

Automated Production of Railway Vehicles

AIM

The German government is actively promoting the use of railway vehicles as a more environmentally friendly mode of transportation. As a result, there has been a significant increase in the demand for railway vehicles in Germany. In response, Fraunhofer IFAM, a German research institute known for its expertise in aerospace research and development, is venturing into the railway vehicle production sector. The primary objective of this initiative is to identify and adapt existing aerospace production technologies for the manufacturing of railway vehicles.

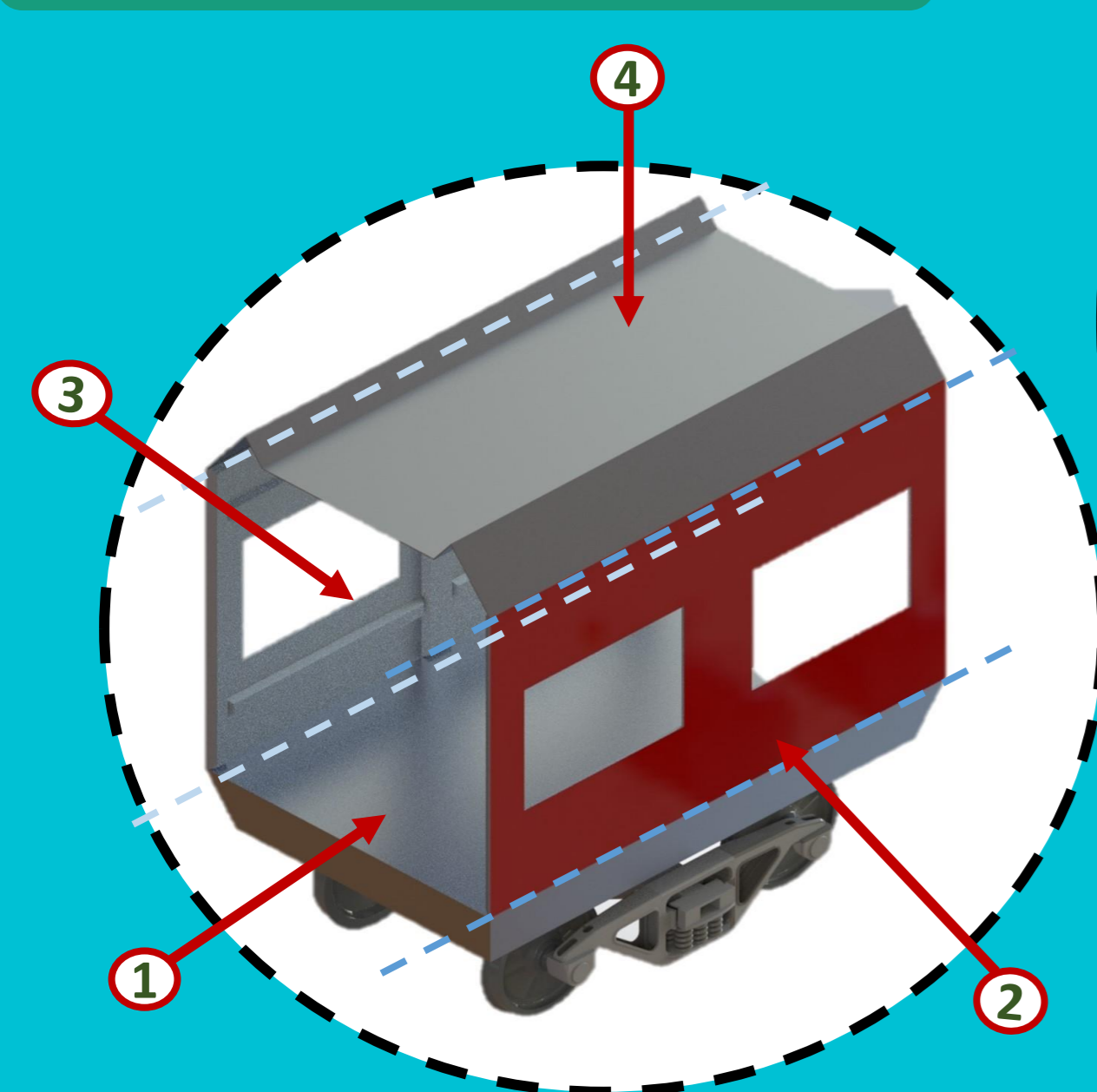
METHODOLOGY

- 1. Initial Phase:** Comprehensive analysis of conventional railway vehicle production methods.
- 2. Research Phase:** In-depth investigation of cutting-edge aircraft manufacturing technologies.
- 3. Conceptualization Phase:** Generation of various potential solutions.
- 4. Collaborative Evaluation Phase:** Thorough assessment and integration of selected solutions with the Fraunhofer IFAM team.
- 5. Visualization Phase:** Employing Computer-Aided Design (CAD) tools for rendering and visualizing the finalized project concept.

CONCEPT OVERVIEW

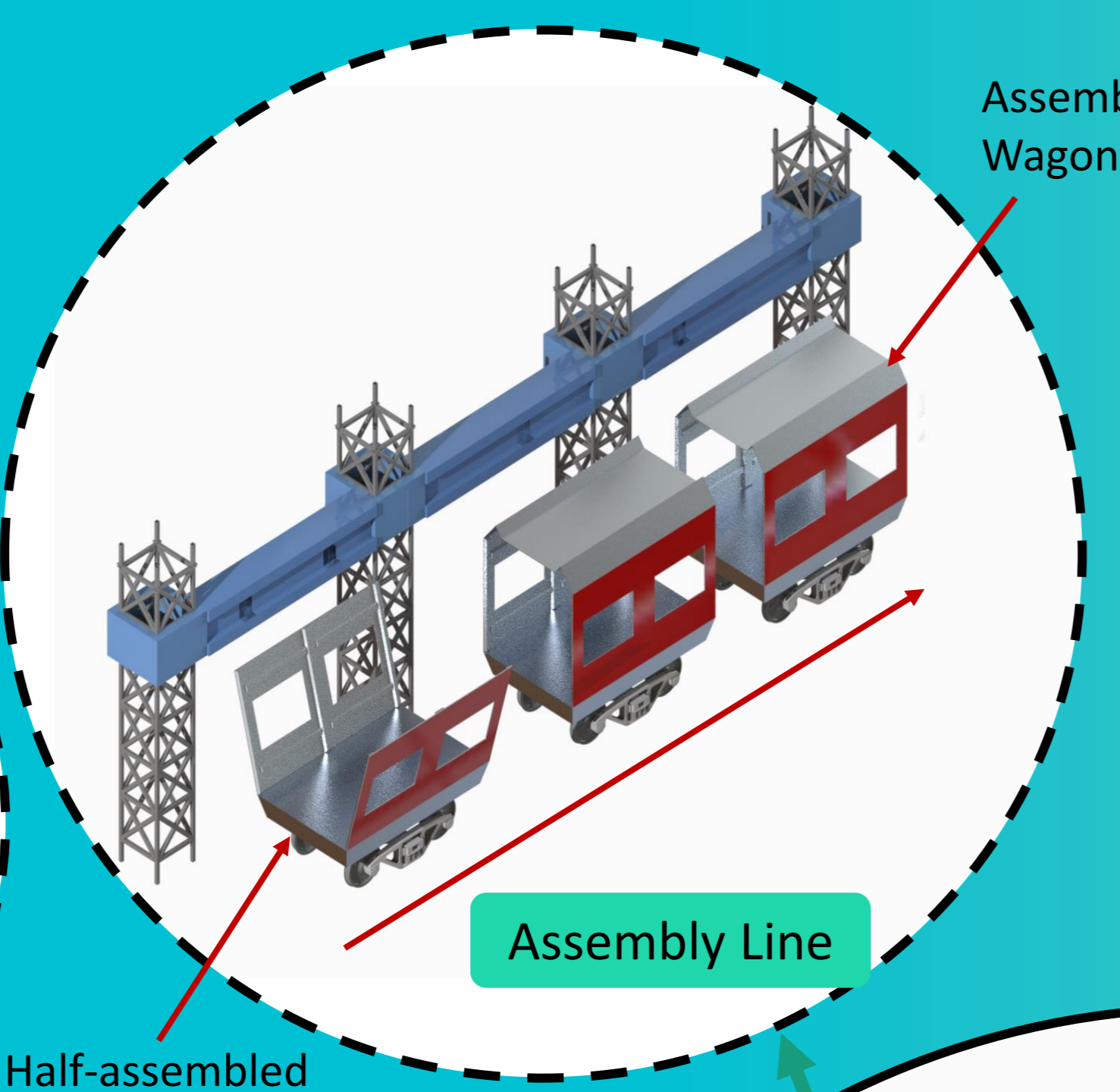
BAHNCRAFT is a high-tech railway production line consisting of three main parts: Wagon Assembly, Assembly Wheel Arc, and Advanced Joining technologies. It is assisted by Automated Guided Vehicles (AGVs) and a rail-based transport system for efficient logistics. BAHNCRAFT was selected based on strict criteria such as reliability, cost-efficiency, time savings, scalability, automation, economic viability, ecological sustainability and safety. The concept is adaptable for brownfield projects, integrating well with existing infrastructure.

Wagon Assembly



Side walls assembled in sequence as numbered and in the same direction as the arrows

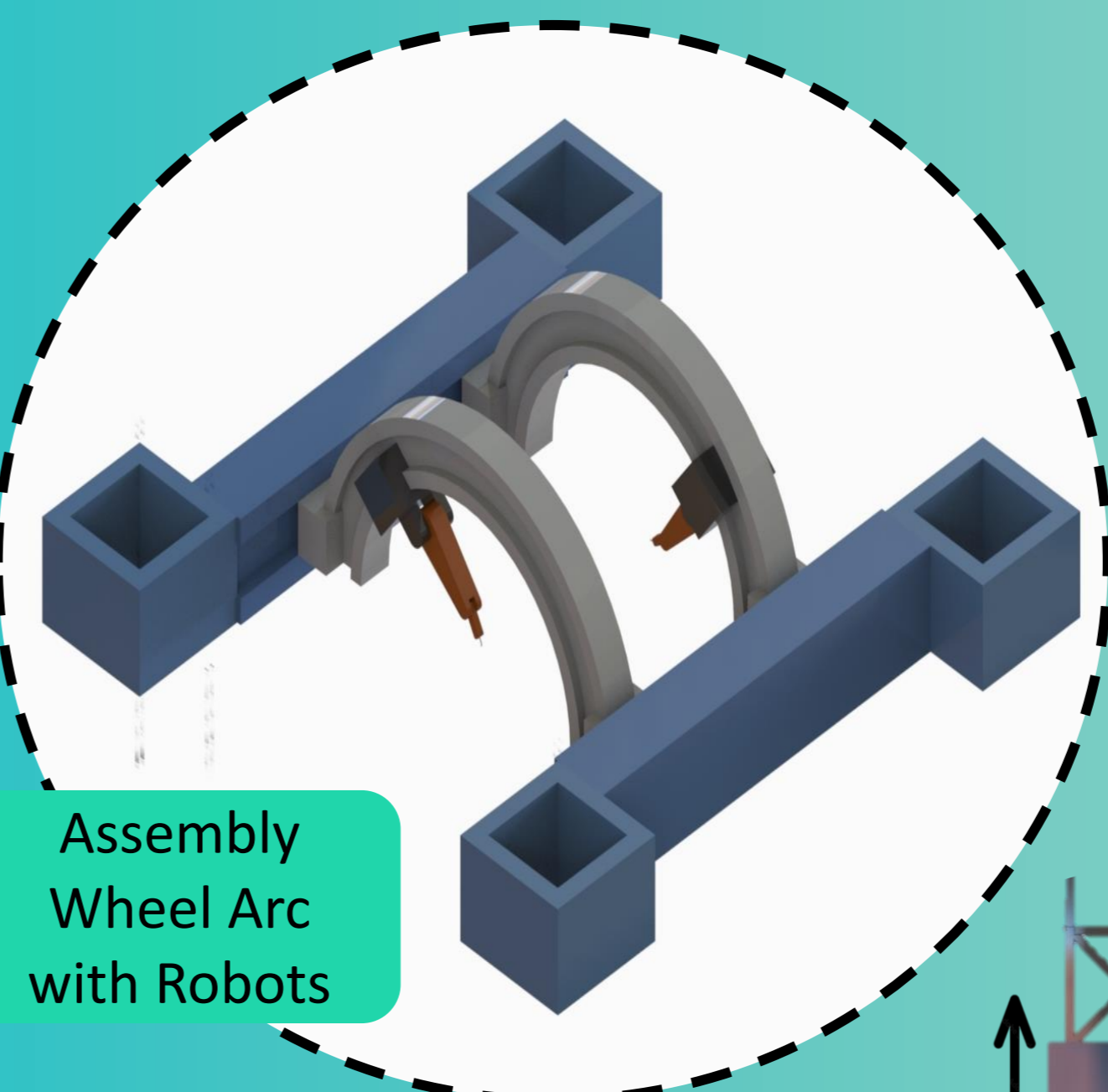
- Smaller sheets for the side walls of the wagon used for precise and efficient car body construction.
- Robots in the assembly wheel properly secure plates before performing particular operations like as welding, drilling, and so on, eliminating the need for jigs.
- Finally, an automated painting system provides a perfect finish.



Half-assembled Wagon

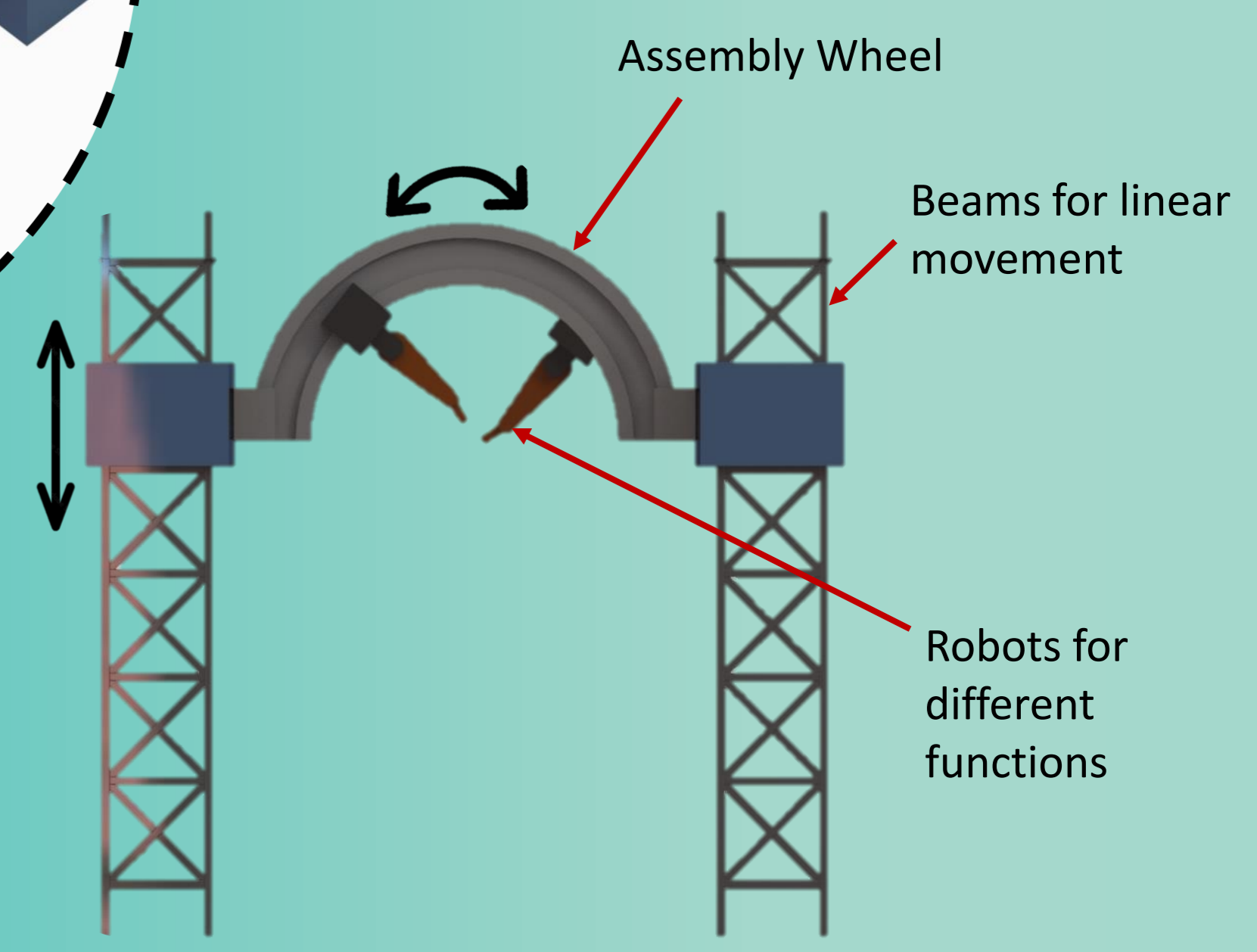
Assembly Line

Assembled Wagon

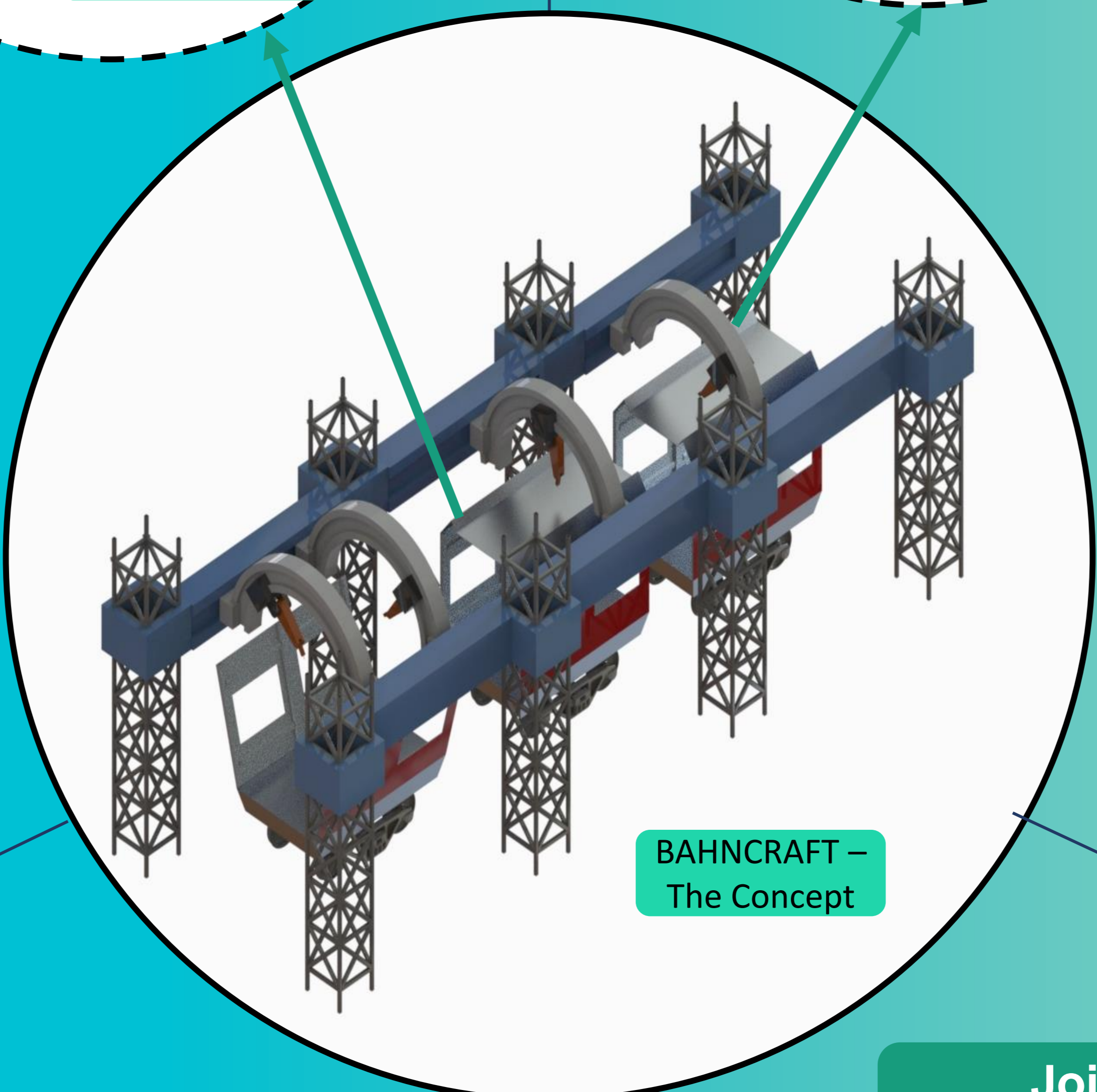


Assembly Wheel Arc with Robots

Assembly Wheel Arc Robot

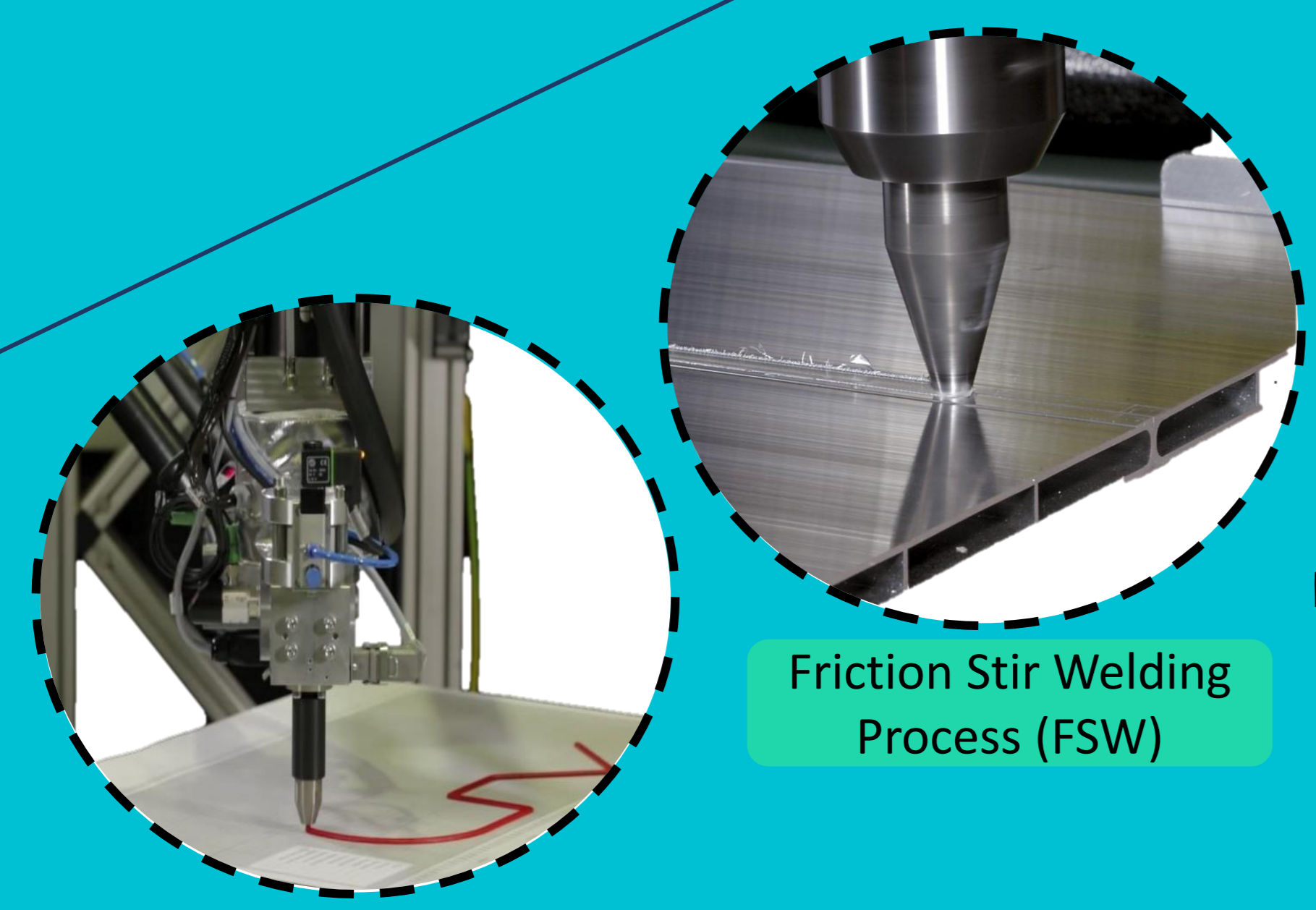


- Semi-circular assembly wheel arc used as platform for robots.
- Secure positioning on vertical beams for vertical movement.
- Robots assemble train car body sections with versatile end-effectors such as for positioning, gripping, joining and assembling.



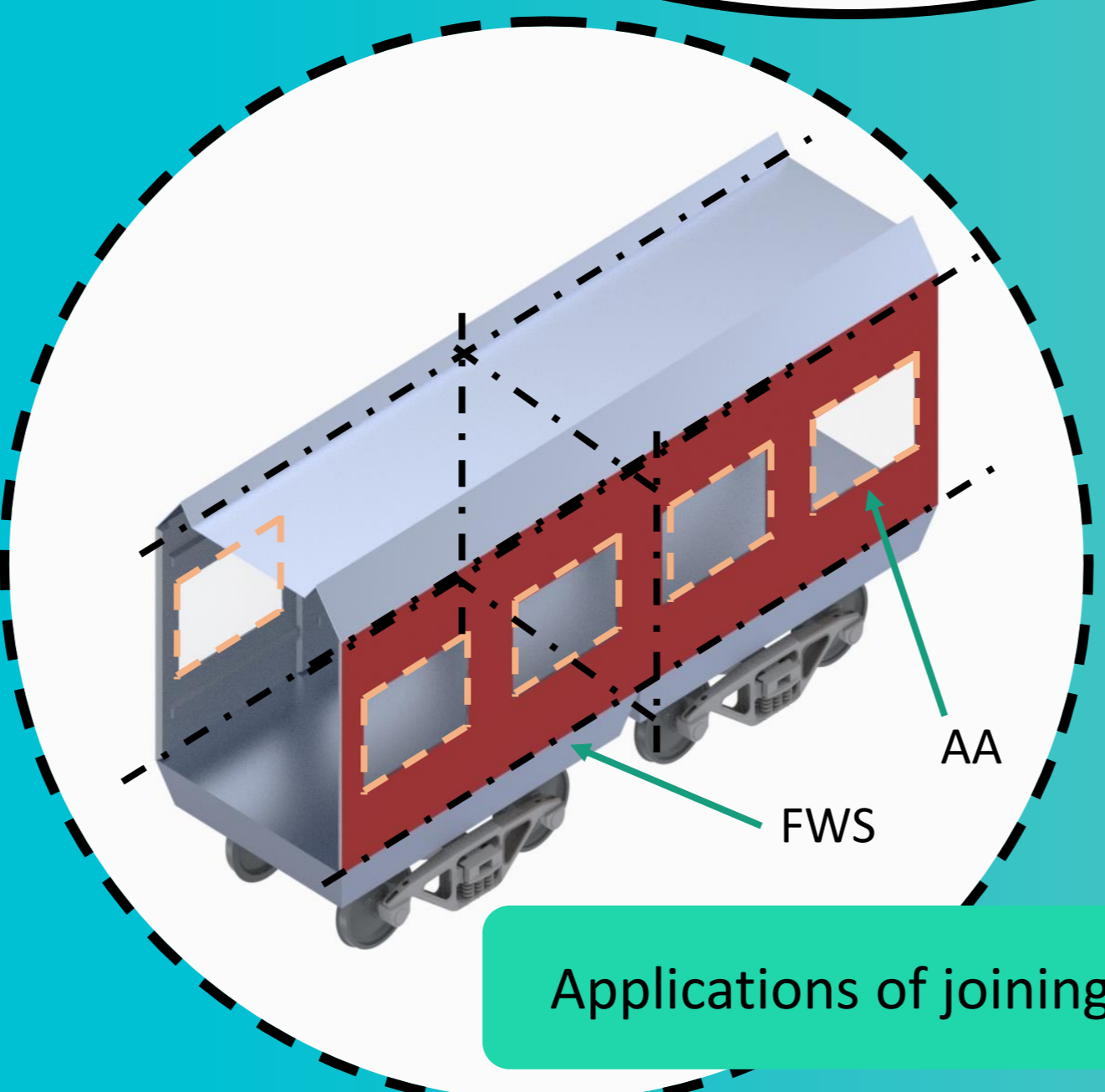
BAHNCRAFT – The Concept

Joining Technologies



Friction Stir Welding Process (FSW)

Automated Adhesive Application (AA)



Applications of joining

- Friction stir welding ensures strong, defect-free joints, especially for Aluminium components.
- Adhesives provide greater strength and durability while also being compatible with a wide range of materials such as glass, composites, rubbers, etc. as well as requiring less preparation and post-processing.
- Pre and post surface treatment may be necessary for both technologies – also performed by robots in Assembly Wheel Arc.

CONCLUSION

BAHNCRAFT addresses the demand for eco-friendly railway vehicles in Germany. It combines traditional railway manufacturing with advanced aerospace technology to create an automated production system that could revolutionize future train development. BAHNCRAFT could be the spark for the "Train of Tomorrow," emphasizing on sustainability, automation, adaptability, and innovation. In essence, BAHNCRAFT represents a forward-looking, innovative approach to railway production, shaping a more sustainable and efficient future in transportation.