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Manufacturing Processes and Digital **To**ols for more **S**ustainable **C**omposite **A**erostructures

Deliverable D4.4: "Implementation of digital twin for lay-up processes – Summary"

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Dissemination Level		
PU	Public	
SEN	Sensitive information	X

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SUMMARY

Deliverable D4.4 presents the prototype software and underlying data framework for integrating manufacturing and quality control data from the Automated Fibre Placement (AFP) lay-up process into a digital twin of the manufactured composite component. It describes the data structures, interfaces, and software components required to acquire, organise, store, and access data generated during the lay-up and inspection processes.

The deliverable introduces the manufacturing database based on the Hierarchical Data Format (HDF5), including the underlying data structure and the relationships between the different types of information stored within the digital twin. The implementation builds upon an already existing Composite HDF5 schema, which provides a structured framework for representing composite manufacturing data and supports the consistent organisation and exchange of information between different tools and process stages. The relevant elements of this schema and their application within the project are described, including extensions required to accommodate the specific manufacturing and inspection data generated during the AFP process.

The integration of geometry information into the digital twin is presented, including the relevant geometry sources and their relationship to the manufacturing data. The deliverable further describes how data from the lay-up robot and associated process parameters are transferred to and represented within the digital twin. The corresponding interfaces and data flows are outlined to demonstrate how information generated during the lay-up process can be systematically linked to the digital representation of the manufactured component.

A dedicated part of the deliverable addresses the integration of in-line inspection data. Typical defects relevant to AFP lay-up are introduced, and the structure used to represent detected defects and their associated measurement information in the manufacturing database is described. This includes the spatial and process-related information required to associate inspection results with the corresponding regions of the manufactured component, thereby enabling inspection data to be traced back to the digital twin and the underlying manufacturing process.

Finally, the deliverable presents visualization software for accessing and inspecting the information contained in the manufacturing database. The visualization functionality provides a means of exploring the digital twin and its associated manufacturing and inspection data, including the spatial representation of relevant information. The presented software and data interfaces demonstrate the connection between the AFP lay-up process, in-line quality control, and the digital twin, providing a foundation for consistent data management, traceability, and further analysis of composite manufacturing data.