



FFPLUS SUCCESS STORY: BUSINESS EXPERIMENTS

AERODYNAMIC AND STRUCTURAL OPTIMISATION OF MODULAR BICYCLES USING HPC

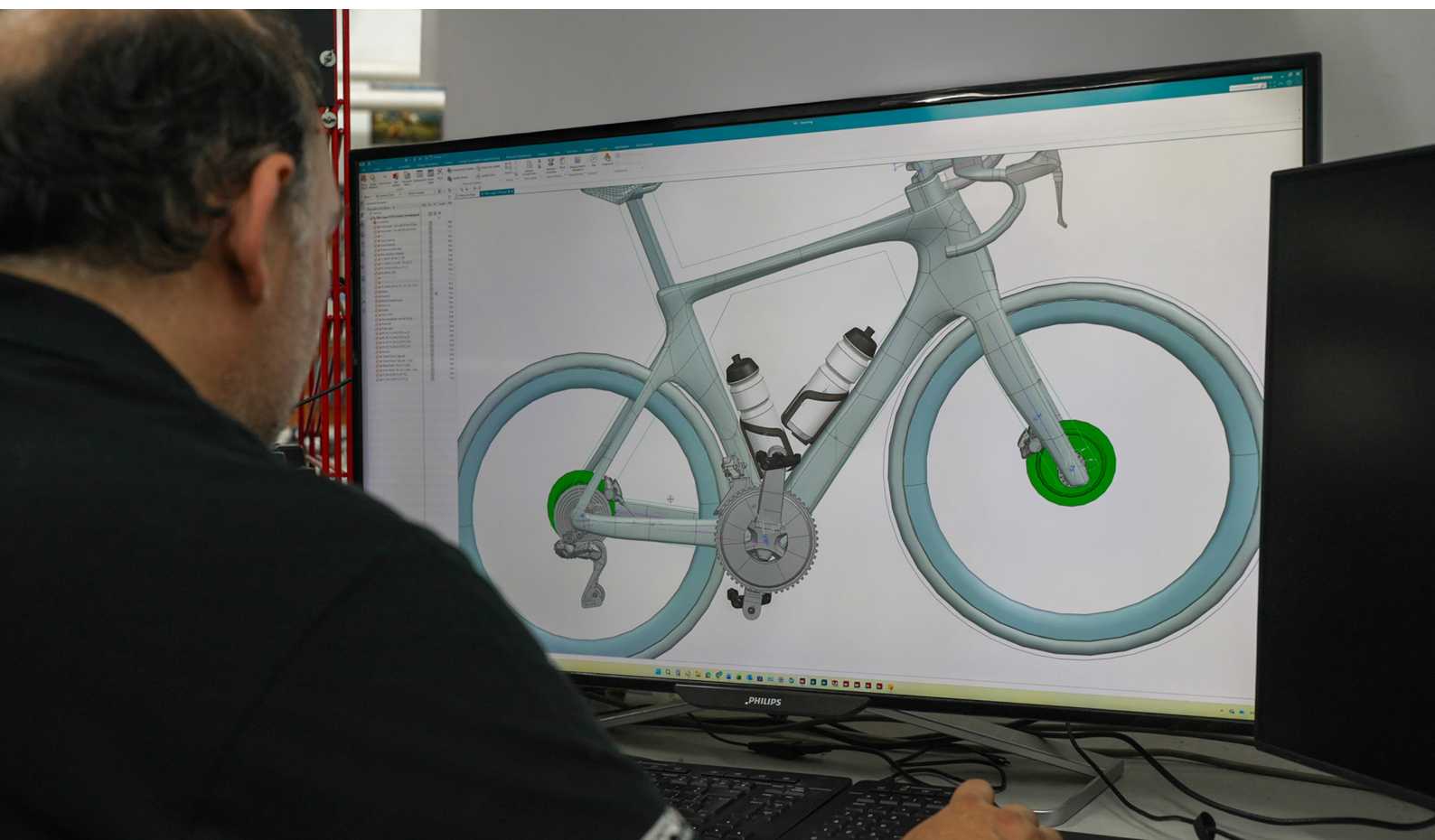
ORGANISATIONS

Advanced Engineering (AE) is a Greek SME designing and manufacturing carbon-fibre bicycles for competitive and recreational cycling. **National Technical University of Athens** provides CFD, aerodynamic optimisation and HPC expertise. **Politecnico di Milano** advises on automated CFD workflows and HPC use. **FOSS** supplies black-box optimisation software and structural-optimisation guidance.



THE CHALLENGE

Advanced Engineering aims to launch a modular road bike that converts into a triathlon version by changing only a few components. However, its trial-and-error aerodynamic and structural design process, constrained by limited local computing, can take up to a year. Evaluating many shapes, riding conditions and carbon-fibre configurations is computationally intensive, so HPC is essential to shorten development and secure competitive performance gains.



Technology used: HPC, CFD, Structural Mechanics
Industry Sector: Cycling, Manufacturing

THE SOLUTION

The team deployed automated Computational Fluid Dynamics and structural optimisation workflows on the LUMI supercomputer. CFD assessed bicycle shapes across multiple speeds, airflow angles and manufacturing constraints to reduce drag and side forces. Structural optimisation then varied carbon-fibre layers, orientations and materials to cut weight, increase lateral stiffness, improve comfort and meet ISO requirements. HPC made the design search feasible within days rather than months.

THE IMPACT

HPC-enabled automation reduces the design phase and associated engineering costs by 50%, replacing lengthy trial-and-error work with repeatable aerodynamic and structural optimisation. Material-efficient carbon-fibre designs are expected to lower manufacturing costs by 15-20% while improving performance, comfort and manufacturability. Advanced Engineering plans to produce 50 additional bikes annually, generating up to €350,000 in yearly revenue and creating two jobs. Reusing the same HPC workflows for mountain-bike frames, wheels, handlebars, seatposts and cranksets could add up to €100,000 a year and one further job. This validated capability also supports expansion into high-performance luxury boats, where optimised hydrodynamic, aerodynamic and structural components could generate up to €300,000 annually and create two jobs. This gives Advanced Engineering a scalable digital design capability for faster product development and entry into new markets.

BENEFITS

- 50% shorter design phase, with a similar reduction in design costs.
- 15-20% lower manufacturing costs through carbon-fibre material savings.
- 50 extra bicycles/year: up to €350,000 revenue and two new jobs.
- New cycling products could add €100,000/year and create one job.
- Luxury-boat applications could add €300,000/year and create two jobs.



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