Project n° 101138859

DIGITAL TWINS OF LASER PROCESSING FOR MULTI-CAPABILITY MANUFACTURING OF COMPLEX COMPONENTS AND DIGITAL CERTIFICATION

Newsletter #2

01. Identification and description of production lines: Insights from Tasks 1.1 and 1.2

The initial objective of the first work package within the **DILAPRO** project was to assess the current status of the different pilot production lines, including their processing steps, quality control procedures, and data collection methods. Additionally, a list of potential use cases for different components was proposed to establish a strong foundation for meeting the requirements of the digital twin, certification processes, and various industrial sectors.

To fully realize the potential of the **DILAPRO** project, a digital upgrade is necessary, involving the integration of IoT devices and control elements to enhance the pilot production lines and facilitate the collection of pertinent data for the development of digital twins.
The identification and description of production lines summarizes the current situation of each pilot line and their certification. It also gathers information about the current sensors and data available as well as the sensors and data that will be implemented within **DILAPRO** project.

The DILAPRO project is making significant upgrades to several pilot lines to support the development of digital twins. These enhancements include adding new sensors and monitoring systems to improve data collection and process monitoring.

Pilot Line 1
Upgraded with a pyrometer and new HMI system for comprehensive parameter tracking.

Pilot Line 2
Enhanced with an eddy current sensor, a novel application for this equipment.

Pilot Line 3
Exploring advanced temperature distribution methods and adding an eddy current sensor.

Pilot Line 4
Integrating additional sensors to collect extensive operational data for digital twin use.

Pilot Line 5
Equipped with sensors for thermal predictions and defect detection.

Pilot Line 6
Upgraded with pyrometer and acoustic monitoring system for improved data accuracy.

These improvements are crucial for ensuring the quality and efficiency of complex products manufactured using laser technologies.

02. Certification Analyses & Stage 1 Audits: Insights from Tasks 1.5 and 1.6

Certification Analyses (Task 1.5)

As part of our ongoing efforts to streamline and enhance certification processes, Task 1.5 has focused on defining the requirements for digital certification in laser-based manufacturing. This task draws on the comprehensive mapping of the ISO/ASTM 52920 standard to establish digital auditing pathways for our use cases. By examining the various components of this standard, we can adapt it to the specific needs of our production processes, ensuring that each step meets rigorous quality and compliance criteria.

In defining these pathways, a key aspect has been understanding the variable scope of qualification that the ISO/ASTM 52920 standard allows. This flexibility is crucial for additive manufacturing, where processes can vary significantly depending on the specific application.

Through a detailed assessment of each use case, we have identified the necessary digital data types, sources, and formats required for certification. This includes everything from process control data and validation plans to detailed records of design changes and manufacturing process quality.

These insights are helping us pave the way for efficient and reliable digital certification, ensuring that our manufacturing processes meet the highest standards of quality and compliance.

Stage 1 Audits (Task 1.6)

In Task 1.6, Stage 1 Audits were conducted across six DILAPRO facilities, providing a comprehensive analysis of their readiness for digital certification. These audits included thorough evaluations of each facility's operational readiness, material management, environmental controls, and adherence to maintenance protocols.

The physical audits revealed several critical facets of operational readiness. For example, the audits highlighted the need for improvements in material management practices, such as proper storage and handling to prevent contamination. Facility layouts also require optimization to enhance operational efficiency and reduce risks. Environmental monitoring, including control of humidity and temperature, was identified as essential for maintaining consistent quality in additive manufacturing processes.

These audits are crucial for guiding the development and refinement of our digital certification pathways. By addressing the gaps identified during the physical audits, we can enhance the readiness of our facilities to support advanced digital auditing processes, which can then in turn be refined further. This transition from manual to digital audits not only streamlines compliance but also improves the overall efficiency and effectiveness of our quality assurance efforts.

As we continue to implement these insights, the integration of digital tools in our certification processes is showing significant advantages. Continuous data capture and analysis can provide a detailed and accurate picture of the manufacturing process. Maintaining digital logs ensures better traceability and simplifies the documentation required for initial certification and for upholding existing certifications.

The insights from Tasks 1.5 and 1.6 are instrumental in shaping the future of digital certification in laser-based manufacturing. By leveraging these digital capabilities, DILAPRO is setting new benchmarks for efficiency, reliability, and sustainability in the industry.

03. WP2 Drives Excellence in Laser Technology Optimization and Modelling

Work Package 2 is pivotal in refining the quality of laser manufacturing technologies within the **DILAPRO** Project. This phase concentrates on establishing a multi-modal framework that optimizes these technologies, essential for creating **DILAPRO**'s digital twins. The approach integrates experimental capability, simulation modelling, and the development of statistically parameterized reduced models.

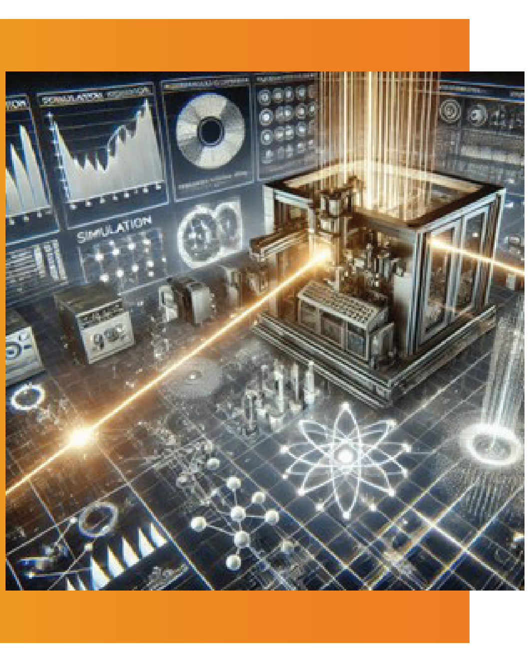
The primary goals of WP2 include:

Material Behaviour Database Development
Creating a comprehensive database for **DILAPRO** materials by simulating the thermo-mechanical conditions encountered during laser-based processes such as Powder Bed Fusion (PBF), Direct Energy Deposition (DED), and laser texturing.

Enhancing Numerical Models
Strengthening existing high-fidelity laser material interaction models to achieve at least 90 % accuracy in predicting microstructural characteristics and mechanical properties.

Data Integration
Merging material behaviour databases and simulation models into a unified data platform, facilitating broader access and virtual expansion of material datasets.

Reduced Order Model Creation
Developing faster reduced order models that target a computational time of one hour or less, thus enabling algorithm-based process optimization.



WP2 consists of three main tasks:

Task 2.1: Process Design
In this task, we conduct physical simulations to study the effects of laser interaction on material properties, generating data for Digital Twins and creating user guides.

Task 2.2: Numerical Modelling
We will enhance simulation models to improve understanding of laser-material interactions, using sensors for calibration and tracking residual stresses.

Task 2.3: Digital Twins
We will combine models and data for process optimization, automating simulations and integrating faster alternatives into the digital platform.

Events

DILAPRO Project Showcased at European Welding Association Event

Participation in this event underscored our commitment to innovation and collaboration within the industry.

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Time to Work Together 1st physical meeting in Liége

Our first in-person meeting brought together DILAPRO Project members for an engaging and productive session.

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New Collaboration with HORIZON EUROPE Projects

DILAPRO is happy to announce the initiation of a new collaboration with four fellow HORIZON EUROPE projects: Wavetaylor, Flash, Wise, and Laser Way.

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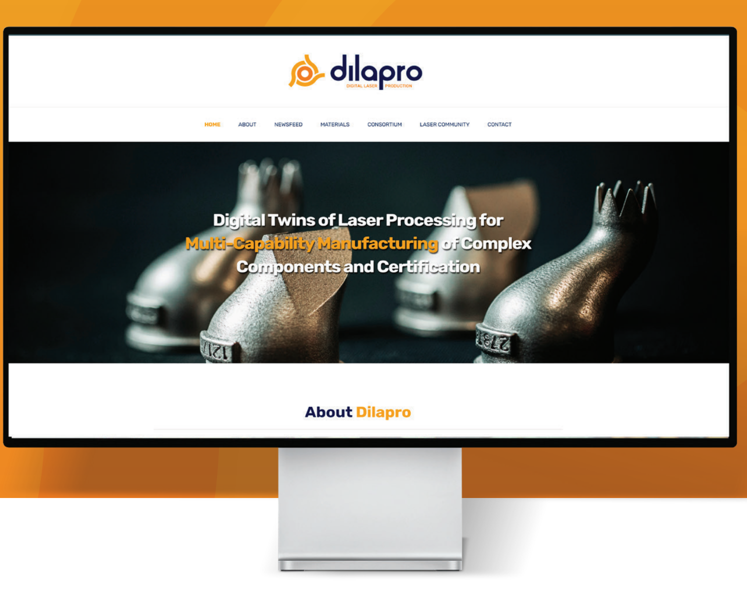

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