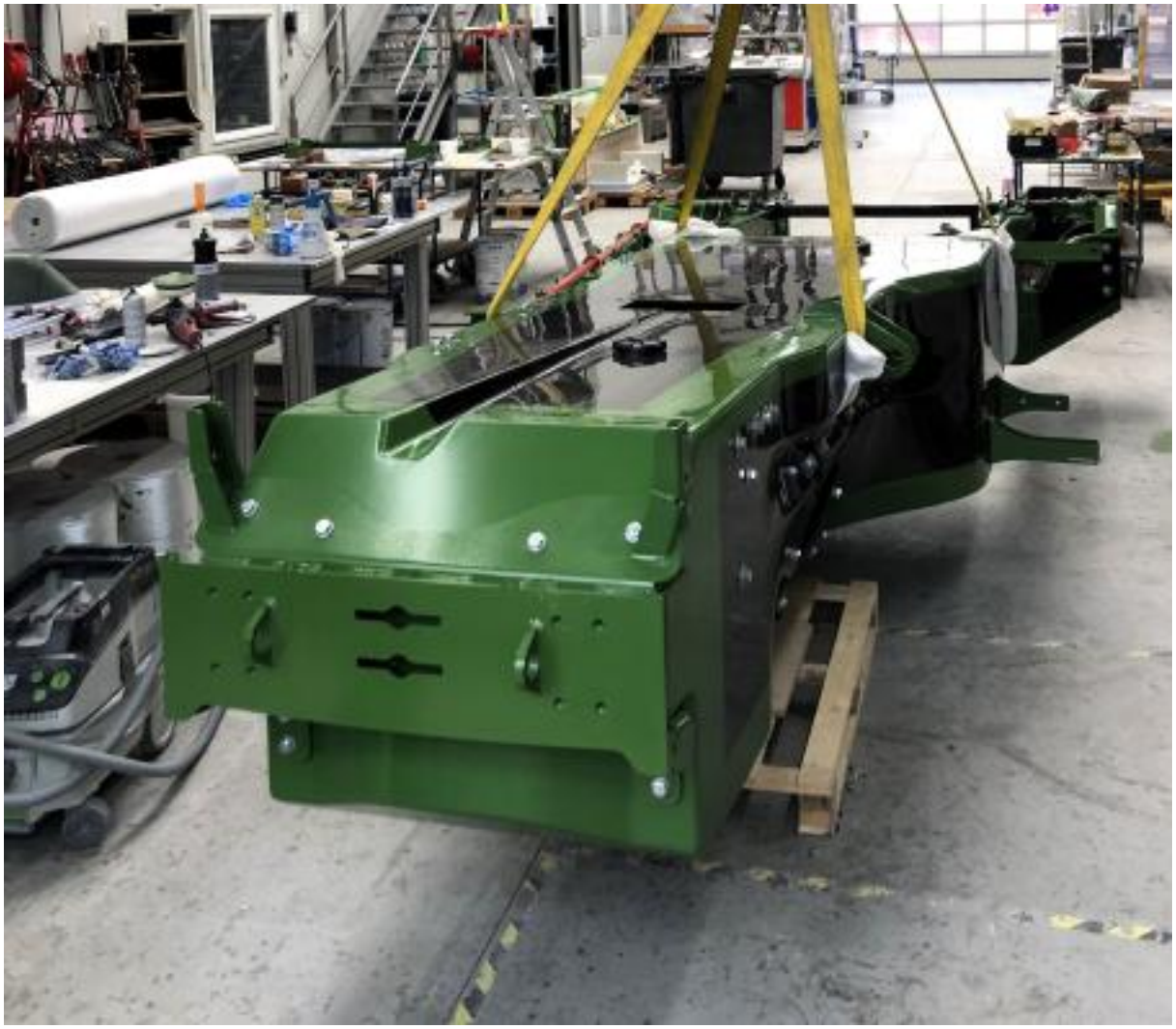
Reducing the weight of agricultural machinery: lightweight, functionally integrated carbon chassis

About this project



AGRILIGHT

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Markets:

Reducing the weight of agricultural machinery: lightweight, functionally integrated carbon chassis

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Material: Biocomposites, Aramid fibres, Basalt fibres, Glass fibres, Carbon fibres, Natural fibres, Thermoset plastics, Yarns, rovings, Laid webs, Woven fabrics, Knitted fabrics, Nonwovens, mats, Aramid fibre composites, Basalt fibre-reinforced plastic, Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP), Natural fibre reinforced plastics (NFRP), Closed-pore

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Technology Transfer Program Leichtbau

Context

The performance of agricultural harvesters has risen sharply in recent decades. At the same time, machines are getting bigger and heavier, which presents manufacturers with various challenges. On the one hand, the high weight leads to increased soil compaction, which worsens the living conditions for soil organisms and restricts root growth and water absorption. As a result, the fertility and yield of agricultural land decreases. On the other hand, the heavier and larger machines lead to problems in complying with road traffic regulations.

Purpose

The AGRILIGHT team aims to significantly reduce the weight of the harvesters through the use of innovative lightweight construction concepts. They are developing a functionally integrated lightweight structure made of glass fibre and carbon fibre composites to replace the central steel frame of the machines and integrate adjacent components - such as tanks - into the component. This change is intended to reduce fuel consumption and CO2 emissions while minimising soil compaction. In addition to the ecological improvement, the researchers would also like to simplify the road traffic authorisation of the machines thanks to the reduced weight.

To further reduce assembly times and costs, the team is developing new approaches to structural hybridisation for the particularly stressed interfaces of the machines. The aim is to be able to retain existing joining methods from metal processing for lightweight, fibre-reinforced materials.

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Procedure

At the start of the project, the team analysed the existing steel structure and the adjacent functional units of the harvester. It then developed the new functionally integrated frame structure made of fibre-reinforced plastics (GRP/CFRP), taking into account the specific mechanical, electrical and chemical properties of these materials.

For structural hybridisation, the team uses multi-layer insert technology, in which metallic inserts are integrated into the fibre composite during production. This means that existing joining methods from metal processing can be retained and downstream work steps such as drilling and gluing can be omitted, which significantly simplifies assembly.

At the end of the project, the new frame structure will undergo extensive mechanical testing to assess its suitability for series production. To do this, the team integrates the prototype into a realistic test setup and tests the frame on a special test bench to simulate real-life operating conditions. In this way, the team ensures that the new structure remains intact over the entire service life of the machine.

The developed prototype will be presented for the first time at Hannover Messe 2024 and shows a weight reduction of over 430 kg compared to the conventional steel frame construction. The project has been recognised as a finalist for the prestigious JEC Innovation Award in the Equipment Machinery & Heavy Industries category.

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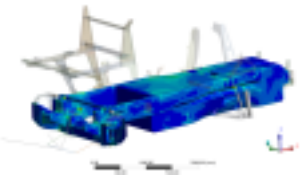


Funding duration:

Funding sign:	03LB2019	**Funding amount:**	EUR 1.7 million

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2019A - AGRILIGHT in the federal funding catalogue

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Project coordination

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KRONE

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Semi-finished parts, Materials, Tools and moulds	✓
Services & consulting Training, Consulting, Testing and trials, Engineering, Prototyping, Validation, Simulation, Maintenance and repair	✓
Field of technology	
Design & layout Lightweight manufacturing, Lightweight design, Hybrid structures	✓
Functional integration	
Measuring and testing technology	
Modelling and simulation Loads & stress, Structural mechanics, Materials	✓
Plant construction & automation	
Recycling technologies	

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing 3D printing	✓
Coating (surface engineering) Painting	✓
Fibre composite technology Manual lamination, Resin infusion process, Resin transfer moulding, Pre-preg processing, Vacuum infusion	✓
Forming	
Joining Adhesive bonding, Screwing	✓
Material property alteration Heat treatment	✓
Primary forming Others (Reaction Injection Moulding)	✓
Processing and separating Drilling, Turning, Sawing, Grinding, Cutting	✓
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials Biocomposites	✓
Cellular materials (foam materials) Closed-pore	✓
Composites Aramid fibre composites, Basalt fibre-reinforced plastic, Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP), Natural fibre reinforced plastics (NFRP)	✓
Fibres Aramid fibres, Basalt fibres, Glass fibres, Carbon fibres, Natural fibres	✓
Functional materials	
Metals	
Plastics Thermoset plastics	✓
Structural ceramics	
(Technical) textiles Yarns, rovings, Laid webs, Woven fabrics, Knitted fabrics, Nonwovens, mats	✓