

MDO Supported by KBE

G. La Rocca (TU Delft)

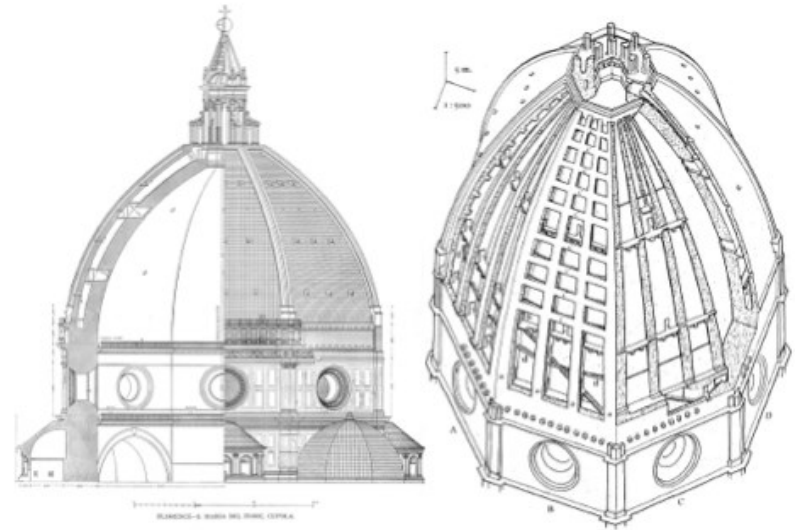
EWADE 2015

**12th European Workshop on
Aircraft Design Education
Delft, The Netherlands**

September 2015



When Fillippo Brunelleschi designed the cupola of the Santa Maria del Fiore in 15th century Florence he worked alone.



In designing the Boeing 747 Joe Sutter started with a few hundred engineers in his team but finished with 4.500.

*The number of individuals involved in the design process has grown with time reflecting the **increase in complexity** of the **products** and the **design process** itself.*



*Designing a modern product is a process involving an **intricate web of cross-connections** between the parts of the products systems and their abstractions in the underlying mathematical modeling*

*The number of individuals involved in the design process has grown with time reflecting the **increase in complexity** of the **products** and the **design process** itself.*



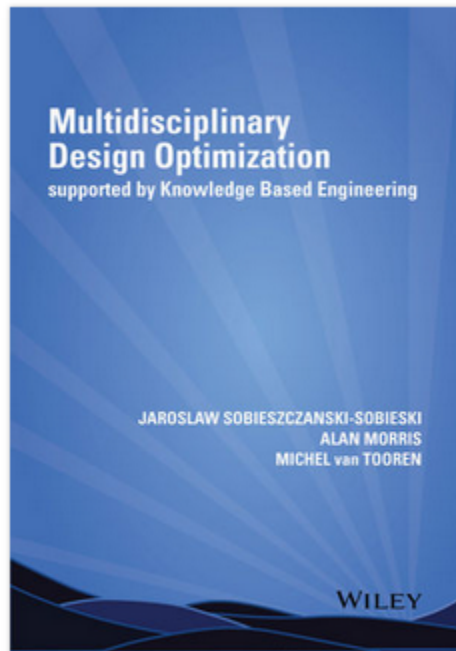
everything influences everything else!



*Designing a modern product is a process involving an **intricate web of cross-connections** between the parts of the products systems and their abstractions in the underlying mathematical modeling*

Two technologies have emerged to help cope with this situation:

- **Multidisciplinary Design Optimization (MDO)**
- **Knowledge Based Engineering (KBE)**

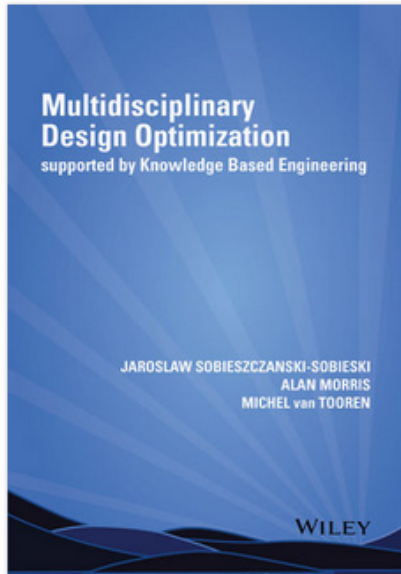


Multidisciplinary Design Optimization Supported by Knowledge Based Engineering

Jaroslaw Sobieszczanski-Sobieski, Alan Morris, Michel van Tooren

ISBN: 978-1-118-49212-3

408 pages
September 2015



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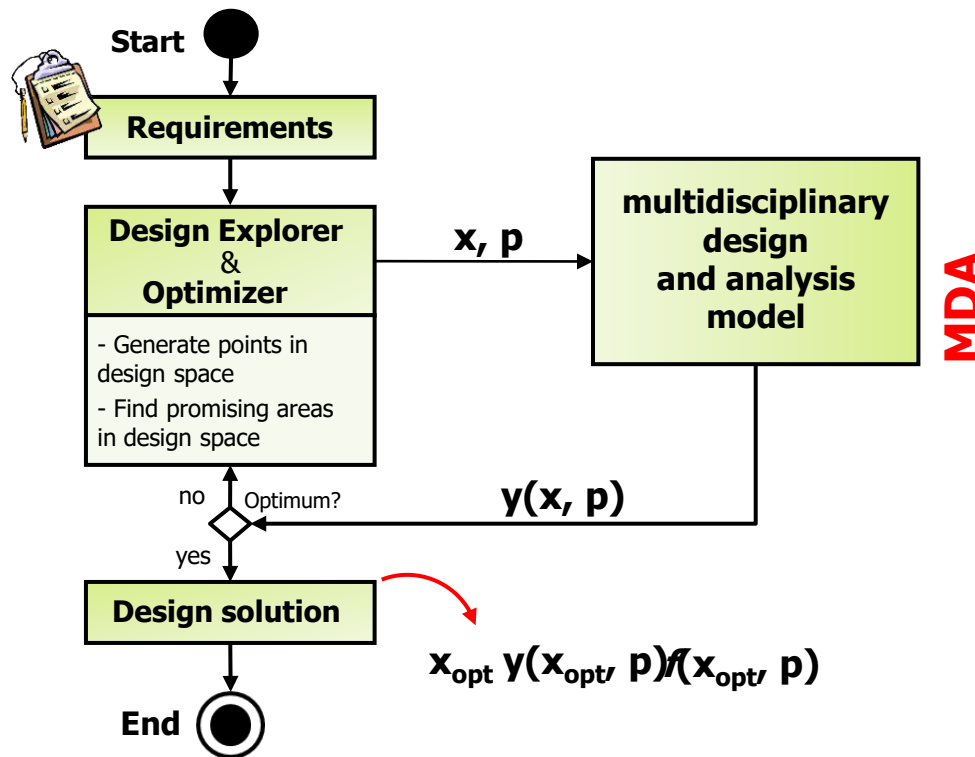
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- Provides a pathway through basic optimization methods to MDO methods
- Emphasizes real world engineering design practice in the application of optimization methods
- Comprehensively covers MDO and **is the only book to directly link this with KBE methods**

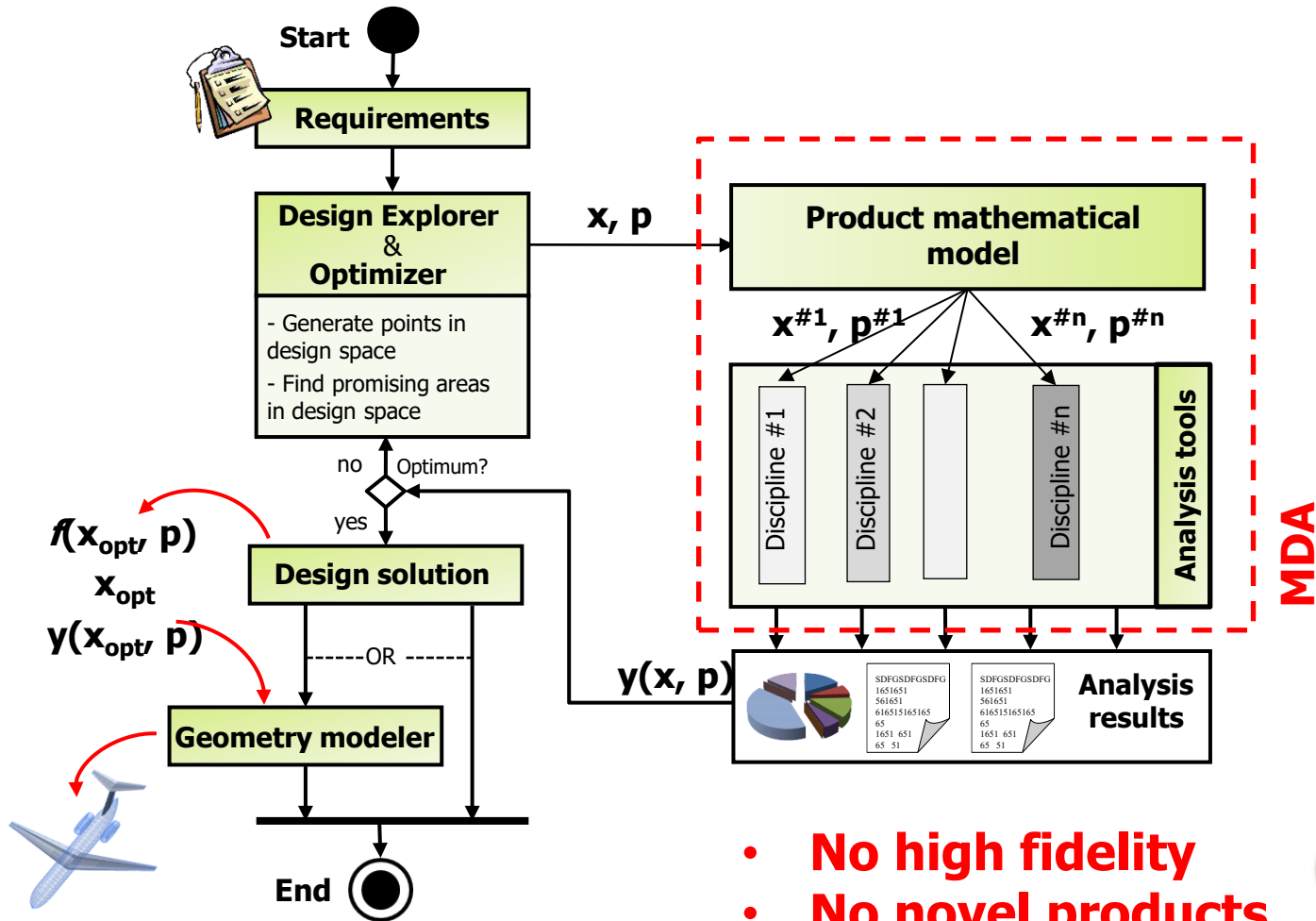
Why MDO “supported by KBE”?

Generic MDO system representation:



Why MDO “supported by KBE”?

MDO system implementation **without geometry**



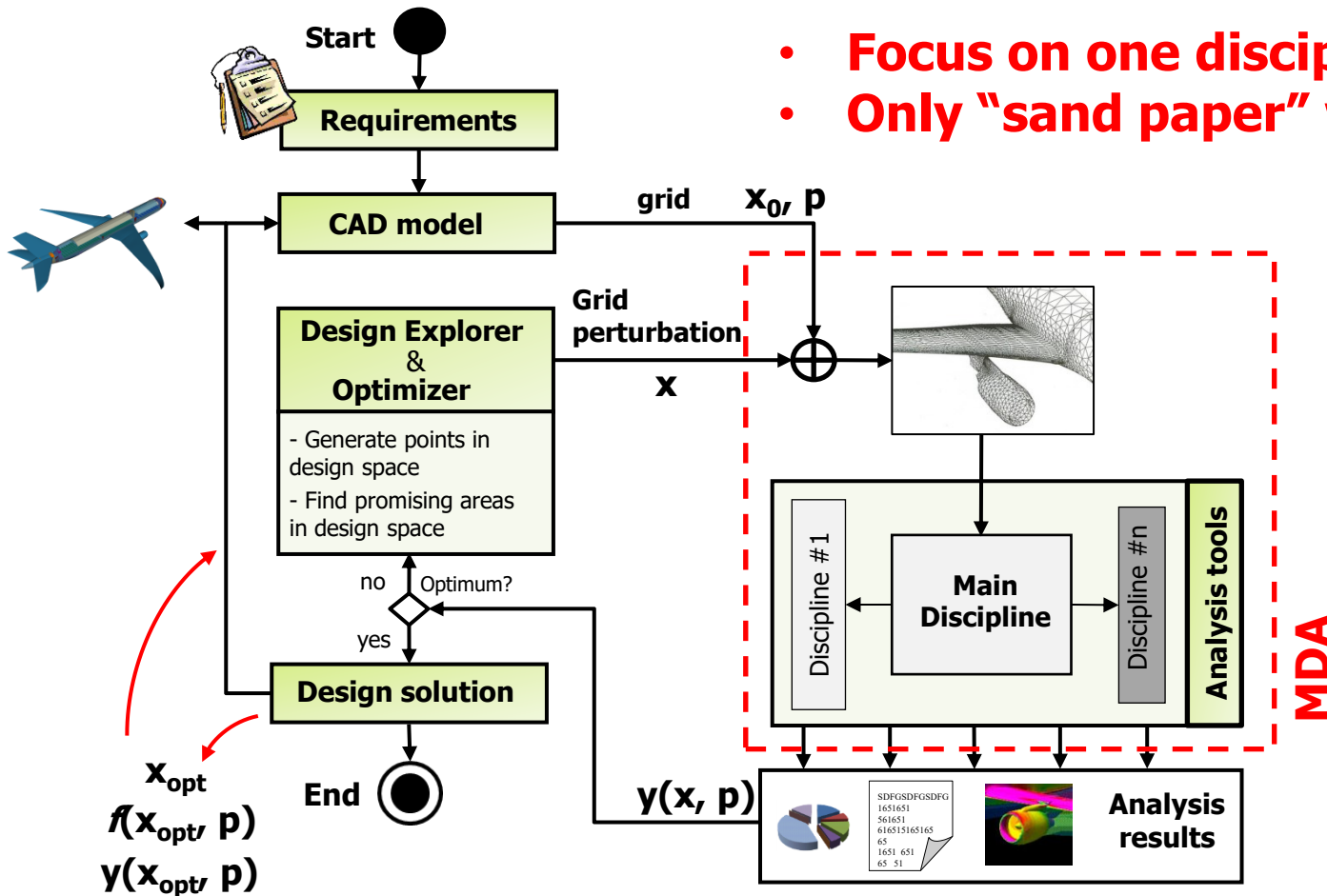
- No high fidelity
- No novel products



Why MDO “supported by KBE”?

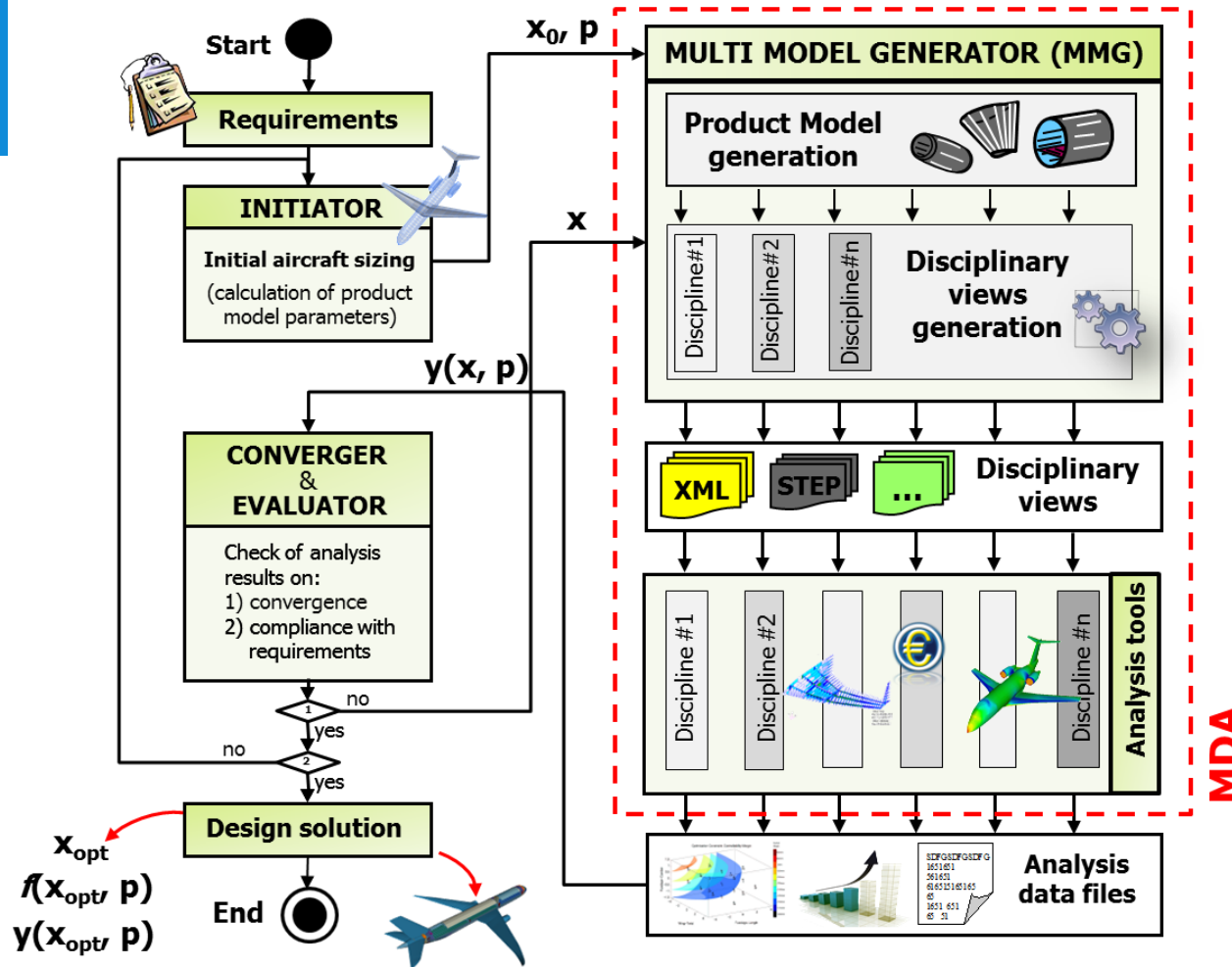
MDO system implementation based on **grid perturbation approach**

- Focus on one discipline
- Only “sand paper” work



Why MDO “supported by KBE”?

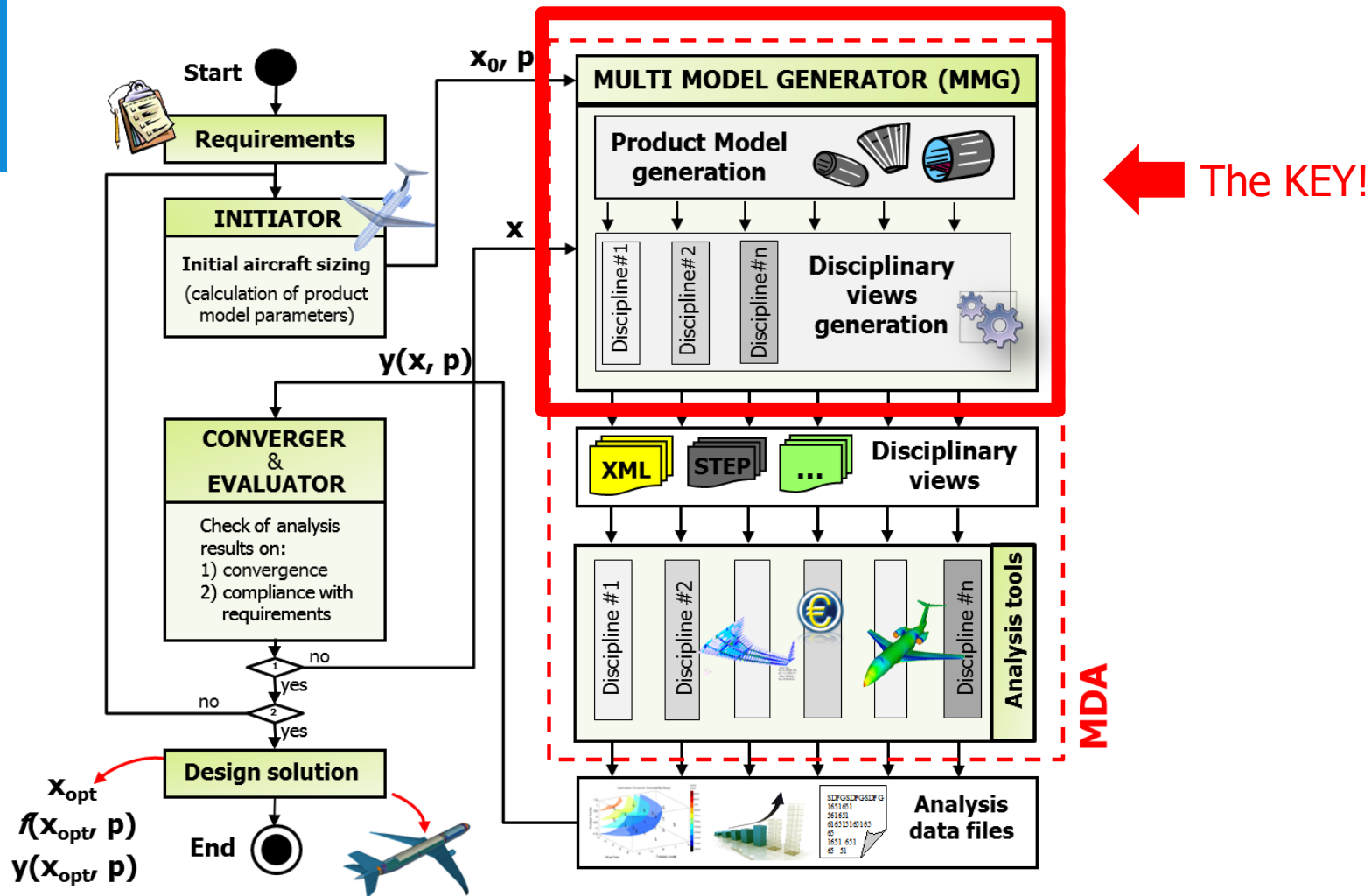
MDO system implementation with **generative model in-the-loop**



- 
- Truly multidisciplinary
 - Multi-fidelity
 - Topology modification allowed
 - Suitable for novel design studies
 - Suitable for distributed design

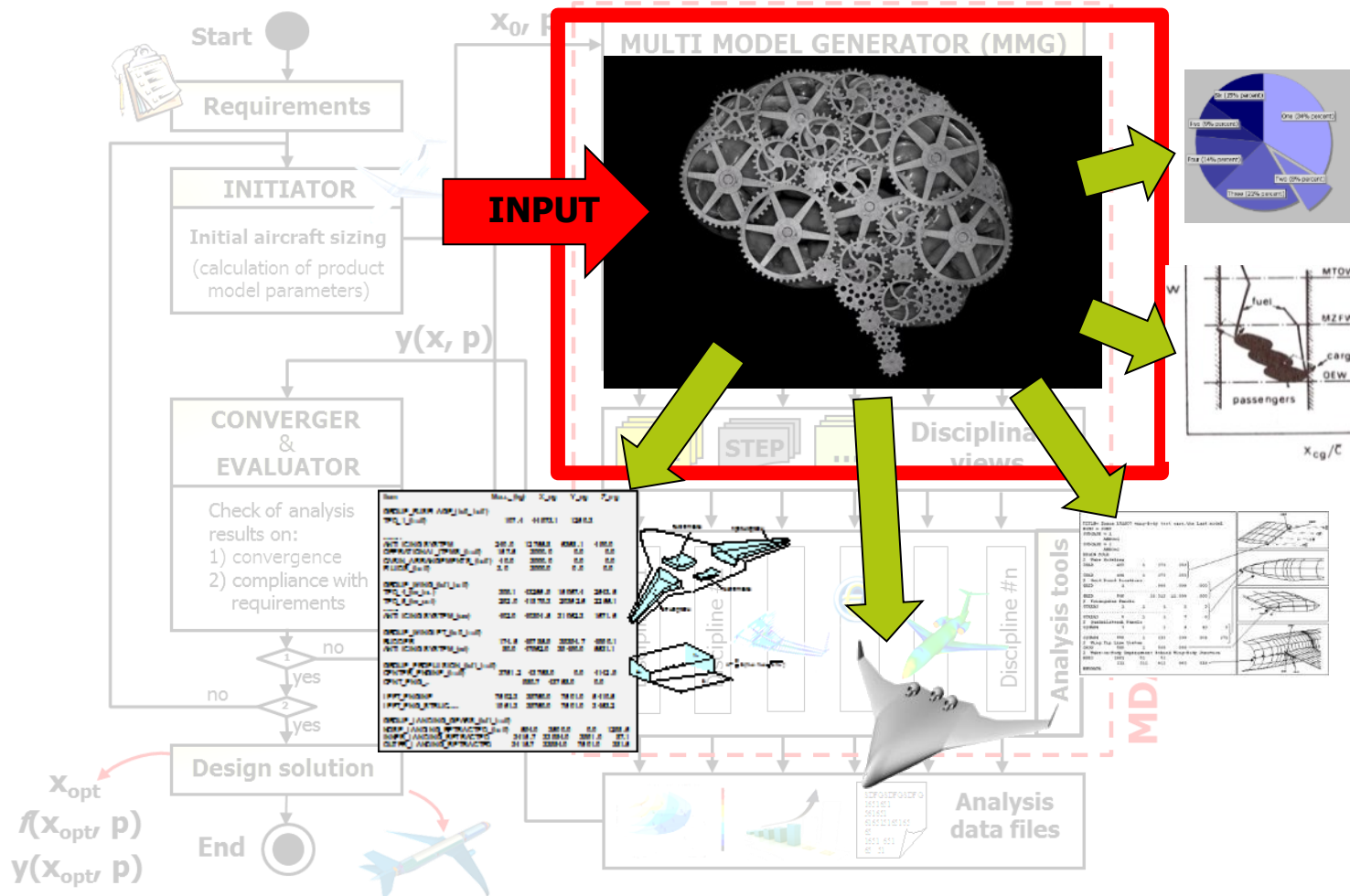
Why MDO “supported by KBE”?

MDO system implementation with **generative model in-the-loop**



Why MDO “supported by KBE”?

MDO system implementation with **generative model in-the-loop**



KBE Technology for generative design

The Generative model requires the following functionalities:

1. Geometry manipulation (as a top class CAD system)
2. Ability to generate geometry and derived/associated data (the product views or abstractions) automatically
3. Handling both *declarative* and *procedural* knowledge



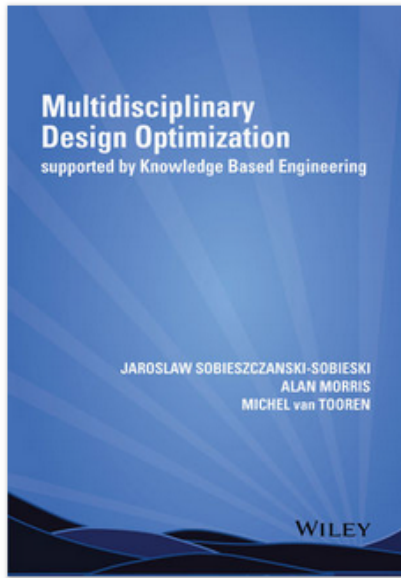
To describe a design
(*design as a noun*)



To describe a design process
(*design as a verb*)

Knowledge Based Engineering is THE TECHNOLOGY to deliver such functionalities!

HOW?



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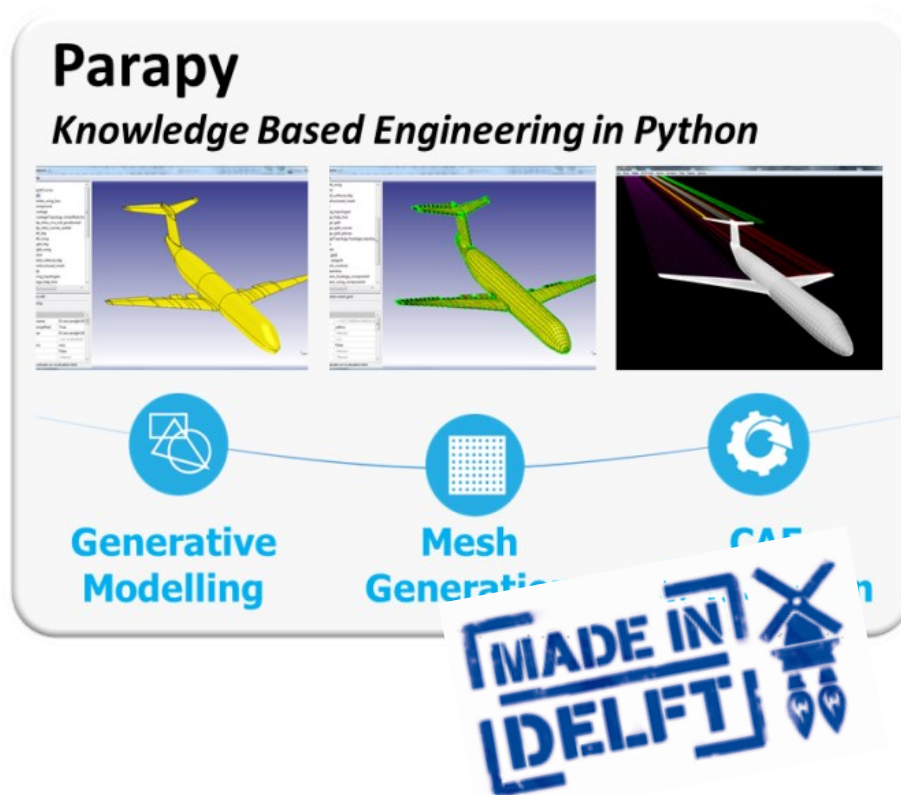
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Our new textbook for:

- **MSc course AE4205:** *MDO for Aerospace Applications*
- **MSc course AE4204:** *Knowledge Based Engineering*

Thank you Michel, Alan and Jarek for making me part of this
Thanks to Reinier and Dave for their input and feedback

By the way, are you interested in the latest generation Knowledge Based Engineering system?



PARAPY: a brand new **Knowledge-Based Engineering** platform in the **Python** language.

Capture and automate your routine engineering tasks:

- **CAD modelling**
- **Grid generation**
- **CAE pre/post-processing**