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Plenary Lecture #1

From Document-centric to Model-centric: using Models for Industrial Design in the Aerospace Industry

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Background

This keynote discusses the shift from document-centric to model-centric approaches in industrial design, specifically in the aerospace industry. The traditional document-centric approach relies on a series of design documents that outline the product's specifications, requirements, and manufacturing instructions. However, this approach can be time-consuming, error-prone, and difficult to maintain. In contrast, the model-centric approach relies on models that serve as a single source of truth for all design-related information. The use of models enables better collaboration, simulation, and analysis, leading to improved product quality and reduced time-to-market. This paper presents methodologies, tools and and best practices for implementing model-centric industrial design in the aerospace industry, highlighting the benefits and challenges of this approach. The findings of this paper suggest that model-centric industrial design is a promising solution for addressing the complex challenges of the aerospace industry.

Procedure

In recent years, the Aerospace Industry has been moving towards a more model-centric approach, where digital models and simulations are used extensively throughout the functional design of product. However, the industrial design still heavily relies on document-centric processes with no digital continuity with the functional design.

Document-centric processes involve creating and managing documents that contain engineering drawings, specifications, and other types of information that are used to manufacturing, assembly and testing an aerospace product. These documents are typically stored in a PLM (Product Lifecycle Management) system and are reviewed and approved by various stakeholders throughout the product development process.

On the other hand, model-centric processes involve creating and managing digital models that represent various aspects of the product, including its geometry, structure, behavior, and industrial system. These models can be used to perform simulations, analyses, and tests that are critical to the aerospace product development and certification process.

Aerospace products and their industrial systems have decades-long useful life cycles for different product variants [1]. Industrial requirements are increasingly considered during the conceptual design phase of new aerospace product development. Decisions made during development will have an impact on the lifecycle of the industrial system. To achieve this goal, Model-centric design tools are needed to support collaborative engineering processes and functional and industrial co-design [3].

The iDMU (industrial Digital Mock Up), as proposed in [4] can be designed under the paradigm of Model-centric, and the most relevant potential opportunities are integration of knowledge, reusability, and traceability, reduced costs, higher quality, and decreased time-to-market in addition with the automation of manufacturing document generation.

Currently OBE (Ontology Based-Engineering) methodologies, and MfM (Models for Manufacturing) methodology [5] developed to help industrial design teams to deploy the model-centric approach, are the game player in this challenge.

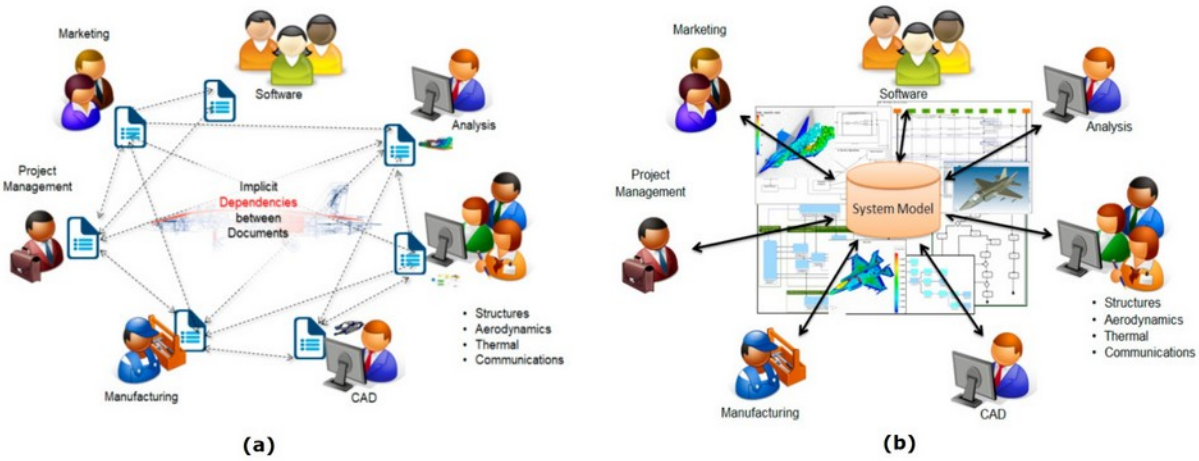

Figure 1. (a) Document-centric engineering; (b) Model-centric engineering. Adapted from [2]

The keynote is focused on the challenges related to the journey from a Document-centric to a Model-centric in the industrial design of the Aerospace Industry.

Conclusions

- Evolution from Document-centric to Model-centric is a progressive process led by the organization, supported by employees, and facilitated by technological resources.
- The application of Model-centric methods and tools and the concept of "Design in Context" with Model-Centric needs to harmonize the Functional and the Industrial models definition.
- Software commercial tools require an R&T effort to support the use of Model-centric along the lifecycle.

References

[1] Mas, F., Arista, R., Oliva, M., Hiebert, B., Gilkerson, I., 2021. An updated review of PLM impact on US and EU Aerospace Industry, in: 2021 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC). Presented at the 2021 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC), pp. 1–5. https://doi.org/10.1109/ICE/ITMC52061.2021.9570205.

[2] Madni, A., Purohit, S., 2019. Economic Analysis of Model-Based Systems Engineering. Systems 7, 12. https://doi.org/10.3390/systems7010012.

[3] Mas, F., Ríos, J., Gómez, A., Hernández, J.C., 2016. Knowledge-based application to define aircraft final assembly lines at the industrialisation conceptual design phase. International Journal of Computer Integrated Manufacturing 29, 677–691. https://doi.org/10.1080/0951192X.2015.1068453.

[4] Mas, F., Menendez, J.L., Oliva, M., Rios, J., Gomez, A., Olmos, V., 2014. iDMU as the Collaborative Engineering engine: Research experiences in Airbus, in: Engineering, Technology and Innovation (ICE), 2014 International ICE Conference On. IEEE, pp. 1–7. https://doi.org/10.1109/ICE.2014.6871594.

[5] Mas, F., Racero, J., Oliva, M., Morales-Palma, D., 2018. A Preliminary Methodological Approach to Models for Manufacturing (MfM), in: Chiabert, P., Bouras, A., Noël, F., Ríos, J. (Eds.), Product Lifecycle Management to Support Industry 4.0, IFIP Advances in Information and Communication Technology. Springer International Publishing, Cham, pp. 273–283. https://doi.org/10.1007/978-3-030-01614-2_25