BREAK OUT SESSIE

Smart Manufacturing

- Kies voor full screen weergave (zie icoontjes rechts onderin uw beeld)
- Vragen? Zet ze in de Q&A of bewaar ze tot de Ask the Expert sessie later in het programma
- Alle break outs zullen worden opgenomen en de presentaties worden achteraf met u gedeeld.

Agenda

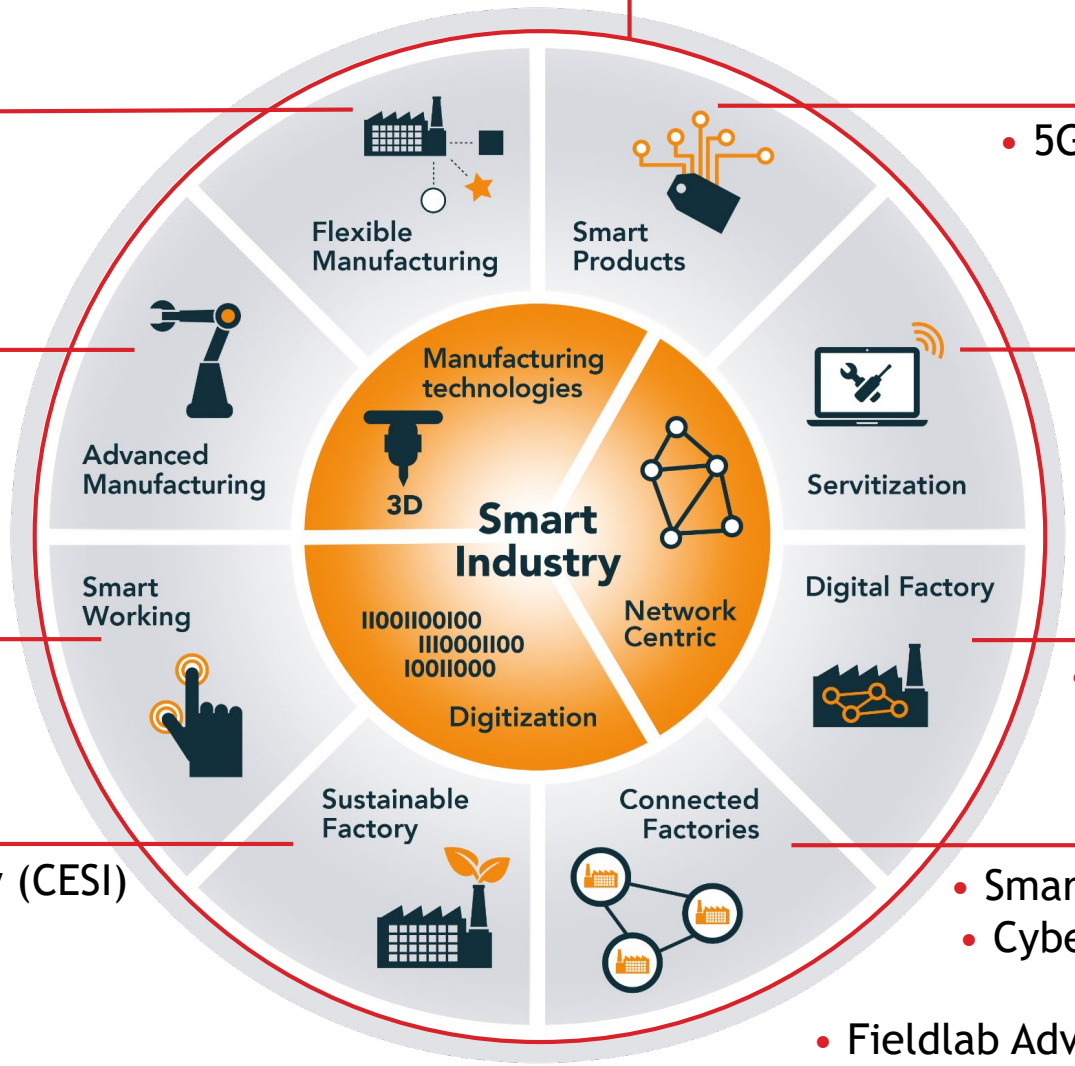
- **Introductie**
- K3D-AddFab 3D Metal Printing – Luuk Wissink
- Multi Material 3D Printing – Gerald van Santen
- Fieldlab Flexible Manufacturing – Randy Kerstjens
- Q&A
- Poll

Projects overview

1. Fieldlab Flexible Manufacturing
2. Smart Connected Supplier Network
3. Fieldlab Multi-Materiaal 3D
4. Addfab 3D Metal Printing
5. Fieldlab High Tech Software Cluster
6. FutureTec
7. Advanced Manufacturing Logistics
8. Digital Factory of the Future

SMART INDUSTRY TRANSITIONS

- High Tech Software Cluster
- Fieldlab Flexible Manufacturing
- 5G High Tech Application Center
- K3D-Addfab (3D metal printing)
- Fieldlab Multi Material 3D
- Data Value Center - SI
- FutureTec (Education & Training)
- Digital Factory of the Future
- Circular Economy in Smart Industry (CESI)
- Smart Connected Supplier Network
- Cyber Resillience Center Brainport
- Digital Innovation Hub AI
- Fieldlab Advanced Manufacturing Logistics



Agenda

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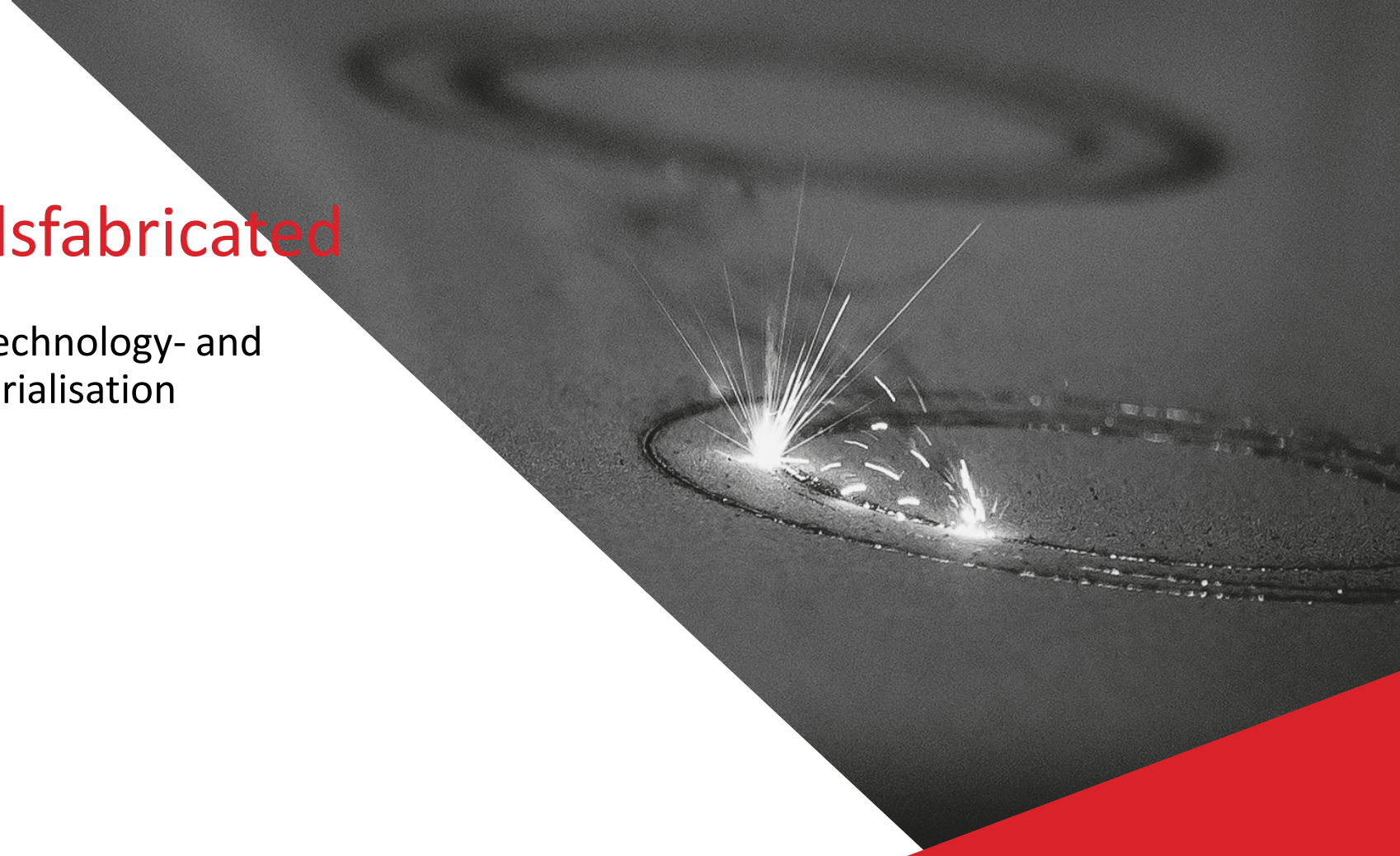
- Q&A
- Poll

INNOVATION PROGRAM

K3D-AddFab 3dmetalsfabricated



3D Metal Additive Manufacturing technology- and expertise centre focussed on industrialisation of 3D metal printing

- Industrialisation
- Quality management
- Industrial applications

K3D
MASTERS IN 3D METAL PRINTING

INNOVATION PROGRAM

K3D-AddFab 3dmetalsfabricated

PARTNERS

K3D
MASTERS IN 3D METAL PRINTING

KMWE

NTS

SUMMA College

DE VALK
value added metals

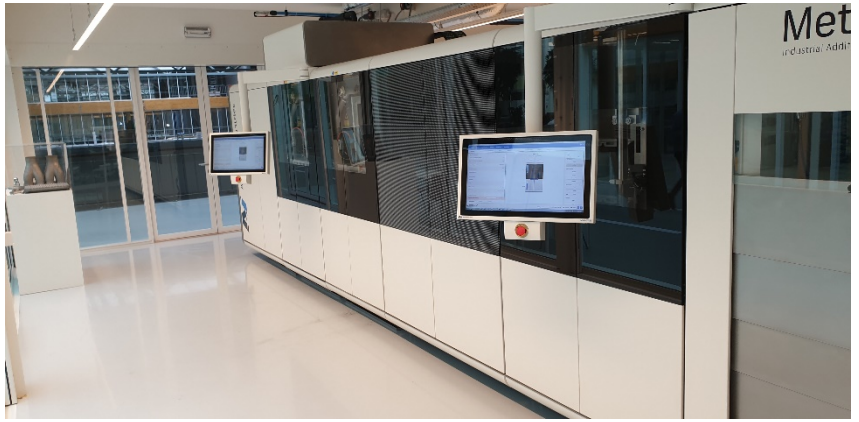
Additive Industries

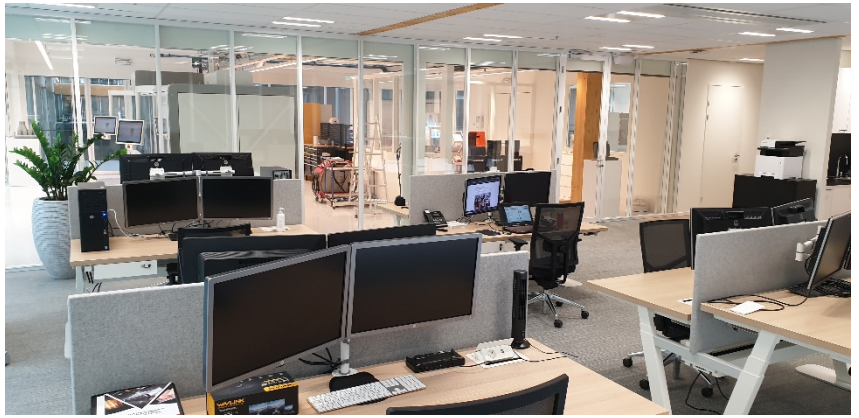
Brainport
Industries

K3D
MASTERS IN 3D METAL PRINTING

Quick overview

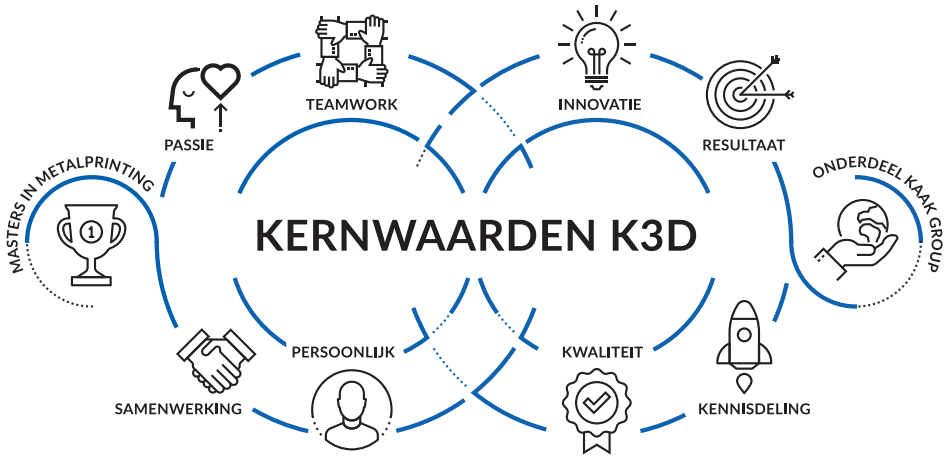
- Phisically located @ BIC D.08
- 3D metal printing
- More than 6 years experience
- > 90.000 3D metal printed applications
- 2 Industrial metal printers

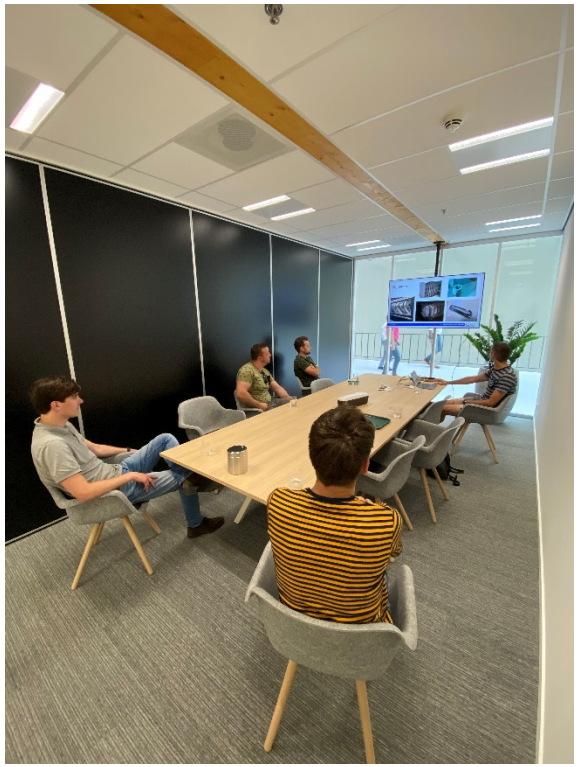


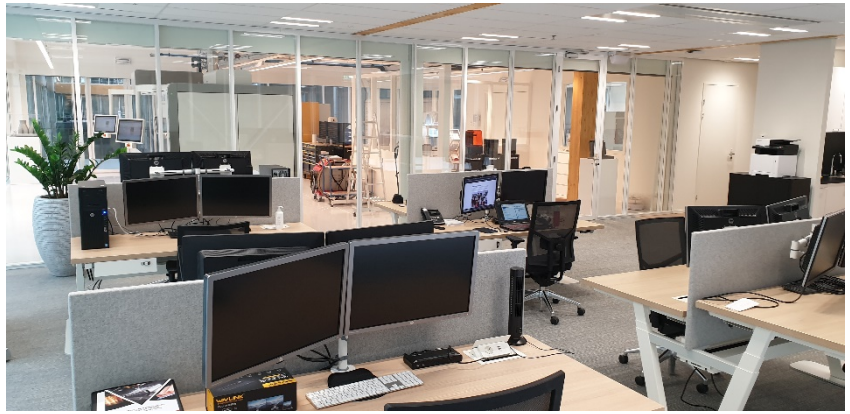


Core values

- Joint research
- Teamwork
- Innovation
- Knowledge sharing
- Co-creation
- Cooperating rather than competing





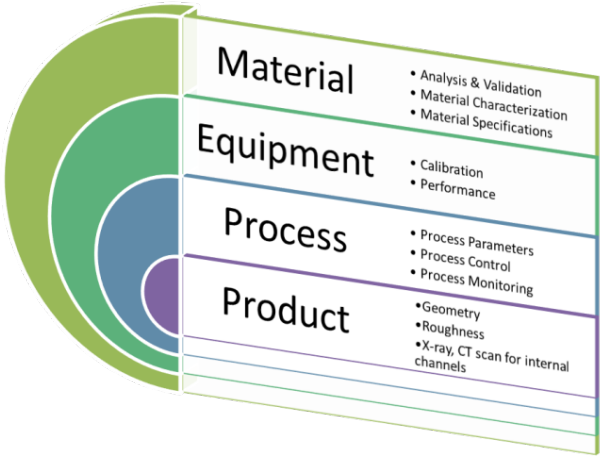


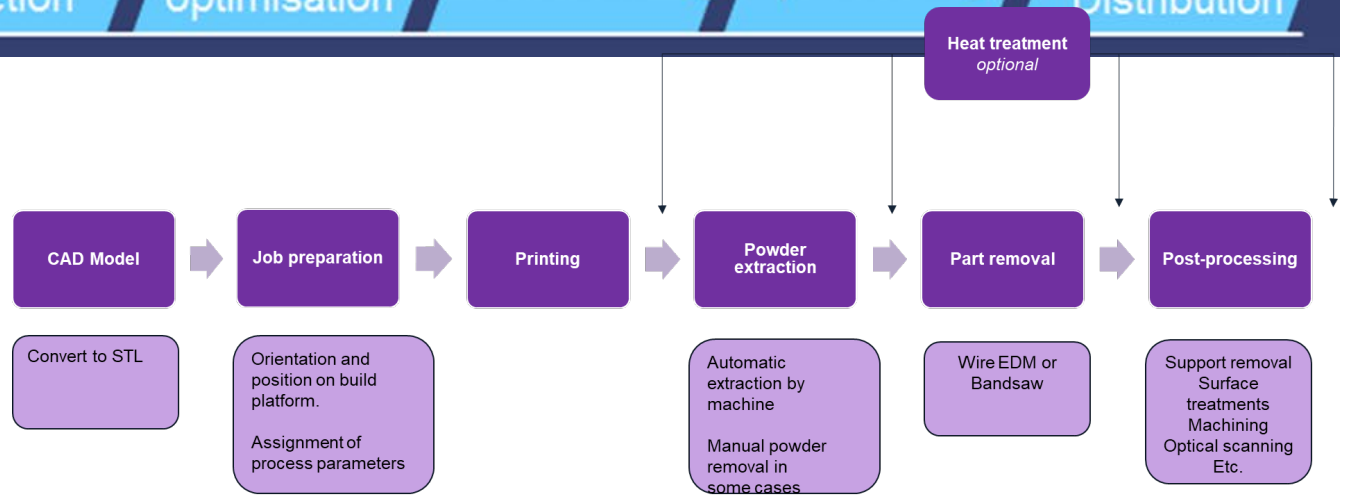
K3D
MASTERS IN 3D METAL PRINTING

Industrialisation

General remarks during research:

- Logging of results and a blueprint of the process are key to accellerate
- Difficult to implement





Quality management

General remarks during research:

- Logging
- Reproducibility
- Standardization

1. BUILD PREPARATION

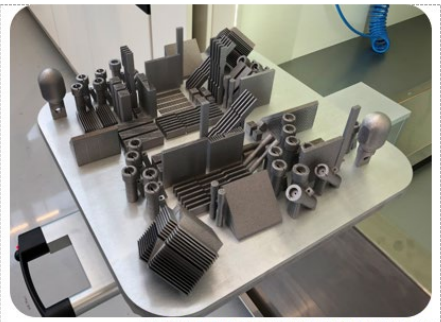
A. TEST SAMPLES

Several tests were chosen to use as input for the design of the Engineering Model of the telescope housing. Furthermore several tests were chosen to be repeated to compare the results of the MetalFab1 machine to the SLM 280HL machine used in the first phase of the SROSP study.

Table 1.1 displays a short overview of the test samples in this sample program. A full overview can be found in the test matrix which is added as attachment in this report.

Sample Type	Amount	Orientations	Remarks
Tensile Bars	34	0, 45 & 90 degree	Same as during first SROSP study
Charpy Blocks	16	0, 45 & 90 degree	Test results not available from first SROSP study
Hardness Blocks	4	0, 45 & 90 degree	
BRDF Plates	8	45 & 90 degree	Multiple plates to test different black coatings
Density Blocks	10	0 degree	
Vane Structure	6	0, 45 & 90 degree	Test to see what is possible with thin walled structures
Baffle Structure	22	45 & 90 degree	Test to see if it is possible to integrate the baffle structure in the telescope housing
Metallography	3	90 degree	
Fatigue Rods	12	0, 45 & 90 degree	
Powder Capsules	2	NA	

Table 1.1: List of all samples



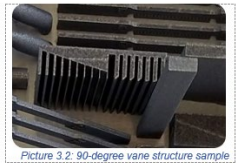
Picture 1.1: All test samples visible on building plate

B. VANE STRUCTURE SAMPLES

Testmatrix & Test set-up

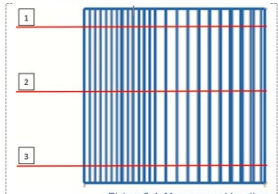
Six specimens were assigned for testing different wall thicknesses and the consistency of these thicknesses under varying build angles. Two specimens were printed in a flat 0-degree angle (059 & 060), two specimens under a 90-degree angle (061 & 062), as seen in picture 3.2. The final two (062 & 063) were printed under a 45-degree angle on three sides to see the performance in all conditions. (picture 3.2).

Number 059 was disabled during printing to prevent damaging the recoater.



Picture 3.2: 90-degree vane structure sample

All wall thicknesses were measured on two or three locations across the wall with a digital caliper and compared to the nominal values. This is shown in picture 3.4.



Picture 3.4: Measurement locations

Picture 3.3: 45-degree vane structure sample

Test results

The measured average of the test results are shown in table 3.4, all other can be found in the test matrix, added as attachment. Sample 063 & 064 each have three sides. Therefore measurements on these samples were done three times.

	Geometrical Inspection Left to Right (mm)																
#	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.1	0.15	0.2	0.25	0.3	0.4	0.5	0.6	0.8	1.0
060	1.60	1.57	1.58	1.57	1.55	1.54	1.59	0.16	0.22	0.27	0.22	0.33	0.4	0.57	0.61	0.84	1.03
061	1.55	1.52	1.56	1.56	1.58	1.58	1.56	0.17	0.21	0.23	0.27	0.34	0.39	0.54	0.67	0.83	1.06
062	1.54	1.55	1.55	1.55	1.52	1.55	1.54	0.16	0.20	0.22	0.21	0.31	0.39	0.55	0.65	0.84	1.03
063.1	1.53	1.55	1.57	1.53	1.53	1.45	1.55	0.20	0.21	0.24	0.25	0.32	0.39	0.54	0.67	0.84	1.09
063.2	1.58	1.54	1.54	1.53	1.53	1.54	1.53	0.22	0.21	0.25	0.26	0.32	0.40	0.54	0.65	0.84	1.04
063.3	1.49	1.50	1.50	1.46	1.52	1.50	1.51	0.24	0.24	0.28	0.25	0.32	0.42	0.53	0.66	0.83	1.03
064.1	1.54	1.54	1.54	1.52	1.53	1.52	1.54	0.21	0.23	0.26	0.25	0.29	0.41	0.57	0.65	0.86	1.04
064.2	1.52	1.51	1.51	1.52	1.52	1.52	1.52	0.20	0.21	0.22	0.28	0.29	0.37	0.56	0.65	0.84	1.04
064.3	1.55	1.53	1.51	1.48	1.5	1.51	1.51	0.21	0.32	0.27	0.32	0.32	0.45	0.54	0.64	0.84	1.04

Table 3.4: Geometrical inspection of vane thickness

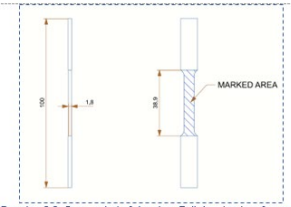
D. TENSILE SAMPLES

Testmatrix & Test set-up

The same 34 tensile specimens were printed as during the SROSP Phase 1 study. During product removal six 0-degree tensile specimens however were damaged and deemed unusable for tensile testing. It was therefore decided that tensile bar 005 would be tested in an 'as build' condition, to give more data on the 0-degree tensile bars.

Testing is performed by the Coating Evaluation Lab at KMWE Aero Engine on a Zwick/Roell type BZ1-MM14750.ZW0. The full test report is added as attachment.

Picture 3.5: Zwick/Roell BZ1-MM14750.ZW0



Drawing 3.2: Screenshot of drawing. Full drawing in reference #8

Test results

The test results are shown in table 3.6. An average is given for each possible condition. Furthermore table 3.7 shows a comparison between the results from machine tensile bars printed in a 90-degree angle. This comparison is between samples from the first SROSP study, which were printed on a SLM280HL machine against the Factory Acceptance Test results and samples printed during this sample program.

Noticeable conclusions

- Build plate heating set at 100°C looks to have had an impact on the mechanical properties when comparing them between the non-stress relieved FAT settings. The height of this impact is however unclear and future testing is necessary to confirm it.
- Some values are far off from the average, which might be caused by faulty testing. This could be due to the small dimensions of the tensile bars in combination with the material. Due to this al future tensile tests will be done with cylindrical tensile bars which have a larger more steady cross section.
- Tensile bars in Phase 1 of the SROSP study were not stress relieved, which makes comparing the specimens difficult.

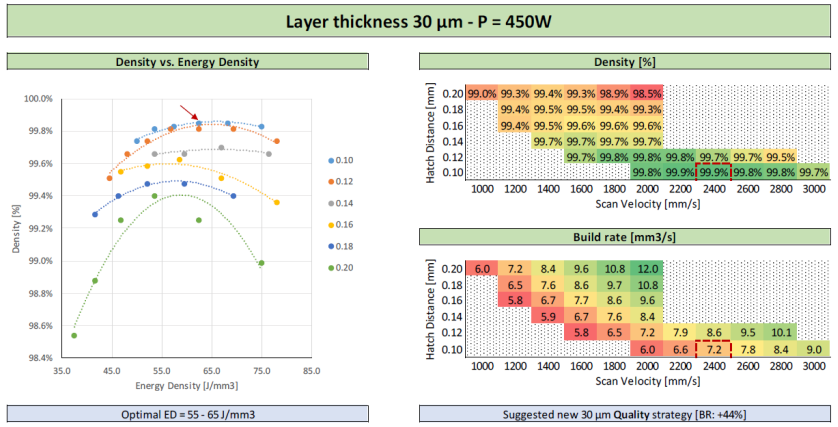
Picture 3.6: Machined tensile sample

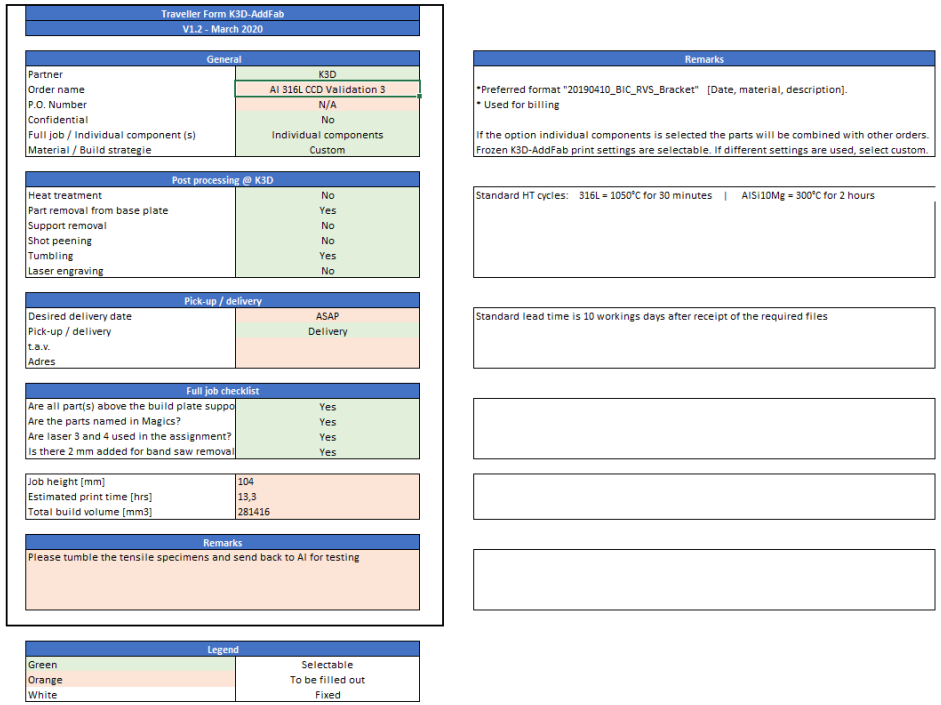
Industrial applications

General remarks during research:

- Proces development
- Faster printing / speed settings / lower cost price
- Workflow traveller form → improve process and ready for series production

Process development AlSi10Mg - Results





Traveller Form K3D-AddFab
V1.2 - March 2020

General	
Partner	K3D
Order name	Al 316L CCD Validation 3
P.O. Number	N/A
Confidential	No
Full job / Individual component (s)	Individual components
Material / Build strategie	Custom

Post processing @ K3D	
Heat treatment	No
Part removal from base plate	Yes
Support removal	No
Shot peening	No
Tumbling	Yes
Laser engraving	No

Pick-up / delivery	
Desired delivery date	ASAP
Pick-up / delivery	Delivery
t.a.v.	
Adres	

Full job checklist	
Are all part(s) above the build plate suppo	Yes
Are the parts named in Magics?	Yes
Are laser 3 and 4 used in the assignment?	Yes
Is there 2 mm added for band saw removal	Yes

Job height [mm]	104
Estimated print time [hrs]	13,3
Total build volume [mm3]	281416

Remarks
Please tumble the tensile specimens and send back to Al for testing

Remarks
*Preferred format "20190410_BIC_RVS_Bracket" [Date, material, description].
* Used for billing

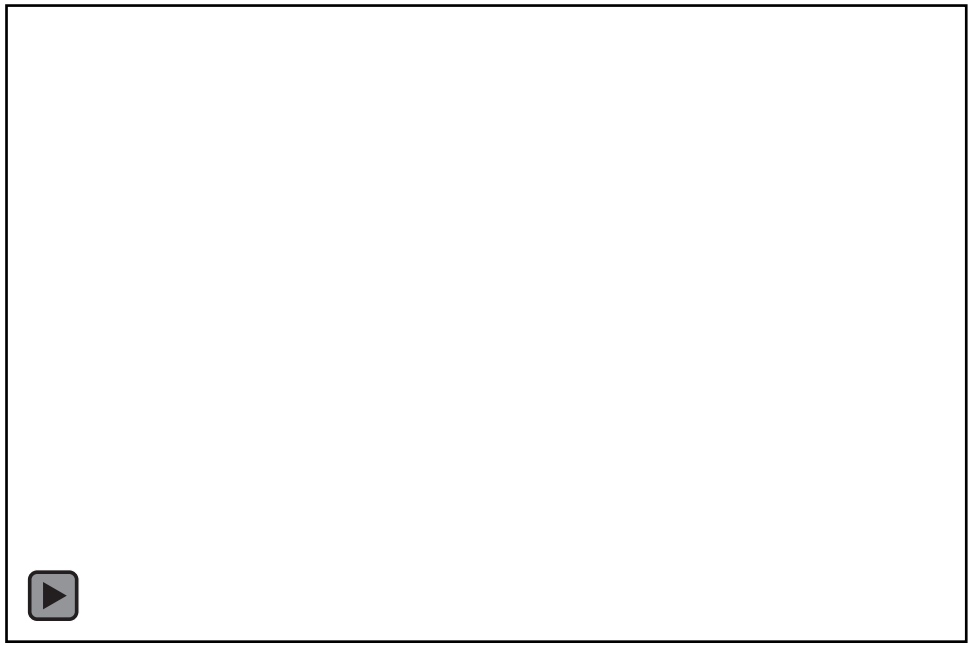
If the option individual components is selected the parts will be combined with other orders.
Frozen K3D-AddFab print settings are selectable. If different settings are used, select custom.

Standard HT cycles: 316L = 1050°C for 30 minutes | AlSi10Mg = 300°C for 2 hours

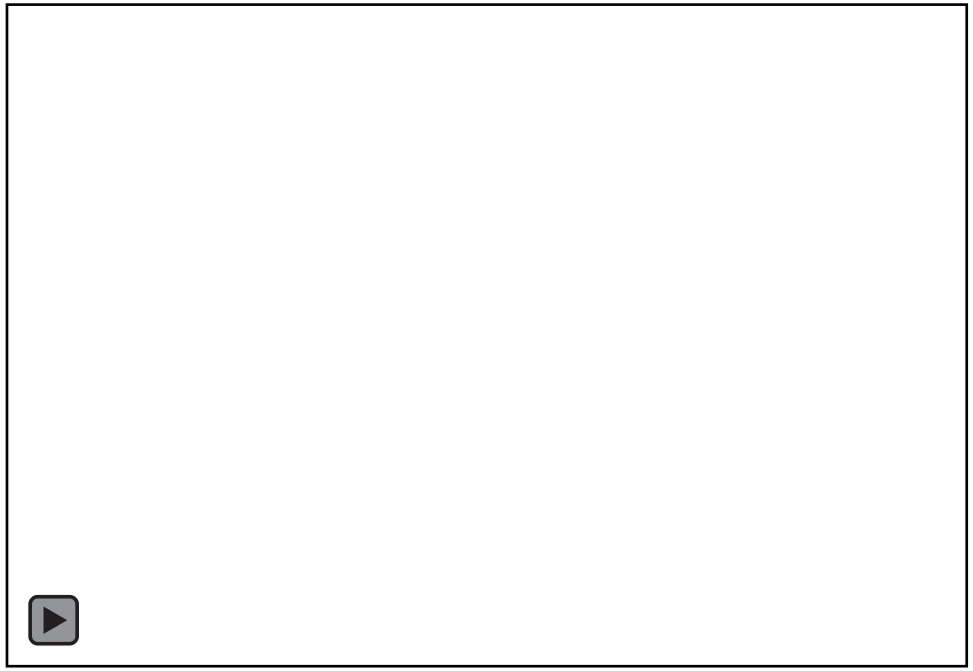
Standard lead time is 10 workings days after receipt of the required files

Legend	
Green	Selectable
Orange	To be filled out
White	Fixed

New developments



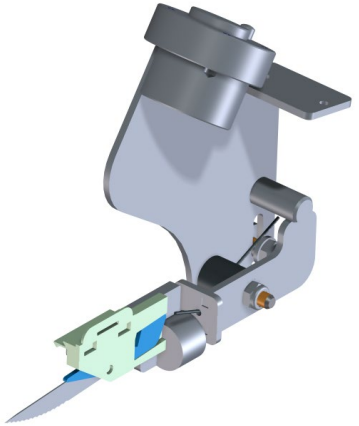
Translation actuator



Rotation actuator

K3D
MASTERS IN 3D METAL PRINTING

Businesscase – cutting knife (1/2)

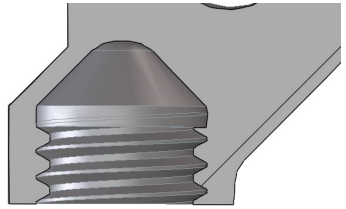


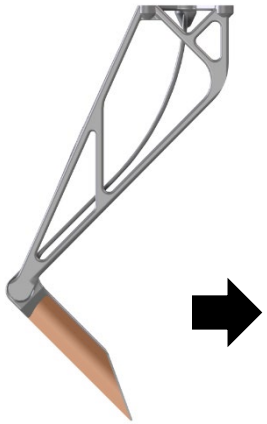
Old design (instable)

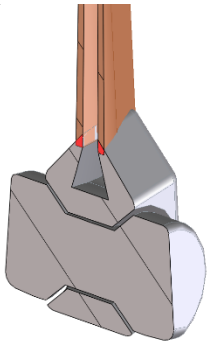
1. A lot of parts (20)
2. Heavy (900 grams)
3. Long lead time for complete production and assembly
4. A lot of production steps
5. Dough sticks to the knife
6. Not stiff enough
7. Big error probability

Goal:
Improve the weaknesses and use the same interface for attaching to the robot

Businesscase – cutting knife (2/2)



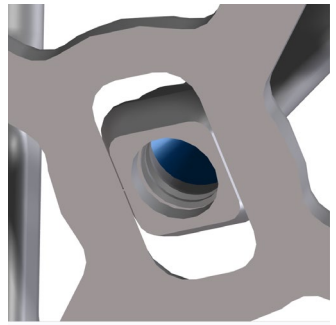




Modifications (opportunities 3DP)

1. Freedom of design
2. Funtion integration
3. Include thread
4. Bearing
5. Leafspring with internal air channels
6. Adapt stiffness of leafspring
7. Personalization

Conclusion:
Optimal use of the possibilities of 3DP.



K3D
MASTERS IN 3D METAL PRINTING

What can we do for you?

- Knowledge and inspiration sessions
- Training and education
- Guidance in finding and searching for the business case
- A large ecosystem
- Production of prototypes, small series or medium series
- 3D printing in stainless steel, aluminum and tool steel
- Shorter the delivery times

Contact us @:

addfab@k3d.nl

eindhoven@k3d.nl

lwissink@k3d.nl

0315-339432 / 06-42204187

Or contact one of our partners

DE VALK value added metals

KMWE

NTS

SUMMA College

Brainport Industries

Additive Industries

Agenda

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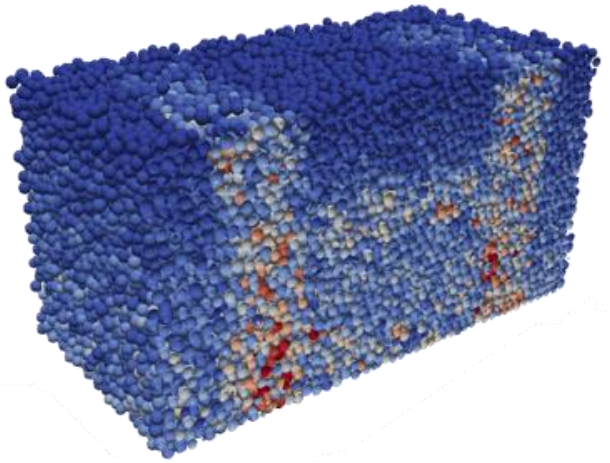
- Poll

INNOVATION PROGRAM

Fieldlab
Multi Material 3D



An eco-system that focusses on

industrial multi material additive manufacturing opportunities.

- Applications
- Pilotlines within fieldlab
- Research
- Automisation of additive manufacturing processes

FIELDLAB MM3D

Scope

Project: Next Step in industrial multi-material AM

Development of a pilot plant for polymer and multi-material additive manufacturing.

Industrio's pilot line high-speed printer will be the first industrial polymer printer for mass customization of printed shoes and insoles.

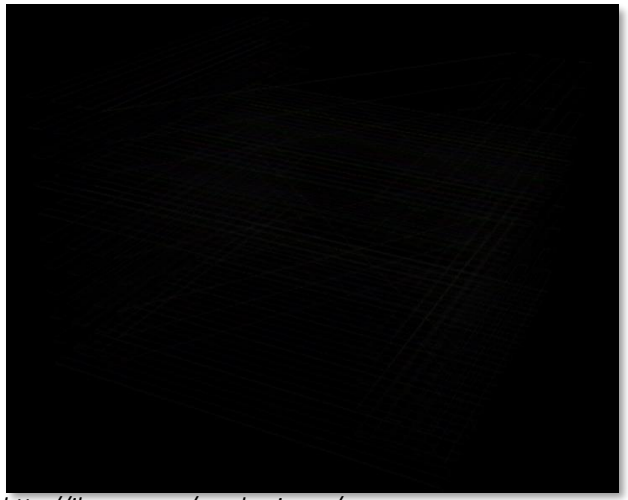
The AMPC Solutions pilot line will be the first industrial 3D print farm solution for automated printing of spare parts for example for automative, tooling, jix and fixtures.

TU/e will be analyzing and optimizing the properties of the different materials and material interfaces as a result of the process conditions.


TU/e

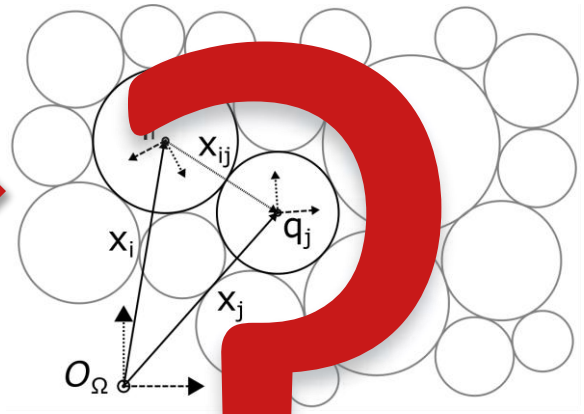
Simulation of Additive Manufacturing (AM) processes

- Input:
  - G-code
    - Print path
    - Printer settings
  - Pro-file
    - Material parameters
    - Model parameters
    - Integration parameters



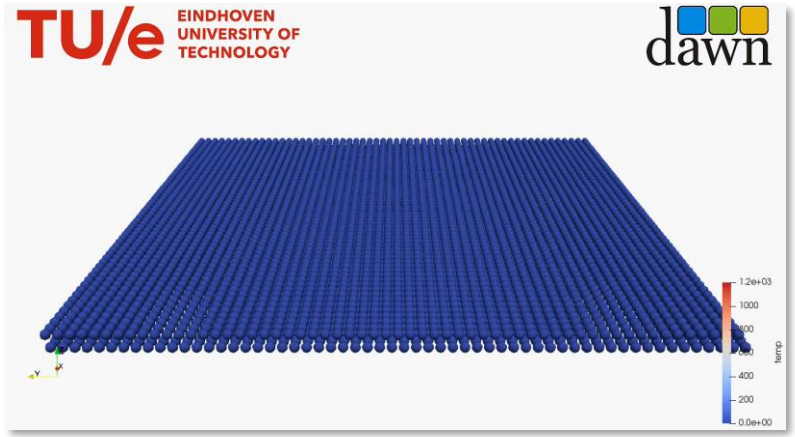
http://jherrm.com/gcode-viewer/

- Simulation:
  - Discrete Element Method (DEM) framework



- Including
- Thermo-mechanical coupling
- Contact, b s, gravity & damping
- Conductio heat source
- Thermal dependency
- Distinct powder & solid interactions
- Boundaries & material deposition

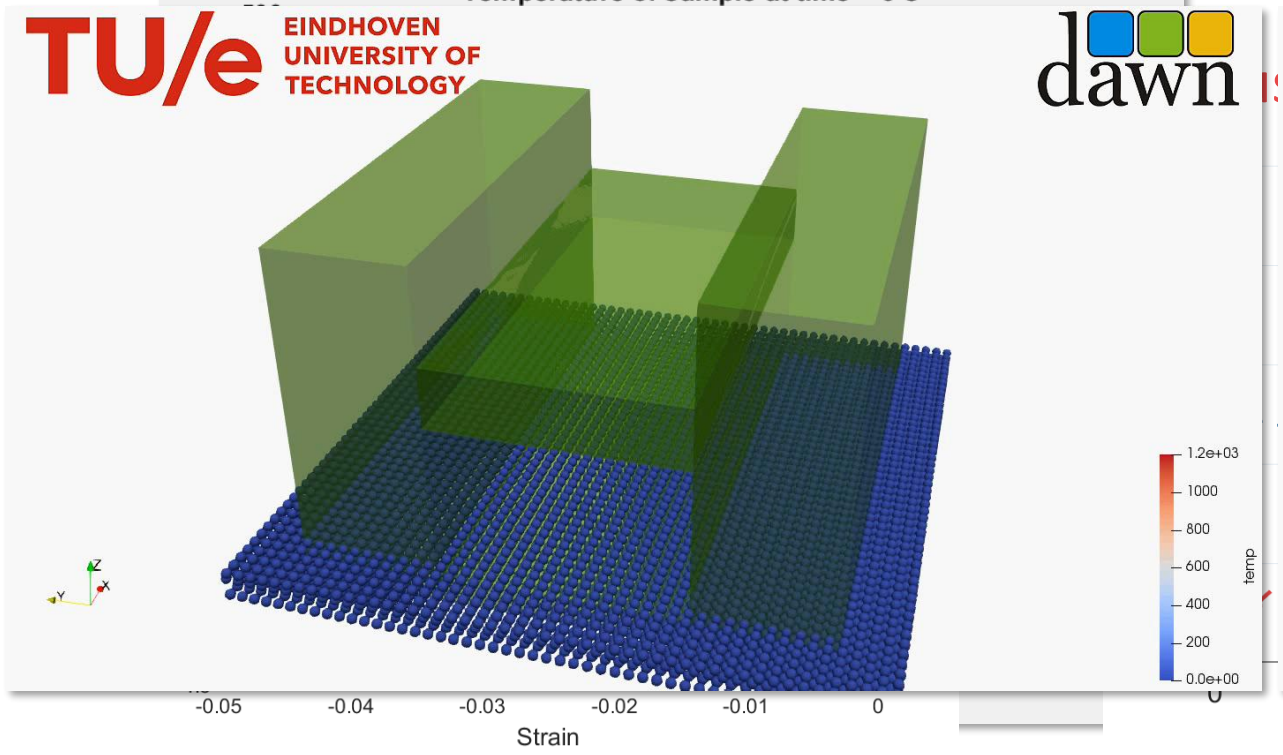
- Result:
  - VTK output - Paraview
  - Full process data



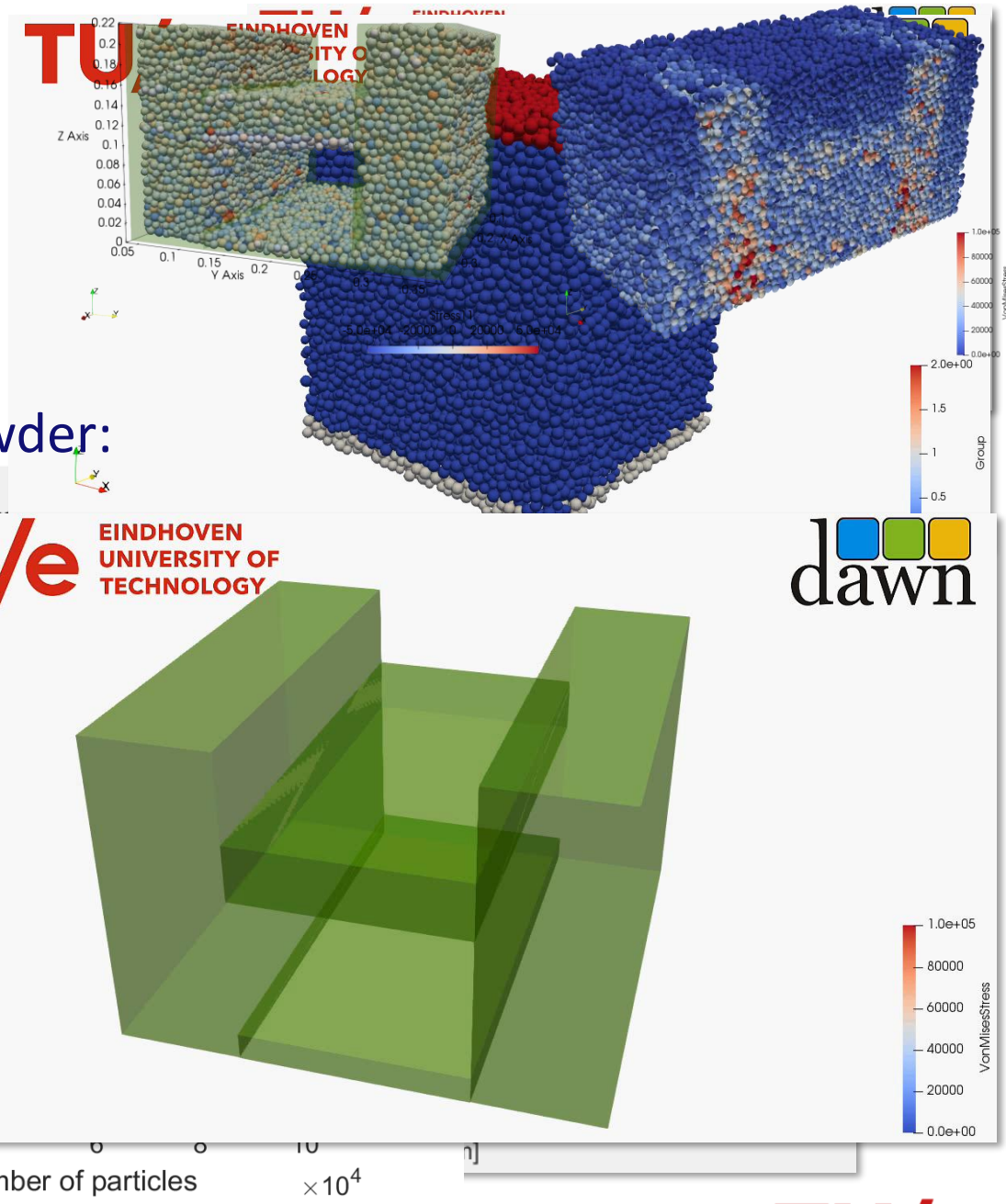
Capabilities of DEM framework

- Simulation of heat conduction
- Simulation of solid properties
- Simulation of printing process: H-shape

Solid:



Powder:




INDUSTRIO

FIELDLAB MM3D

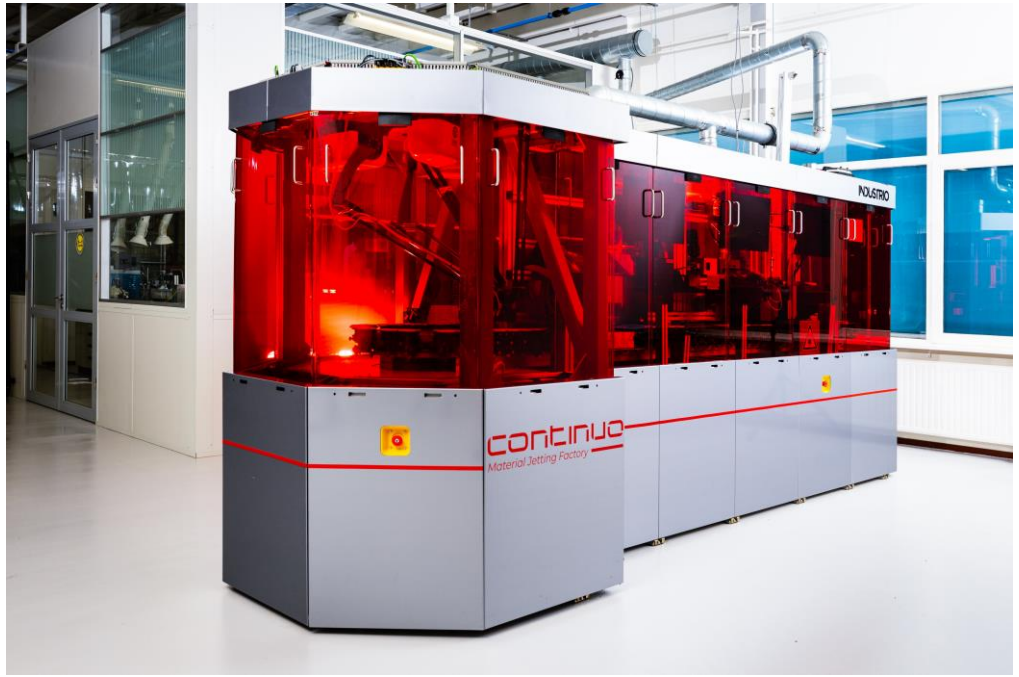
Industrio – Smart manufacturing

Development of a multi material 3D printing industrial machines. Factories in a container, dedicated and specialised machines to enable a new way to produce:

- Flexible
- Distributed
- Personalised

The developed production systems are based on several 3DP techniques, such as:

- Material Jetting
- Selective Laser Sintering
- Material Extrusion



FIELDLAB MM3D

Industrio

Products focus lies in consumer wearables, e.g:

- Shoes and insoles
- Prosthetic implants
- Glasses

Multi material lies in:

- Different polymer materials
- Combining different printing techniques
- Embed electronic products

If you have any use cases, please contact us!


AM
PC
SOLUTIONS.COM

Industrial Additive Manufacturing Printfarms

AMPC
SOLUTIONS.COM

BIC MM3D Project

AMPC SOLUTIONS.COM

Scope

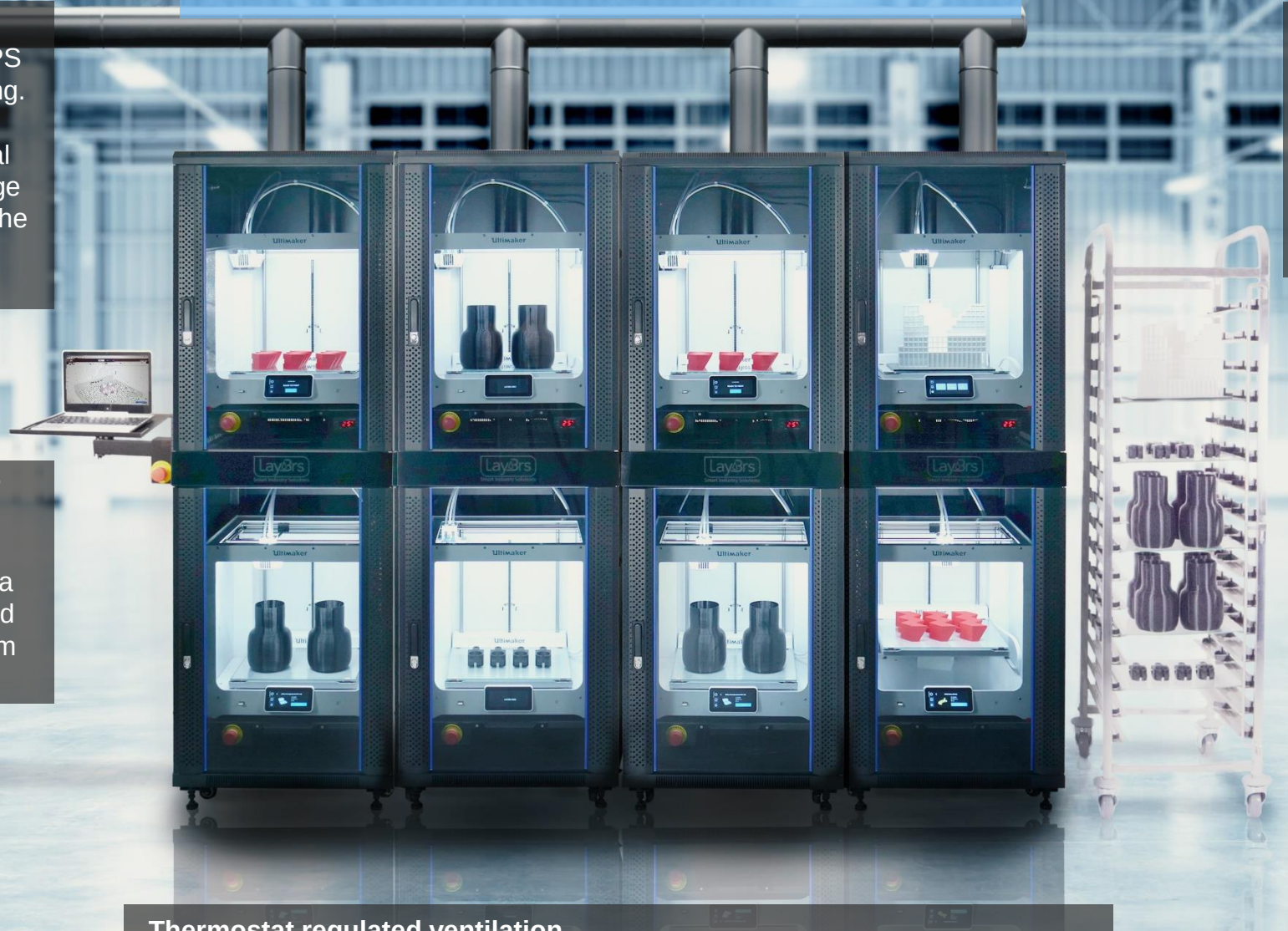
- Hardware: Acclimated cabinets with particle and airmanagement system (local/central) with future automatic loading and unloading system (gantry/co-bot) (working together with partners such as: Ultimaker)
- Software: Integrating automising and production software into industrial printfarm (working together with partners such as: 3yourmind)
- Business Cases: with printed products; workshops printing with multi-material filament. Example: Printing with steel (316L) in a printfarm

Example with co-bot

Your ultimate Printfarm

Touch screen console
For printer management, UPS monitoring and error signaling. Work offline or in the entire network with the professional Ultimaker software to manage your print jobs, or integrate the total solution within your network with Cura Connect.

Lockable glass front door
Lockable doors prevent unwanted access to the 3D Printers. Easy to open with a lockable glass front door and blind back door for maximum accessibility.



Equipped with UPS
For dealing with power outages, the UPS has a capacity to handle 10 to 20 minutes. Your printers will continue until the power supply is up and running.

Fully extendable rail system
For easy access of your 3D Printer, the printers can be fully pulled out of the rack. This enables you to replace the filament on the back or perform maintenance.

Thermostat regulated ventilation
Ensure an optimum climate for the printing process and electronics, with temperature-controlled fans, including air filters to enable a healthy work environment. .

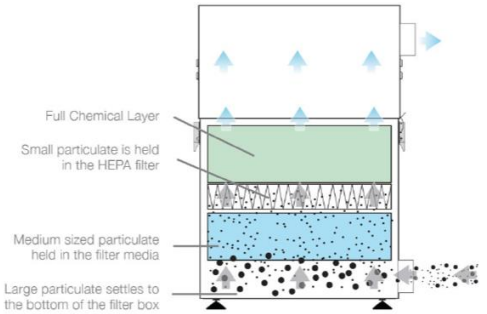
AMPC

Cabinet AMPC
10060 (DUAL)

Cabinet
AMPC 16080

Cabinet
AMPC
22060

Central Air Management system



Decentral industrial filtering unit

Our partner benefits

Value Proposition 

1. Founders and team experienced in AM/3D printing
2. Solution for industrial and educational purposes
3. Using AMPC cabinets increases efficiency and
4. Saves space on shop floor
5. Helps the operation of desktop size 3D printers in a controlled and compact environment
6. Flexibility to tailor finish cabinets as per customer's needs
7. AMPC offers one-stop shopping for a full configuration
8. Broad level of cooperation possibilities from drop shippers to distributors
9. Easy-to-install cabinets

Key Selling Arguments 

1. Integrated solution
2. Safety
3. Stable production environment
4. Available in 4 different dimensions
5. Cabinets with neat and clean design
6. Makes a 3D printer farm mobile in-house

Set-up your AMPC 3D Printfarm Solution

Contact information

Wilt u graag meer informatie over het Fieldlab MM3D?

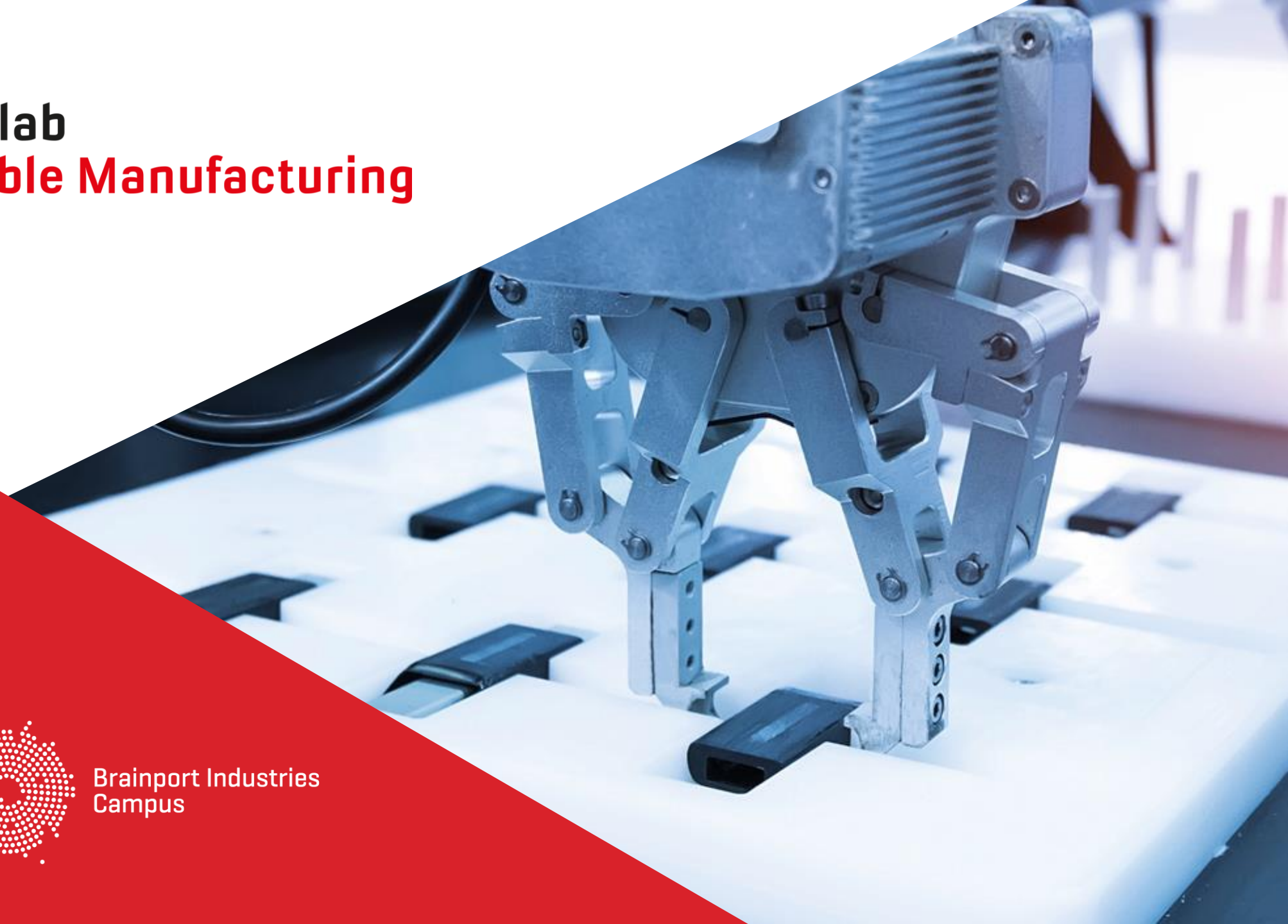
Neem dan contact op met:

- **Industrio**: Ir. Marc Evers - Marc.Evers@industrio3d.com
- **AMPC solutions**: Ir. Ing. Arno Gramsma - arno@ampc-solutions.com - +31 (0)6-10904189
- **TU/e**: Dr. ir. Joris Remmers, Associate Professor - J.J.C.Remmers@tue.nl

Agenda

- Introductie
- K3D-AddFab 3D Metal Printing – Luuk Wissink
- Multi Material 3D Printing – Gerald van Santen
- **Fieldlab Flexible Manufacturing – Randy Kerstjens**
- Q&A
- Poll

Fieldlab
Flexible Manufacturing



Brainport Industries

Brainport Industries Campus

Quick overview

- Consortium (20+ partners)
  - End-users & manufacturing companies
  - System Integrators & Technology Providers
  - Knowledge institutions
- Physically located on the BIC
- An environment for
  - Inspiration through demo’s
  - Meeting and testing new techniques
  - Training and workshops

Partners

TNO
NEWAYS
KMWE
MaromeTech
making robotics & mechatronics work for you!
avans hogeschool
Berenschot
Brabantse Ontwikkelings Maatschappij BOM
Brainport Industries
ACCERION
YASKAWA
SMART ROBOTICS
MASTERS IN FLEXIBLE AUTOMATION
PERFECT ASSEMBLAGEBEDRIJF
rexroth A Bosch Company
Bronkhorst® Flow Technology
FESTO
OMRON
TU/e
TEGEMA
de cromvoirtse
snel metaal op maat
total productivity
improves your productivity
Fontys
VinciTech
Implementers of Innovation

Fieldlab
Flexible Manufacturing

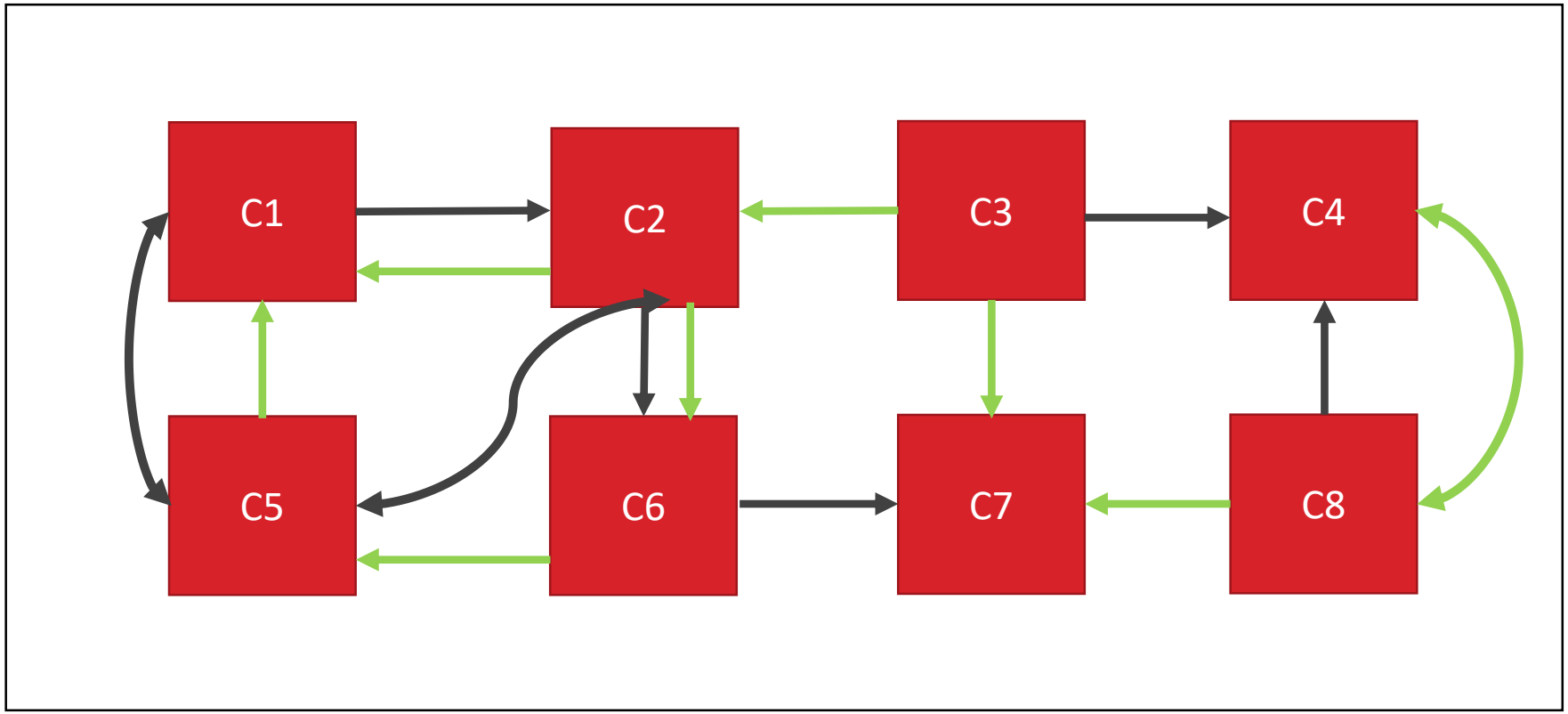
WHAT IS A

Flexible Manufacturing System

> A production system that is designed to easily apapt to changes in the type and quantity of the product being manufactured. Machines and computirezed systems can be configured to manufacture a variety of parts and handle changing levels of production.

OUR VISION ON

Flexible Manufacturing with a cell-architecture



Fieldlab
Flexible Manufacturing

Technologies used..

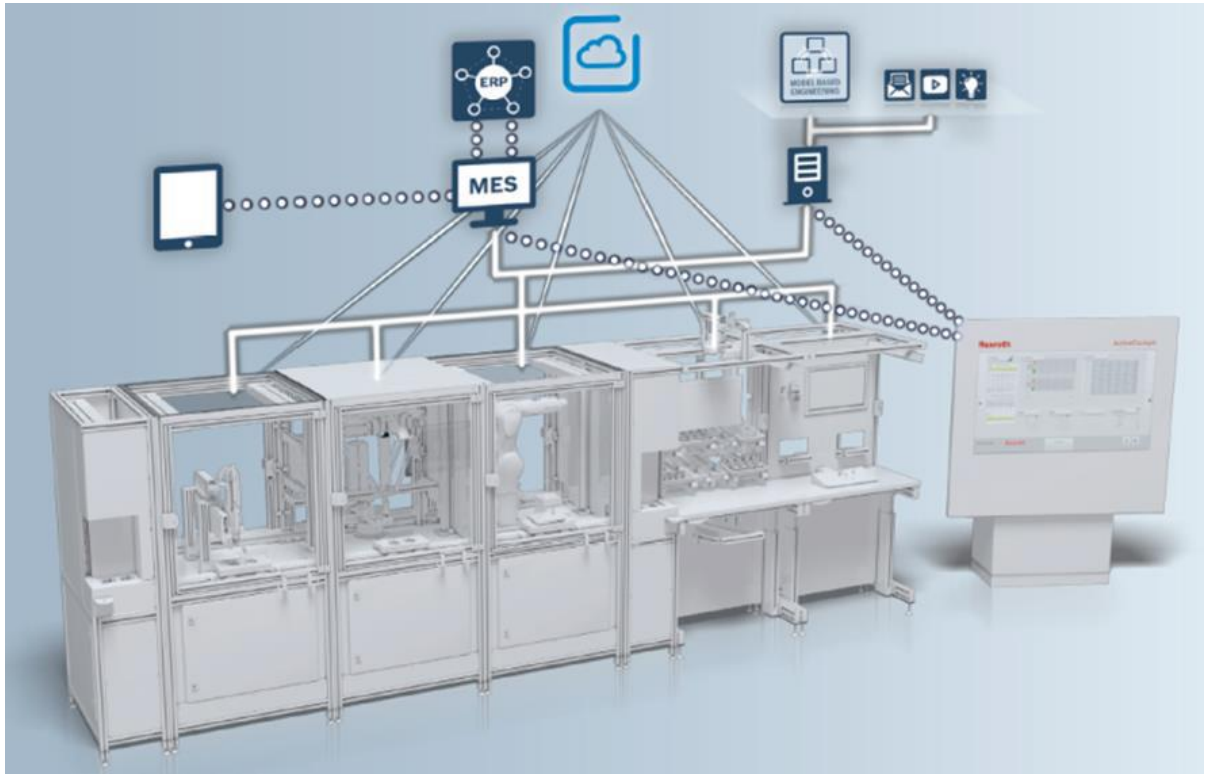
- Robotic arms (cobots / robots)
- Autonomous Mobile Robots
- Vision systems
- Transport systems
- AR / VR
- Artificial Intelligence
- Etc…..

Main focus area’s

1. Self-learning assembly line
2. Human-robot collaboration
3. Flexible handling
4. Binpicking
5. Safety, flexibility and traceability

MAIN FOCUS AREA'S (1 OF 5)

Self-learning assembly line



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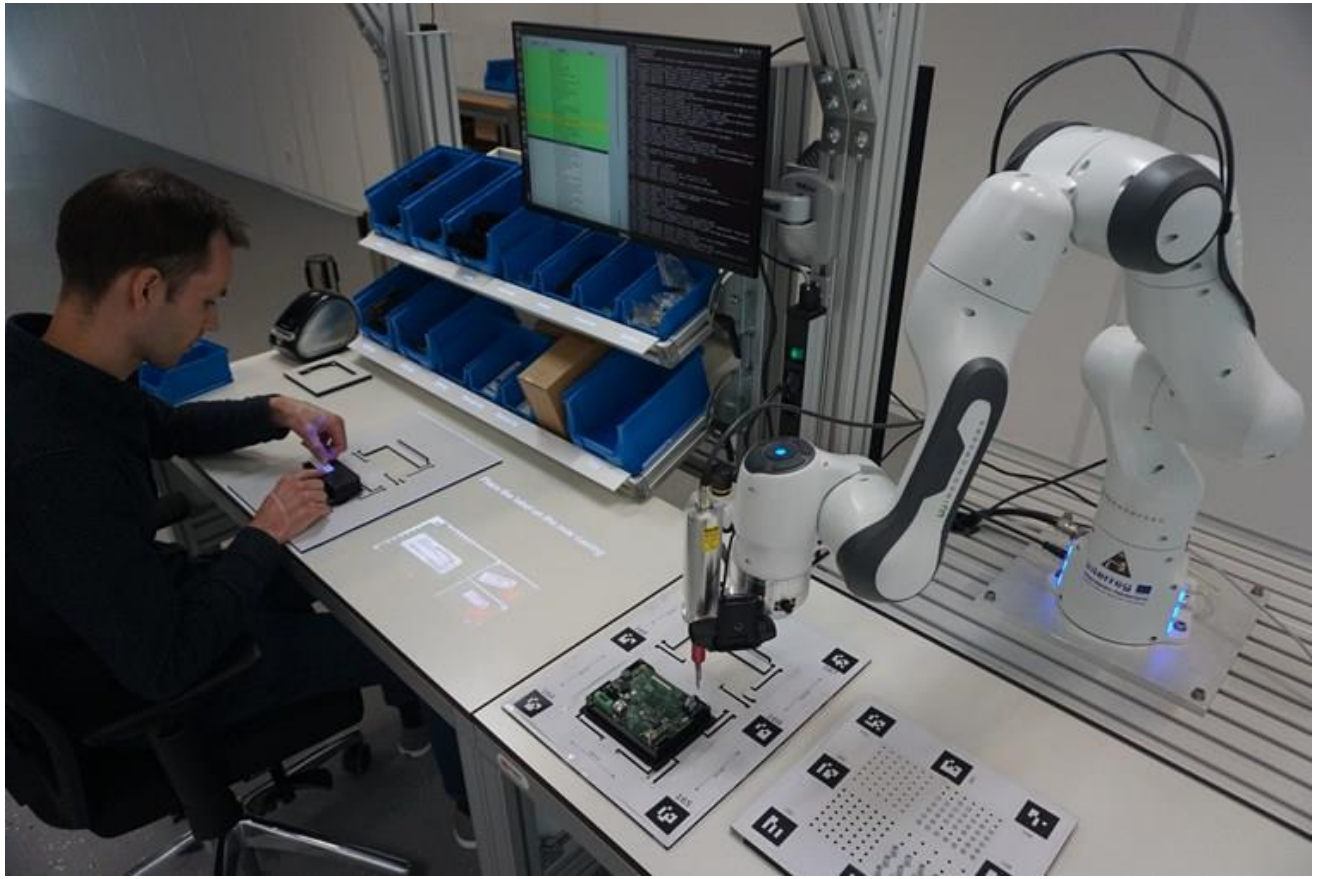
Flexible Manufacturing

MAIN FOCUS AREA'S (2 OF 5)

Human-robot-collaboration



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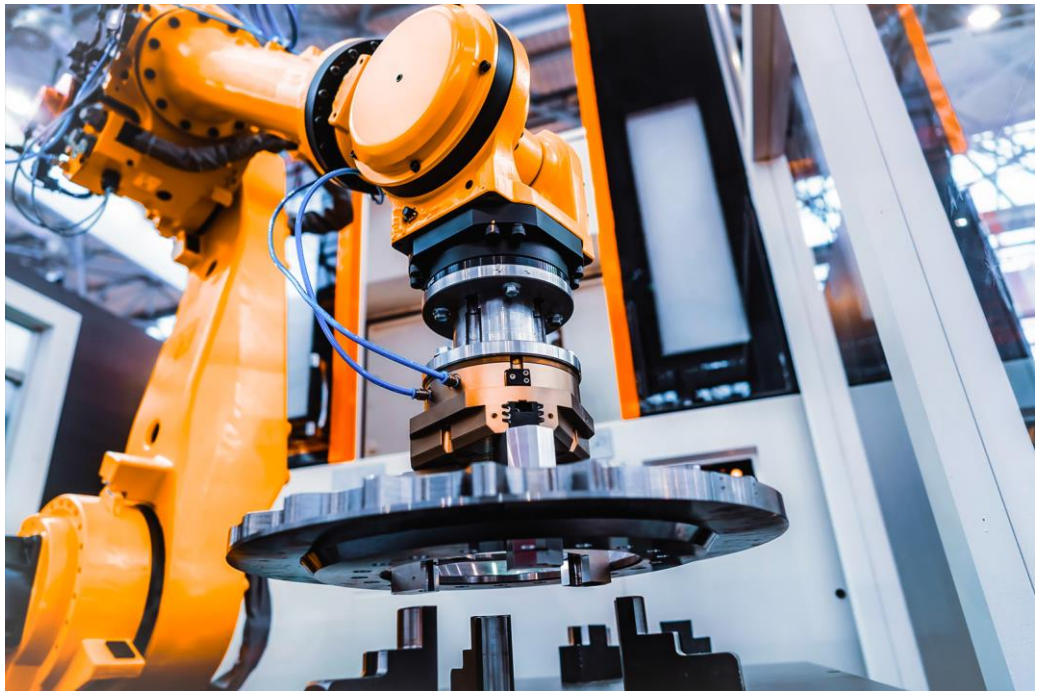
Flexible Manufacturing

MAIN FOCUS AREA'S (3 OF 5)

Flexible handling

- Zero programming
- Flexible gripper technology



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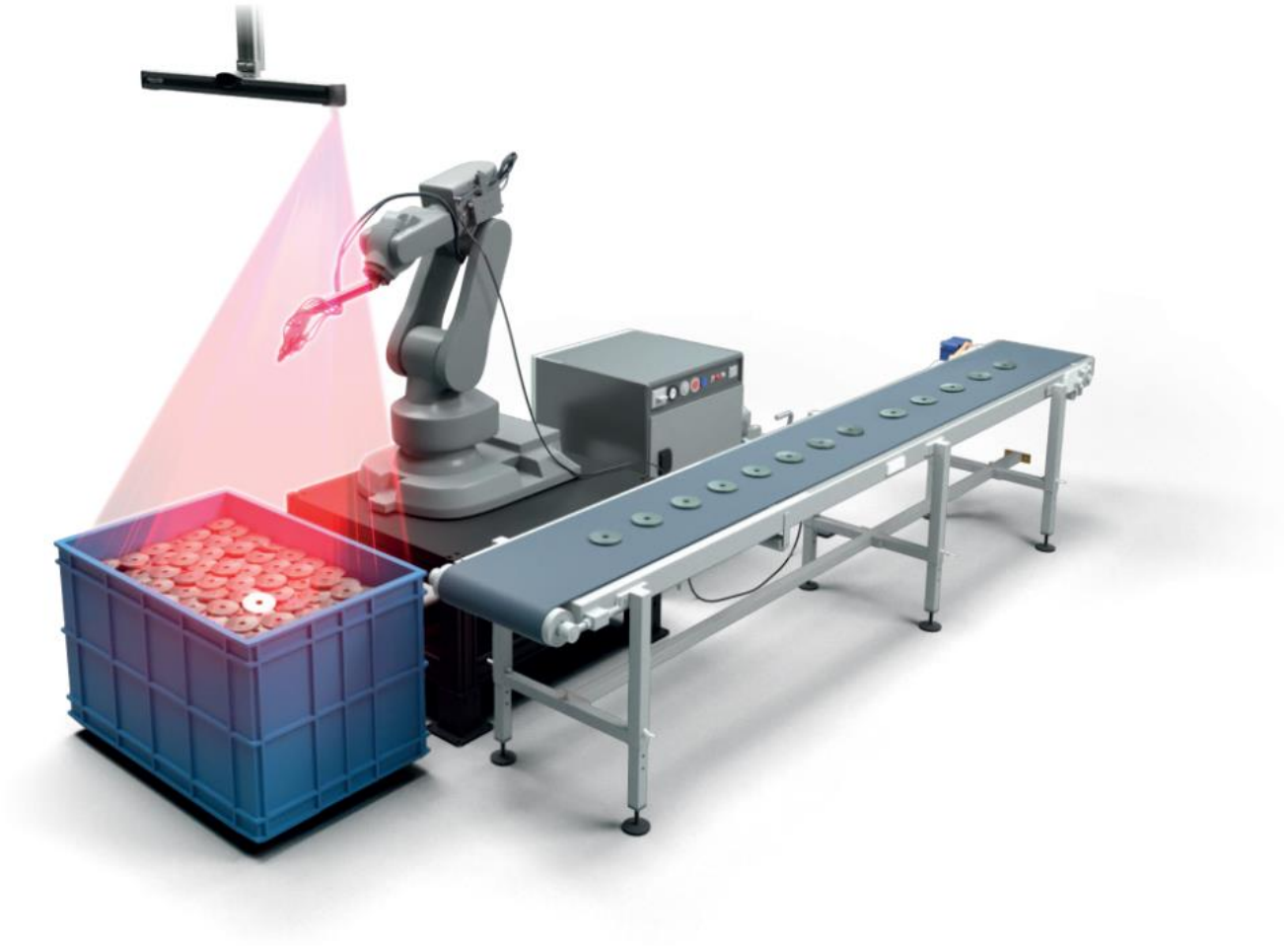
Flexible Manufacturing

https://robodk.com/blog/program-end-effector/

MAIN FOCUS AREA'S (4 OF 5)

Binpicking



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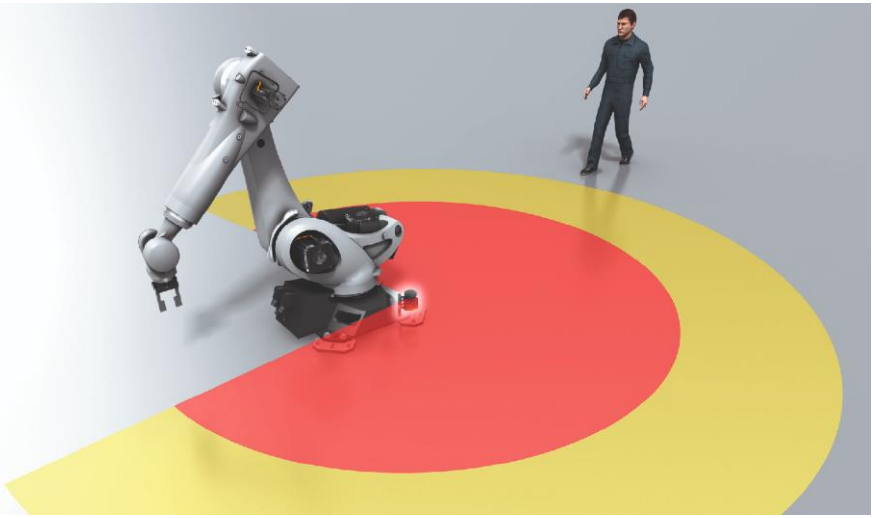
MAIN FOCUS AREA'S (5 OF 5)

Safety, flexibility and traceability



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https://metrology.news/making-safe-robotics-more-productive/

https://www.therobotreport.com/omron-automation-flexible-manufacturing-traceability-automate/

https://www.controleng.com/articles/improving-automation-safety-with-self-taught-industrial-machines-robots/

Fieldlab
Flexible Manufacturing

Picture by Smart Robotics

CONTACT DETAILS

Questions after the session?

- www.flexiblemanufacturing.nl
- Randy Kerstjens
  - r.kerstjens@fontys.nl
  - rk@concept-robotics.nl
- Brainport Industries / Steffie van de Vorstenbosch
  - s.vandevorstenbosch@brainportindustries.nl

Fieldlab
Flexible Manufacturing

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BREAK OUT SESSIE

Smart Manufacturing