DVN-I
Automotive Interior

Thu, 17 February 2022 Weekly Newsletter **NEWSLETTER #99**

Editorial

Cabin Air Quality Goes Beyond Pollutants

TRAFFIC AND GROSS POLLUTION IN INDIA (APA IMAGE)

In our last three DVN-I Newsletters, we reported that audio, interior lighting, and DMS are no longer just what one listens to when driving, not just what one sees when sitting in the vehicle, nor just a safety feature; they've evolved to improve the whole driving experience.

This week's in-depth article looks at IAQ (interior air quality), which is growing in importance as more driving is done in dense urban traffic and people are increasingly aware—and concerned—about it. IAQ is quantified as the concentration of pollutants like CO_2, NO_x and VOCs. Now it's moving beyond ust measuring negatives and adding a positive evaluation through fragrance, which is becoming a major criterion of occupant perceived quality and a design element reflecting the signature of the brand.

IAQ will be another focus of our next DVN Interior Workshop, this 25-26 April in Köln. The rubric of the event is ***Experience Interior • Technology for Safety, Comfort, & Fun***. Get set to exhibit, to speak, or just to attend! Find more information **here**.

We're ever so glad you're with us!

Philippe Aumont
General Editor, DVN-Interior

In Depth Interior Technology

Cabin Air Quality and Fragrance

IAQ—interior air quality—is becoming a major concern because of increasing density in bigger and bigger urban areas. The pandemic has further increased awareness and concern over air cleanliness (and ambient hygiene in general), as Covid-19 is spread by aerosols, suspensions of fine particles in the air.

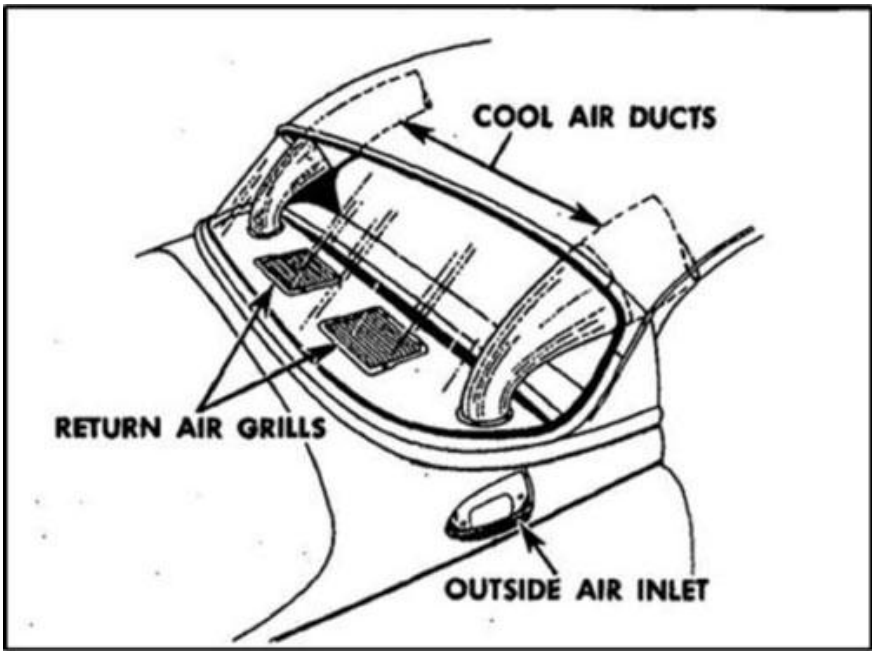
Although commuters typically spend only 5½ per cent of their time in vehicles, the emissions from various interior components of motor vehicles, as well as exhaust, tire and brake dust, cigarette smoke and nicotine vapor, and other exterior air-dirt inducted by the HVAC system are significant sources of harmful air pollutants that can tend to become concentrated at unhealthy levels inside vehicles.

Car IAQ is, of course, directly influenced by exterior air quality, with some aggravating factors. First of all, the air intake is positioned where pollutant concentration is high: close to the road, and behind other vehicles, and so the cabin can accumulate levels of particulate matter and gases that are unpleasant and unhealthy to breathe. The number of passengers in the car also exerts an influence via their own emissions—not only of exhaled CO_2 but also perfume, cologne, and other scented products on their person and clothing; their own smoking or vaping, etc.

Until the industry starts making intelligent vehicles that automatically keep the car cabin's air clean, the ventilation settings on the dashboard was the best way to optimize comfort and healthful air by setting the fan speed, ventilation mode, and selecting outside or recirculated air intake. Sometimes there was no good option. The car cabin is like a box with small holes for gas exchange. That means the air in the cabin will eventually be ventilated, or equilibrated, with the outside air. But that can take anywhere from a minute to an hour depending on fan speed, ventilation mode, and cabin air recirculation. Cabin air filters came along in the 1990s and 2000s,

originally designed to remove relatively large particles like pollen and dust. They aren't very good at filtering out the much smaller, sub-micrometer particles from vehicle emissions.

Research on IAQ: Fractional Recirculation



MID-1950S GM A/C SYSTEM (SAE IMAGE)

Heejung Jung, a professor of mechanical engineering at the University of California–Riverside's College of Engineering and the Center for Environmental Research and Technology, studies how outdoor pollution gets inside cars, and identifies ways to improve cabin air quality. He has devised a standard test method based on data from 100 vehicles, which was built into a database to help drivers protect their respiratory health by including cabin air quality among factors to consider when buying a car.

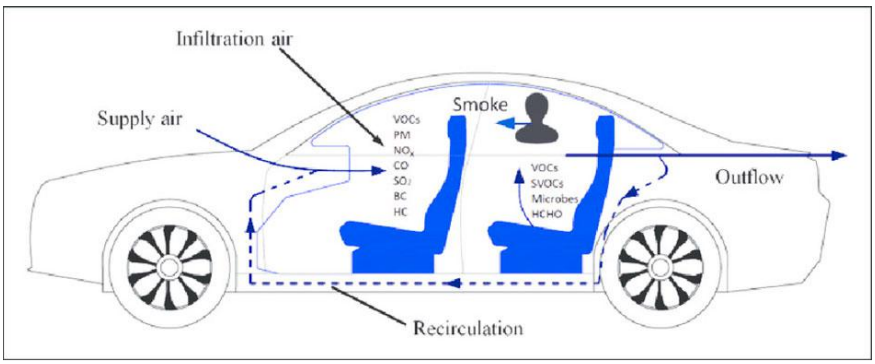
Closing the windows and choosing the recirculation setting of the car's ventilation system and a low blower speed reduces particulate matter concentration—taking out most of the ultrafine particles that can lodge deep in the lungs. But recirculated air means CO_2 builds up inside the car as its occupants exhale.

Jung's group has developed a way to open the recirculation damper door at specified angles to control the extent of exchange between recirculated and fresh air—a technique called fractional recirculation—thus attempting to ameliorate CO_2 buildup while controlling particulate matter at the same time.

In the meantime, Jung advises "When you see polluted road conditions such as a congested road or lots of trucks in front of you, then choose recirculation mode and adjust the fan speed. Full recirculation at the lowest fan speed should not be used for more than a few minutes as CO_2 will quickly build up within the cabin". If pollution persists for longer than a few minutes, Jung recommends increasing the ventilation fan speed. Vehicle cabins are not airtight, and a higher fan speed results in a bit more ventilation than low speed. But it is noisier, and Jung said that auto manufacturers should incorporate fractional recirculation into their ventilation designs.

"This principle applies to all enclosed environments such as airplanes, buses, trains, subways, and buildings," Jung said. "We can significantly reduce exposure to air pollutants in some environments where people spend the most time with air circulation systems that include fractional recirculation."

Cabin Air Quality – Literature



INTERIOR AIR POLLUTANT SOURCES AND TRANSPORT. BC: BLACK CARBON; HC: HYDROCARBON. (BIN XU IMAGE; TONGJI UNIVERSITY)

A 2016 research review by Bin Xu, done at Tongji University in 2016, summarizes major findings reported in literature on air quality inside passenger vehicles' cabins, including chemical species, related sources, measurement methodologies and control measures. Information given in literature has provided solid evidence that air pollutants commonly observed inside cabins are at high exposure levels and can pose adverse effects on passengers' health.

A variety of air pollutants are emitted at a range of levels from various sources under various ventilation or driving conditions. Ventilation mode and airflow rate, the age and air-tightness of the vehicle, interior materials, number of passengers, and ambient pollution level outside the vehicle all play important roles in determining the in-cabin pollutant concentrations.

To reduce the in-cabin exposure levels of air pollutants, some guidelines, national standards, and protocols have been derived to ensure a better safeguard of drivers and passengers during transit and travel. The development of manufacturing standards based on the environmental health perspective would be an important improvement of more environmentally friendly vehicles with a consideration of the wellbeing of passengers. The measures could include using the largest ventilation airflow rate; installation of an air purifier unit inside the vehicle; applying a high-efficacy cabin air filter in the ventilation system, and prebaking interior materials to release most of their VOCs prior to installation to vehicles, rather than once they're already installed and "baking" inside the car on a hot, sunny day.

Air purifiers

VOLVO IMAGE

A car air purifier removes odors, dust, mold, bacteria, pet dander, and harmful microorganisms from the air inside a car. With the Chinese market in mind specifically, Volvo has developed a new air filtration system for their S60, S90, XC60, and XC90 models. The plan is for this advanced air cleaning system to be available on every car builds on their Scalable Product Architecture (SPA) platform, including the Polestar 1.

The system cleans out fine particulate matters from the cabin by dint of ionization and a synthetic fiber-based filter. Up to 95 per cent of all PM 2.5 particles (i.e., those smaller than 2.5 microns) removed from the cabin air.

Drivers of equipped Volvos can use the Volvo On Call smartphone app to easily schedule an extra cleaning of the cabin air ahead of their journey. The app then tells drivers about the PM 2.5 levels inside the cabin after cleaning.

Odor: beyond IAQ

Air quality is not only a matter of CO_2, NO_x and VOC concentrations. Odor is also important, as it influences our perception of an environment. Eating a burger with onions in the car affect how the cabin smells for quite awhile—negatively! Or we could talk about the factory-fresh "new car smell"—caused by offgassing of parts, materials, and finishes inside the car; it's prized in Western markets and despised in China.

Odor has on influence on motion sickness, especially for the younger generations. Some sickening smells can result in what's colloquially known as "Sick-Car Syndrome," a feeling of illness and lethargy that stems from breathing the pollutants trapped in the vehicle.

On the other hand, there's fragance, which automakers are now keen to present as a personality or signature element of the interior. Fragrance can comprise aromatherapy, which is the use of essential oils from plants (flowers, herbs, or trees) as a complementary health approach. Many essential oils are used in aromatherapy, including those from Roman chamomile, geranium, lavender, tea tree, lemon, ginger, cedarwood, and bergamot. It can complement relaxing position, and even a massage you may get in your car seat.

Nissan: The Science of Scent

Nissan recently published on their innovation website a story about Ryunosuke Ino, the automaker's “Smell Master” tasked with refining Nissan’s new-car smell. Working from the Nissan Technical Center in Japan as a technical expert in the Vehicle Interior Air Quality department, Ino leads a team that analyzes and authorizes materials used in Nissan vehicles.

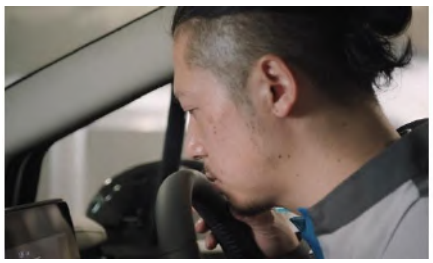
The team is in charge of checking the aroma of new vehicles. Also, so that the passenger experience is literally a breath of fresh air, he also checks car air conditioning systems and how vehicle smells can change over time. **See video.**


NISSAN IMAGES

“Smell is an important factor in a comfortable car experience, and Nissan is very particular about it,” Ino says. “Usually, passengers smell the nearest thing based on where they are in a car, so it’s important that we experience from all seats.”

Research suggests that our sense of smell is surprisingly strong and can recognize hundreds of thousands of different smells. Smells travel via the body’s olfactory neuron tracts to brain centers focusing on memory and emotions, such as the orbitofrontal cortex, amygdala and hippocampus. That’s why a car smell can trigger strong memories.

Studies also show humans rely more on their eyes but can perceive tremendous numbers of different smells that can also leave a lasting impression. For Ino, it’s not just the critical first impression but how we perceive smells within the cabin during the drive.




NISSAN IMAGES

“First of all, I try to identify where the smell comes from,” he says. “I try to locate it and evaluate from the vehicle user’s perspective, such as accessing the glovebox or using the sun visor mirror. I position my torso and head just like they would to gain an accurate impression.”

During a vehicle’s cabin volatile organic compound (VOC) evaluation process, which typically takes place over three days, Ino and his team of smell experts sniff the headrests, dashboards, mirrors, glove compartments, visors, seats, ceilings, cupholders, carpeting, and any components with measurable scent.

Seats using the same materials are evaluated individually, as they may come from different suppliers with unique production processes. Ino’s team aims to ensure the

cabin's pleasing atmosphere is enjoyed by all occupants, so work extends to parts suppliers making the fabrics, adhesives and polymers used in Nissan vehicles.

NISSAN IMAGE

Air circulation and exposure to sunlight are crucial factors impacting car smell, so the team uses a special environmentally sealed testing room controlled for heat and humidity, with a lighting system that simulates intense sunlight.

Ino wears a Nissan uniform washed without detergent, ensuring that his smell impressions are clean and without influence. "The day before a check, I try not to eat garlic dishes and foods with strong smells." He says.

Preferred consumer smells vary by region, so Nissan has teams in North America and Europe doing similar testing. "Nissan's smell standards are designed mainly by me as the global lead Smell Master," he says. "However, each region is slightly different based on customer feedback, and their *meister* makes the final decision for their market.

Another Example: Nio ES7

NIO ES7 (NIO IMAGE)

In the Nio ES7, revealed at 2021 Shanghai Motor Show, the invisible air vents in the front and rear provides scenario-based precise airflow control for comfort. The smart fragrance and air quality systems keep the cabin clean and refreshing.

Conclusion

Car IAQ is becoming of higher importance, as urban air is getting more and more polluted, and as people are more and more aware (and then, more concerned) about it.

As illustrated with Nissan Smell Master, Cabin smell and fragrance is becoming a major criterion of occupant perceived quality, and a design element reflecting the signature of the brand.

However, China is considering introducing mandatory in-car air quality regulations in order to protect the health of drivers. Such a positive move for the occupants, could conceivably increase development efforts for car makers, and especially their interior parts suppliers, where parts would need to be tested an in-car environment test, after their doors have been shut for hours. Smells like a challenge!

Interior News

SemsoTec: Haptics, Acoustics With no Distraction

INTERIOR NEWS

SEMSOTEC IMAGE

SemsoTec, founded in 2009 and based in Garching, Germany, works on innovative operating concepts with voice control, hovering, gesture control, force sensing and haptic feedback implemented in the display and in other smart surfaces to present information in situationally appropriate, quickly and accurately recognizable ways. Another driver: the increasing differentiation of manufacturers through the experience in the vehicle, including an unmistakable design language. The goal is a tidy and inviting vehicle interior, with information surfaces always right there and only when they are needed.

According to SemsoTec, it is best to standardize where the most costs are incurred. These are usually the displays, which come in standard sizes and resolutions aside from custom designs. The panels can also be configured and shaped more and more easily. In contrast, the HMI, the operating concept, the surface shape and design of the user interface, as well as the mechanical integration are customer-specific areas.

For improved operating safety, SemsoTec works on better readability through reduced reflections and increased contrast. They've developed a technique, together with

major Japanese films manufacturer Dexerials, to dramatically reduce reflections below the surface of a display's cover glass.

For haptic feedback on display surfaces, SemsoTec has a tuning tool to measure the operating feel of a mechanical reference switch and then recreate it as a mechanical movement signal via eight channels of an equalizer on the target actuator. The aim was to design the operation in such a way that the position and the triggering of a function are reported back without distracting the driver.

Important settings must not be stored in sub-sub-submenus. Simple and distraction-free operation must be possible via haptic or acoustic solutions. By integrating tactile surface structures, rotary actuators that use the touch display as a functional surface, or outsourced sensors in smart surfaces, car manufacturers are doing meanwhile a lot to optimize their operating concepts.

Magna's Mirror-Inbuilt DMS

INTERIOR NEWS

MAGNA IMAGES

Magna has secured a high-volume, global award from a German automaker for the supplier's in-mirror DMS starting in 2024.

This system reduces packaging complexities by fully integrating Magna's high-resolution camera, infrared emitters, and electronic control unit into the company's interior mirror. One of the unique features is the camera which is hidden behind the mirror glass, providing both packaging and styling improvements compared to existing solutions on the market today.

Advanced software monitors the driver's head, eye and body movement to help detect signs of distracted behavior, drowsiness and fatigue. In addition, the system features in-cabin monitoring which allows it to not only monitor the driver, but the activities and presence of other occupants in the vehicle.

See video

“Distracted driving remains one of the leading causes of vehicle accidents globally and many markets are consequently making driver monitoring a standard safety technology,” said John O’Hara, President of Magna Electronics and Magna Mechatronics, Mirrors and Lighting. “With our proven leadership and expertise in camera and mirror technology, it’s natural that we have been able to develop an innovative system solution that meets future Euro NCAP and GSR requirements, and optimizes space, styling and costs.”

A unique solution of Magna’s system is the central, unobstructed location high on the windscreen which provides an optimal view of the driver, front seat passenger, second and third row occupants. This allows both driver and occupancy monitoring with a single camera – uniquely packaged into the mirror unit.

“Our driver monitoring system opens up a world of possibilities when it comes to integration with other ADAS vehicle technologies, and lends itself to new mobility concepts such as authentication for ride sharing. With our full systems expertise, Magna is ideally positioned to unlock these opportunities – further helping to improve safety, comfort and convenience for all who share the road.”

Basemark for BMW iX's AR Solutions

INTERIOR NEWS

BASEMARK IMAGE

Finnish automotive software and services supplier Basemark (see DVN Interior 2 December 2021) says it has "contributed significantly" to the augmented reality (AR) applications found in the BMW iX.

Basemark's AR-over-video solution helps point the way on the electric crossover's navigation system, showing upcoming turns and lane recommendations directly on infotainment screen.

The front-view camera automatically sends live video to the curved touchscreen where interactive arrows appear to show the driver exactly where to go. The map remains visible because of split-screen functionality.

AR features that can help drivers with navigation and detecting possible threats on the road are the first applications that the auto industry is seeing, and those deliver value now, providing an on-ramp to a future-proof business that anticipates a driverless future.

AR features also help with parking in congested urban environments, guiding the driver toward available spots, informing about parking limitations and rates, and augmenting the driver’s spatial awareness during parking.

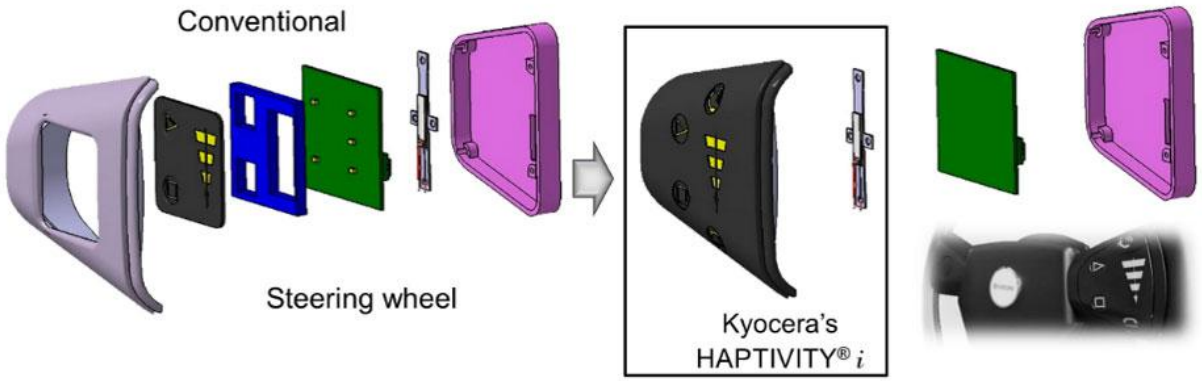
Drivers with certain BMW i4 vehicles will experience augmented reality directly through their infotainment screen while they are using BMW’s navigation system, according to Tero Sarkkinen, CEO and founder of Basemark.

There are of course other applications for this kind of tech, like heads-up displays (HUD), which appear over windshields so drivers don’t have to take their eyes off the road, Sarkkinen says.

Basemark is working toward using sensors to give drivers more information about their surroundings. At last CES, the company displayed its AR with object detection prototype, which takes in raw camera and radar data and performs sensor fusion to help drivers when there's low visibility to increase safety.

3D HMI With Kyocera's Haptivity-i

INTERIOR NEWS



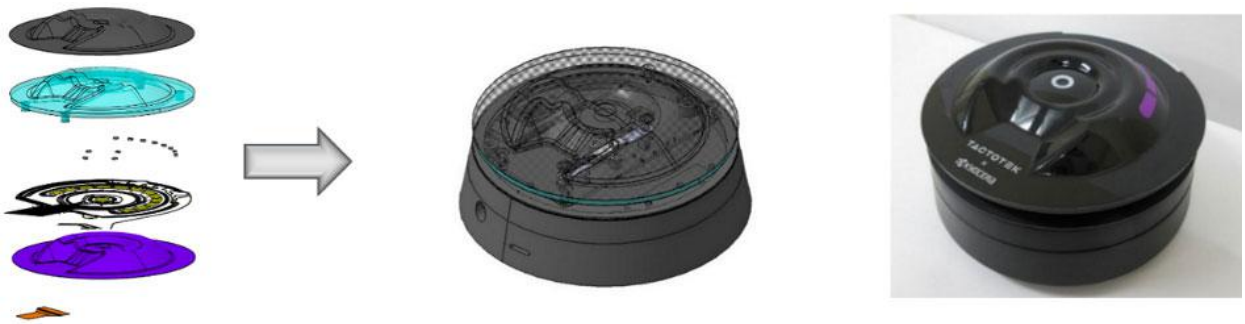
KYOCERA'S HAPTIVITY-I VERSUS CONVENTIONAL PARTS (KYOCERA IMAGE)

Japan-based ceramics and electronics manufacturer Kyocera recently unveiled their Haptivity-i HMI technology, a hybrid innovation combining their patented Haptivity touch technology with Imsetm, a patented 3D injection-molded structural electronics technology from TactoTek. The result lets designers create HMI solutions in a vast range of 3D shapes with thinner form factors, fewer components, improved vibration resistance, and significantly reduced weight. Additionally, because they are fully integrated and seamless, Haptivity-i solutions offer an interface that is reliable, durable, protected from debris and moisture, and easy to clean.

Kyocera's original Haptivity technology employs piezoelectric elements, a vibration amplification mechanism, a control circuit, and proprietary software to transmit vibration through a panel or display surface when touched and pressed. Biomechanically engineered vibration waveforms can replicate real tactile sensations by stimulating neural mechanoreceptors in the user's fingertip — allowing the user to "feel" physical buttons, for example, and press them, on a panel where no physical buttons exist.

TactoTek's IMSE technology integrates printed electronic circuitry and electronic components within 3D injection-molded plastics. It has been already presented in DVN Interior In-Depth Interview on 16 December, 2021.

Integrating Kyocera's unique Haptivity technology into a form factor thinned with IMSE technology creates an alternative to conventional mechanical buttons or a flat touch-panel, resulting in a seamless 3D design that dramatically enhances the user experience.



JOG DIAL WITH HAPTIVITY-I (KYOCERA IMAGES)

Conventional HMI technology involves a complex bill of materials that must be procured from multiple suppliers and assembled. In contrast, Haptivity-iwill offer designers the potential to integrate decorative elements, lighting, touch switches, pressure sensors, tactile actuators and other components into a single module, greatly reducing procurement, assembly and labor requirements.

Sustainability is Mercedes Interior Watchword

INTERIOR NEWS

MERCEDES IMAGES

From leather alternatives based on mushrooms or cacti, to vegan silk and bamboo fibers, the nature-inspired interior of the Mercedes Vision EQXX conveys a sense of lightness and luxury.

In the concept car's recent reveal, Mercedes emphasized that the car offers maximum comfort and style with minimal weight, and without animal products.

The door pulls are made of a high-strength, biotechnology-based and certified-vegan fabric which resembles silk.

A completely new material category is used for details of the seat cushions, with a verified-vegan leather alternative made of mycelium, which is the underground rootlike structure of mushrooms.

Carpets are made of 100% fast-growing bamboo fiber. This natural raw material is not only renewable; it also offers a luxurious look and feel.

Another animal-free leather alternative used for exceptionally supple surfaces is a sustainable cactus-based biomaterial. It’s made from pulverized cactus fibers combined with a sustainable bio-based polyurethane matrix.

In addition, recycled materials are used extensively. One example of this is recycled PET bottles, which are used in a shimmering textile that enhances the floor area and door trim.

Amazon, Apple All In on Cockpits

INTERIOR NEWS

APPLE IMAGE

As often reported, the big digital companies have set their sights on extending their existing platform-based empires to the car. They started with infotainment systems, which enabled partnerships between car manufacturers and digital companies. In the meantime, Android Auto or Apple CarPlay are an integral part of many car models. Also, many AI-based voice assistants such as Siri (Apple) or Alexa (Amazon) are now integrated in the car.

The connectivity services available on the market today are still far behind our smartphones in terms of performance and customer experience. Digital companies now want to change that. digital companies and car manufacturers envision a future where drivers can connect all aspects of their lives, as more automated vehicles open diversified usage scenarios. Occupants will be able to reconcile work, leisure and housework, order groceries or even plan work meetings. Data collected by vehicles could automatically update maps, inform retailers of where their customers are travelling from and notify city workers of potholes.

The biggest problem is probably on the side of the car manufacturers and their traditional suppliers, because the digital companies have a virtual monopoly on connected car technology. But there are also significant advantages. If automakers and suppliers choose to collaborate, they no longer face the challenge of developing independent systems that cannot compete with those of the big digital companies. The latest Berylls analysis shows that within a few years Google has built up an impressive reach in the smartphone mirroring sector, extending to around 80 per cent of annual global car sales. Particularly in the volume segment of the market, which includes General Motors and the Renault-Nissan-Mitsubishi alliance, there is a reliance on partnerships with the digital companies to compensate for a lack of skills and avoid major investments. This leads to an ever-increasing dependence on the digital industry.

However, there are also countermovement. The Volkswagen Group, for example, has agreed to invest heavily in developing its own software and operating systems.

However, this means they have to take on the digital companies. A number of car manufacturers and suppliers have also joined the GENIVI Alliance. The GENIVI Alliance is an automotive industry initiative to develop a scalable open-source solution based on Linux.

News Mobility

GM's Robotaxis Drive Only After Dark

NEWS MOBILITY

GM CRUISE CHEVY BOLT EV (CRUISE IMAGE)

Cruise, the self-driving subsidiary of General Motors, started offering robotaxi rides last week in San Francisco. They are generally only operating from 11pm to 5am.

Driving late at night is easier for autonomous cars and comes with fewer risks. There are far fewer challenges on the roads, as pedestrians, cyclists and other cars are rare. Construction sites, a challenge for robotaxis, are generally not active at night.

But Cruise claims the nighttime hours offer a unique business opportunity. A Cruise representative said "We are starting where we think we can have the greatest impact, drivers are tired, distracted, have low visibility, or drunk. And it's the time when safe and accessible options are most limited."

Cruise riders hail a vehicle on an app. When the car arrives, they hit a button to unlock the doors and then get in. The car doesn't move until passengers buckle their seatbelts. Cruise's late-night trips are smooth enough that one rider fell asleep on its first day of public rides, according to Cruise co-founder Kyle Vogt.

It confirms that self-driving in traffic is still a challenge, and that MaaS hasn’t really found its business model yet. Companies like Uber and Lyft have abandoned in-house self-driving efforts. One self-driving company, Starsky Robotics, shut down as its founder blamed the immature state of artificial intelligence needed for autonomous vehicles.

Self-driving startups, like Zoox and drive.AI sold themselves to Amazon and Apple, respectively. Zoox was acquired for a fraction of what investors previously valued it at.

Drive.AI's founding team split up, with only some of them joining Apple. Waymo, the longtime leader in self-driving technology, having been first to offer a robotaxi trip and launch a public service, offers robotaxi trips in Chandler, Arizona. But its vehicles still struggle with inclement weather, avoid left turns, and aren't programmed to use shared turn lanes.

Ottobahn Mobility Above Traffic

NEWS MOBILITY

OTTOBAHN IMAGE

A Munich-based startup wants to ease traffic congestion with electric gondolas suspended from a rail system. Now the vision of the Ottobahn is becoming a bit more real: a first test track can be built in Taufkirchen, Germany.

Bavaria's Transport Minister Kerstin Schreyer explained: "Especially in the greater Munich area, we need creative ideas like this to decongest traffic." The groundbreaking ceremony for the test track in Taufkirchen is scheduled for mid-March. It will be about 900 meters long. An oval is planned, on which a gondola is to start operation in the second half of the year. Ottobahn then wants to gradually connect up to five nacelles to complete a total of 100,000 test kilometers.

The concept will be realized by electric four-seater gondolas, which are also suitable for transporting goods, travel on a rail system that runs five to ten meters above the road traffic. They are supposed to be able to travel at speeds of up to 240 km/h outside built-up areas, and Ottobahn plans to run at 60 km/h in cities. The pods are powered by electric motors, and the consumption is supposed to be the equivalent of 4 kWh for 100 kilometers. (the Playstation on board helps with travel time sales).

An algorithm calculates the fastest connection for all gondolas along the route in real time. The founders envision users being able to hop on and off at any time along the route. The operation of the system is supposed to be CO_2-neutral, which is why the startup wants to green the necessary track girders and equip them with solar cells, among other things.

In addition to their plans for Munich, the company is considering airports as realistic applications. Their transport logistics and also the connection to the surrounding area could be improved with the Ottobahn, believes the 20-strong team around founder Marc Schindler. As a comparison, they cite the Transrapid, which could have once connected Munich's main railway station and airport. In the long term, Ottobahn says it is aiming for a connection between Munich and Berlin (distance ca. 600 km), for example, which passengers should be able to cover in 2.5 hours.

General News

EVs Have the Best CO2 Footprint: Army Experts

GENERAL NEWS

CHARGE POINT IN STOKE-ON-TRENT, ENGLAND (GETTY IMAGE)

Electrification of vehicles can reduce overall passenger car lifecycle emissions by up to 89 per cent. Gasoline and diesel vehicles have the highest amount of greenhouse gas emissions in comparison. This is the result of research conducted by the Universität der Bundeswehr München (University of the Federal Armed Forces in Munich, Germany).

A much-discussed topic in electrification is the greenhouse gas balance of vehicles over their entire life cycle, from cradle to grave, including raw materials, production, usage and end-of-life. This balance makes vehicle emissions comparable in a holistic way, beyond just consumption on the road.

In a new publication, researchers at the University of the Federal Armed Forces in Munich have compared more than 790 current passenger car vehicle variants and show overall emissions can be significantly reduced with plug-in hybrid and fully electric vehicles.

The results make it clear that juxtaposing individual emission sections within the entire product life cycle is not very meaningful when discussing the climate compatibility of different vehicles. For example, battery electric vehicles have the highest emissions during production. In the overall assessment, however, including use and recycling, they perform better than conventional internal combustion vehicles. The emissions from battery production of a current Tesla Model 3 (standard range plus model) are comparable to the usage emissions of a Volkswagen Passat (2.0 TSI model) over a

distance of 18,000 km, which is only a fraction of its useful life. Conventional gasoline and diesel vehicles provide the highest overall amount of greenhouse gas emissions over their entire life cycle.

Using green electricity, plug-in hybrid and all-electric vehicles can reduce overall emissions by 73 per cent and 89 per cent, respectively, compared to internal combustion vehicles. Alternatively, fuel cell vehicles can reduce greenhouse gas emissions to a similar extent as electric vehicles (which run on conventional electricity) if they currently use commercially available gray hydrogen (60 per cent). More generally, renewable fuels and energy result in the lowest possible emissions over the lifetime of vehicles.

The paper is published in Renewable and Sustainable Energy Reviews, one of the most internationally renowned journals for sustainable energy supply and renewable energies.

The University of the Federal Armed Forces in Munich conducts extensive research on mobility topics. Very currently, the future of digitalized and networked mobility is being researched in the project MORE (Munich Mobility Research Campus) and set up as a model city on the campus of the University of the Federal Armed Forces Munich.

Ford Reconsiders India, Now for EVs

GENERAL NEWS

FORD ASPIRE (FORD IMAGE)

Ford is considering producing EVs in India for export, and possibly for sale in the domestic market, just months after the U.S. automaker decided to stop selling and manufacturing cars in India.

Ford's comments mark a shift in strategy after they said last September they were leaving India as they saw no path to profitability there. The decision came as a setback for Indian Prime Minister Narendra Modi's "Make in India" campaign.

India's market was around 2.5 million cars in 2021, after a record year in 2018 at 4.4 million. There are two Ford plants there—one at Chennai, in the southern state of Tamil Nadu; the other at Sanand, in the western state of Gujarat. Now, Ford says, they are "exploring the possibility of using a plant in India as an export base for EV manufacturing". Ford is increasingly targeting customers in what it said was a "global electric vehicle revolution". The automaker has previously said they plan to invest $30bn in EVs and batteries through 2030.

Ford had less than 2 per cent of the Indian passenger vehicle market (65,000 in 2020) when they stopped production in the country, having struggled for more than two decades to turn a profit. The restructuring was viewed positively by analysts.

"Ford will have to prove India can also be cost-competitive for making EVs, for which it will need big investments to localize the supply chain," a spokesman said, adding that it will also need to figure out how it would source lithium-ion batteries.

The plan is a cornerstone of the Modi government's agenda to cut oil imports and reduce pollution by giving benefits of up to 18 per cent of new investments made by companies to manufacture electric and hydrogen fuel-powered vehicles. Ford is among 20 other companies eligible for benefits under the scheme.