Introduction - Gaining through Multidisciplinary Design

Training potential users through varied examples

Session 4

VIVACE

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VIVACE Forum 1, Warwick UK, 20-21 September 2005

Overview

- Aircraft design process observations
- Multidisciplinary Design Optimisation definition
- MDO and VIVACE
- Introduce this Multidisciplinary Design Optimisation session

Aircraft design process observations

Aircraft design

- Complex process
- Involves many interacting disciplines
- Each discipline has “own” models and tools
- Traditionally top-level design, allocate “limiting” target per discipline
- Each discipline performs initial design iteration
- Feed-back results to top-level design
- Duration week to month(s) per top-level iteration
- Conceptual design model: when accuracy improves, model data diverges

Multidisciplinary Design Optimisation (MDO)

Sample definition from American Institute of Aeronautics and Astronautics (AIAA) Multidisciplinary Design and Optimisation

- “optimal design of complex engineering systems which requires analysis that accounts for interactions amongst the disciplines (or parts of the system) and which seeks to synergistically exploit these interactions”

Informally

- “how to decide what to change, and to what extent to change it, when everything influences everything else”

AIAA MDO technical committee, www.aiaa.org, accessed July 2005

Multidisciplinary Design Optimisation

Five key elements of MDO collaboration

- A process
- A multidisciplinary team
- An integrated design model
- A dedicated facility (set of tools)
- A software infrastructure

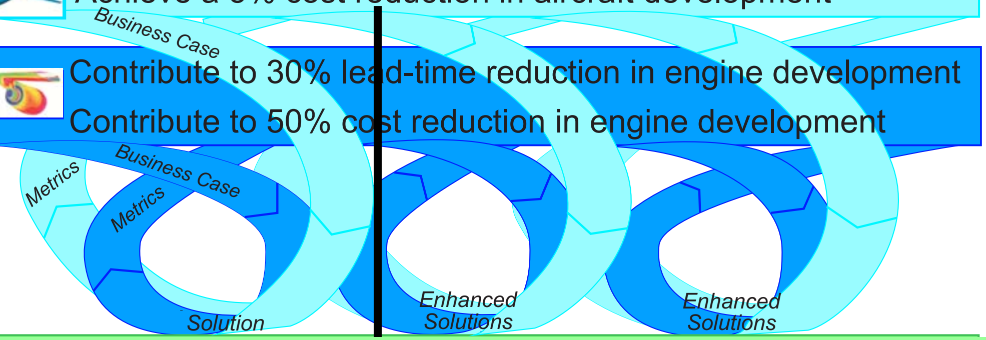
ESA, What is concurrent engineering, www.esa.int/export/SPECIALS/CDF/SEMQOF1P4HD_0.html, accessed July 2005

MDO and VIVACE

VIVACE Objectives

- Achieve a 5% cost reduction in aircraft development
- Contribute to 30% lead-time reduction in engine development
- Contribute to 50% cost reduction in engine development

Evolutionary Approach (3 Iterations)



VIVACE System

- Process
- Multidisciplinary team
- Integrated design model
- Set of tools
- Software infrastructure

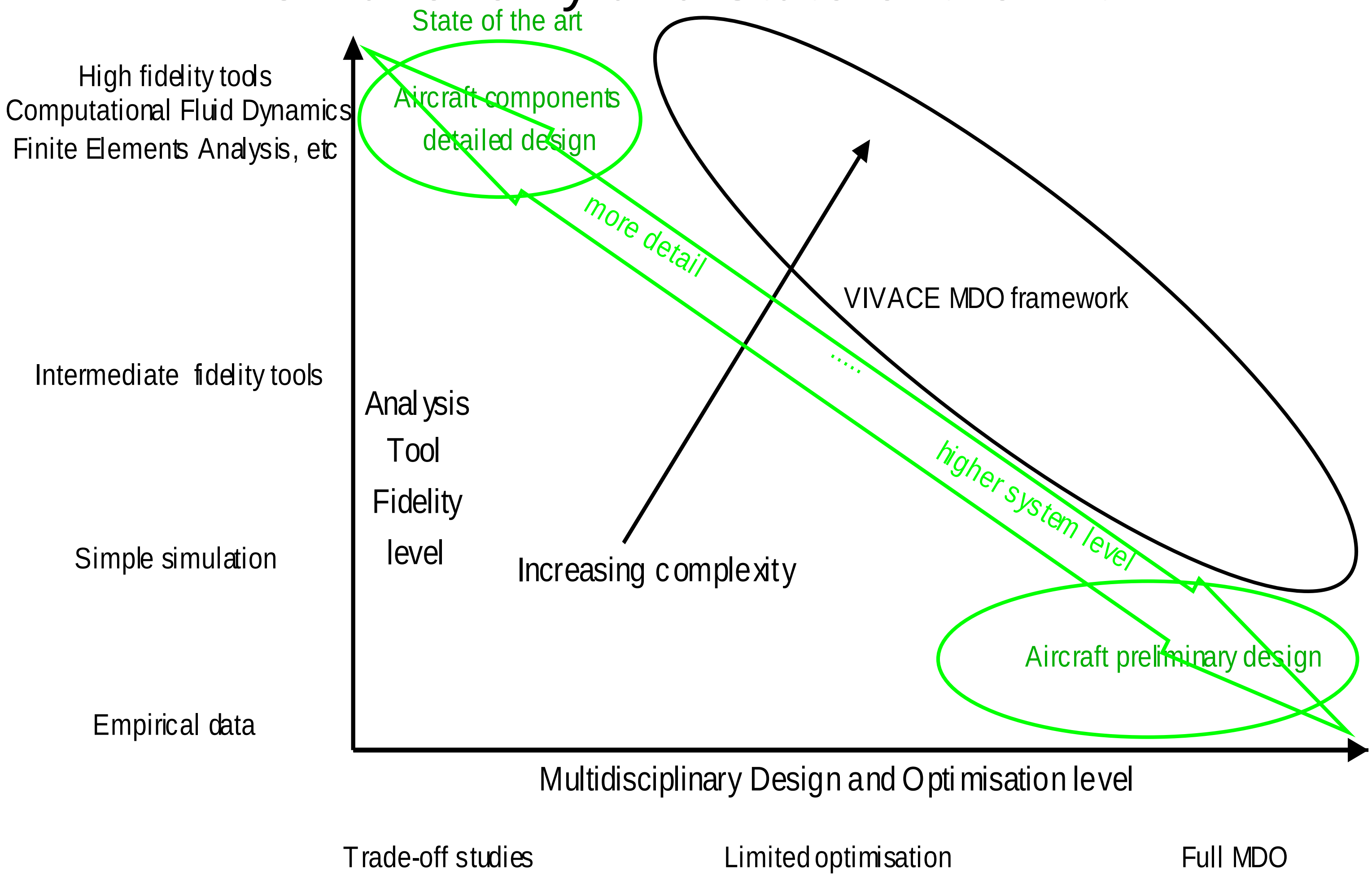
Current status

End of 1st iteration

- Aircraft
- Engine

MDO and VIVACE

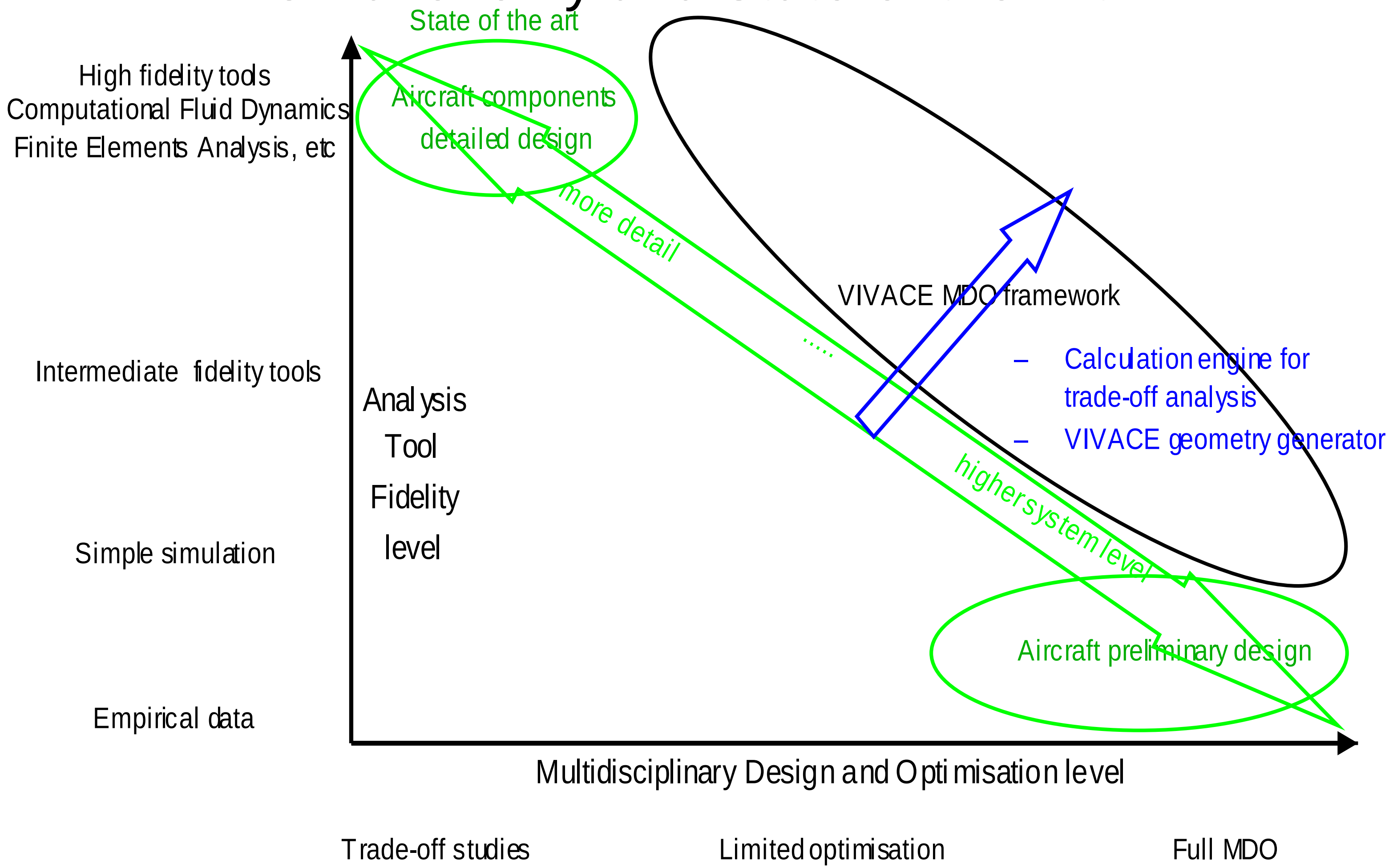
MDO Taxonomy and State-of-the-Art



Extended from “A summary of industry MDO applications and needs”, AIAA 1998, Giesing, Barthelemy

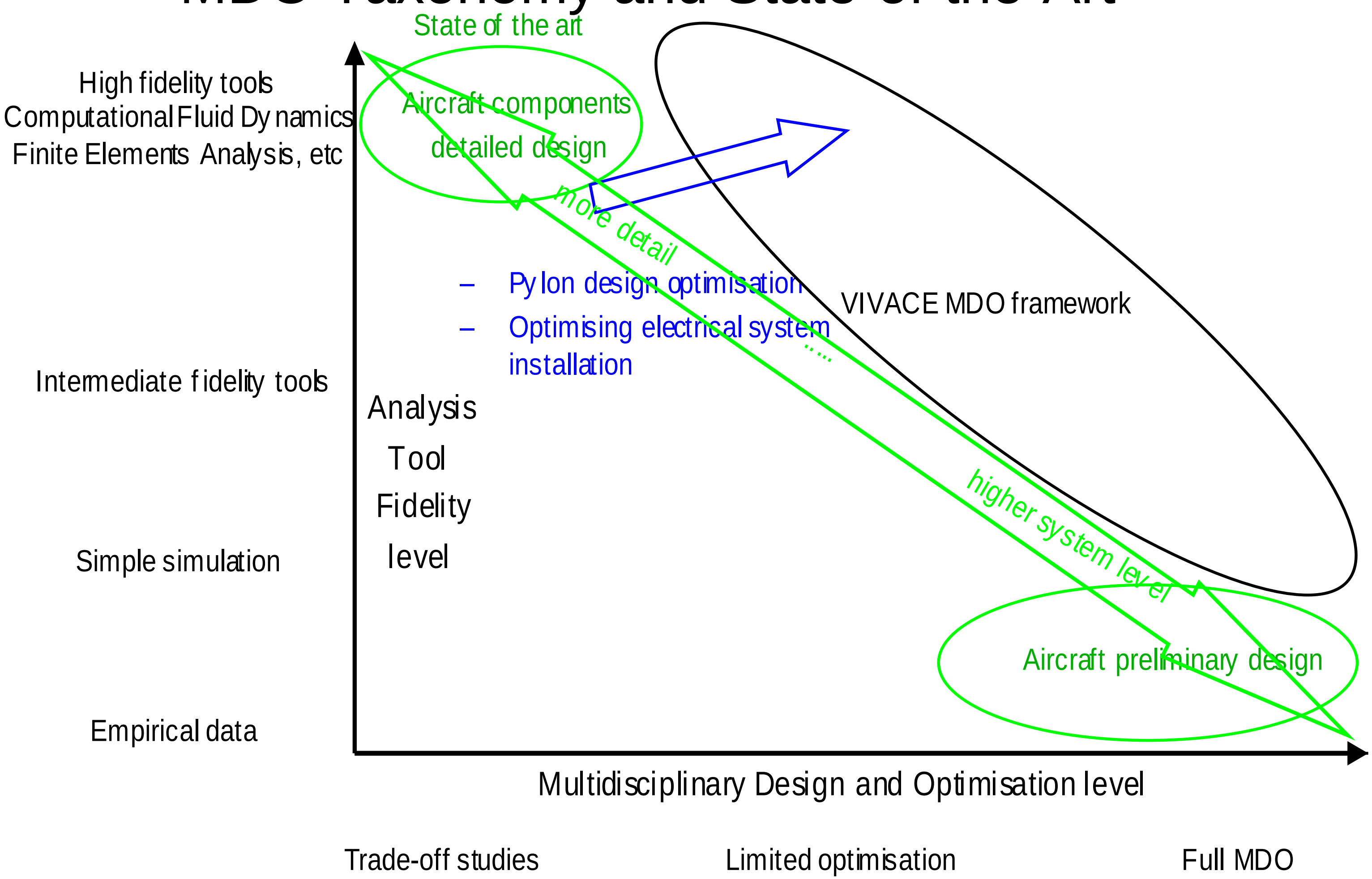
MDO and VIVACE

MDO Taxonomy and State-of-the-Art



MDO and VIVACE

MDO Taxonomy and State-of-the-Art



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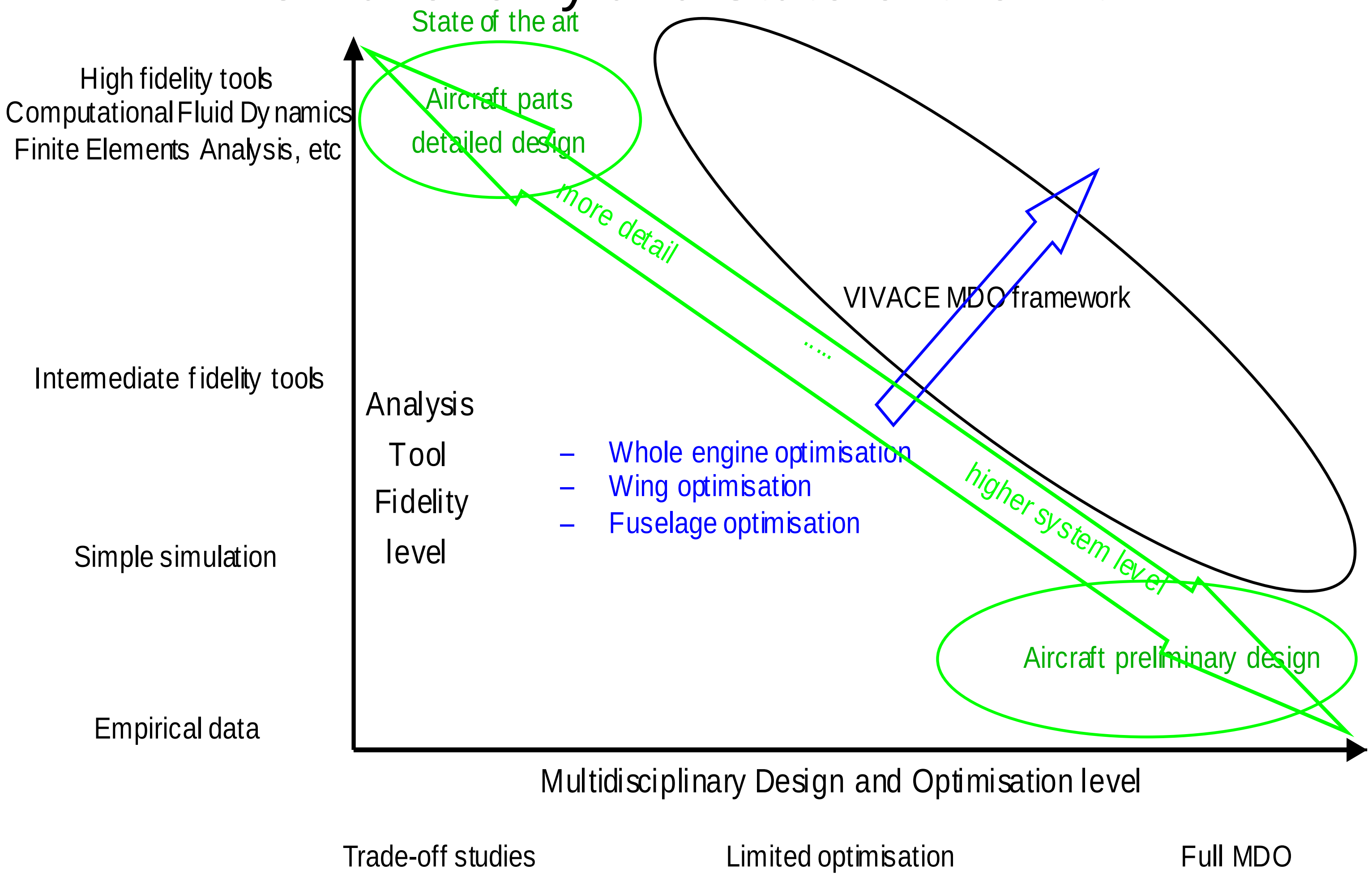

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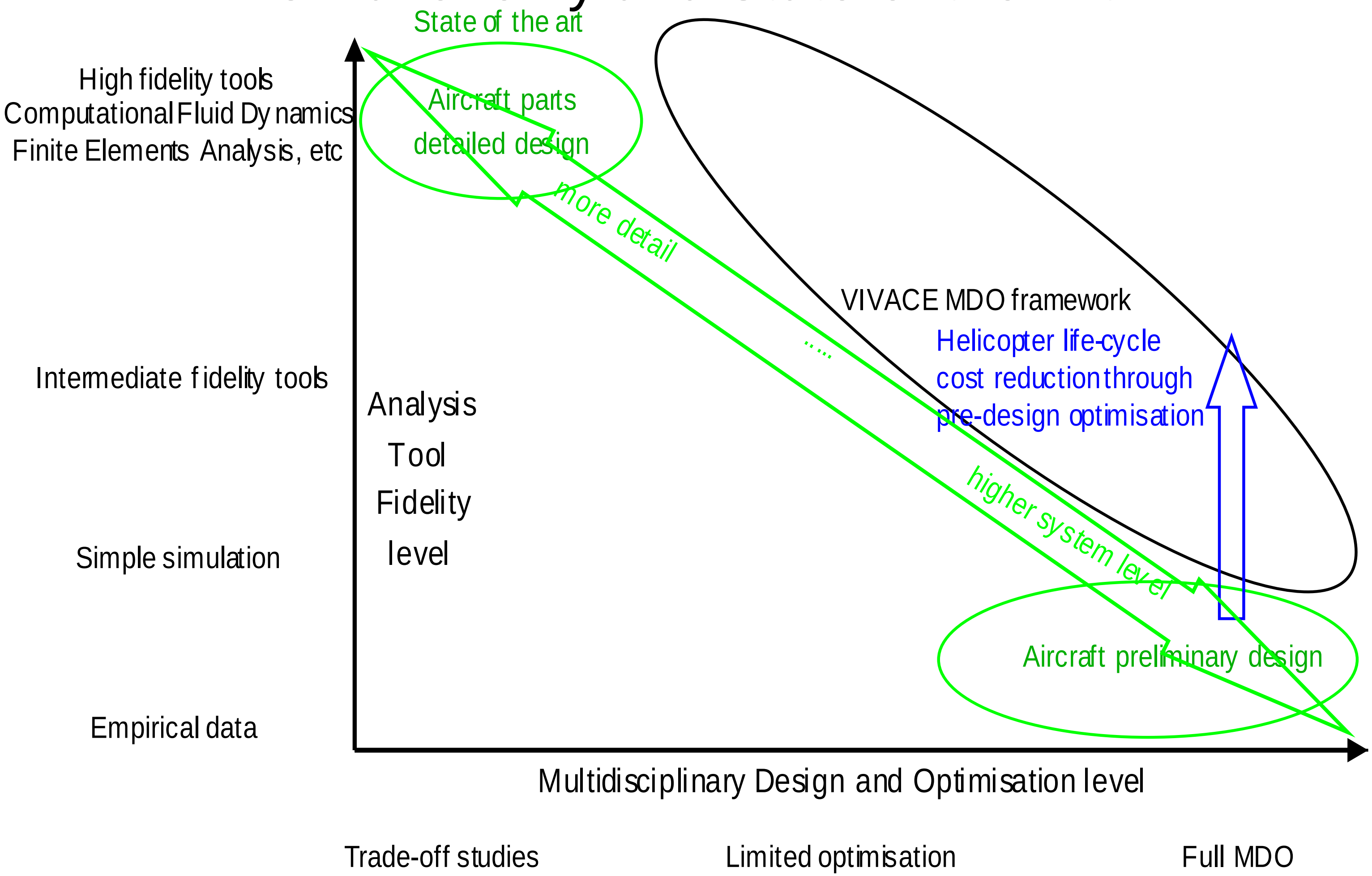

MDO Session Overview

- Helicopter life-cycle cost reduction through pre-design optimisation — J. F. Boer
- Whole engine optimisation — M. Nagel
- Fuselage structural optimisation — S. Grihon
- Pylon design optimisation — S. Grihon
- Optimising the size of the electrical system installation — L. Rouch
- Calculation engine for trade-off analysis — P. Fantini
- Wing Design Optimisation (WDO) including
  - Overview of WDO Use Case — R. Bassett
  - Demonstration of MDA Capability — J. Kos
  - VIVACE geometry generator — J. Maginot