Automating the Design of an Entire Bracket Family: How Thales Alenia Space and CDS Accelerated 2x the Full Workflow

DESIGN EXPLORATION WORKFLOW AUTOMATION

Thales Alenia Space (TAS) is a leading European actor in space and defense, delivering advanced satellite systems, payloads, and orbital infrastructures for demanding institutional and commercial missions. As the sector pushes toward lighter, more efficient, and cost-effective systems, TAS must meet increasingly demanding requirements while maintaining a high-pace production. These pressures challenge conventional engineering workflows and require new approaches to accelerate design while preserving mission-critical robustness.

This challenge is clearly illustrated in the development of antenna reflector tripods (brackets). Although each tripod on an antenna faces identical loads and environmental conditions, slight geometric differences across **80+ variants** force engineers to redesign every unit independently. This prevents reuse of design logic and leads to repetitive, manual modeling work, limiting the time available for part optimization.

To address this, TAS partnered with CDS to deploy Cognitive Design through a two-phase approach. First, a broad **design exploration** was conducted to identify the best-performing tripod configuration, integrating structural criteria, manufacturing needs, cost and CO2 analyses. Once this optimal design was established, it was converted into a **reusable parametric workflow**. This enabled automatic generation of all tripod variants in the family, eliminating the need for manual redesign.

The results were substantial with a drastic reduction of engineering lead time across the tripod family and a significant mass reduction per bracket compared to legacy designs.

Following the project, our next step is to determine how Cognitive Design can be integrated into our design and engineering toolchain. Based on the work carried out with CDS, the results are highly promising and indicate a meaningful evolution in the way we approach engineering at Thales Alenia Space.

- Florent Lebrun, Technology and Innovation Lead at **Thales Alenia Space**

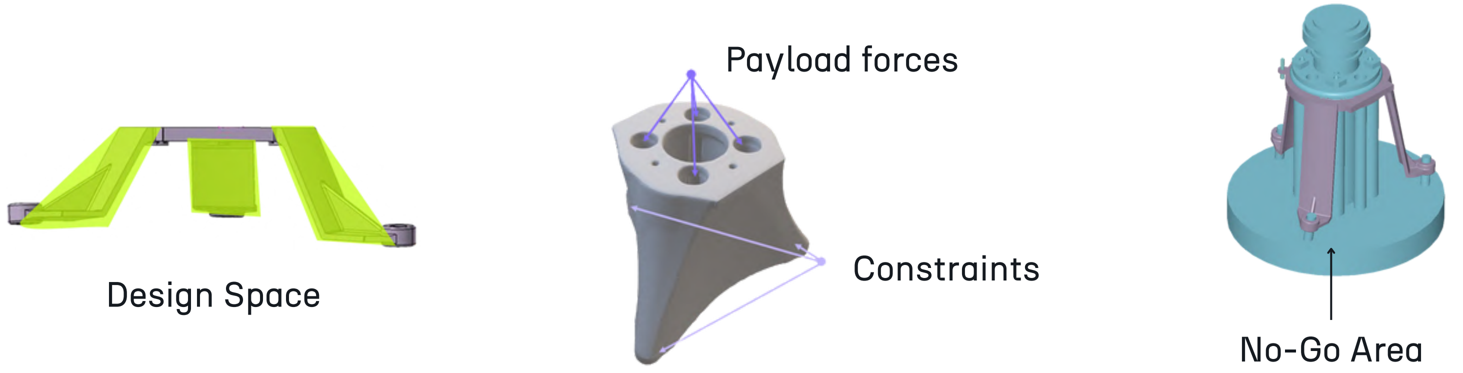
Case study Presentation

TAS produces a wide range of antenna reflector tripods every year to support diverse satellite payload configurations. Although these parts share the same functional requirements and are subjected to identical load cases, their geometries differ slightly across programs, missions, and antenna architectures. In this project, TAS engineers must redesign 80+ tripod variants, each following a full CAD–simulation–manufacturability workflow. Their main objective was to automate low-value CAD tasks while exploring new possibilities of optimization for structural performance of every variants.

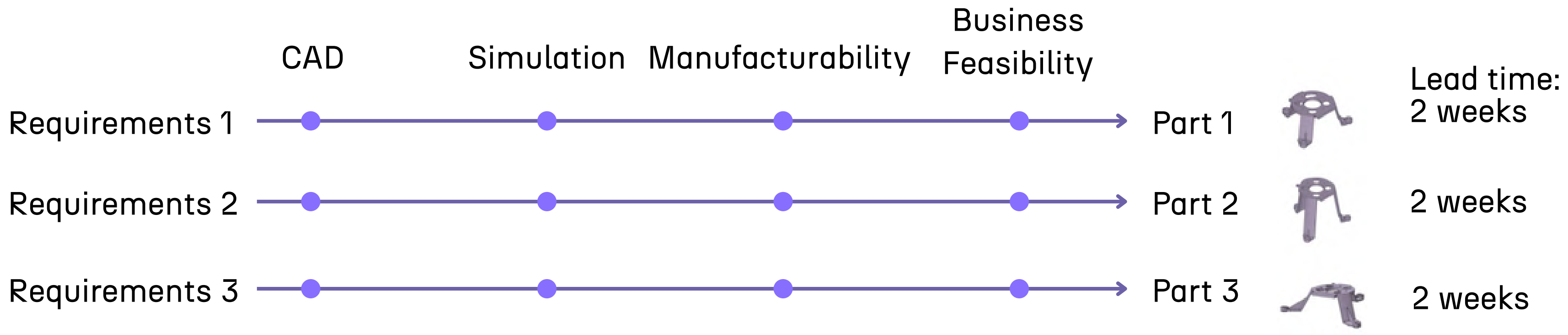
Engineering Constraints and Specifications

To support TAS with a high-fidelity exploration and automation workflow, the project was framed around a precise set of constraints and performance criteria:

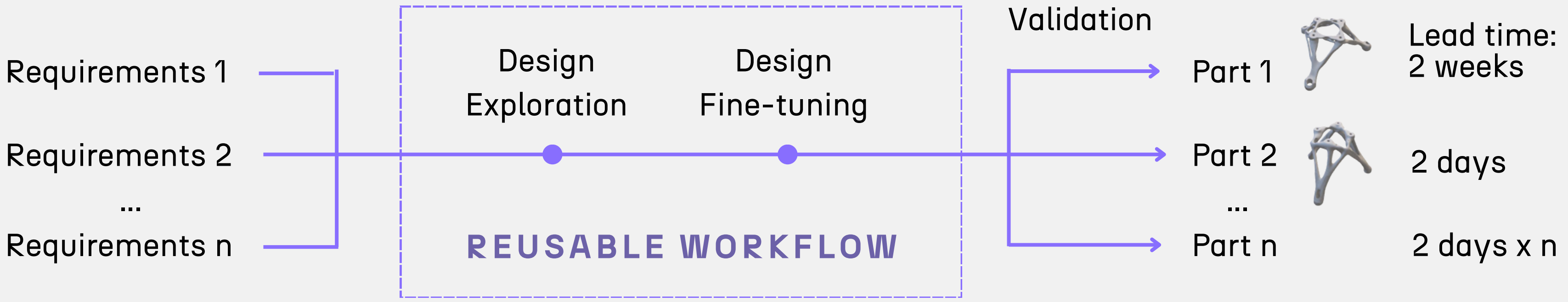
- Materials: Titanium and Aluminum, both for additive and CNC manufacturing routes.
- Weight target: Each tripod must remain below 250 g.
- Stiffness requirement: Maintain or exceed the stiffness of legacy components.
- Manufacturing constraints:
    - Additive manufacturing feasibility, specifically print direction with legs oriented upward.
    - No-Go zones and assembly volumes must be respected across variants.
- Load cases: Three load cases combining 1500 N in X, Y, Z directions.
- Design and interface boundaries: TAS provided the precise design space and the associated non-design regions to ensure seamless integration with the antenna structure.



Current TAS Design Methodology

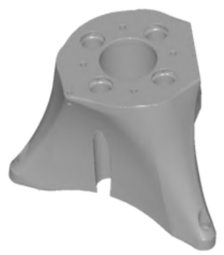


Methodology with Cognitive Design



©Cognitive Design by CDS

Design Workflow with Cognitive Design: Workflow Build-Up



Set up the Design Space and Load Cases from the Legacy Part

The process begins by reconstructing the engineering context of the tripod using the geometry and specifications of the baseline component.:

- Importing the legacy tripod to extract key functional interfaces and assembly boundaries.
- Defining the design space for generative exploration.
- Applying the structural load cases along with all restraints and mounting points.

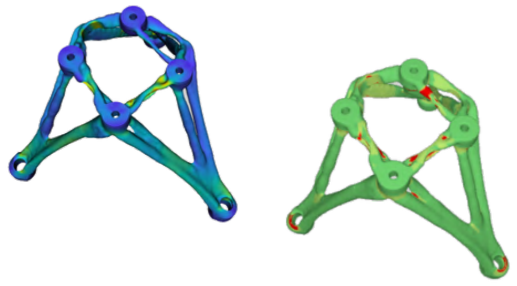
This step provides the structural, geometric, and environmental foundations for an informed generative process.

Generate an Advanced Topology-Optimized Design

With the design space and load cases established, TAS and CDS performed an initial generative synthesis of the tripod:

- The **most efficient structural paths** are identified to carry the applied loads with minimal mass.
- Several topological variants are evaluated simultaneously, enabling **rapid convergence** toward a structurally efficient concept.

This phase yields a first version of a structurally optimal tripod, serving as the foundation for the refined design.

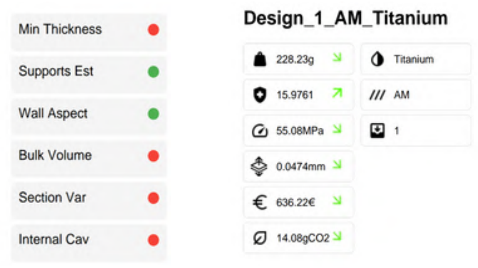


Refine Geometry to Meet Performance and Manufacturing Objectives

The initial generative output is then transformed into a manufacturable, high-performance tripod geometry:

- Part geometry is **refined according stress results** to meet functional and assembly constraints.
- Thicknesses, fillets, local reinforcements, and **AM/CNC-suitable** transitions are applied to guarantee manufacturability while maintaining weight targets.

This refinement stage balances structural performance with real-world fabrication constraints.



Track Iterations and KPIs in the Design Explorer

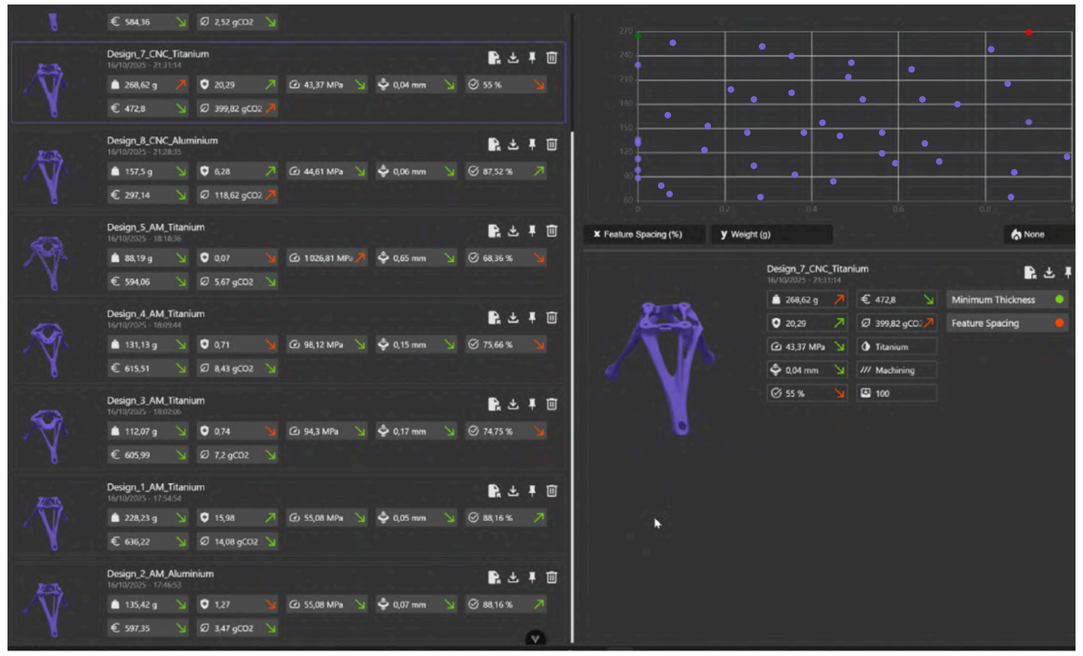
To support decision-making and ensure traceability across variants, each iteration is captured in the software:

- **Quantitative KPIs** such as mass, displacement, stress, stiffness ratio, manufacturability and cost indicators are automatically recorded.
- **Performance tradeoffs** are visualized to help engineering teams compare multiple design candidates.

This step formalizes the design exploration loop and ensures rigor, repeatability, and clear justification for the selected optimal design.

©Cognitive Design by CDS

Design Workflow with Cognitive Design: Design Exploration



Design Explorer view

Compare Design Exploration Results to Identify the Most Suitable Iteration

Once multiple generative and refined tripod candidates are produced, the next step was to evaluate their performance across all relevant engineering criteria. Cognitive Design's Design Explorer provides a structured environment to compare iterations consistently and objectively, allowing TAS and CDS teams to:

- **Reviewing quantitative KPIs** such as mass, maximum stress, stiffness ratios, displacement values, manufacturing feasibility, cost and carbon footprint analysis.
- **Visualizing performance trade-offs** through parallel coordinate plots and comparative charts, enabling rapid identification of designs that satisfy weight, stiffness, and structural safety simultaneously.
- **Filtering and ranking candidates** based on requirements to retain only viable, high-performing iterations.

Extract the Workflow Capturing All Design Intents Leading to the Best-Performing Model

Once the best-performing tripod iteration is identified, Cognitive Design allows engineers to access the complete workflow that generated it. All modeling operations, transformations, constraints, and parameter relationships are already **encapsulated** within that design iteration. Because the workflow is natively captured by Cognitive Design as part of the design iteration, TAS engineers can immediately leverage it to generate new tripod variants, ensuring full traceability and consistency without re-creating any modeling steps.

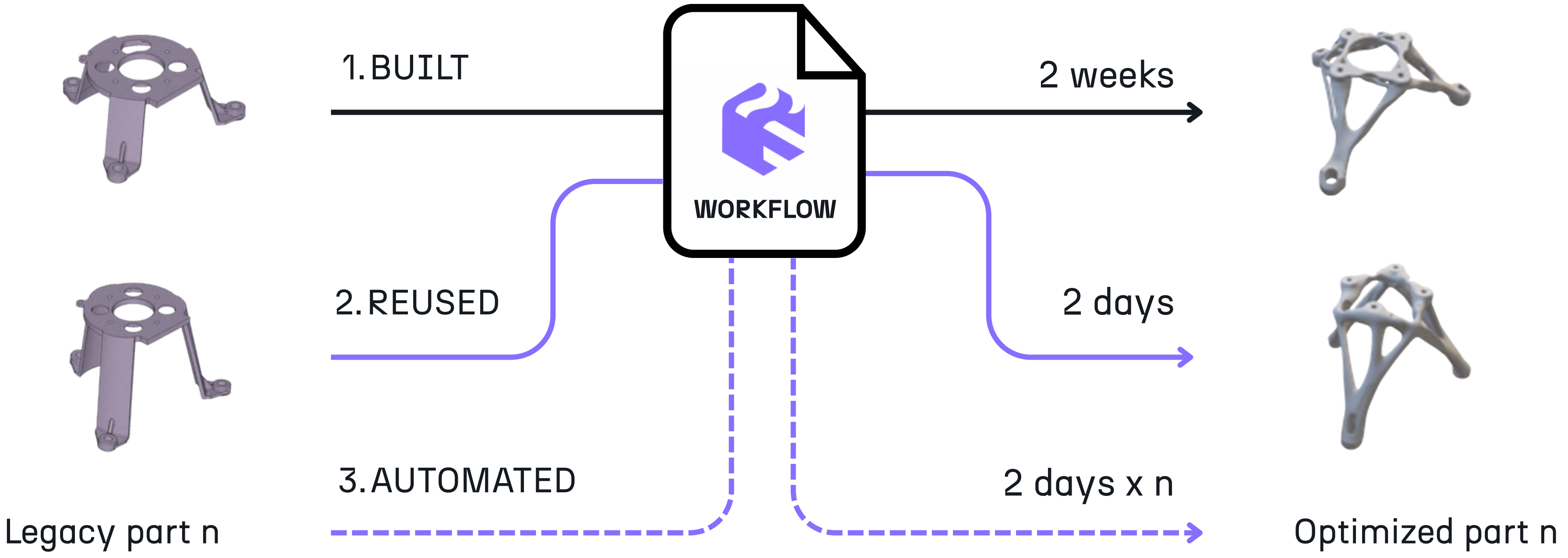
Workflow of the best-performing iteration

©Cognitive Design by CDS

Design Workflow with Cognitive Design: Workflow Automation

Once the optimal tripod workflow is extracted from the selected iteration, it can be **directly reused to generate every variant** across the tripod family. By simply updating the input model or variant-specific parameters, the workflow automatically rebuilt the optimized tripod from start to finish.

The **advanced Back2CAD tool** ensured that engineers can seamlessly continue detailed design work within their standard CAD environment.



TAS Project in Numbers

80+ variants
This is the number of antenna reflector tripod variants that the TAS and CDS teams had to design and optimize.

2 days
After identifying the most promising iteration, TAS and CDS were able to design each tripod variant in 2 days instead of the initial 2 weeks.

50% lead time reduction
Compared to the original workflow, TAS achieved a 50% reduction in the total lead time required to design the entire antenna reflector tripod family.

45% lighter
Relative to the legacy tripod designs, TAS achieved an average mass reduction of 45% per part.

©Cognitive Design by CDS

Conclusion

In this project, Thales Alenia Space achieved a step change in the way antenna reflector tripods are conceived and optimized.

By replacing a manual, variant-by-variant workflow with a unified generative and parametric approach, the teams were able to develop significantly lighter tripods without compromising stiffness, integration requirements, or manufacturability. The resulting designs delivered substantial mass savings (around 45% compared with legacy components) while ensuring full compliance with stringent load case and assembly constraints.

Beyond the gains in structural performance, the project demonstrated how Cognitive Design accelerates the entire engineering cycle. Generative exploration enabled rapid identification of an optimal tripod architecture, and the subsequent automation workflow allowed TAS to generate all variants 2 times faster - a matter of days rather than weeks. This represents a major improvement over traditional CAD processes, where each design typically requires multiple days of manual modeling, simulation preparation, and manufacturability checks.

Moreover, TAS's experience reflects a broader trend toward integrated engineering platforms where design intent, physics evaluation, and automation logic coexist in a single environment. Whether in automotive, aeronautics, or advanced machinery, organisations confronting these challenges can benefit from the same shift toward unified, automation-enabled engineering practices that strengthen both design quality and development agility.

©Cognitive Design by CDS