

QARGOS

INNOVATING WORLD'S FIRST COMPACT LOGISTICS VEHICLE WITH MODSIM APPROACH OF 3DEXPERIENCE WORKS

Case Study



QARGOS relied on SOLIDWORKS design and 3DEXPERIENCE Works modeling, data management, simulation, collaboration, and communication solutions to develop the groundbreaking QARGOS F9 Cargo Scooter Platform, which is expected to revolutionize logistics operations in urban areas.

Challenge:

Invent, develop, and commercialize the world's first purpose-driven, electric, smart, two-wheeled, compact logistics vehicle to revolutionize sustainable logistics operations by providing a safer, more efficient means to deliver goods in crowded urban settings with greater load capacity than existing motorcycles and scooters.

Solution:

Leverage the unified, integrated modeling and simulation (MODSIM) approach offered by the cloud-enabled **3DEXPERIENCE** Works portfolio to accelerate innovation, while securely managing data on the collaborative **3DEXPERIENCE** platform. Implement a digital-twin approach to virtual prototyping with the help of **3DEXPERIENCE** SOLIDWORKS Premium, Collaborative Industry Innovator, SIMULIA Durability and Mechanics Engineer, SIMULIA Fluid Dynamics Engineer, SIMULIA Electromagnetics Engineer, SIMULIA Plastic Injection Engineer, 3D Motion Creator, and 3DSwymer roles on the cloud-based **3DEXPERIENCE** platform.

Results:

- Reduced vehicle weight by 30 percent, saving material cost and increasing vehicle efficiency
- Optimized vehicle aerodynamics, reducing rider fatigue due to drag forces
- Enhanced battery thermal management to improve efficiency, safety, and range
- Maximized size of cargo compartment, increasing cargo payload capacity

In 2016, QARGOS embarked on a journey to develop eco-friendly two-wheel electric vehicles and e-bikes. Their comprehensive market analysis uncovered a significant gap in the logistics sector for transporting cargo between 20 kg and 120 kg using two-wheel vehicles—a gap that presented a market opportunity exceeding US\$5 billion. In response, the India-based startup company aimed to innovate the first electric cargo vehicle platform tailored for this niche, enhancing logistics in densely populated regions and advancing the world's transition to sustainable logistics.



"With SOLIDWORKS and 3DEXPERIENCE Works solutions, we've not just developed an innovative product but have launched a revolution in the logistics operations that will fuel a sustainable business for years to come."

– Alok Das, Co-Founder

The groundbreaking QARGOS® F9 Cargo Scooter Platform was introduced at the **3DEXPERIENCE** WORLD 2024 Conference & Exhibition in Dallas, Texas. The conference was hosted by Dassault Systèmes in February 2024 for 4600+ SOLIDWORKS® users from around the world. The unique QARGOS F9 cargo scooter platform, which has 100+ patents applied in 40 countries, offers a storage volume capacity of up to 225 liters, a load-bearing capability of up to 120 kg (265 lb.), a range of 160 km (100 miles), and Internet of Things (IoT) technology to capture riding analytics, cargo tracking, and route optimization for vehicles within a fleet. The F9 cargo platform is poised to significantly enhance logistics operations for numerous organizations worldwide, especially in regions where scooters, motorcycles, bicycles, and e-bikes are commonly used for delivery purposes. This compact logistics vehicle is specifically designed to serve individuals who depend on two-wheel motorbikes, mopeds, or bicycles as a source of income, and save them from having to carry cargo in a rear box or a backpack worn by the rider, which poses health and safety concerns.

When Founder Vijay K. Praveen, an electrical engineer, established QARGOS in 2013, he worked on e-bikes part-time for a few years before discerning the greater logistics opportunity in 2016, around the same time that Co-founder Alok Das joined the company. QARGOS F9 development began in earnest in 2018, and the company used SOLIDWORKS Premium design software for creating preliminary design concepts. However, as development progressed, it became clear that QARGOS would need powerful simulation and data management solutions to finalize and commercialize a stable, optimized design.

After witnessing a demonstration of the modeling and simulation approach made possible by cloud-based

3DEXPERIENCE® Works solutions on an e-bike example, QARGOS decided to take the next step towards transforming its product development process. With a vision of 100 percent virtual prototyping with a cloud-enabled digital twin, QARGOS added modeling, data management, simulation, collaboration, and communication solutions from the **3DEXPERIENCE** Works portfolio to its SOLIDWORKS installation in 2021, including **3DEXPERIENCE** SOLIDWORKS Premium, Collaborative Industry Innovator, SIMULIA® Durability and Mechanics Engineer, SIMULIA Fluid Dynamics Engineer, SIMULIA Electromagnetics Engineer, SIMULIA Plastic Injection Engineer, 3D Motion Creator, and 3DSwymer roles.

DESIGNING PICKUP TRUCK ON TWO WHEELS

“Designing a two-wheeled, compact logistics vehicle presents a major challenge in maintaining the center of gravity when loaded with 125 kg and when unloaded, to ensure the vehicle remains dynamically stable in various loading scenarios. The unique design and purpose of the vehicle developed by QARGOS, particularly its capacity to carry loads up to 125 kg, required a comprehensive development approach involving multiple iterations. This process was underpinned by extensive simulation, thorough testing, and continuous engagement with potential customers,” Das points out.

“The addition of the **3DEXPERIENCE** Works solutions—particularly the MODSIM workflows [the unification of modeling and simulation on the **3DEXPERIENCE** platform] powered by SIMULIA solutions, which brought us industry-leading simulation technologies like Abaqus®—magnified our capabilities and elevated our development efforts,” Das stresses. “Because **3DEXPERIENCE** Works simulation solutions are fully integrated with SOLIDWORKS, the transition between design and simulation is seamless, supporting the simulation-driven approach that helped us improve the design with every iteration.”

UNIFIED MODELING/SIMULATION APPROACH ACCELERATES INNOVATION

The QARGOS F9 compact logistics vehicle was completely imagined and developed using the



Using SIMULIA Structural Engineer and SIMULIA Fluid Dynamics Engineer solutions from the **3DEXPERIENCE** Works portfolio, QARGOS was able to optimize the scooter's performance, accelerate development, and reduce the weight of the scooter by 30 percent.

unified modeling and simulation approach offered by the **3DEXPERIENCE** Works portfolio. This was made possible due to the industry-leading, multiphysics simulation technologies from SIMULIA, which are fully integrated with best-in-class design solutions from SOLIDWORKS on the cloud-based **3DEXPERIENCE** platform.

The company's plan to develop the vehicle with zero prototyping required QARGOS engineers to virtually assess performance of vehicle system and component designs with the aid of simulations conducted up front—with the SIMULIA Durability and Mechanics Engineer and SIMULIA Fluid Dynamics Engineer roles—in the early development stages to explore hundreds of design alternatives. “This approach enabled development to progress more quickly and effectively,” Das stresses. “The improved accessibility and high-performance computing offered by the cloud-based **3DEXPERIENCE** collaborative environment has made it really easy for key stakeholders at QARGOS

to easily access and share data from anywhere on any device at any time, breaking hardware barriers for performing large complex simulations."

COMPLEX SIMULATIONS IMPROVE DESIGNS, SHORTEN TIME TO MARKET

In utilizing the **3DEXPERIENCE** Works simulation portfolio, QARGOS has been able to resolve difficult engineering issues without resorting to costly and time-consuming physical prototyping and testing, by leveraging physics-based multidisciplinary simulation technologies to predict product performance under real world scenarios. "We've done many different types of simulations, including motion, thermal, vibration, structural, dynamic, and crash simulations," Das notes.

"This has led to dramatic performance-enhancing improvements in several areas—such as aerodynamics, battery thermal management, and the chassis strength and integrity of the F9 compact logistics vehicle—and has enabled us to bring the product to market more quickly," Das explains. "We validated using a different material for the vehicle chassis than what was recommended by our supplier to lightweight the design, resulting in a 30 percent reduction in weight. We optimized the airflow around the vehicle and the drag forces on the rider, and we optimized the battery temperature using simulation to verify that a fluid cooling system was more effective than air cooling. Lastly, we maximized the cargo compartment size, which is almost large enough for a person to sit in. Repeatable simulation best practices and integrated workflows have increased the predictability of product performance with confidence, while saving cost and time by reducing physical prototyping and testing."

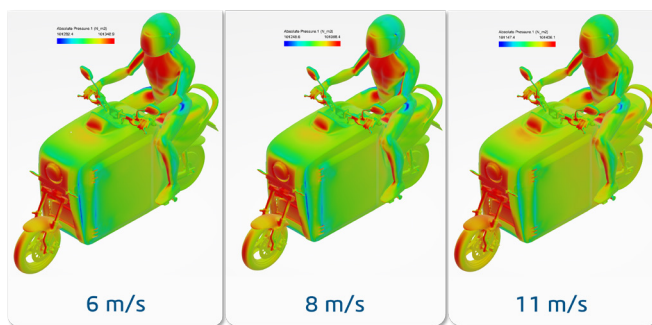
CONTINUOUS IMPROVEMENT TIED TO MULTIPHYSICS SIMULATIONS

Given QARGOS' experience using cloud-based simulations integrated with **SOLIDWORKS** to improve vehicle performance and accelerate time to market, the company plans to continue leveraging multiphysics simulation solutions on the **3DEXPERIENCE** platform to explore hundreds of alternatives for newer designs, and improve and refine the performance of the current vehicle design.

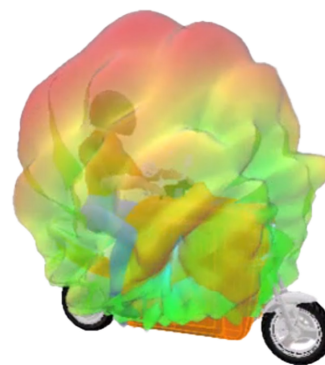


QARGOS leveraged **SIMULIA** multiphysics simulation solutions, including **SIMULIA** Fluid Dynamics Engineer, to simulate the aerodynamic forces on both the rider and the scooter during use, helping to reduce drag and improve scooter performance.

Surface Pressure Plots



With **SIMULIA** multiphysics simulation solutions, QARGOS not only predicted the surface pressures on the scooter and rider shown here, enabling the company to optimize the design, but also made other dramatic simulation-driven improvements, such as improving scooter aerodynamics, battery thermal management, and the strength and integrity of the chassis.



QARGOS plans to continue leveraging multiphysics simulation solutions on the **3DEXPERIENCE** platform to explore hundreds of alternatives for newer designs, and improve and refine the performance of the current vehicle design, such as tapping **SIMULIA** Electromagnetics Engineer to ensure that the scooter's antenna complies with electromagnetic interference (EMI) and electromagnetic compatibility (EMC) requirements.

“Going forward, we are planning on using several SIMULIA roles [on the **3DEXPERIENCE** platform] to guide further enhancements in the coming years,” Das points out.

“We will be using SIMULIA Durability and Mechanics Engineer to continue our crash/impact analysis and conduct battery drop tests; SIMULIA Electromagnetics Engineer to ensure electromagnetic compliance with EMI [electromagnetic interference] and EMC [electromagnetic compatibility] requirements; SIMULIA Plastic Injection Engineer to validate the manufacturability of injection-molded plastic parts, including our battery cell holder; and 3D Motion Creator to analyze the vehicle suspension’s response,” Das says.

MANAGING DATA, INTERACTING WITH CUSTOMERS

In addition to benefiting from **3DEXPERIENCE** Works simulation solutions, QARGOS tapped the portfolio’s transparent data management capabilities to tighten revision controls during development. The company also utilized design visuals from the SOLIDWORKS model to initiate customer engagement and testing. “We’ve shared a model of our storage compartment

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with potential customers. That set the stage for more than 500 product demonstrations and more than 30,000 miles of road testing,” Das explains.

“**3DEXPERIENCE** Works data management capabilities ensure that our data is clean and secure and that feedback from customers—like the field trials Amazon has conducted—isn’t lost and makes its way into our design iterations,” Das says. “With SOLIDWORKS and **3DEXPERIENCE** Works solutions, we’ve not just developed an innovative product but have launched a revolution in the logistics operations that will fuel a sustainable business for years to come.”

Our **3DEXPERIENCE**® platform powers our brand applications, serving 11 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3DEXPERIENCE** Company, provides business and people with virtual universes to imagine sustainable innovations. Its world-leading solutions transform the way products are designed, produced, and supported. Dassault Systèmes’ collaborative solutions foster social innovation, expanding possibilities for the virtual world to improve the real world. The group brings value to over 250,000 customers of all sizes in all industries in more than 140 countries. For more information, visit www.3ds.com.

