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Transportation Research Concepts - Attachment 3

Additional submitted attachment is included below.

What is the reason BMW has not made any further composite cars after the BMW i3

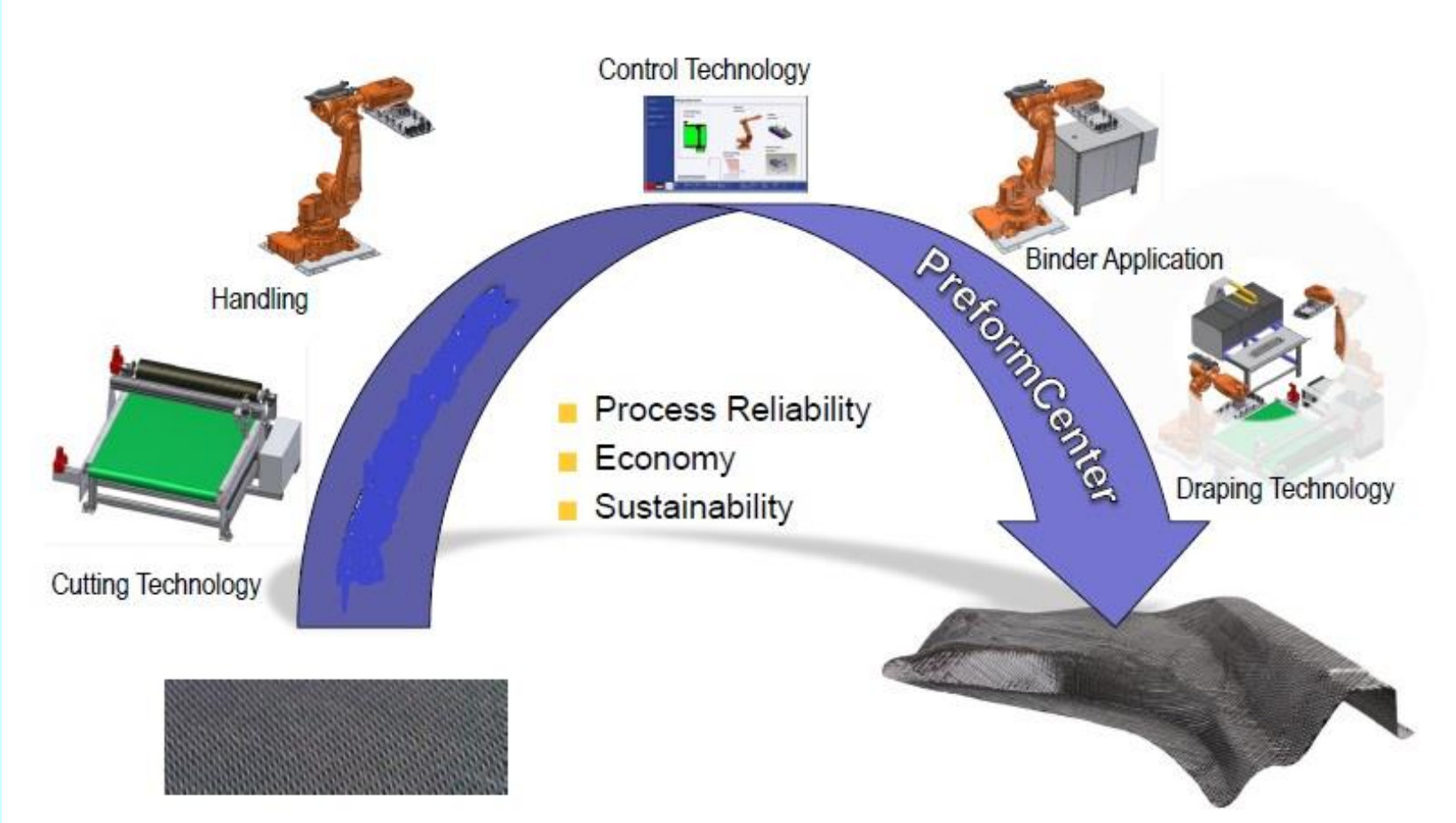
High cost reason: layup process not fully automation

Most composites are laminated, which involves laying up sheets to create the laminate. Therefore, the major production process for composite laminate is layup.

The layup process, which is time and labor-intensive, serves as the bottleneck in the mass production of composites.

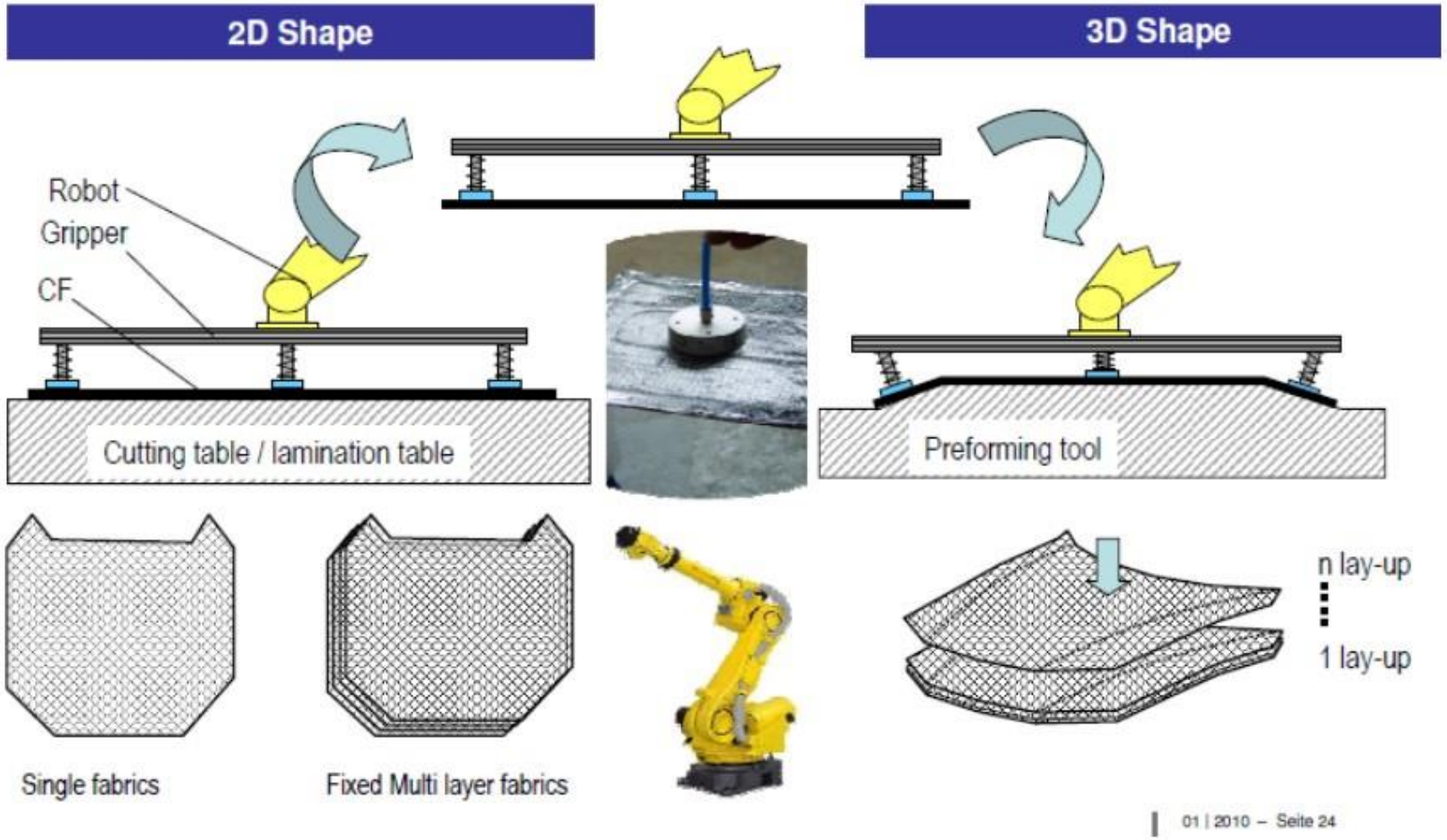
The high cost of composite products is primarily due to the labor-intensive layup process, rather than the high price of raw materials.

Only panels can be automated for layup



Only panels can be automated for layup

Gripping Mechanism is Critical for a Layup Robot



Picture cited from Dieffenbacher.
http://speautomotive.com

BMW can only make simple composite panels and glue them together to get a drive cell

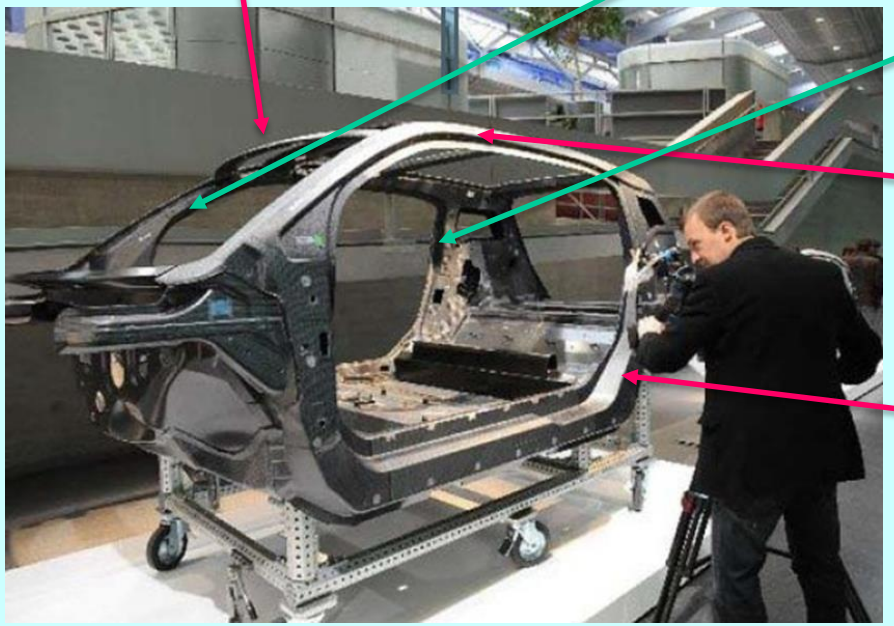


Image courtesy of BMW

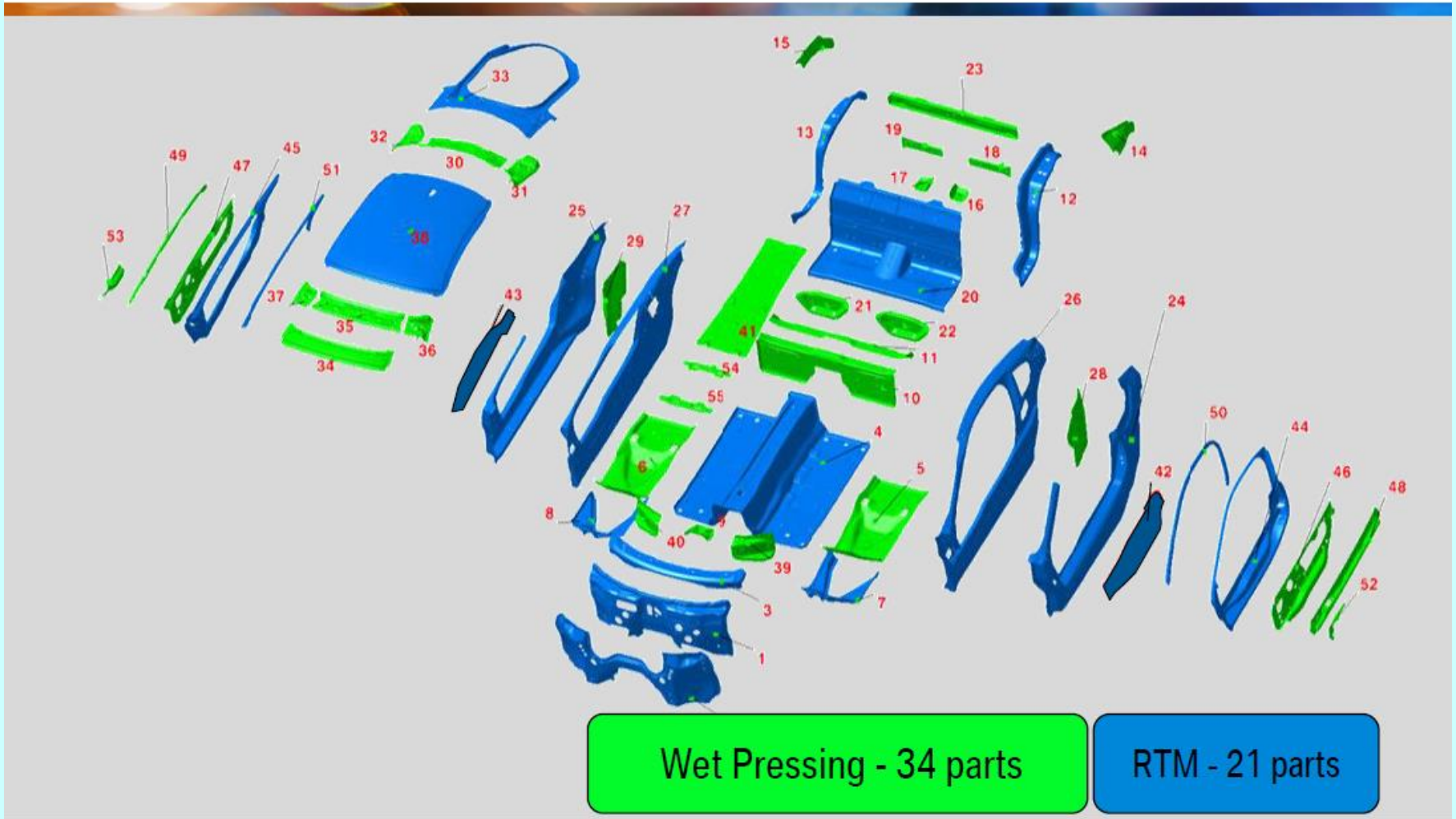
STRUCTURAL CFRP AT THE BMW GROUP.
THE IDEA OF BMW i - LIFE AND DRIVE MODULE CONCEPTS.

BMW i3 - Electrical driven

BMW i8 - Hybrid driven

[URL 15a]

STRUCTURAL CFRP AT THE BMW GROUP.
THE IDEA OF BMW i - RTM AND WET PRESSING PARTS OF THE i8.



High cost reason: not an integration composite production

It makes 55 composite pieces for a car body, because it can not layup fabrics for a complex structure.

Our new robot technology can layup fabrics for a complex structure, integrate 55 pieces into 8 parts and save 80% manufacture cost.

It give up to make composite car wheel in 2012

It can not make monocoque tub by mass production

Image courtesy of Mclaren

- It can only make simple shape panels and glue panels together to get a driver cell.
- It can not make complicated structures automatically.

Our technologies can automatically make monocell

One generation ahead of time

In comparison

•We are able to automated make complicated wheels and tubs, not only panels at an affordable cost.
•Much less cost to build a mass production line.

Fully automating the layup process for complex structures is the key to achieving low-cost production

The BMW i3 composite car is a great example of the potential for composites in family cars, as it has reached a level where it neither loses nor earns too much money for a composite family car.

If we add our automated layup technology to BMW's composite technology, the major technological difficulties for low-cost mass production of composites in the auto industry can be overcome.