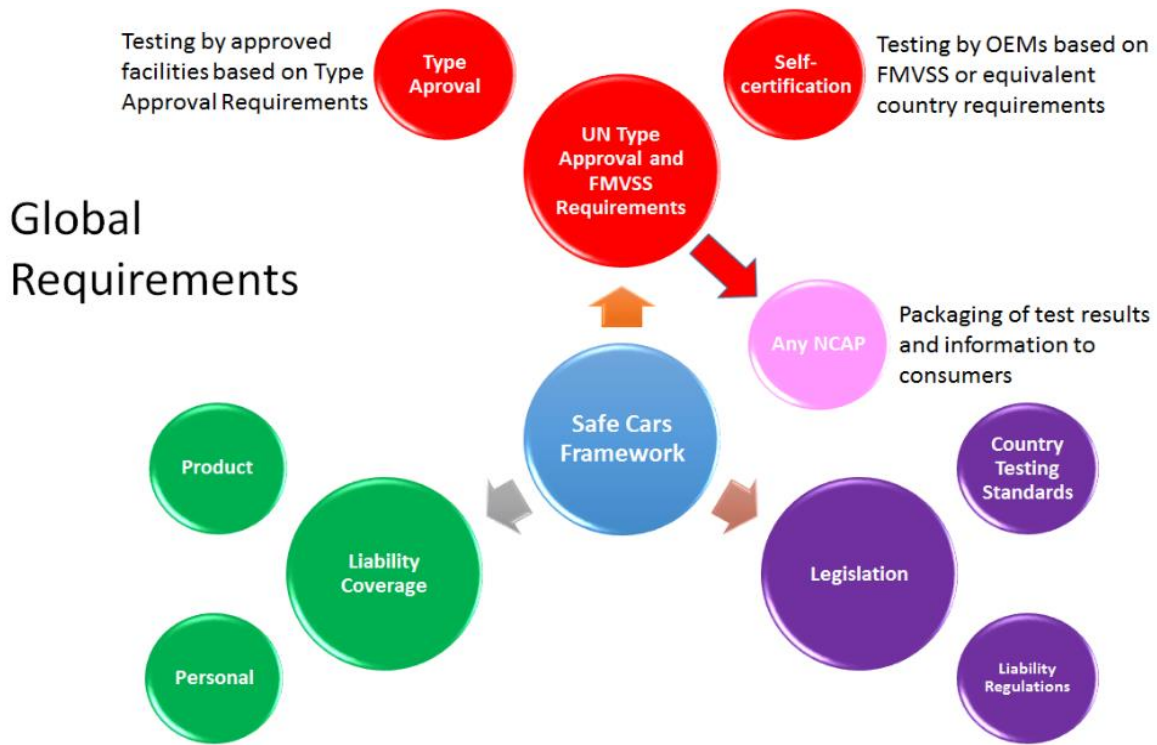


FIG. 9.5 A Global Vehicle Approval Process. An international framework for preparing requirements, passing legislation, and distributing liability for introducing improved safety systems in vehicles that can apply to both processes. (Diagram by Michael L. Sena.) in *The Real Case for Driverless Mobility*, Michael L. Sena and Alain L. Kornhauser. Elsevier (2024).




Dispatch Central



The topics covered in Dispatch Central are newsworthy, but I leave it to others to deliver them “as they break”. I give them a little time to settle in, and try to provide an analysis of their impact.

The 6th Princeton SmartDrivingCars Summit

AFTER THE 4TH PRINCETON SMARTDRIVINGCARS SUMMIT, which was held virtually due to COVID, Alain Kornhauser and I agreed co-author a book that would explain why driverless cars have an important place in the future of transportation. That was three years ago, and the book was published in January of this year. The chapters of the book provided the organizing structure for much of the 6TH SUMMIT held in the PRINCETON UNIVERSITY School of International Affairs on 30-31 May. The agenda for the two days is shown below.

6 th Princeton SmartDrivingCar Summit											
Wednesday, May 29			Thursday, May 30				Friday, May 31				
			Current State, Challenges & Future Outlook				Deployment (Just Dong It)				
			Welcome Morning Keynote & Plenary Presentations								
			Plenary Panels: Moderator + 3 panelists + 3 Discussants				Plenary Panels: Moderator + 3 panelists + 3 Discussants				
			Proof of Concept			Proof of Market		Proof of Policy			
			People Who Drive Themselves (ADAS)			People Who Drive Themselves (ADAS)					
			Lunch & Lunch Keynote								
			People Who Need a Ride (MOVES)			People Who Need a Ride (MOVES)					
			Non-People Who Need a Ride (Freight)			Non-People Who Need a Ride (Freight)					
VIP Network Reception (Alain's House)			Reception Banquet Banquet Keynote				Reception Gala Alain's 42nd 39th				

There were three major differences between this Summit and the previous five. First, most of the participants were invited and were expected to deliver a keynote, give a presentation on one of the three principal topics and three principal themes, and/or participate in a panel. The topics were People Who Drive Themselves; People Who Need a Ride; and Non-People (e.g., freight)

That Need a Ride. The themes were: Proof of Concept; Proof of Market; and Proof of Policy.

The second difference was that there were no separate workshops or break-out sessions. All the participants heard everything that everyone else heard. Active engagement and discussion was encouraged.

Thirdly, and most importantly, the 6TH SUMMIT had single focus, which was to discuss the immediate opportunities for implementing our recommended approach to delivering rides to the unserved and underserved members of communities, those who cannot afford to own or operate a car, those who are not able to afford taxis or who do not have friends or families who can provide rides, or who are not able to drive themselves. In past summits, participants presented their views on the current status of advanced driver systems and driverless technologies, and there was no carry-over from summit to summit. It felt like there was no progress being made on the goal of delivering affordable mobility to those who who need it. That was the principal reason that Alain and I decided to author our book, to make a compelling case for driverless mobility.

“The novelty of driverless vehicles is that there is no driver, and the only thing that should mean to the rider is that the cost of the trip is significantly lower. The vehicle itself should not be a novelty.”

Chapter 6: The Business Proposition of Affordable Mobility

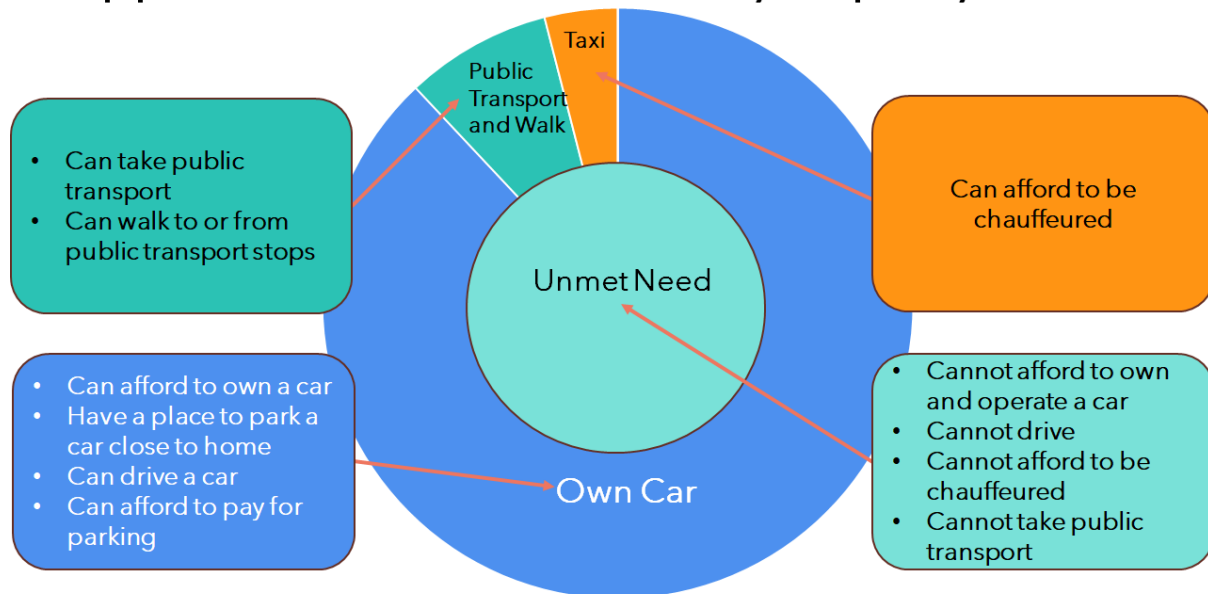
Meeting the unmet need for mobility

In the U.S., 89% of adults over 25, totaling 205 million people, have driver's licenses, but that does not mean they all drive. 79% of those over 75 who have drivers' licenses, representing 7% of the total population, drive once per year. 71% of 16-19-year-olds, which is 9% of the population, drive once per year. Either they do not own their own car, or the family car is used by another family member. Four percent of licensed drivers lose their license each year. That is 8 million drivers. Twenty-five percent of all U.S. adults over 25, which is 57 million people, have a disability that affects their ability to drive. And the big number of unserved or underserved are the 52% of households that have incomes lower than \$75,000 and cannot afford a car costing over over \$29,000.

The diagram below shows the approximate percent of daily trips that are made by people with their own car, by people taking public transport and walking, and by taxi or equivalent. The vast majority of trips are made by car, and many of them have no passengers.



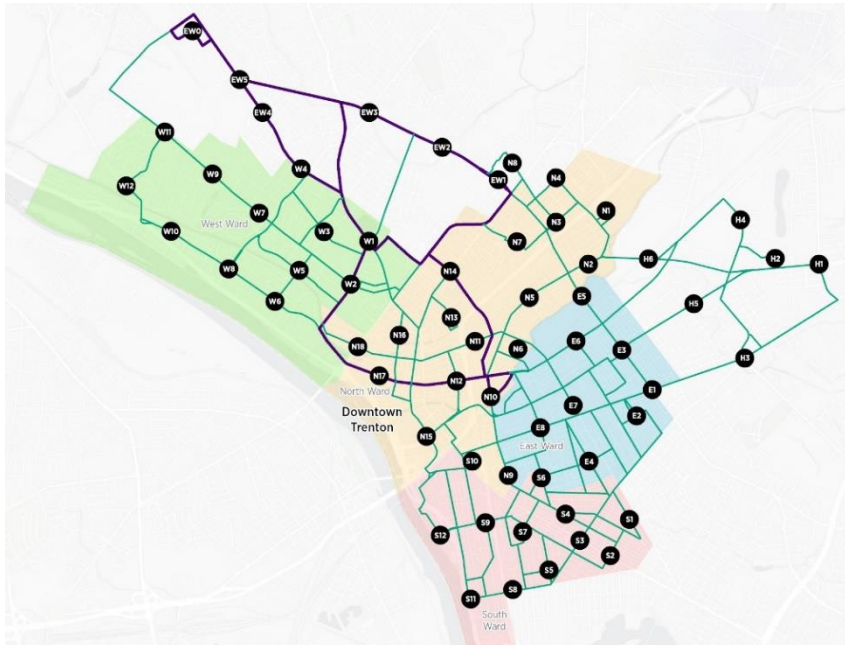
Approximate Percent of Daily Trips by Mode



The real case for driverless mobility is meeting the unmet needs of people who cannot afford to own and operate their own car, cannot drive, cannot afford to be chauffeured, and cannot take public transport, either because it does not exist or does not take them to where they need to go when they need to get there. It is not a replacement for the private car, the bus, a taxi, or people's own two feet. Perhaps, in time, sustaining improvements will make it attractive to those who are not underserved because it provides affordable and convenient rides, but we should not wait for a replacement to a private, self-driven car or a chauffeured taxi to use driverless technology within controlled operational design domains.

On the second day of the Summit, we showed a simulation of how driverless cars could be employed within a community to deliver point-to-point rides. Pick-up and drop-off points are positioned within a five-minute walk of all residences, and daily trips from each household are calculated based on census data. Simulated trips to work, school, shopping, recreation, and all other places are estimated based on

the demographics of the residences within the census district. A significant amount of time and effort has been put into developing the simulator over the years by Alain and his students, and they are all credited with special mention at the end or out book.



It's time for MOVES to get moving

At this time next year, there should be a real MOVES²³ pilot project in a real community, not just a simulation. That is the goal. If there is a 7TH SMARTDRIVINGCARS SUMMIT, it should be a celebration of the achievement of that goal, but the real purpose of having a gathering is for participants to roll up their sleeves and discuss problems that have been identified during the previous year and ways to make improvements. There will be other venues to talk about driverless freight applications, driverless vehicle standards development, safety, and insurance, and we should do all we can to support developments in all areas. However, if the mission of SmartDrivingCars – at least as I understood it – is to be fulfilled, it is with delivering rides to the large number of people who need a ride but who cannot afford one.



²³ MOVES: Mobility Opportunity – Vehicle Equity System

Musings of a Dispatcher: Shrinking or Growing

We need to learn to right-size our cities

On towns that have lost half their population: "They're like a man who has lost a hundred pounds and is still trying to wear his old clothes."

Alan Ehrenhalt, E.REPUBLIC

ARCHITECTS AND PLANNERS learn how to design for places that are growing, but not for places that are shrinking.²⁴ Yes, there has been increasing attention given to adaptive re-use and re-purposing of existing buildings, rather than removal and building of new facilities, but there is little point in adapting old buildings to new functions if there are no tenants with new functions who want to move in. A study by researchers at the University of Chicago concluded that over 40% of the nearly 30,000 U.S. cities are at risk of facing a 12-23% population decline by 2100, with more of the at-risk cities in the North and Midwest compared to the South and West.²⁵

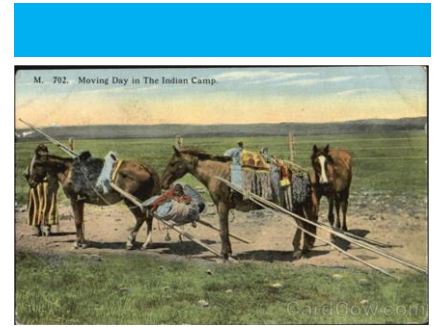
The real problem is that once a town or a city has built its basic infrastructure of roads, sidewalks, sewers and sewage treatment, garbage disposal, water distribution, electricity generation and supply, street lighting, and traffic signals, and has set in motion the regular operation and maintenance of this infrastructure, it is very difficult to downsize it so that it serves a population that may be one-half or less of its peak size. Ask the current mayors of Cleveland, St. Louis, or Detroit. In 1950, Detroit was the 5th largest city in the U.S. with a population of 1.9 million. In 2021, it was the 27th largest city with a population of 632,464, down fully 65.8%. Cleveland went from 914,808 to 367,991 (7th to 54th), and St. Louis from 856,796 to 293,310 (8th to 70th).

Hunter-gatherers picked up their tents and moved when the area where they were hunting and gathering

²⁴ I spent seven years in undergraduate and graduate school studying architecture and urban planning. When I left the full-time practice of architecture and urban planning five years after I completed my studies, I was a licensed registered architect.

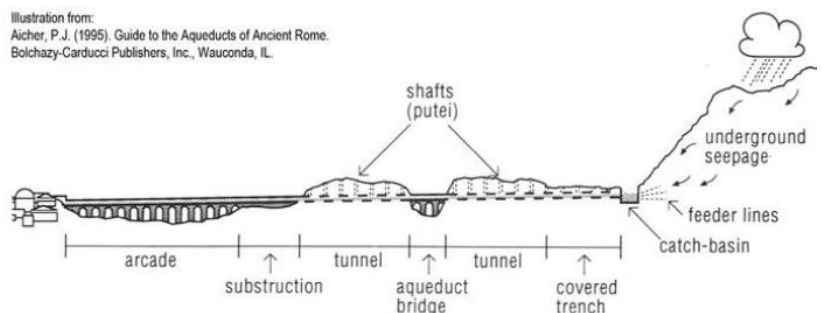
²⁵ Sutradhar, U, Spearing, L, and Derrible, S. *Depopulation and associated challenges for US cities by 2100. NATURE CITIES 1*; pp 51-61 (2024).

could no longer support them. Early farmers rounded up their animals and bags of seeds and moved to more fertile fields when their crops stopped growing. Our early ancestors were careful not to invest too much time and energy in structures and infrastructure they would have leave behind or which would weigh them down during their inevitable moves.



Once civilizations began investing in infrastructure, whether it was utilitarian, ornamental, or symbolic beginning around 12,000 years ago, moving became more difficult or unthinkable. Cities were founded when improvements in transportation and agriculture made food surpluses possible, and their founders did everything they could to make their settlements grow. And they grew. Unless a city was sacked and all its the inhabitants slaughtered or carried away to serve as slaves; unless it was swallowed by an earthquake, washed away by a flood, smothered by a volcanic eruption, or visited by a plague; unless the road or waterway carrying trade that was the reason for its existence changed its path; unless the natural resource it provided played out; unless it no longer offered opportunities for its young, who left for greener fields, and those remaining simply died out; or unless the leaders decided to move to a new location while their cities were at their peak and they had the resources to do it, the cities carried on, and many of them, like Damascus, Jerusalem, Athens, and Rome, are still with us.

I was thinking that societies²⁶ which decided to build an aqueduct must have had a strong belief in their future. Among the great engineering accomplishments of early civilizations defining permanence and invincibility, aqueducts were the tour de force. When we think of aqueducts, we think first of Rome. However, it was the Assyrians who built the



²⁶ Merriam-Webster provides two definitions that apply:
a: an enduring and cooperating social group whose members have developed organized patterns of relationships through interaction with one another
b: a community, nation, or broad grouping of people having common traditions, institutions, and collective activities and interest

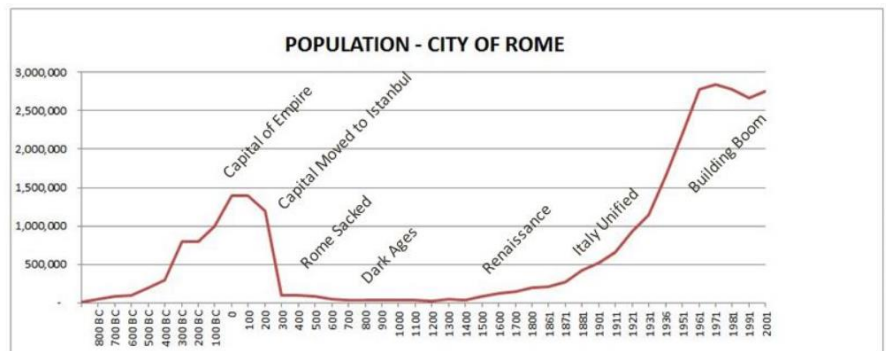
first aqueduct four hundred years before Censor Appius Claudius Caecus built Rome's Aqua Appia. Nineveh was the capital and largest city of the Neo-Assyrian Empire located on the eastern bank of the Tigris River on the site of today's Mosul in Iraq. It was founded around 6000 B.C. and was the largest city in the world for fifty years, before it was sacked in 612 B.C. by Babylonians, Persians, and other tribes. It was the Assyrians under King Sennacherib I who built the first large-scale aqueduct between 703 and 690 B.C., an 80-kilometer feat of engineering called the Jerwan Aqueduct. Its main purpose was to provide water for the city's hanging gardens which some archeologists claim were the real Hanging Gardens that had nothing to do with Babylon. Nineveh was mostly abandoned by the 13th century A.D.

Nevertheless, it was the Romans who set the precedent of investing in infrastructure, both in their capital of Rome and across their entire empire, to allow for the expansion of their cities which they were building to last forever. Aqueducts were perhaps their biggest investment. They built eleven just for the city of Rome, but constructed hundreds around the empire, like the majestic Pont du Gard in southern France. They also built water distribution systems, sewage systems, public baths and latrines, irrigation systems, fountains, huge arenas, housing, monumental buildings, and, of course, their famous roads that are still in use to this day. What the Romans built, they built to last forever. In the case of the city of Rome, the first phase of forever turned out to be around a thousand years, from its founding in 753 B.C. to its fall in 476 A.D. It was Odoacer, the first Germanic king of Rome who deposed Romulus Augustulus, Rome's last emperor. The Roman Empire continued for another thousand years after the city of Rome's fall with its center in another great city, Constantinople, to where Emperor Constantine had moved the Empire's center of gravity by building a new capital in 330 A.D., which today is called Istanbul.

The city of Rome's population collapsed after its sacking and did not recover to its former peak until fifty years after the reunification of the city with the rest of Italy in 1870, the so-



The Pont du Gard Aqueduct built in the first century AD to carry water over 50 km near the town of Vers-Pont-du-Gard in southern France.



called *Risorgimento*. The Pope controlled Rome for most of the time after its collapse up to the time that the last piece of the reunification puzzle was completed and the Pope's meager army was conquered by the forces of the King of Savoy. Rome once again became the capital of what was then the Kingdom of Italy, and it began to grow again. For over 1400 years, the city tottered on the edge of extinction with a population of no more than 20,000 inhabitants. At times, it was completely depopulated. Its irrelevance was its saving grace because its structures were not totally plundered for building materials.

Shrinking or disappearing cities wasn't always a problem

For most of the time that humans have been evolving, the fate of cities was not an existential problem for the vast majority of people. Until the 18th century A.D., the large majority of people lived outside the confines of cities. Cities were inhabited by the ruling classes and those who were there to serve them. In 1801, around 20% of the population of the United Kingdom lived in towns or cities of 10,000 or more, and London, which had a population of one million, comprised 10% of the total. Fifty years later, urban dwellers were 40% of the population, and by 1901, it was 75%. In the United States, 15% lived in cities in 1850. By 1900, it was 40%, and by 1920, it was over 50%.

Industrialization not only encouraged the gathering of more and more people into urban agglomerations, but industrialization's inventions also made cities even more permanent and expensive to build and maintain than those built in the past. Steel frames and reinforced concrete are more difficult to disassemble and reuse than brick and stone structures.

Cities don't shrink; that's the problem

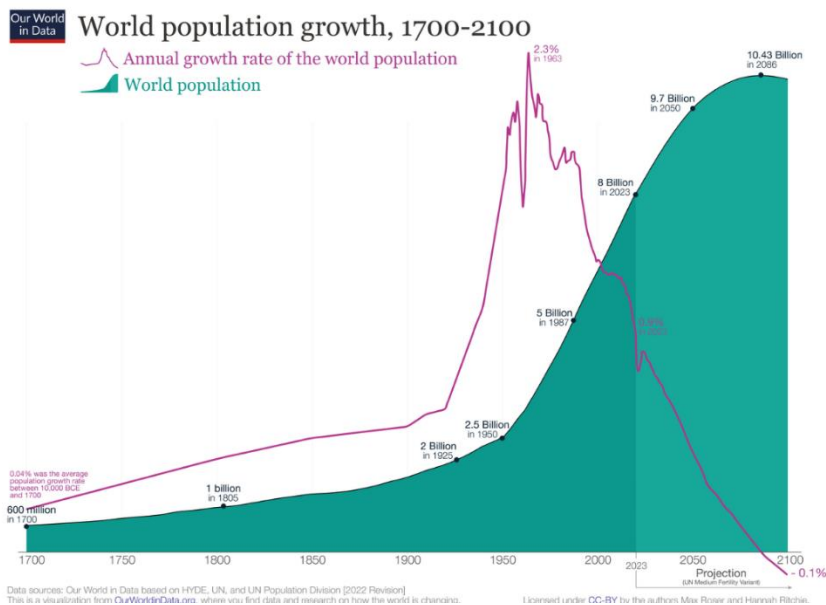
Urbanization seemed to be the inevitable condition toward which the inhabitants of Planet Earth were striving. Between 1950 and 2014, the number of workers in cities grew globally from 800 million to 3.85 billion. A UN report in 2018 estimated that 54% of the world's population lived in urban areas, and that this would rise to over 75% by 2050. Then, COVID-19 arrived on the scene, and one of its effects has been the acceleration of the turning of the trend from urbanization to de-urbanization.



Rome: Ruins of the Forum, Looking towards the Capitol in 1742 by Canaletto

Other de-urbanization factors were already at work when COVID arrived, including: a) a drop in the fertility rates; b) the disappearance of many types of manufacturing and mining jobs as a result of automation; and c) resource depletion and technological changes.

As the chart below based on United Nations data clearly shows, the rate of global population growth peaked at 2.3% around 1963. When the fertility rate drops below 2.1%, the total population begins to decline because the number of births is lower than the number of deaths. Since 1963, except for a few years of rises, the growth rate has been in constant decline. South Korea's fertility rate dropped to 0.78 in 2022, and Japan's is 1.26. (Japan's population dropped from 126.5 million in 2018 to 123.3 million in 2023 and is projected to drop to 88 million by 2065.) In 2020, the OECD average birth rate was 1.58. As the rate of population growth declines, absolute growth slows down. By 2100, the growth rate is projected to be minus 0.1%, and with the global population just over 10 billion, total population growth is projected to start turning negative.



We know the causes, but only beginning to understand the effects. Cities and countries have tried to reverse their population-shrinking trends. Hungary and South Korea offer bonuses for babies; Youngstown, Ohio and many other de-industrialized cities offer steep tax abatements for new business to locate in their jurisdictions; Boston has reinvented itself numerous times since it was settled in 1630 by English Puritans.

Boston's latest reincarnation was from being the minicomputer capital of the world (think DIGITAL EQUIPMENT CORP., PRIME COMPUTER, and DATA GENERAL) to a biotechnology center. No one has figured how to put coal, iron, copper, gold, and silver back into the ground, but many former mining centers hope to find newly valuable minerals. Sometimes mitigation measures work, like those in Boston, but often, once the downward death spiral begins, it is difficult to reverse it into an upward growth direction.

The signs of a city with a shrinking population are easy to recognize, including abundant numbers of abandoned houses sit on overgrown properties; boarded up businesses outnumber those that remain open in what had been a central business district; industrial buildings lie derelict with weeds and trees taking over the parking lots; schools are closed or converted to elderly housing. What we don't see are the problems that fewer people cause for essential infrastructure that was built for the city's peak population. Christopher Berry, director of the *Mansueto Institute for Urban Innovation* at the UNIVERSITY OF CHICAGO, has found that as cities lose population, the cost of providing public services tends to stay about the same. "Virtually nowhere reduces the public sector in line with the population," he says.²⁷ He says further that it is unclear why this occurs in every instance, but the result is that the remaining taxpayers have to pay more to support the same level of services they had before the population declined.

An article by the WORLD ECONOMIC FORUM provides an example of why taking concrete steps to right-size infrastructure should be a priority, rather than just keeping things running as they did for the larger population. The example is Leipzig, Germany.²⁸ Leipzig was an important industrial and cultural center prior to World War II. It grew from 20,000 in 1810 to 700,000 by 1937. Following the war, it became part of East Germany and its cultural and economic activities were moved to Berlin. It was a heavy industry city when reunification occurred in 1990, with polluting and outdated technology and a population of 550,000. Following



²⁷ THE ECONOMIST APRIL 20TH 2024. Briefing *Shrinking America*.

²⁸ <https://www.weforum.org/agenda/2018/03/managing-shrinking-cities-in-an-expanding-world/>

reunification, many of its industries closed and it lost over 100,000 residents within ten years. The city's water distribution system was designed to provide 200 liters of clean water per person per day. By the end of the 1990s, usage was 92 liters as a result of both a reduction of over 250,000 users since its peak, and replacement of toilets and showers with more efficient ones. Lower demand meant more water staying in the pipes for longer periods, risking bacterial growth and microbial contamination. Lower water usage also meant lower wastewater generation, contributing to sedimentation in sewer pipes because of low flow velocities. This required using clean water to periodically flush the sewer system. The result was higher operation and maintenance costs, and higher long-term investment costs for restructuring the water system at the same time as consumption and revenue declined. I am certain that city managers in cities with shrinking populations who read this WEF report could have told the same story and added many of their own.

Not everyone can pick up stakes and move on

If cities lose population, there are two groups who remain: the founding families along with those who have a great deal of money and prestige invested in what they have created; and those who cannot afford to leave. When cities fail, the value of homes and other properties collapse, for the rich and poor alike. The rich may eventually decide to write off their losses, donate their estates to the city or local college, and build new mansions elsewhere. But for the poor, even if there was someone who wanted to buy their home, the buyers would not be prepared to pay a price that would repay the mortgage or provide enough to pay for a home in a growing city where there might be a job or pay for a place in a retirement community. Homeowners stop repairing their homes and put off paying their taxes, which must increase to cover the basic costs of the infrastructure.

Why ghost towns are not a good option

Someone who has lost 100 pounds can buy a new suit if he can afford it, or she can have the old clothes altered. As a last resort, the person who has lost the weight can simply wear baggy clothes. It is more difficult for cities to right-size. In the bad old days, we just let towns that lost their purpose simply wither, possibly all the way down to becoming a ghost town with zero residents. Today, that is neither



The deserted ghost town of Bodie, California; population: Zero © Zack Frank

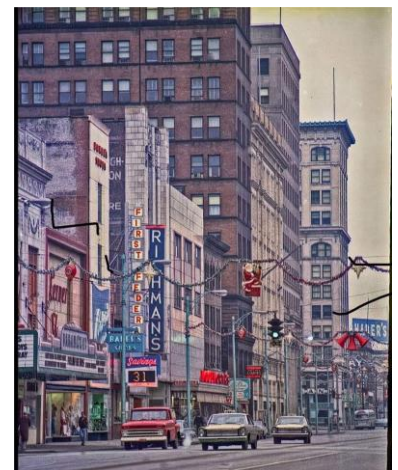
politically smart nor socially acceptable. While the populations are shrinking, the people who are left behind are still voting—at least in countries that are democracies. We are seeing what that means in U.S. and many countries in Europe with votes going to populists who blame the plight of the left-behinds on globalization and policies designed for the wealthy.

Cities need to be designed to shrink if they lose population

Ideally, it should be possible to shrink the size of a city's infrastructure by shortening the lengths and reducing the diameters of the water and sewage pipes, removing the unused portions of schools and offices, relocating the residences and other facilities that are at the periphery of the old urban area into the smaller circumference of the new urban area, and rolling up the streets and sidewalks that are no longer needed and selling them to places where they would be used. Sounds like an impossible dream. For existing cities, it is.

The best cities have been able to do is tear down abandoned homes, stores, offices, schools, and factories and reinvent themselves as smaller versions of their former selves. That is what Youngstown, Ohio has been doing, now with 60,000 residents, down from its 1950 peak of 170,000, and what Scranton, Pennsylvania has been doing after losing one-half of its top 143,000 population registered in the 1930 census. Scranton has had a small uptick in its population in recent years after finding a new purpose within an extended region as an educational and governmental center, but more importantly as a logistics hub with super-cheap land and labor to serve the New York and Philadelphia metropolitan areas, both only 120 miles away.

There are two keys to survival for cities that have lost significant numbers of their populations, and this was driven home for me by what I learned while searching the web for information about whether Scranton's founding family members were still living in the city. (They're not.) I came across a web site with entries from people who had moved to Scranton from larger cities, including New York and Philadelphia. Every one of them referred either to Scranton's closeness to nature or the significantly lower cost of buying a house, and getting much more for the amount paid, as a



Youngstown, Ohio at its peak. It looks just like downtown Scranton, PA in the '60s, before Scranton's downward spiral began.

reason for moving to the city. But many of them were surprised that the property taxes were comparable to what they had paid in the larger cities. So, the two keys to survival for the cities that have lost weight are to accentuate the positive and eliminate the negative, to borrow a phrase from an old Johnny Mercer song made famous by Bing Crosby and the Andrews Sisters, with the positive being something that is lacking in the bigger cities, like proximity to nature, including inside the city, and the negative being high taxes. It's not one or the other; it's both. Scranton's conversion of the former CENTRAL RAILROAD OF NEW JERSEY railroad bed running alongside the Lackawanna River into the *Lackawanna River Heritage Trail* is an excellent example of accentuating the positive.

In 1900, Scranton was bigger than Los Angeles

Cities like Atlanta, Georgia, Austin, Texas, and Phoenix, Arizona may believe they will grow forever, just like Rome did in its heydays, but there are no guarantees that they will not suffer the same fates as Detroit, St. Louis, Youngstown, or Scranton. It's not too late for the growers to change the way they are growing to prepare for de-urbanization if and when it comes. One thing growing cities should stop doing—immediately—and shrinking populations cities should not even consider, is building monuments which are just ego-boosters and eventually become white elephants. Cultural centers, sports arenas, conversions of steel mills and railroad yards into national parks and building in-city shopping malls all sound like great ideas, but they usually don't generate new tax revenues because of the giveaways necessary to attract them, and they don't create sufficient numbers of jobs to make them worthwhile.

While DARPA is encouraging bright, young engineers to invent ways of developing driverless vehicles, maybe it or another government agency could encourage research into how to build urban infrastructure that shrinks and grows with population. Instead of training starchitects who will design Gehryesque museums, why not prepare them to design structures that can be disassembled and moved when the need for them vanishes. Maybe some investors that are pouring money into the next great gadget could think about funding a think tank that would produce a better way of financing schools so there will be people who can invent those



The Lackawanna River was an open sewer until a group of concerned citizens, led by Mary Scranton, cleaned it up. It's now known as an excellent trout fishing stream. The unidentified fisherman in a photo provided by Flyfisherman.com, appears pleased with his catch, a brown trout. When I grew up along the banks of the river, you avoided falling into it at all cost.

gadgets. Real estate taxes as the primary source definitely do not work in cities and towns with dwindling numbers of taxpayers.



Here is my suggestion for how to help cities struggling to make ends meet. How about if all of us who grew up in places that are now financially strapped cities, but who never returned to those cities, funnel our college annual giving donations to our home cities instead of to our universities. My alma mater has an endowment worth around \$34.3 billion (March 2023), with an annual budget for 2023-24 expenses of \$2.9 billion to take care of 5,600 students. It had revenues of \$1.12 billion, including \$465 million in student fees collected. It provided over \$700 million in aid to students. The shortfall of \$1.78 billion is made up from a payout from the endowment and other investment income. Annual giving in 2023 brought in \$82 million, which does not come close to making up for the total extraction, but investments grow and the endowment is not shrinking. Why shouldn't the universities, like the cash-strapped cities, tailor their costs to their income?

Scranton has an annual budget of \$118 million to take care of 77,000 people. (No wonder it has so many potholes.) It never sent me a note asking for a donation. Scranton needs my money more than my university, and once I have established who should receive my donation, I intend to start a new annual giving program and encourage my friends who grew up in the city and have left to consider contributing to it. Think of it as paying real estate taxes in absentia.



About Michael L. Sena

Through my writing, speaking and client work, I have attempted to bring clarity to an often-opaque world of highly automated and connected vehicles. I have not just studied the technologies and analyzed the services. I have developed and implemented them and have worked to shape visions and followed through to delivering them. What drives me – why do what I do – is my 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. Most importantly, I put vehicles into their context. It's not just roads; it's communities, large and small. Vehicles are tools, and people use these tools to make their lives and the lives of their family members easier, more enjoyable, and safer. Businesses and services use these tools to deliver what people need. Transport is intertwined with the environment in which it operates, and the two must be developed in concert.



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