

MEPHISTO

Modelling for Early Phase Investigation into alternative System and Technology Options

Jakob R. Müller

Industrial and Materials Science (IMS)

Systems Engineering Design

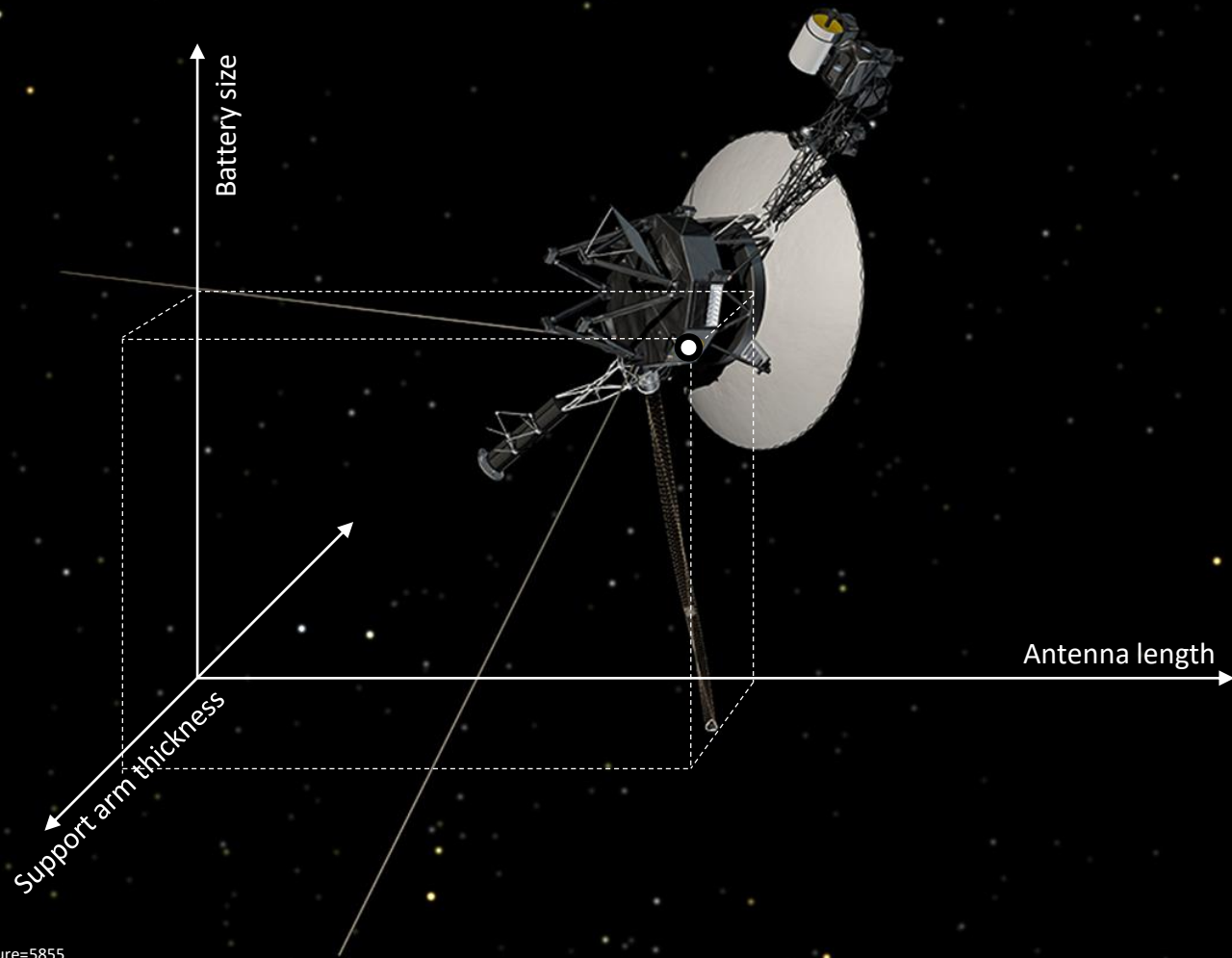
Ola Isaksson

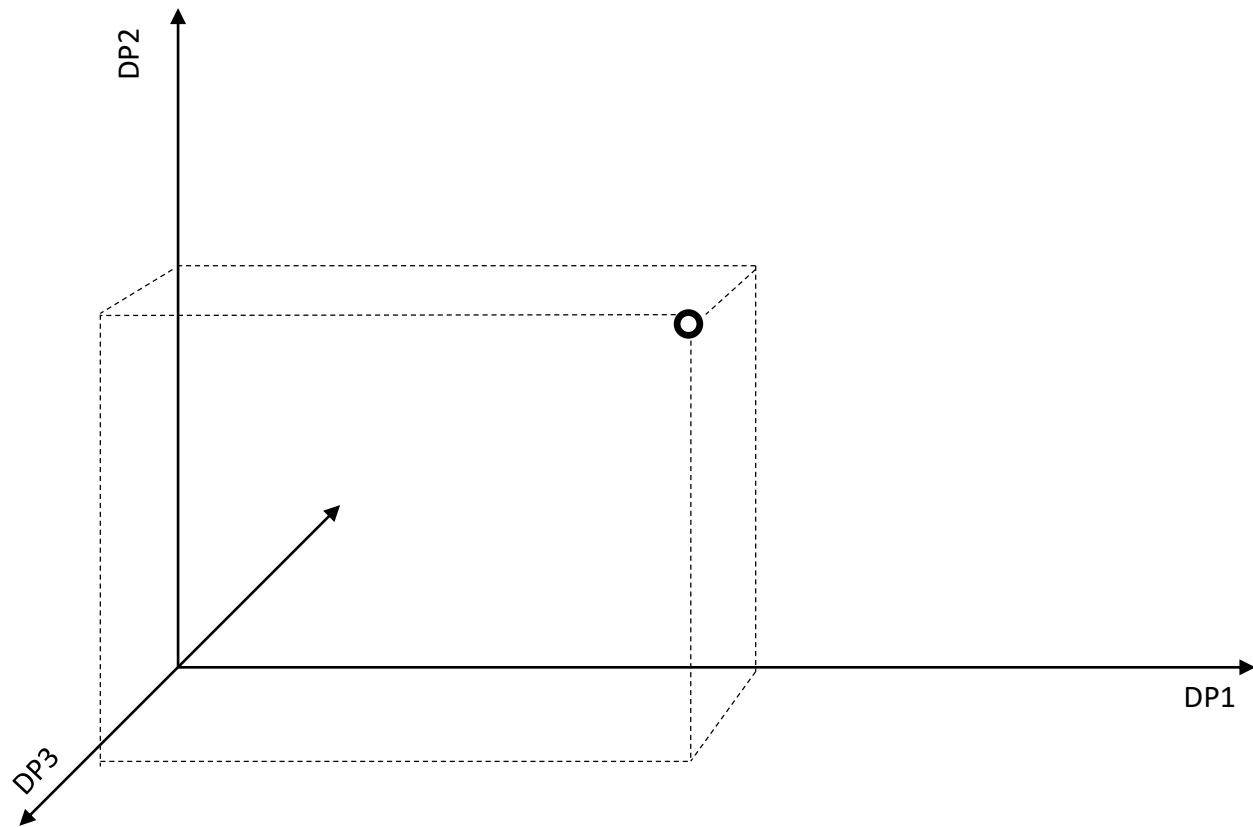
Massimo Panarotto

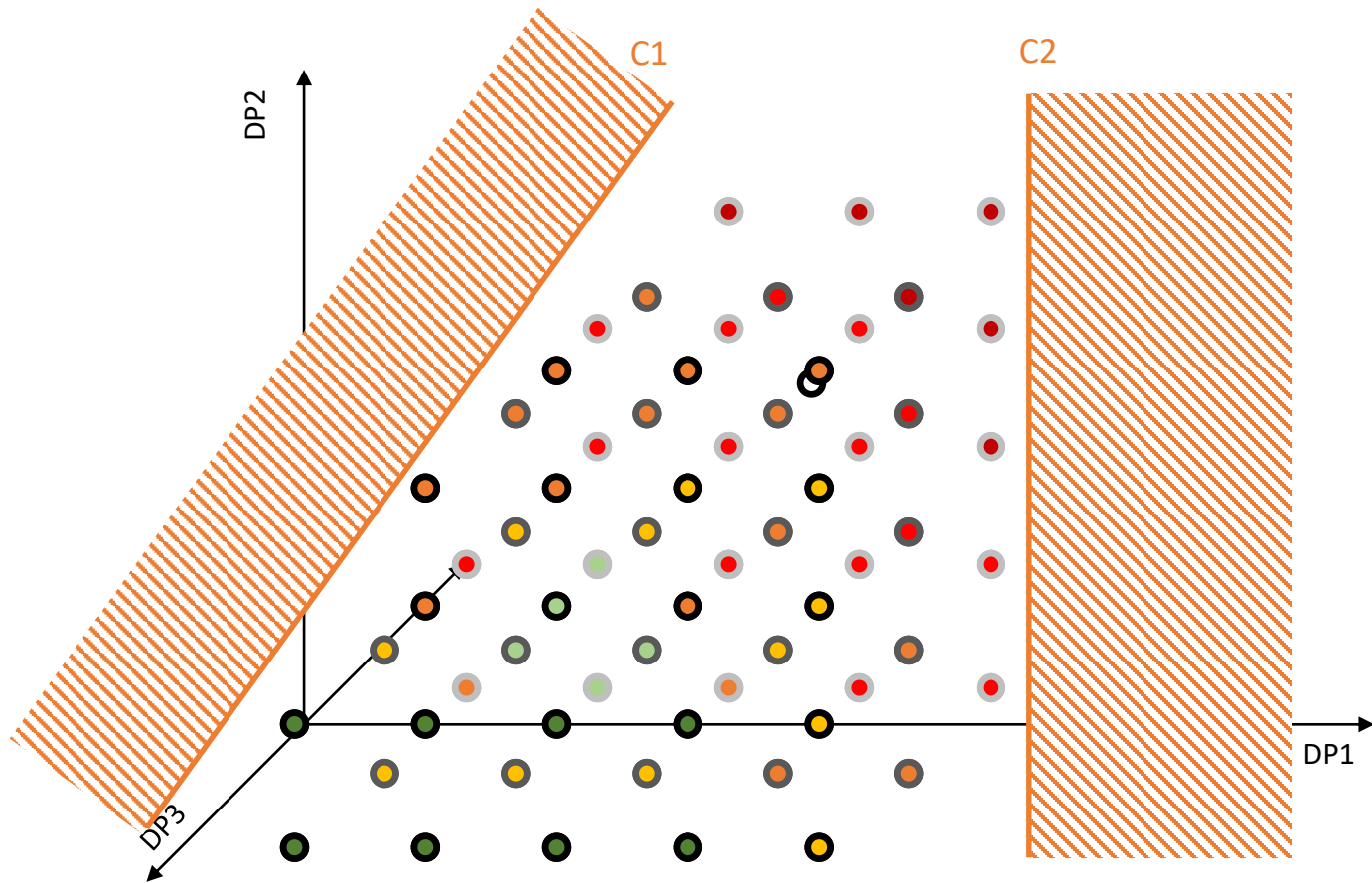
Johan Lööf

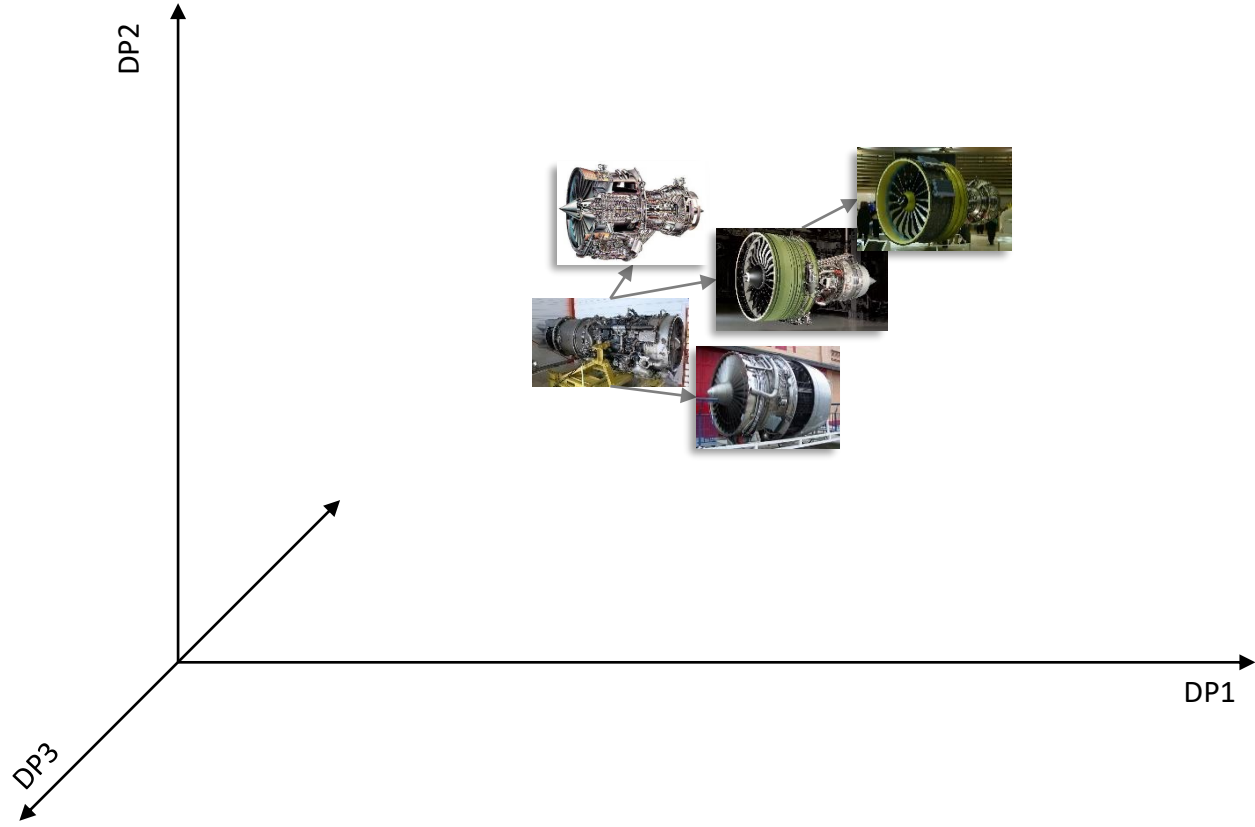
Coupling function and geometry models to enable multi-domain design space exploration

Jakob R. Müller

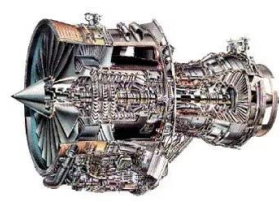
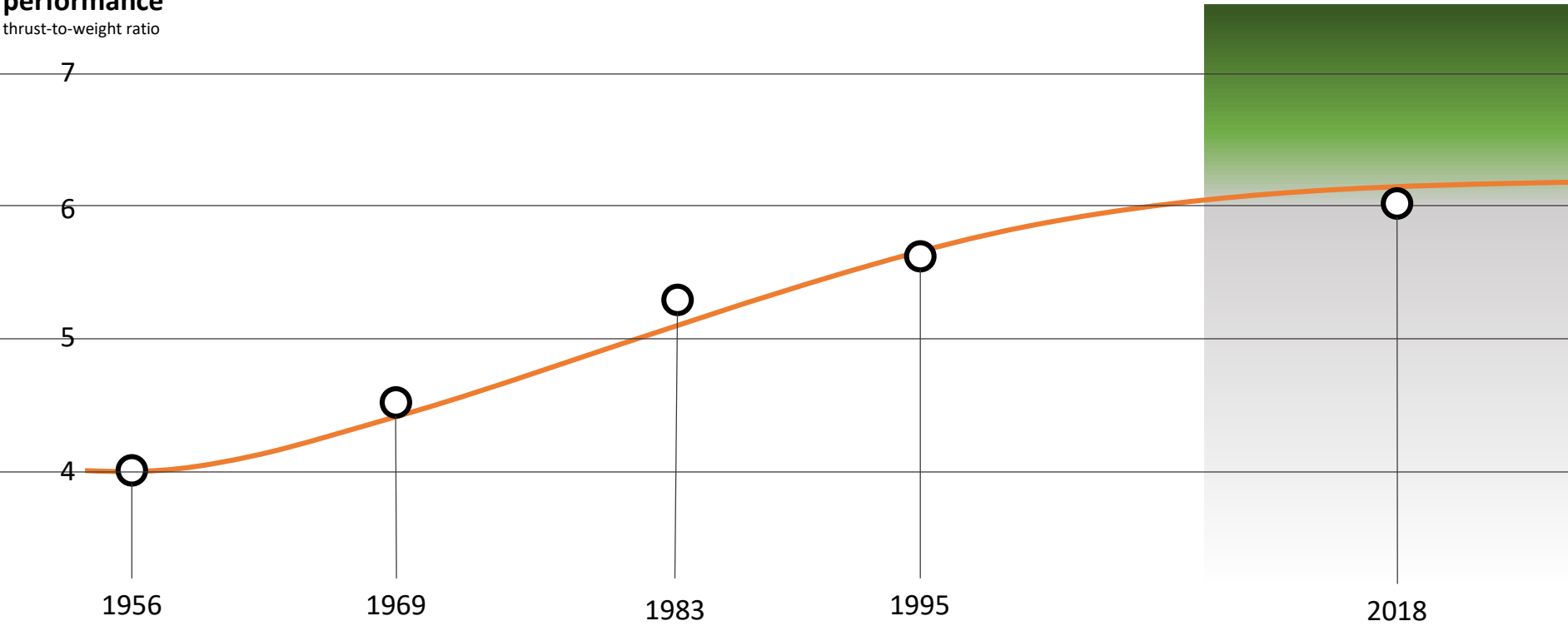


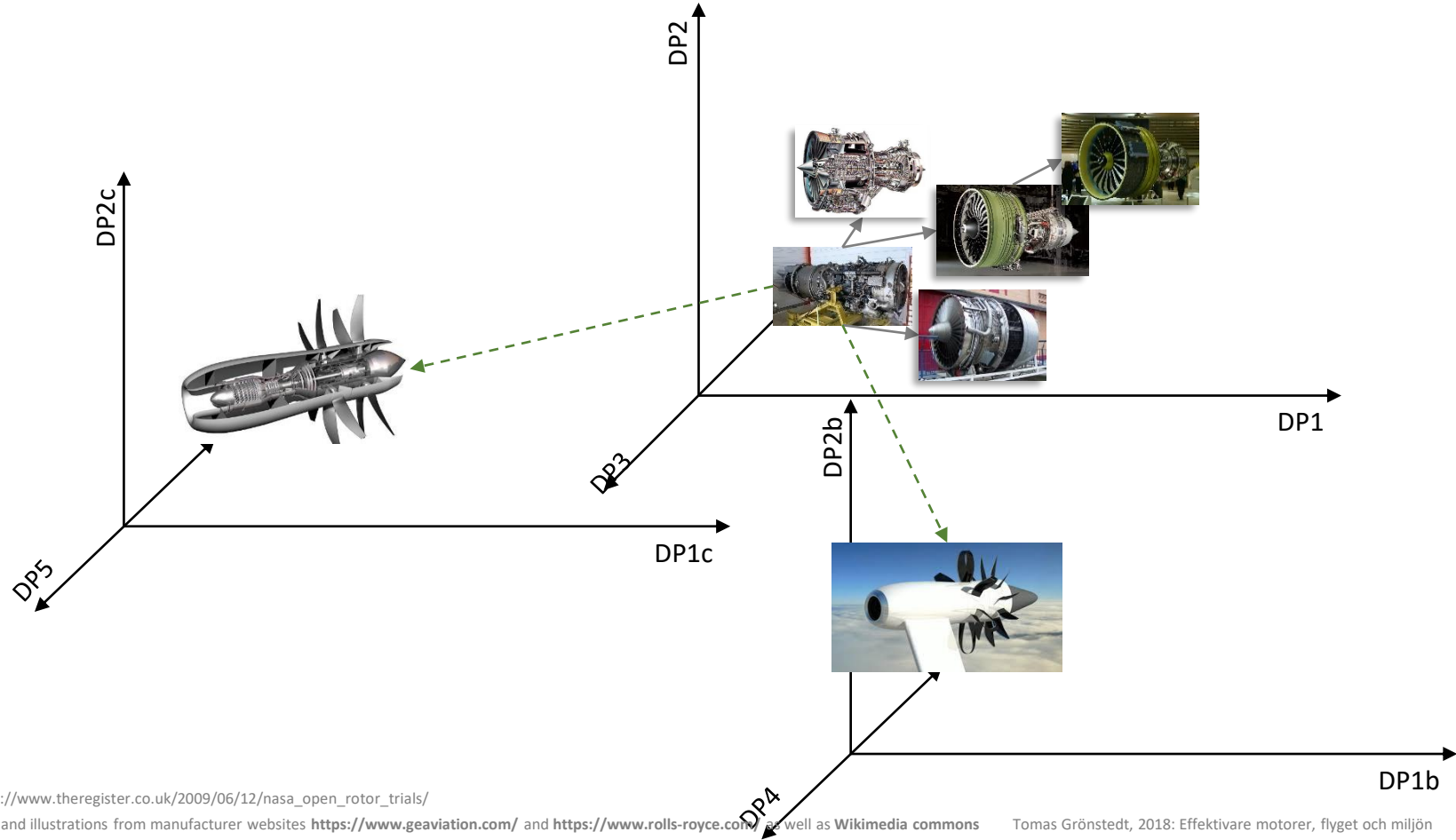






performance
thrust-to-weight ratio





https://www.theregister.co.uk/2009/06/12/nasa_open_rotor_trials/

Data and illustrations from manufacturer websites <https://www.geaviation.com/> and <https://www.rolls-royce.com/> as well as Wikimedia commons

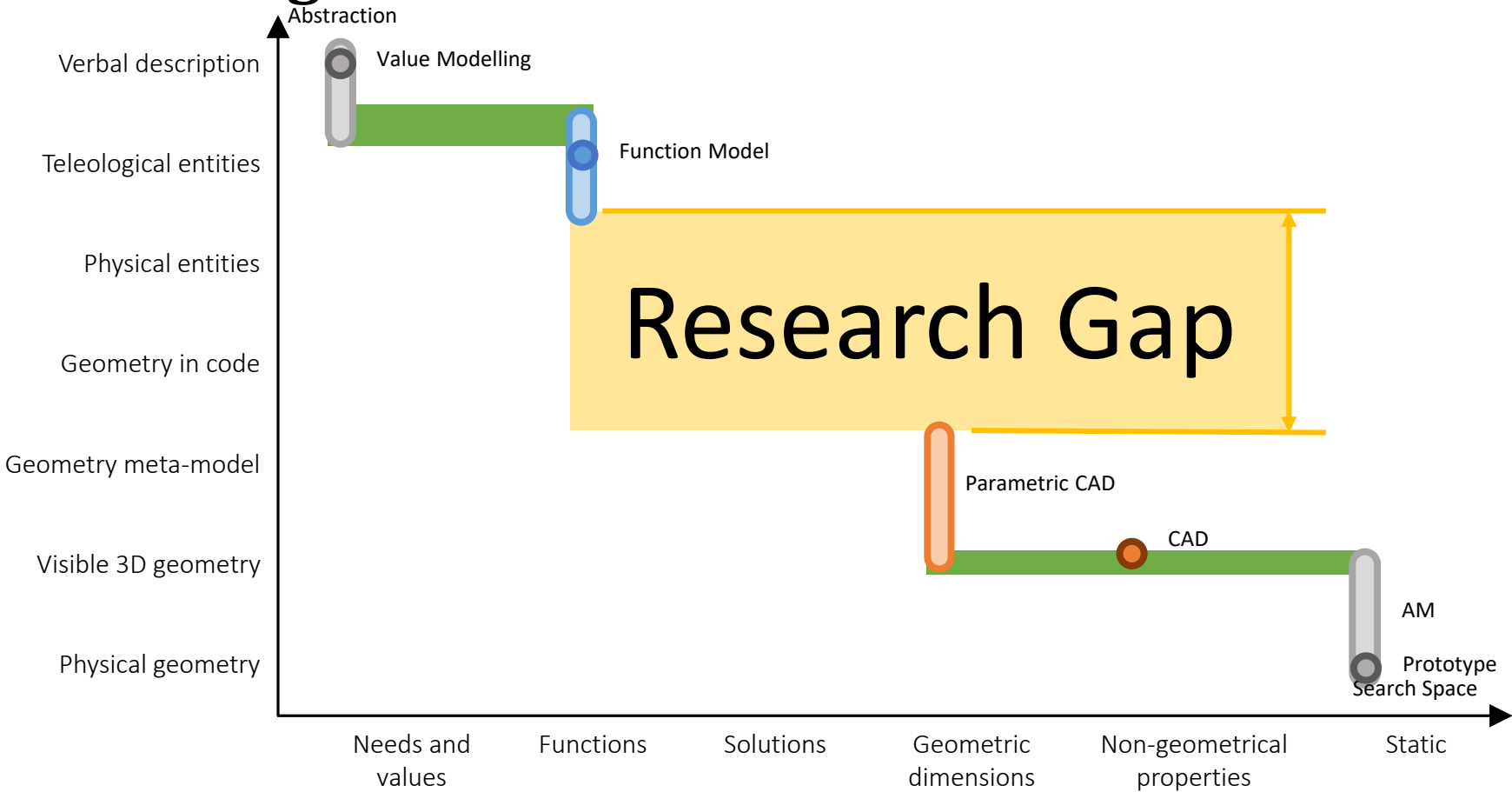
Tomas Grönstedt, 2018: Effektivare motorer, flyget och miljön

Research Question

How can design space exploration be improved to be faster, more systematic, and cover a wider area of the design space?

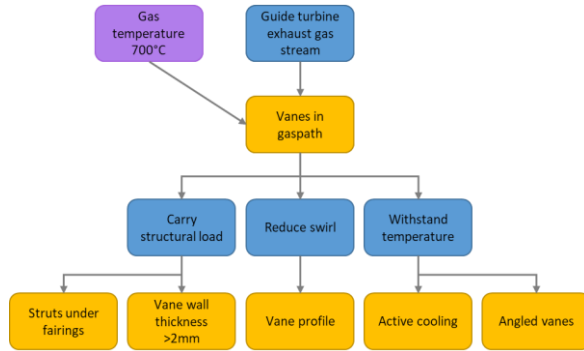
How to methodically support the exploration of divergent, non-continuous design spaces in product development?

Background: Product models



Frame of reference

Function Modelling (EF-M)



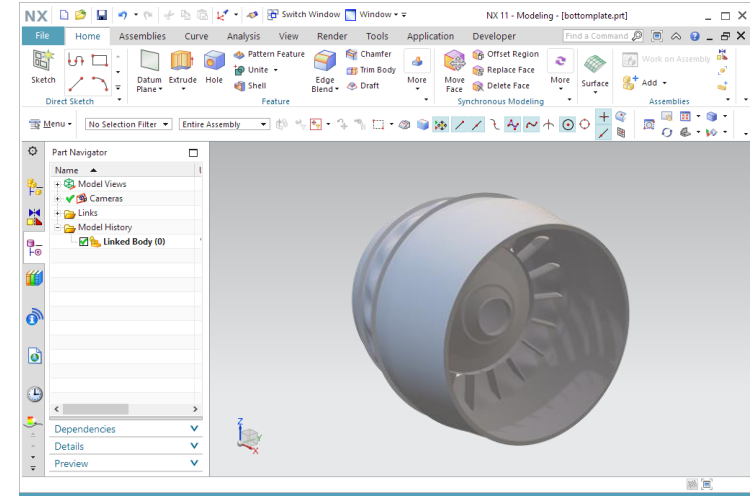
Alternative options

Analysis: systemic, modularisation...

Design Rationale

Rarely to not used

Geometry Modelling (CAD)



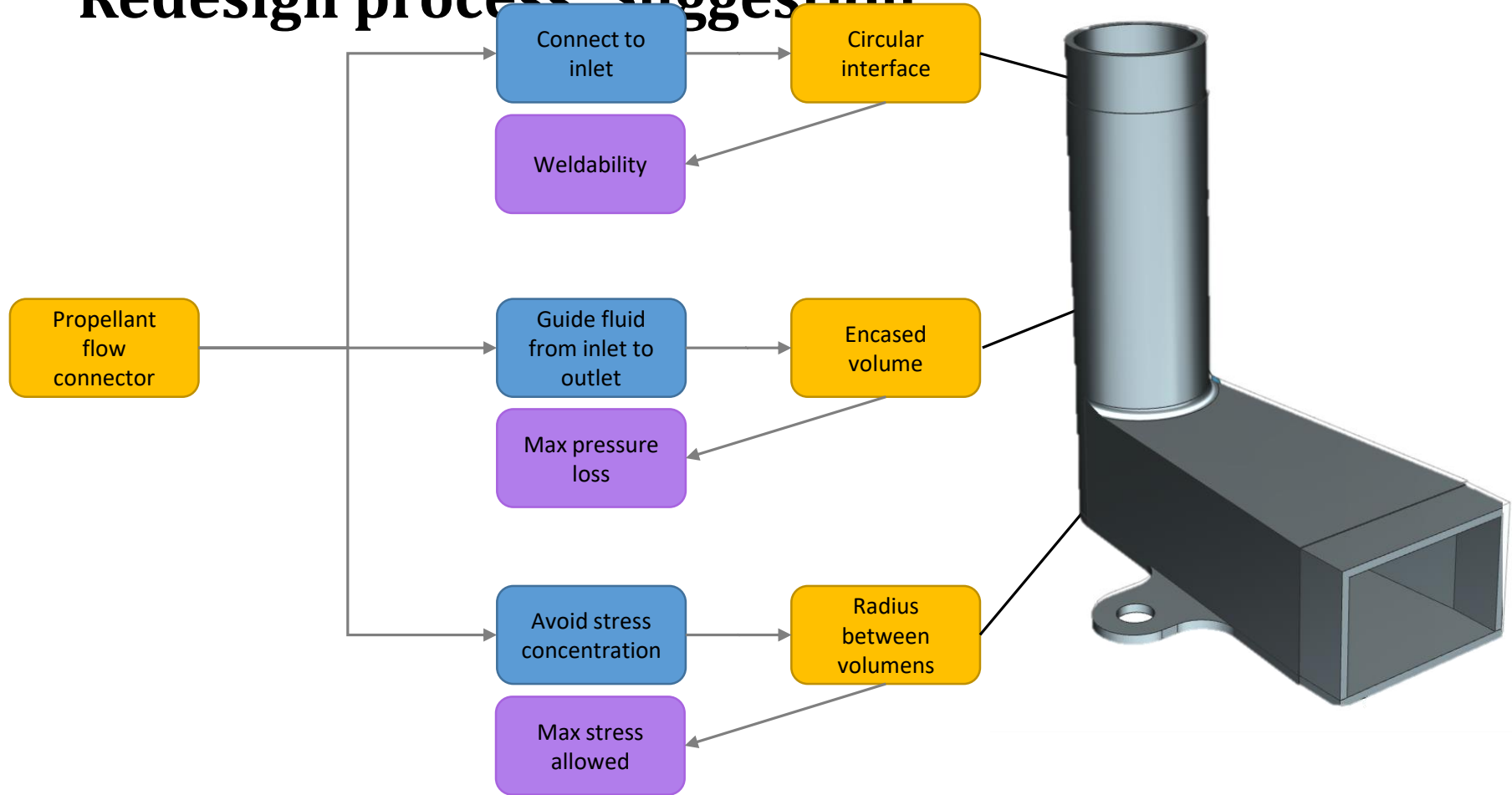
Illustration

Analysis: structural, aerodynamic, thermal...

Manufacturing

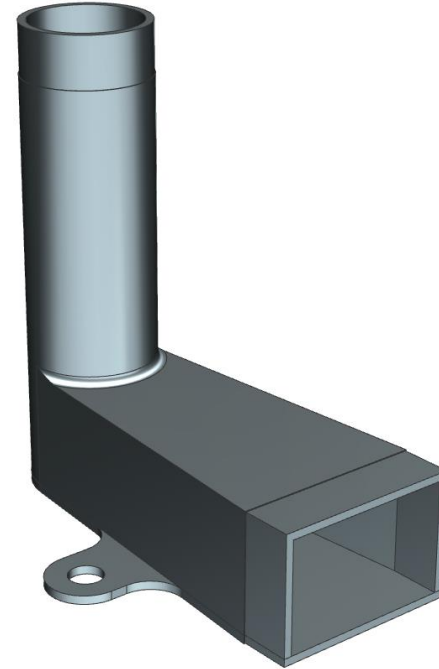
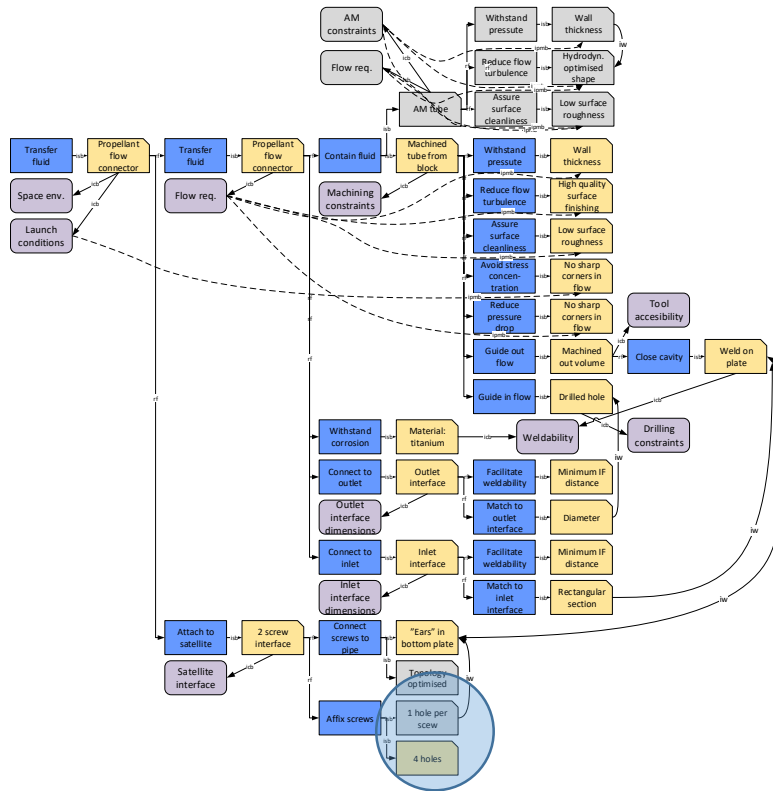
“Standard product model”

Redesign process: Suggestion

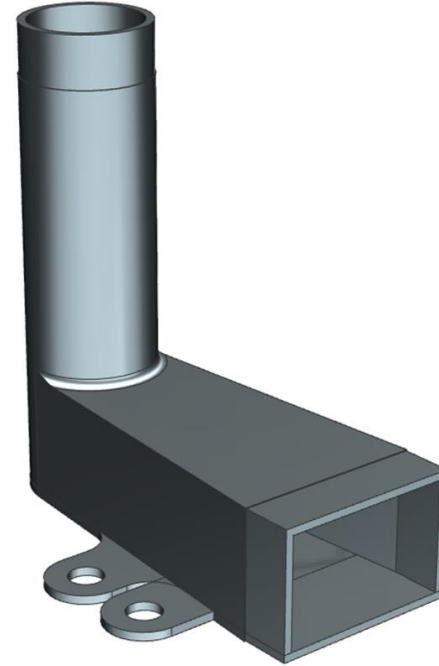
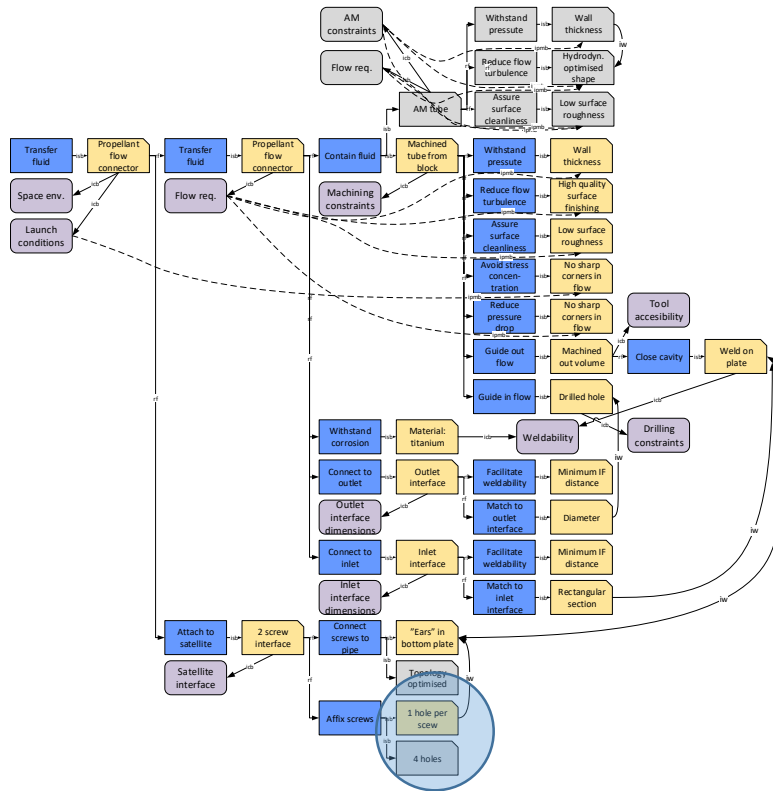


[illegible]

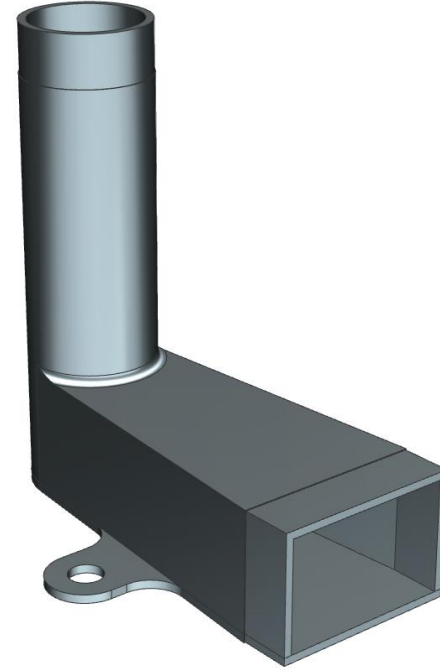
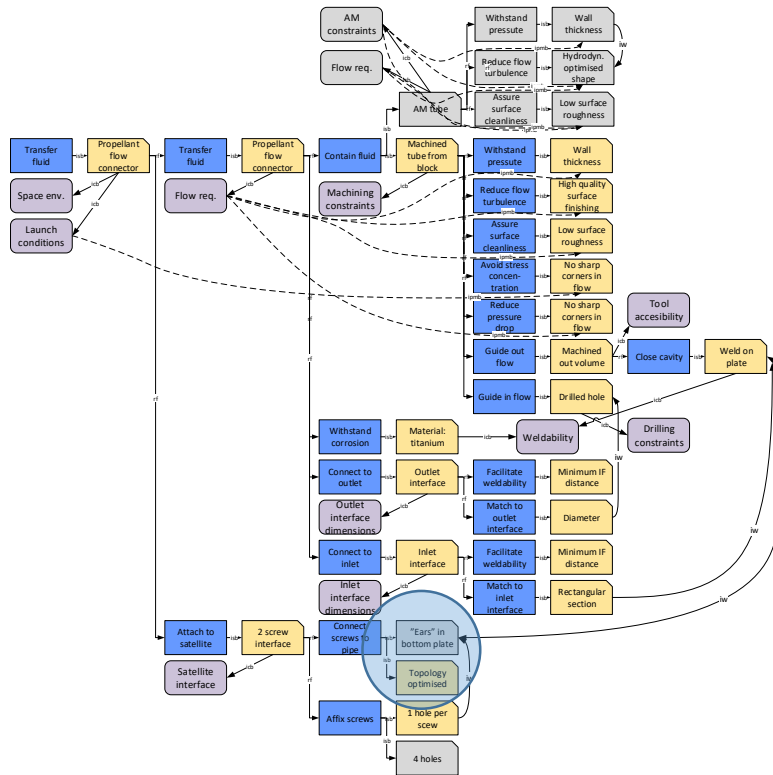
Redesign-process: Application



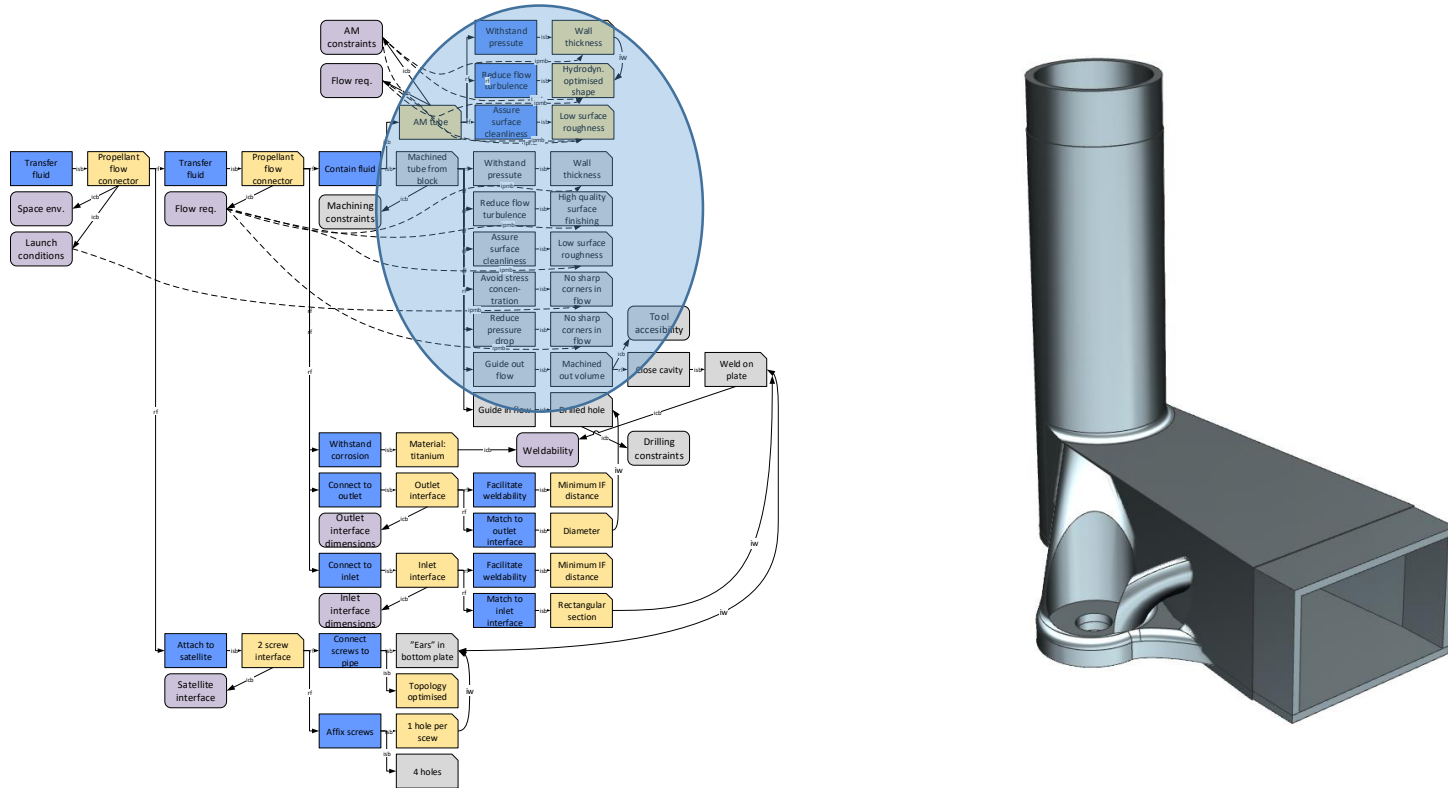
Redesign-process: Application



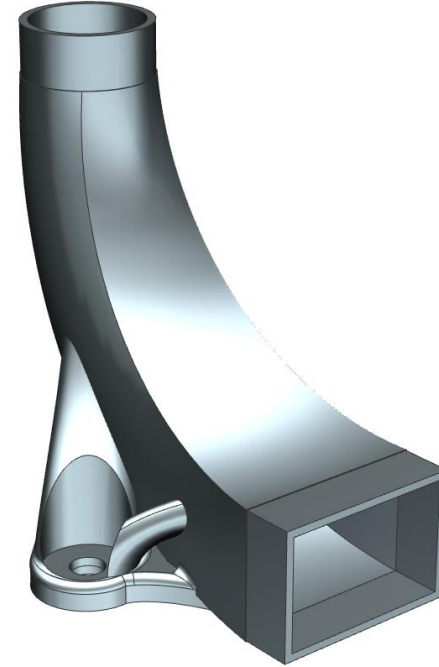
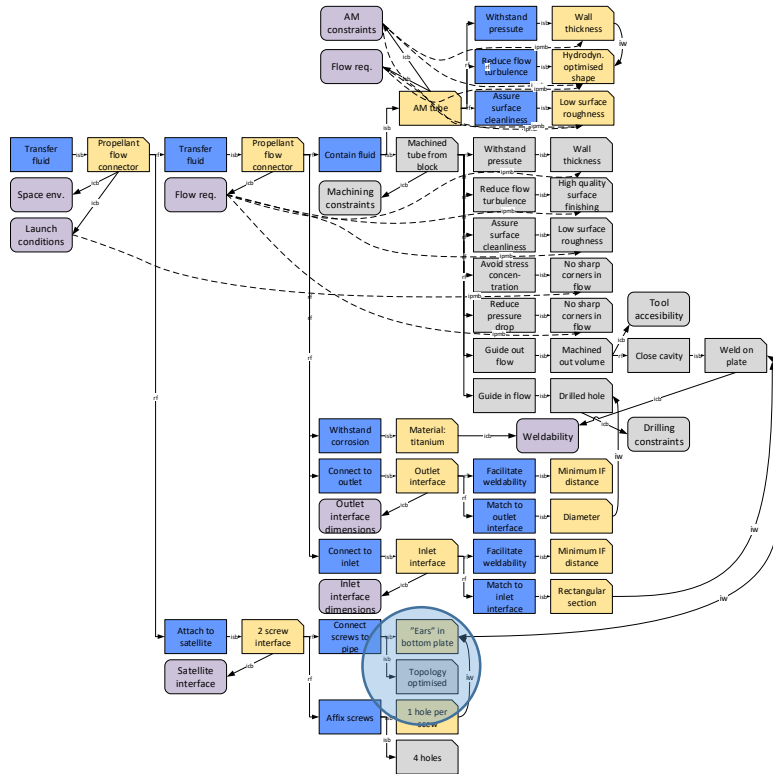
Redesign-process: Application

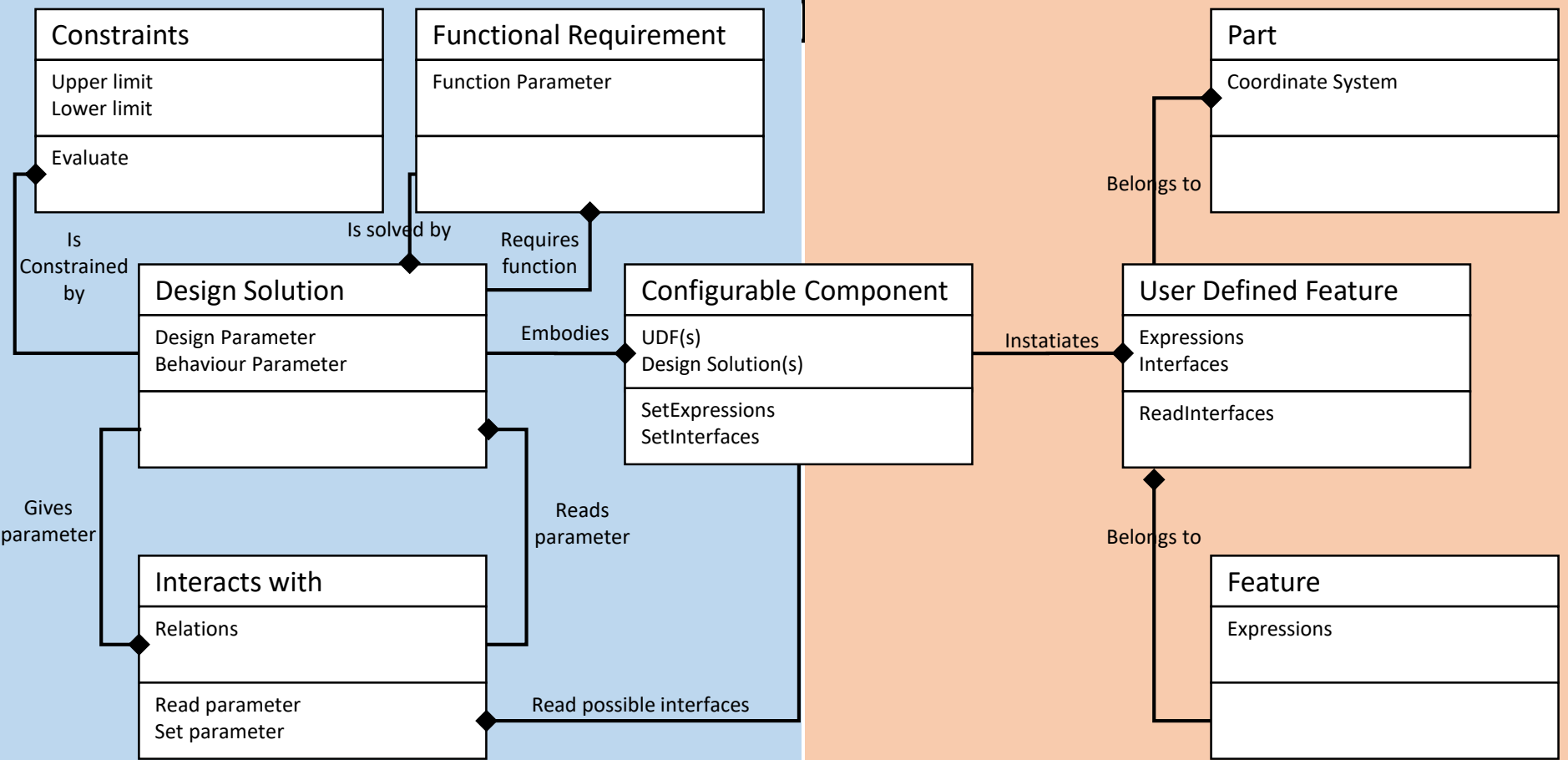


Redesign-process: Application



Redesign-process: Application





Function Model

Geometry Model

Python Framework

Journal script (NXOpen)

Configurable Component

UDF(s)
Design Solution(s)

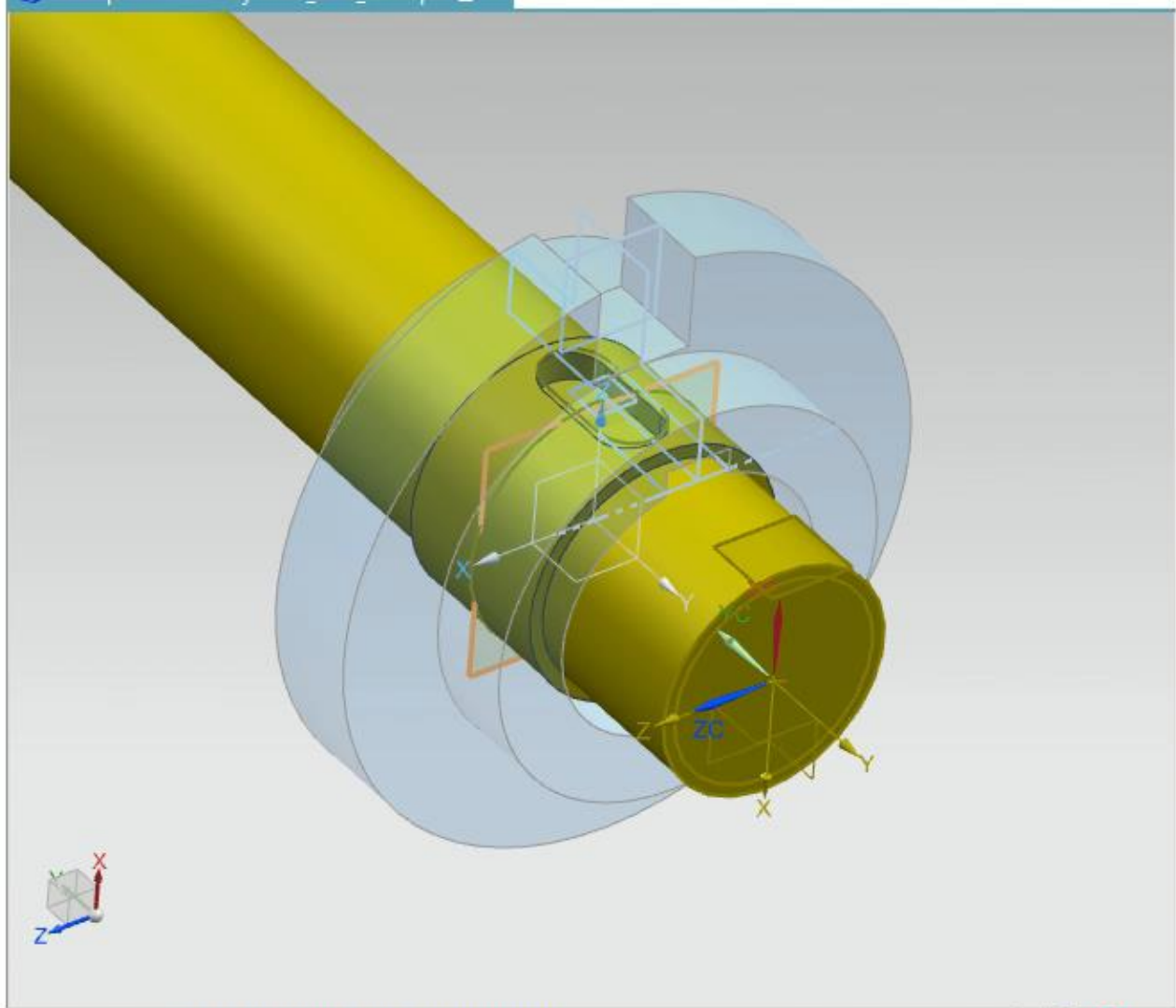
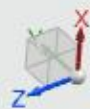
SetExpressions
SetInterfaces

Instantiates

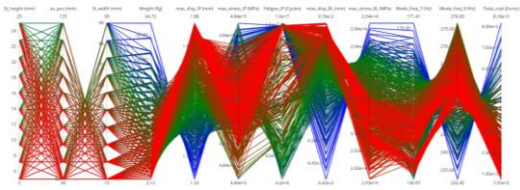
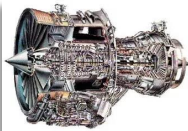
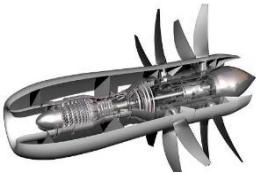
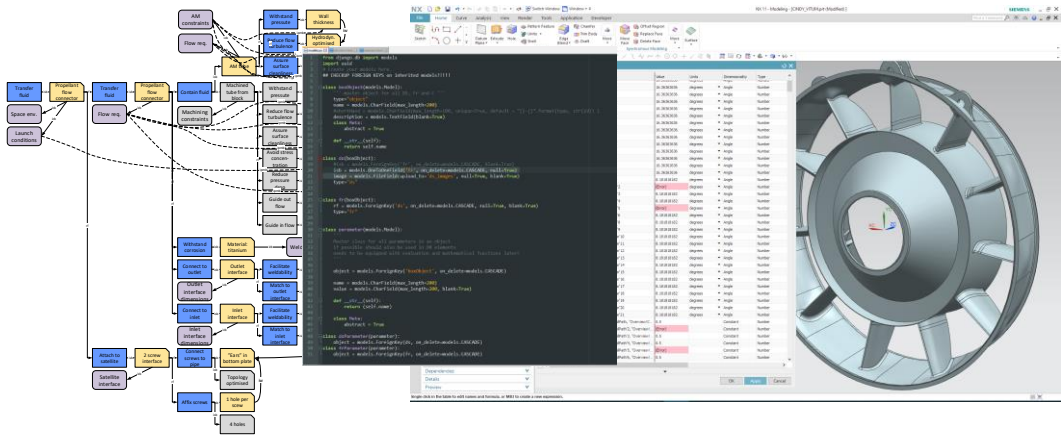
Siemens NX

Function Model

Geometry Model



Conclusions



Conclusions

How to methodically support the exploration of divergent, non-continuous design spaces in product development?

Function-based geometry model for design space exploration

Extending/varying existing geometry model with reduced modelling effort

Enabling simulation and assessment of large numbers of alternatives

Change progression analysis of new functions, constraints, requirements

Capturing systemic and legacy knowledge

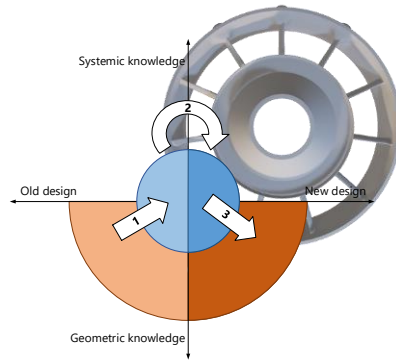
Validation of results

Collaboration with GKN Aerospace

Development of tools

Ongoing work

Thank you.



Licentiate Thesis

Towards automated conceptual design space exploration

An investigation into the design process of aerospace components

Jakob R. Müller

wingquist
LABORATORY



Supervisors: Prof. Ola Isaksson
Dr. Massimo Panarotto
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