Case Study: World's First GR Yaris Engine to BMW ZF 8HP Transmission Adapter

Introduction to cadworks

Cadworks is a Norwegian company founded by 3D design engineer Stian Marthinsen; specializing in 3D Scanning, Reverse Engineering, and advanced CAD design. Known for handling challenging automotive and motorsport projects, cadworks delivers innovative digital solutions tailored precisely to client needs, backed up by 20 years of experience from the industrial and construction sectors - along with extensive involvement in various motorsport disciplines over the last two decades.

Stian Marthinsen - cadworks

By combining experience, technology, and creativity, cadworks transforms complex physical components into new, innovative designs.

Project Challenge

Cadworks faced an ambitious task; to design the world's first adapter plate connecting a Toyota GR Yaris G16E-GTS engine, delivered with a manual transmission and 4WD system - to a BMW ZF 8HP51Z automatic transmission for RWD Toyota Supra.

With no existing solution, ensuring accurate alignment between two distinctly different components - presented significant challenges. Precision was crucial, as even minor misalignment would either cause problems down the line, or a waste of expensive CNC machined parts.

Tools and Technology

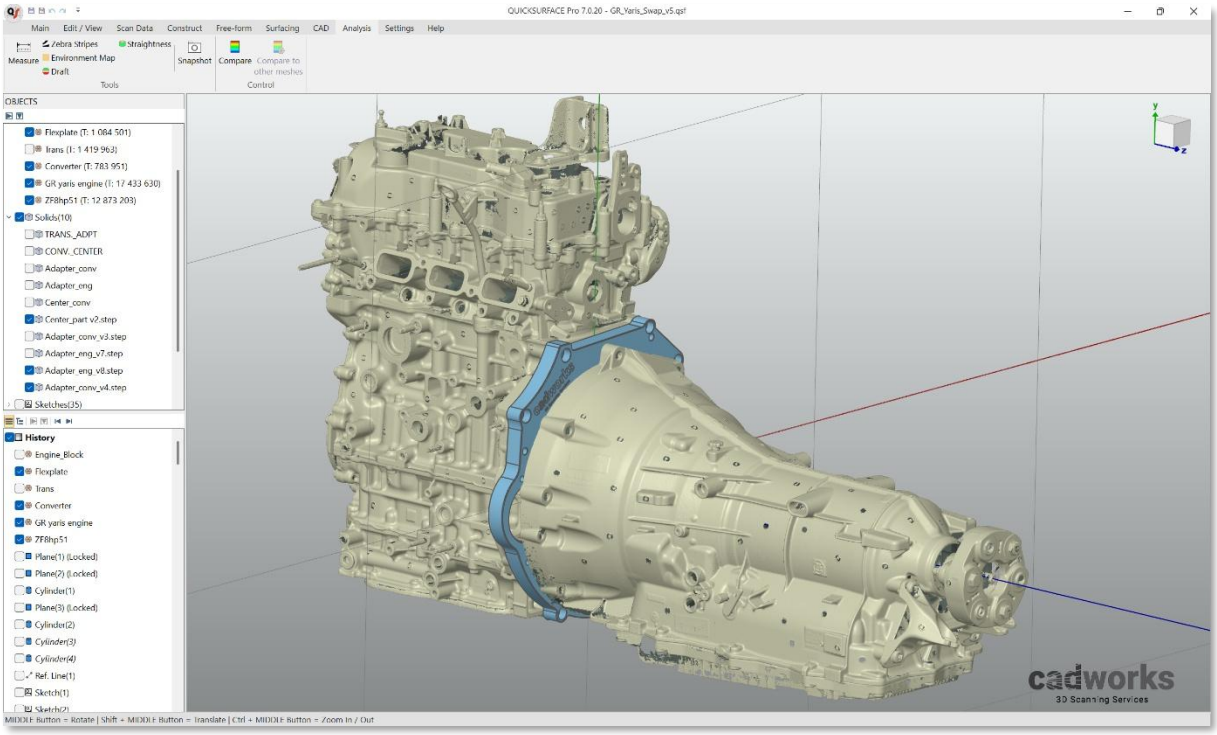
Utilizing the SHINING 3D EinScan HX 3D scanner, cadworks captured detailed scans of critical components, including the GR Yaris engine, GR Yaris automatic flexplate, BMW ZF transmission, and BMW converter plate. The accuracy of these scans laid the foundation for the project.

Toyota G16E engine from a GR yaris

Stian surrounded by things he enjoys the most when working:

3D scanners, PC/3D design and race cars!

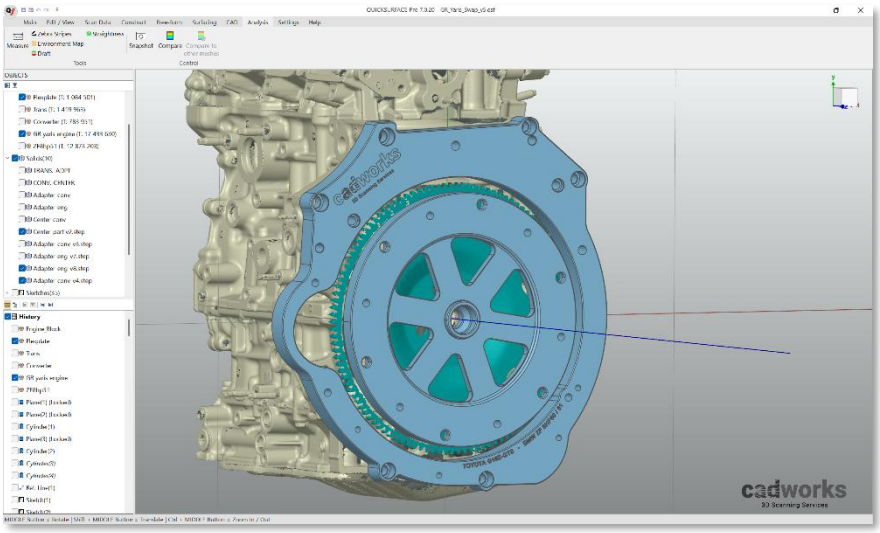
The standout tool for this project was QUICKSURFACE Pro software; having full control over all mesh components, mesh XYZ world alignment, mesh optimalization, parametric CAD integration, and the most helpful mesh to CAD deviation analysis – all in one intuitive software, made it a huge project time saver!



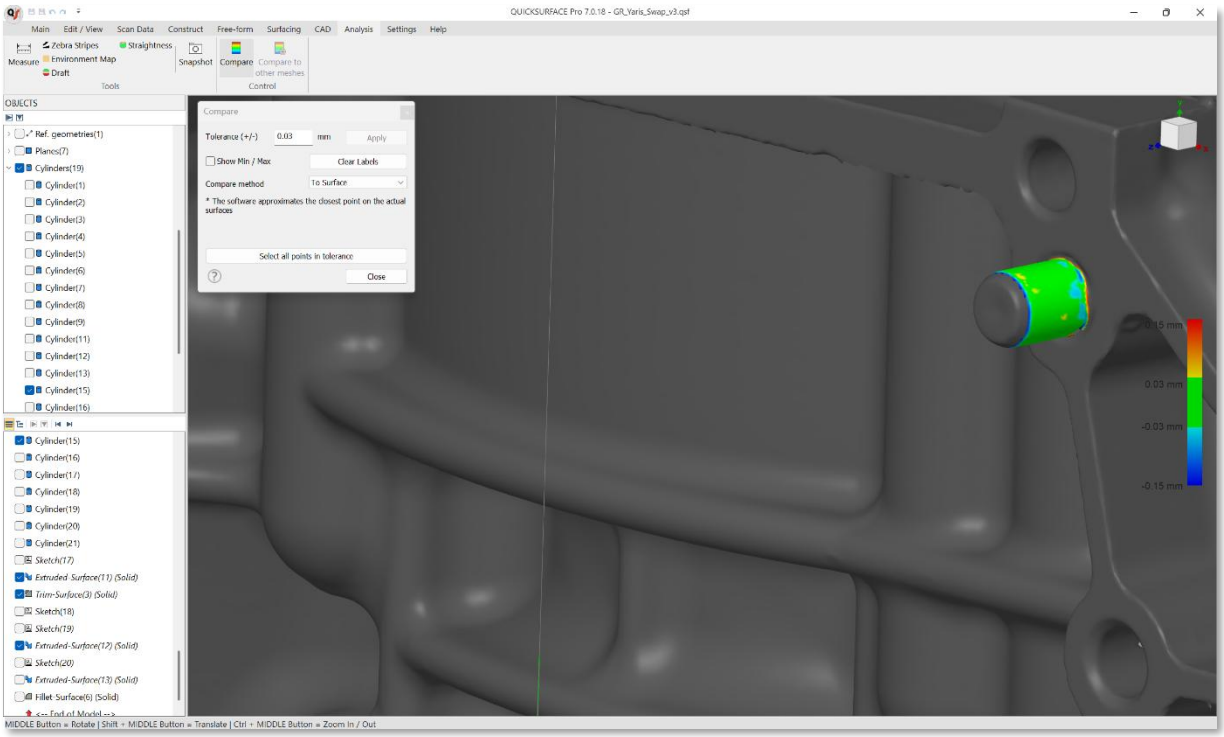
Design and Engineering Process

Cadworks used scan-data as references for designing entirely new adapter components. QUICKSURFACE made aligning multiple different scan-data both precise and with confidence, which is very important for the rest of the project!

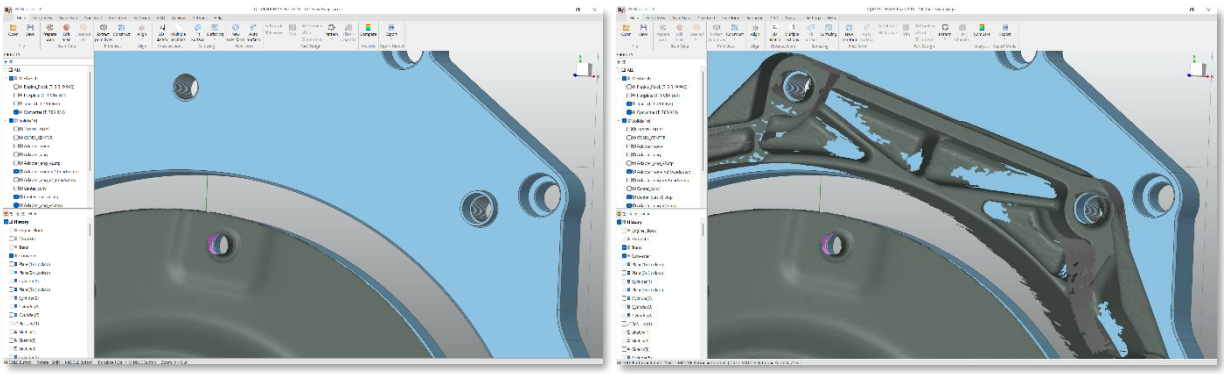
Origin was set at center of the crankshaft; this makes aligning other scan-data to the engine block/crankshaft more accurate – and CAD is set up to be much more efficient.



The accurate scan-data of OEM dowel pins from the engine block and guide pins from the BMW transmission served as critical references, ensuring a perfect fit and assembly alignment - similar to original factory specifications.



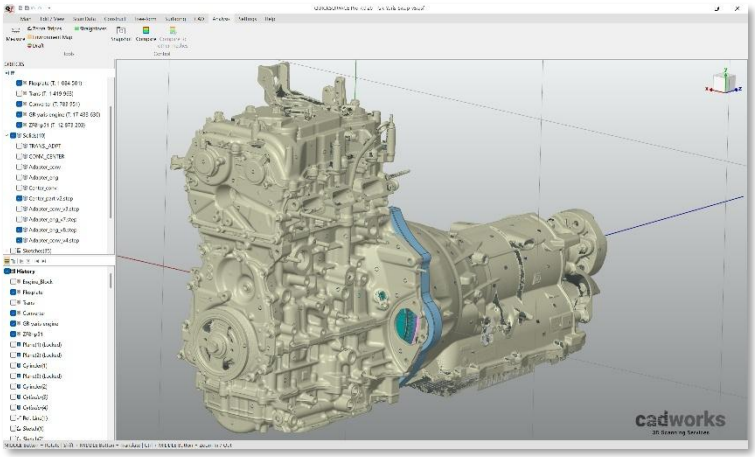
Through careful alignment in QUICKSURFACE, cadworks validated the adapter's alignment digitally, significantly reducing the time spent on physical prototyping. Deviations between CAD and mesh data were constantly monitored.



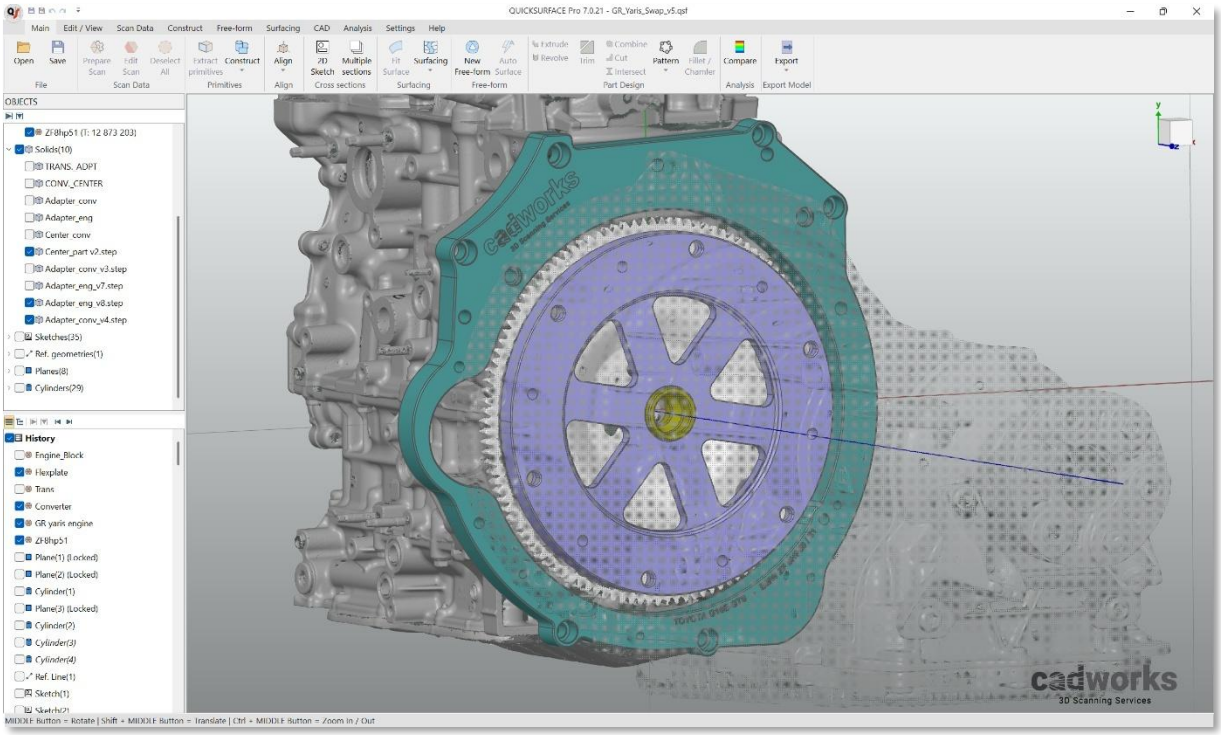
Extracting primitives from the scan-data with real-time CAD to mesh deviation and constraint to XYZ or other features, was somewhat a game changer for my workflow.

Stian Marthinsen | cadworks, 2025

In CAD design, when working with millions of polygons as you most likely are going to do when Reverse Engineering - it is crucial to still have quick and responsive software. Unfortunately, your go-to CAD software would struggle to handle this much data! QUICKSURFACE on the other hand does it without any issues.

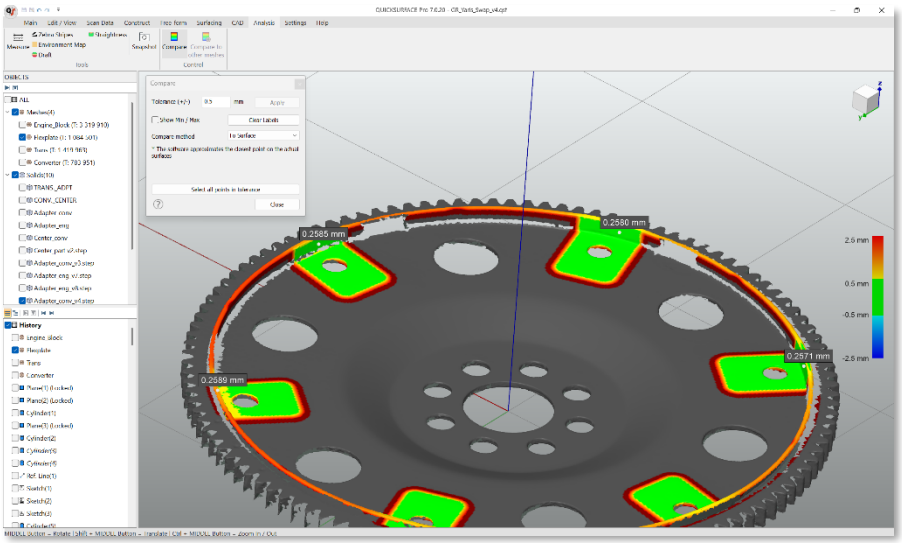


In regard to large scale mesh and CAD, an essential benefit during design was QUICKSURFACE's excellent parametric CAD integration. This feature significantly streamlined the process of creating custom adapters, making the entire experience enjoyable and highly productive in design stage.



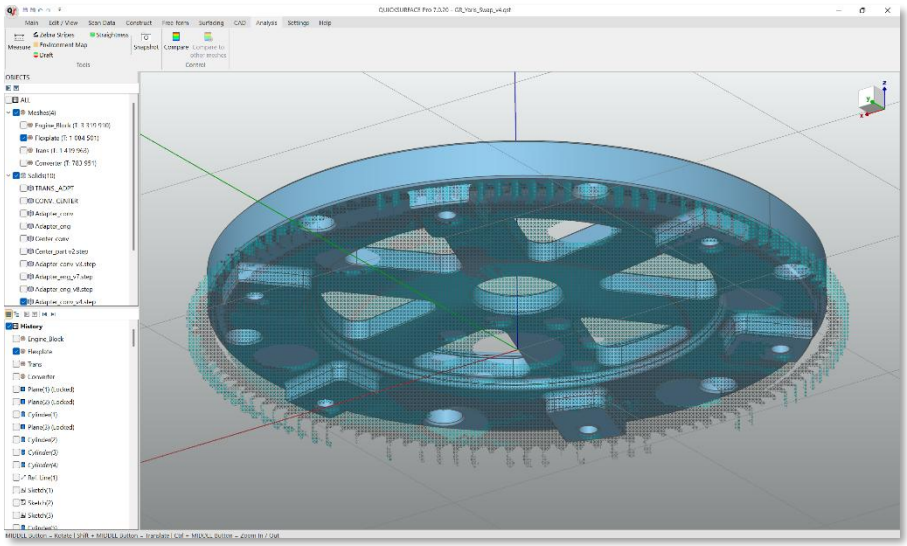
Overcoming Technical Challenges

The project's main technical challenge revolved around achieving perfect coaxial alignment. Cadworks relied heavily on QUICKSURFACE to address this by accurately aligning the converter adapter plate CAD design; with the Toyota flexplate scan-data and dowel pins located in the engine block. This method ensured the converter plate adapter was correctly aligned and centered.



The designed spacer tabs on the converter adapter, was analyzed with CAD to mesh deviation – to ensure alignment and tolerance for fitment.

CAD design of converter adapter with spacer tabs, to get clearance to Toyota flexplate and get correct bolt patten design.



QUICKSURFACE's immediate visual feedback on deviations provided confidence that the adapter plate would align flawlessly, a fact confirmed by successful first-time physical prototyping later in the product development.

Benefits of QUICKSURFACE

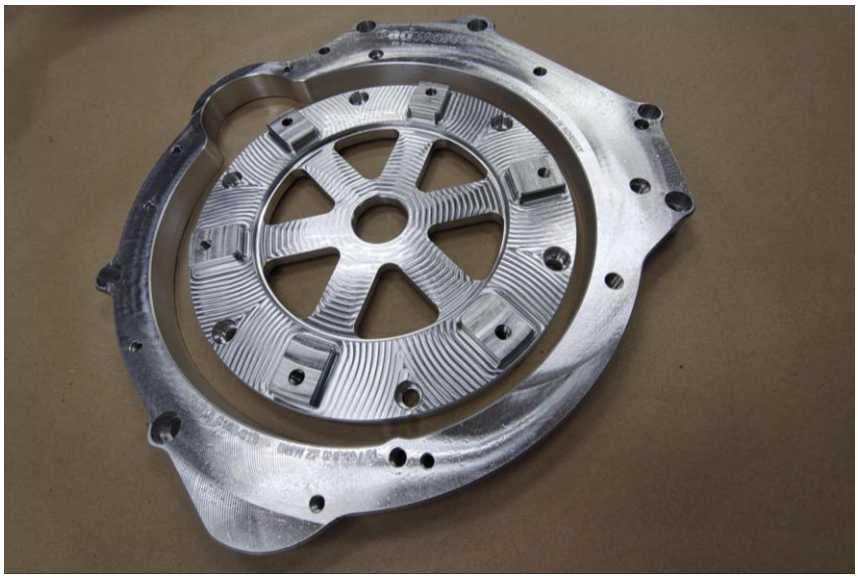
QUICKSURFACE significantly optimized cadworks workflow, eliminating guesswork and providing rapid, reliable verification of component alignment. The software extensive benefits included:

- **Real-time Deviation Visualization:** Detect and correct potential alignment issues instantly, significantly reducing risk.
- **Extract Primitives:** Very powerful tool! With integrated primitive to mesh deviation analysis. One of the most used tools in this project.
- **Large scan-data handling performance:** Efficiently handle and process large, detailed mesh files without performance degradation.
- **Parametric CAD Integration:** Enabled enjoyable, productive custom part creation directly within the software environment.
- **All-in-one Solution:** Combined mesh processing, XYZ world alignment, deviation analysis, and detailed CAD / surfacing modeling into one powerful interface, simplifying workflow.
- **STEP Export Feature:** Seamlessly export CAD models as STEP files for further engineering analysis such as finite element analysis (FEA).
- **Efficient Workflow:** Saved substantial project time, improved precision, and provided confidence from initial digital designs through to physical prototyping.

Results and Impact

The first physical prototype confirmed the success of the digital alignment strategy. The initial prototype was crucial for gaining hands-on understanding and validating assembly compatibility. Cadworks went beyond standard prototyping by successfully mounting the transmission directly onto the 3D-printed adapter, enabled by tapped threads within the plastic prototype. This capability demonstrated the strength and accuracy of the initial design, significantly impressing the client and further proving the project's viability.

Prototypes were a success, and the client was impressed by the ease of assembly!



Next up was CNC machining the part in 7075 aluminum for strength and durability.

The parts came out beautifully!

Conclusion

Through 3D scanning technology and QUICKSURFACE Pro software, cadworks successfully tackled the world's first adapter plate connecting a GR Yaris engine to a BMW ZF 8HP transmission – designed in QUICKSURFACE Pro! This project exemplifies innovation in automotive product development, underlining the transformative potential of precise digital solutions in solving complex engineering challenges.

Product render of scan-data mesh models with CAD design.