Cutting and Stacking Cell

for Automated High Volume Manufacturing of Dry Fiber Fabric Stacks

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Speakers

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Schmidt & Heinzmann

COMPOSITE EQUIPMENT & MACHINERY

Product and Background

Aerospace part:

Legacy: Prepreg Honeycomb sandwich

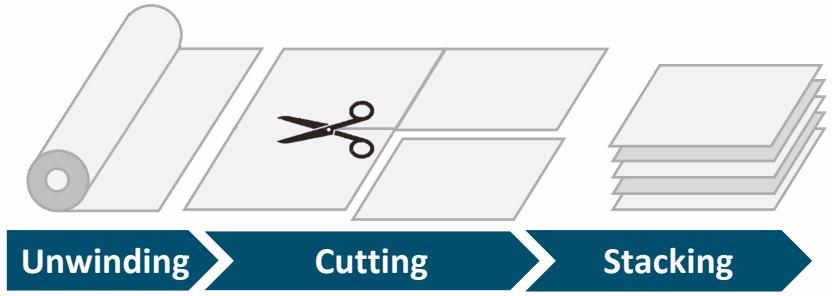
- Hand Layup Process
- Low Cost Country Build
- Autoclave Manufacturing Process

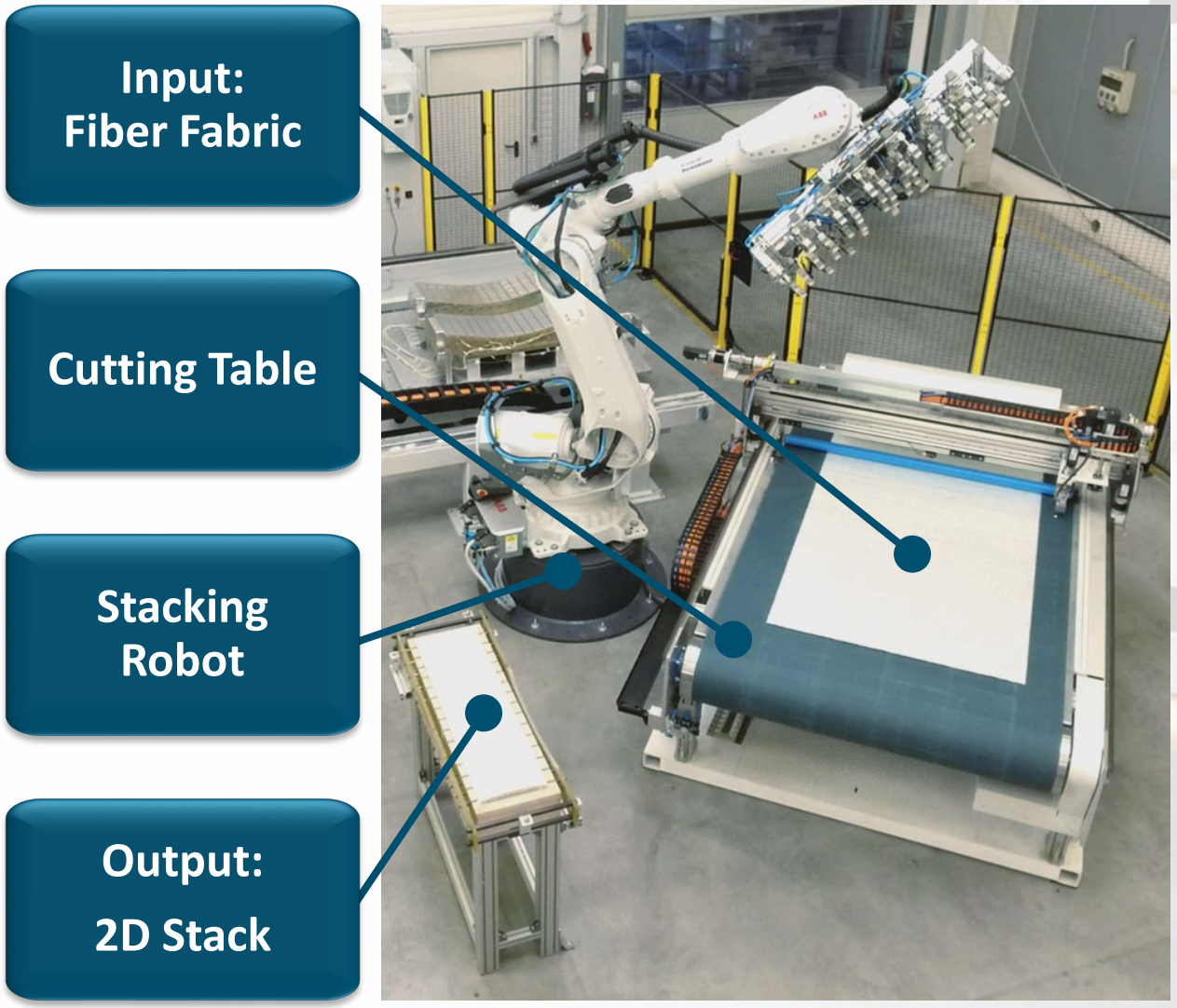
- Increased Automation
- Out of Autoclave Manufacturing

Now: One Shot Monolithic RTM

A Simple Task!

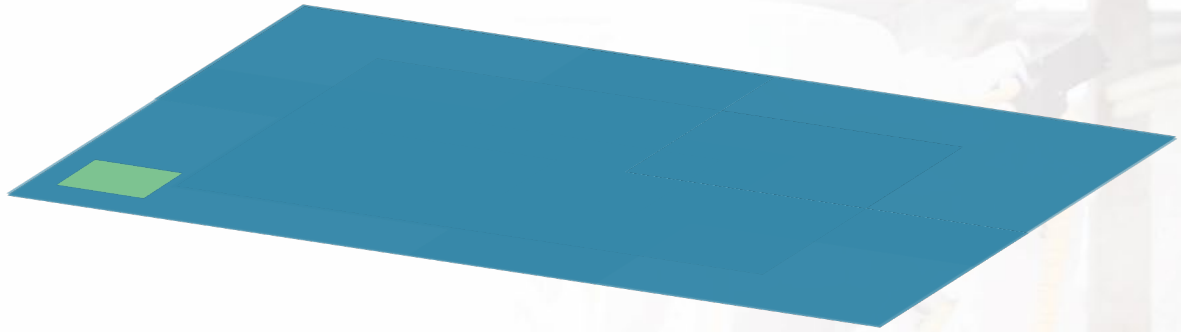
Schmidt & Heinzmann's task: realize 1st process step - from fabric to 2D stack





A Simple Task?

- ~ On average **8** plies per stack
- ~ Each ply needs to be positioned and stabilized
- ~ Stack needs to be labelled for traceability
- ~ **9** stacks per component
- ~ **10** components per shipset



Number of required Operations: 2520

Strategies

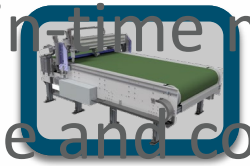
Material

~ One spool at a time

~ Just-in-time manufacturing

Type I

~ Divide and conquer approach



Type II

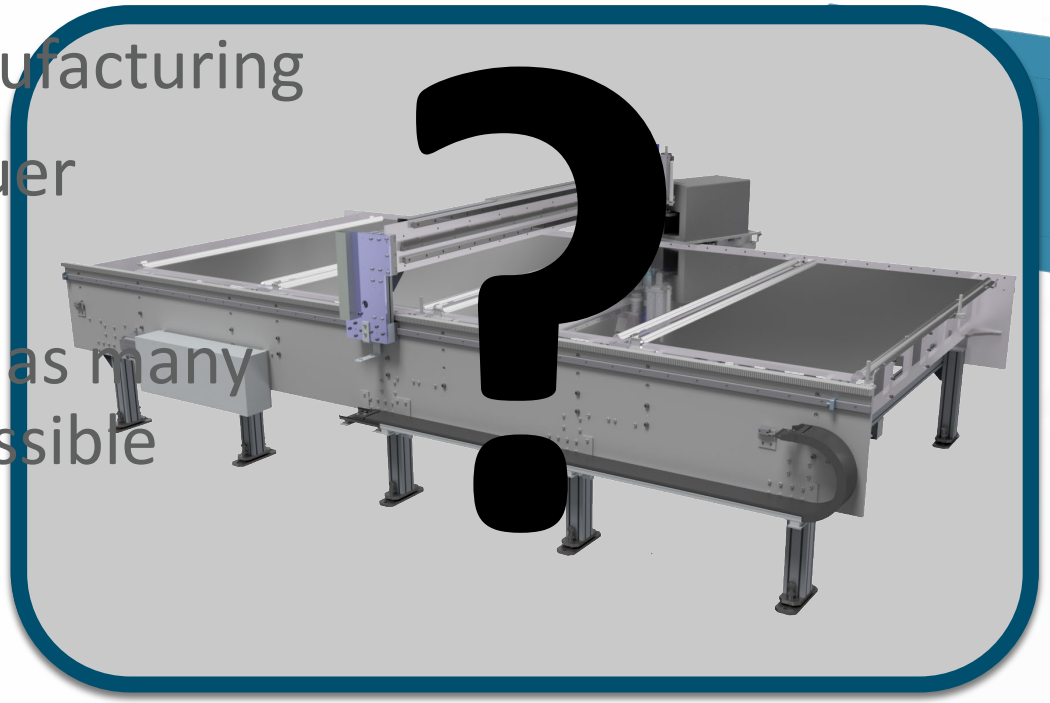
~ Parallelization of as many operations as possible

Type III

Type IV

AutoCut

Stacking Table



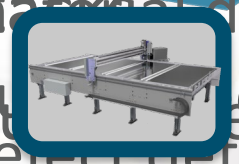
~ 4 Axis CNC

~ 3 Axis CNC

~ Automated conveyor and unwinder

~ Space for parallelized stacking of up to **16** stacks

~ Compensation of material drift



~ Automated labelling

~ Automated material defect detection

~ Fully autonomous, without manual intervention

Strategies

Controlled and coordinated by one PLC

Material

Type I

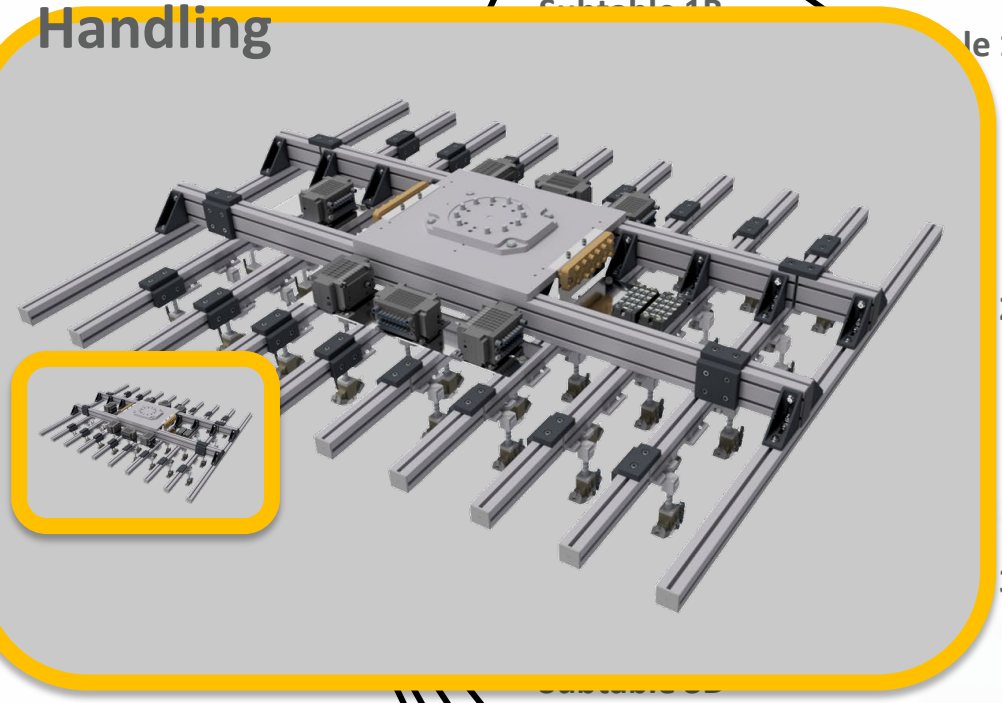
Type II

Type III

Type IV

AutoCut

Handling



Subtable 1A

le 1

2

3

Subtable 4A

Subtable 4B

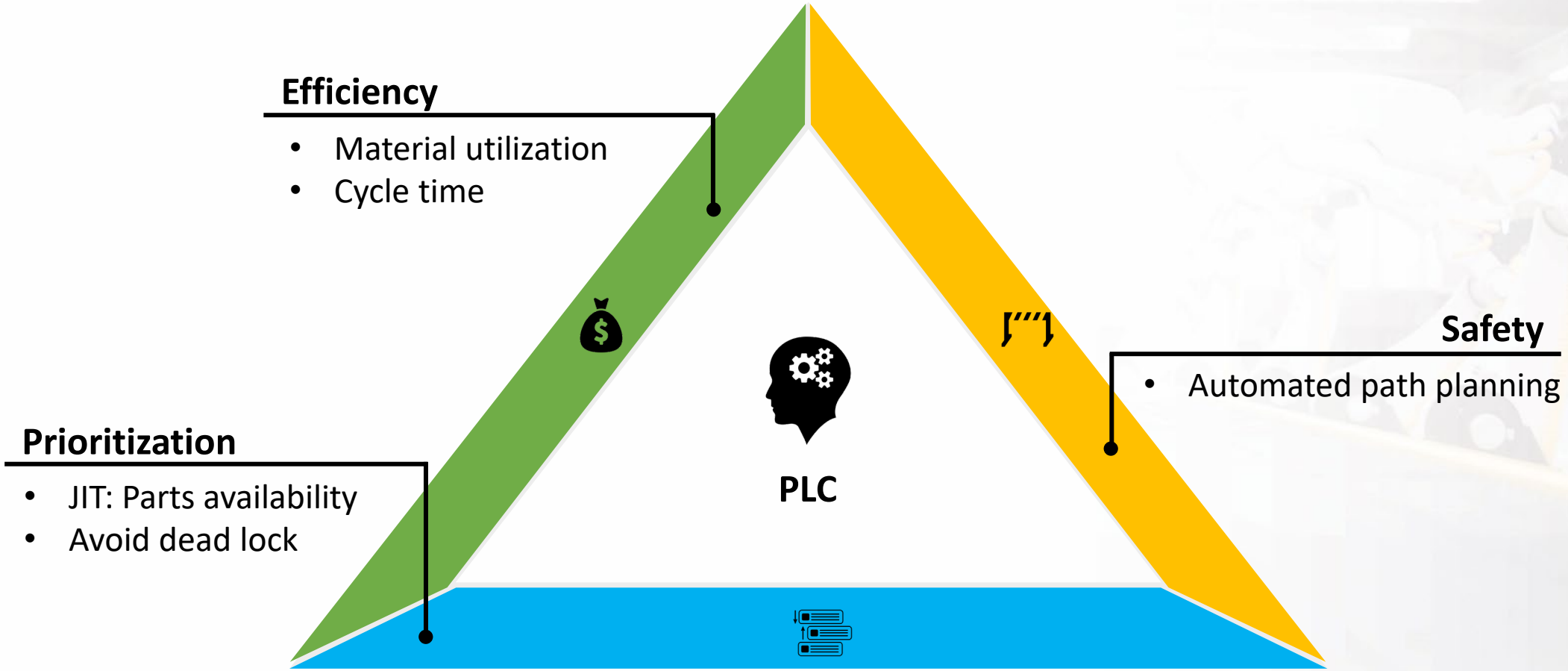
Subtable 4C

Subtable 4D

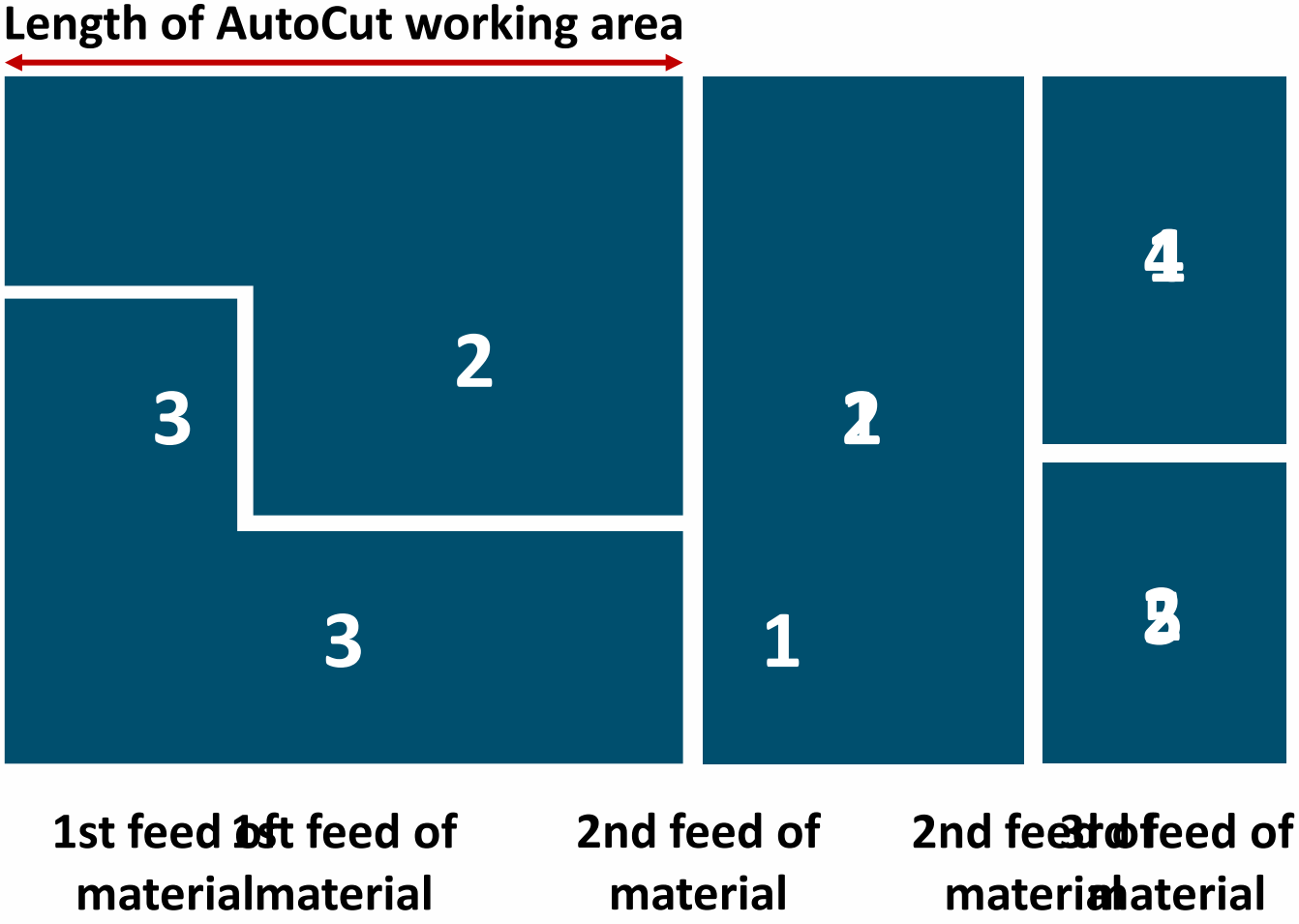
Table 4

- ~ Matrix EOAT with more than 100 individual zones
- ~ Combined with 7 axis industrial robot
- ~ Best-in-class positioning accuracy
- ~ Best-in-class Orientation accuracy

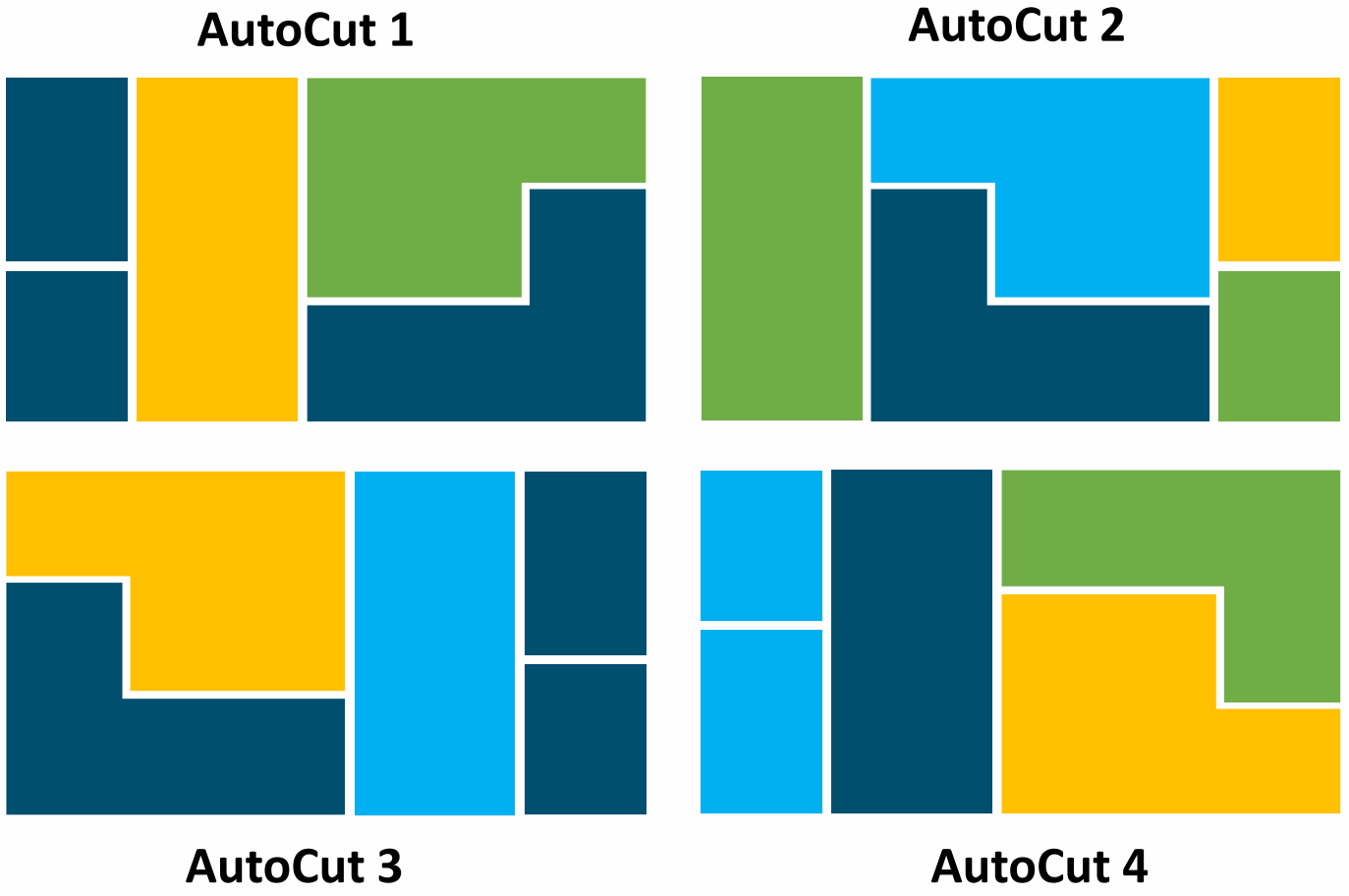
Production Planning Algorithm

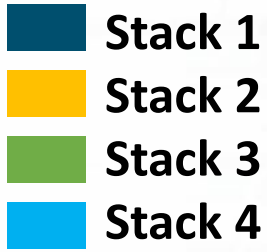


Prioritization

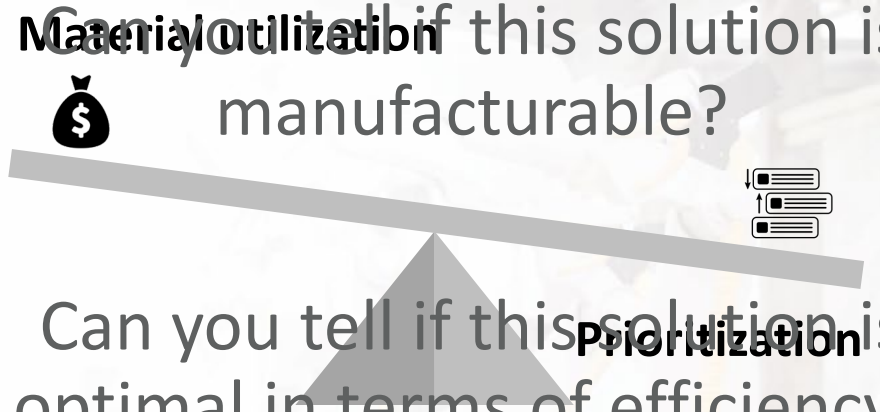


Prioritization





Can you tell if this solution is manufacturable?

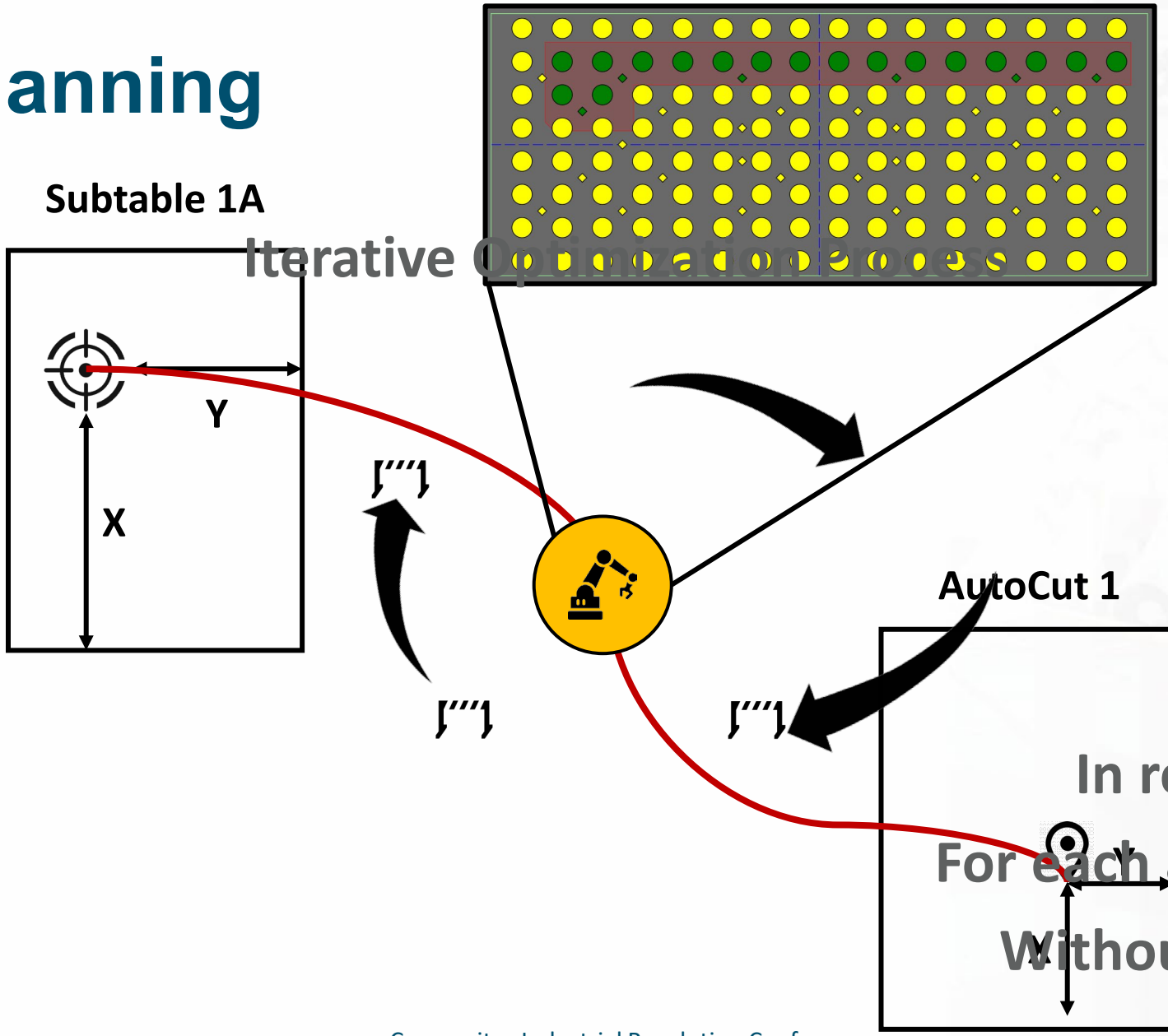


Can you tell if this solution is optimal in terms of efficiency?

- Prioritization is key to JIT manufacturing and low cycle time
- **But Prioritization is only one part of the problem…**

Our PLC can ;)

Path Planning



Target Position

- Dictated by the end-user
- Constrained by placing table

Gripper Position

- Constrained by optimal alignment with gripper elements
- Constrained by ply size

Pick-up Position

- Dictated by nesting
- Constrained by:
  - AutoCut
  - Robot body
  - Other machine elements

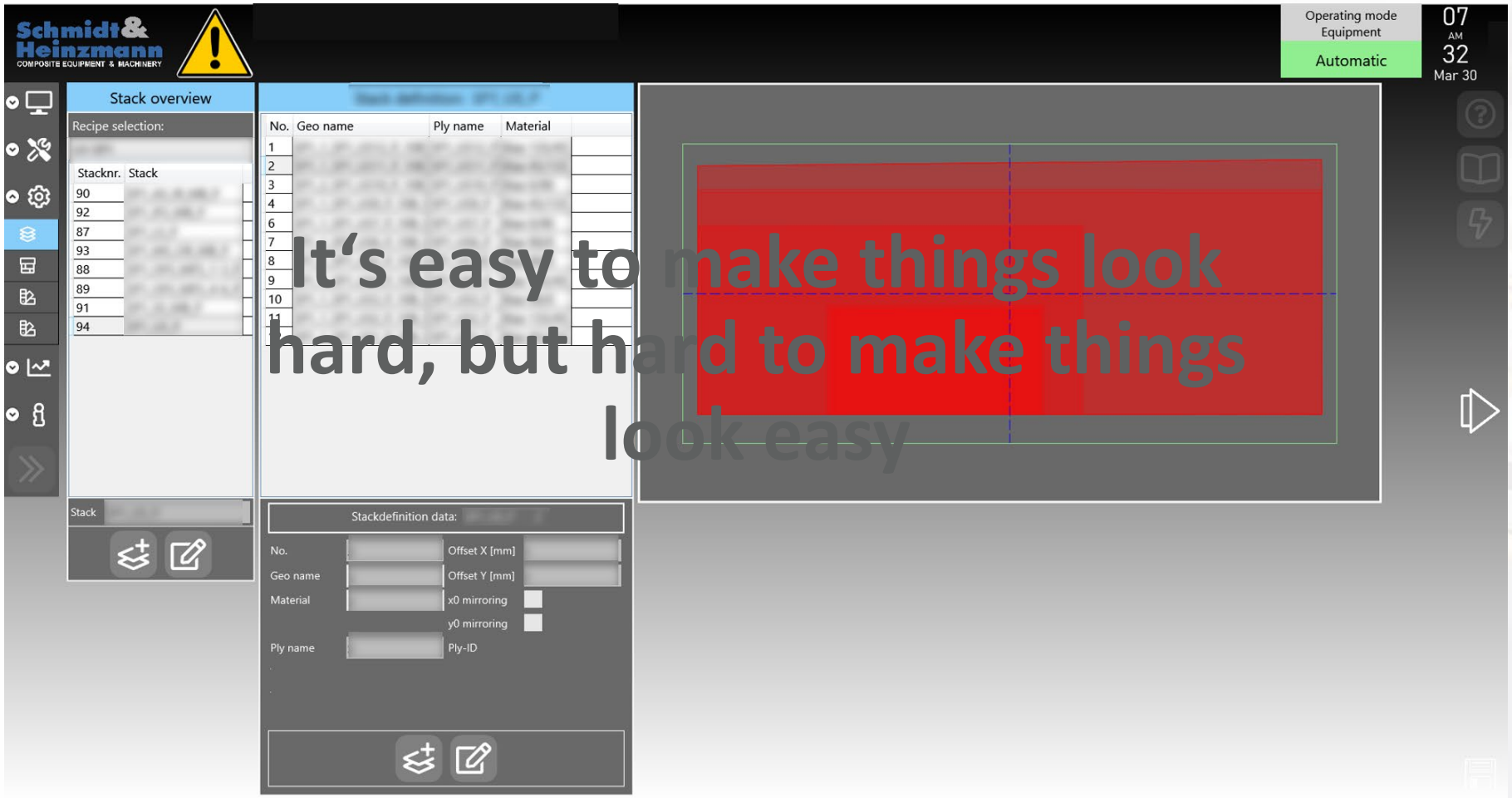
Iterative Optimization Process

In real time…

For each and every ply…

Without crashing ;)

The Way to Go : User Interface



The Way to Go : User Interface

Contact

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Thank You

For Your Attention