REAL-TIME MONITORING OF DED ADDITIVE MANUFACTURING PROCESS FOR ZERO DEFECT MANUFACTURING (REDAMP)

EIT Manufacturing

EIT Manufacturing is supported by the EIT, a body of the European Union

PRIMA INDUSTRIE

Guaranteed
Value the future, upgrade the past

LORTEK
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Tekniker
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

University of Applied Sciences and Arts of Southern Switzerland
SUPSI

FROM RESEARCH TO INDUSTRY
cea

January 2020

510k€ EIT Funding

System specs
Feb/2020

Lab validation
June/2020

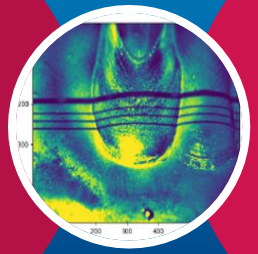
Integration of systems
Oct/2020

Industrial validation
June/2021

AI coupling
Nov/2021

CHALLENGE

Need for zero-defect production by enabling in-line monitoring and defect detection to allow for in-situ repair & to guarantee the part's suitability for demanding applications & reduce certification cost



SOLUTION

Adapting advanced on-line monitoring and NDT techniques for early defects detection, using AI techniques allowing immediate repair to avoid material waste & provide a pathway to certification of WAAM via NDT.

BENEFITS

Industrialisation of inline NDT for in-situ repair of defects to reduce rejection rate and material waste and the need for rework after production., contributing to zero-defect manufacturing and facilitating certification.

MAIN PROJECT RESULTS

1
SPIN-OFF CREATED
Guaranteed
Value the future, upgrade the past

ALL DEFECTS > **500µm**
WILL BE DETECTED
DURING THE PROCESS

VALIDATED FOR **2 3**
MATERIALS AND
PROCESSES

"This EIT grant provided us with the chance to connect research and industries that are willing to boost and innovate their manufacturing strategies"

JOACHIM ANTONISSEN
General manager GUARANTEED
WAAM SERVICE PROVIDER
REDAMP project
AIM: REal-time monitoring of DED Additive Manufacturing Process for zero defect manufacturing

www.guaranteed.be

www.linkedin.com/company/guaranteed-b-v

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MANUFACTURING & SOCIETAL CHALLENGES

DED Manufacturing techniques are large-scale metal AM technologies that use an arc welding process (WAAM) or a laser with powder (LMD). They offer a viable alternative to traditional manufacturing, with a wide range of use cases in all industries, are cheap and fast and are waste-free since all material is used. Energy consumption is a 10th of the needed one for casting and subsequent operations. These technologies are of particular interest for high-end applications requiring high value material and are also well suited to repair products, thereby avoiding the need to store large amount of parts.

INDUSTRIALISATION OF WAAM CAN BENEFIT INDUSTRY, END-USERS AND COMMUNITY AS A WHOLE

- Cost of a conventionally produced part by casting and machining can be reduced by factor 10
- WAAM provides a sustainable solution due to lower energy consumption and material waste. This is even more important for critical materials such as Ti.
- The ability to repair damaged parts is another key benefit which allows to reduce spare parts stock and enables to reshore production to EU, reducing import of spare parts from low-cost labour countries and contributing to a sustainable circular future.

BENEFITS

- Wire is 2-4 x cheaper vs powder
- Wire does not cause disposal costs
- Wire has 99% yield

CHALLENGES

- Need for zero-defect production by enabling in-line monitoring and defect detection to allow for in-situ repair and to guarantee the part's suitability for demanding applications
- Reduce certification cost

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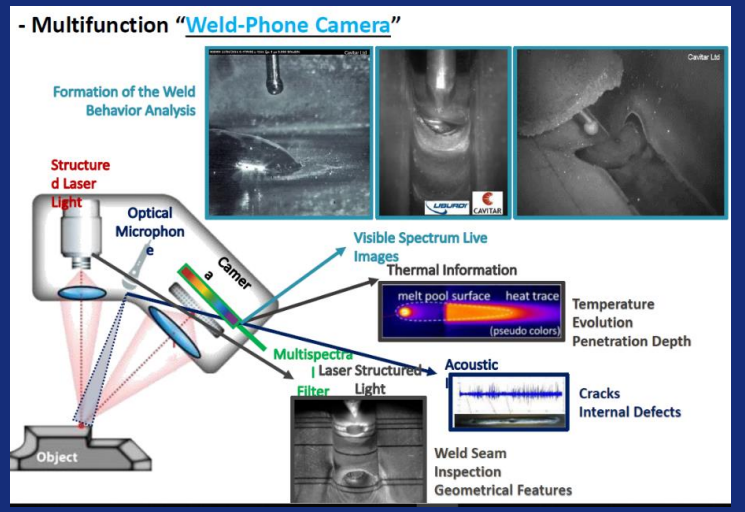
PROPOSED SOLUTION

- REDAMP is a 2 years program aiming at adapting advanced on-line monitoring and NDT techniques for early defects detection, associated to AI techniques.
- REDAMP will be an educational and open platform for dissemination of DED processes and performance demonstration



VALIDATION

- Method that will guarantee that all defects larger than 500µm will be detected during the process
- 2 materials: steel and Ti
- 3 processes: WAAM, WLAM, p-DED
- Various industrial components
- Combining monitoring technologies: thermography, vibration monitoring -SAW, vision based melt pool monitoring, layer height and width by laser profilometry and structured pulsed laser light.

INNOVATION

- REDAMP will use proven AI methods for correlation between monitoring data and built part quality by NDT technologies (X-ray, ultrasonic inspection)
- The system developed in this project will allow early defect detection allowing its immediate repair, avoiding material waste and providing a pathway to certification of WAAM via NDT.

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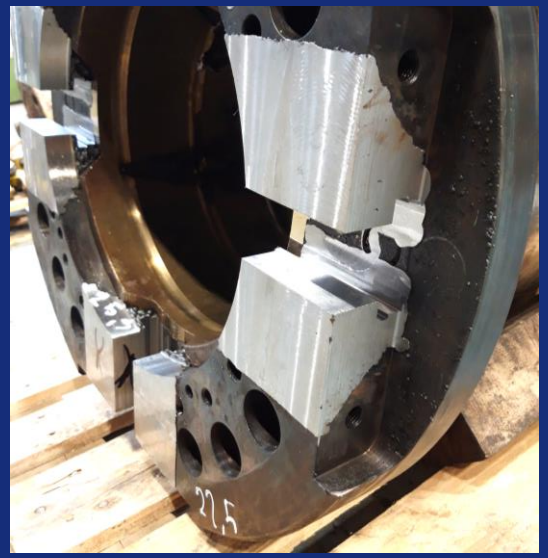
BENEFITS

Industrialisation of an effective, DED-compatible, inline NDT-system to allow for in-line repair of defects to decrease rejection rate as well as material waste and the need for rework after production. Thereby contributing to zero-defect manufacturing as well as facilitating certification. This will be supported by data processing, data fusion and correlation between observed signals and process part quality, while dissemination will be done through providing demonstration access to “open” DED platform/equipment.



TECHNOLOGY

- REDAMP will allow immediate repair during the manufacturing process, will avoid material waste and will be valuable for the certification of DED parts for demanding structural applications.
- Implementation of the on-line monitoring technologies developed in REDAMP, will allow to guarantee the part’s performance, while the in-line NDT inspection will allow to significantly reduce the certification cost and time which is crucial to achieve profitable business cases.

MARKET

- Being able to repair or produce large metal obsolete parts (replacing castings or forgings) represents huge value to the oil & gas, maritime, mining and energy industries.
- The spin-off Guaranteed has been set-up to offer an industrial service to repair or produce damaged/obsolete parts allowing refurbishment of ageing installations and thereby avoiding full replacement resulting in significant material and energy savings.
- Guaranteed will create new jobs while global market has been estimated >50 M€.

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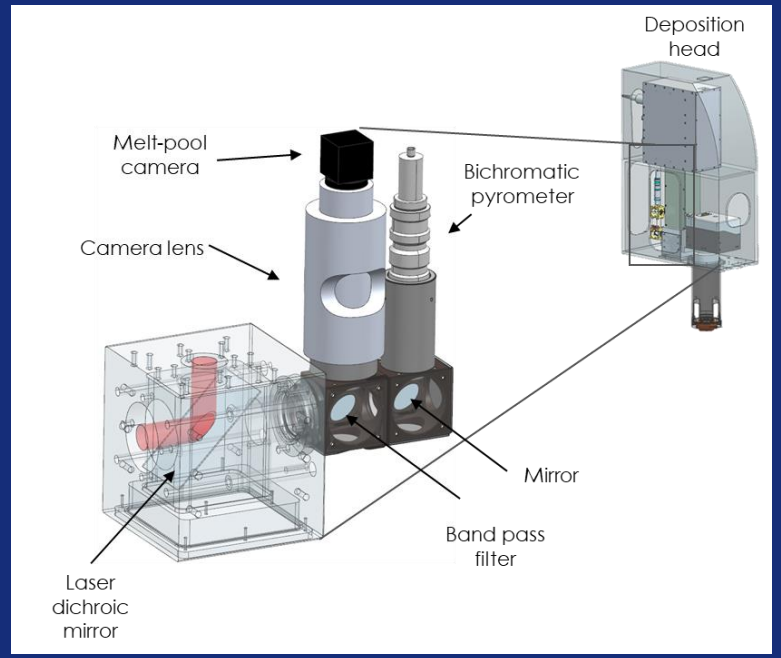
EIT FUNDING AND SUPPORT

This EIT grant provided us with the chance to create connections on one side among different research institutes, all presenting a solid background in AM process monitoring but applied to different technologies (arc based DED or WAAM, laser based DED or LMD techniques using either powder or wire as feedstock) and exploiting different inspection techniques (thermography, visual based inspection, t-SAW...) and on the other side, between research institutes and industries that are willing to boost and innovate their manufacturing strategies



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RESULTS AND NEXT STEPS

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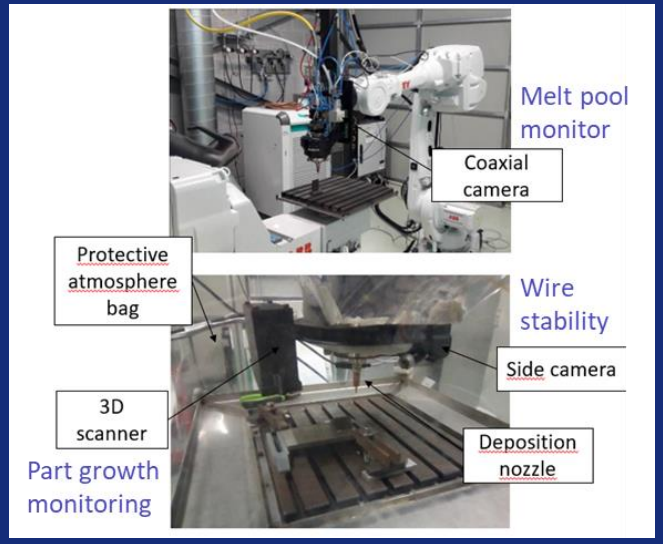

ACHIEVEMENTS

- Literature survey on NDT requirements, available guidelines and standards, complemented with material and machine specific requirements
- Lab validation of all monitoring and NDT technologies
- Integration of monitoring systems achieved at lab scale
- Development of data processing algorithms to analyse monitoring data
- www.guaranteed.be created as spin-off by OCAS

OUTLOOK

- Integration of the new monitoring hardware and first experimental testing campaigns
- Offline and online validation of the inline NDT technology
- Further development and validation of the data processing algorithms
- Correlation data monitoring to defect monitoring using AI routines

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