ABB ROBOTICS

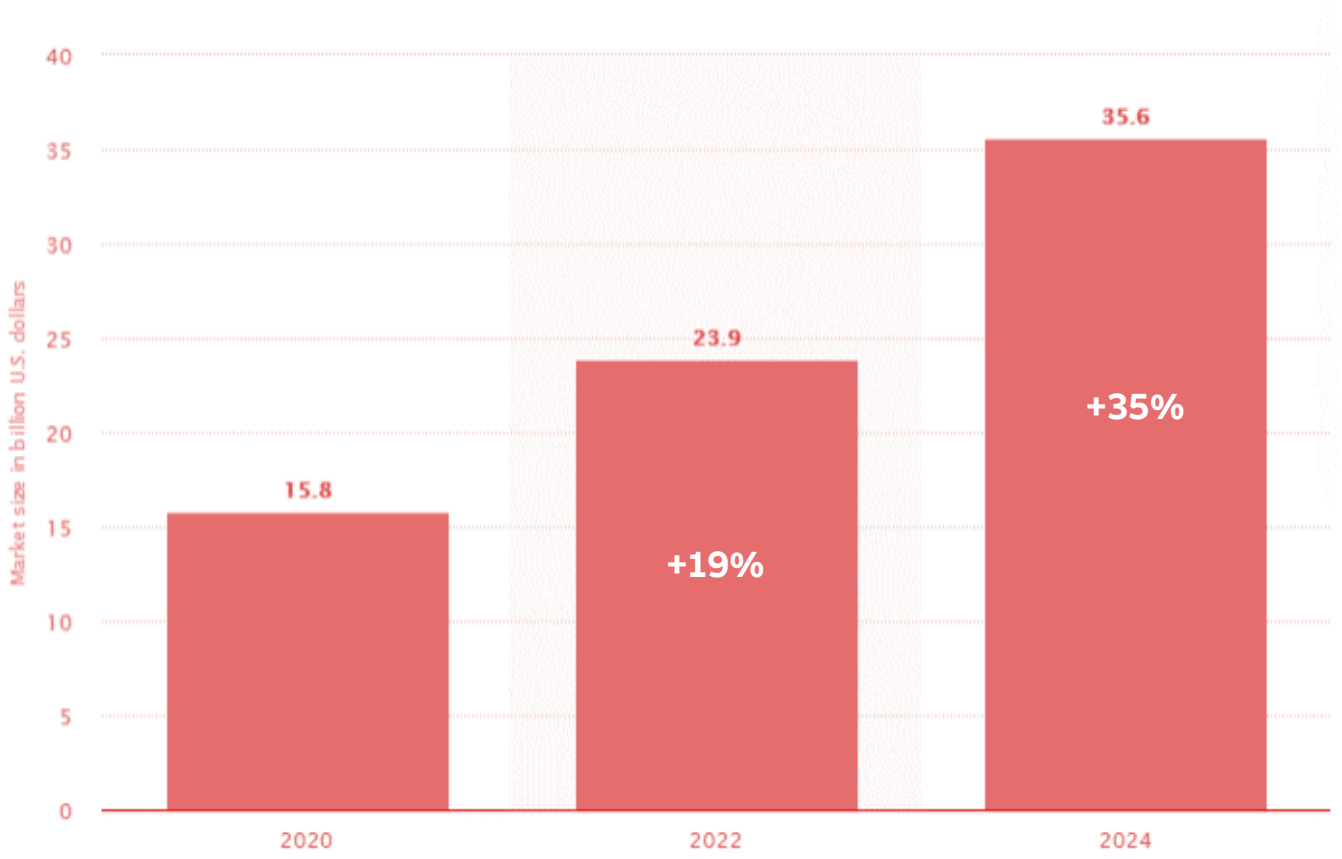
RobotStudio 3D Printing PowerPac

Additive Manufacturing of large scale objects

Document ID.: Rev.:

Why 3D printing

- Overall markte size set to double in the next 5 years
- CAGR of 22% annualy
- Fastest growing segment in manufacturing
- Largely untouched by other robot manufacturers
- Leveraging existing products and technology
- Based on very clear client feedback

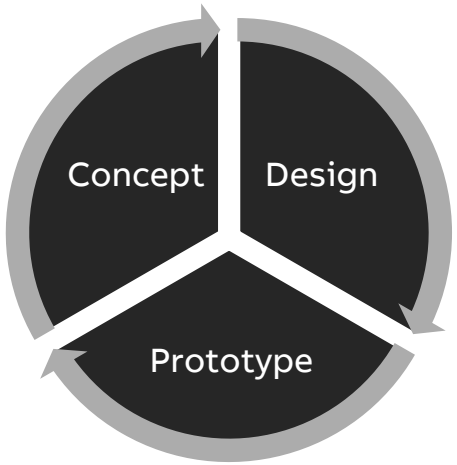


3D Printing

Production methods (upscaling production)

Prototyping

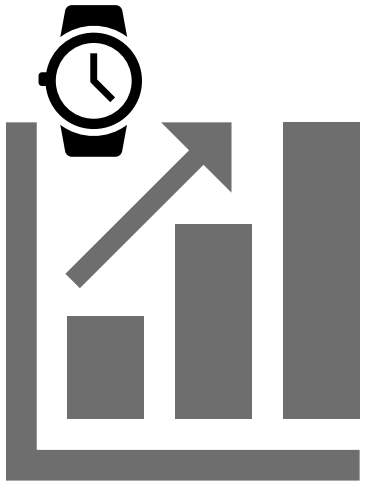
Quick production of a single product for valuation purposes such as parts & fixtures. This during the design phase of a product.



90% Engineering – 10% Printing

One Off / Small Batch production

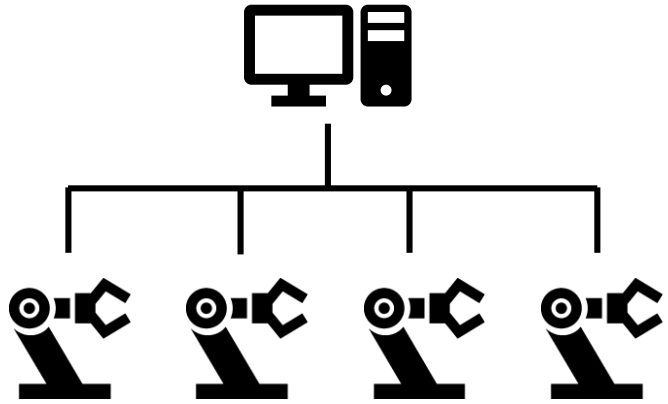
From Single piece to Small Batch production of unique/tailored products with quick time-to-market.



50% Engineering – 50% Printing

Automate Production

Additive manufacturing of complex parts with minimum amount of programming. Translation of CAD geometry via G-Code to RAPID via integrated 3D Printing PowerPac in RobotStudio.

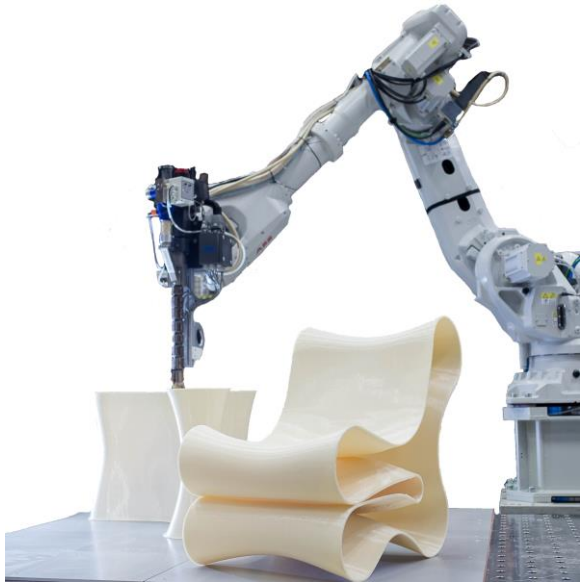


10% Engineering – 90% Printing

3D Printing

Materials

Plastics & Composites



Concrete & Ceramics

Metals (Arc and Laser welding)

Food & Other Materials

3D Printing

Market segments

Automotive & Aerospace

Automotive
(granulates, clay)

- Prototype parts
- Prototype car bodies
- Fixtures
- Interior details for short series production (e.g. premium cars and trucks)

Aerospace
(Arc and Laser welding)

- Additive manufacturing instead of traditional subtracting manufacturing.

Construction & General Industry

Construction industries
(concrete)

- Building elements
- Houses
- Bridges
- outdoor furniture etc.
- Concrete + Steel Wire Reinforced

General industries
(granulates, clay, WAAM)

- Prototypes
- One off production
- Small batch production

Other

Outdoor industry
(bio composite granulates)

- Boat hulls
- Molds for boat hulls
- Interior details for boats (e.g. yachts)
- Canoes/Kayaks
- Wakeboards etc.

Food

- Prototypes
- One off production
- Short series production
- Chocolate decorations

3D Printing PowerPac

Benefits

Converts G-code to RAPID code with support for multiple print processes
The PowerPac reads G-code files and converts them to RAPID code, supporting processes such as welding, dispensing, and granulate extrusion.

No manual RAPID programming needed
The complete RAPID print program is generated automatically; no additional RAPID programming is needed.

Interpolation of external axes
Tools available for calculating interpolation of linear and rotational coordinated external axes to provide smooth movement.

Granulate extrusion can be controlled as integrated robot axis
If the extruder screw is driven by an ABB compatible motor, it can be controlled as an integrated robot axis, which provides precise process control.

No limitation on the number of G-code coordinate points
Coordinate data is loaded dynamically during execution, which enables printing very large objects.

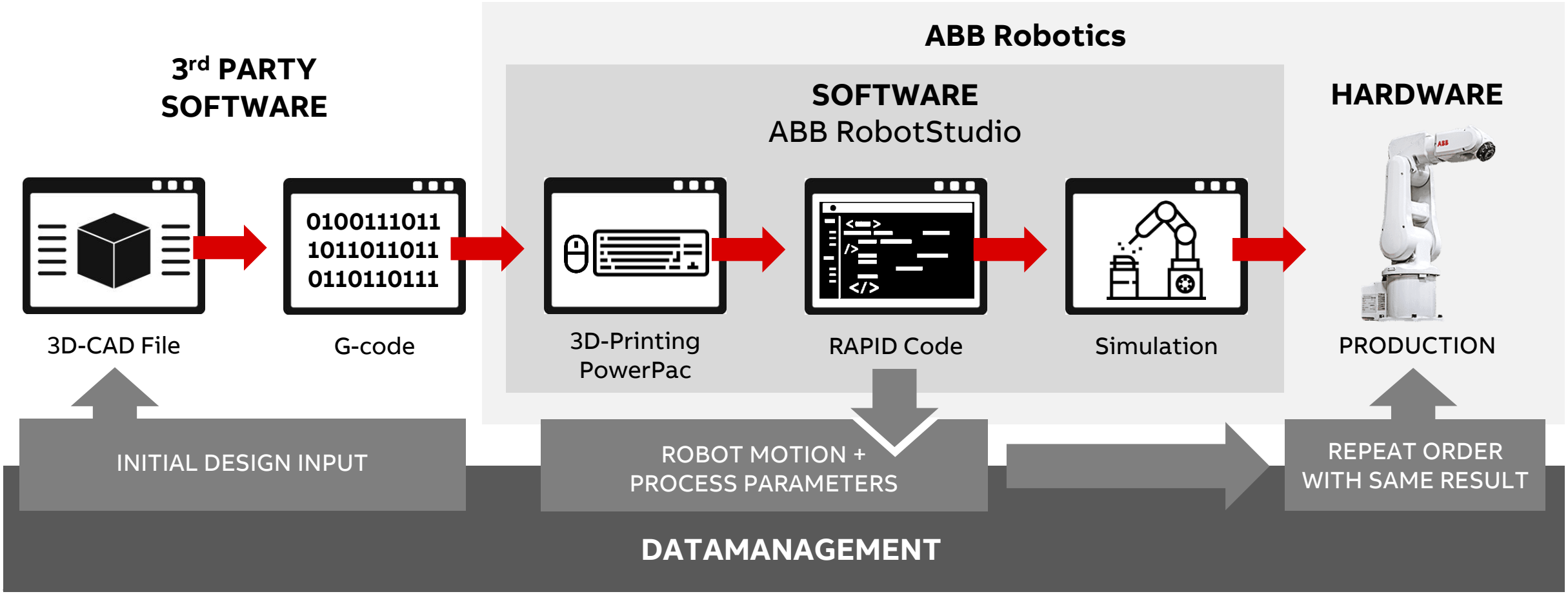
Filtering G-code points
Different tools to filter out unnecessary G-code points for smoother robot movement.

Reachability control
Tools to check the reachability of the whole printing area before the print starts.

Simulate printing in RobotStudio
Before the print program is transferred to the physical robot, it can be simulated and verified on RobotStudio.

3D Printing

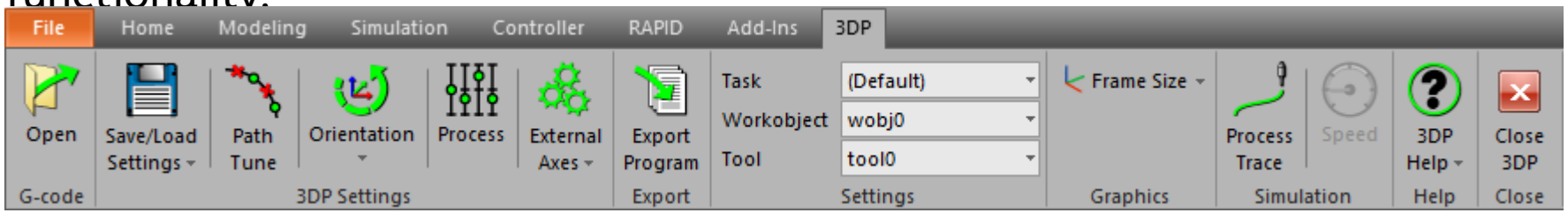
Additive Manufacturing Process Flow



Overview

3D Printing PowerPac

The *3D Printing PowerPac* is a RobotStudio Add-In that extends RobotStudio with 3D printing functionality.



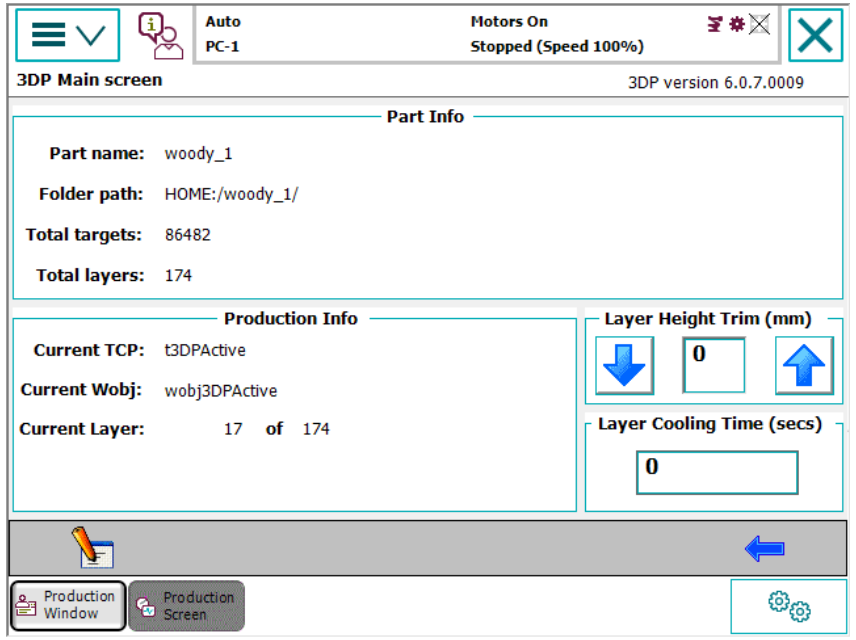
- Generates RAPID code from G-code (used for traditional small 3D printers).
- No limit of number of coordinate points = no limit of product size .
- Support for coordinated external axes (linear and/or rotational).

Overview

3DP RobotWare Add-In

The *3DP PowerPac* works in conjunction with the *3DP RobotWare Add-In* installed in the robot controller used for printing.

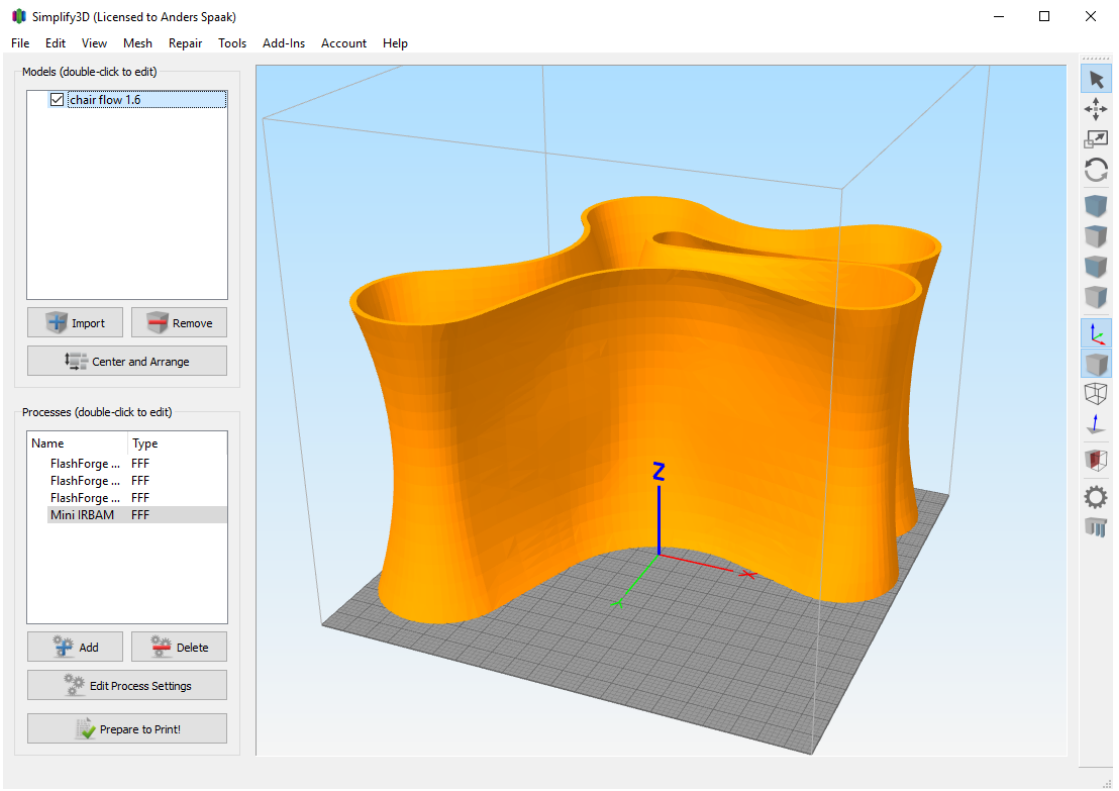
- Supports a variety of processes, such as welding, printing with granules or concrete.
- Dynamic loading of RAPID data during execution without motion disturbance. Enables printing of large products.
- FlexPendant User Interface for process overview and tuning.



Workflow – generate G-code

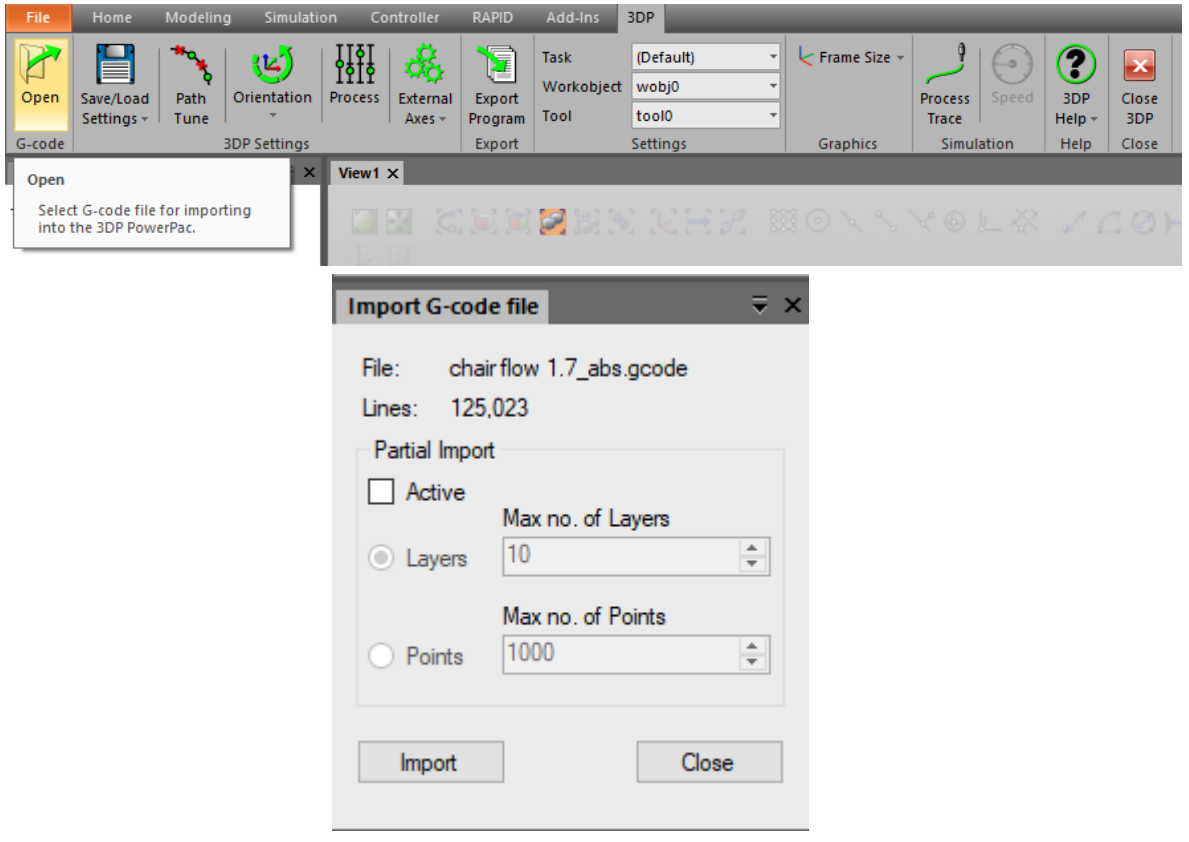
– Import a CAD file of the product to a 3rd party slicer software used for standard 3D printers.

– Generate a G-code file.



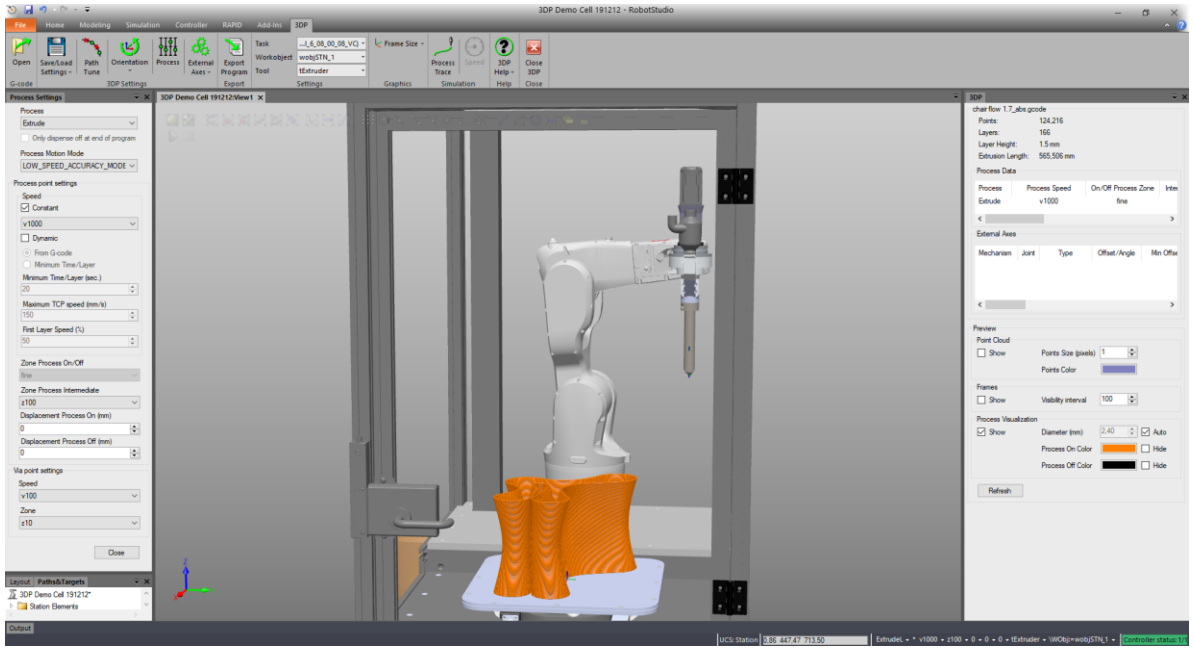
Workflow - Import

– Import the G-code file to the RobotStudio 3DP PowerPac.



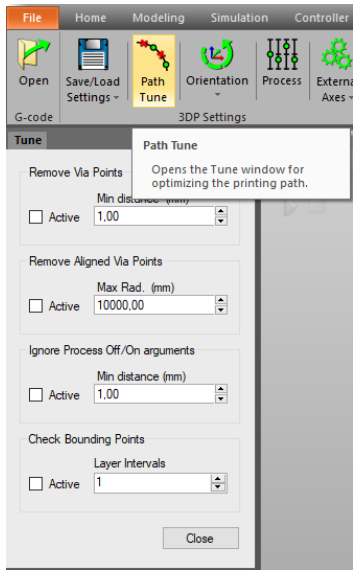
Workflow - Preview

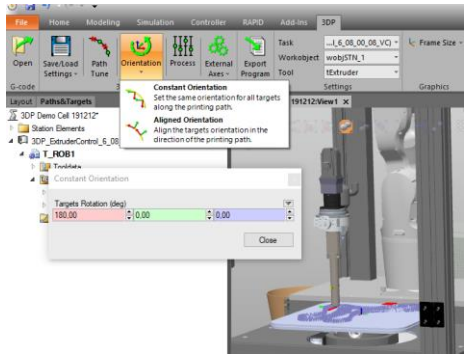
– Verify the printing position, targets orientation etc.

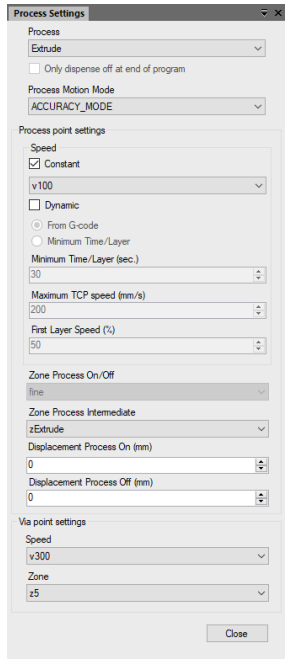


Workflow – 3DP Settings

– Optimize the G-code path.
– Define tool orientation.
– Define process parameters such as process instruction, speed and zone data.





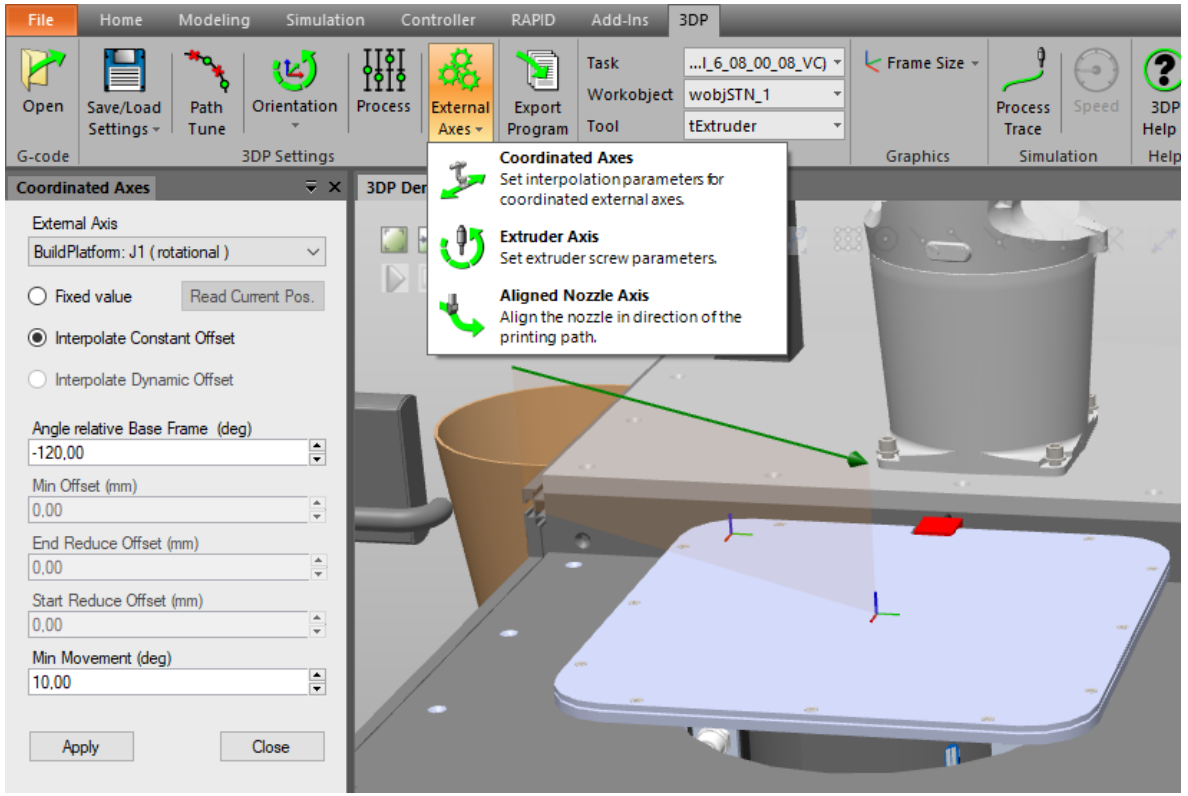


Workflow – External Axes

– If rotational and/or linear coordinated external axes are used, define interpolation parameters.

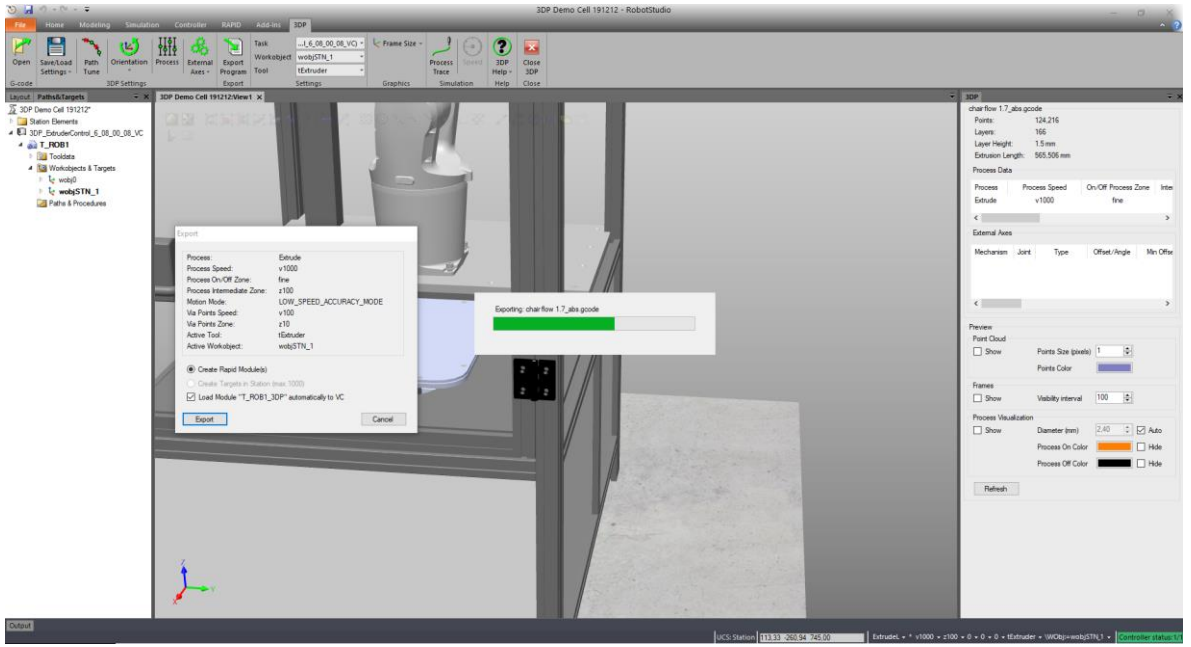
– If an extruder for granules is used with the screw controlled as an external axis, define the rotation parameters.

– If a rotating nozzle controlled as an external axis is used, define the nozzle angle relative the path direction.



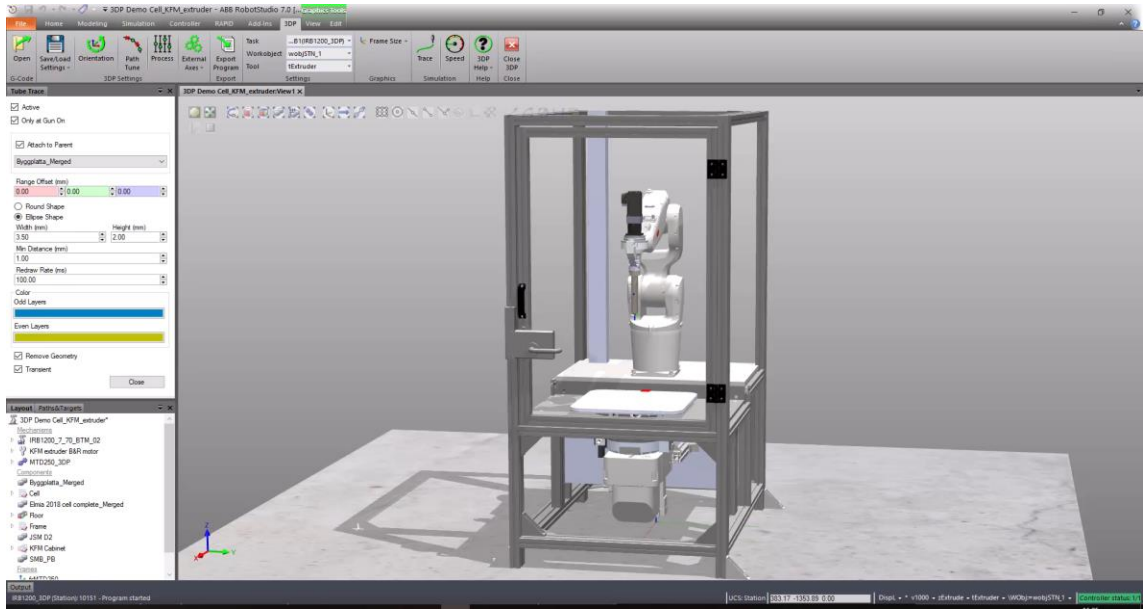
Workflow - Export

– ExportRAPID modules to the Virtual Controller.



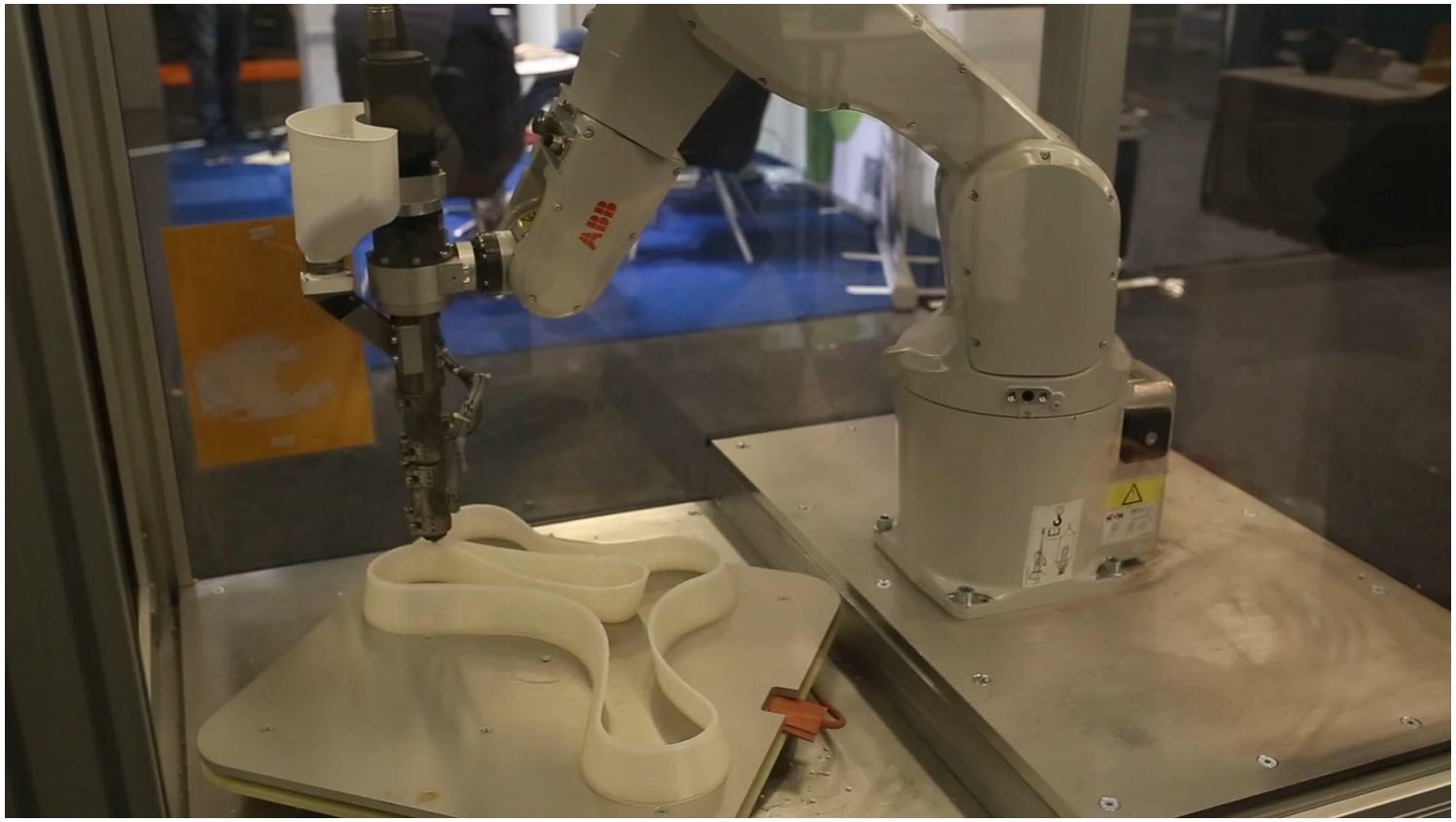
Workflow - Test run in RobotStudio

– Test run the print in RobotStudio.
  Visualize the print with *Process Trace.*



Workflow - Production

Transfer the RAPID files generated by the 3*DP PowerPac* to the real controller and start the print.



Success Story ABB/BAM/WEBER BEAMIX

3D-Concreteprinting (Eindhoven – The Netherlands)

ABB-Robotics / BAM / WEBER Beamix

Hardware- & Software Setup

- IRB7600
- Track (10mtr. = As 7)
- Ext. Axis (Tool Extender – Kop = As 8)
- Safemove 2 Pro (Open environment)
- 3D-Printing PowerPac + Dispense Ware

<u>Parties:</u>

- BAM Infra
- Saint Gobain Weber Beamix
- ABB-Robotics Benelux
- ABB-SE R&D (3D-Printing PP)
- Technology Support (Site support)
- L&P Services (Mechanical)

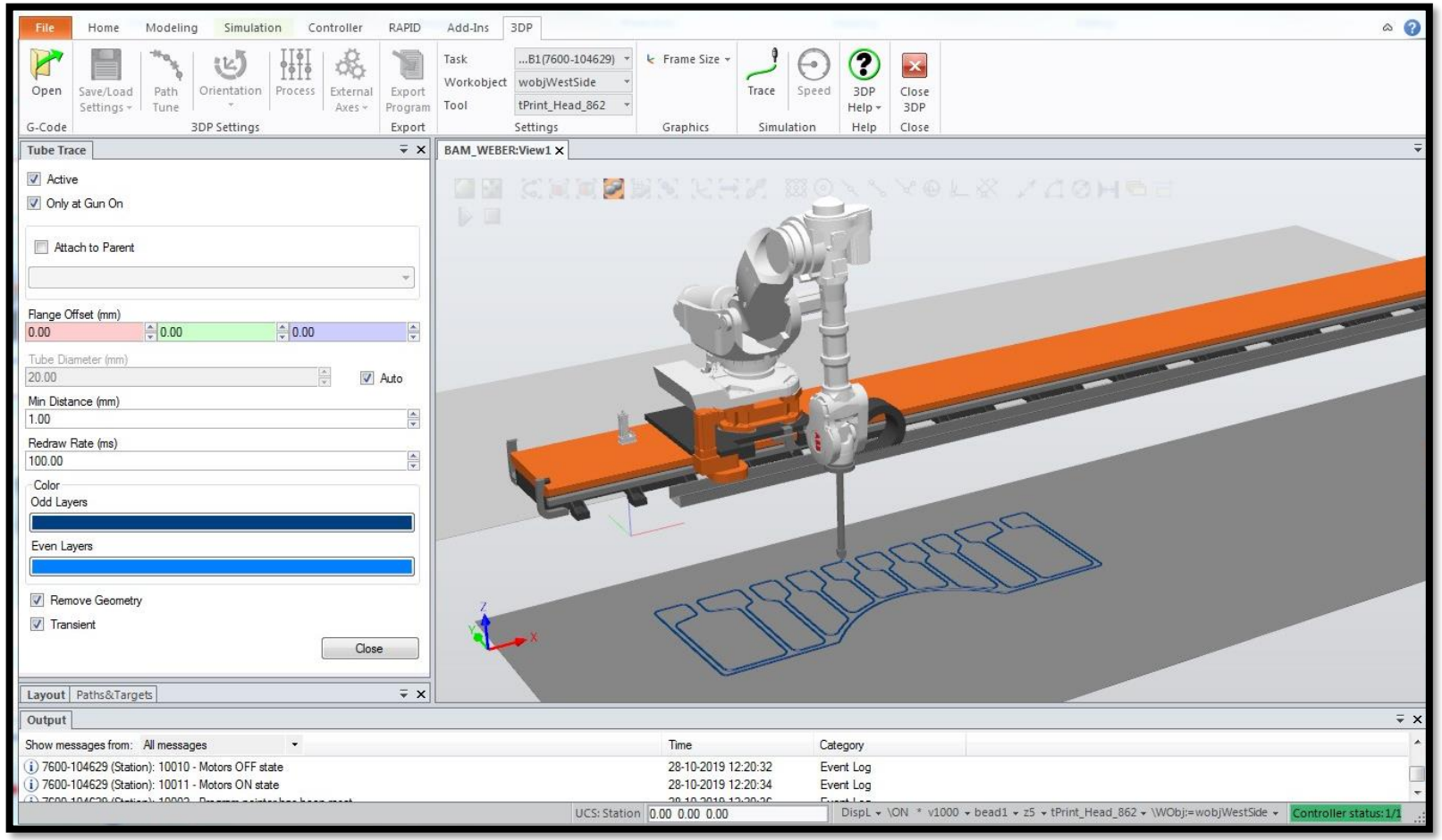


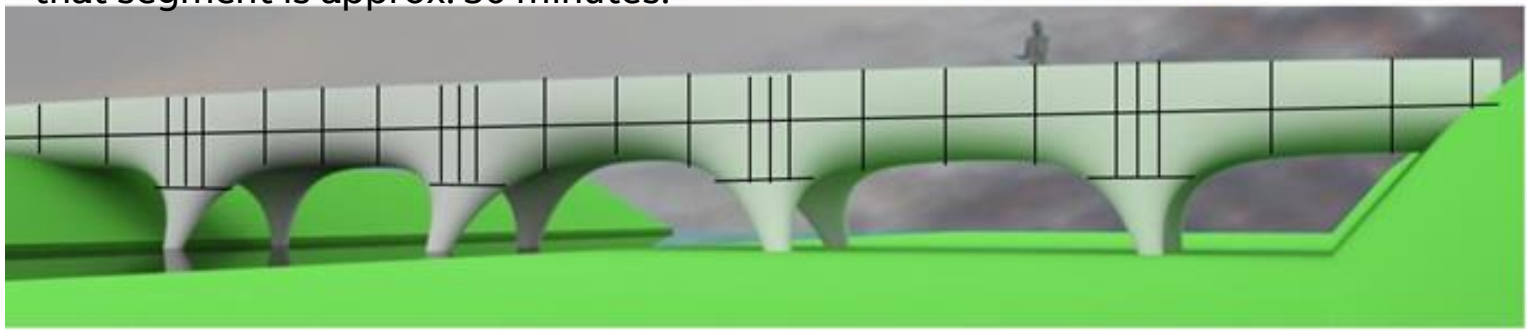
ABB-Robotics / BAM / WEBER Beamix

1st Project

Bike Bridge Nijmegen NL
The bridge is 30 meter long and divided into 150 transportable segments.

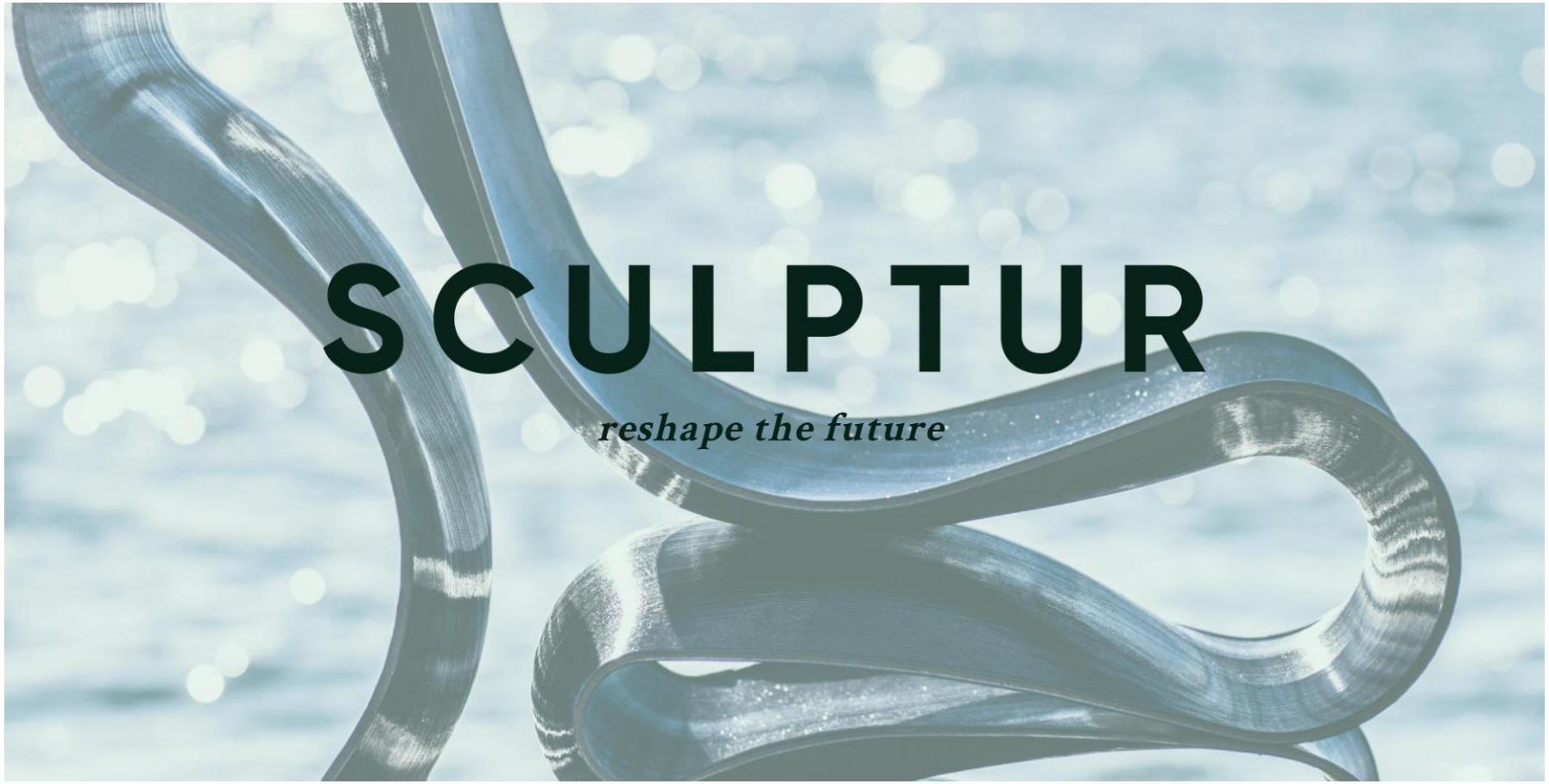
Without the 3DP PowerPac it took approx. 5 days to program one segment (5 days * 150 = 750 days).

With the 3DP PowerPac the time from a received CAD file of a segment until the robot starts print that segment is approx. 30 minutes.



Sculptur - 3D printing of furniture in recycled plastic

http://sculptur.se/



RI.SE - 3D printed kayak

https://www.ri.se/en/what-we-do/our-areas/additive-manufacturing

Media

Swedish environment minister first to try kayaking in robot printed kayak

http://www.thewoodregion.se/nyheter/miljoministern-forst-att-paddla-unik-kajak-pa-hammaro/

EUROPEISKA UNIONEN
Europeiska regionala utvecklingsfonden

THEWOODREGION
EUROPEAN INNOVATION CENTER

Media

The world largest 3D printed sailboat was printed at The Wood Region in Sysslebäck, Sweden with an ABB robot and the RobotStudio 3D Printing PowerPac.

https://www.hamnen.se/artiklar/inshore-24-varldens-storsta-3d-printade-segelbat-ar-svensk/