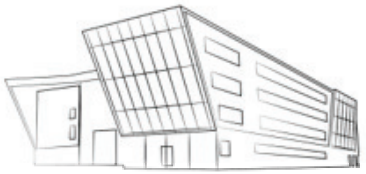

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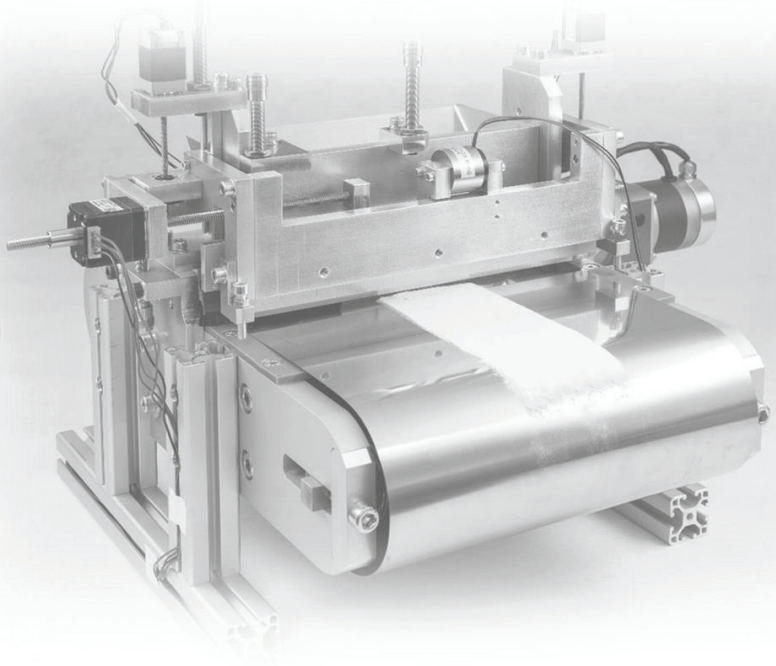

AUTOMATED CONTINUOUS FABRICATION OF LOAD-PATH ADAPTED THERMOPLASTIC FIBER PREPREGS

26 June 2018 | Felix Gabriel, Daniel Nebel and Alexander Fürst | ECCM18

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NFF NIEDERSÄCHSISCHES FORSCHUNGSZENTRUM FAHRZEUGTECHNIK

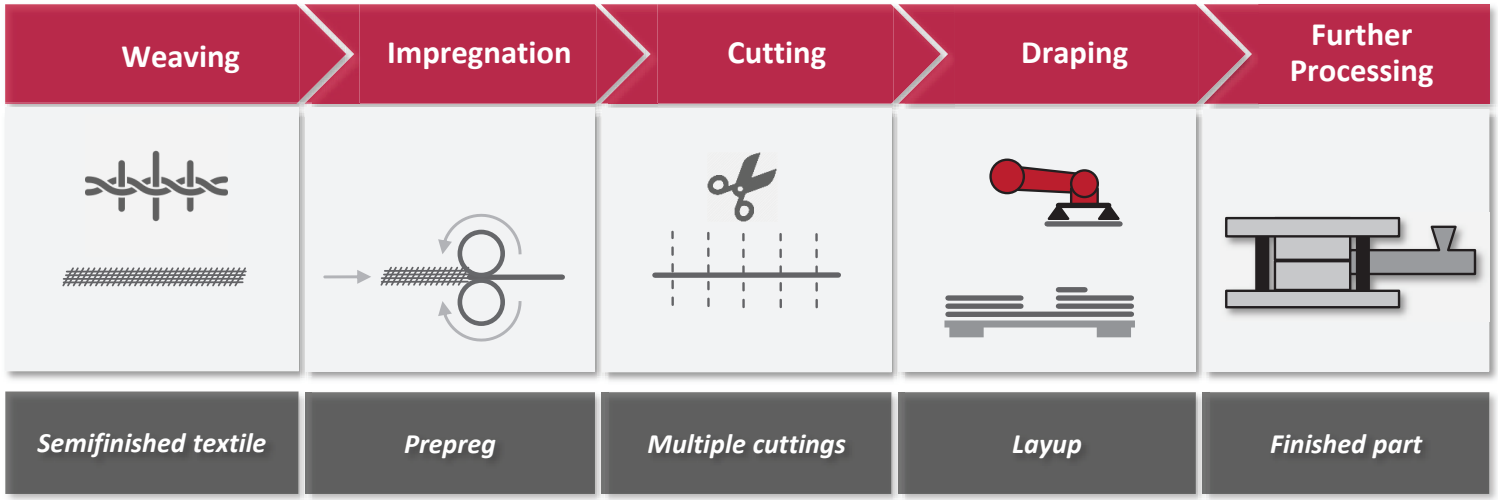
Outline: Automated Continuous Fabrication Load-Path Adapted Thermoplastic Fiber Prepregs

- **Introduction and Motivation for Load-Path Adapted Thermoplastic Fiber Prepregs**
- Objective: Adaptive matrix application for load-path adapted textiles
- Solution approach: Sensor-based control strategy for automated powder application
- Conclusions and Outlook

Introduction and Motivation for Load-Path Adapted Thermoplastic Fiber Prepregs

Status quo: fabrication process for fiber-reinforced thermoplastic parts

- Draping of isotropic prepregs into a load-path adapted layup
- Consolidation of the layup into the finished part



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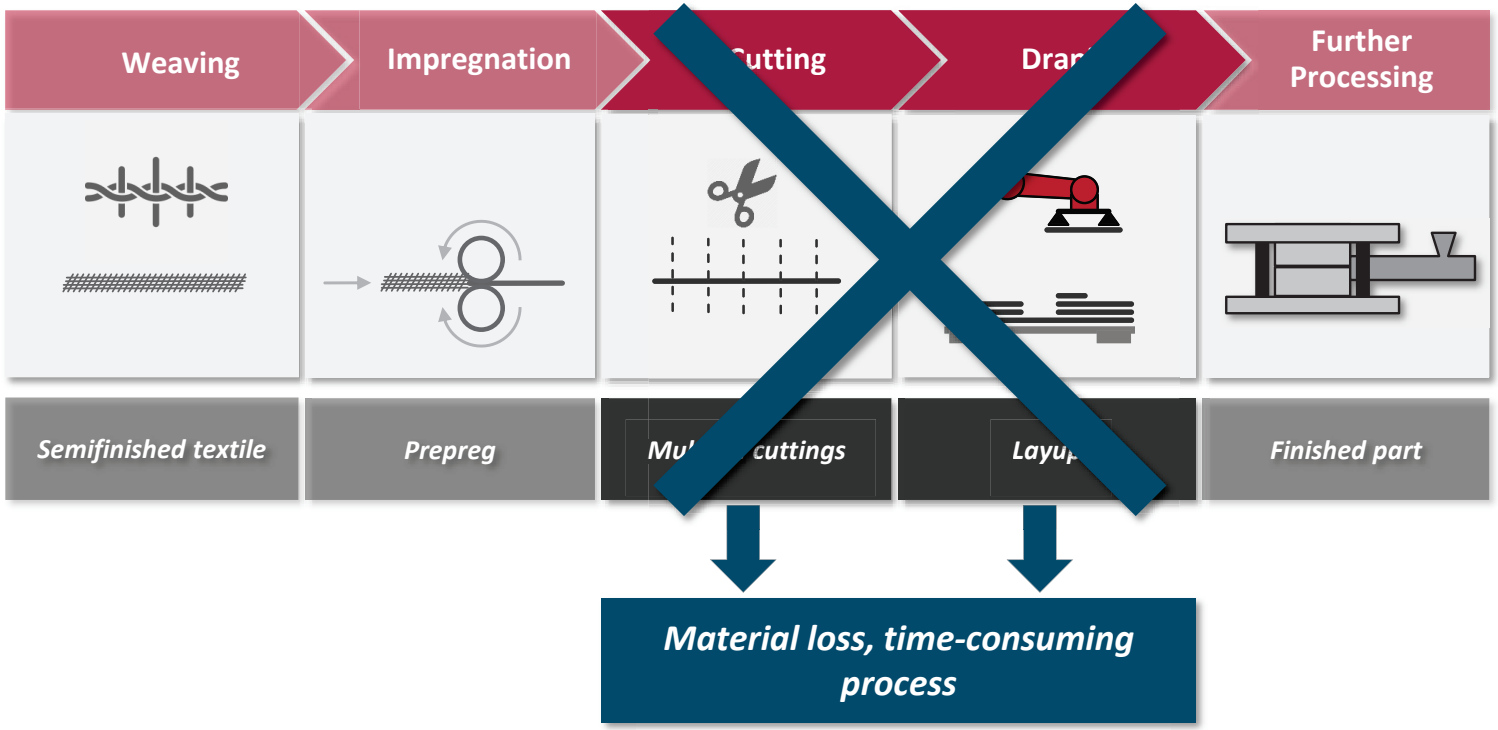
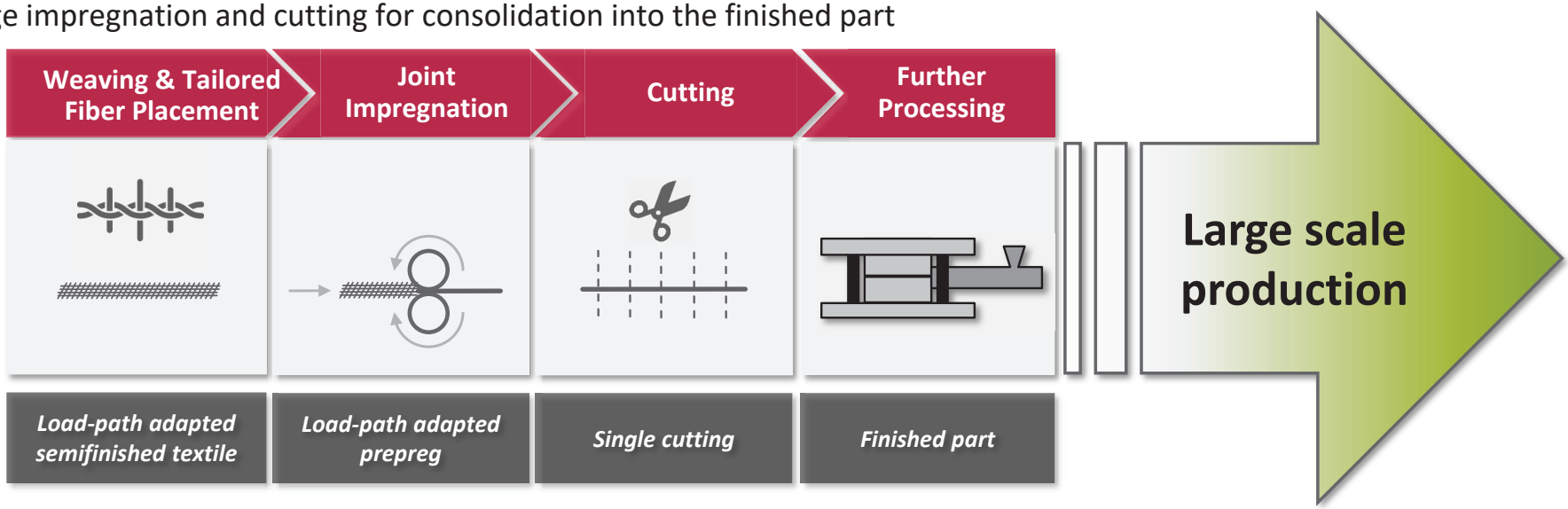


Introduction and Motivation for Load-Path Adapted Thermoplastic Fiber Prepregs

Solution approach: utilization of load-path adapted semifinished textile

- Fabrication of load-path adapted semifinished textile (tailored fiber placement)
- Single-stage impregnation and cutting for consolidation into the finished part



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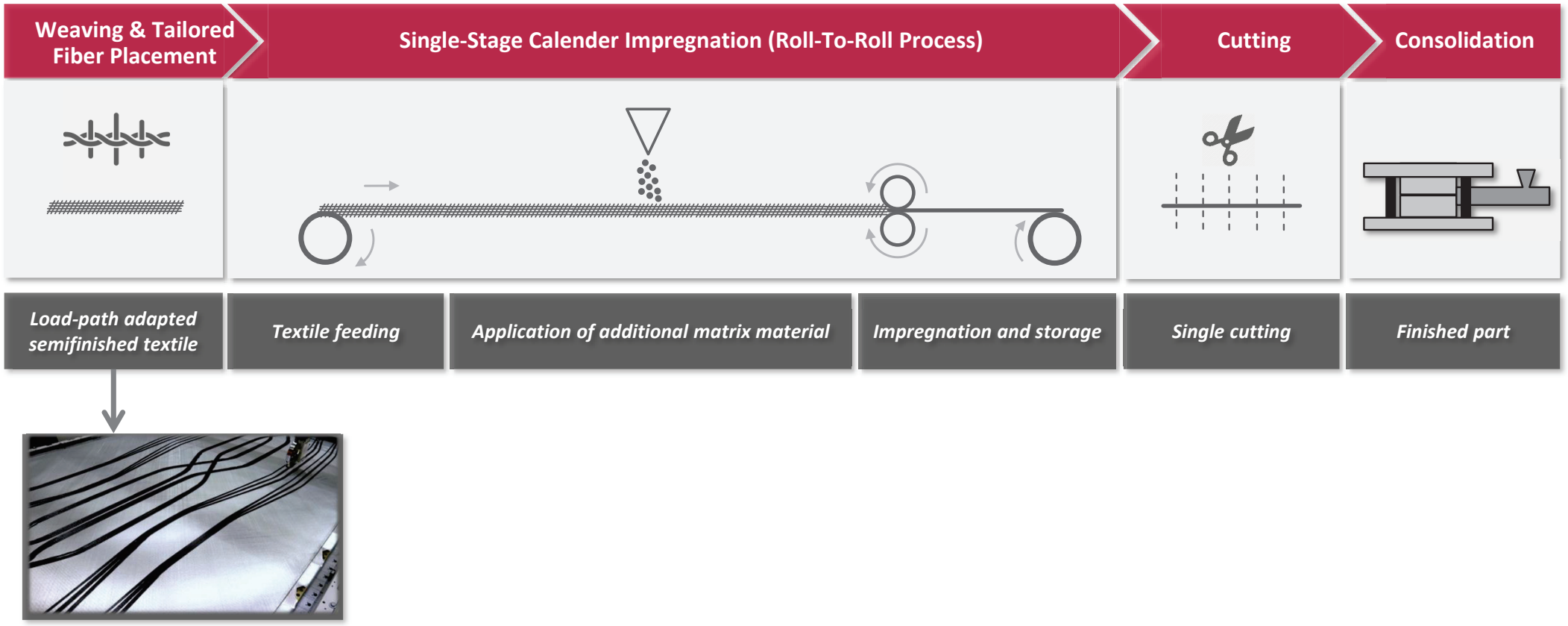

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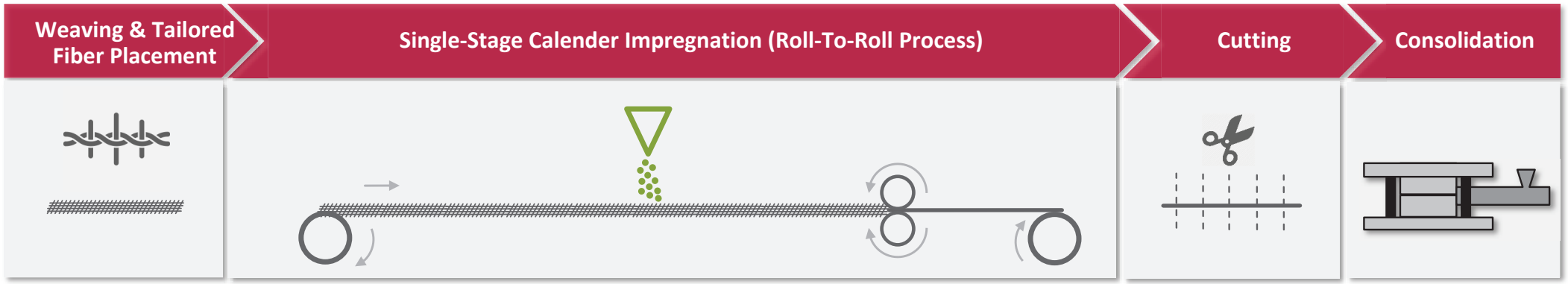

Problem: Asymmetries can lead to deflections and fiber washing

Objective: Constant fiber volume ratio

Solution: Automated application of additional matrix material

Project „ProText“ at Open Hybrid LabFactory

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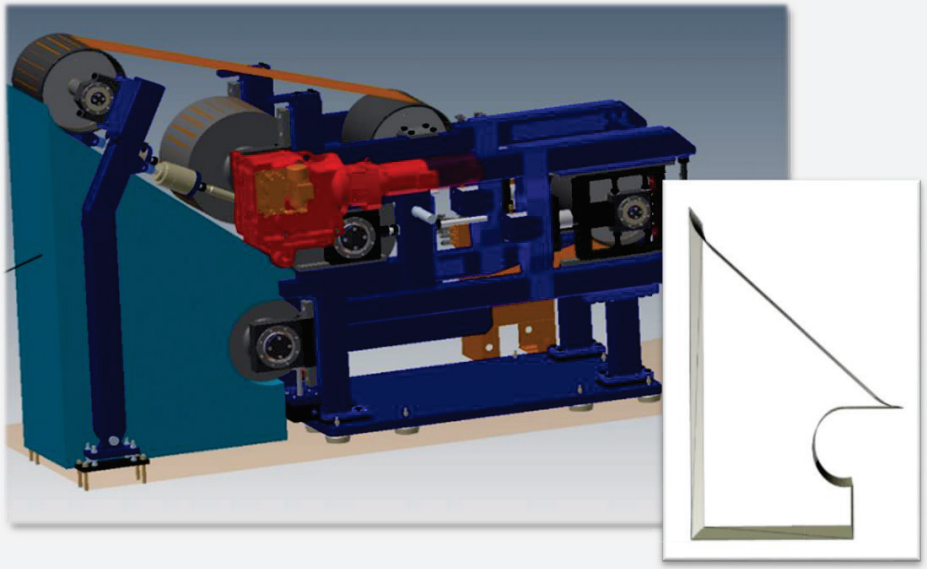
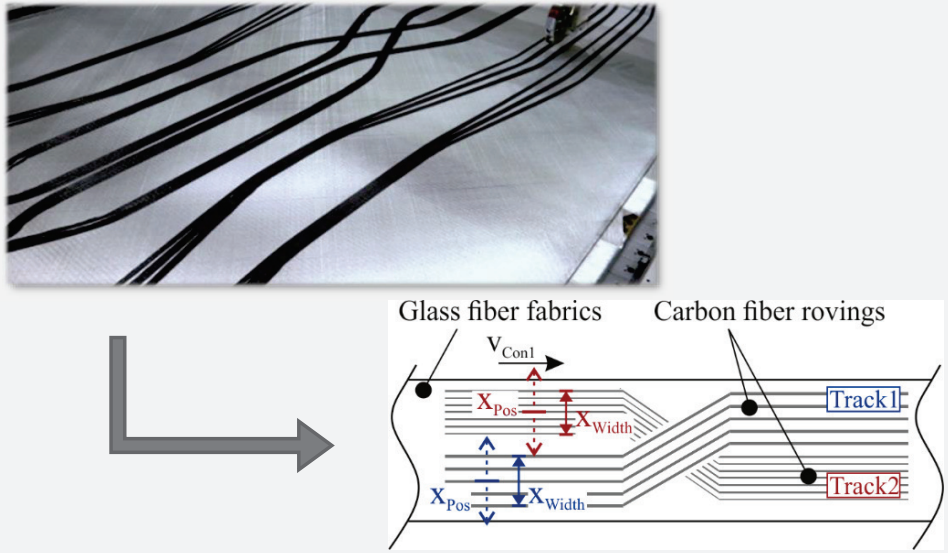
Boundary Conditions | **Design Process** | **Control Strategy**



Available Design Space in the Calendering Plant



Simplifying Reduction of the Geometrical Complexity

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Introduction and Motivation for Load-Path Adapted Thermoplastic Fiber Prepregs

Boundary Conditions | **Design Process** | **Control Strategy**

Clarify and define the task

Product planning | Determine requirements

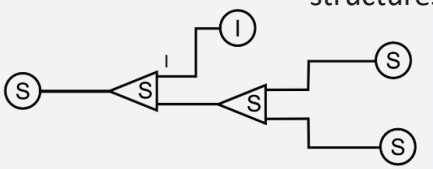
→ List of requirements

Determine functions and their structures

Derive functions from task | Develop function structures

→ List of sub-functions

→ Function structures



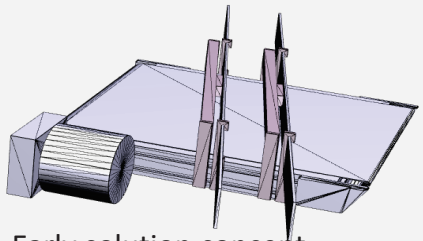
Search for solution principles and their combinations

Search for solution principles | Assessment of solutions and choice of final design

→

	Solution principle 1	Solution principle 2	...
Sub-function 1			
Sub-function 2			
...			

→



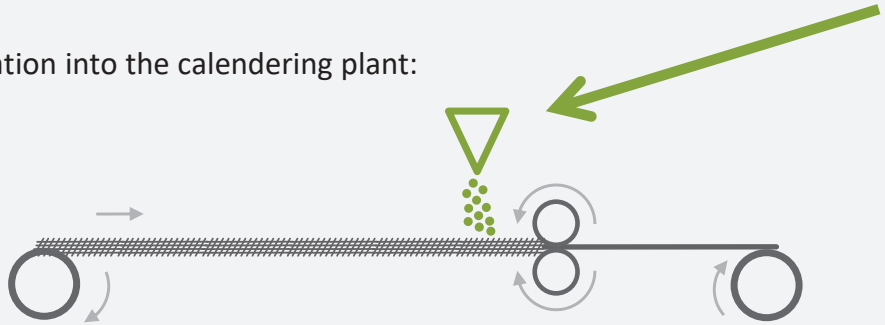
Early solution concept

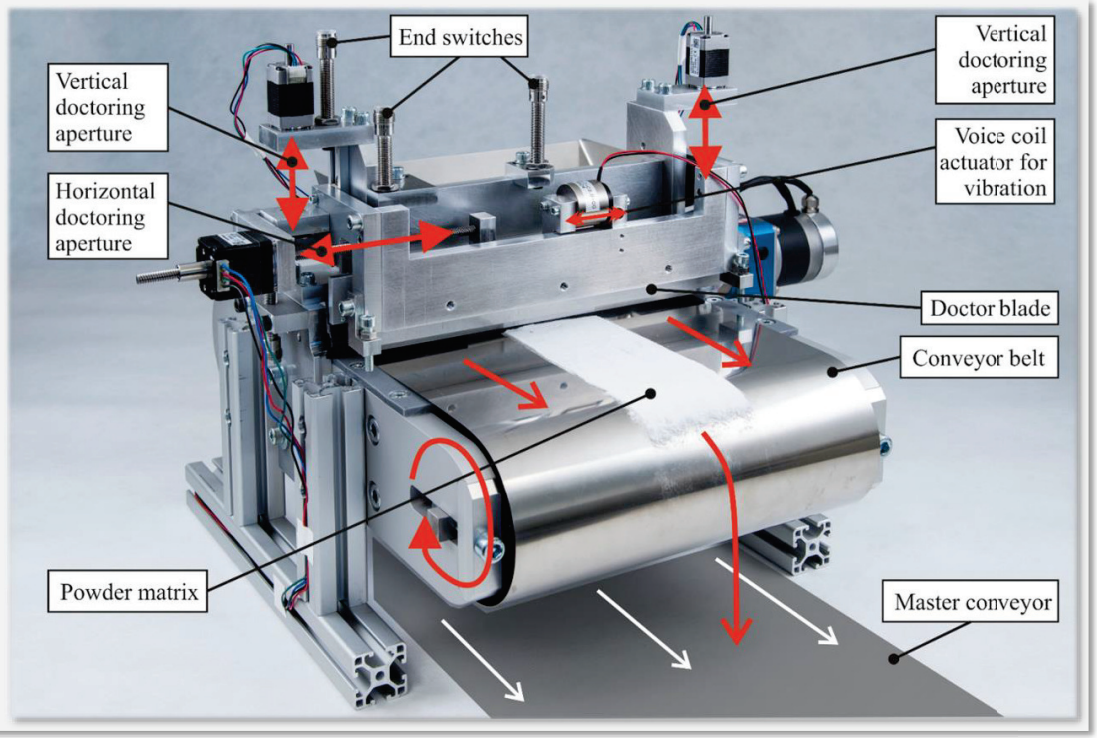
Introduction and Motivation for Load-Path Adapted Thermoplastic Fiber Prepregs

Final design:

- Application of additional matrix in powder form
- Powder dosing by doctor blade
- Powder feeding by conveyor belt, placed above the master conveyor

Integration into the calendering plant:





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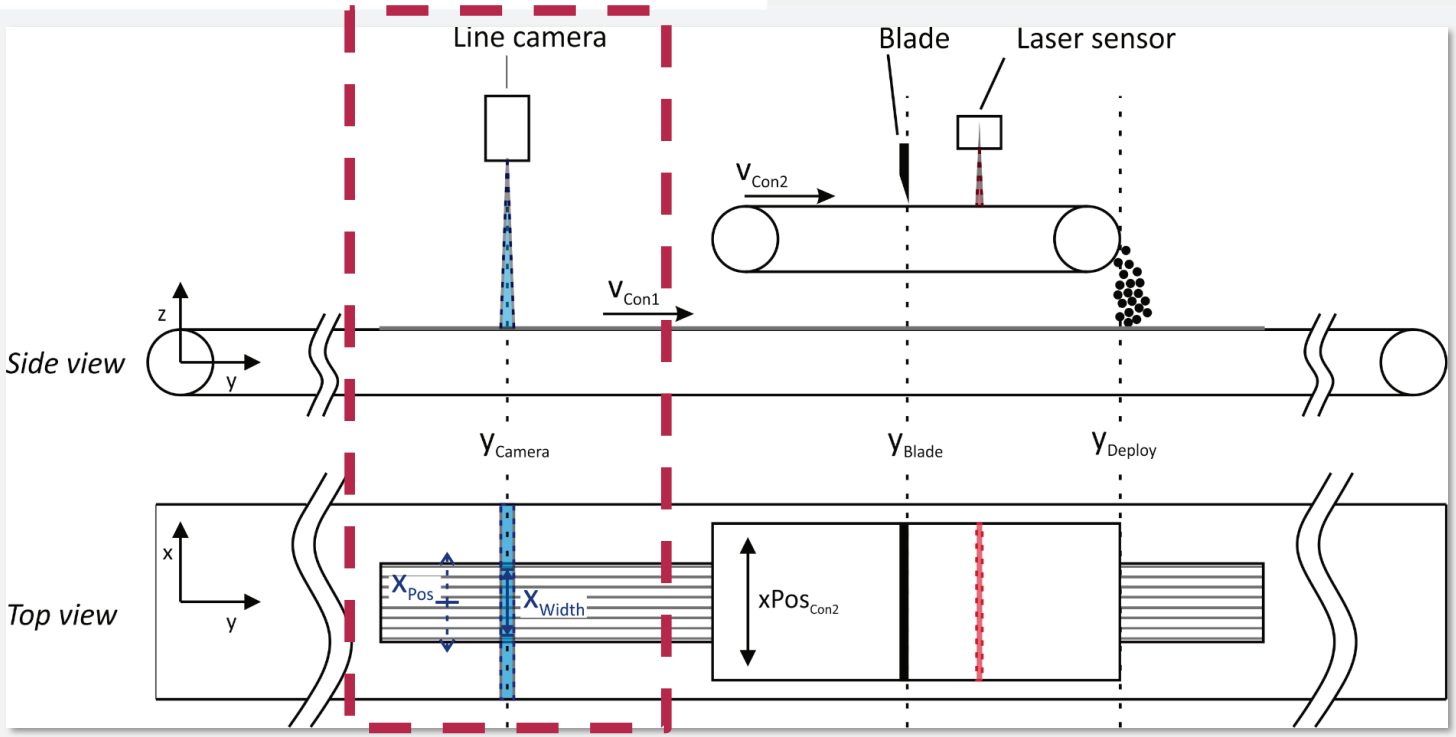
Boundary Conditions | **Design Process** | **Control Strategy**

Optical detection of carbon fibers

Transversal module positioning

Laser-guided powder dosing

Synchronized powder application



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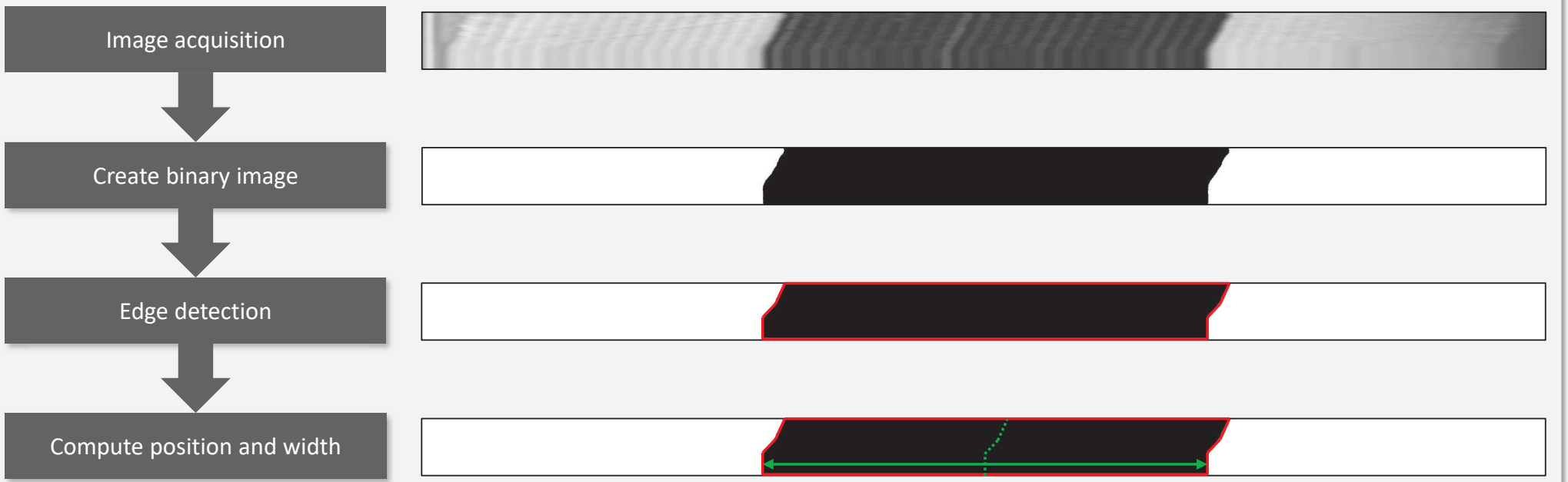

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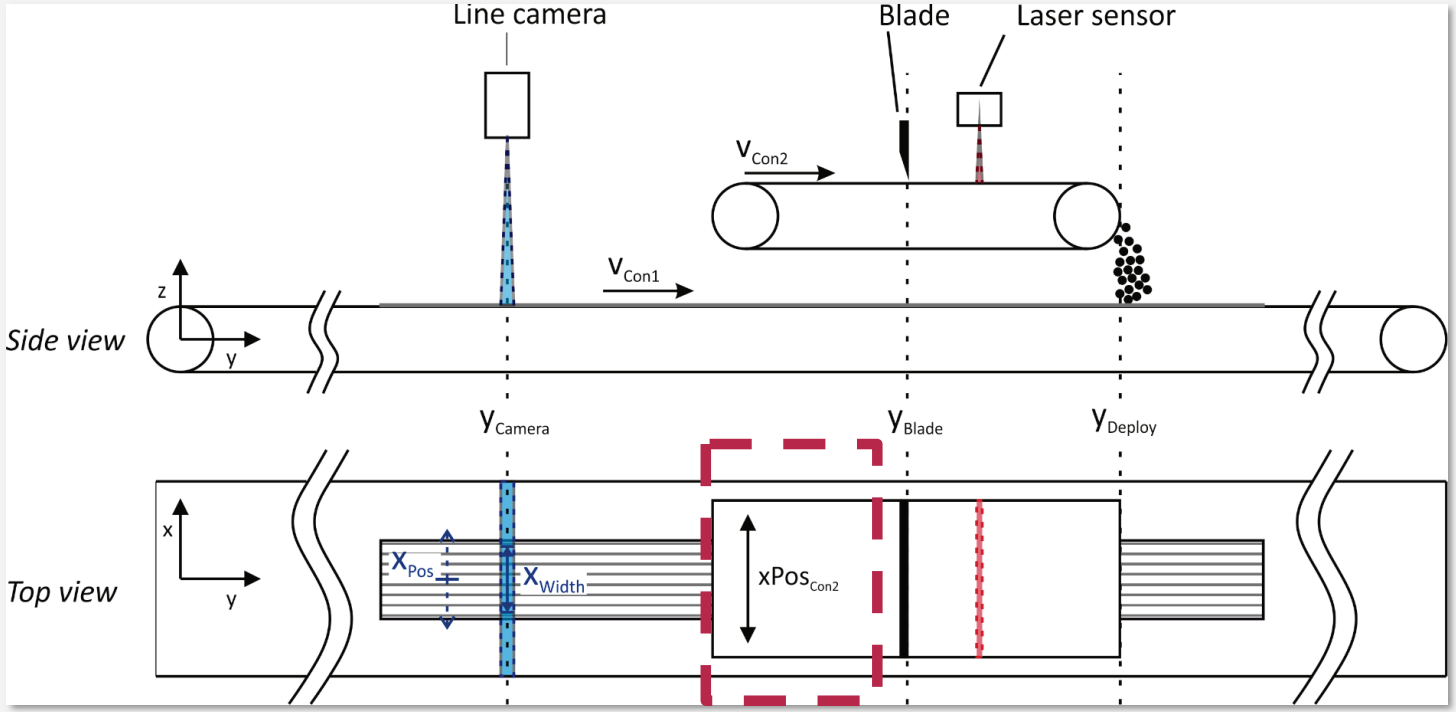

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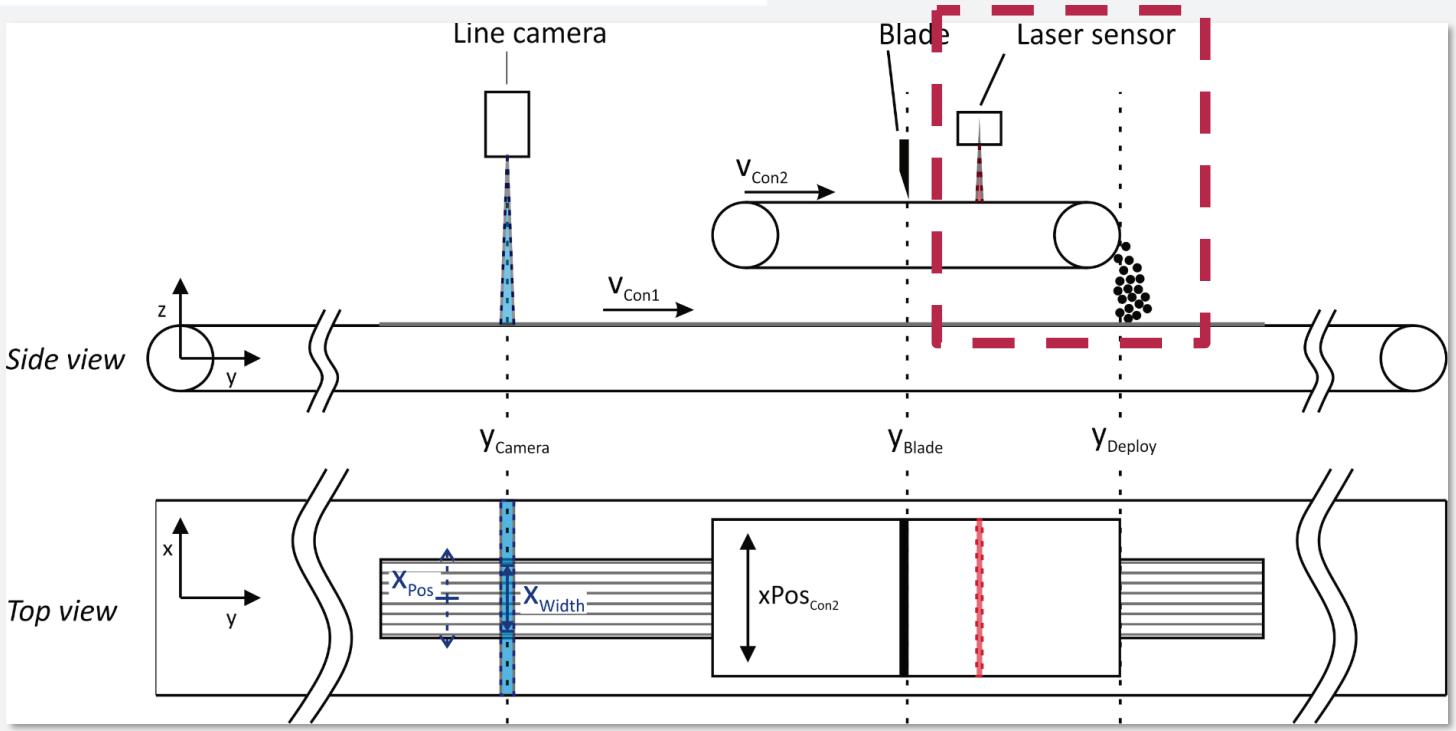

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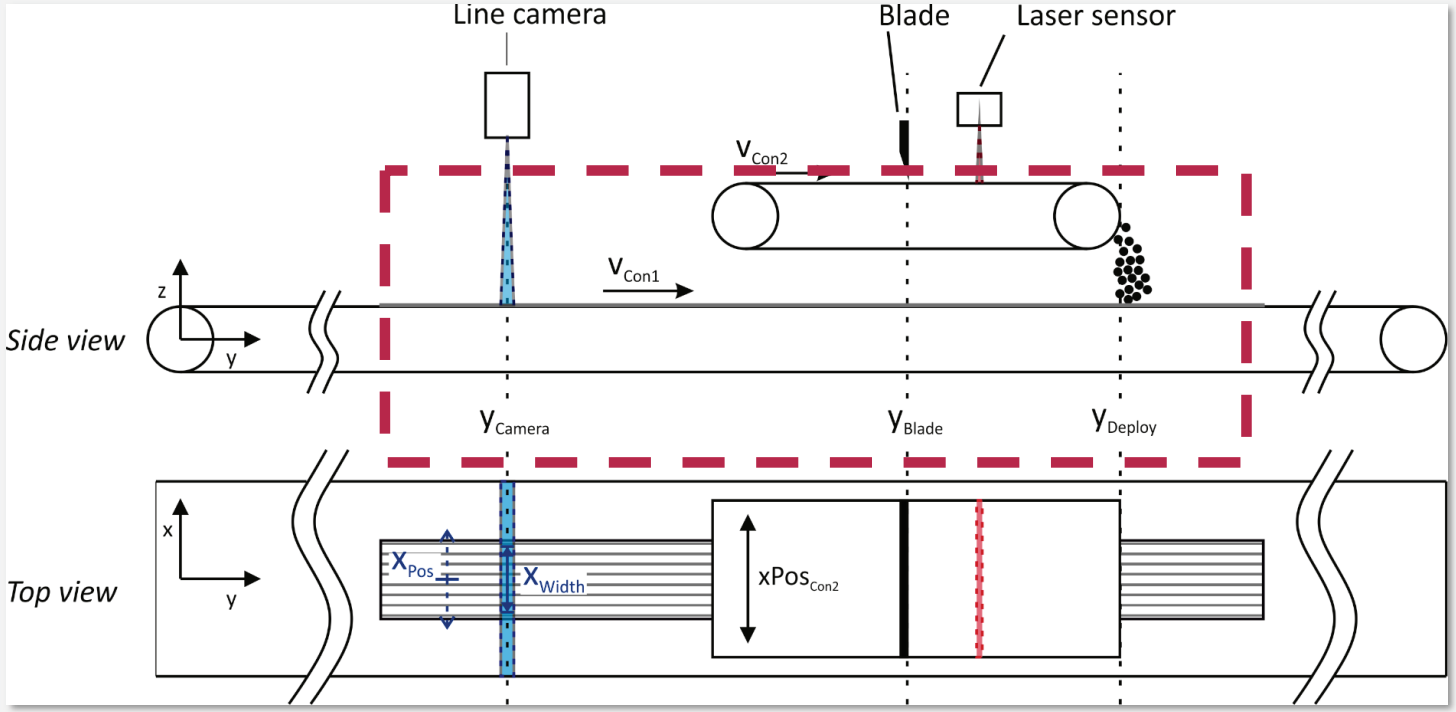

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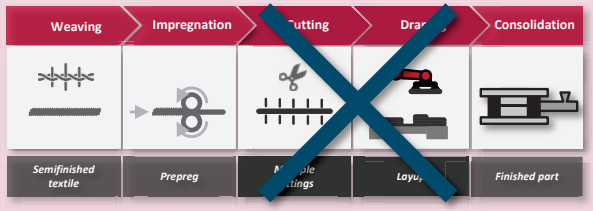
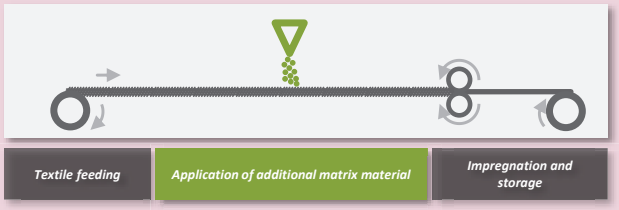
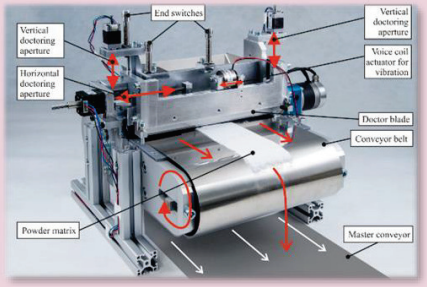
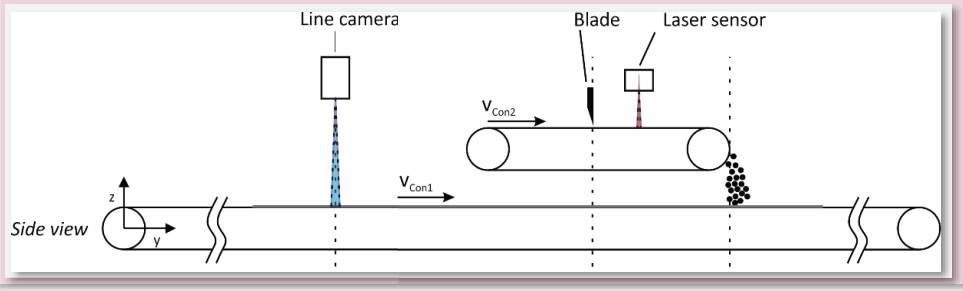
Conclusions and Outlook

Conclusions





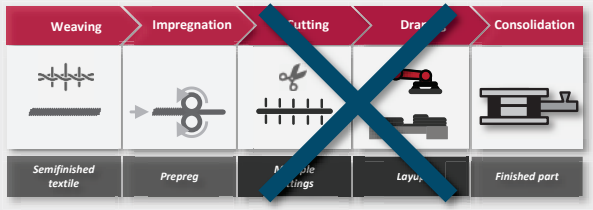


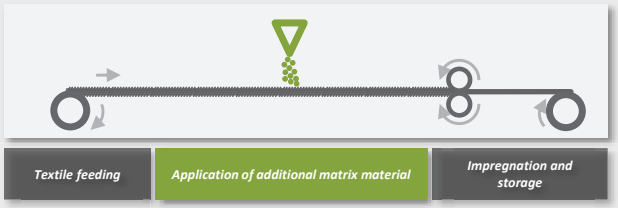


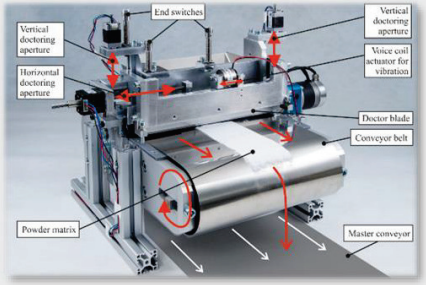
Outlook

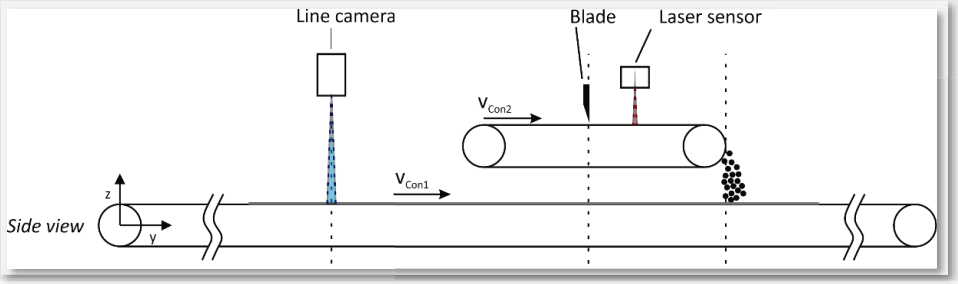
Conclusions and Outlook

Conclusions



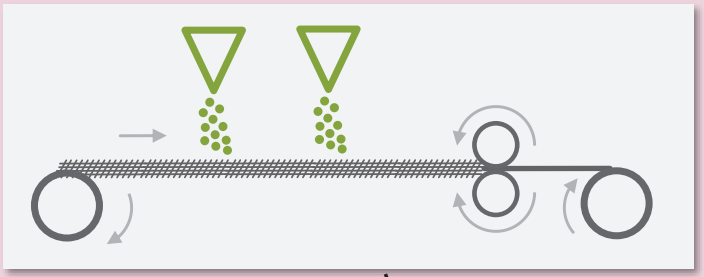


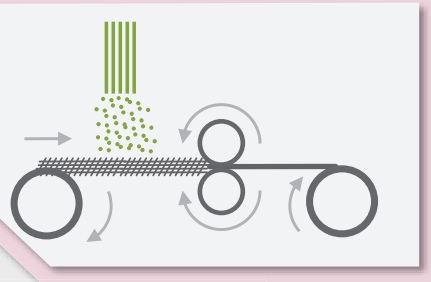




Outlook

Proof of Concept ↘





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