Aerosud has adopted a systems approach called design for certification (DFC). This doctrine forms the back bone of the design for additive manufacturing framework. The framework represents a process workflow that incorporates several activities required to design, assess and certify components. The framework is broken down into six functions, CAD, Optimisation, Internal and external featuring, manufacturability, qualification and certification. Concepts can be evaluated through several design loops providing the most effective and efficient design solution for the customer. Requirements are assessed and matched to one of the several AM engineering services listed below:

Design for Additive Manufacturing Framework

PART CONSOLIDATION ASSESSMENT (PCA)

Traditional manufacturing methods limit part complexity, hence assemblies are made up of many components that are joined by bonding or mechanical fastening. Additive manufacturing allows for the manufacture of complex integrated components, reducing and/or omitting fastening requirements to manufacture the assembly. In PCA, an assembly is assessed for potential part reduction by integrating several parts into fewer or even a single parts. Customers can expect a comprehensive report containing the optimised build set-up, topology optimisation and certification results, and a CAD model of the final concept.

PRISMATIC COMPONENT CONCEPTUALISATION (PCC)

Prismatic components are parametrically designed, hence parts can be manufactured by traditional methods or by additive manufacturing. As opposed to a PCA, PCC is a single component assessment which is based on a designated design space and the functional requirements. Traditional manufacturing constraints are considered when conceptualising a design solution. Customers can expect a comprehensive report containing the optimised build set-up, topology optimisation and certification results, and a CAD model of the final concept.

BIOMIMETIC COMPONENT CONCEPTUALISATION (BCC)

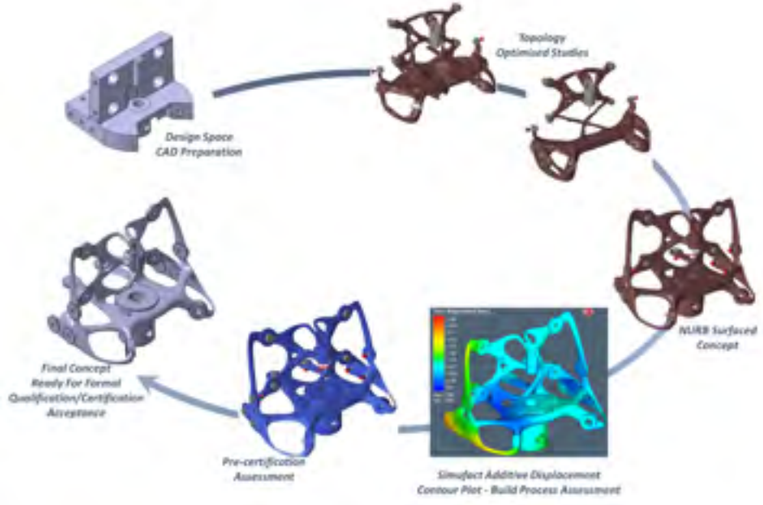
Biomimetic components invoke the design freedom additive manufacturing can accommodate. Parts are not typically manufactured by traditional methods but are certainly additively manufacturing. As opposed to a PCA, BCC is a single component assessment which is based on a designated design space and the functional requirements. Additive manufacturing constraints are considered, however a limitless freedom of design approach is taken when conceptualising a design solution. Customers can expect a comprehensive report containing the optimised build set-up, topology optimisation and certification results, and a CAD model of the final concept.

AM SUITABILITY ASSESSMENT (ASA)

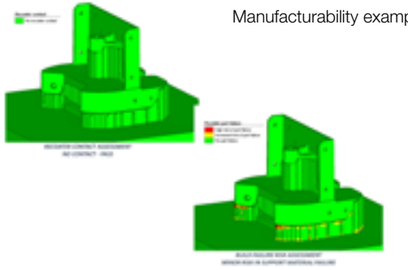
AM Suitability Assessment is a simple investigation based on the component, the desired material and manufacturing process. Expert knowledge of the build process, limitations and the material characteristics are used to determine if a component can and should be additively manufactured. Customers can expect a report advising a parts suitability for additive manufacturing and design changes if required.

ADDITIVE MANUFACTURABILITY ASSESSMENT (AMA)

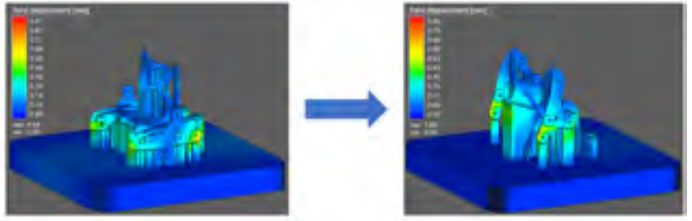
AM Suitability Assessment is a comprehensive investigation based on the component, the desired material and manufacturing process. Expert knowledge of the build process, limitations and the material characteristics are used in addition to a simulation of the build process. An additive manufacturing simulation will provide detailed insight to build failure risk, optimised build configurations, final part distortion and residual stresses. To further reduce part distortion, an optimised build model is created. Customers can expect a comprehensive report advising on suitability for additive manufacturing, design changes if required, the optimal build configuration which includes a manufacturing CAD model, expected distortion and residual stresses.



Manufacturability example - Build Opti

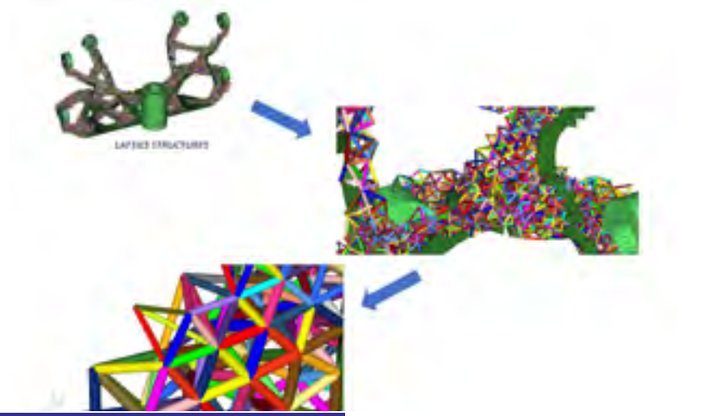


Manufacturability example - Build Failure



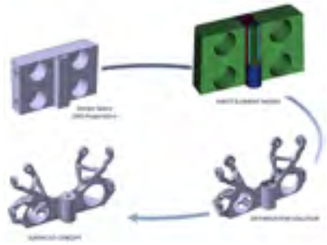
INTERNAL & EXTERNAL FEATURE ASSESSMENT (IEFA)

The design freedom of additive manufacturing allows for the manufacture of complex components which would not be possible using traditional manufacturing processes. Internal design features are typically lattice structures, however, other features such as hollow tube-like bamboo structures can be realised. External design features are structures that can be used as functional features but may not improve the structural integrity of the component. Such features are permanent support features which do not get removed and aesthetically improve the component. Customers can expect a CAD model of the final concept.



TOPOLOGY OPTIMISATION ASSESSMENT (TOA)

Topology optimisation assessment is the analysis of a component by means of simulation to improve the component's structural efficiency. Components will weigh less while maintaining or maximising stiffness compared to conventional designs. Depending on the manufacturing constraints applied, prismatic or biomimetic components will be derived. Customers will be provided with CAD models of the final concepts only. Components will not be assessed for manufacturability or functionality.



QUALIFICATION/CERTIFICATION ASSESSMENT (QCA)

The aerospace environment demands that the material and manufacturing process be qualified. Aerosud is an approved DOA and POA with NADCAP and AS 9100 Rev D compliance approval. Aerosud has the expertise to consult and provide services to customers to get DOA and POA status, certify their facilities and their additive components for the aviation market.

CAE-TO-CAD CONVERSION (CCC)

Simulation models and scanned components outputs stereolithographic (STL) file formats. These file formats must be converted to CAD geometry. Expertise in reverse engineering techniques are used to convert the stl data file into a STEP, IGES or Catia V5 CATPart file format. Customers can expect a CAD model of the final concept.

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