

TRANSFORMING AEROSPACE MANUFACTURING:

OMNIFACTORY
MANUFACTURING REDEFINED

THE OMNIFACTORY® - A NEXT-GEN TESTBED
FOR DIGITAL AND AGILE PRODUCTION

The Future Automated Aircraft Assembly Demonstrator Phase 2 (FA3D2) project delivered the **Omnifactory®**, a national experimental testbed and technology demonstrator in digital and informatics enabled aerospace manufacturing technologies. It is an enhancement of a proof-of-concept FA3D Phase 1 technology demonstrator developed and funded by the University of Nottingham with £1.5M and commissioned in June 2016. The proposal for FA3D2 was created as a result of strong interest and 'pull' from numerous international aerospace companies, some of which are already benefiting from the **Omnifactory®**.

The **Omnifactory®** provides a unique opportunity for manufacturing businesses to test and validate world leading technologies, so that they can compete on cost and quality with the best rival offshore businesses. It aims to reduce the Capital Expenditure or Non-Recurring Costs (NRC) of production facilities by implementing novel assembly approaches. By providing higher levels of automation driven by model-based enterprise technologies, companies will benefit from increased productivity, upskilled labour force, a robust tolerance to demand variability

and dramatically reduced Recurring Costs (RC) to enable industry to successfully compete with lower wage economies.

The FA3D2 project successfully completed on 31st March 2023, which culminated in the launch of **Omnifactory®** on 1st March 2023. This FA3D2 project addressed a strategic shortfall in the national infrastructure for the development of a next generation aerospace flexible assembly system by:

- Providing a **national experimental testbed and technology demonstrator** in digital- and informatics-enabled aerospace manufacturing technologies
- **Building on the successful FA3D proof of concept demonstrator** funded by the University with an investment of £1.5M mitigating the risks associated with building a larger facility
- Converting the strong interest from industry (Airbus, Airbus Helicopters, BAE Systems, GKN, GE Aviation, Rolls-Royce and others) into future projects for **building UK assembly & manufacturing capability**

- **Providing support** for major ATI and Clean Sky 2 initiatives
- Developing a **national aerospace assembly demonstrator** for digital technologies
- Providing **significant projected return of investment**

The **Omnifactory®** provides a unique agile production infrastructure in both the digital and physical domains. It combines an innovative reconfigurable floor solution with an integrated software stack connecting design, lifecycle-management, simulation, planning, validation, virtual commissioning, and control.

The reconfigurable flooring system was designed by University of Nottingham to meet the unique requirements of a future production environment for high-value, high-complexity, variable-rate products. The solution is scalable and can be installed in new factories or retrofit into existing facilities. Modular connection points allow for any existing or future assets to be deployed and can also interface with metrology systems to enable high accuracy motion control.

The integrated software architecture demonstrates an end-to-end model-based systems engineering approach to the design and delivery of reconfigurable production systems. Commercial software packages are integrated using in-house knowledge and augmented with bespoke developments to push the boundaries of automated code generation, artificial intelligence, and data analytics. It is believed that the **Omnifactory®** is unique in the UK, in terms of the close integration between the physical and digital domains, and in the ability to demonstrate the digital capabilities in the context of an automated physical production environment.

By developing a digital manufacturing approach to leverage the digital capabilities, and combining it with a physical environment that enables fast, repeatable, and accurate asset location and reconfiguration, the University of Nottingham has delivered an environment that can:

- **Cost effectively manufacture complex products in small volumes**
- **Rapidly respond to demand and volume fluctuations**
- **Accommodate changes in product design, mix, and scheduling priorities**
- **Dramatically reduce time-to-market and support rapid production scale up**

Omnifactory®, where different digital technologies are implemented to improve traditional manufacturing practices, is revolutionising the world of manufacturing by making it more efficient and cost-effective.

Omnifactory® is a unique facility that enables manufacturers to develop, demonstrate, and rapidly implement the latest digital manufacturing technologies in industry.

Working closely with our industrial partners, we are transforming current practices and improving productivity across the sector by developing the next generation of smart, highly agile, and efficient factories, which is also supporting localised manufacturing supply chains. By leveraging technologies such as the Industrial Internet of Things (IIoT), artificial intelligence (AI), and data analytics, we are dramatically accelerating the development and sustainable manufacturing of new products and delivering significant societal, economic, and environmental benefits to the sector.

Manufacturing processes have a significant impact on the environment, with a large proportion of the carbon footprint of some products being created during their production and logistics. By creating a new generation of smart, highly efficient factories embedded in local supply chains, we are contributing to the net-zero agenda and make a significant step towards the circular economy.

One example of how this facility is being utilised is in the Innovate UK / ATI project Enhanced Low Cost Automation Technology (ELCAT) project, where we developed flexible manufacturing systems without the need for expensive 'black box' integration, by fusing real-world industrial experience with game-changing theoretical proposals backed by academic analysis.

The ELCAT project has enabled this thinking to be taken to a point of physical reality, maturing and de-risking the associated technology threads to a level ready for final development and adoption in GKN Aerospace.

The **Omnifactory®** facility is also hosting the FLEXCELLE project, in which aerostructure assembly processes are being reimagined and demonstrated with BAE Systems and Spirit Aerostructures. Through this project, the optimisation of facility architecture for variable rate assembly is being developed and demonstrated. The utilisation of large-volume, non-contact metrology supports the assembly of adaptively machined structural components. The project is validating the use of workpiece positioners in aerospace assembly as part of a reconfigurable assembly system by assembling a fuselage demonstrator in the **Omnifactory®** environment.

Omnifactory® also contributes to industry by providing a working demonstration of an end-to-end digital industry solution. By using commercial software in a real working deployment, the real-world challenges around integration are explained. By generating this know-how and offering it to the industry, **Omnifactory®** helps companies to understand the business case and be a better customer. Building on an already strong relationship with the technology providers, and leveraging their contacts in industry, the team at Nottingham are also helping to refine and improve the technology offerings available to industry. ■

