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# Multidisciplinary optimization and integration requirements for large-scale automotive and aerospace design work

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## Abstract

Automotive and aero industries are rapidly increasing applications of numerical simulations for structural, structure-interfacing, and multi-field analyses ranging from structural stiffness and strength, to crashworthiness and durability. Simulation applications and tool chains are cast into sophisticated, but strict, processes to ensure reliability, design integration, and interaction between partners, departments and suppliers.

Commercial and in-house optimization frameworks, i.e., process integration and design optimization (PIDO) tools, have evolved considerably, allowing for coupling of processes, tools, and individual design parameters. Thus, the designer/CAE specialist is required to master the challenges arising from the complexity of such processes. Although originally intended for this specific purpose, even efficient PIDO implementations may not be suitable for general applications from an enterprise standpoint. Especially for multi-disciplinary optimization when analyses from various disciplines compete and their influences need to be balanced.

This paper presents the background and rationale why PIDO implementations may not be suitable from an enterprise aerospace/automotive perspective. A view of the bottlenecks is also presented, along with proposed approaches to resolve them.

Specifically, to increase the efficient use of commercial PIDO tools in the automotive and aerospace industries, these integration and optimization frameworks should provide:

• Friendlier ways of integrating existing third-party and legacy tools

• Interactive human control of the optimization process, i.e., "on-the-fly" adjustments of the design variables, targets, constraints, and optimization methods

• Intuitive and robust support of heterogeneous computing systems

• Ease of maintaining and modifying the created processes that should be available both in GUI and batch modes.

The PIDO approach demands high flexibility, with strong end-user interaction and interfacing.

**Keywords:** process integration and design optimization (PIDO); MDO; complex engineered systems; enterprise optimization framework; big data; preliminary design.