European Commission

Digital Transformation Monitor

Industry 4.0 in Aeronautics: 3D/Design - applications

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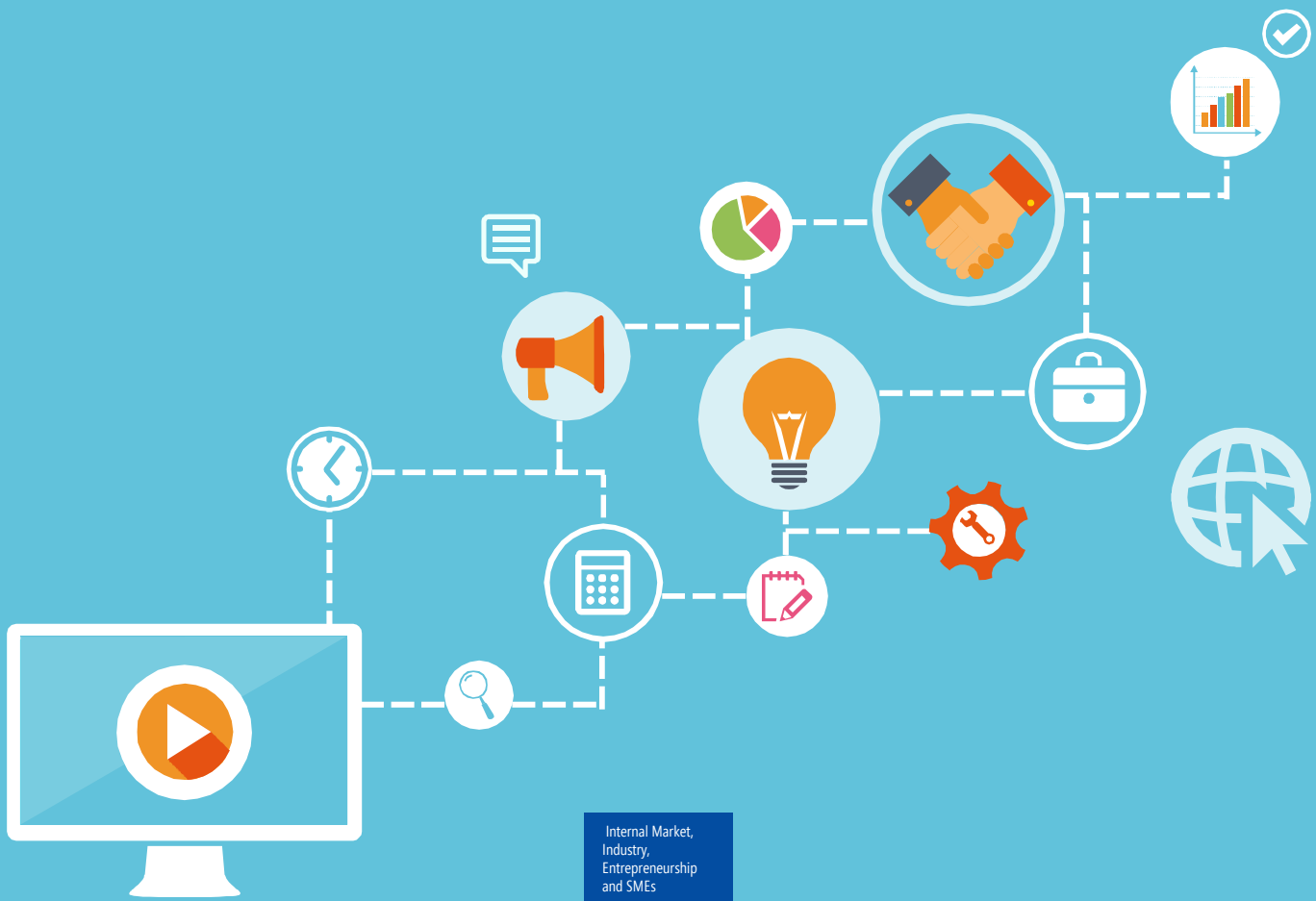

Internal Market, Industry, Entrepreneurship and SMEs

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Industry 4.0 in Aeronautics: 3D/Design - applications

Advances in 3D technologies have brought innovations in the aeronautics manufacturing industry. Virtual reality and augmented reality have extended 3D design capabilities. They allow 3D design and associated engineering solutions to be used throughout the whole manufacturing process and help to reduce production cost and to increase flexibility and efficiency.

1

New 3D Design capabilities

3D design and engineering solutions have long been at the forefront of the digital transformation of aerospace engineering.

The Industry 4.0 trend is pushing the evolution further, because of both evolutions in the visualization technologies and integration with other smart factory solutions.

Aerospace at the forefront of 3D design

The aerospace domain has always been at the forefront in the adoption and the development of 3D design. These technologies bring benefits that are well aligned with the domain needs and result in important gain in productivity.

The introduction of CAD solutions in the 1980s has had a strong impact on the aerospace industry by speeding up the design of aircraft.

It has also enabled significant gains in the complexity of designs resulting in more efficient solutions. This has an impact both on the performance of the aircraft and on the manufacturing process in itself (reduction of material use and costs).

These transformations were particularly welcome in the aerospace industry because of the importance of design (critical in aircraft performance) and the high costs of manufacturing and mock-ups.

New 3D tools for manufacturing

The recent development in 3D technologies is bringing new opportunities for optimizations in aerospace manufacturing.

Virtual Reality and simulation.

3D simulation technologies have evolved toward highly immersive virtual reality applications. This development of visualization technologies now enables the visualization of complete, scale 1, CAD mock-ups in real-time immersive and interactive 3D.

The benefits for design are direct and important. The access to a full mock-up speeds up design and integration tasks. The set-up of immersive, virtual mock-up enables design and engineering teams to directly "meet" in the virtual mock-up to confront design options and rapidly take critical decision on space allocation.

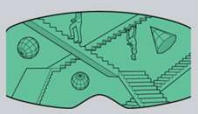
For several years now, Airbus has deployed the Optis[2] HIM virtual reality solution in several production centres - namely Hamburg, Saint Nazaire and Toulouse – with a variety of use cases.

The virtual reality rooms are thus used by engineers of various departments to confront design ideas while facing a scale 1, 3D mock-up. They are also used by user experience designers evaluating cockpit designs or for training purpose.

The promises of augmented and mixed reality

The recent developments of augmented and mixed reality promise new applications in aircraft manufacturing. The ability to superpose and/or mix digital mock-ups with actual physical objects (such as an aircraft in the assembly line, or parts from a supplier) will bring new immersive capabilities in design. This will bring more flexibility in the design, tighter integration with suppliers and a more continuous design process.

Figure 1: Characteristics of new 3D design technologies[1]

Characteristics	Virtual Reality	Mixed Reality	Augmented Reality
Augments the real environment with useful information	✗	✓	✓
Combines virtual elements with the real environment	✗	✓	✗
Transports the user to a virtual environment	✓	✓	✗
Completely replaces the real world	✓	✗	✗
Visual example			

Source: IDATE DigiWorld, Artificial Reality, November 2016; Illustration: Wired.

A recent drop in cost of 3D technologies

The development of consumer virtual reality and augmented reality application (mainly through the video game market) result in a drop in the price of equipment. This will increase the adoption of 3D technologies and their widespread use in aerospace design.

The price drop in Virtual Reality setup (from several hundred thousand to a few million EUR for a CAVE automatic virtual environment – aka CAVE)[3] to a few thousand Euros for a headset-based setup is enabling more companies to equip themselves.

For large design offices, that used to have a single equipped room, virtual reality is now becoming potentially available on every engineer desk. And what was until now restricted to only large manufacturers with R&D budgets, is now becoming available to smaller companies (aerospace suppliers).

2

3D integrated in the production process

The use of 3D technologies in Aerospace is more and more extending beyond the initial design of the product and impacting the whole production process. This brings important productivity benefits, but also requires efforts in data integration and standardization.

Simulation in the engineering process

The impact of 3D technologies is also increasingly felt beyond the initial design phase and throughout the engineering and manufacturing process[4]. The productivity increases as the production process of aircraft becomes increasingly supported by a digital copy of the plane and equipment.

Latest 3D simulation technologies are used not only to design shapes but throughout the production process[5] to define the assembly processes, optimize the setup of supporting equipment, define which materials to use, and validate ergonomics for both the end user and the workers in manufacturing.

This increased use of digital mock-up transforms them into a central point of centralization and exchange of information that bring flexibility to the manufacturing process.

3D enabled training

As 3D mockups become available and immersive experience develops, one of the key opportunities is to use these tools in training activity.

Improved training results in higher security and efficiency for aircraft manufacturers but also for the entire value chain.

Aerospace here also led the way, with the development of flight simulators. But new developments go beyond the training of pilots. Virtual reality settings are used to train engineers[6] and factory workers[7] on the precision manufacturing tasks they have to accomplish by visualizing them and repeating the movements on a 3D mockup in virtual reality.

3D enabled training can also apply to maintenance tasks. Mixed or augmented reality is used to display instructions over the actual piece of equipment to repair.

The challenge of data exchange

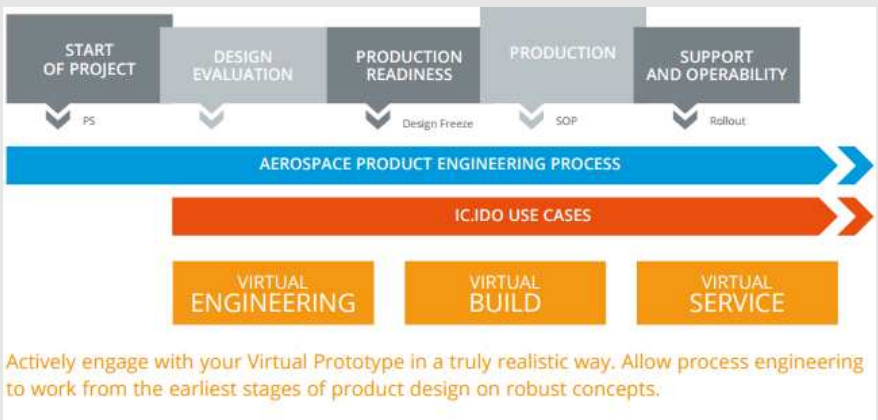
As 3D is extending beyond design and the 3D mock-up becomes a digital double of the aircraft, the access to this 3D data is becoming critical for the whole value chain.

This implies that third party manufacturers and suppliers have to follow the main manufacturers in their choices of technology, invest to stay competitive and to keep the ability to work efficiently with the data of the manufacturer.

This also implies that software leaders in the 3D industry can create *de-facto* standards and/or walled garden depending on the opening of their data formats. In the absence of a real standardization process, third party software providers have to enter partnership with leaders of the 3D design industry to get access to their specific data format.

The impacts of 3D technologies in the industry 4.0 trend are thus tighter integration of the actors in the value chain. But this integration can come at a high cost for the smaller actors that have to adapt to new practices.

Figure 2: 3D products integrated throughout the aerospace engineering process



Source: ESI

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About the Digital Transformation Monitor

The Digital Transformation Monitor aims to foster the knowledge base on the state of play and evolution of digital transformation in Europe. The site provides a monitoring mechanism to examine key trends in digital transformation. It offers a unique insight into statistics and initiatives to support digital transformation, as well as reports on key industrial and technological opportunities, challenges and policy initiatives related to digital transformation.

Web page: https://ec.europa.eu/growth/tools-databases/dem/

This report was prepared for the European Commission, Directorate-General Internal Market, Industry, Entrepreneurship and SMEs; Directorate F: Innovation and Advanced Manufacturing; Unit F/3 KETs, Digital Manufacturing and Interoperability by the consortium composed of PwC, CARSA, IDATE and ESN, under the contract Digital Entrepreneurship Monitor (EASME/COSME/2014/004)

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