2020 AND BEYOND

What can we expect from the next 20 Years of Automotive Technology?

CONT ENTS

2000s – *The evolution of the Connected Car.*

2000
THE YEAR OF THE HYBRID
In July, Toyota released the Prius, now the top selling hybrid. GPS Sat Nav also became mainstream in our cars as we welcomed the new Millennium.

2001
INTRODUCTION OF HANDS-FREE BLUETOOTH

2002
REVERSING CAMERAS

2003
AUTOMATIC PARKING
Advanced Dual Clutch Transmissions (DCT) were also popularized in mainstream cars.

2008
ADVANCED TURBOCHARGING GOES MAINSTREAM.

2010s – *Saw another major shift in the evolution of the Connected Car. More Driver Assist Features were added. In-car WIFI and App Integration opened the door to in-vehicle services such as playing music, providing 3D navigation and streaming real-time traffic data.*

2010
HONDA FITTED FIRST DVD PLAYER IN THE HONDA ODYSSEY

2014
TESLA RELEASES AUTOPILOT FEATURE
In-vehicle Wi-Fi improved with the advent of 4G Hotspots. Apple entered the Automotive market with the release of CarPlay, enabling consumers of iOS devices to use these devices as a display and a controller within the car.

2015
KEYLESS ENTRY BECOMES MAINSTREAM
Android Auto released to compete with Apple CarPlay and offer consumers similar in-car services.
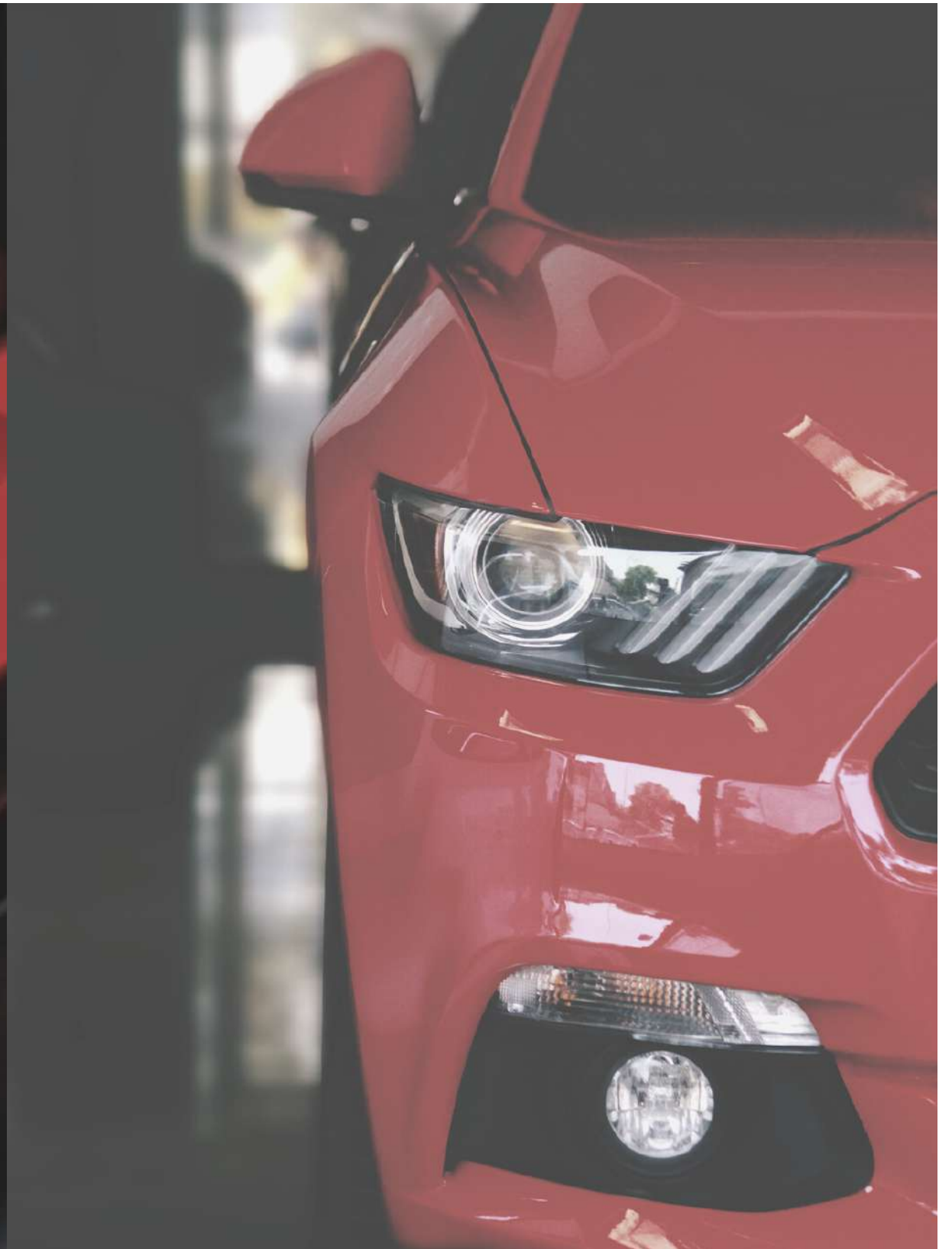
2017
AUDI LAUNCHES THE WORLD'S FIRST ERIES PRODUCTION L3 CONDITIONAL AUTOMATION SYSTEM

2018 WAYMO ONE LAUNCHES IN AZ, THE FIRST COMMERCIAL SELF-DRIVING SERVICE IN THE US

2019
TESLA'S CYBERTRUCK ARRIVED
Harley-Davidson's ground-breaking LiveWire all-electric motorcycle went on sale. Ford releases electric-SUV version of the Mustang.

2000-2019

WHAT IS THE STANDOUT PIECE OF AUTOMOTIVE TECHNOLOGY FROM THE PAST 20 YEARS IN YOUR OPINION, AND WHY?

The Automotive Technology industry is in a state of motion. Never has the industry been on the verge of such impactful change. With new technology emerging daily, we are getting closer to the **Connected, Autonomous, Shared** and **Electric** era of mobility.

To kick off TU-Automotive Detroit's 20th birthday celebrations, we asked our partners what the standout piece of automotive technology was from the last 20 years and what technology will have the biggest impact in the next 20.

Paul Myles, *Editor-In-Chief*, **TU-Automotive**

"CONNECTIVITY HAS BEEN, AND WILL CONTINUE TO BE, THE GREATEST CHANGE TO THE AUTOMOBILE SINCE THE INTERNAL COMBUSTION ENGINE BECAME THE POWERTRAIN OF CHOICE MORE THAN 140 YEARS AGO.

That's because it not only opens the door to a myriad of potential services for helping automakers and service providers to engage with consumers at an individual level, it will be a key component in securing robust and reliable autonomous driving capabilities in years to come."

Jan Walker, **5G Americas**

"I would say the integration of computers in vehicles which has led to so many different applications. The most important tech that has come out of computers in vehicles is all the safety features that are now built in and work seamlessly with vehicle and driver. This is followed by vehicle efficiency, driver and passenger comfort and entertainment."

Scott J McCormick, *President,* **Connected Vehicle Trade Association**

I"In my opinion, the most important automotive technology from the past 20 years was the development, advancement and introduction of vehicle communications. With that ability for the car to obtain real time road, weather and traffic information it creates safer and more efficient travel. This will also be critical as we advance through the next levels of automated driving."

James Raia, **The Weekly Driver**

"The introduction of a high performance, all-electric sports car, Tesla, was the biggest stand out piece of automotive technology in the past 20 years. I am not an advocate of the vehicle, but it has changed the game and has pushed many manufacturers to introduce competition."

Andrew Jackson, *Research Director,* **PTOLEMUS**

"Emissions. The progress that has been made with forced induction (i.e. turbocharging, and more specifically variable vane technology) has been critical.

As with it, engines have been downsized which has helped to reduce/offset the mass of the overall vehicle and increase engine efficiency.

Broadly speaking, comparing a car from 2020 (in terms of physical size/mass) to one from 2000 suggests that cars have improved around 46% in terms of fuel consumption (though this is based on manufacturers' claimed consumption figures…).

I deliberately exclude hybridization from this as the technology has been niche till now, but I think this will explode over the next 10 years at least. Not least due to Regulation (EU) 2019/631 which is forcing manufacturers to lower the fleet emissions of their vehicles rapidly.

Dave Zoia, *Executive Director - Research,* **Wards Intelligence**

"THE LITHIUM-ION BATTERY

Electrification is one of the biggest driving forces in the industry today, and the inevitable migration to fully electric vehicles wouldn't be possible without the development of an automotive-grade lithium-ion battery."

Juergen Daunis, *Head of IoT CV Sales Engagement*. **Ericsson**

"Electric Vehicle has a huge impact, replacing big part of the traditional value chain and enabling new players to enter the market."

Drew Winter, *Director, Content,* **WardsAuto**

Electronic stability control, first introduced in volume by Bosch on German luxury cars in the mid-1990s and later required on all vehicles sold in the U.S., Europe and Canada, has prevented more crashes, especially deadly rollovers, than all other safety technologies combined.

While auto safety once was dominated by "passive" devices such as seatbelts and airbags that worked only when a crash was occurring, ESC led us into a new era of "active safety" where sensors recognized a rollover was about to occur and selectively braked individual wheels to prevent the crash. ESC also ushered in the era of "sensor fusion" by using the same sensors already being used in vehicles for antilock brakes and traction control."

Bob Gritzinger, *Industry Analyst, Advanced Propulsion and Technology,* **WardsAuto**

Adaptive cruise control, and specifically, full-range adaptive cruise control that can manage a vehicle's speed from expressway speed down to stop-and-go. Like the simple speed control that preceded it, adaptive cruise control is relatively simple to add to vehicles as manufacturers add radar sensors necessary to meet forward collision warning and automatic braking objectives. And like traditional cruise control, once drivers begin to use it and understand its capability and dependability, (or lack thereof, depending on the vehicle),

they'll come to use it and rely on it. The net effect is a generally safer driving public as rear-end collisions diminish in either number or severity, despite the fact that more and more drivers are heavily distracted behind the wheel."

Doug Newcomb, *Senior Industry Analyst, Mobility,* **Wards Intelligence**

"Without a doubt, Google's unveiling of its self-driving car project in late 2010. While automakers had been working on the technology for decades, it took Google – and a threat from Silicon Valley – to motivate the auto industry to develop the technology. More than a $100 billion in investments later, it's poised to change the industry and also transform transportation as we know it."

Phil Magney, *Founder & Principal,* **VSI-Labs**

"CONNECTIVITY IS THE STAND OUT TECHNOLOGY

"This is easy. Connectivity is the stand out technology that has enabled a new era of location-aware services, largely safety and entertainment. And for the next era of automated driving and new mobility services, connectivity becomes the life-blood."

WINNER OF EUROPEAN AUTOMOTIVE START UP OF THE YEAR 2019

Peter Suma, *Chairman & co-CEO,*
Applied Brain Research

WHAT IS THE STANDOUT PIECE OF AUTOMOTIVE TECHNOLOGY FROM THE PAST 20 YEARS IN YOUR OPINION, AND WHY?

Autonomous Technology Computing Chips and Algorithms!

The pursuit of autonomous devices began in a series of widely spaced spurts beginning with devices such as the depth guidance systems for orpedoes developed in 1860, to the first airplane autopilot built by Sperry corporation in 1912, to the 1925 Houdina radio-controlled car. The performance expectation has always been that the devices should do what a reasonably capable human would do in the same situation. While the mechanics of motors and remote controls came relatively easily, the question of give machines a level of cognitive abilities to pilot the devices has been elusive. Those efforts began later and started slowly as with the mechanical progress.

The pursuit of artificial intelligence methods was arguably born in 1951 when Marvin Minsky developed his Stochastic Neural Analog Reinforcement Calculator (SNARC). Then in 1958 Frank Rosenblatt at Cornell invented the Perceptron algorithm.

Both developments began the exploration in earnest into artificial neural networks (ANN's) for use in developing AI. This pursuit slowly progressed in the 1960's, 70's, 80's and early 90's.

The past twenty years since 1995 however have seen a relatively sudden burst of sequential leaps in our ability to make AI control systems for cars, leading to today's impressive, if still fundamentally flawed, autonomous driving systems. Major advances toward autonomy of the past 20 years include: the commercial launch of the GPU (1999) eventually enabling the training and deployment of the powerful large AI algorithms, the development of the Long Short-Term Memory (LSTM) algorithm (1996) which enables AI systems to better process time varying data like video and control signals by learning from a signal past and current information, the extension of statistical learning methods into pervasive and practical Deep Learning (2011), the development of ensemble methods, like boosting, to enable many AI models to be used together to improve accuracy, and more recently, the development of AI accelerator methods including recently commercially viable neuromorphic chips and algorithms that are modelled even more directly than Perceptrons on how neurons compute. Neuromorphics is just the latest development that borrows once again from our understanding of how brains compute. They offer us very low power AI computing for automotive and other power limited uses, as well as algorithms like the Legendre Memory Unit (LMU) developed by our company this year, which is a replacement for the LSTM algorithm, superior in accuracy, scalability and power efficiency.

These developments, come from and drive forward the past twenty years of progress in understanding how the only working model of real intelligence, our brains, works. We have advanced functional neuroscience and feed a lot of that progress back into the development of our AI algorithms. Brain scanning technologies and the success of neuromorphic methods to show how many circuits in the brain compute and the application of these techniques to AI, to produce large AI systems composed of many networks that route information, learn related but independent features, categories, dynamics and maps of the world, our mental models and our actions. These more complex AI systems owe their existence to both novel human ingenuity but also in many fundamental ways to the growing understanding of how the brain computes. All of which serves our ability to progress toward systems that model and predict the world and our's and our's cars possible actions, to choose better control actions from those possibilities, leading to better and safer autonomous systems for cars and other devices.

In retrospect, the past twenty years will likely have shown themselves to have been a major period in the transition from a long history of motivating but sparse steps forward toward autonomy to a period of rapid and continual progress the algorithmic and computational achievements of which form a solid base for truly functional autonomous systems in the coming few decades.

The automotive industry has been there all along, beckoning all those who dream of the ultimate form of automation, autonomy. The industry's unprecedented early and bold investments in autonomous technology have driven the field of AI and now functional neuroscience to new heights of excitement, funding and expectations. Without the automotive industry's demand for progress and the offer of the rewards of the realization of it, particularly in these past two decades, it is hard to imagine where we would find such a fruitful and motivating development platform for advancing autonomous technology.
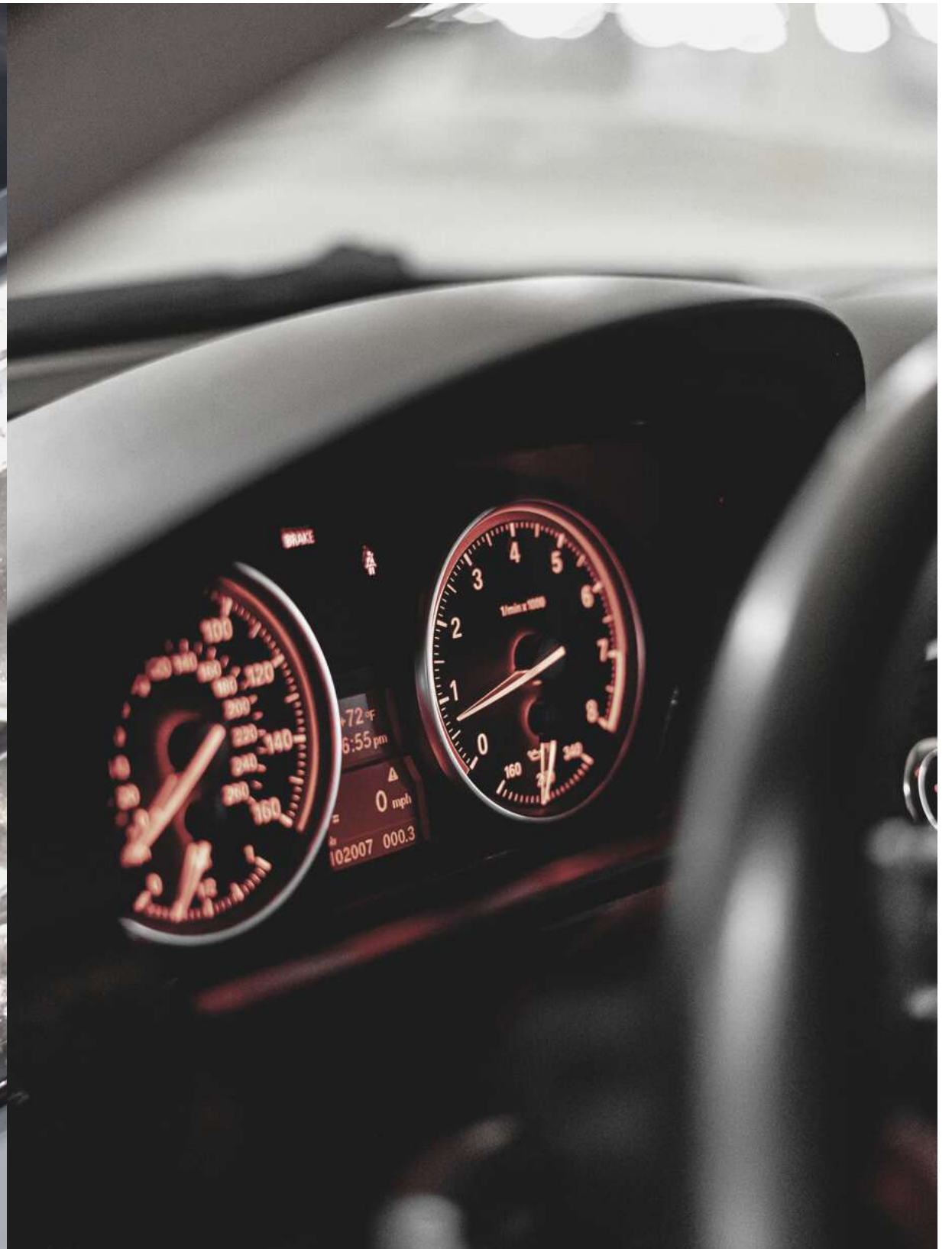
2020 AND BEYOND

WHAT AUTO TECH DO YOU PREDICT WILL HAVE THE BIGGEST IMPACT IN THE NEXT 20 YEARS, AND WHY?

Paul Myles, *Editor-In-Chief,* **TU-Automotive**

"My money is on the long-term evolution of hydrogen technology that will become the true champion of green technology that BEV cannot. I foresee the automobile become part of the energy storage story that Japan and Korea are scripting where sustainable electricity production will be stored in hydrogen form, free from the leakage and degradation of lithium-ion batteries, and then used to convert back into electric energy as and when it is required, offering long-range travel fueled by a well proven 'gas-station' infrastructure."

Dave Zoia, *Executive Director - Research,* **Wards Intelligence**

"ARTIFICIAL INTELLIGENCE.

AI-based software will dominate in nearly every facet of the automobile of the future, from how it drives to how safety-systems work to how it connects and interacts with everything around it."

Jan Walker, **5G Americas**

"As we move through semi-autonomous into autonomous technology, I see that has being revolutionary, game changing, and basically making our automotive experiences of 2020 look archaic by 2040. Whether those vehicles will be flying or on the roads it will be an entirely different experience and change people lives in significant ways. This will probably look like more convoy like travel, thus much more efficient and less delays; safe travel for children getting to school or activities, with busy parents no longer having to rely on buses or others to drive their children; greener cities with autonomous vehicles, through more green spaces being created within this entirely different ecosystem."

Scott J McCormick, *President,* **Connected Vehicle Trade Association**

"I believe the technology with the biggest impact over the next 20 years will be the development of aluminium air batteries. Lithium is a finite resource as oil and creates more issues with spent battery disposal and charging infrastructure. Aluminum-air batteries can produce substantially more energy for greater range than lithium Ion and are recyclable."

James Raia, **The Weekly Driver**

"I think autonomous driving will provide the biggest impact in the automotive industry in the next 20. Progress has advanced and regressed, but in two decades I think the autonomous driving industry will be integral part of city and highway driving and steadily increase in popularity."

Andrew Jackson, *Research Director,* **PTOLEMUS**

"I predict we'll see manufacturers have no choice but to hybridize as there isn't the maturity in the EV supply chain (i.e. not enough batteries) o suddenly start manufacturing "full" EVs at a scale that would be required for mass adoption throughout Europe and/or the world. Arguably we're starting to see this already (just think about how many hybrids you see advertised today's in mainstream media and how "acceptable" they are; 20 years ago, hybrids were ridiculed!)

I'll leave it there for now as safety is more conceptual than just a "thing"/component etc… But in simple terms, car safety today is incredible compared to what it once was 20 years ago. Motorist fatalities have falling 30% in the last 20 years in the UK alone

Drew Winter, *Director, Content,* **WardsAuto**

"The most significant technology of the next two decades will by artificial intelligence. This will be reflected not so much by flashy Sci-Fi examples, but in the way it makes production and design faster and more efficient, and by the way it makes our everyday lives easier with natural language recognition, cabin monitoring and voice and gesture recognition."

Peter Suma, *Chairman & co-CEO,* **Applied Brain Research**

"Autonomous Technology. The societal and historical scale changes that will be ushered in by the development of full automotive autonomy for self-driving and all the spinoff advances that the core technologies will create will be the source of the largest impacts in the coming twenty years."

Bob Gritzinger, *Industry Analyst, Advanced Propulsion and Technology,* **WardsAuto**

"While fully autonomous self-driving vehicles in the wild are still well off (if ever), adaptive cruise control (along with lane-keeping and blind-spot detection) will be the technology that enables semi-autonomous driving in many situations, including open-highway cruising and the painful commuter stop-and-go traffic we have all come to despise. In my vision of the near future of semi-autonomous driving, we'll make better use of our available highway traffic lanes by designating "Adaptive Cruise Control Lanes" that, like today's HOV lanes, will be open to only vehicles equipped with ACC. Slip into the lane at designated lane breaks, set ACC to the posted speed limit and recommended following distance – and become part of a "train" of cars whizzing smoothly along without the usual hiccups and slowdowns that occur for no apparent reason (but likely caused by one driver, miles ahead, brake tapping)."

Doug Newcomb, *Senior Industry Analyst, Mobility,* **Wards Intelligence**

"Autonomous technology. As with the advent of the Internet 20 years ago and smartphones a decade later, autonomy will be a disruptive technology that will have second- and third-order effects we can't anticipate at this point – the same way we couldn't have predicted things like crowd-sourced content via YouTube and social media platforms like Facebook and Twitter that have become billion-dollar businesses."

Juergen Daunis *Head of IoT CV Sales Engagement,* **Ericsson**

"Industrial Cellular Connectivity (e.g. 5G) will have a huge impact enabling a reliable business transformation including new mobility and transportation concepts and Autonomous Driving (AD) for specific use cases."

Phil Magney, *Founder & Principal,* **VSI-Labs**

"AUTOMATED VEHICLE TECHNOLOGIES.

"Automated vehicle technologies will have the biggest impact of them all. These technologies are enabling a new era of safety and convenience features. Simultaneously, further evolution of AV technologies are leading to driverless robotaxis that will enhance the safety of vehicular transportation while disrupting traditional business models greatly."

2000 - 2020 AND BEYOND

WHAT IS THE STANDOUT PIECE OF AUTOMOTIVE TECHNOLOGY FROM THE PAST 20 YEARS IN YOUR OPINION, AND WHY?

Stephan A. Tarnutzer, *President,* **AVL**

"The Internal Combustion Engine, while considered by many as "old" technology, has evolved in efficiency year-over-year for the last 20 years. It's an incredible example of what ingenuity can do!"

Vivek Jaikamal, *Director of Business Development,* **AVL**

"In my opinion, the most stand out piece of auto tech is the resurgence of the Battery Electric Vehicle. It addresses an urgent global issue of reduction of greenhouse gases from personal transportation."

William Rotramel, *Consultant,* **AVL**

"I believe this would have to be the automotive microcontroller. Automotive electronics advancements have been the enabler to many improvements in the light duty vehicle segment. They have enabled incredible reductions in vehicle emissions and improvement in fuel efficiency. They have enabled the modern HEV and EV to become a real alternative to ICE powered transportation. The microcontroller processing speed and software advancements have improved vehicle safety by enabling the control of multistage airbags, side curtain and side seat bag protection, pre-crash control of belt restraints and active safety with ESC, ABS and AEB and smart cruise control functions. In addition, telematics has brought new entertainment streaming into the vehicles and allowed for additional safety through crash information and vehicle location features which can activate without driver interaction.."

WHAT AUTO TECH DO YOU PREDICT WILL HAVE THE BIGGEST IMPACT IN THE NEXT 20 YEARS, AND WHY?

Stephan A. Tarnutzer, *President,* **AVL**

"The virtual development and testing tools – with the ever-increasing complexity of technologies used on a vehicle, future developments and deployments cannot happen without virtual simulation tools."

Vivek Jaikamal, *Director of Business Development,* **AVL**

"If you consider impact on the environment and sustainable transportation, it will be the adoption of more recycled and recyclable materials in the automobile (up to 98%) as well as the large-scale replacement of ICE vehicles with BEVs. This is important as the total life cycle of an automobile will be reduced significantly, and they will need to be replaced more often. If you consider the impact on safe transportation, it will be large scale automated driving – which will drastically reduce crashes due to human errors."

"VIRTUAL DEVELOPMENT AND TESTING TOOLS.

William Rotramel, *Consultant,* **AVL**

The advancement of automated driving functions will have a major impact on mobility methods, vehicle architecture and most importantly vehicle occupant safety. In addition, with connectivity and automated driving we will see many mobility options emerge, particularly in urban areas, which will result in reduced traffic congestion, improved energy usage and will accelerate propulsion system methods toward EV's and fuel cell vehicles. Most importantly, we will see a dramatic reduction of vehicle accidents and occupant deaths and injuries over this time period as more safety-oriented AD functions are developed and integrated into mass market vehicles."

AVL IS JOINING US AT THIS YEAR'S TU-AUTOMOTIVE DETROIT - JOIN THEM IN JUNE!

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"

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