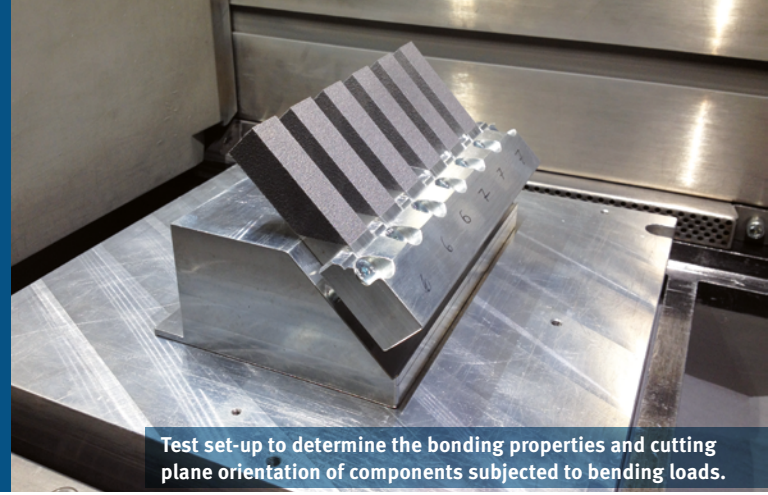
ReziProK

Resource-efficient Circular Economy – Innovative Product Cycles

RePARE

Regeneration of Product and Production Systems through Additive Repair and Refurbishment

In mechanical and plant engineering, the customer-centred improvement of delivery speed and quality is a key objective, whereas resource efficiency has been less of a focus so far. The project "RePARE" aims to complement measures such as preventive maintenance and the high safety stock of spare parts with additive repair procedures, thus enabling the systematic regeneration of spare parts.



Test set-up to determine the bonding properties and cutting plane orientation of components subjected to bending loads.

Resource-efficient Circular Economy – Innovative Product Cycles (ReziProK)

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Additive Repair in Mechanical and Plant Engineering

The competitive pressure in the mechanical and plant engineering industry leads to new strategies to ensure differentiation from global competition. One strategy for enhancing economic and ecological sustainability is to extend the life cycle of machines by converting, replacing or upgrading components. In order to contribute to this, the project is investigating the remanufacturing of partially worn spare parts using additive manufacturing processes such as Selective Laser Beam Melting or Laser Metal Deposition in the sense of additive repair.

With the help of an economic-technical framework, an evaluation is made of which components are suitable for remanufacturing. From a business management point of view, holistic service concepts for the use of additive repair are defined and, by means of parameters, the reparability is evaluated in terms of a rebuildor-replace decision. The consideration of life cycle assessment extends the view of sustainability.

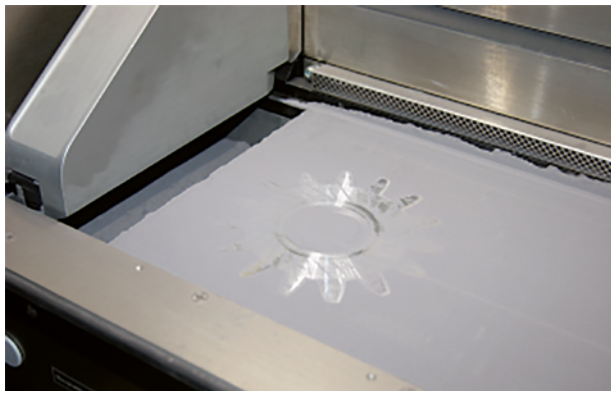
The Potentials

The use of additive manufacturing for the remanufacturing of spare parts is associated with various potentials and challenges, which will be investigated and discussed in the project, also by tests using demonstrator components. On the one hand, the costs incurred by manufacturers, such as spare parts storage and logistics, and customers, such as downtime costs, can be minimized and the life cycle of components extended. On the other hand, there is the challenge of carrying out downstream activities such as installation and removal as well as quality assurance of the spare part with regard to warranty and liability issues. Since the market for additive manufacturing is highly dynamic, the project team also looks beyond the research period in the context of a scenario analysis, for example to anticipate developments in production unit costs.

First results

In the course of the project work so far, potential applications for additive repair and refurbishment have already been identified, even beyond high-priced capital goods, as well as decision variables for the selection of suitable components. Furthermore, a damage classification is used to select suitable repair strategies according to the condition of the component. With the application of Laser Powder Bed Fusion (LPBF) for the repair of demonstrator components, first data for the evaluation of economic and ecological factors could be collected.

For the integration of additive repair into after-sales services, assistance systems were designed to support the assessment of technical feasibility as well as the support of accompanying service activities such as on-site assembly/disassembly.



Building a new geometry onto a conventionally manufactured gear by selective laser beam melting

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Consortium and Results

In RePARE, scientists from the German Research Center for Artificial Intelligence (DFKI) are working together with engineers from the Institute for Product Development (IPeG) at Leibniz Universität Hannover. The DFKI team will explore the potential that arises from the business model and the circular economy and provide a summarizing framework by developing a complete system for the systematic integration of additive repair scenarios right through to the service processes. The IPeG investigates different repair strategies for plant engineering components, executes practical tests and subsequently validates the regenerated components. The results are incorporated into an assistance system that supports designers in the design and planning of repair tasks.

From industry, the researchers receive support from DMG Mori Spare Parts GmbH and Windmöller & Hölscher KG. The industrial partners are supporting the project by collecting and classifying wear mechanisms and comparing manufacturing technologies for the recirculation of components. Furthermore, from a practical point of view, questions regarding the type or mechanism of damage, suitable materials and integration into the value chain are of interest. Based on these questions, a quantification of the procedures with regard to processes, life cycle assessment and proportionality can be carried out.

The project "RePARE" is funded within the funding measure "Resource-efficient Circular Economy – Innovative Product Cycles (ReziProK)".

"ReziProK" is part of the research concept "Resource-efficient Circular Economy" of the Federal Ministry of Education and Research (BMBF) as part of the FONA Field of action 6: "The circular economy – efficient use of raw materials, avoiding waste" and supports projects that develop business models, design concepts or digital technologies for closed product cycles.

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Resource-efficient Circular Economy – Innovative Product Cycles (ReziProK)

As part of the FONA Field of action 6:
The circular economy – efficient use of raw materials, avoiding waste.

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