SIMULIA

3DEXPERIENCE®

OVERCOME WLTP DISRUPTION WITH SIMULATION AND DIGITAL CERTIFICATION

DASSAULT SYSTEMES

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SIMULIA's complete automotive simulation solution eases the burden of WLTP testing for ranges with many models and variants.

EXECUTIVE SUMMARY

The Worldwide Light Vehicle Test Procedure (WLTP) is a new test regime for vehicle emissions in much of the world, and is much more stringent than the previous measurement procedure. WLTP, or a modified form, has already come into force in the EU and Japan, and will be introduced over the next few years in China, India and South Korea. Vehicles sold in these territories will have to meet WLTP standards in order to be sold. However, WLTP poses several challenges to manufacturers: emissions measured under WLTP tend to be higher, every vehicle configuration needs to be tested individually, and there are limited suitable testing facilities.

Digital WLTP certification can help engineers overcome these challenges. This whitepaper will explain how SIMULIA simulation solutions can be used to design vehicles that meet WLTP and to certify vehicles virtually. This reduces the risk involved in developing a new vehicle design, reduces the time and cost of certifying a vehicle, and allows many different configurations to be tested quickly.

THE CHALLENGES POSED BY WLTP

The increased emissions reported by WLTP can be approximately 25% higher than under New European Drive Cycle (NEDC), making the EURO 6 fleet wide target of 95 g/km of CO2 by 2021 more difficult to achieve. This increases the pressure OEMs are under to reduce emissions, and will potentially increase consumer taxes and fees.

In order to close perceived loopholes in vehicle testing, WLTP requires far more testing than the previous New European Drive Cycle (NEDC) regime did. Every vehicle option needs to be tested to allow for changes to aerodynamics, mass, inertia, rolling resistance and tire pressure. To increase the realism of the test scenario, a higher speed drive cycle is used, along with realistic vehicle shift points and cold start temperatures.

The need to meet precise customer requirements and stand out in a crowded market has led manufacturers to expand their offerings in recent years. Custom configurations increase the complexity even further, with thousands of possible options on some vehicles. Under WLTP, every configuration that will affect vehicle performance needs to be tested. This delays vehicle development and has led some manufacturers to reduce their range of customizations.

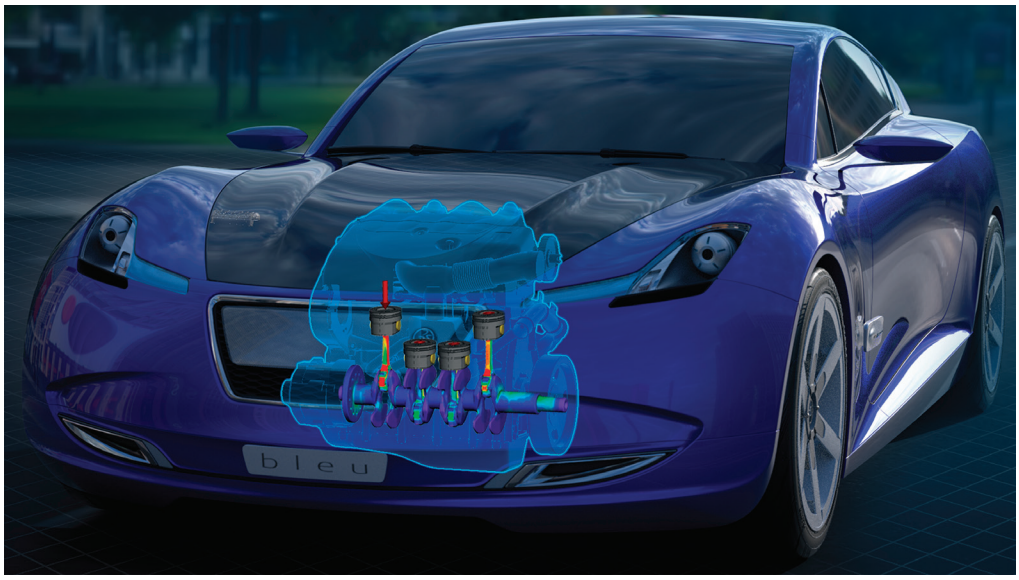
Another issue is that physical wind tunnels are currently at full utilization, and there is insufficient global wind tunnel time for both WLTP certification and vehicle development. Despite new investments, this is predicted to continue into the 2020s. Hundreds of millions are spent annually on wind tunnel time, and the alternative for OEMs is costly coast down testing.

THE SIMULIA SOLUTION

All of the challenges listed above fall into two main categories: there are the challenges facing OEMs and manufacturers during the design stage in order to meet stricter emissions standards, and there are the challenges that arise during testing itself. SIMULIA has solutions for both of these in order to support manufacturers though the entire cycle from initial design to final certification.

WLTP Vehicle Emissions solution

Most car components affect emissions in one way or another, whether through weight, aerodynamics, power consumption, friction or drive performance. SIMULIA has a wide range of solutions tailored to each part of vehicle design. SIMULIA software can be used to optimize structural, thermal and dynamic performance of the powertrain, chassis and suspension performance, the exhaust system, engine cooling, aerodynamics, and performance in adverse conditions. The electric drive solution also offers tools for designing hybrid vehicles, as well as electric vehicles which can avoid WLTP altogether.



Improving powertrain performance is a crucial step towards reducing emissions.

Each of these can cut a vehicle's emissions, and implementing simulation across the design of all components allows these reductions to multiply, as shown in the table below:

Industry Process Experience	Benefit	Reduction in CO_2 (g/km)
Powertrain Structural Performance	25-30 kg mass reduction	1
Chassis & Suspension Performance	25-30 kg mass reduction	1
Exhaust System Engineering	0.042L/100km improved fuel efficiency	1
Vehicle Thermal Performance	15°C	1
Tire Engineering	10% rolling resistance reduction	2-4
Vehicle Aerodynamic Performance	0.015 m² aerodynamic improvement (CD×Af)	1
Vehicle Performance in Adverse Conditions	0.015 m² aerodynamic improvement (CD×Af)	1
Electric Drive Engineering	23.2 km increased range (PHEV)	25% reduction

Because SIMULIA tools are available on the **3D**EXPERIENCE platform and are compatible with both each other and with other Dassault Systèmes design software, engineers from across different teams can co-operate. Breaking down silos increases the potential for new, innovative solutions that can reduce a vehicle's emissions and improves the efficiency of designers. In addition, OEMs and tier 1 suppliers can share data more easily and build more accurate simulation models.

WLTP Digital Certification solution

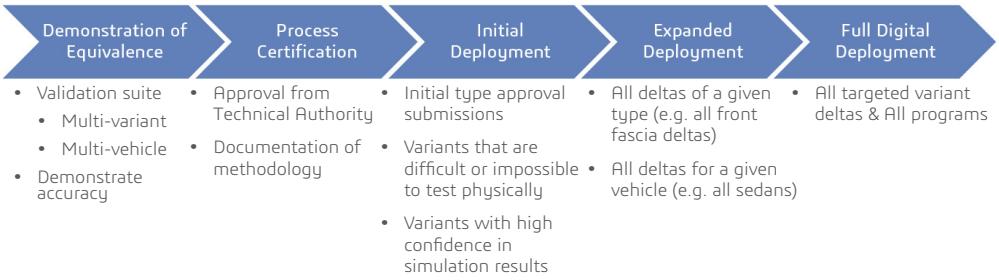
The WLTP regulations allow for vehicles to be tested virtually using simulation, as long as the approach is validated and approved by the regulators. SIMULIA offers a turn-key, scalable solution for digital homologation under WLTP, with the industry expertise to implement it in manufacturer workflows and get it certified.

SIMULIA's computational fluid dynamics (CFD) and Lattice-Boltzmann technology offers industry-leading accuracy for vehicle aerodynamics simulation, along with validated workflows for predicting aerodynamic variants. Compared to physical wind tunnel testing, simulation can

SIMULIA PowerFlow is used in 80% of automotive OEMs worldwide and is a trusted, mature technology for virtual aerodynamic testing

result in savings of hundreds of thousands or even millions of euros, and avoid the backlog at fully-booked test facilities. 80% of worldwide vehicle OEMs use SIMULIA aerodynamics software for vehicle development, making it a trusted solution. An example of the scalable simulation workflow is shown in Figure 1.

The fully documented best practices, the training and the expertise provided by SIMULIA staff enable immediate deployment, and SIMULIA's WLTP verification strategy has been approved by multiple technical services. Built-in templates to ensure process is accurate and repeatable end-to-end, from geometry preparation, through simulation methodology and setup, to results post-processing and analysis. The SIMULIA simulation technology is fully compatible with other Dassault Systèmes industry solutions to ensure on-target vehicle launch that meets design and regulatory requirements.



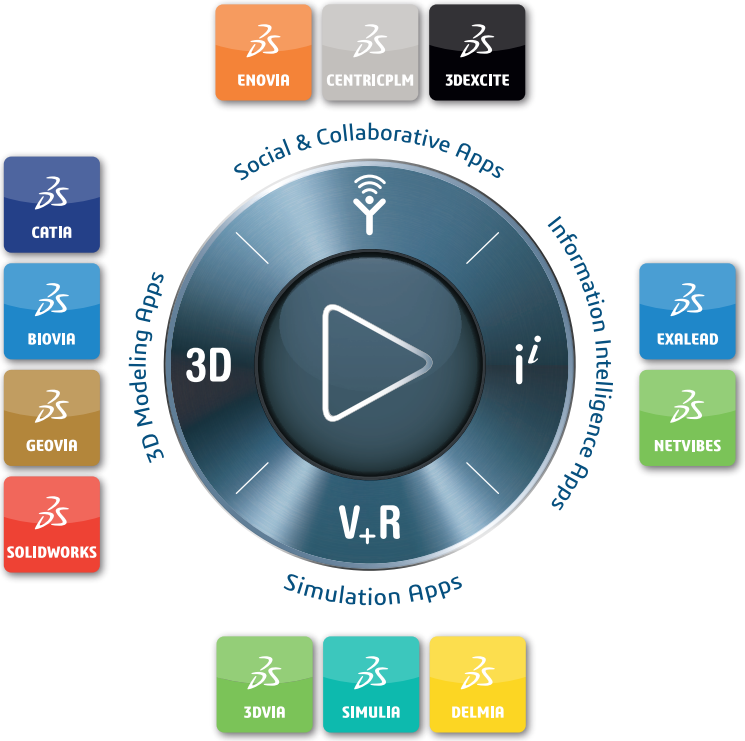
The WLTP digital certification process

Extensive validation has been performed for relevant workflows across the industry, demonstrating predictive capability for evaluating vehicle variants. SIMULIA offers an approved validation strategy for demonstrating the equivalence of measurement and simulation. This includes the structure the test cases that need to be validated against experimental results within WLTP requirements

SIMULIA has engagement with Technical Services and Technical Authorities for WLTP digital certification, with deep technical knowledge to satisfy inquiries from Technical Services or Authorities. The company is currently working with governing bodies such as the European Commission (EC) and United Nations Economic Commission for Europe (UNECE) to keep up to date on changes or clarifications that may come in the next revision of GTR15.

CONCLUSION

With many of the world's biggest vehicle markets implementing the WLTP test standard, manufacturers need to be able to overcome the challenges it poses. With the simulation solution offered by SIMULIA, OEMs and suppliers can optimize components in order to meet the stringent limits on emissions. The entire vehicle can analyzed virtually with the interactions between different parts considered, giving engineers more scope to reduce emissions. Verifiying emissions with simulations substantially reduces the risk of failing WLTP testing. Virtual prototyping also reduces the number of physical tests required, avoiding the backlog at wind tunnel facilities and cutting development time and costs substantially. Virtual testing is allowed as a substitute for physical testing in WLTP, and SIMULIA expertise helps users to set up a WLTP compliance regime that will be approved by the regulator.



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