

Valeo SVA - Special Vehicle Applications

Valeo SVA use Romax software and services to achieve a CAE-led design process for eMobility system development



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Jérôme Mortal,
Transmission Systems Product Group R&D and Electrification
Director at Valeo

Air quality targets, agreed by governments and enforced by legislation, are driving the automotive industry to use electric drive systems in higher numbers. Alongside cleaning up inner-city air pollution, the industry is under pressure to supply solutions to meet growing urbanization as well as additional factors such as reduced room for car parking. The change to the requirements for e-drive units means a shift in the way they are supplied; whereas before they would come directly from car manufacturers, now these OEMs are joined in the market by start-ups and Tier 1 suppliers, all competing to offer e-drive systems to power the next generation of vehicles. As these automotive suppliers move towards new types of mobility solutions, suppliers are also expected to work differently with OEMs. Whilst previously they may be tasked with supplying simple parts to precise specification, as systems become more complex, suppliers are increasingly being asked to work on a subsystem level, or even on the full propulsion system. Concurrently, electrification, autonomous driving, connectivity, car-sharing and reducing battery costs are all contributing towards increasing demand and mounting pressures.

Client

Listed on the Paris stock exchange, Valeo is an automotive supplier and partner to automakers worldwide. In 2019, the Group generated sales of 19.2bn EUR and invested 13% of original equipment sales into R&D. Employing nearly 115,000 people across 33 countries, Valeo create innovative products which contribute to reducing CO₂ emissions and developing intuitive driving.

Challenge

Designing and supplying micro-urban eMobility solutions which are versatile and cost-effective, utilizing a robust process which expedites development cycles.

Solution

Adopting CAE-led design processes, achieved through gaining knowledge from Romax engineering experts and using Romax software for comprehensive analysis of integrated electric driveline systems.

Benefits

Eliminating one physical prototyping iteration by moving testing to the simulation stage, leading to a 7-9 month reduction in development times.

Jérôme Mortal, Transmission Systems Product Group R&D and Electrification Director at Valeo comments, “The industry is moving faster now than we have seen in the automotive world before. It is hard to believe that just 5 years ago we were working on new ICE production plants. We believe that, by 2030, electrified vehicles (mainly 48V and BEVs) will make up two-thirds of cars worldwide. Our vision is that mobility will be strongly diversified, with a range of micro urban electric mobility on offer alongside versatile hybrid and electric passenger cars.”

Tier 1 suppliers, such as Valeo, have the chance to expand their product portfolio by offering drive systems suitable for a range of applications, from low power (e.g. e-bike) to high power (e.g. truck), which can be installed into vehicles by multiple manufacturers. Valeo’s range of products covers small mobility (<50km/hr, <100km), light electric vehicles, mild hybrids, hybrids, plug-in hybrids and full electric vehicles (which offer high performance at zero CO₂ emissions). Within the small-mobility range, Valeo develop micro-solutions (e.g. e-bikes), scooters, and simple city cars, ensuring competitiveness through reusing and recycling components across the product family. Whilst Valeo already supply a range of e-drive systems, they have recently focused on low power application solutions,

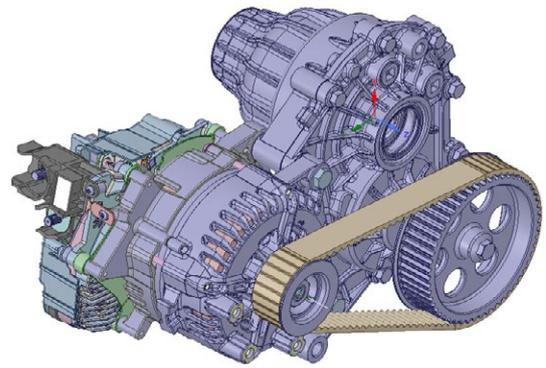
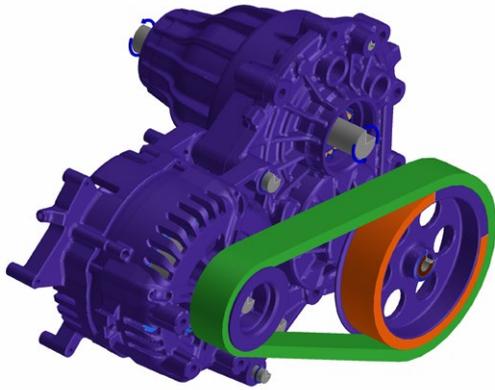
intending to develop a product suitable for multiple applications in order to reach a broader market.

“To keep up with the incredible speed that the industry is moving at, we need tools which enable us to simulate very quickly, so that we can increase the range of products we offer,” Jérôme explains. “For this reason, we use Romax software and services for both gear and electrical machine design, from architecture and layout, to concept and detailed design. However, it is also critical for looking at the system integration and allows us to capture critical electro-mechanical interactions. Romax software gives us an all-in-one environment for comprehensive static and dynamic analysis of an integrated electric driveline system, from a component to a system level, across the whole development cycle, and allows us to move towards CAE-led design processes.”

Versatile micro-urban eMobility solutions

Valeo were tasked with developing a low power 48V e-drive system. Their design consisted of a simple air-cooled system, with power from 6-10.5KW, a bespoke modular transmission, integrated inverter, and permanent synchronous claw pole motor (reusing an existing Valeo motor). Jérôme explains further: “As with most projects, our first steps were to select the optimal reducer ratio and to optimise the consumption, trying to find the right type and size of battery and optimise the full efficiency of the system, based on basic vehicle data and Valeo motor and inverter characteristics. We use Romax Concept in these early design stages, which allows us to investigate multiple layout options with ease. Later, we use Romax Enduro and Romax Spectrum to perform system evaluation, trying to find the best trade-offs across efficiency, performance and gradeability. Our design approach considers multiple performance targets simultaneously. The optimization and variability analysis helps us to create high quality robust designs, and to move towards a Right First Time philosophy.”

During initial layout studies, Valeo investigated various solutions and decided to use a belt drive to connect the e-motor with the gearbox: a solution which offered great variability of ratio while keeping the unit versatile to be installed in multiple applications. Jérôme Mortal comments: “We had a theory that using the belt would improve decoupling and reduce interaction between the two subsystems.” Although Valeo were confident this solution would work, the first design gave far from the desired performance – “we observed unexpected behaviour, mainly due to the stiffness of the belt, so we decided to quickly evaluate some different solutions, working closely with suppliers to make sure what we were simulating was manufacturable.”



Since Valeo had no experience of simulating a belt drive, they called upon the expertise of Romax engineering teams, alongside using Romax software tools. Romax optimised the model, checked the results, performed NVH analysis of the system, and gave training to Valeo SVA. On discovering a resonance issue caused by a higher order harmonic, a change to the belt drive material was found to provide a solution. The design was then validated and verified, looking specifically at the stress and bending limits of the system. Jérôme Mortal explains: “With the versatility of Romax Enduro, we were able to achieve the required durability at an early stage and, in addition, we were able to freeze the design of the housing early. Everything we simulated in the early stage was confirmed later on by test.”

The project brought together four partners: the vehicle OEM (who provided tests and set the specifications), Valeo (who designed and developed the new e-motor architecture, reusing some existing parts for a competitive and affordable solution), Dana (gear and lubrication design), and Romax Technology (belt drive stage simulation and NVH analysis). Jérôme Mortal comments: “As well as providing great software, Romax provided important engineering support. Romax was integral in optimizing the durability while minimising the noise and vibration and getting the best efficiency early in the design process.”

The resulting architecture uses one type of reducer, one type of machine, and can be packaged in different configurations – it has already been used for 1 application in the EU, 1 in India, and 1 in China, all using the same machine and same reducer. This new concept for traction machines, which met targets for durability and NVH, benefits from a patented invention which makes it possible to implement and maintain an adapted tension without needing additional mechanisms to prevent slippage on the Poly-V belt in the powertrain. “Using a belt-drive might seem a surprising choice, however, it makes the system very versatile for different applications, since it covers a very wide ratio (from 9.2:1 to 21:1),” continues Jérôme. “Whilst redesigning systems from scratch for each application may be the ideal, modularity is important in order to be successful in new urban eMobility. The system we have created is very simple and cost-effective.”

Using trustworthy simulation results to eliminate one iteration of physical prototyping

In urban mobility, time to market is key. For new products, typically the customers’ aspiration is 2 years. For this project, Valeo were given 18 months from concept to start of production. In order to achieve this significant reduction in development time, Valeo had to find a way to accelerate the process. They decided to eliminate one prototype iteration by using simulation to test the system extensively within the virtual environment. Having used Romax software for previous projects, Valeo had the confidence that simulation results from Romax could be trusted: confidence which supported their decision to increase the level of virtual testing.

Jérôme Mortal explains: “It is critical that we get a robust design from the very start, and that we can rely on the accuracy of the results so that we can trust them without having to physically test everything. Tools like Romax have allowed us to hugely reduce our physical testing – we only do this now to complement simulation, with approval runs on the testbed to confirm the results of the simulation. Not that long ago we were having to test every single assumption. Now, by the time we get to the A-sample stage, we only test one set of samples before moving to manufacturing. Combining proven software and engineering expertise from Romax gave us the confidence to take the risk of eliminating a full prototype iteration, relying heavily on virtual simulation. With this new approach, we have achieved a 7 to 9 month reduction in development time.”

Valeo SVA delivered the drive unit just 18 months after the start of the project (it was launched in June 2020, and can now be bought in the Citroen AMI One). But even more significantly, Valeo SVA have demonstrated that intelligent use of simulation can allow suppliers to significantly reduce the time and cost of developing a new e-drive unit. “We have shown that it is possible to get a new product into production very quickly, in a process which is only made possible through increasing virtual simulation, which in turn is only possible because the quality of the Romax simulation results gives us the confidence to eliminate tests. We are proud of what we have achieved, and our customer is very happy. We intend to apply this process and knowledge gained in future projects.”



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