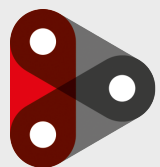




# TECHNOLOGY UPDATE

FLEXIBLE MANUFACTURING | BIN PICKING

D O N D E R D A G 2 4 M A A R T | 1 5 : 0 0



**Fieldlab**  
**Flexible Manufacturing**

**FACTORY** of the  
**FUTURE**  
innovation program

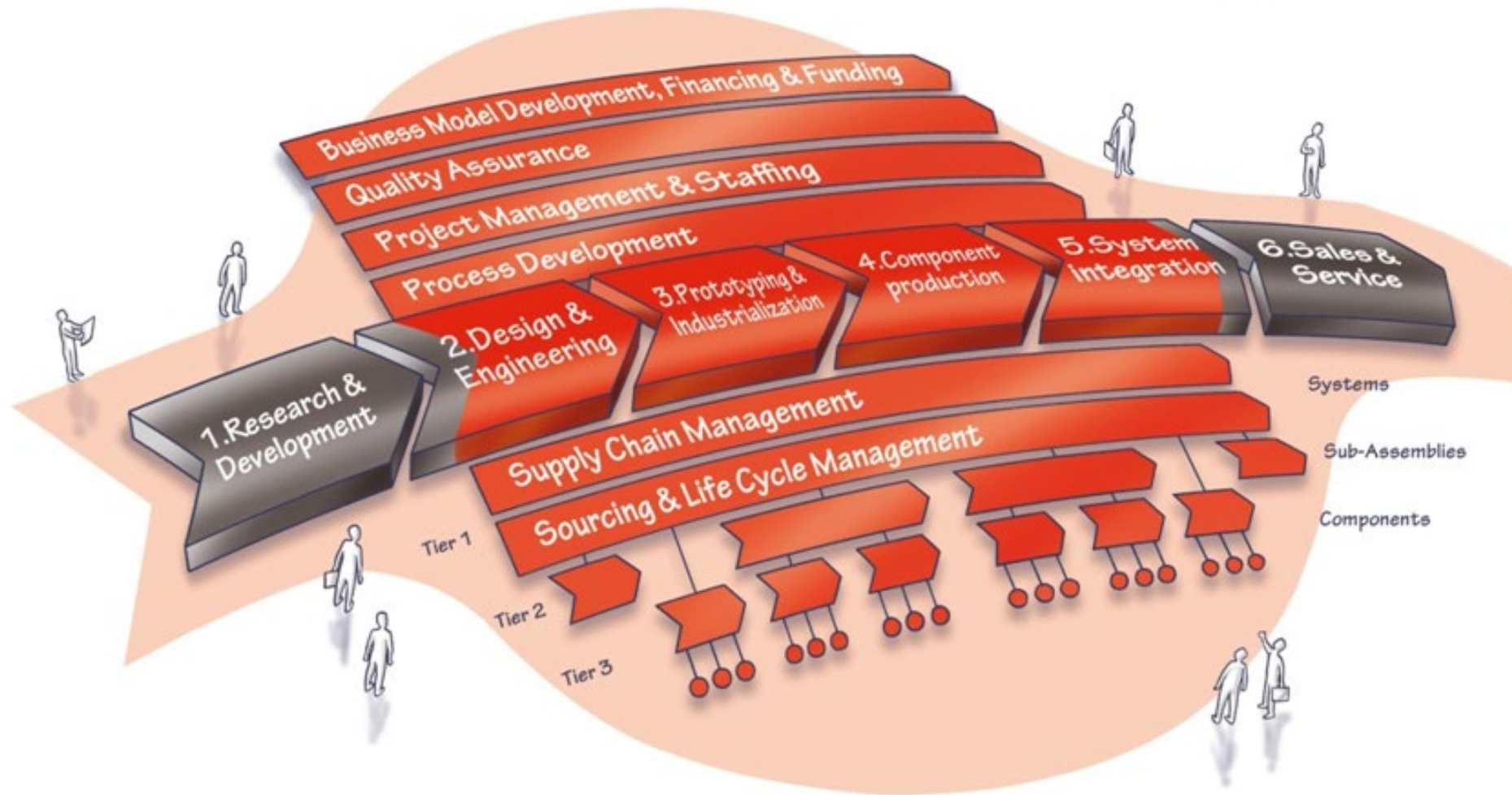


**Brainport**  
**Industries**

## Programma

- **15:00 – 15:10**  
Plenair welkom en introductie Innovatieprogramma, Brainport Industries en BIC  
*John Blankendaal, Brainport Industries*
- **15:10 – 15:20**  
Introductie en toelichting Fieldlab Flexible Manufacturing  
*Edwin van der Weele, Brainport Industries*
- **15:20 – 15:40**  
Wat is bin-picking en wat kan ik er nu al mee?  
*Danny de Greef, Affix Engineering*
- **15:40 – 16:00**  
Flexibel bin-picken met robots en verschillende 3D technieken  
*Matthieu Bemelmans, Vincitech*
- **16:00 - 17:00**  
Demonstraties proefopstellingen en netwerkborrel  
*Factory of the Future Experience Center*

# Brainport Industries' Open Supply Chain



# Members – January 2022





# Brainport Industries Campus

CAPREON

SDK



EINDHOVEN

KMWE

Brabantse Ontwikkelings Maatschappij  
**BOM**

Provincie Noord-Brabant

Total Area Campus Park: 200 Ha  
Max. Buildings: 65 Ha (10% / 6.5 Ha 100.000 m2 completed BIC-cluster 1 )







Brainport Industries  
Campus

## BIC current tenants

S::DK



anteryon

KMWE

FLUKE

Additive  
Center

affcubator

arketiger

AM-FLOW

AZIOBOT

avans  
 Hogeschool

SUMMA  
College

Fontys

PROCUREON  
SAPPHIRE SOLUTIONS

TOMRA  
SORTING SOLUTIONS

Maker  
Point

K3D

luxexcel  
3D printed lenses

YASKAWA  
The Drive for Quality

AMS  
Automation & Manufacturing Services

Kieue  
Engineering

VDL  
VDL TBP ELECTRONICS

FESTO

Subsidiefocus

ceratec  
TECHNICAL CERAMICS BY

TNO

BG.legal  
ziet kansen

DVCSI

CHRO  
INTEGRALASAPPHIRECENTRUM  
BRAINPORT

HIGH TECH  
SOFTWARE  
CLUSTER

AML  
Advanced  
Manufacturing  
Logistics

SC  
Sn smart  
connected  
supplier  
network

BOM  
Business Operations Management

ORTEC

IJSSEL  
technologie

kpn

SIEMENS

ITAM  
software training  
solutions

FUJITSU  
FUJITSU GLOVIA

CORDIS  
SUITE

FESTA  
solutions



macroscoop

FULLFACT  
Productivity Solutions

RUBIX

BESTRONICS  
Specialist in Print-Assembly

ENGIE

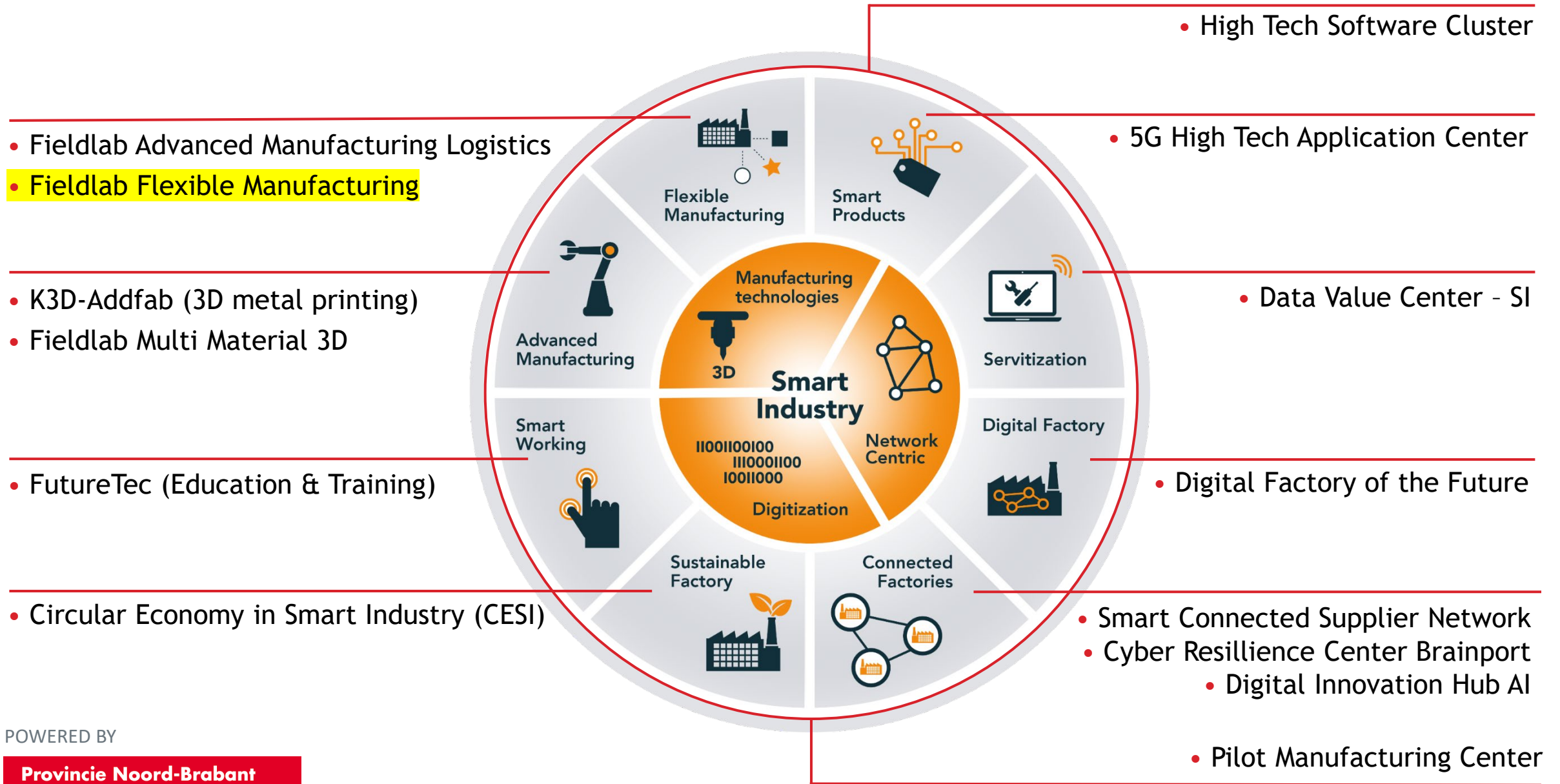
sodexo

Faes  
The Packaging People





# INNOVATION PROGRAM | BIC PROJECTS & FACILITIES



POWERED BY

**Provincie Noord-Brabant**



**Fieldlab**  
**Flexible Manufacturing**



**Brainport  
Industries**



**Brainport Industries  
Campus**

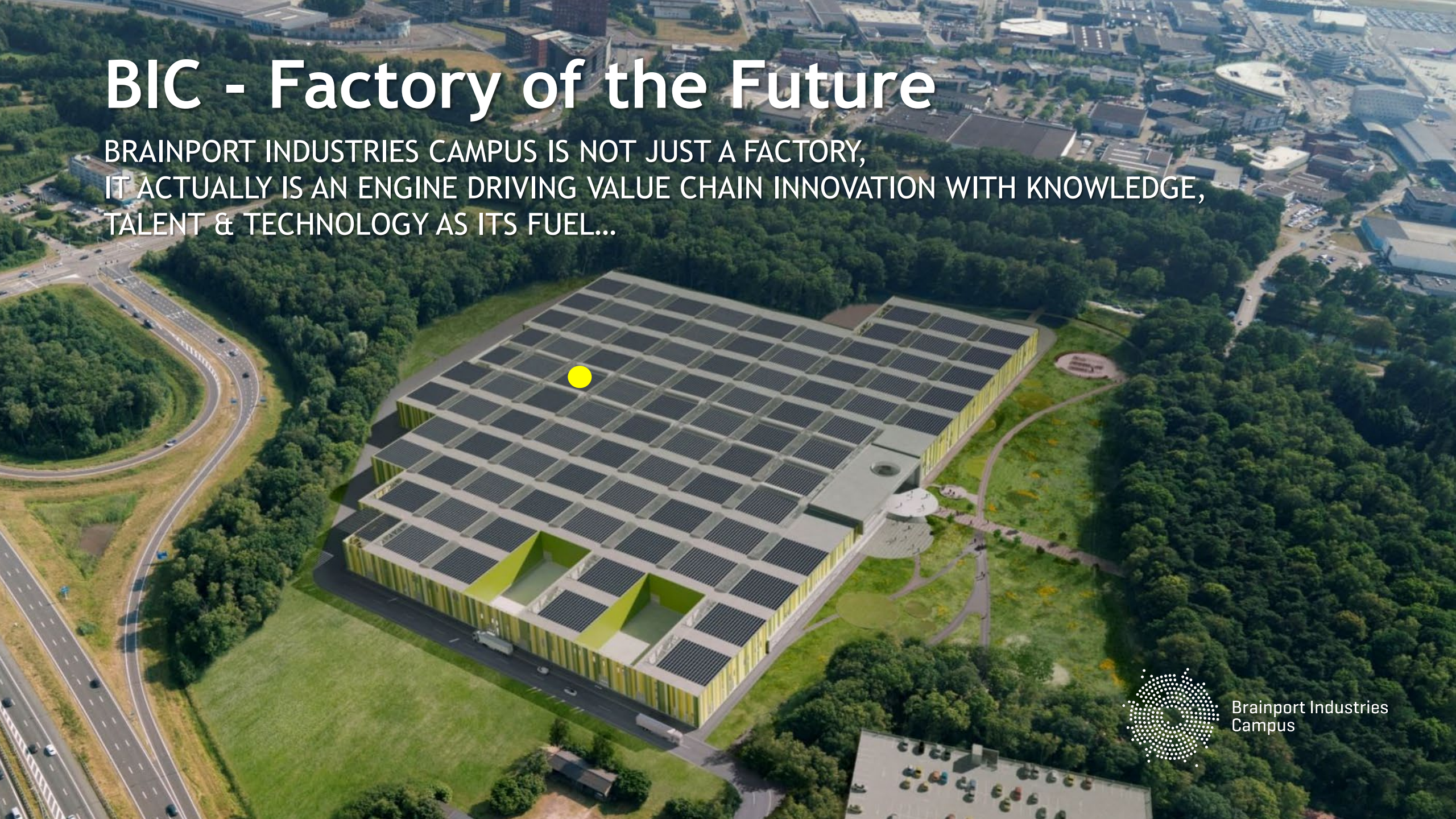
Powered by:

**Provincie Noord-Brabant**



# BIC - Factory of the Future

BRAINPORT INDUSTRIES CAMPUS IS NOT JUST A FACTORY,  
IT ACTUALLY IS AN ENGINE DRIVING VALUE CHAIN INNOVATION WITH KNOWLEDGE,  
TALENT & TECHNOLOGY AS ITS FUEL...



Brainport Industries  
Campus



# FACTORY OF THE FUTURE EXPERIENCE CENTER

## Goal

The *Fieldlab Flexible Manufacturing (FlexMan)* at the BIC is a physical space that is suitable for doing demonstrations, experiments, tests, knowledge development, workshops and trainings. With that it actively contributes to:

1. Inspire SMEs in the manufacturing industry and help them on their way in the world of flexible manufacturing
2. Develop and make flexible manufacturing technology applicable for manufacturing industry by working on actual use-cases of companies
3. Make students become acquainted with flexible manufacturing technology



# FACTORY OF THE FUTURE EXPERIENCE CENTER

## Value proposition

- Physical space of almost 400 m<sup>2</sup> at the 'hotspot' Brainport Industries Campus (BIC) in Eindhoven
- Place for equipment/set-ups for performing experiments, tests, developments
- Mix of specialties; breeding ground for innovation in the field of flexible manufacturing
- Partners that are actively involved in reaching the goals described; knowledge and educational institutions, technology providers, companies with use-cases
- Close proximity of educational institutions and students for executing projects
- *'Experience center' with technology and knowledge of partners, for residents of BIC, the Brainport Industries network and other visitors*
- *'Workshop' with needed facilities to perform experiments, tests and developments*





# FACTORY OF THE FUTURE EXPERIENCE CENTER

From > to

■ **Fieldlab Flexible Manufacturing**

■ **Factory of the Future Experience Center**

- **Flexible Manufacturing**
- Digitale Fabriek
- Smart Connected Supplier Network (SCSN)
- ....
- ....



## FACTORY OF THE FUTURE EXPERIENCE CENTER

### Activities Experience Center

- Demonstration set-ups
- Knowledge events
- 'Live long learning modules' (education)
- Use of available facilities
- Free first advice/intake ('quick scan')
- Participate in Factory of the Future 'Experience Game' (under development)



- Commercial follow-up by tech partners on initial intake, quick scan or Smart Factory Experience Game
- Research activities
- Practical experiments and development
- Collaborative innovation
- Projects with students



# Benefits for Experience Center partners

- 1. Marketing:**  
Regular publicity about demo's, activities and events in the Experience Center by the BIC and Brainport Industries communications channels
- 2. Business leads:**  
Commercial leads by presence, demo's, knowledge events and advice for interested companies
- 3. Innovation for future business:**  
Co-operation with other partners, resulting in new joint innovations and future business
- 4. New resources:**  
Close contact and co-operation with students talent pool for scarce resources

## FACTORY OF THE FUTURE EXPERIENCE CENTER

# WANTED!

The EC is always 'under construction'; demo- and experiment set-ups come and go.

EC is always looking for:

1. *Partners* with inspiring technology offer, committed to contributed to the EC-goals;
2. *Projects* for EC; actual use-cases in the field of flexible manufacturing to tackle 'live' issues.





## UPCOMING TECHNOLOGY UPDATES

### Calendar

- 21 apr: Technology Update | Smart Supply Network
- 19 mei: Technology Update XL

[www.fabriekvandetoekomst.com](http://www.fabriekvandetoekomst.com)



POWERED BY



Provincie Noord-Brabant

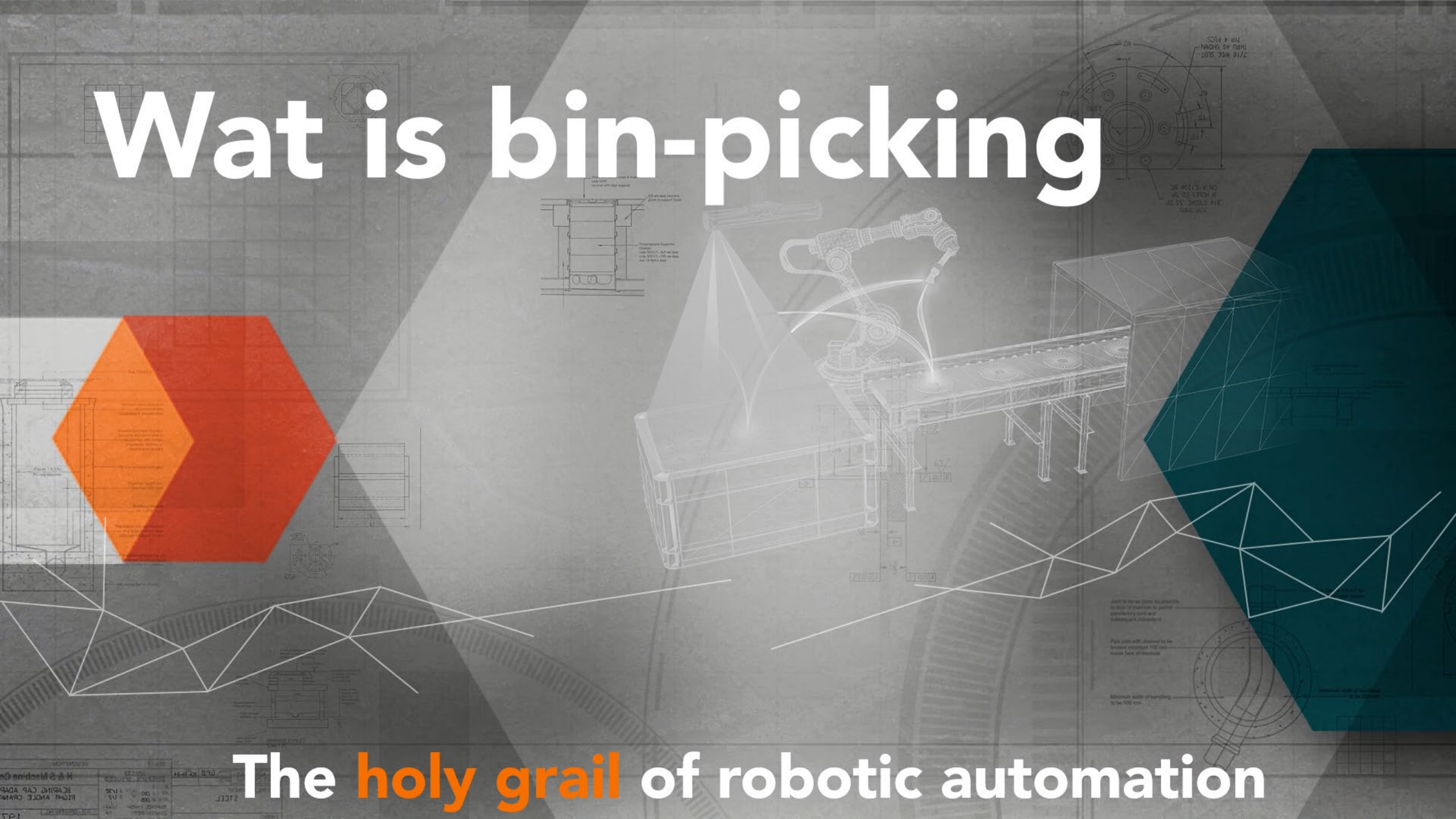


## FACTORY OF THE FUTURE EXPERIENCE CENTER

### Contact details

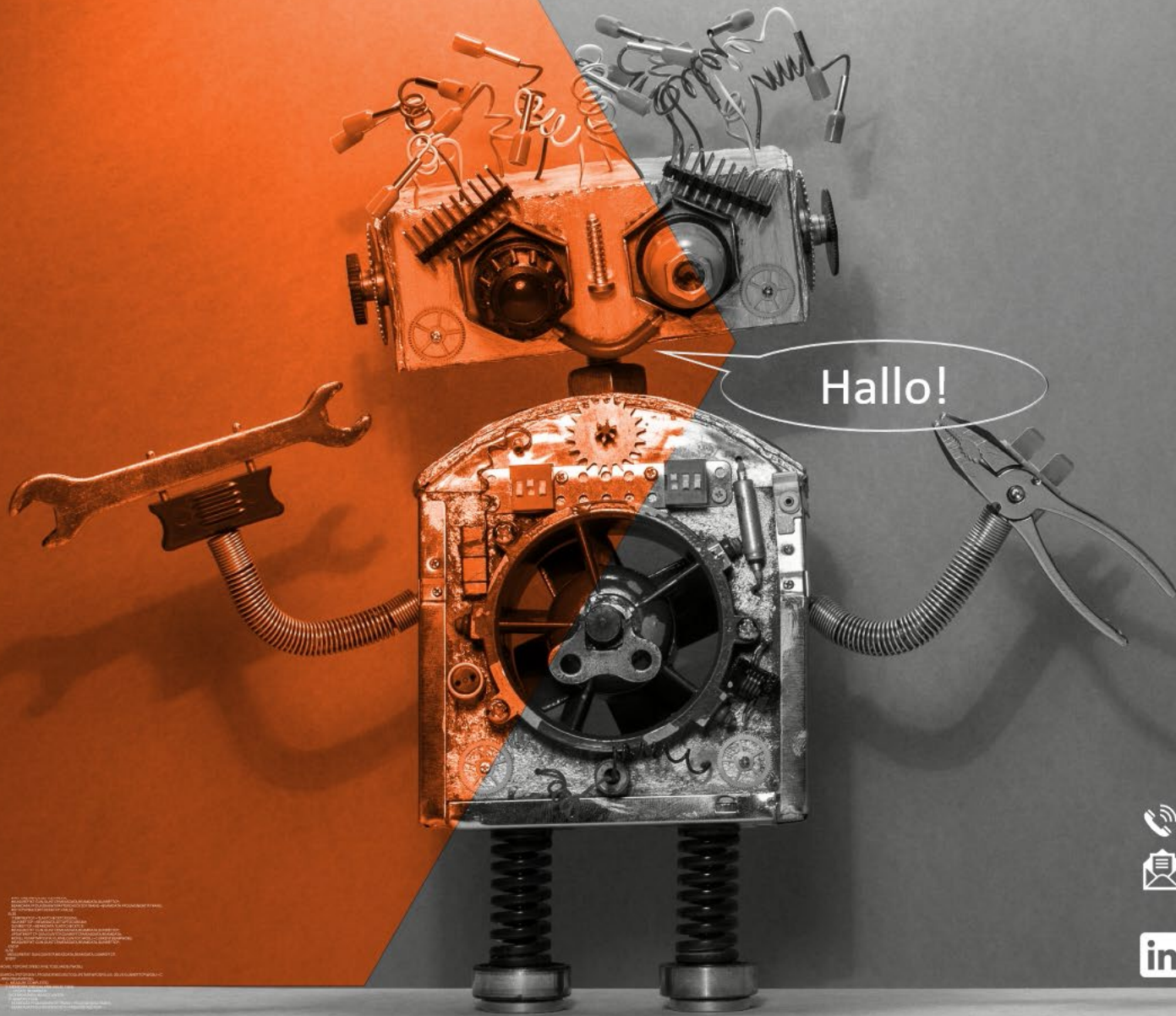
- Fieldlab Flexible Manufacturing > **Edwin van der Weele**
  - e.vanderweele@brainportindustries.nl
  - +31 6 52 60 39 51
- Brainport Industries > **Steffie van de Vorstenbosch**
  - s.vandevorstenbosch@brainportindustries.nl

# Wat is bin-picking



The **holy grail** of robotic automation





# Danny de Greef

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# Wat is bin-picking



**Bin picking is een proces waarbij een robot, uitgerust met 3D vision technologie, onderdelen uit een bak gevuld met ongeorganiseerde stukken haalt en ze vervolgens correct uitlijnt.**



# Verskillende varianten

- Bekende objecten



- Random objecten



- Layered

Dozen

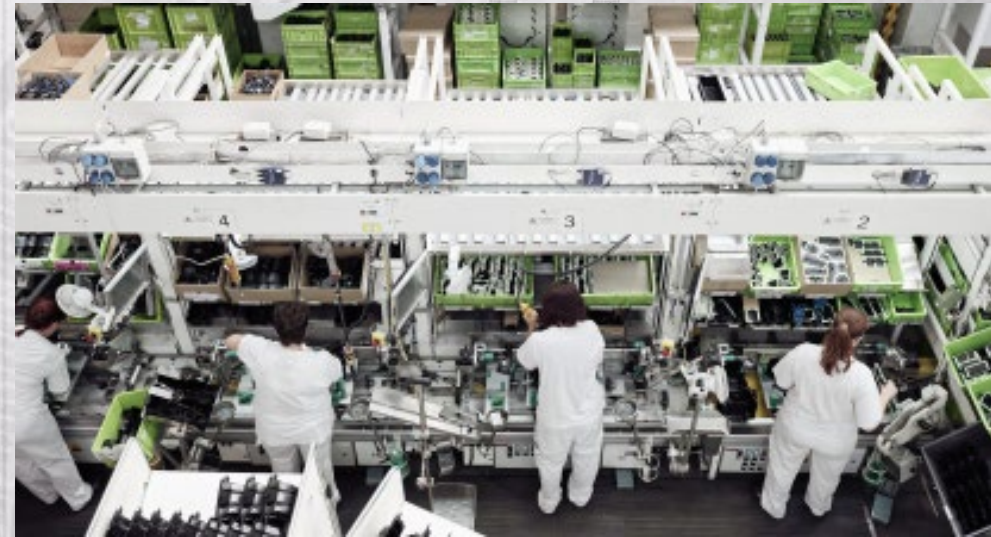
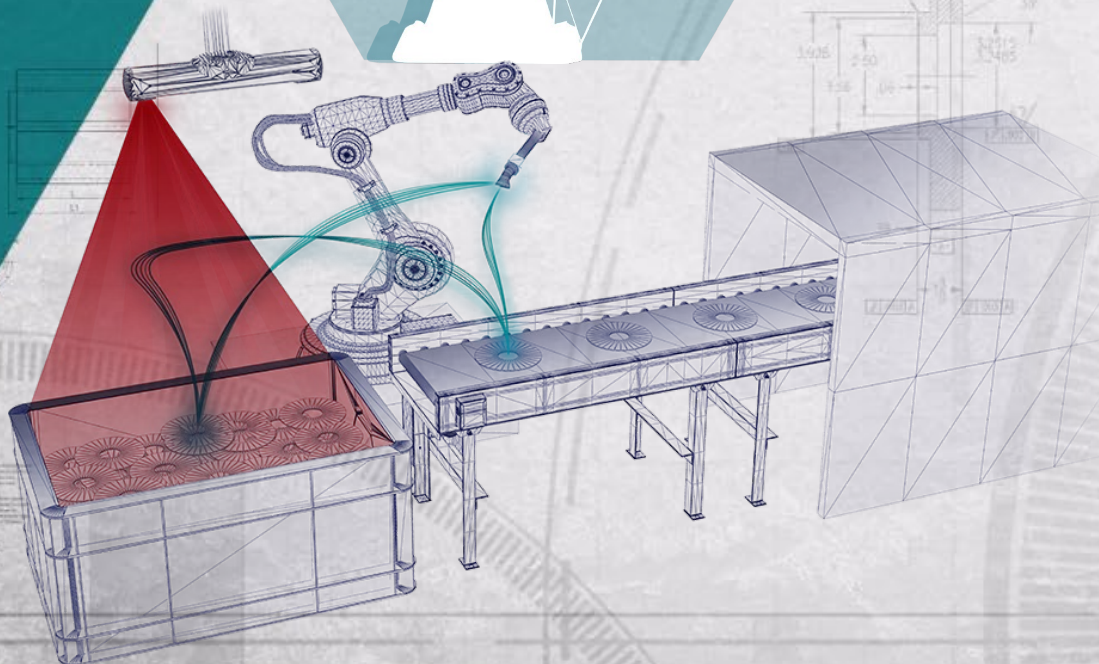




# Waarom bin-picken

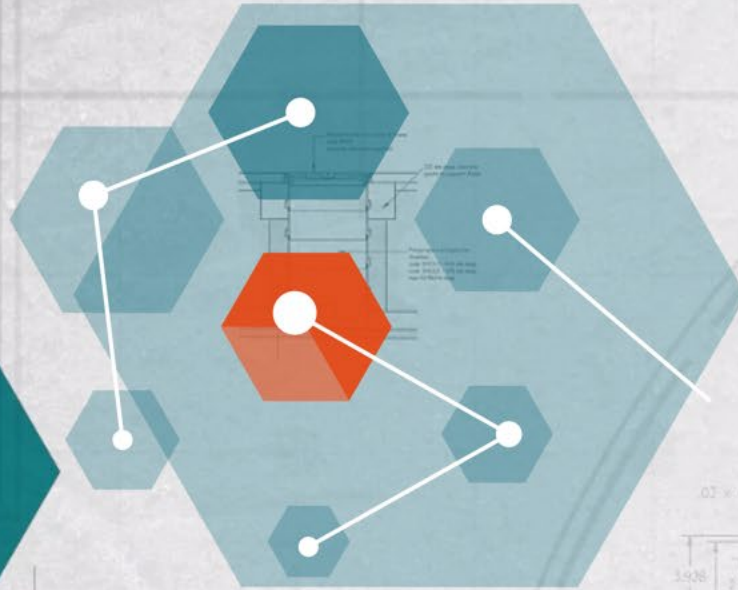


- De taak van een operator is vaak het eentonig verplaatsen van onderdelen.
- Tekort aan mensen. (productie zekerheid)
- Ergonomische belasting mensen.
- Kostenbesparing.
- .....

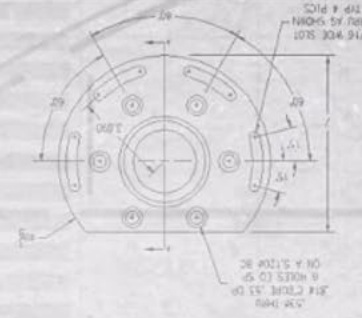




# Wat is er nodig



- Robot
- Camera
- Objecten (parts)
- Gripper
- Software
- (Bin)

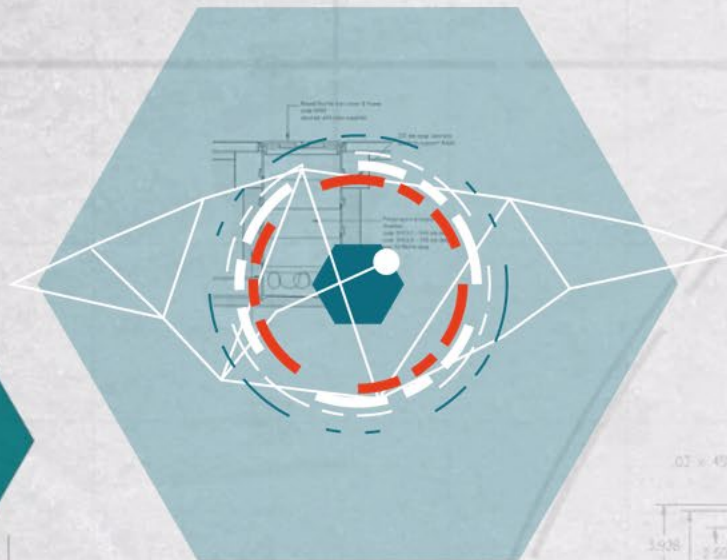




# Uitdaging bij bin-picken

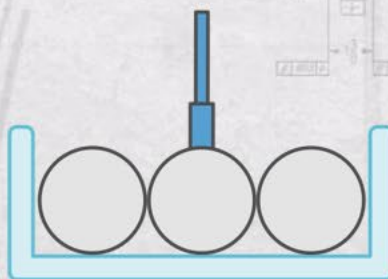
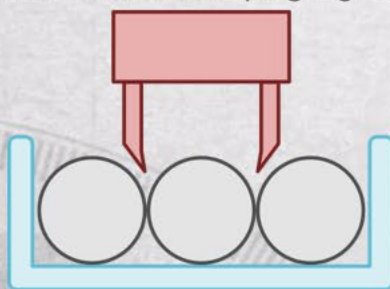
Kijk goed naar het object,  
vorm en materiaal.  
Kies vervolgens het juiste  
systeem.

- Object herkennen
- Pick locaties (grijper)
- Pick positie bereikbaar?



Unreachable clamping region

Reachable surface



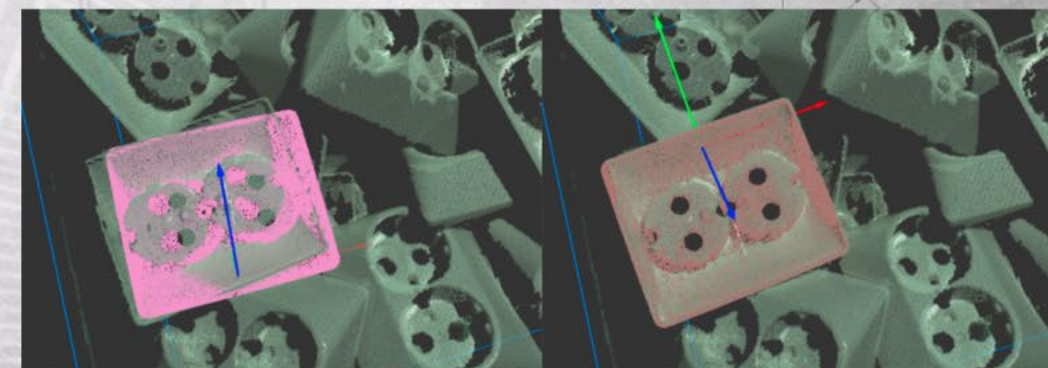
false positive

true positives



high error

low error

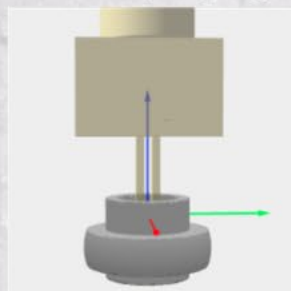




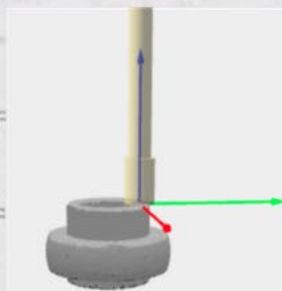
# Uitdaging bij bin-picken

Meer pick locaties op het deel verhoogt de slagingskans.

Good clamping region

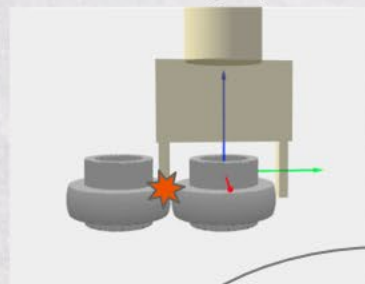


Poor surfaces

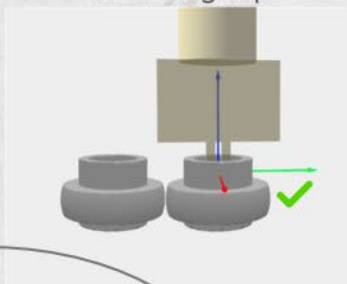


- Object herkennen
- Pick locaties (grijper)
- Pick positie bereikbaar?

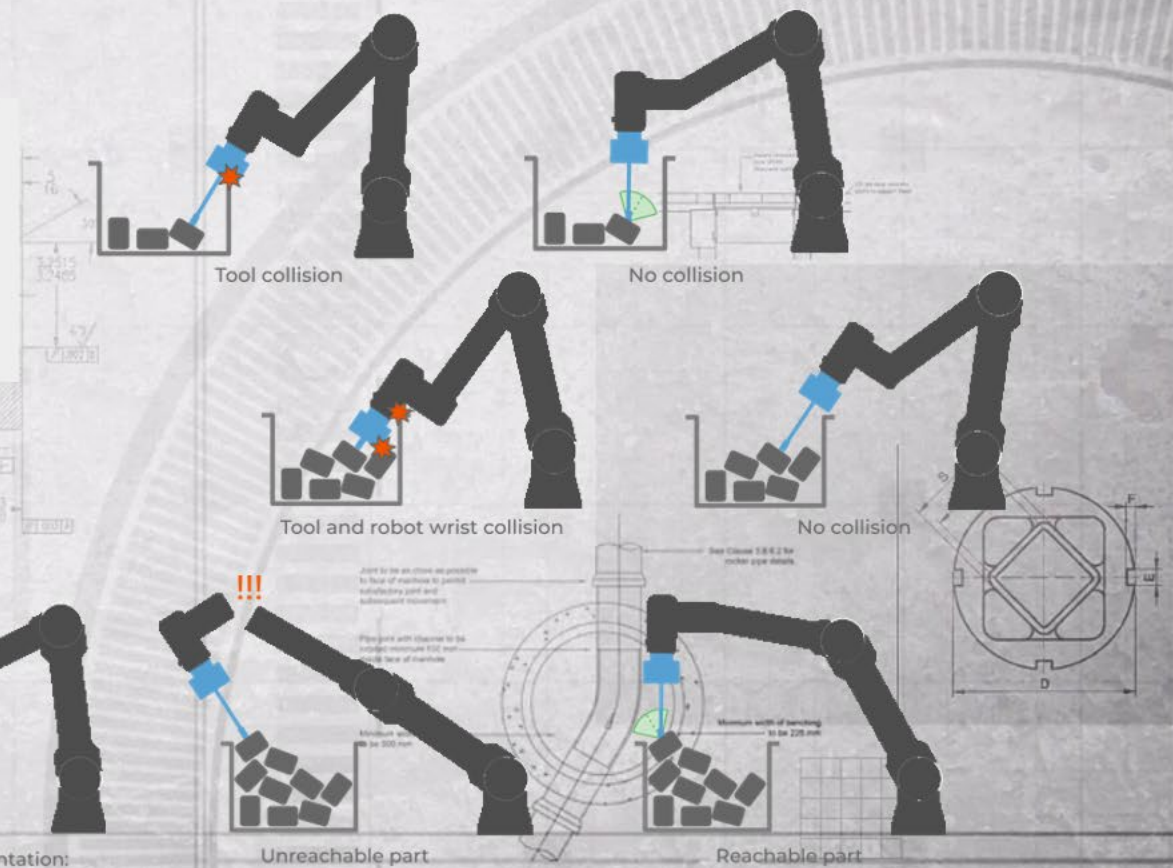
External grasp



Internal grasp



Een systeem dat rekening houdt met de robot voorkomt problemen in de praktijk.



Slanted tool - tilt configuration 1: Tool collision

Slanted tool - tilt configuration 2: Unreachable part + collision

Flexible pick orientation: Reachable, collision-free

Unreachable part

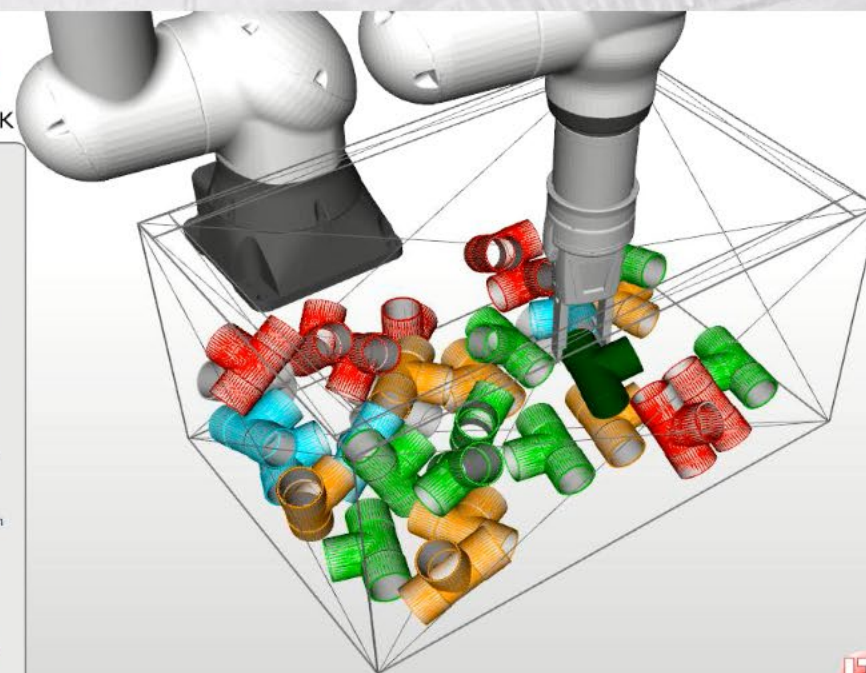
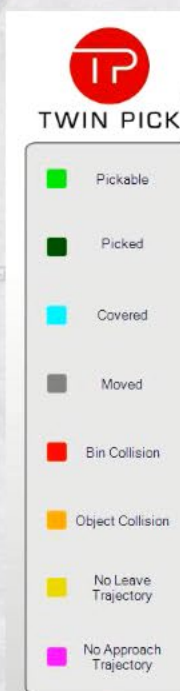
Reachable part



# Test eerst koop later

- Digital Twin

Voordat er ook maar iets  
gefabriceerd of gekocht  
hoeft te worden kan je de  
volledige setup al testen  
in de Cloud.





# Vragen?



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# Flexibel Bin-Picken met robots en verschillende 3D technieken

Ir. Matthieu Bemelmans

Project Leader | Algorithm Specialist

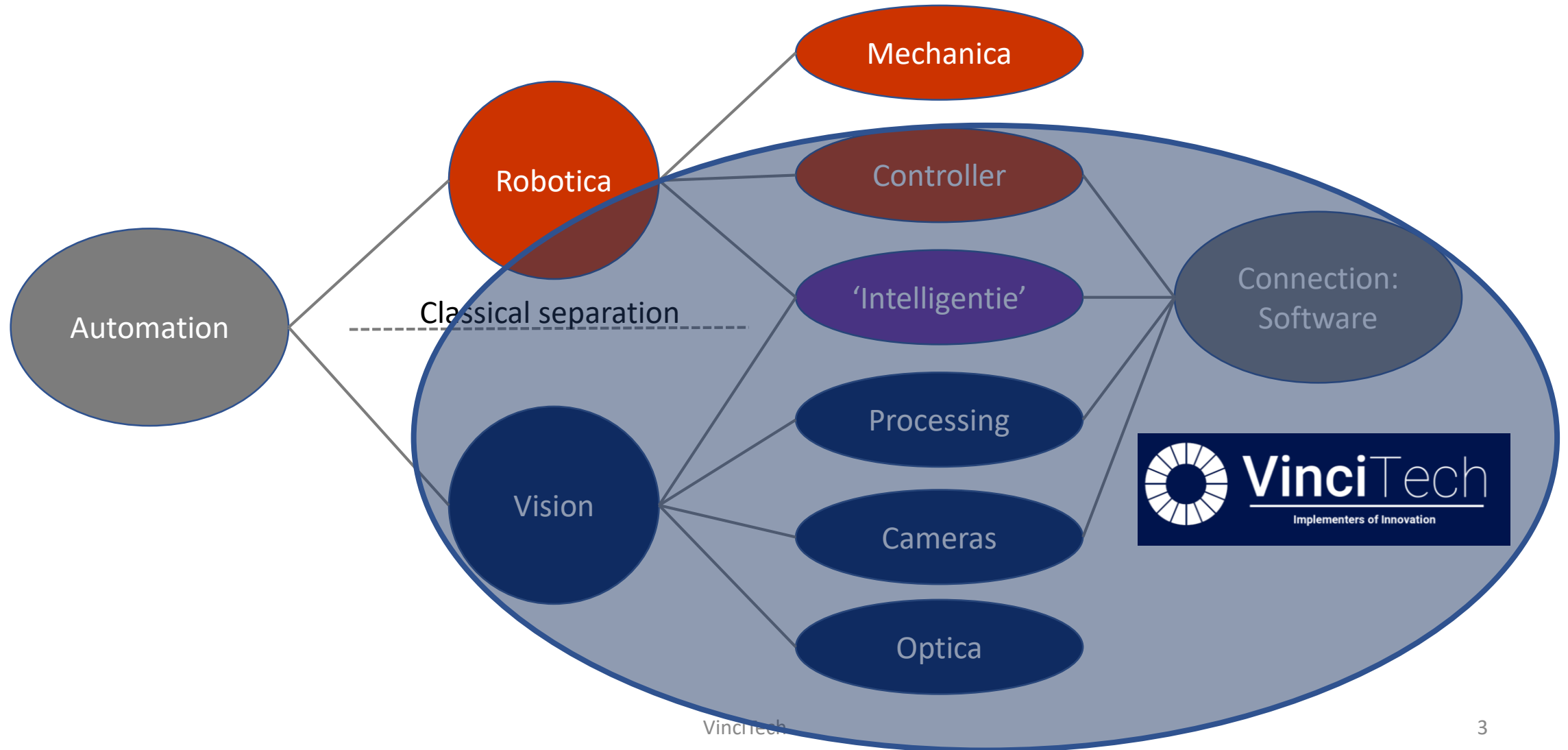
VinciTech

# Topics vandaag

1. Bin Picken: algemeen
2. Hardware: scanners/camera's
3. Software: matchtechnieken
4. Collision Avoidance
5. Aandachtspunten: (project)technisch



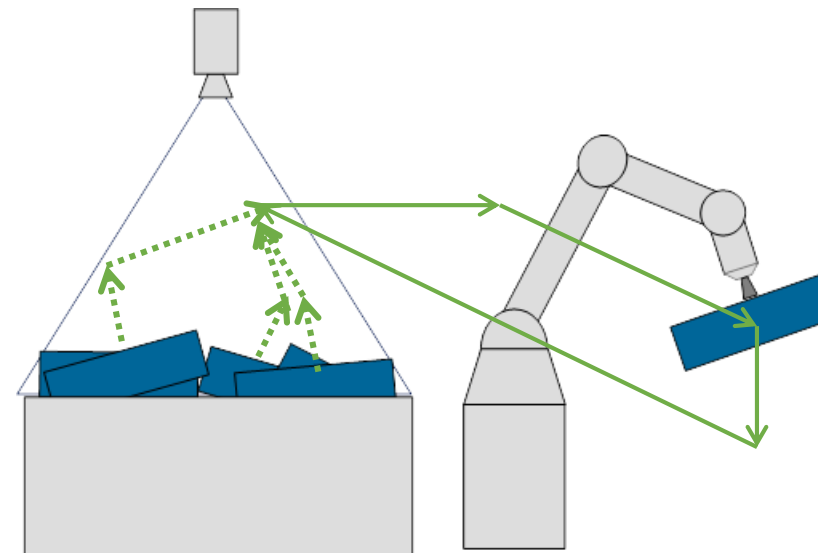
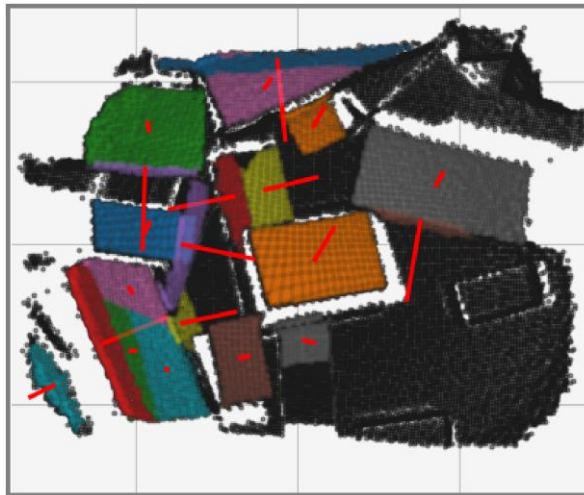
# Vision & Robotics



# Bin picking

## Process

- Basis Robot Cycle
- Camera pakt beeld
- Software verwerkt beeld
- Pak pickpoints
- Robot naar pickpoint





# Bin picking: Technieken

**Kern:** Bepaling van pickpoints in 6D (waar en hoe)

Optie 1:

- Maak 3D beeld, *point cloud*,
- Feature en object-herkenning in 3D
- Kan met en zonder (!) objectkennis/CAD

**Focus vandaag**

Optie 2:

- Optie 2: Maak 2D beeld(en)
- Featuredetectie in 2D (gaten)
- 2D-info + camerainfo + objectinfo → 3D info
- Kan met 1 of meerdere camera's (stereo feature matching)

# Bin Pick system

- Many components to achieve a **good** Bin-Picking System
- General components:
- **ALL NEED TO WORK**

| Optics                                                                                                         | Camera                                                                                    | Image Processing Software                                                                                                   | Robot Control Software                                                                                           | Infrastructure Layer                                                                                                                        | Production Machines                                                                                                      |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Material</li><li>• Filters</li><li>• Lens</li><li>• Lighting</li></ul> | <ul style="list-style-type: none"><li>• Type</li><li>• Control</li><li>• Driver</li></ul> | <ul style="list-style-type: none"><li>• Calibration</li><li>• Object Detection</li><li>• Pickpoint Identification</li></ul> | <ul style="list-style-type: none"><li>• Path Planning</li><li>• Collision Check</li><li>• Digital Twin</li></ul> | <ul style="list-style-type: none"><li>• Visualization</li><li>• Communication</li><li>• User Interface</li><li>• Settings/Recipes</li></ul> | <ul style="list-style-type: none"><li>• Robot</li><li>• PLC</li><li>• IO</li><li>• Gripper</li><li>• ERP / MES</li></ul> |



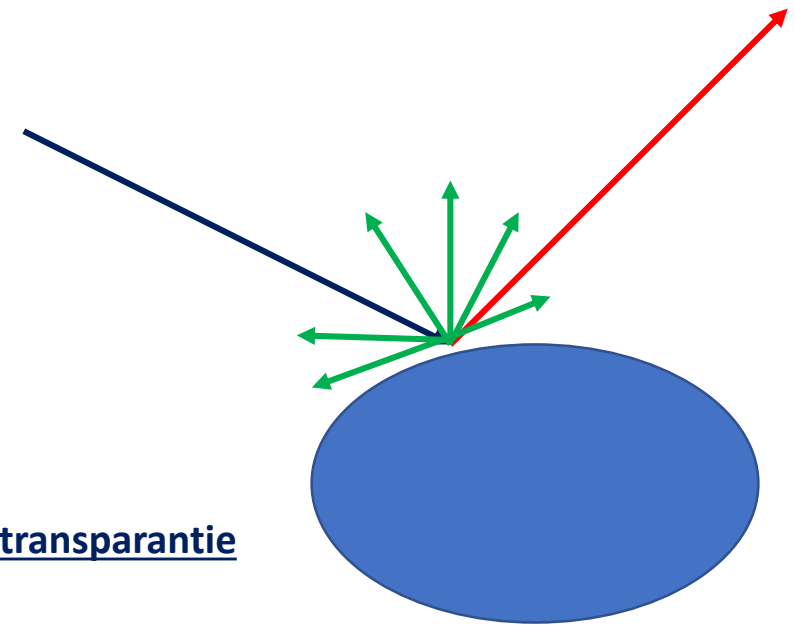
# 3D Vision: Point cloud hardware

O.a.:

- Laser
  - + zeer precieze data
  - langzamer, beweging nodig
  - oppervlakte-effecten
- Time-of-Flight
  - + compact
  - + snel
  - + betaalbaar
  - oppervlakte-effecten
  - niet heel nauwkeurig
- Structured light
  - + Mooie data
  - + Snel
  - oppervlakte-effecten

Actieve acquisitiemethoden, sensor bestraalt objecten

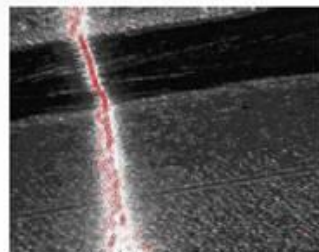
Allen last van *niet-lambertiaanse optica*: Spiegelende reflectie & transparantie



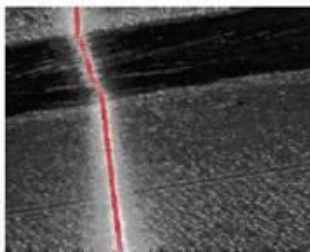
# 3D Vision: Hardware

3D Vision, many options for data-acquisition

We pick the best one **for the job**,  
regardless of brand



Standard camera  
with linear response (60dB) & COG



Photonfocus 3D camera  
with LinLog® response (120dB) & Peak Detector

VinciTech

## Properties



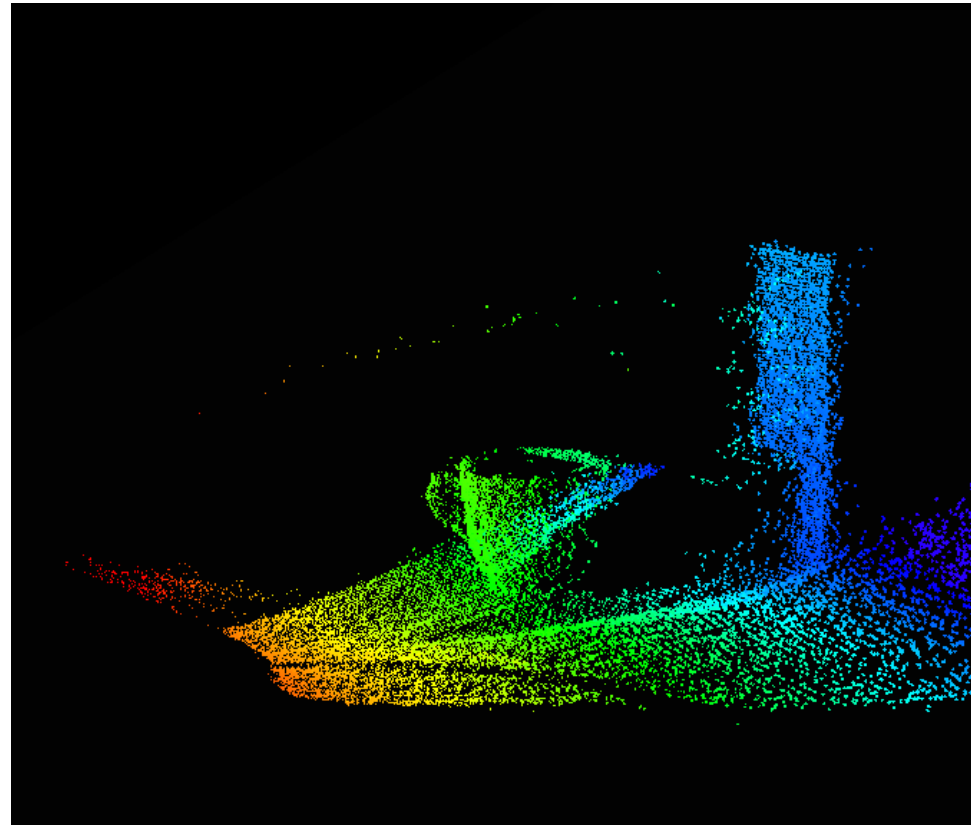
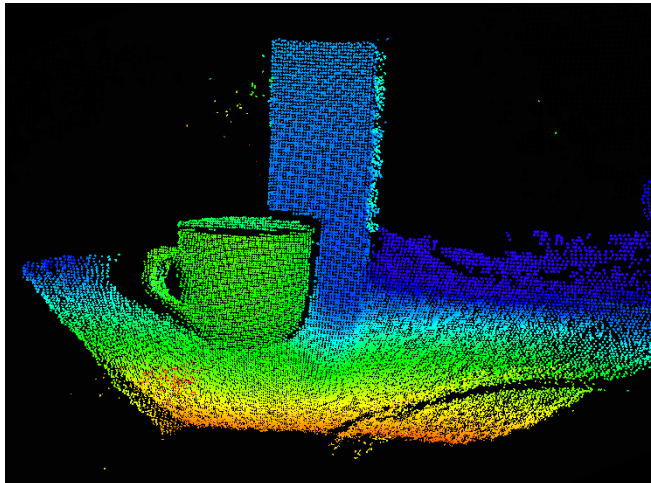


# 3D Vision: Software

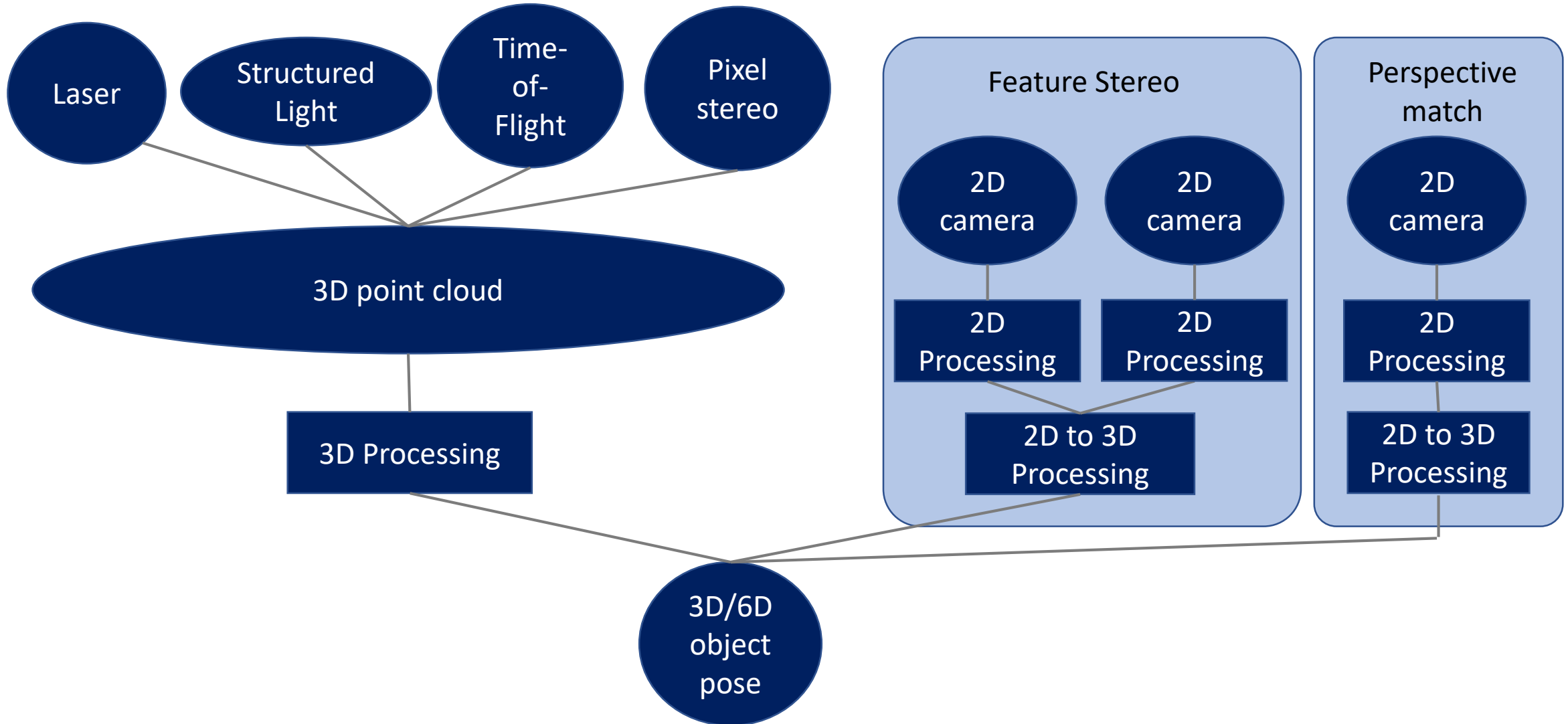
Pointcloud, so? Software needs to proces!

Deal with:

- Noise
- Occlusion
- Sparse data
- Heterogeneos data



# Technology Overview





# Software: CAD matching of niet?

## **Classic: object CAD matching**

- + Precies
- + Exact pickpoint bekend
- + Handig bij zeer grote series
- Instellen per product, een product tegelijk
- Vaak precieze tekening + point cloud nodig (ruis)

## **CAD-loos op verschillende objecten**

- + Pakken bij randen of vlakken
- + Zeer makkelijk in te stellen/wisselen
- + Flexibel, mixed products
- Wisselend pickpoint
- Aflegnauwkeurigheid

# Nauwkeurigheden

Vragen: Benodigde nauwkeurigheid?

- Verenkelen of ook precies herpositioneren?
- Tolerantie van gripper?
- Tolerantie van aflegplek?

## **Aflegnauwkeurigheid bepaalt oppaknauwkeurigheid**

Eventueel:

- Mechanisch positioneren bij afleggen (glijtafel)
- Hermeten bij neerleggen
- In-air hermeten

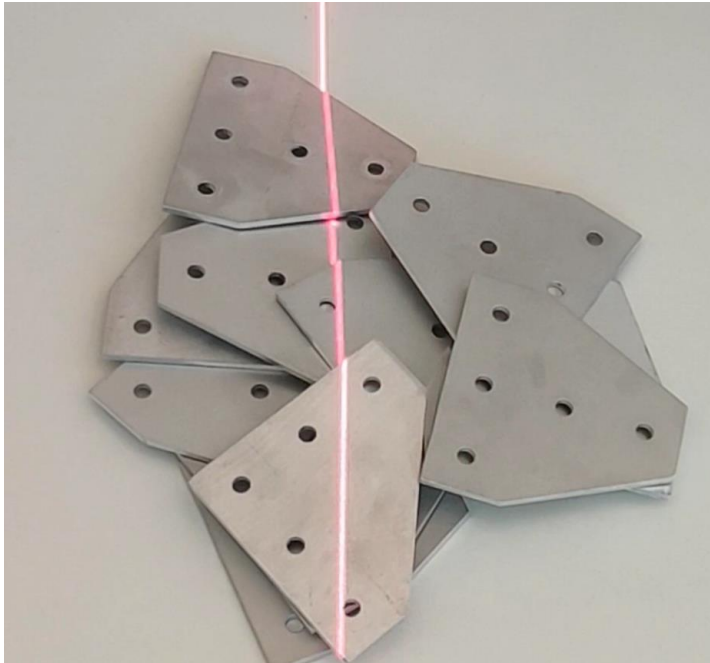
# Praktische groepen

Vaak snel picken gewenst, snel beeld → Stereo/Time of Flight

→ Ok voor grote/middel objecten, nauwkeurigheid ~1cm.

Lastig oppervlak, klein object of zeer precies? → Laser/Structured Light

Klein/dun



Presentatie

Middel



Fieldlabs

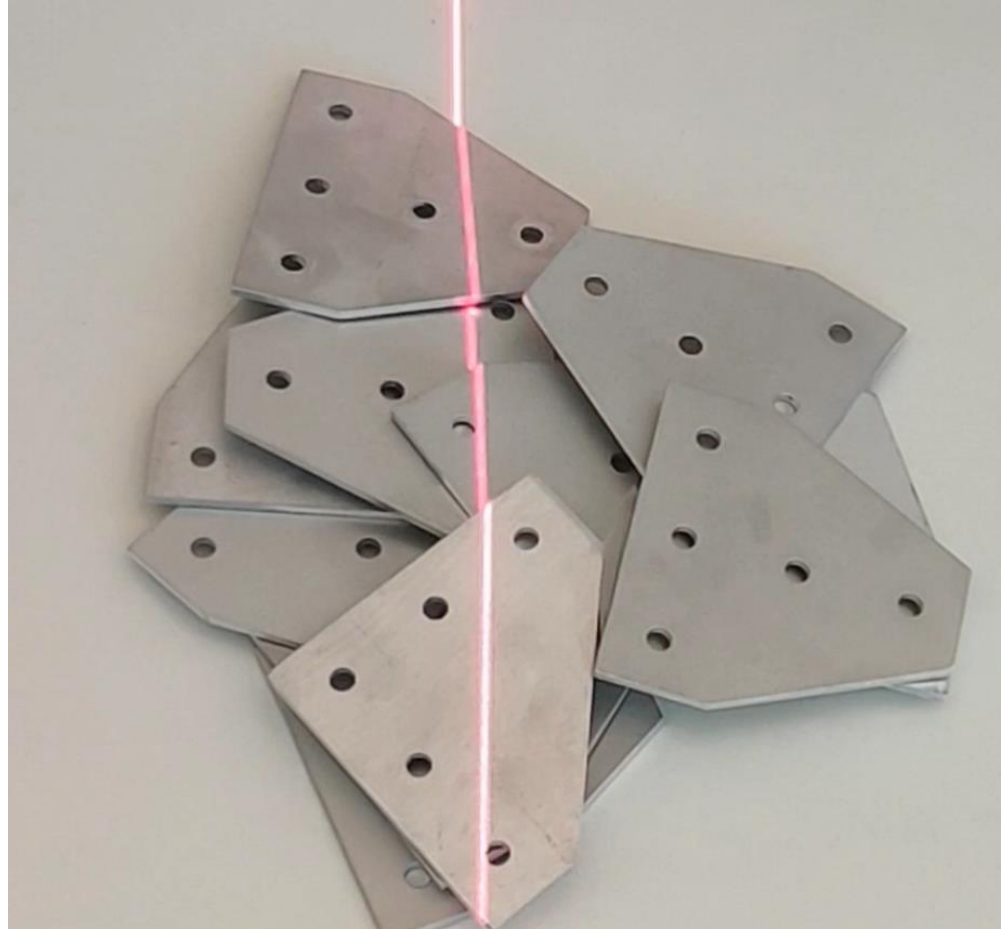
Groot

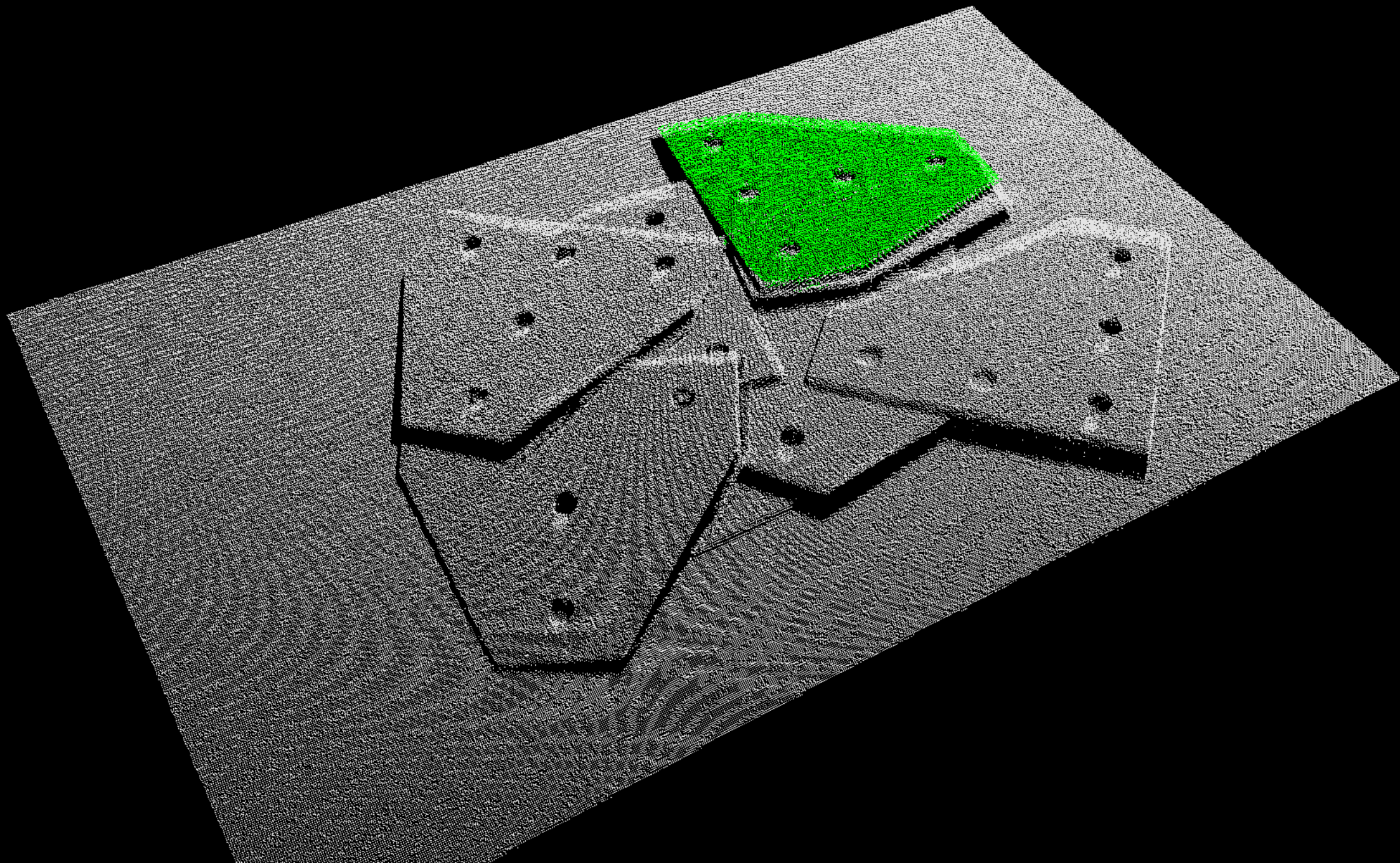


Video



# Categorie klein/dun: laser + object matching







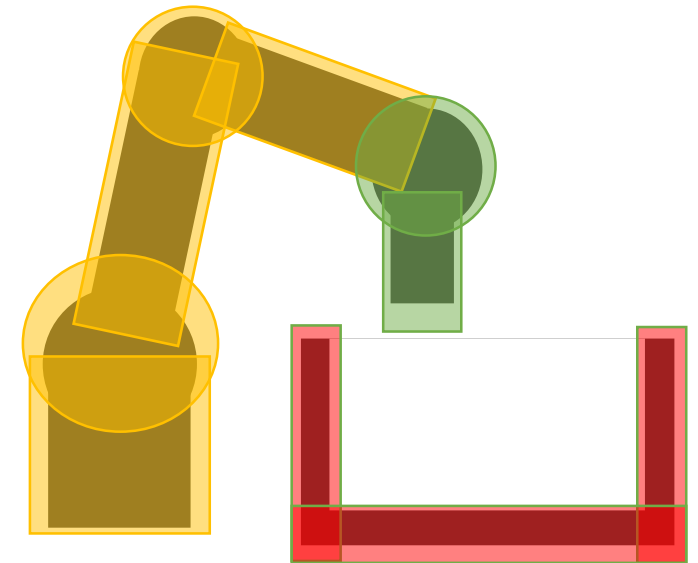
# Categorie Middel: Fieldlabs

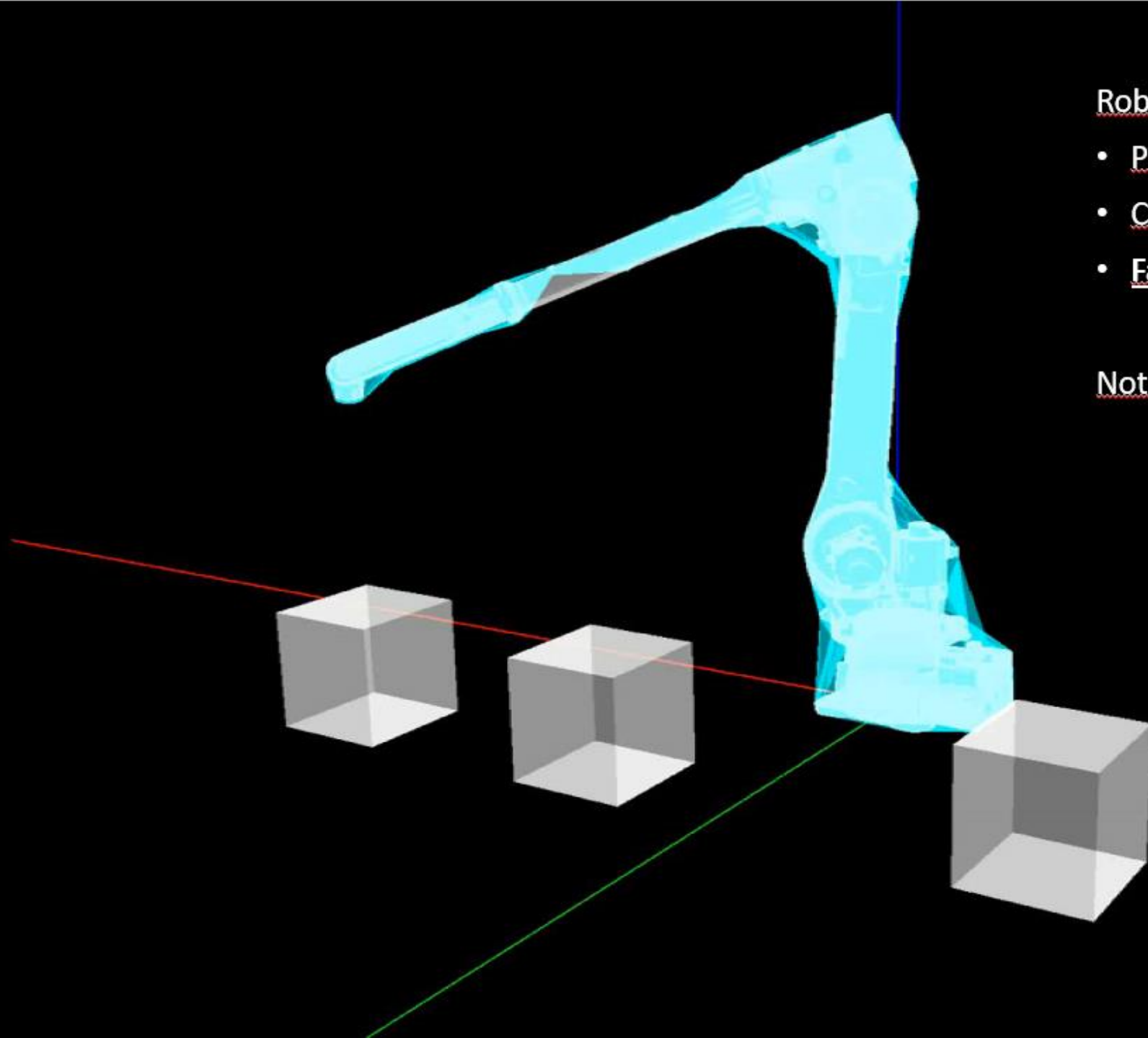




# Collision checking: New Technology

- Normally: checking with bin volume/cubes + point cloud
- **Tool Check** or **Full Robot Check?** (kinematics needed)
  - Sometimes tool not enough
  - For optimal speed: kinematics needed
- **New: Advanced Robot Collision Checking**
  - Digital Twin



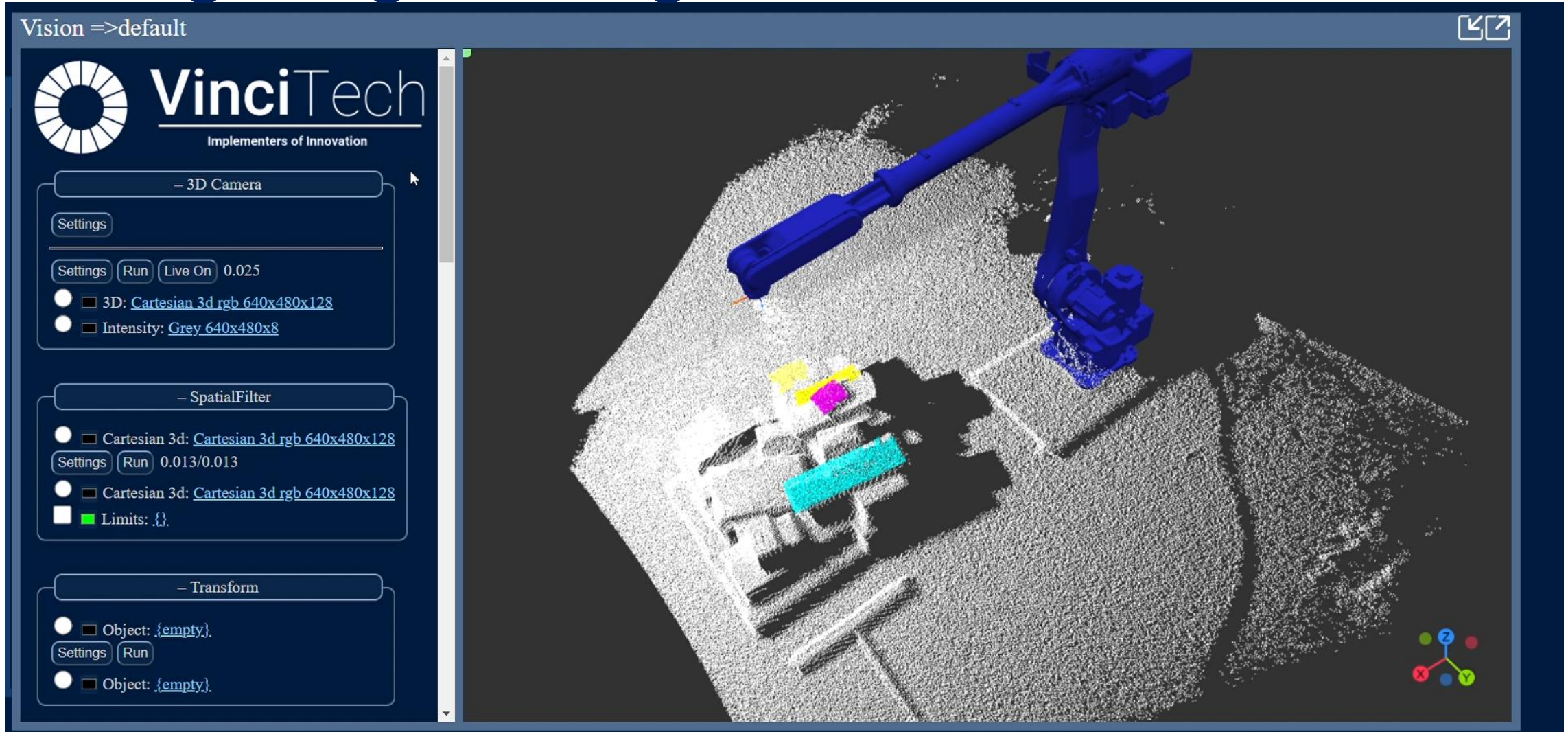


### Robotics + vision:

- Path different every time
- Collision check complex on full robot
- Fast new algorithms needed

Not OFFline but Online calculation needed

# Categorie groot: Digital Twin





# Categorie groot: Video



- Objecten binnen 0.2s
- Georiënteerd afleggen
- Hier dozen, kan ook op pijpen, panelen, platen etc.

# Let op: Aandachtspunten

- Oplossing: klantspecifiek, maar modulair
- Klant kan machine bedienen/instellen
- Eigen tool/celdesign mogelijk
- Nauwkeurigheden en toleranties
- Eerst testen met samples: materiaal belangrijk
- Verschillende producten op één lijn?
- Wat heeft waarde? Snelheid, precisie, productspectrum?
- Hou rekening met mispicks

# Flexibel Bin-Picken met robots en verschillende 3D technieken

Bedankt voor de aandacht

Ir. Matthieu Bemelmans

Project Leader | Algorithm Specialist

VinciTech