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Project Results

IDEaliSM

Optimum multidisciplinary design boosts industrial competitiveness

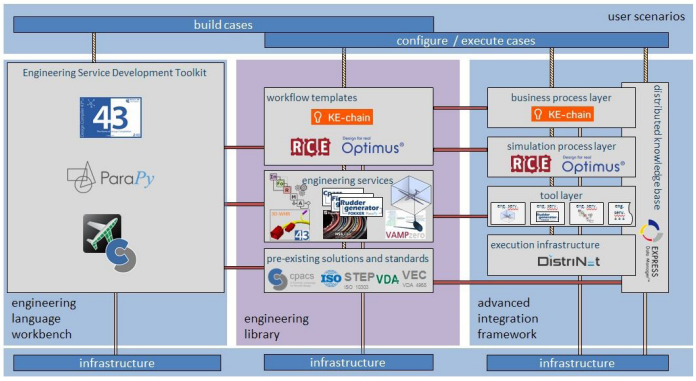
EXECUTIVE SUMMARY

The ITEA project IDEaliSM has created a flexible and service-oriented framework for multidisciplinary design optimisation (MDO) that integrates people, process and technology. The outcome of this is significantly accelerated time-to-market and a sharp reduction of development costs for high-tech structures and systems.

PROJECT ORIGINS

High-tech manufacturing is a fiercely competitive market, one in which high-performance engineering plays a central role and presents a number of challenges. These include the difficulty of assessing the multidisciplinary effect of design decisions, limited re-use of data, information and standard solutions, the prevalence of non-value adding activities, repetitive and labour-intensive design activities, and the existence of silos of data where there is no single source of truth. IDEaliSM responded by promoting a paradigm shift in product development whereby effective management of valuable resources and shared knowledge, methods and tooling are complemented by more flexible collaboration and a higher level of integration throughout the full design chain.

With the objective to make high-tech products more affordable and reduce the lead time in the mobility market, predominantly aerospace and automotive, the project's solutions focused on the realisation of service-oriented and distributed engineering processes. The question it sought to answer was how engineers can collaborate in the virtual environment in which "servitisation" is becoming a growing trend in the global market place. The resulting IDEaliSM development framework helps European industries enhance integration and flexibility in product development thereby reducing effort (50% efficiency gain), cost and time-to-market (by up to half) for designing innovative aircraft and automotive structures and systems.



IDEaliSM framework consisting of a Engineering Language Workbench, an Engineering Library and an Advanced Integration Framework

TECHNOLOGY APPLIED

IDEaliSM employed three use cases to illustrate and demonstrate its framework. Firstly was the 'Aircraft Design Challenge', in which Airbus Defence and Space wanted to improve its processes for early aircraft design by including multidisciplinary design optimisation as well as increasing the degree of automation. It demonstrated how the inclusion of a new, IT supported aircraft design process can boost product quality and cut development time and resources, ultimately leading to significantly improved competitiveness. Fokker Aerostructures was also a beneficiary of this radical new way of working (High Performance Engineering). It developed an aircraft rudder within a single month to a level that corresponds to the normal results of the Full-Scale Development (FSD) phase up to the Critical Design Review (CDR).

The second use case – the '10-day harness' – responded to the innovation goal of Fokker Elmo to develop a wire harness in 10 days at the equivalent level of the detailed design and production preparation phases (including tool and assembly definition) up to Production Readiness Review (PRR). In this use case, the Wiring Interconnection System (EWIS) design was optimised by applying process automation and multidisciplinary optimisation techniques, reducing cost and lead time and strengthening Fokker Elmo's position with respect to aircraft OEMs.

The third use case, 'Cockpit in 3 weeks', answered the challenge of DRÄXLMAIER to develop an automotive cockpit wire harness within three weeks by integrating mechanical, electrical and electronic components inside the installation space provided. The automation technologies developed and provided within the IDEaliSM project significantly cut cost and lead

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time, without any concessions to quality.

The project's three main deliverables were an advanced integration framework for distributed Multidisciplinary Design and Optimisation, an Engineering Language Workbench (a set of domain specific and high-level modelling languages, ontologies and data standards) and a methodology for service-oriented development processes. These deliverables mean that a coherent set of methods and tools is now available to generate, apply and re-use engineering knowledge.

MAKING THE DIFFERENCE

Essentially, the partners have acquired a set of high-performance engineering services that is capable of generating the product development benefits demanded and needed by automotive and aerospace manufacturers and suppliers – the integrated solution.

The solution has been exploited in various ways, such as the hybrid workflow system created by Noesis and KE-works to seamlessly integrate manual activities with automated simulation and optimisation workflows in distributed environments. Another example of exploitation is the CPACS defacto standard - the Common Parametric Aircraft Configuration Scheme - by the German Aerospace Centre (DLR) that provides a standardised structure for exchanging product data between engineering services within aircraft design. This allows the creators of engineering services as well as simulation workflow experts to easily obtain relevant information from the data format. Product optimisation is expected to be evident in terms of weight reduction (up to 15%) and recurring costs of aircraft redesign (by as much as 10%). Furthermore, a reduced lead time and automation boost allow more time for design space exploration and the quick creation of initial designs. The Belgian Noesis Solutions employs a composite structures optimisation strategy that can drastically reduce not only the lead time for the design and manufacturing of composite material structures but even the weight of the structure.

The impact of the project's results on industrial competitiveness is evident in various ways. Human error is reduced through automated data conversion and validation, process standardisation and data standards. In addition, specific design activities and engineering tasks can be significantly streamlined (by as much as 90%). IDEaliSM has demonstrated how fast, robust and low-cost product development and manufacturing services can help the European aerospace and automotive industries be strong competitors on the world stage.

MAJOR PROJECT OUTCOMES

Dissemination

- 12 publications; 6 publications pending
- Presented at 19 conferences and events
- Organised its own Smart Engineering Event with over 60 participants
- Created 7 new full-time positions; 2 fellow researchers

Exploitation (so far)

- IDEaliSM product development framework architecture: an architecture blueprint to support the implementation and use of a distributed framework for Multidisciplinary Design Optimisation (MDO) based upon engineering services
- Hybrid workflow system (Optimus -KE-Chain): workflow application to integrates simulation workflows with human interactive tasks for distributed environments
- Optimus simulation workflow cloudification: analysis and optimisation workflows on virtualised computational infrastructures suitable for large-scale parallel computing and optimisation
- Wire harness modularised framework: a modular and extendible set of 3 engineering services to design wire harness designs for the automotive industry driven by multi-physics

Standardisation & Spin-offs

- Application and promotion of STEP / ISO 10303-AP209 standard
- Improvement of CPACS data exchange format
- Developed automatic converters from CPACS to STEP P21 and EXPRESS scheme
- Spin-off in MDO architecture advise under consideration by TU Delft

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Project end
January 2018

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