CESVIMAP: Innovation as a service

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CESVIMAP, Centro de Experimentación y Seguridad Vial MAPFRE [*MAPFRE's Center for Experimentation and Road Safety*], is MAPFRE's R&D centre in the framework of **MAPFRE Open Innovation (MOI)** model. We are a MAPFRE's innovation laboratory involved with new mobility products and services developed around, for instance, Usage Based Insurance (UBI).

Figure 1. The CESVIMAP headquarters building in Ávila.
Source: CESVIMAP.

Our **mission** is to contribute to overall mobility and to the design, development, experimentation, and implementation of innovative practical solutions that help transform the insurance sector, based mainly on technology.

We are a **global bellwether as a technology centre** for designing, using, maintaining, repairing, recycling, and improving the safety of automobiles and other mobility solutions for goods and people. Our technology research is aimed at reducing the accident rate and finding more efficient, less expensive procedures for effecting repairs.

CESVIMAP includes environmental aspects and social value generation by coming up with innovative formulas for insurance based on its R&D activities, innovation, consultancy, training, knowledge dissemination, and promoting the circular economy connected with managing the end of the life cycle of vehicles.

CESVIMAP was established in 1983 and is currently a **global bellwether for innovation**. Other centres using CESVI's approach have been created around the world since that time, in Argentina, Brazil, Colombia, France, and Mexico, working to achieve a safer future and increasingly coordinating among themselves.

Relevant facts

In figures, CESVIMAP operates daily around a core of nearly 120 researchers, engineers, and technicians working in a cutting-edge technical facility of over 40,000 square metres in size. We have been adding value to MAPFRE and to society from our headquarters in Ávila for almost 40 years.

A **high level of environmental and social responsibility** is our foundation, and our goal is to create value for MAPFRE and for society using a range of work vectors, as already mentioned a little earlier.

- Research and Development and Innovation.
- Sharing knowledge.
- Consultancy activities.
- Providing updated training.
- Doing valuable work on projects concerning vehicle end of life management.

From our inception we have experimented on over 700 vehicles in our crash test facility and have completed more than 600 research projects.

With our sights continuously set on the future, we have been in the forefront of studying new means of transport: electrified vehicles, PMDs (personal mobility devices), etc. We have also experimented on self-driving vehicles to ensure that their technology meets the highest safety standards.

We **share** the **knowledge** gained from our research **with industry** and with society: insurers, vehicle manufacturers, transport providers, mechanics, and students. In this connection, we are proud to assist **claims adjusters**, mechanics, and students in entering the insurance sector and in gaining knowledge of MAPFRE's best practices. By way of an example of the scope of that work, let us say that over 76,000 students have visited our facilities or our online platform and that we have taught over 6,000 courses.

Our journal and social media are other ways we use to share our knowledge. In numbers, today we reach:

- More than 145,000 readers of the CESVIMAP Journal.
- More than 33,000 followers on social media.
- More than 7,500,000 YouTube views.
- And we have released nearly 2,600 technical publications and 50 books for professionals and students.

Through our **consultancy** activity, we provide independent advice for professionals on request using B2B[1] and B2A[2] business models. Our consultancy work already totals nearly 65,000 hours.

Referring to the field of **claims adjusters**, over five million adjuster's reports are drawn up yearly based on CESVIMAP's bodywork and paintwork standards in such countries as Argentina, Chile, Colombia, Ecuador, Spain, Mexico, Peru, Portugal, Venezuela, and more.

A concern for **sustainability** and the environment are among our chief core values. With that in mind, in 2004 we created **CESVI Recambios (spare parts)**, CESVIMAP's centre for processing vehicles no longer in use. There we eliminate the potential environmental impact of MAPFRE vehicles that have been declared a total loss. To date we have decontaminated more than 46,000 vehicles, recycled their hazardous parts, and put back on the market nearly a million and a half parts, giving them a warrantied new lease of life so that other, new ones do not need to be manufactured. By our own decision we do not market the structural or safety components of vehicles.

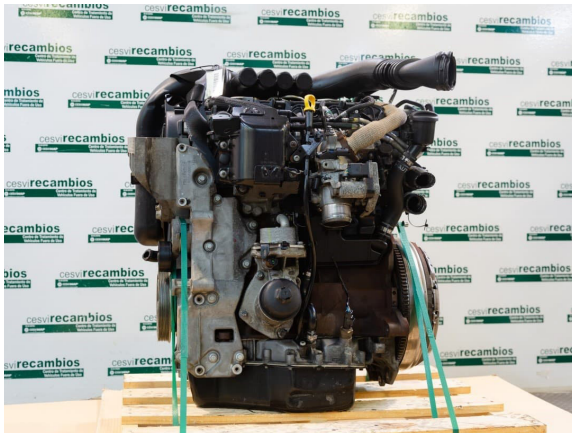

Figure 2. CESVI Recambios.
Source: CESVIMAP.

International presence

CESVI BRAZIL (1996), CESVI ARGENTINA (1996), CESVI MEXICO (1998), CESVI FRANCE (1999), and CESVI COLOMBIA (1999). MAPFRE decided to transplant the CESVIMAP approach to other countries, where our working methods have been successfully implemented.

(1) B2B: *Business-to-Business*, a business model or means of exchanging information between two businesses.
(2) B2A: *Business-to-Administration*, a business model comprising a series of cooperative activities or transactions between business and government bodies.

CESVIMAP is also a member of RCAR (*Research Council for Automobile Repairs*), an international organisation with the shared goal of conducting research to enhance vehicle repairability.

We are also a *Global Innovation Partner* of International Bodyshop Industry Symposium, IBIS Worldwide, and we work with them on various international conferences on automotive topics that are worldwide in scope.

Comprehensive training

CESVIMAP provides comprehensive training in the workshop aimed at all the different categories of automotive professionals, executives, garage managers, receptionists, body repairmen, painters, electricians, and mechanics for vehicle manufacturers, contract hire companies, car sharing companies, automotive suppliers, government law enforcement agencies, etc. Our training is also directed at secondary school teachers and **university programs**, and there is an agreement with the Catholic University of Ávila in place. Training can be either through classroom or online learning.

CESVIMAP is an expert in **garage management and consultancy**. It has excelled at garage setup and design for more than 30 years, developing public-oriented work stations and best practices. Our TQ (qualified workshop) and PROMASS garage certification programmes bring a professional outside look at businesses. Our CESVIRating programme provides practical guidelines for independent garages or repair shop networks to help them optimise their resources and obtain return on their investments so as to attain their goals, and it is now 100% online.

All of CESVIMAP's knowledge comes from studying new automobile models. First, they are subjected to a series of collision tests in the special crash test area. They are then assessed and put back into their original safety conditions at the centre's experimental shop. The vehicles are then classified on the basis of the test results so that insurance policies can be issued having in mind the cost of repairs.

CESVIMAP's research work is rounded out by its outstanding work in traffic accident reconstruction. This lets us establish the conditions preceding the accident and work out what happened with a view to providing objective data for the claims adjuster's report and potentially for use in court. The work also has a helpful impact on road safety by furnishing relevant data on human factors, road and weather conditions, vehicle condition, and the functioning of safety components. This work is topped off by studying vehicle burning.

CESVIMAP also provides **comprehensive training for claims adjusters and insurance companies** in all matters related to adjuster's reports and vehicle appraisals for university credit, e.g., the Advanced Automobile Claims Adjuster Course. This year's course in 2021 will mark the 25th anniversary of this training. We also hold technical courses on industrial vehicles, agricultural machinery, motorcycles, and traffic accident reconstruction.

Figure 3. Claims adjuster and garage manager.
Source: CESVIMAP.

Vocational training

CESVIMAP supports vocational training in different ways; these include putting together complete technical reference works and publications, building an extensive multimedia document collection, issuing the CESVIMAP Journal quarterly for more than 35 years, and directly working with and supporting vocational training students and teachers

with programmes like the COMFORP and FORTECO programmes, lending them parts, bodies, and other materials to practice on.

CESVIMAP's technical publications for professional appraisers and repairmen report on the results of research conducted on vehicle repairs and appraisals. All our publications depict the working procedures carried out a CESVIMAP shops in full documentary and graphic detail.

CESVITECA is an extensive document collection specialised in vehicle repair and appraisal, an online CESVIMAP library for garages, claims adjusters, the automotive sector, and teaching staffs. On the occasion of the pandemic, we made this available to professionals free of charge for six months.

The CESVIMAP Journal is a free communications medium that sets out the results of CESVIMAP's research and experimentation in technical articles that contain illustrations of working processes and equipment and product testing carried out by CESVIMAP.

University courses

The CESVIMAP BUSINESS CHAIR was established in 2009 under a cooperative agreement between CESVIMAP and the Catholic University of Ávila (UCAV). Some of this programme's chief attributes include:

- Involvement in developing curricula.
- Subjects are taught by experienced professors and CESVIMAP technicians.
- Proposals and guidance of degree course final projects.
- Training and advice during work and teaching internships at CESVIMAP and ongoing monitoring of performance.
- Involvement in the sustainable development doctoral programme.
- Holding conferences, seminars, meetings, and symposia concerning the automotive sector, one of these being the CESVIMAP Lecture Series.
- Teaching courses for UCAV's own degrees.

Besides acting as thesis directors and advisers for students, a series of teaching activities are carried out under CESVIMAP's aegis, including the University Advanced Course in Automobile Appraisal, the Expert Technician in Automotive After-Sales Course, and the University Technical Course in Road Traffic Accident Reconstruction.

Mobility

CESVIMAP has a special department that studies and analyses all aspects of what is known as CASE (***Connected / Autonomous / Shared / Electric***) mobility. We examine mobility from different vantage points from a claims adjuster and bodywork perspective, considering how electric mobility modifies all the parts and components making up the structure of a vehicle. We have thus ascertained that manufacturers are taking a two-fold approach to developing electric vehicle platforms, adapting internal combustion engine vehicle platforms to electric vehicles or creating platforms especially for electric vehicles. Conventional modular platforms permit cost savings through standardised components and economies of scale, but they also present difficulties to developing electric cars, mainly because of the batteries, because the platforms developed for internal combustion engine vehicles were not designed to house the traction batteries for electric vehicles from the get-go.

Recent EU emissions regulations and tough anti-pollution measures (Regulation 2019/631 of 17 April 2019) have taken a mean of 95 g/km CO_2 as their fleet-wide goal for vehicles. These regulations are currently being implemented and mean that electrification is clearly here to stay. In addition, the multi-billion euro fines faced by automobile manufacturers that exceed those limits will bring about a radical shift in the playing field. CESVIMAP's involvement and its research take on still greater significance in this context.

We can say that here at CESVIMAP we are a leader **in electrification and mobility**. We were the first research centre to study electric cars, back in 2011. With the knowledge we have gained, we are now in a position to offer the market the specialised training it needs, with unrivalled teaching staff and equipment and the ability to work on actual vehicles or use virtual reality.

Figure 4. The CESVIMAP garage and its self-driving car.
Source: CESVIMAP.

PMD research at CESVIMAP

New means of transport based on the concept of micromobility (small distances with the final stage being covered on foot or by bicycle) adapted to users' mobility needs have been developed. This is the context in which personal mobility devices, or PMDs, have arisen, and they are making greater inroads daily.

CESVIMAP, in cooperation with the MAPFRE Foundation, has performed a study entitled "Crash tests on electric scooters and risks associated with charging procedures". The report breaks down accident data form PMDs by accident type, the vehicles involved, rider age, the road on which the accident occurred, and severity. This report garnered intense media coverage – more than 10 television channels, 14 radio stations, and 70 newspapers covered the story. The report includes experiments focused on modifying PMD components and on overheating from manipulating their batteries and using portable chargers.

The analysis of this information on the most common accidents involving PMDs in cities initially made possible simulations using special traffic accident reconstruction software. Then based on that assessment real crash tests with dummies were designed and performed at the CESVIMAP facility. The apparatus used to conduct the crash tests for PMDs with dummies has been patented at the Spanish Patent and Trade Mark Office.

CESVIMAP, an ADAS laboratory

Since 2015 CESVIMAP has been conducting research, testing, disassembling, and evaluating vehicles that include ADASs(3) as standard equipment, for instance Autonomous Emergency Braking (AEB) systems or Lane Departure Warning (LDW) systems and developments enabling them to correct steering. The object is to gain a clear and precise picture of how these systems work and their limits, that is, to ascertain the circumstance in which they may not work, either because their sensor has failed to detect the situation or because the system's programming does not contemplate cases of that kind.

Why are we evaluating ADAS vehicles? The main objective of our research is to **assess a vehicle's ability to avoid accidents** and, in that way, avert personal injury and property damage, which directly impacts on road safety. Furthermore, the presence of ADAS sensors *may affect vehicle repair costs*, since they tend to be located in places relatively highly exposed to the effects of accidents. For instance, a parking accident involving a ball hitch coupling will have a substantial effect on repair costs and thus on insurance companies' bottom lines and on policyholders' pocketbooks.

The point is to weigh the cost-benefit of these systems, taking as a starting point that if an ADAS works properly, repair costs become a secondary consideration. However, if a system malfunctions or does not work at all, the increased repair cost is not justified, hence the system's cost-benefit ratio is dubious.

Services for insurers and claims adjusters

We here at CESVIMAP have been in a privileged position from which to observe the changes that have been taking place in the work of insurance companies in assessing damage to automobiles. **We have worked with them side-by-side the whole time**, in the face of technical changes, changes in processing and file management, evolving technologies, and the like. Our whole reason for being is to provide automobile claims adjusters and professional damage appraisers working with garages, fleet management companies, contract hire companies, and others with the necessary know-how to enable them to cope with the tasks they face. Thanks to the new connectivity technologies, different products for locating stolen vehicles, variable insurance premium rating, and accident prevention and detection are coming onto the market.

Claims adjuster mobility

For claims adjusters, mobility is a must. This has understandably caused the conventional tools of their trade they use to draw up their reports for insurance companies and policyholders to be adapted so that their mobile devices can be linked online to all the applications contained in the *claims adjuster's tool kit*. This allows them to assess losses, provide guidance to garages, reconstruct accidents, etc. The benefits are clear: cases can be processed faster, and adjusters can increase the number of appraisals and close processing right at the garage, reducing the number of visits and enhancing follow-up of the work they have performed.

The power of AI when appraising damage to vehicles

In cooperation with CESVIMAP, MAPFRE's Innovation and Operations Departments have developed an artificial intelligence model for use in directly purchasing insurance policies for used vehicles online. This is made possible by the company's use of trailblazing artificial intelligence (AI) software capable of detecting dents, scratches, and small defects in the bodywork in real time from photographs taken by the user him or herself on their mobile phone. This was done in cooperation with the company Control Expert, which trained the predictive model using a very high

(3) ADAS stands for Advanced Driver Assistance Systems.

volume of varied images and the expected response for each. As a result, the software is able to determine whether a vehicle is damaged or not from photographs it has never seen before, with an accuracy of 95%.

The innovative aspect of this pilot project is to have a learning algorithm (state-of-the-art technology known as *Deep learning*) analyse images in real time and detect the presence or absence of damage of all kinds. This appraisal allows policies to be personalised for each customer. If the customer approves, he or she can then benefit from the insurance policy on the spot, with no waiting and no need move, and the policy can be issued in minutes, without any human involvement.

Automated appraisal from images using AI is one of the strategic objectives of MAPFRE as an insurer and of **MAPFRE Open Innovation** as the company's innovation division.

Systems like these can also be used to buy home or business insurance apart from car insurance. Expediting procedures and giving customers a simple, modern, personalised experience is key to these new generation products.

Online audits

Besides offering quality work, managing a garage **profitably** also requires **optimising procedures**. It is therefore necessary to monitor all aspects of the business carefully so as to keep profit margins at an acceptable level. In recent months the market has changed drastically, and the traditional business model of companies that viewed digitisation as a long-term project has shifted to one in which online functions have become much more important.

In keeping with the current changes in business practices, CESVIMAP now offers **online audits**. This procedure provides repair shops with data concerning their strong points and where they have room for improvement based on the documents and images furnished by the shops themselves or by the network or brand they belong to. The objective is to offer the same guarantee of quality as the on-site inspection variety but with fast assessments made possible thanks to this innovation.

ISO certification

From the very outset CESVIMAP decided to put its faith in the quality of its research, dissemination, services for repair shops, and training while carrying out all its activities with the utmost concern for protecting the environment.

In 2001 we implemented a Quality Management System to certify training activities. This certification under ISO standard 9001 recognises CESVIMAP's creative ability to adapt to its customers' needs and design bespoke training programmes in the automotive field. This ability was the result of our own know-how and methods. This is the building block CESVIMAP uses to organise whatever is needed for training and to monitor progress and outcomes with the objective of continuous improvement in its training capabilities to be able to fulfil the increasingly exacting demands of its customers.

A year later, in 2002, CESVIMAP certified its environmental Management System under ISO standard 14001. This certification recognised the measures taken by CESVIMAP to comply with applicable legal requirements and each year's environmental commitments in the framework of its dedication to preventing pollution and protecting the environment.

ISO standard 14001 helps manage and identify environmental risks that may arise internally in the company in the course of its activities. Risk prevention and environmental protection are both taken into account. The quest for sustainability has become one of the linchpins on which the business activities are based.

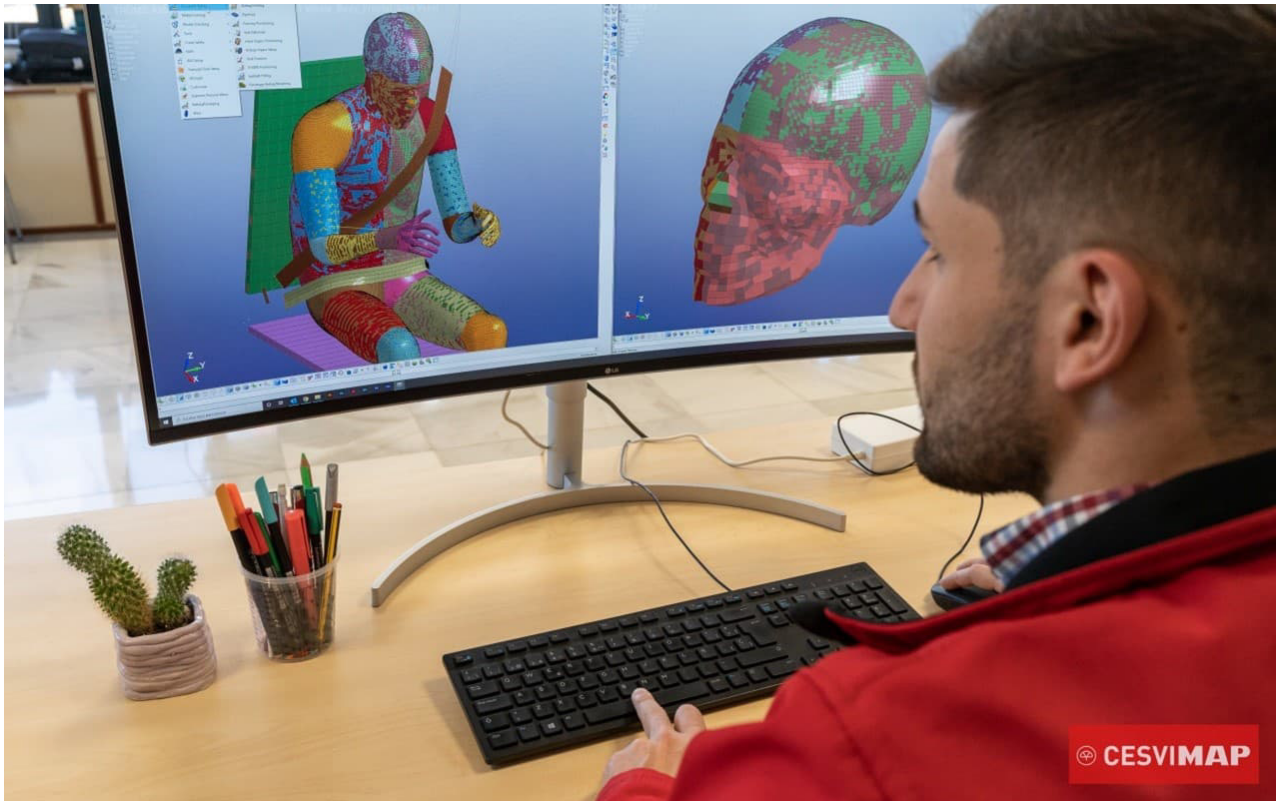

Figure 5. Computer road safety simulation software.
Source: CESVIMAP.

Furthermore, in 2016 we were certified under ISO standard 39001 Road Traffic Safety, recognising our engagement in that area and the many actions taken to promote road safety in our society. The road traffic safety management system is a tool that helps organisations reduce the incidence and the risk of suffering traffic accidents and limit their consequences. CESVIMAP's management system also encompasses sustainable mobility and promotes methods of transport consistent with its commitment to the environment.

Additive manufacturing and the automotive industry

CESVIMAP works in other fields related to the automotive industry. For example, it studies advances in additive manufacturing[4] technology to see how vehicle manufacturers and other providers design, market, and apply 3D printing to this field. CESVIMAP specialised engineers regularly attend the major trade fairs in Spain and in Europe (ADDIT 3D, BIEMH International Machine Tool Exhibition, MetalMadrid, Formnext, etc.) to collect first-hand all information related to the sector so we can be ready for these advances and play a role in a future that is increasingly turning into the present.

CESVI Recambios

Today no-one can imagine our society and our way of life without the automobile. However, when a car reaches the end of its useful life, it can pose a threat to the environment. Cesvi Recambios, CESVIMAP's Authorised Parts

(4) Additive manufacturing is a process based on converting a digital model into a solid three-dimensional object.

Processing Centre, is a touchstone for how to dispose of vehicles in an ecologically responsible manner, prolonging the lifetime of parts (*recambios* in Spanish) that are in good condition by using them to repair other vehicles and helping to recycle the base material of the rest, steel, plastic, aluminium, glass, rubber, tyres, fabric, and so on.

Responsible consumption means prolonging the lifetimes of the products we use and subsequently converting them into other, new products to the extent possible. Automobiles too can be reused or recycled. But is a used car as reliable as a new one? How can we be sure that it is still suitable for use after an accident? And if it breaks down, does it have a guarantee? Cesvi Recambios works to ensure that the used parts recovered from an automobile meet all the requisite requirements and safeguards so that they can extend their lifetimes into a second cycle.

Since it started operating, Cesvi Recambios, CESVIMAP's End of Life Vehicle Processing Centre, has recycled more than 46,000 vehicles. It decontaminates hazardous components like batteries and all the vehicle's fluids. It recovers the vehicle's materials: steel (currently most of the total weight) and other materials that can put to a wide range of industrial uses like aluminium, plastics, copper wiring, and glass. In that way it can give at least 85% of the weight of vehicle a new lease of life.

More than 53,000 tonnes of CO_2 saved attest to the work carried out by CESVI Recambios on behalf of the environment. Its automated working methods are able to neutralise the environmental impact of MAPFRE vehicles that have been declared a total loss by affording their parts a second life.

In short, CESVIMAP endeavours to create value for MAPFRE and society through its strong commitment to the **environment**. CESVIMAP can be defined by four terms, research, innovation, generation of knowledge useful to the insurance industry, and support for applying that knowledge to day-to-day operations. This knowledge is conveyed to **claims adjusters, insurance companies, and transport professionals** to help attain a safer society on the road.