

# FLAP Project

Sustainable and Flexible Automation of Seasonal Production through  
Dynamic Resource Management (FLAP)

Luis Ribeiro, Docent, PhD (Project Coordinator)

Senior Associate Professor in Manufacturing Engineering with  
Specialization in Industrial Cyber-Physical Systems

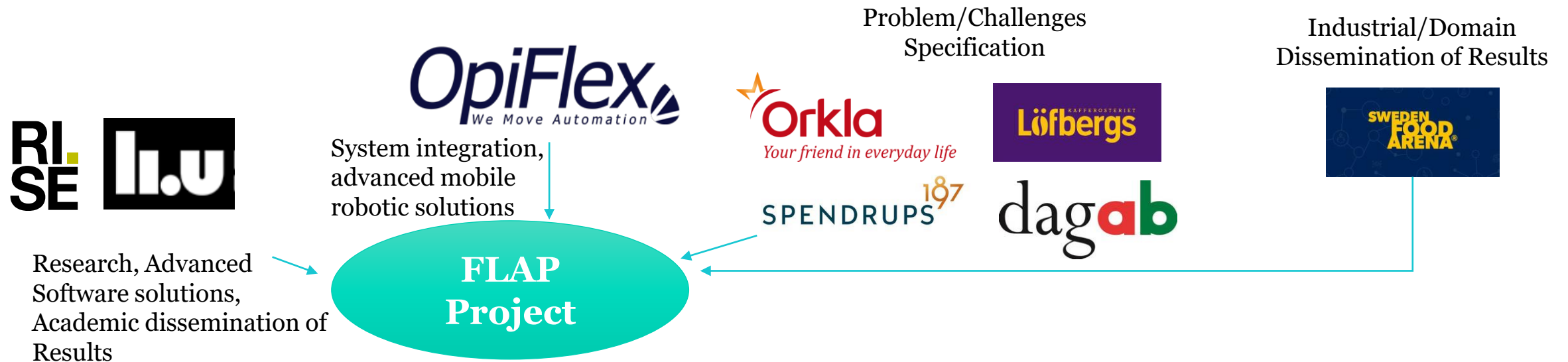
[Luis.Ribeiro@liu.se](mailto:Luis.Ribeiro@liu.se)

# Project Goal in One Sentence...

Combine state of the art robotic solutions with smart and autonomous decision-making software to support the on-demand production of **custom pallets** using shared resources.



# Project Partners



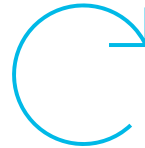
# Why custom palletization? Challenges?



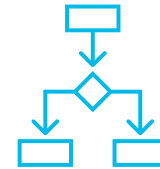
Current  
palletization is done  
manually



The packing  
procedure is not  
optimal



Workers unwilling  
to do unfulfilling  
work



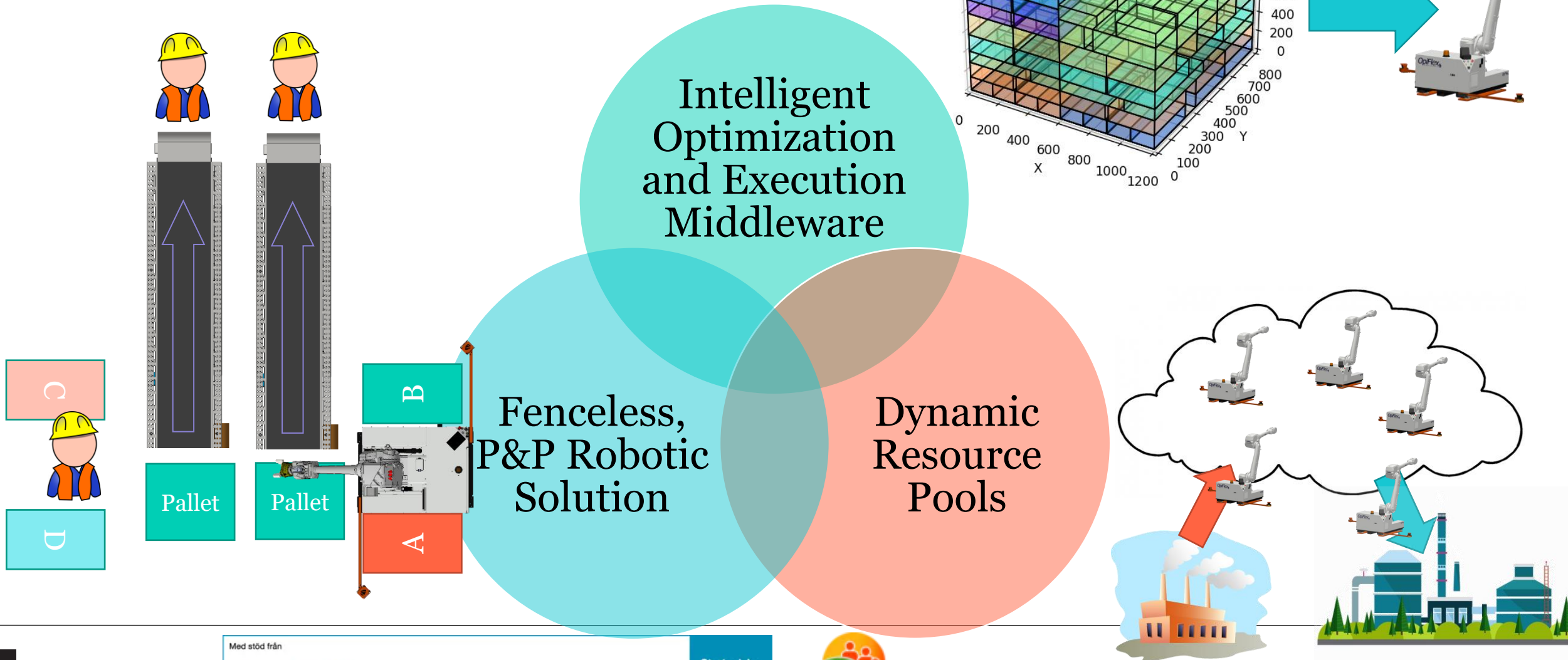
Manual  
palletization is not  
resource efficient



Existing robotic  
palletization  
solutions are  
oversimplified

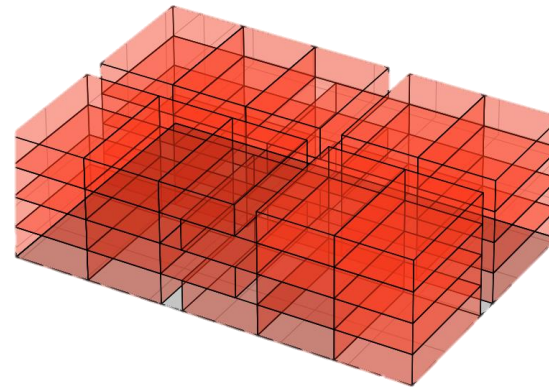
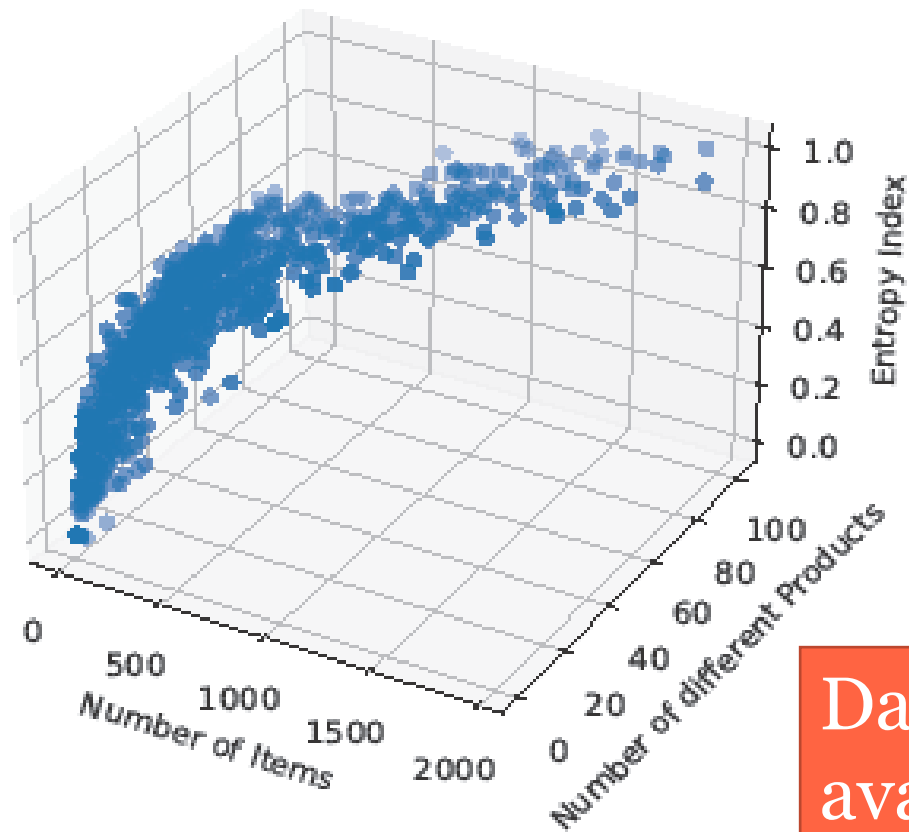


# The FLAP approach!

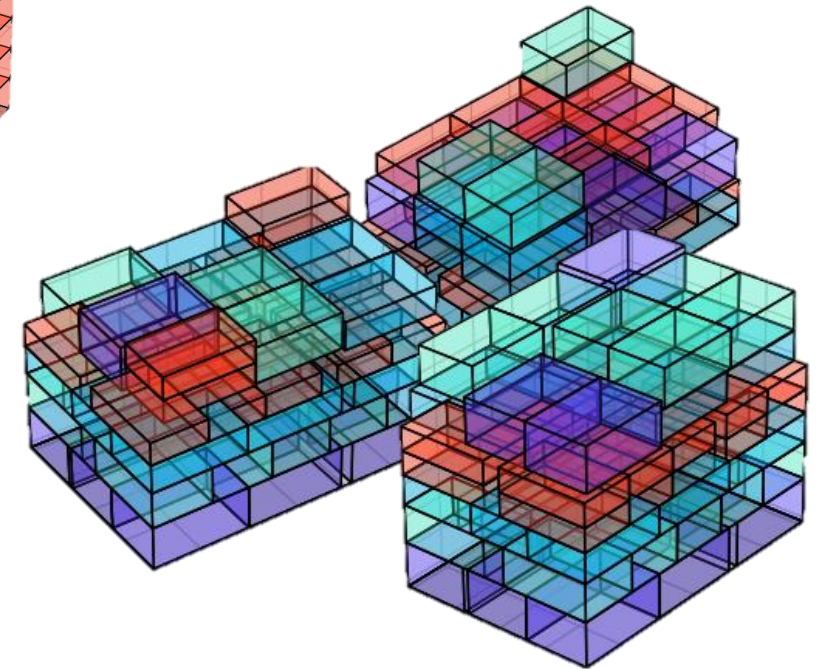




# Orders have different degrees of complexity...



Entropy between 0 and 0.2

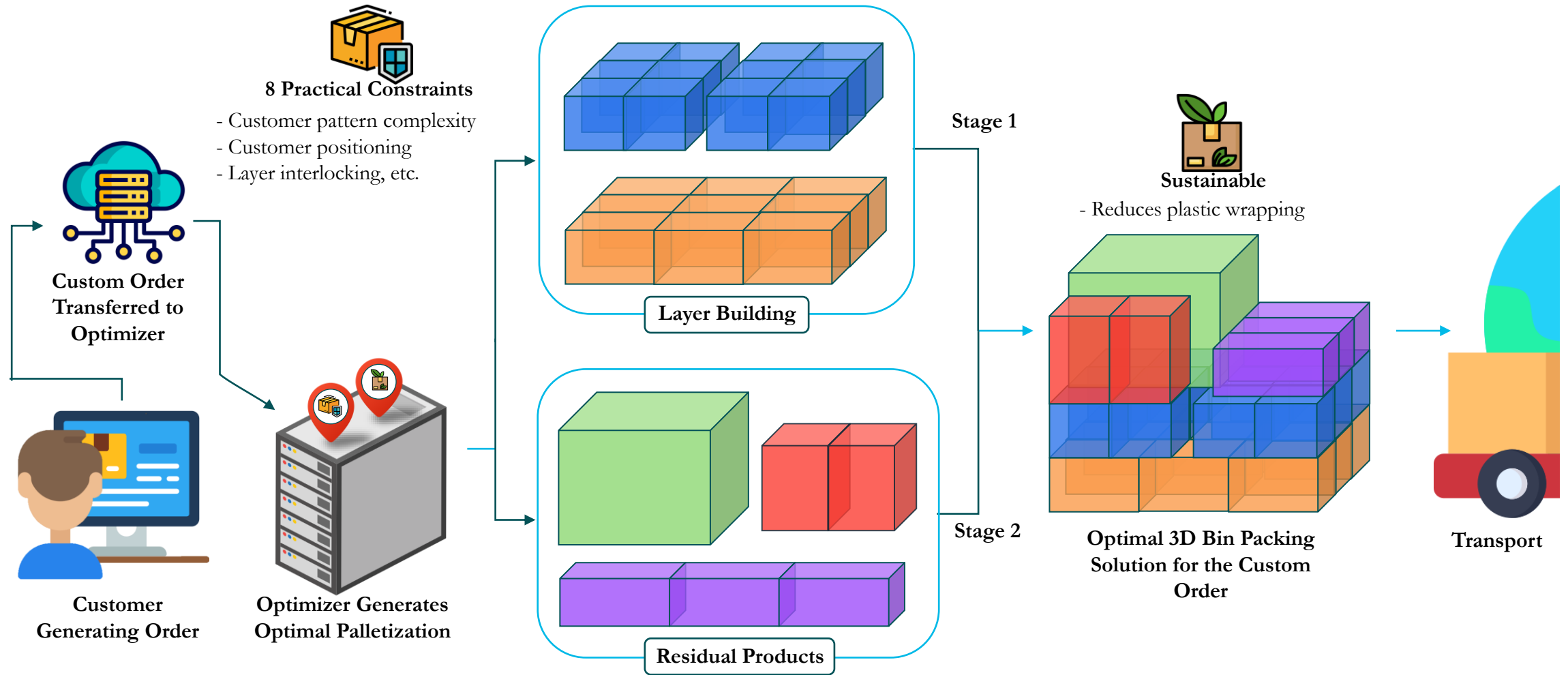


Entropy between 0.8 and 1

Dataset publicly available!!!!

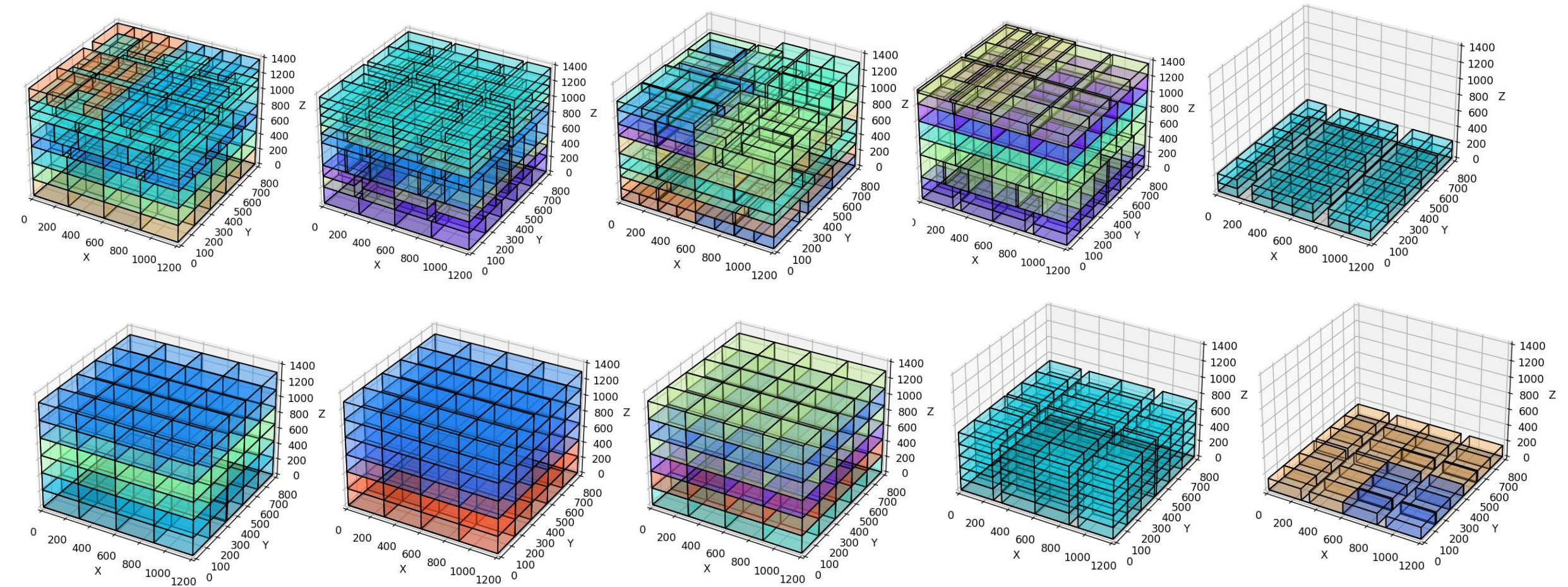


# How does the system work?





# Example (1439 items and 65 different products codes, with quantities per product code ranging from 1 to 40)

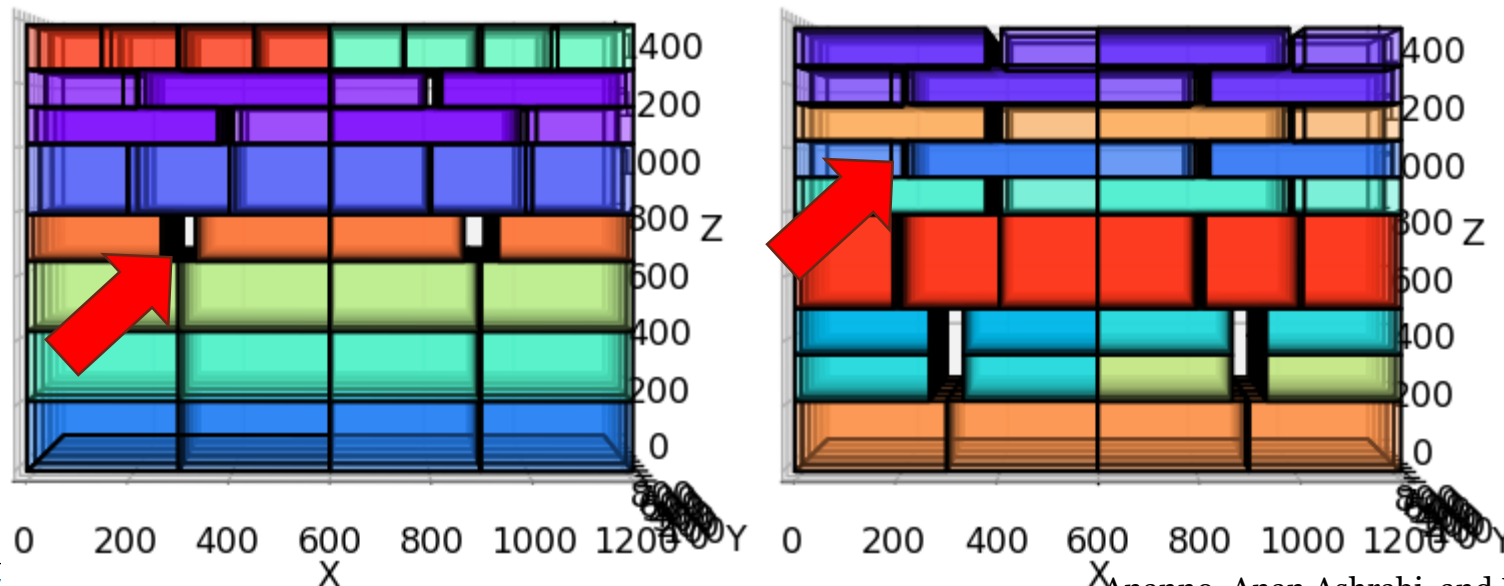




# Interlocking Patterns

When deploying the layers the priority is to place layers of the same product together to facilitate handling.

The algorithm explores different placing patterns to maximize the interlock between the layers (see arrows as examples)

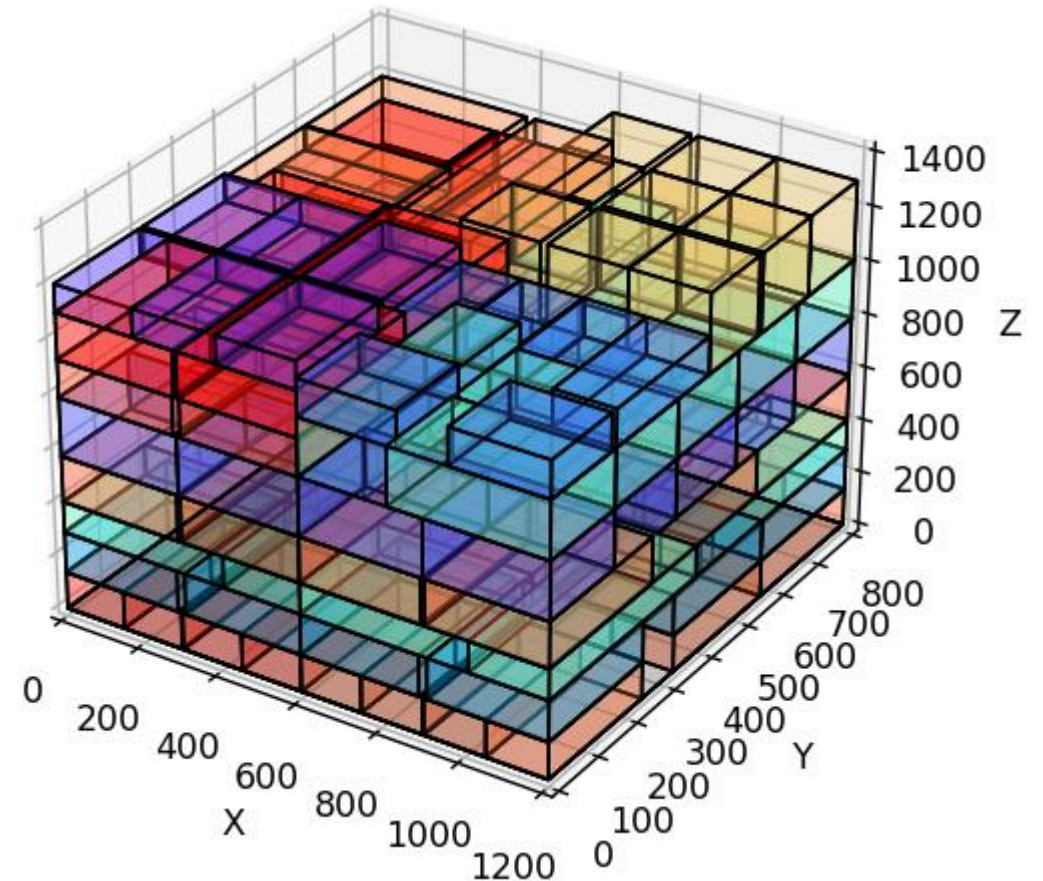


# Building compact mixed pallets...

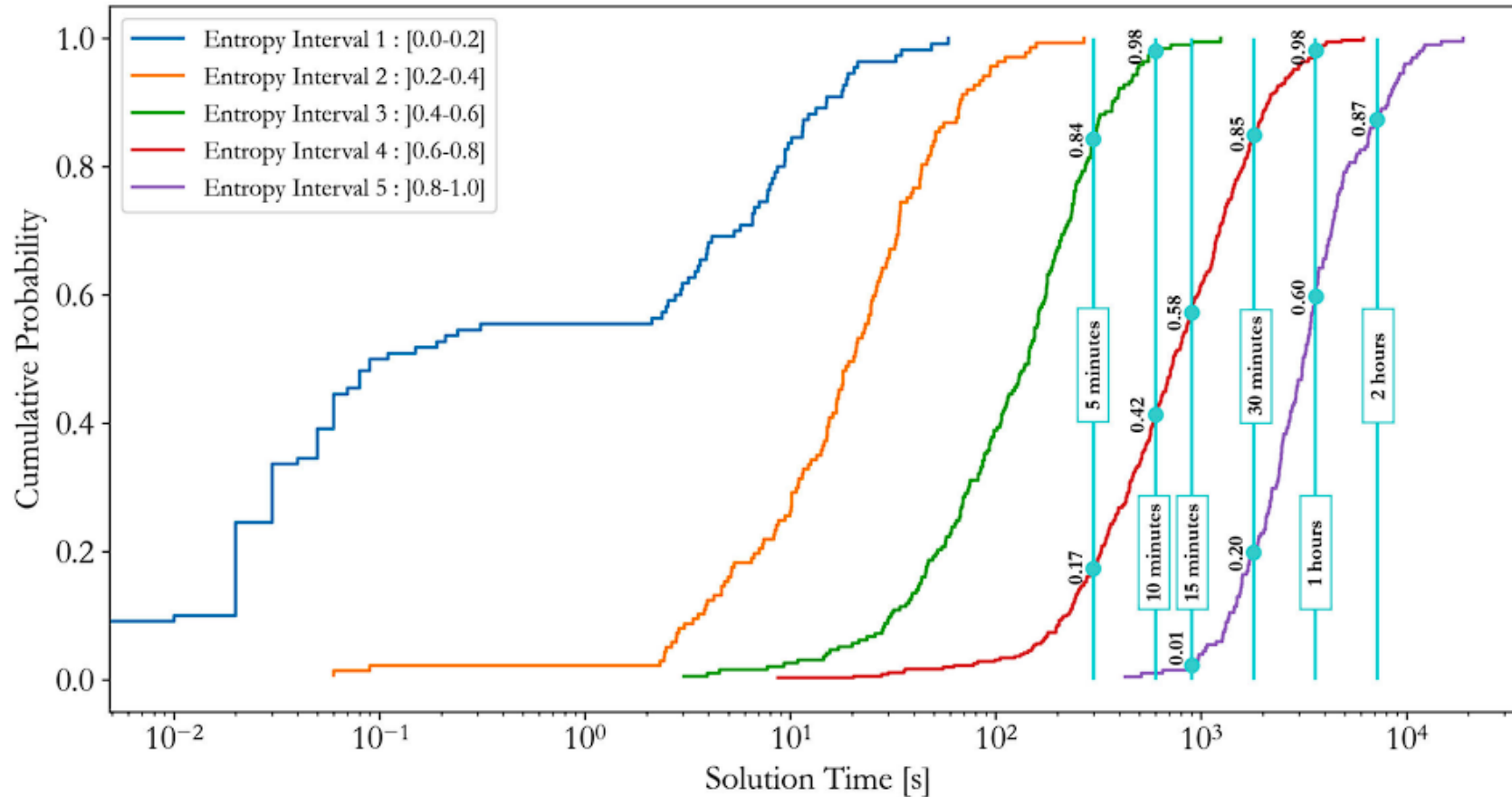
The algorithm takes into account the following constraints:

- Non collision
- Stability and support
- Full shipment
- User specific constraints (products of the same type should ideally be packed together, limit the usage of plastic wrapping by pallet design, manual to automated process compatibility)

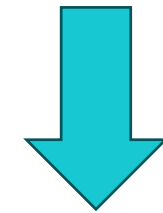
With of course the goal of minimizing the number of pallets used!



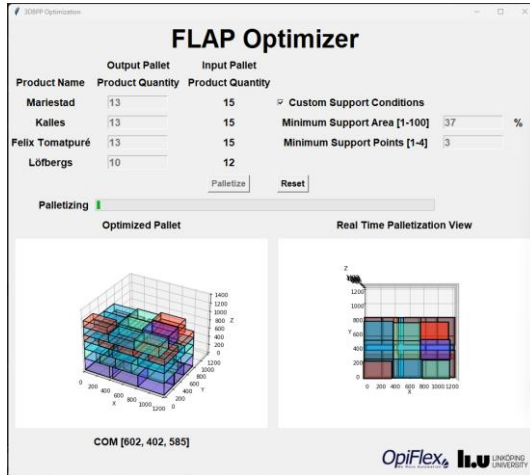
# Algorithm Performance in Real Data



For an in-depth discussion see...



# Industrial Application (10 x speed)



Video place holder!



# Thank you!

For further information:

**Luis Ribeiro** - Docent, PhD (Project Coordinator), Senior Associate Professor in Manufacturing Engineering with Specialization in Industrial Cyber-Physical Systems - [Luis.Ribeiro@liu.se](mailto:Luis.Ribeiro@liu.se)

**Anan Ananno** – PhD Student at Linköping University  
[Anan.Ashrabi.Ananno@liu.se](mailto:Anan.Ashrabi.Ananno@liu.se)