

Hybrid Manufacturing with Robotic CNC Technology

Combining additive and subtractive manufacturing in a single robotic workplace – a new paradigm for industrial production in the Industry 4.0 era

CZECH-GERMAN ECONOMIC FORUM · UNIVERSITY OF OSTRAVA

Challenges of Modern Industrial Manufacturing

Material Waste

Traditional CNC machining removes up to **80% of material** from the blank — high costs, low efficiency.

Time and Flexibility

Manufacturing large components requires lengthy changeovers, multiple machines and complex logistics.

Precision and Geometry

Complex shapes are difficult to produce with conventional methods — a compromise between design and manufacturability.

Tool Costs

Manufacturing moulds and prototypes with traditional methods is time-consuming and expensive for small batches.





PILLAR 1

Large-Format 3D Printing (LFAM)

Additive manufacturing enables rapid production of **large near-net-shape components** with minimal material waste.

→ **Near-net-shape manufacturing**

Printing the approximate shape reduces machining volume by tens of percent.

→ **Large working space**

Robotic systems overcome the dimensional limitations of conventional printers.

→ **Prototyping speed**

Shortened development time from design to functional part.

PILLAR 2

Why CNC Machining Remains Essential

Additive manufacturing alone does not achieve the tolerances required in aerospace, energy or mould manufacturing. Machining is key to final precision.



Surface Roughness

Milling achieves $Ra < 0.8 \mu m$ — printing does not.

Dimensional Tolerances

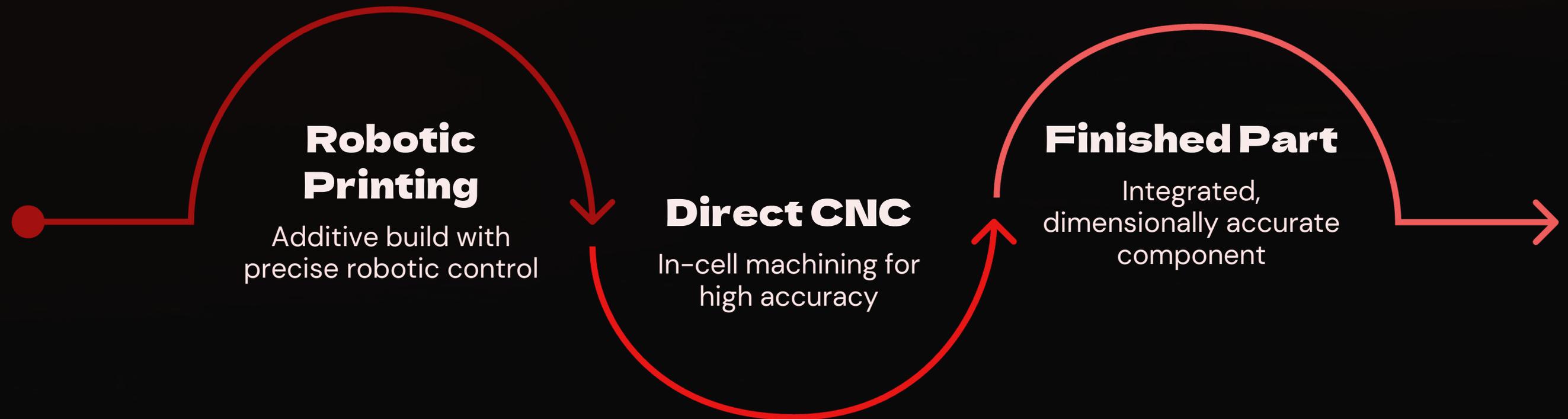
Precision IT6–IT8 is achievable only by machining.

Functional Surfaces

Holes, threads, seating surfaces — always require machining.

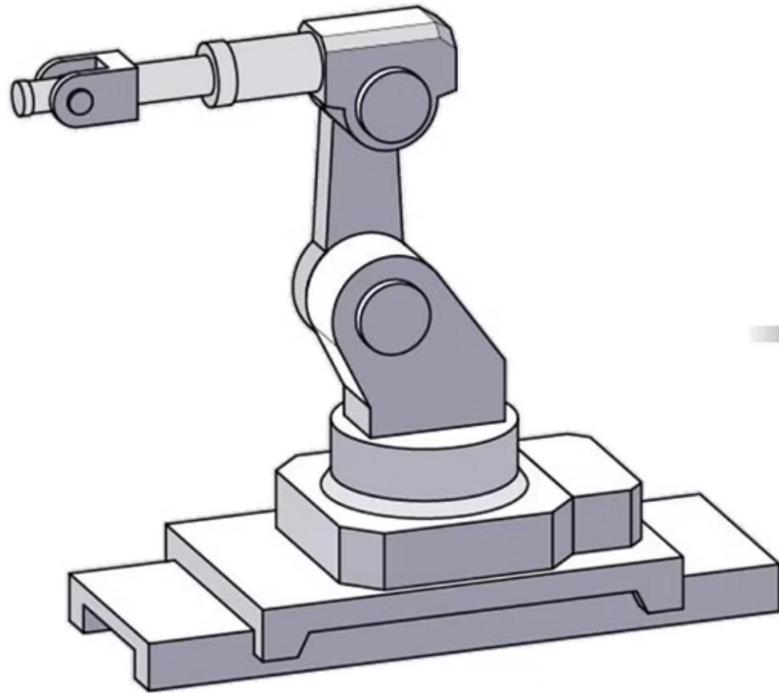
Hybrid Manufacturing Concept: Printing + Machining

Both processes take place in a single robotic workplace without changeover — the result is elimination of positional errors and dramatic reduction in manufacturing cycle time.



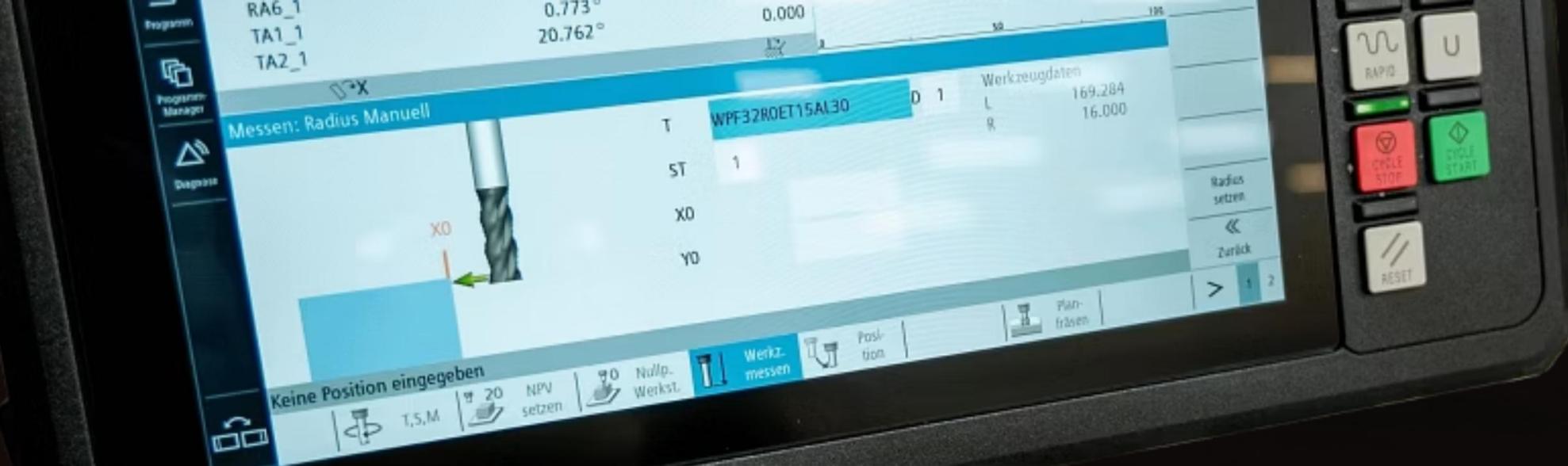
SINUMERIK Run MyRobot /Direct Control /Direct Handling

Robot Arm 3rd party supplier



SIEMENS





PILLAR 3

Siemens SINUMERIK Control System



Tool Management

Native tool management for additive and subtractive operations.



Machining Cycles

Standard ISO cycles available directly in the robotic environment.



Advanced Interpolation

Smooth multi-axis paths for complex geometries without compromise.



NC Programming

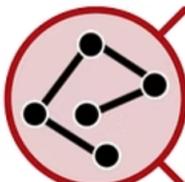
Standard G-code and ShopMill — no need for operator retraining.

Key technologies of the MABI precision robot

Challenges Robotic



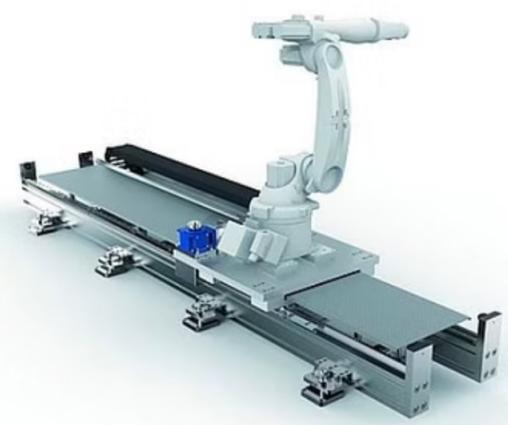
Non-rigid structure



Complex kinematic chain



Limited (absolute) accuracy



MABI Robot Core Technologies

1 Secondary encoder (gearbox output side)

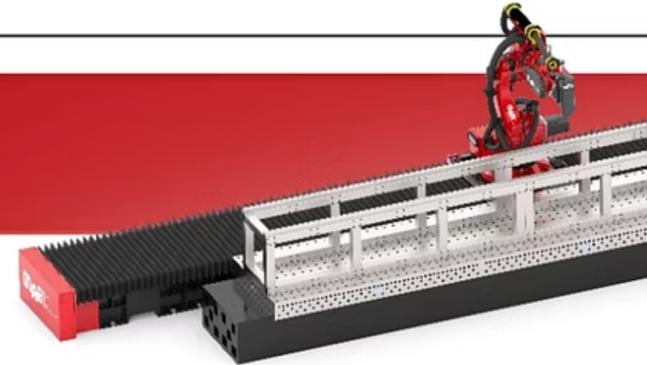
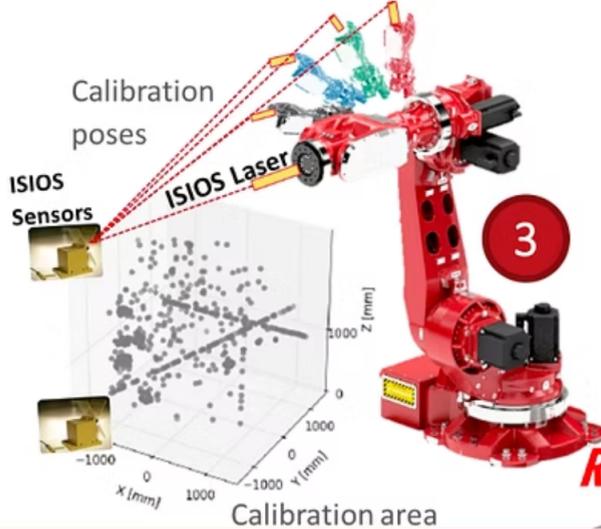
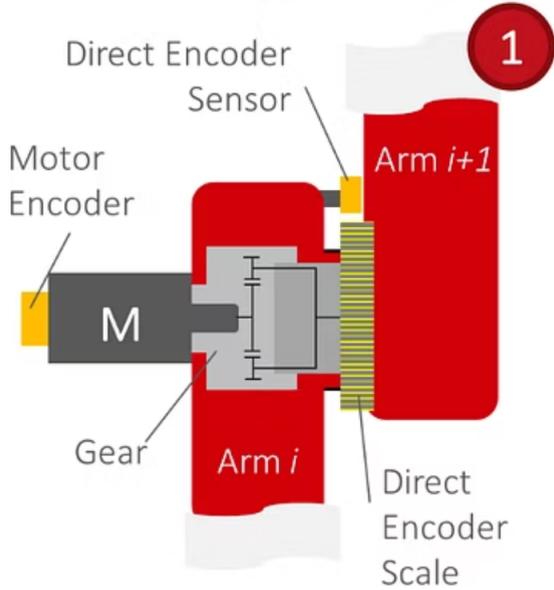
Higher rigidity and repeatability (<0.02mm)

2 CNC control SINUMERIK One

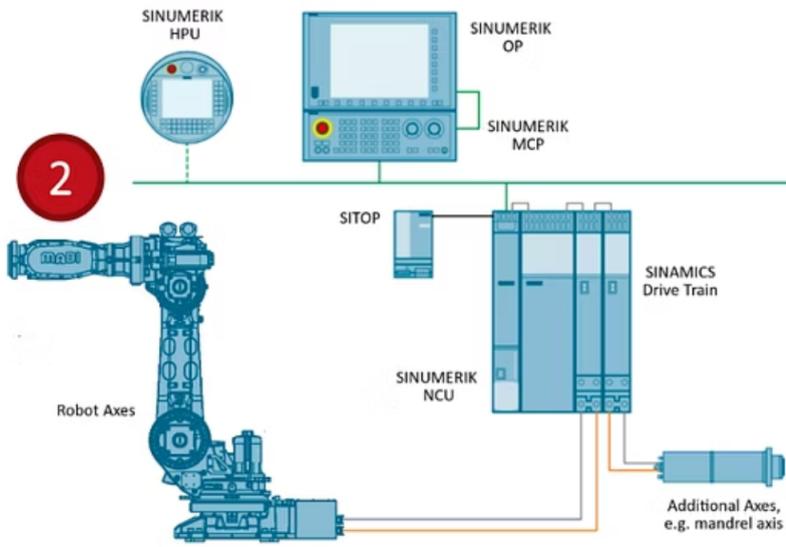
Constant feed with high path accuracy

3 ISIOS absolute calibration (optional)*

High absolute accuracy bidirectional in the entire workspace (0.11mm mean)



SIEMENS



Key Benefits of Hybrid Manufacturing

-60%

Material Waste

Compared to conventional machining from solid material.

1x

Workplace

Printing and machining in a single robotic centre.

IT6

Achievable Precision

Final tolerances thanks to integrated CNC machining.

40%

Reduced Manufacturing Time

Elimination of changeovers and inter-operation logistics.

Traditional vs. Hybrid Manufacturing

The hybrid approach fundamentally changes the equation between **flexibility, precision and efficiency**. A single robotic system replaces an entire manufacturing chain for large-scale components.



Industrial Applications



Aerospace

Structural parts, brackets and lightweight components from light alloys of large dimensions.



Mould Manufacturing

Rapid production of shaped inserts and moulds for pressing with precise functional surfaces.



Defence Industry

Durable components with complex geometry in short runs and with high reliability.



Energy

Blade segments, turbine parts and components for renewable energy sources.

Jiří SAMEK

CEO, SinuCraft

Mobile: +420 733 133 220

Email: jiri.samek@sinucraft.com