

# Automation Meets Food Sector Needs

Sustainable and Flexible Automation of Seasonal Production through  
Dynamic Resource Management (FLAP) 31-03-2022

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# Agenda

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- 9:00-9:20 Welcome and FLAP Progress report, Prof Luis Ribeiro
- 9:20-9:35 Insight findings, Andreas Olsson Orkla and Johan Frisk OpiFlex Automation AB
- 9:35-9:40 Small break
- 9:40-10:10 Workshop- group discussion of automation challenges and possibility's
- 10:10-10:30 Workshop group representative present outcome and potentials
- Summarize and invite for next step

# An Industrial Domain that Feels the Need!

**TABELL 3.** Hur skulle ni vilja beskriva företagets potential för en ökad automatisering av produktionen?

Källa: Livsmedelsföretagen

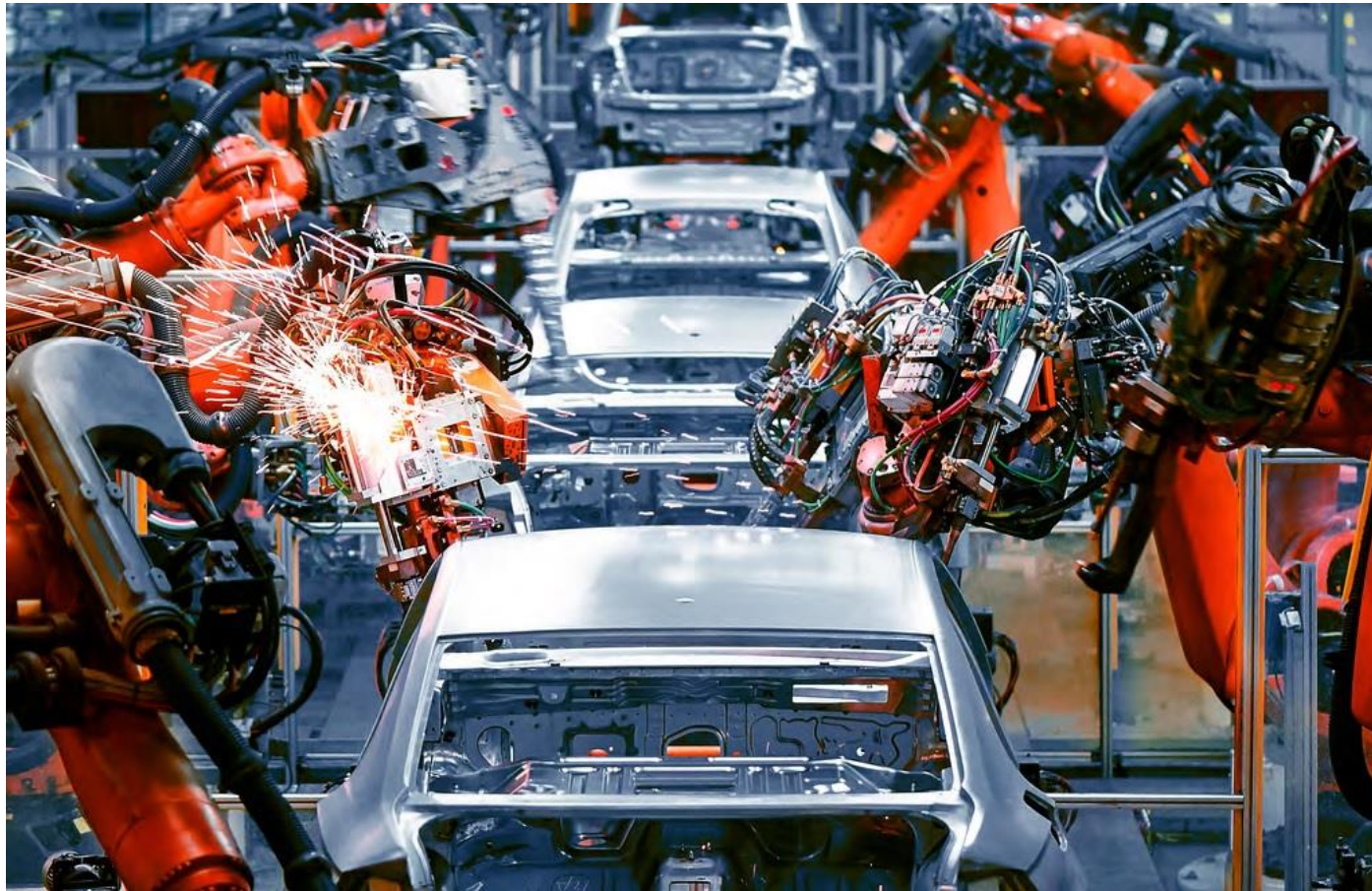
Det finns viss automationspotential	56%
Det finns stor automationspotential	43%
Ej relevant för oss	1%
Dagens befintliga automationsteknik är fullt utnyttjad	0%
Vet ej	0%

**TABELL 5.** Vilka är de enskilt viktigaste orsakerna bakom företagets ökade investeringskostnader? Frågan besvarad av 55 procent av företagen, dvs de som angav att de skulle öka investeringsgraden. Flera val möjliga (delvis överlappande svarsalternativ).

Källa: Livsmedelsföretagen

Vi måste expandera produktionskapaciteten	66%
Vi måste öka automationsgraden	62%
Våra anläggningar är ålderstigna	58%
Investeringar i ökad "hållbarhet"	57%
Vår maskinpark är ålderstigen	56%
Vi behöver energieffektivisera produktionen	31%
Annat	5%

# When people think about automation...

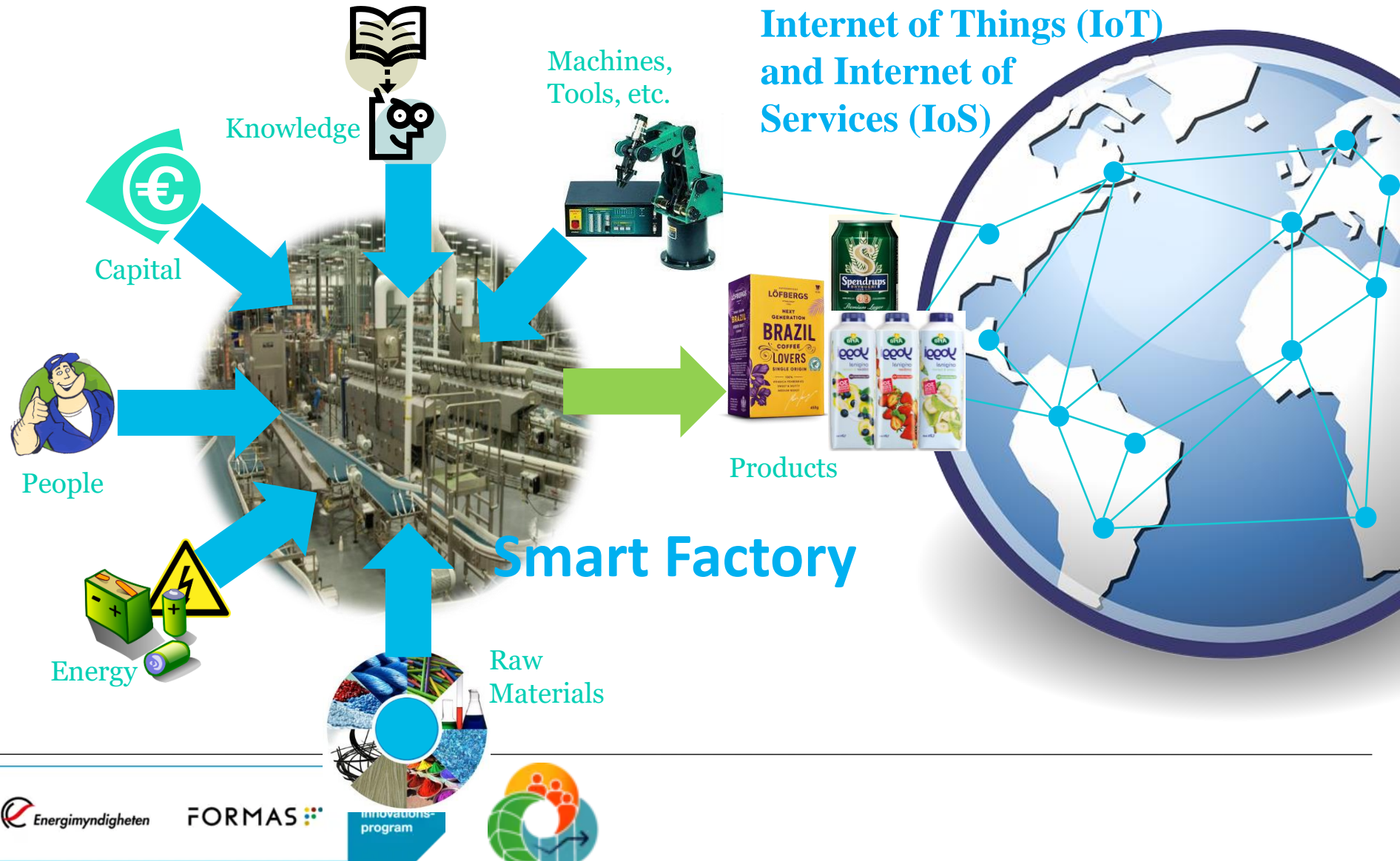




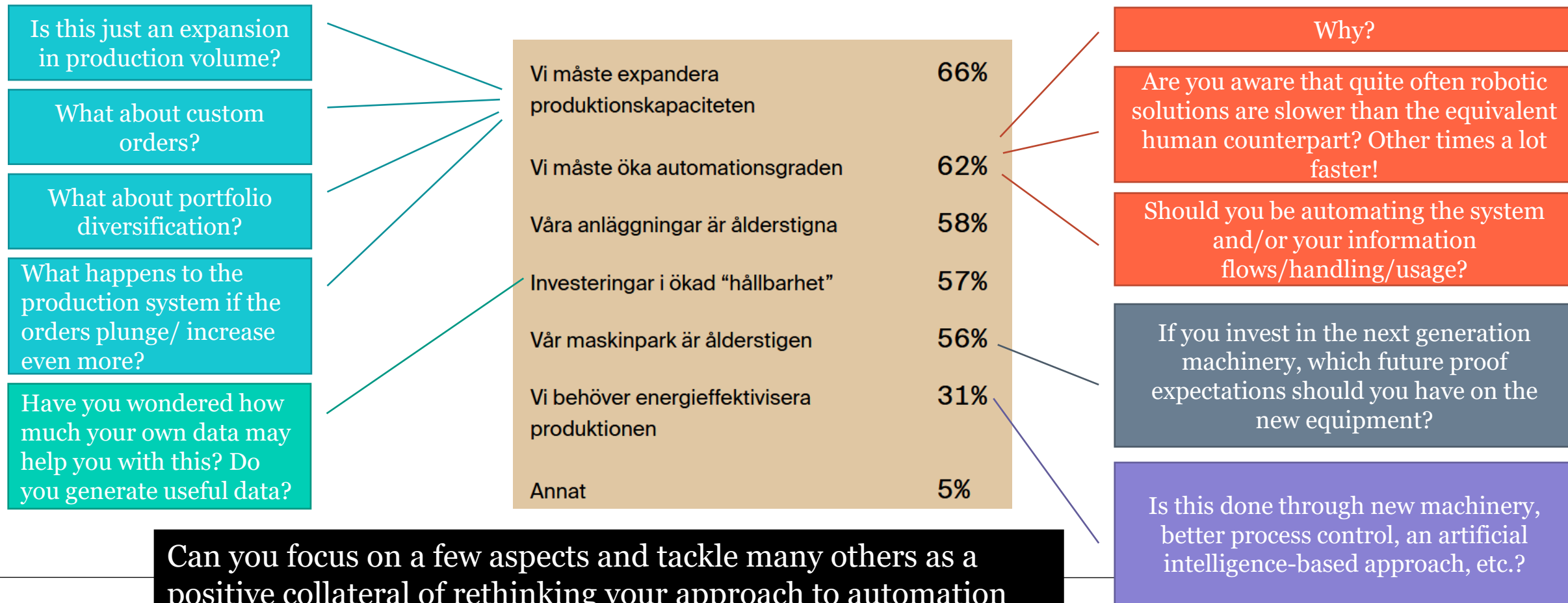
# Perhaps a more complete View...

Digitalization is a global game changer in all industrial domains!

Together with automation it will help you improve on all these dimensions!



# So many questions research and development projects can help you with...



Can you focus on a few aspects and tackle many others as a positive collateral of rethinking your approach to automation and digitalization in a more overarching way?

# Research projects may seem too overwhelming however...

They are an excellent opportunity to engage and exchange ideas with other companies in the domain -> **you are not alone with your problems.**

You do not need to engage and commit to a long project, many useful and preparatory results can be obtained by running pre-study projects (typically 6 months).

You can use these smaller projects to test out ideas, evaluate the feasibility and reach of certain development directions, understand what is important, decide on the next steps, etc.

In the great majority of the cases your investment in the project is just time, it is a very risk-free environment.

Projects are legally protected by collaboration agreements, so they are a relatively safe environment for sharing even sensitive information.

# Project Fact Sheet

## View and Objectives:

- The food and beverages sector is characterized by seasonal variability and products have important variations in form factor and presentation. Fixed automation is deployed for catering for the high throughput needs of certain products. However, the industry is seeing an increase in custom orders which require the depalletization and repalletization of products originating from the main lines. The project will combine state of the art mobile robotic solutions with autonomous decision-making software to support the on-demand production of custom goods using shared resources.

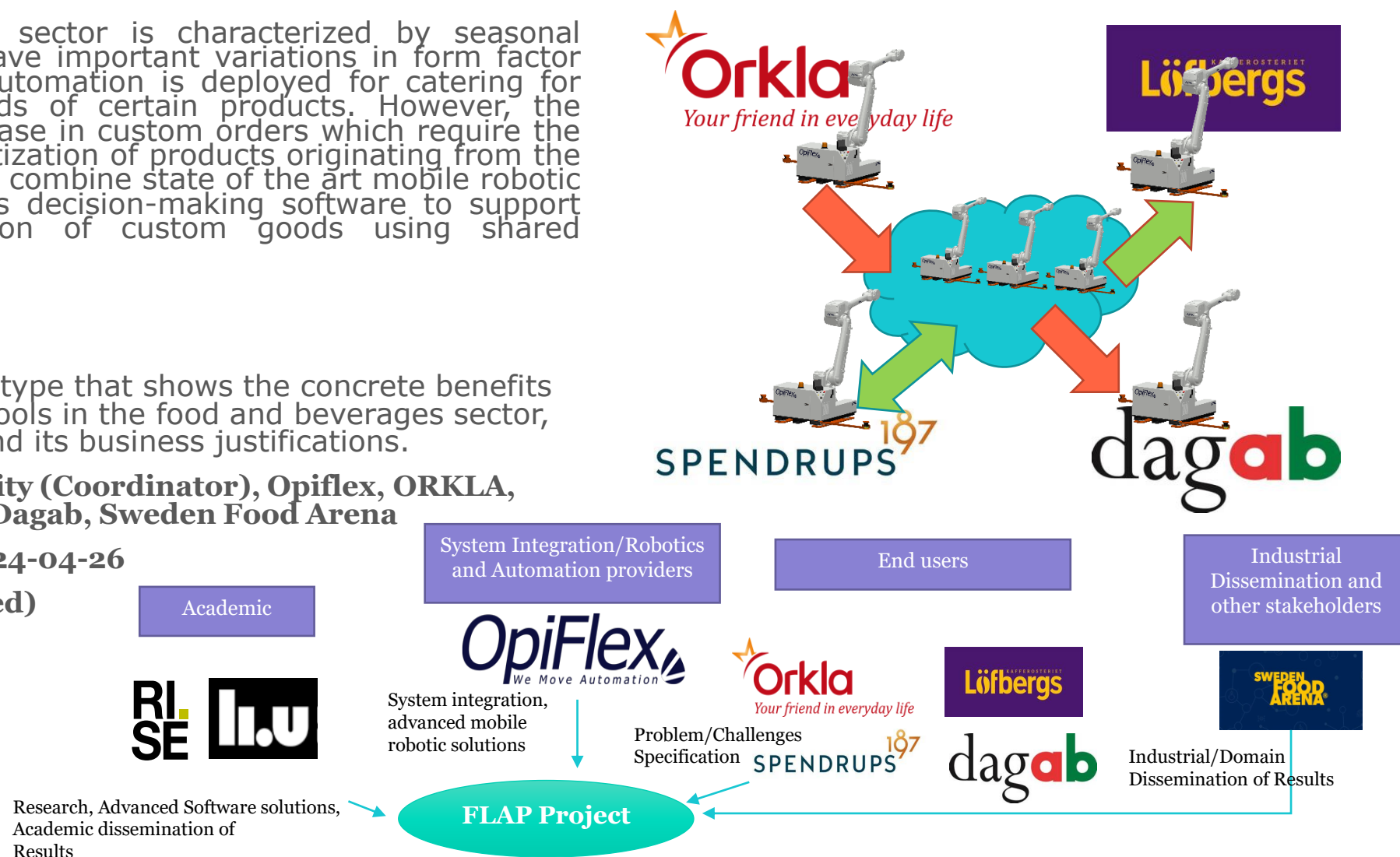
## Expected Results:

- The construction of a prototype that shows the concrete benefits of using shared resource pools in the food and beverages sector, in the palletizing section and its business justifications.

**Partners:** Linköping University (Coordinator), Opiflex, ORKLA, Spendrups, RISE, Löfbergs, Dagab, Sweden Food Arena

**Projektid:** 2021-04-29 to 2024-04-26

**Budget:** 4 981 953 kr (financed)





# Seasonal Production – The pressure on the System

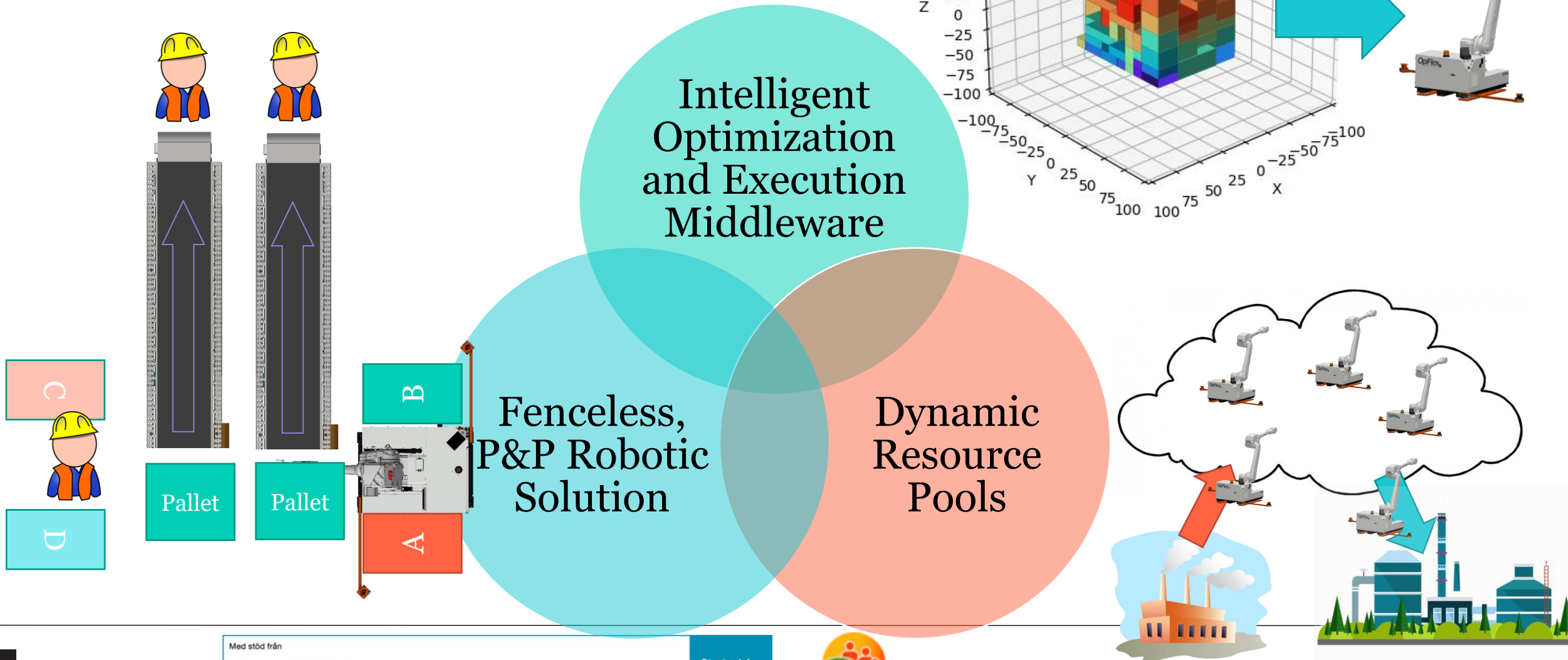
Seasonal variations are normally tackled using human resources that are temporarily employed to overcome seasonal production peaks. Temporary employment is sensitive to external conditions (market competitiveness, pandemics, war, ...)

New business customers are creating more variation in the ordering patterns. For example, smaller business in retail and emerging online business (e.g. meal boxes) are driving an increase in custom orders (mixed pallets) which adds to the complexity

Palletizing and repalletizing are nonvalue adding activities that suddenly start to gain a lot of importance. They are also extremely unfulfilling for operators which perceive them as boring and physically taxing work.

**Simultaneously, fixed automation costs are impossible to justify!**

# The FLAP approach



# The mix pallet use case – Why is it difficult?



PERFECT PALLET IN THE  
SHORTEST TIME

If you are creating a pallet with different products on it:

- products need to be palletized in a stable arrangement
- many product have load limits
- everything needs to fit into a well-defined envelope
- ...

If you are palletizing with robots then:

- not all the palletizing sequences are possible (collisions with the gripper, reach,...)
- non rigid materials are a challenge to robots

If you aim to optimize the system then:

- The best final arrangement is not necessarily the optimal from a palletization performance perspective (irregular feed of the system, excessive logistic load, ...)

# The mix pallet use case – Why is it difficult?



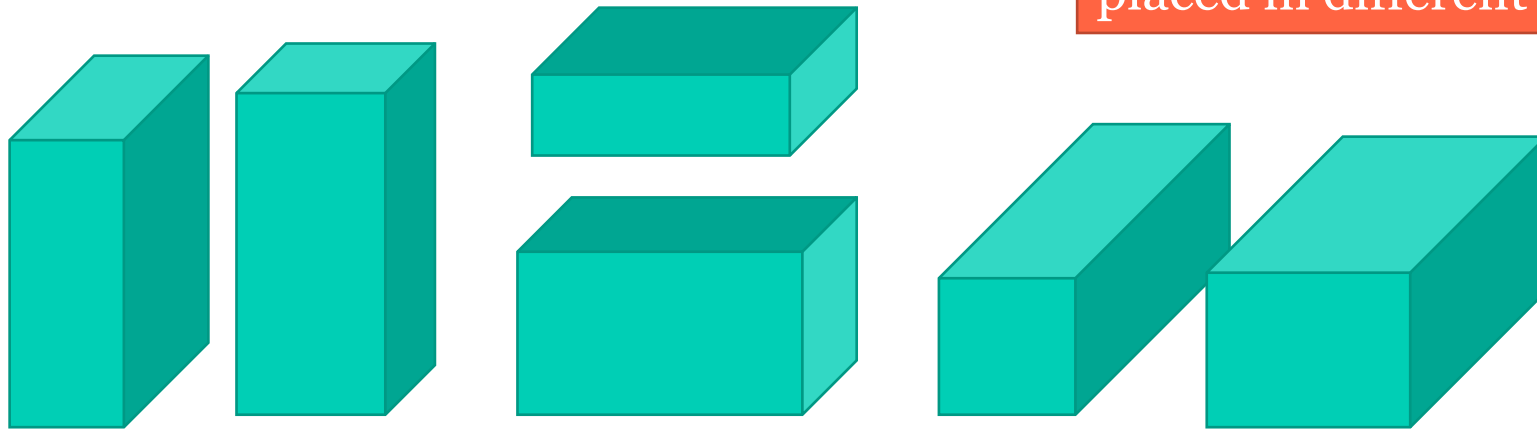
PERFECT PALLET IN THE  
SHORTLISTING

Think that if you have  $n$  products you have  $n!$  different palletizing sequences, how to you find one that works and is relatively good?

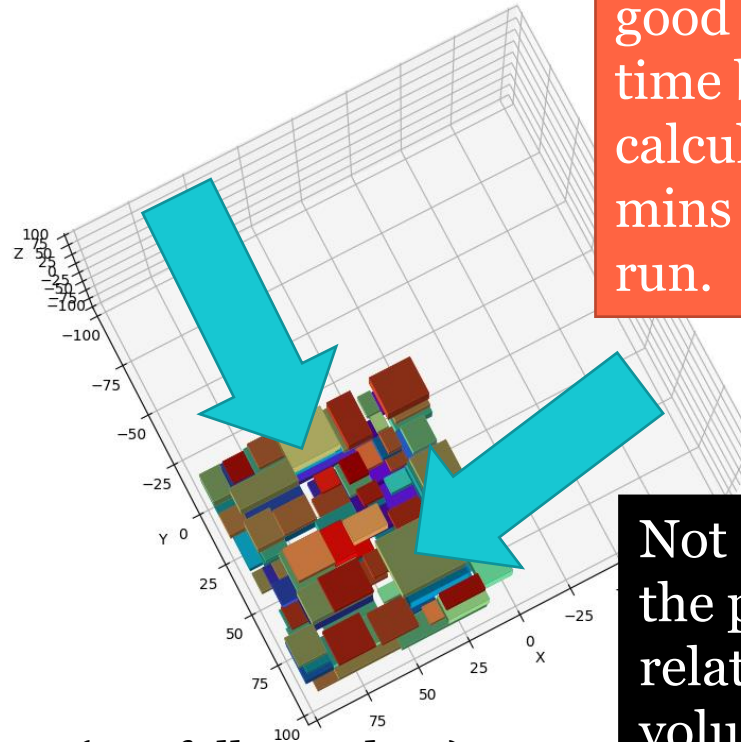
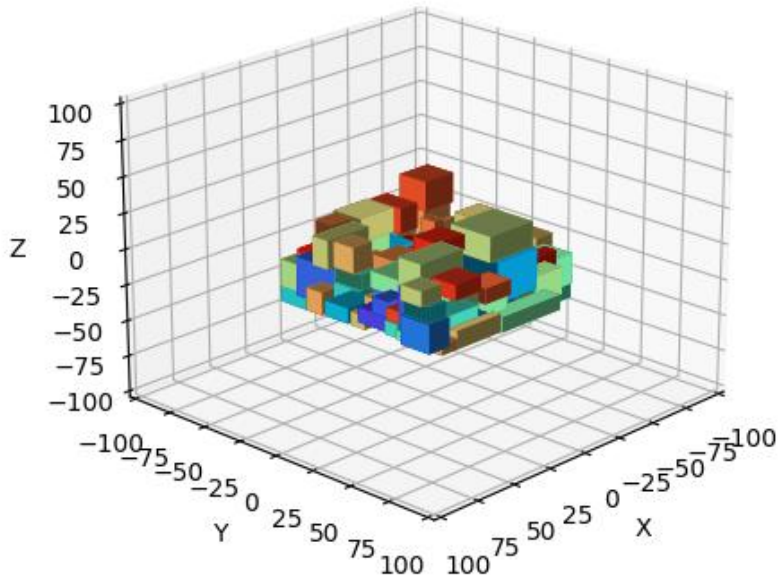
$n = 10 \Rightarrow 3\,628\,800$  different possibilities

But products, particularly boxes may also be placed in different orientations!

So, you need to decide on the placing sequence but also where and how to place them! Any optimization algorithm will be evaluation millions of possible solutions.



# The mix pallet use case – Why is it difficult?



You need to converge to a solution in good time, there is a limited amount of time before the next pallet needs to be calculated, so you probably have about 2 mins maximum for each optimization run.

Not all solutions are good solutions, and the problem is very sensitive to the relative proportion of products and their volumes

6 different package types of random sizes (not fully random). 110 Packages Execution time 315s (VM), 116 s (Xeon).



# The display pallet use case – Why is it difficult?



- Display pallets are almost always designed to be assembled by humans
- Quite many different designs, which makes their assembly difficult to generalize
- Non rigid materials are a challenge for robots

From an optimization perspective is an easier than the mix pallet case since products and their position are fixed so the development of robotic manipulation patterns are possible.

# Revisiting the FLAP approach – Dynamic Resource Pools



Which problems do they solve:

- The need to ramp up production on demand
- Lack of operators in the market
- Enable the use of automated solutions in an economically sustainable way
- Promote the use of shared resources (environmental impact)

What are the assumptions:

- Companies that consume resources from the pool have complementary seasonal needs
- Technical solutions are sufficiently standardized for plug and produce integration

Furthermore, you can think of company internal resource pools or external resource pool (open marketplaces) and everything in between.

# Our findings so far, what have we solved?

- We have experimented, and still are, with different algorithms for optimizing the palletization order and determine the best positions for each product on the pallet considering different constraints. We have found some good generic solutions, but these require customization to address some specific use cases.
- We have developed the flexible robotic concept for manipulating the products in the pallets and for executing robotic assembly of display pallets in an effective way.
- We have started to investigate new business models for resource pools in the food and beverages sector.

# We still have two more years to go!

- We will be consolidating and improving our algorithms for palletizing.
- We will be further developing the concept of resource pools and optimizing the used of shared resources.
- We will be further investigating the constraints that apply to the development of internal and external resource pools
- We will further integrate and develop our prototype that wraps together the results of the project





# Thank you!

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