



Automotive: what are the solutions for 2035?

Shared vehicles, autonomous, flying ... to meet the needs of users by 2035, the automotive is reinventing itself. The transformation has already started and is pushing manufacturers to review their development priorities and change their business models, without abandoning the present! In France, manufacturers, subcontractors and laboratories are in the race and new players are already offering unprecedented solutions ready to hit the road.

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State of the art

Automotive in 2035: Toward a New Definition

The transformation of the private car with combustion engine into a connected and shared autonomous electric vehicle has started. All players in the ecosystem are mobilized to meet a double challenge: to prepare for the future, while continuing to invest in making models that meet today's needs.

No doubt, the automotive is one of the driver of the industry on earth! In 2017, according to the Committee of French Cars Manufacturers, the global production of vehicles rose by 2.4% to 97.4 million units. That's 25% more than in 2000! And while China is now the world's largest manufacturer and consumer of cars, the European Union is still the world's second largest producing area. What about 2035? Several scenarios are put forward by the specialists of the sector, which expect a volume between 100 and 120 million units a year. The range is wide, but one thing is sure, the actors of the automotive sector must be prepared to face considerable upheavals. "In a world where the population is concentrated in very dense urban areas, the model of the personal vehicle which transports a single person for short or long journeys and which remains at a standstill 93% of the time is no longer suitable and the modifications to be made to the current public transport systems are too important to be considered, says Guillaume Devauchelle, director of innovation at Valéo. New mobility solutions based on autonomous, electric and shared vehicles are needed."

From the car to the mobility solution

Why electricity? Because this energy is most suited to urban areas in terms of noise nuisance and pollution. Why shared? Because this mode reduces the number of vehicles used and is the more economical. According to a study by the firm Roland Berger on the poten-

tial market for vehicles dedicated to car-sharing, the cost per kilometer of a Robo-taxi thus amounts to 0.3 Euros against 1.5 to 2 Euros for a classic taxi and about 1 Euro for a personal vehicle. Why Autonomous? Because in an urban environment, the automation of driving eliminates congestion while increasing the average speed-which currently peaks at 15 km / h in the city! - and avoids wasting time in uninteresting tasks, such as parking the car. And in rural areas, it offers a means of locomotion to an ageing population potentially more able to drive. Note, this characteristic of the car of the future implies that it is also connected to infrastructure and other vehicles.

Towards very different vehicles

Distance to be travelled, typology of user, geographical area, immediate environment, multi-modality... the input variables of these new mobility solutions are numerous and their combinations almost infinite, opening the way to very different vehicles. For the transport of small groups of people in the city center, Navya (see article on page 16) or Transdev for example develop shuttles able to move without a driver at low speed in controlled environments. This is also the option chosen by Renault with its EZ-GO Robo-taxi concept unveiled in March 2018 whose interior has nothing to do with that of a today's vehicle. From mini-cars to automated cars synchronized on motorways, all confi-

gurations are possible, even flying cars (see box on page 13). And with all these new uses, the car is no longer limited to a simple means of locomotion. "It becomes a place to live," says Vincent Caulet, Automotive Market Manager at Cetim. A place of work, entertainment, relaxation ... All kinds of activities that require a complete review of the configuration of vehicles and their interior.

With the concept Symbioz, the French manufacturer even considers the car as a "living room", an integral part of an individual home. And what about classic cars for individuals? They retain the advantage, even in 2035. "At that time, they should still account for 70% of sales," says Sean Farrell, Marketing Strategy Director of Lisi Automotive. But manufacturers are already banking on a proliferation of models and variants and a high degree of customization. >>>

An e-book on the car in 2035!

What future for the automotive industry?

This is the question asked by Cetim to big names in the sector as part of an e-book entitled "Looking ahead: key trends for the automotive sector" around five major themes: tending to zero pollution, bring more comfort in the vehicle of tomorrow while guaranteeing maximum safety, sketching the contours of the car factory of the future, the place of virtual and simulation in the design of the tomorrow's vehicles and the inevitable globalization of the market. A reference book available in November 2018.

>>> Strong impacts on the industry

The mutation will be long, but it is launched. According to the Automotive Platform (PFA), by 2035, the market share of 100% electric vehicles in Europe should reach 19%, and the one of Plug-in hybrids 10%. Non-electrified conventional combustion engines (petrol and diesel) account for no more than 30% of sales. With regard to self-driving, "within 15 years, 8% of sales will be made on vehicles of the level. 4, that is to say, able to take full control under certain conditions, and 100% autonomous Robo-taxis of level 5, will represent 1% of the market, announces Eric Esperance, Partner of automotive pole of Roland Berger France. It is still a little, but on a market of more than 100 million units, we are talking about several million vehicles every year! " And some are getting ahead, like the american giants of car sharing and digital. Waymo, a subsidiary of Google, announced in January 2018 the purchase of ... 62,000 Chrysler Pacifica hybrids to build a fleet of vehicles without drivers for the



With its concept Symbioz Renault sees the car of tomorrow as an integral part, of the home but "Detachable".

public. "This time, they are no longer weak signals," says Guillaume Devauchelle.

New Challenges

For the automotive supply chain industry, all these upheavals are new challenges. Aboard Robo-taxis, the notion of "quality of life on board" becomes preponderant. "This requires considering new aspects such as sensations related to materials, the integration of genuine materials in passenger compartments, or the added value provided by the Internet of Things in terms of comfort and safety, explains Vincent Caulet. The design of these vehicles also induces a further noise-vibration-comfort approach in the simulation and test phases. "The proliferation of models in a context of accelerated release of new products and" unit "manufacturing also implies a massive use of simulation, as well as of the product on the manufacturing processes.

Objective:" to produce good quality parts " at first "and guarantees the viability of machines intended to operate sometimes 24 hours a day. Already in the spirit of all manufacturers, the ecological challenge also becomes even greater ... because we must aim for zero pollution! The ways to achieve this are known: lightening, with the use of new metallic and composite materials and optimized designs

(topological optimization, eco-design ...), the improvement of conventional powertrains, the development of 100% electric traction chains and the integration of new fuels such as hydrogen ... "Solutions to test, validate and industrialize", notes Vincent Caulet.

Towards individual production

Some areas are preparing to radically change products. For the undercarriage of the future, for example, Michelin is relying on a wheelbase that replaces the wheel and the tyre, and the bearing is recharged by additive manufacturing. However, "in the factories, a whole part of the manufacturing process will remain unchanged. But the arrival of autonomous vehicles is leading us to levels of regulatory constraints similar to those of the aeronautics world. This makes it possible to place a particular emphasis on traceability aspects, "notes Eric Marchiol, Digital officer Manufacturing of Supply chain of the Renault-Nissan-Mitsubishi Alliance (see page 13). The manufacturers also anticipate the use of more diverse materials in production. Are we heading towards a complete overhaul of production methods? "The platform logic currently in force is far from being questioned, replies Eric Espérance. It is a good way to increase the

Mondial.Tech: a B to B meeting to prepare for the future

Giants of the Net, start-ups specialized in breakthrough technologies, creators of new services, the automotive ecosystem welcomes many new players.

In order to adapt to this new industrial situation, the Paris Motor Show, which celebrates its 120th anniversary this year, is also evolving and doubles for the first time a B2B event: Mondial.Tech. "It is positioning itself as an aggregator of content and communities around innovative solutions for the automotive and mobility of tomorrow. For its first edition, it brought together manufacturers, equipment manufacturers, technology suppliers and start - ups on a dense program of conferences, including a day of keynotes during which leading automotive and tech leaders confronted their visions of tomorrow's mobility" commented Jean- Claude Girot, General Commissioner of the two shows.

diversity of the offer, to make personalized cars and small series of very specific vehicles dedicated to customer targets, cities, etc. while absorbing large volumes and reducing costs by pooling parts that are not visible. "The number of available engine bases is already decreasing. And for some parts, we are already seeing the drastic reduction of the number of references. We have screws that screw in plastics, in nuts to be pinched or directly into sheet metal," says Sean Farrell.

Strong cultural constraints

The major difficulties for today's automotive stakeholders: "They must invest in new technologies such as the autonomous car and create new services. They must also invest in the medium term, that is to say, improve the current production tools to keep their markets," explains Éric Espérance. In this rapidly changing ecosystem, the equipment manufacturers may be the big winners. "In direct relation with all the manufacturers, they are concentrators of needs. In addition, they master the technologies and benefit from a scale effect," continues Eric Espérance. However, nothing is played yet because in addition to the user's fears towards gear that is beyond their control, disruptive technologies raises new issues. How to permanently ensure the cleanliness of a shared vehicle? Can a connected car be hacked? "There are also reliability issues. Currently 10% of accidents have technical causes. With the autonomous car, the



And if cars were flying?

Finished the run- off roads! Around the world, there are dozens of autonomous flying vehicle projects! Among them, two Airbus projects: Cityairbus a four-seater vehicle still in development and Vahana, a single-seater that has successfully completed its first flight. The aircraft manufacturer is also working on Pop. Up (photo), a concept of mixed flying taxi with Audi. The principle: a cabin fixed, as needed, on a wheeled chassis or a flying base. Safran has also embarked on the development of innovative electric hybrid propulsion systems for Bell's vertical take-off and landing vehicle concept. Several manufacturers are also in the ranks, like Aston Martin and its Volante Vision Concept, Daimler, and the Chinese Geely, who bought the American Terrafugia.

Developments are moving fast. The developments are progressing quickly. New players such as Pal-V or Lilium Jet are already ready to market their vehicles. In early 2018, the British Rolls Royce, a specialist in aircraft engines, has meanwhile presented an announced prototype ready to take off in 2020!

accidentology will decrease, the shocks will be less brutal, but the rare accidents will undoubtedly be over-mediatised, as in aviation today. This could delay the adoption of these technologies", warns Eric Kirstetter, Partner at Roland

Berger's automotive division. The image of the grumpy driver behind the wheel in the traffic jams may still have many good years ahead ...

■ JSS

The service station of tomorrow will be multi fuel

Classic gasoline, including biofuels, diesel of different levels of quality, liquefied propane gas, natural gas for vehicles, hydrogen, electricity, Adblue for anti-pollution systems ... With the proliferation of uses and vehicles, the service station of the future becomes a multi-energy feeding point. Larger than at present, especially for security reasons, more oriented towards services, they are also rarer on the territory. Some will be specialized in product types and customers, especially professionals. Remains a question to be addressed: between the prohibition of such sites in urban areas and the lack of profitability in rural areas, where to implant these new generations of stations?



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Points of View

The French are well positioned in the race to innovation

In the domain of research, product and process innovation, French players, car manufacturers and equipment manufacturers, are among the best in the world and are continuing their efforts to maintain their lead.

"The concept of series disappears"



Eric Marchiol, Digital officer Manufacturing & Supply chain of the Renault-Nissan-Mitsubishi Alliance

"Our aim is to produce, as close as possible to the places of consumption, vehicles that meet exactly the wishes of each client.

Thus, the notion of series disappears but the one of large volume remains. Already, with the combination of possible options, we no longer produce identical vehicles and the structure of our factories allows us to consider multiplying by 10 their level of diversity in terms of silhouettes. In concrete terms, this involves the integration of new technologies such as metal printing, but we are moving all our current processes towards "one-off" production. For the manufacture of plastic injection bumpers, we are working, for example, on the possibility of changing moulds with each new part. As part of a project called "Full Track & Trace", we also aim at total traceability of products and processes. By 2025, all parts of our vehicles will be serialized, and their "lives" will be known at any time before, during and after production in our factories. The aim is to improve traceability, but also to nurture new after-sales services and to constantly know the stock and outstanding amounts in our factories. Our other digital transformation projects aim at real-time control of production based on data from machines, by using the information collected to organize predictive maintenance and optimizing our installations, without forgetting the human aspect, especially with the use of mobility tools tailored to each user."

"Federate Forces on promising topics"



François Badin, industrial project manager at the IFPEN Carnot Institute

"Technological innovations in the automotive world are currently responding to a global concept called ACES (Automatic Connected Electric and

shared) All these aspects are discussed, and progress is being made in these areas. For example, vehicle electrification will be built on advances in connectivity and sharing. The major French players in the sector, both manufacturers and equipment manufacturers, are well placed in the global race, but the small structures, SMEs and Midcaps, also have a major role to play. In the new information and communication technologies, in particular, innovations are often driven by start-ups.

In France, the structure of the Carnot institutes, particularly in the context of sectoral actions such as Carnauto, which brings together several institutes with the aim of boosting SME innovations in the automotive world, is particularly important. well adapted to their emergence. It makes it possible to make the link between upstream research and the transfer to the economic fabric and thus to have on our shelves the products and solutions of tomorrow. This federates forces on promising subjects. The research and industrialization actions of the Carnot institutes are carried out in close collaboration with the other actors in the sector (PFA, Competitiveness Clusters, research centers, etc.). "



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"A DNA change for all components"

Guillaume Devauchelle, innovation director of Valéo

"The car as we know it today is adapted to the uses of the twentieth century but not to those of the future. The future will see large concentrations of people in mega-cities - and the desertification of other areas - which will create needs that only

new mobility solutions based on autonomous, connected and electric vehicles will be able to meet. And that brings about a real paradigm shift! Indeed, as part of these new mobility solutions, the car becomes a means of transport, and also a place of entertainment, learning, care ... The possibilities are almost endless. And many of the necessary technologies seem already available, these upheavals represent a real.

DNA change for all vehicle components. To ensure automated driving, for example, "vision" sensors need to be cleaned very regularly and car lighting needs to be adapted. The management of the air conditioning of an autonomous shuttle will have nothing to do with that of a conventional vehicle. Some components will necessarily multiply the functions. The taillights could notably be used to implement "Welcome Scenarios" on autonomous taxis to accommodate the user who has reserved it, their air conditioning will be responsible for "cleaning" the air between each use and the cameras on board the vehicles will provide presence detection, identification, vigilance detection, pulse measurement or other passenger constants to adapt transport conditions ... The car is reinventing itself and all actors must think about the technological bricks they will be able to offer and their activity to find a place in this new paradigm. "

"Autonomous taxis will ask for more fixations"

Sean Farrell, Strategy and Marketing Director, Lisi Automotive

"Currently, a car account between 3000 and 5000 mounting points. The inevitable electrification of vehicles induces a reduction of the needs for certain bindings, but the future also offers us new challenges. Indeed, in 2035, new mobility solutions could represent 30% of the market. This segment includes "autonomous taxis". The emergence of these solutions will considerably change the specifications of manufacturers. The interior fittings of the vehicles will have to adapt to this new use, for example by loading additional equipment or even swivel seats. We will therefore have to provide suitable fastening solutions to ensure passenger comfort and safety. In addition, while today's cars are 95% of the time, to be pro-

fitable, these taxis will have to drive continuously, without idle time. This implies faster wear of vehicles - even if one gains more reliability - and more frequent intervention frequencies for maintenance or repairs. Today, manufacturers require interior fixtures to accept five disassemblies without replacement. On these taxis, we are targeting 20 disassemblies. Maintenance operations should also be carried out as quickly as possible to limit downtime, which will involve implementing innovative solutions. "



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Approach

Navya, pioneer of intelligent mobility

Created in 2014 Navya has sold 89 autonomous shuttles on public or private sites that complete the transport offer. His latest project: an autonomous taxi soon to be testes in real conditions.

Navya enters the world of the big ones! In July 2018, the company is listed on the Euronext Paris stock market. At the same time, in August it signed a 30 million financing agreement with the European Investment Bank (EIB). This will ensure its development and reinforce its leading position in new smart and shared mobility solutions.

Rapid ascent

In 2014, Christophe Sapet founds what is then a start-up of about fifteen employees.

The entrepreneur is not at his first attempt, since he is also the creator of Infogrames and Infonie. Within one year, it develops and markets a self-driving vehicle presented in 2015: Shuttle Autonom Shuttle. Today Navya has more than 220 employees at its two French sites (in Lyon and Paris) and the United States near Detroit (Michigan). Its Autonom Shuttle is a 100% electric and 100% self-contained public transport vehicle, with no steering wheel, pedal or driver seat, which can accommodate up to 15 passengers. It runs at 25 km / h and has an average driving time of 9 hours. "Our speciality is the first and the last kilometer, for which the business model with driver is rarely viable," explains Diego Isaac, head of communication and marketing. The autonomous vehicle makes it possible to serve new areas and increases the capilarity of the transport network. As of June 30, 2018, the 89 Navya shuttles operating in 17 countries have carried more than



275 000 passengers. The company combines services such as the maintenance or supervision of shuttle buses on the move. From the control center based in Lyon, technicians can access vehicle data, for example to establish diagnoses. A communication module also makes it possible to exchange with the passengers and a 360° camera can visualize, in real time, the situation inside if necessary.

A battery of last generation sensors

"The specificity of Navya lies in its latest generation sensor architecture that we choose and implement, as well as in the software part with artificial intelligence that makes decisions," says Diego Isaac. Based in Paris, his R & D team conceives

On the esplanade of the Defense, three shuttles of Navya circulate each day in the middle of the walkers.

the software, programs and algorithms that pilot the vehicles, which are based on three principles: perception (locating the vehicle and detecting obstacles), the decision (planning the route and the trajectory) and the action (application of decisions). For some sites, a GNSS antenna can communicate with a reference beacon at any time to determine and confirm the position of the vehicle in an ultra-precise manner. An odometry system measures the speed of rotation of the wheels to estimate that of the shuttle and to confirm its position. Cameras are used to detect obstacles and assess their position relative to the vehicle, while analysing the environment (signs, lights) to trace the information. Finally, 2D and 3D perception sensors

map the environment, also detect obstacles and guarantee a precise position.

A solid experience

For two years, Navya has operated the Lyon Confluence site. The 1.3-kilometer route includes 5 stops to serve the different buildings in the area. On the Esplanade de la Défense, three Autonom Shuttles can be seen safely in the middle of pedestrians, on three different circuits, covering the area, which receives more than 50 000 visitors a day. In Sion, two shuttles move in real traffic conditions on behalf of Carpostal, the largest Swiss public transport company. To accelerate growth, Navya has signed a technology partnership agreement with Valeo and is deploying with Keolis, the two groups forming part of its main shareholders. The transporters are also associating Navya with its development projects. The two partners funded the first pilot self-driving shuttles on public roads in the city of Candiac, near Montreal, Quebec, for a period of 12 months. The 2 km route includes several stops throughout the city to best meet the mobility needs of users, particularly for home- work journeys. The project is supported by the Québec government.

The main challenge for the development of autonomous vehicles: safety. As the slightest accident

can ruin years of effort. With the progress of the artificial intelligence, the problem becomes less technological and legislative. "It is complicated to advance the legislation, recognizes Diego Isaac. We regularly exchange with the public authorities to show them how the autonomous vehicle operates. Other obstacle, the perception of the general public must change. The autonomous vehicle must be accepted. For this, we want to put in place devices that make it possible to test the shuttles, in order to overcome the apprehensions. "Toward the autonomous taxi The latest project of the company: the Autonom Cab, the first autonomous taxi capable of carrying 6 people, which should be deployed in Lyon and Perth (Australia) in the second half of 2019. If the shuttle is still operating on the same route, the taxi must travel on different routes at the order. With 10 Lidars sensors, 6 cameras, 4 radars, 2 GNSS antennas and 1 inertial unit, the sensor architecture allows a triple redundancy on all the functions, which guarantees the reliability of the vehicle and its safety. Without forgetting the comfort! On board, the passenger has all the connectivity to work, make an interactive cultural tour of the city, order museum tickets or book a restaurant. ■ AL



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With the **Autonomous Cab**, Navya moves from the autonomous shuttle circulating in a "controlled" environment to the Robo-taxi evolving among the other cars.