

HYBRID MANUFACTURING technology

KOVOSVIT MAS, a.s. and CTU - RCMT



- All products around us needs parts and components.



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- Everyone who solves manufacturing production needs a „production“ machines.



- **Additive Manufacturing** is a new EU industrial segment of Machine Tools according to CECIMO Since 2015



cecimo

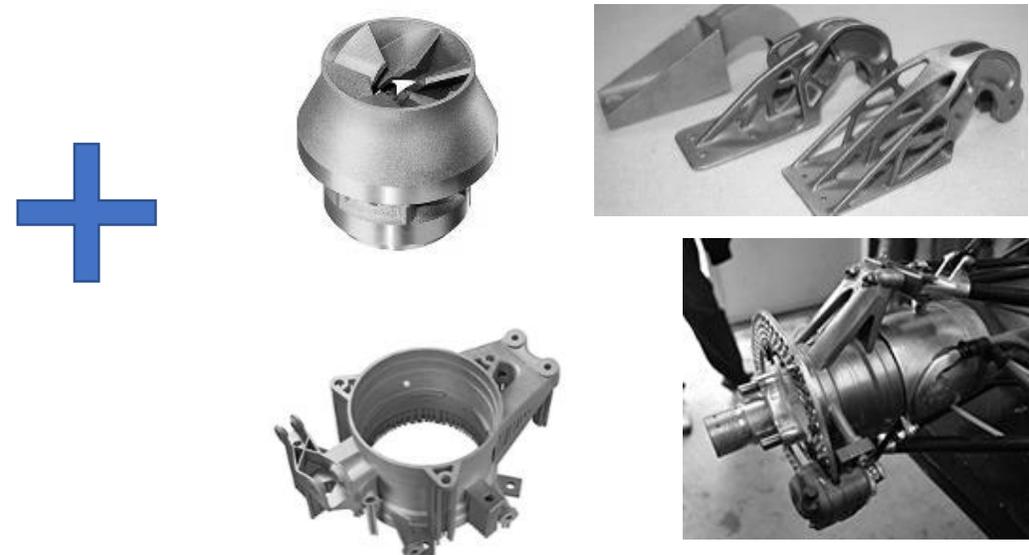
European Association of
the Machine Tool Industries

■ Production technologies are gradually expands on Additive Manufacturing and Hybrid Manufacturing technology.

MODERN TECHNOLOGY CASTING | FORMING | WORKING



ADDITIVE MANUFACTURING AND HYBRID MANUFACTURING

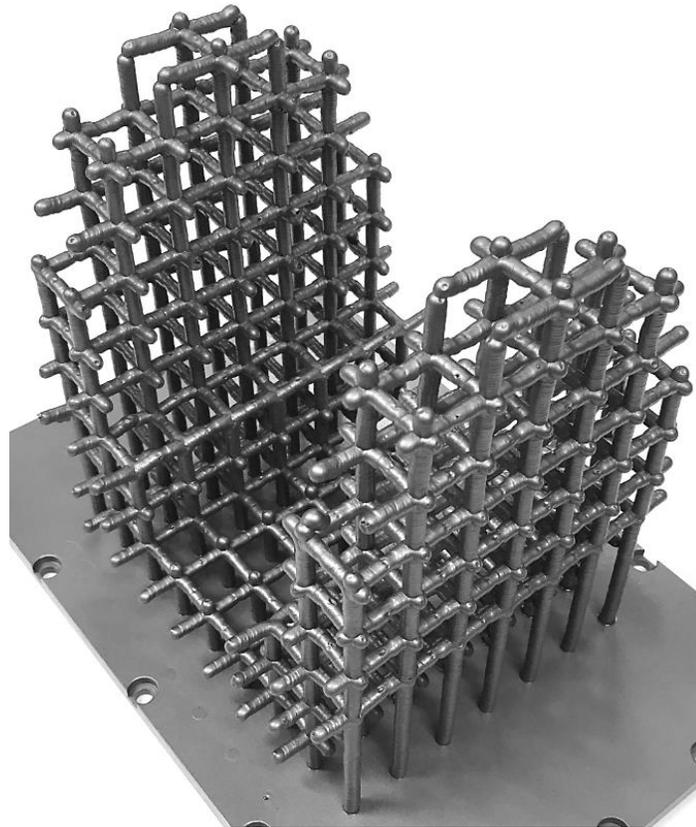


■ Examples and motivation

3D printing and hybrid technology cuts across all sectors.



Production of prototypes and complex parts



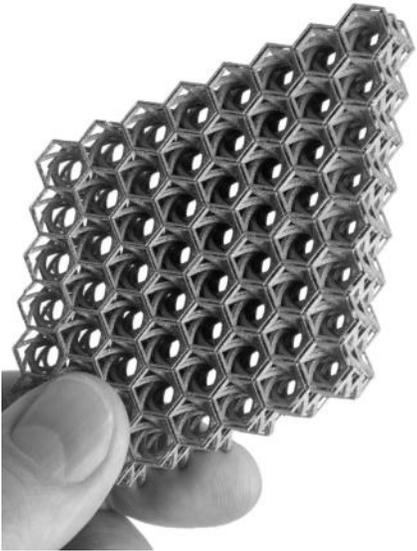
Unmanufacturable parts otherwise



Repairing

■ Examples and motivation

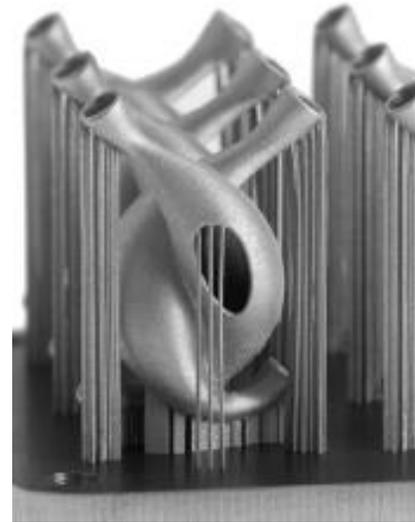
3D printing and hybrid technology cuts across all sectors.



Unmanufacturable parts otherwise



Fully personalized parts

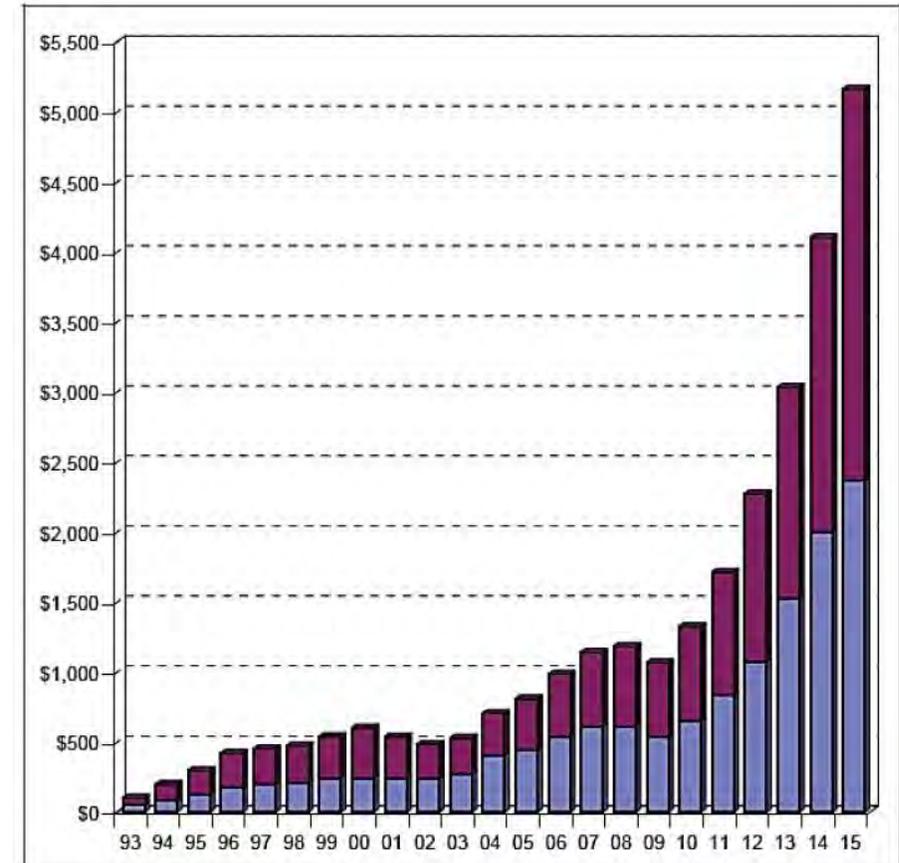


Substitution of assembly by one part



Internal cooling canal

- 3D printing of metals is one of the modern trends and phenomena in industrial production, which defines the status of industrial and machine manufacturers.
- Worldwide turnover is 5.5 billion. USD and the market is growing past 6 years, 30% per annum. (Ed. Machine Tools worldwide market represents roughly 80 billion. USD)

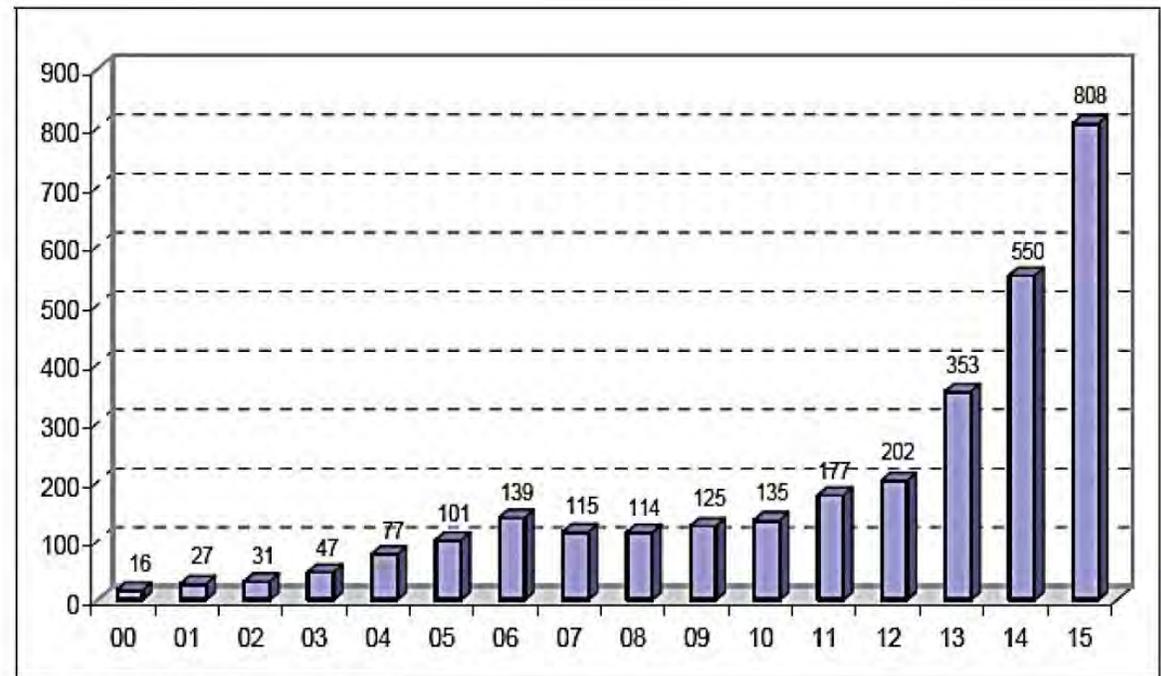


Source: Wohlers Associates, Inc.

The lower (blue) segment of the bars represents *products*, while the upper (burgundy) segment represents *services*. Neither category includes secondary processes, such as tooling, molded parts, or castings. The secondary market segment is reported separately.

- In 2015 the world was sold over 800 machines to print metals market is growing by more than 40% annually the past three years.

Sales of AM systems for metal parts are increasing, as shown in the following chart. Wohlers Associates has been tracking this market segment for 15 years. An estimated 808 metal AM machines were sold in 2015, growth of 46.9% over 2014, when 550 metal AM machines were sold. In 2013 and 2012, 353 and 202 metal systems were sold, respectively.



Source: Wohlers Associates, Inc.

- KOVOSVIT MAS, Inc. Company is preparing for 2017 to present new machine and enter to Additive Manufacturing (AM) market. This is the Hybrid Manufacturing (HM) machine, combining a full generic technology (welding metal), 5-axis and full subtractive technology, using 5-axis milling.



- New unique technology of HYBRID MANUFACTURING.
- KOVOSVIT MAS , Inc. Company and the Research Centre for Manufacturing Technology - RCMT, Czech Technical University in Prague, Faculty of Mechanical Engineering are owners and developers of this technology



■ New unique technology HYBRID MANUFACTURING.



additive technology
(Variability of shape)

+

machining
(Accuracy and quality)

=

Common support structure,
actuators, control and
workspace

■ Technology characteristics

- ✓ The only technology for creating metal parts (AM) developed full in the Czech Republic.
- ✓ Price components is only 25-30 % of the cost of competing technologies.
- ✓ The final price of formed parts is the 100 - 130 Euro / kg.
- ✓ AM for standard construction materials and general engineering.
- ✓ Processing of structural steels, stainless steels, fine-grained and wear resistant steels.
- ✓ The rate of growth of parts of different steels in the range of 0.2 to 1.0 kg / hr.



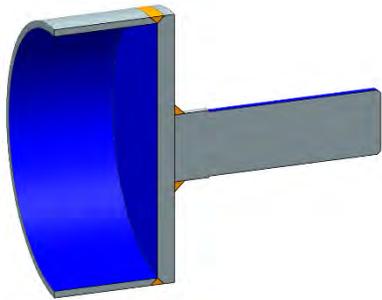
■ Technology of **welding** and **machining** allows these strategies:

- ✓ Welding, various combinations of metals
- ✓ Surfacing functional surfaces, functional parts and details
- ✓ Surfacing hard surfaces and sliding surfaces
- ✓ Repairs
- ✓ Creating full parts
- ✓ Creating full parts with internal channels
- ✓ Creating shell parts
- ✓ Creating hollow parts with internal support structure

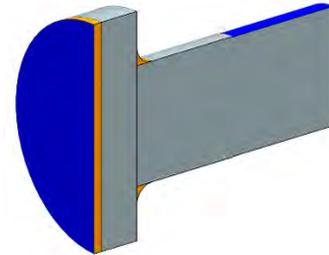


Machining

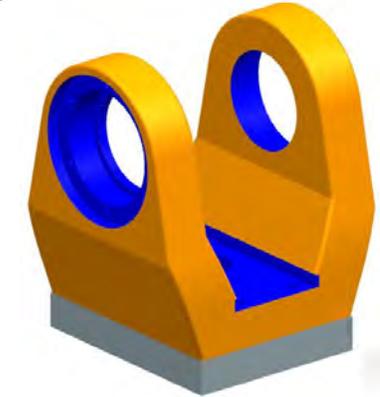
■ Technology of **welding** and **machining** allows these strategies:



- ✓ Welding, including welding various combinations of + Metal Processing



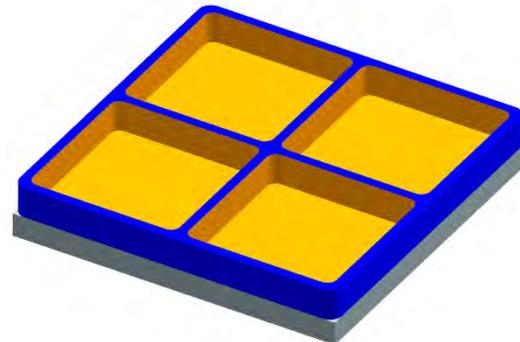
- ✓ Welding on functional surfaces, functional parts and details + machining
- ✓ Welding carbide surfaces and sliding surfaces + machining
- ✓ Repairs including machining



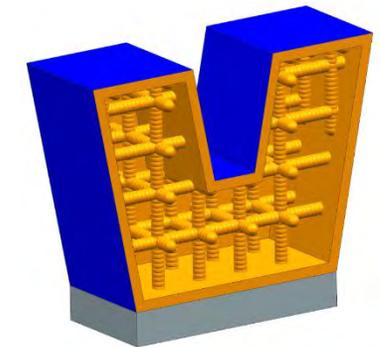
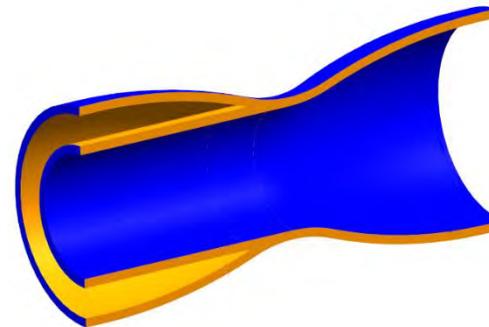
- ✓ Creating full parts including Machining



- ✓ Creating full parts with internal channels



- ✓ Creating shell parts including Machining



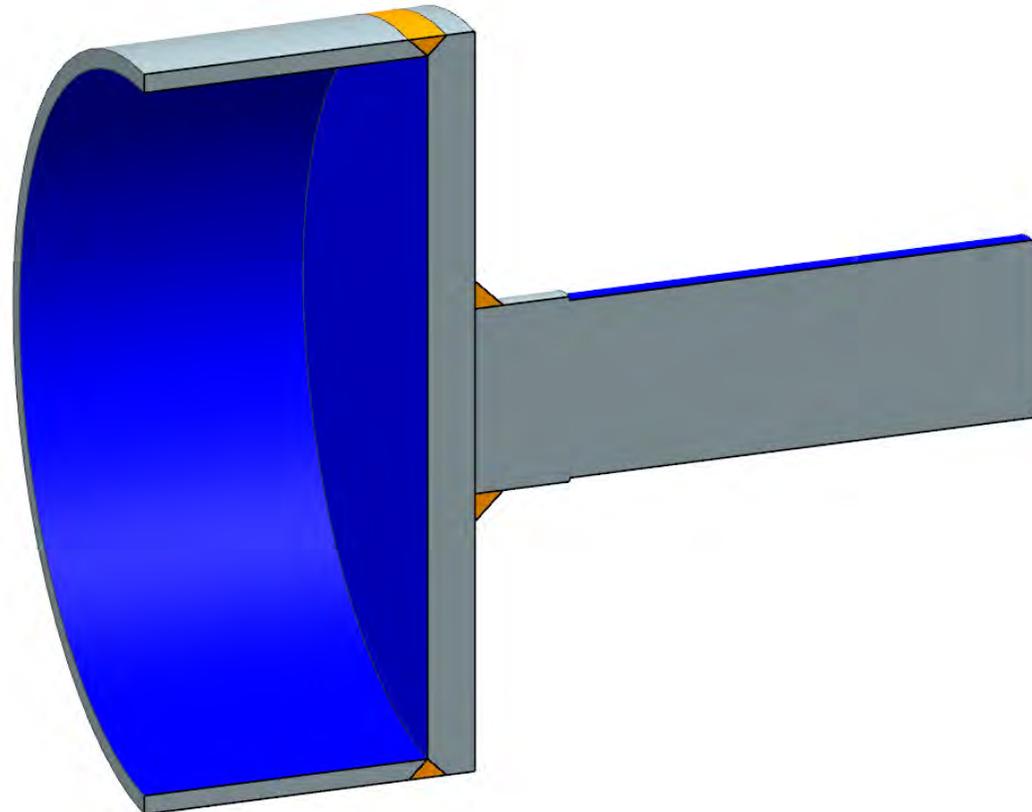
- ✓ Creating hollow parts with internal support structure + machining

■ Technology of **welding** and **machining** allows these strategies:

✓ Welding, including welding various combinations of metals



Machining

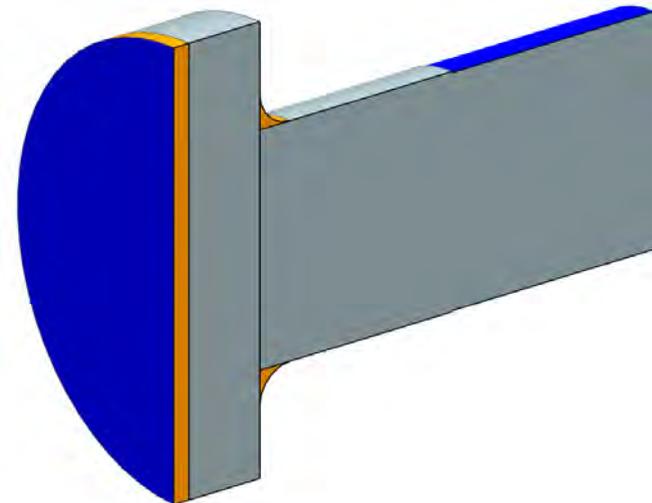
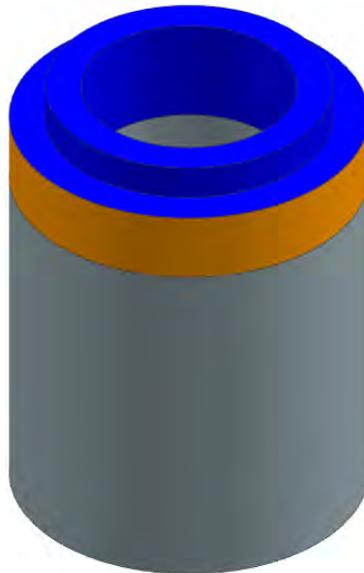


■ Technology of **welding** and **machining** allows these strategies:

- ✓ Surfacing functional surfaces, functional parts and details
- ✓ Welding hard metal surfaces and sliding surfaces
- ✓ Repairs



Machining

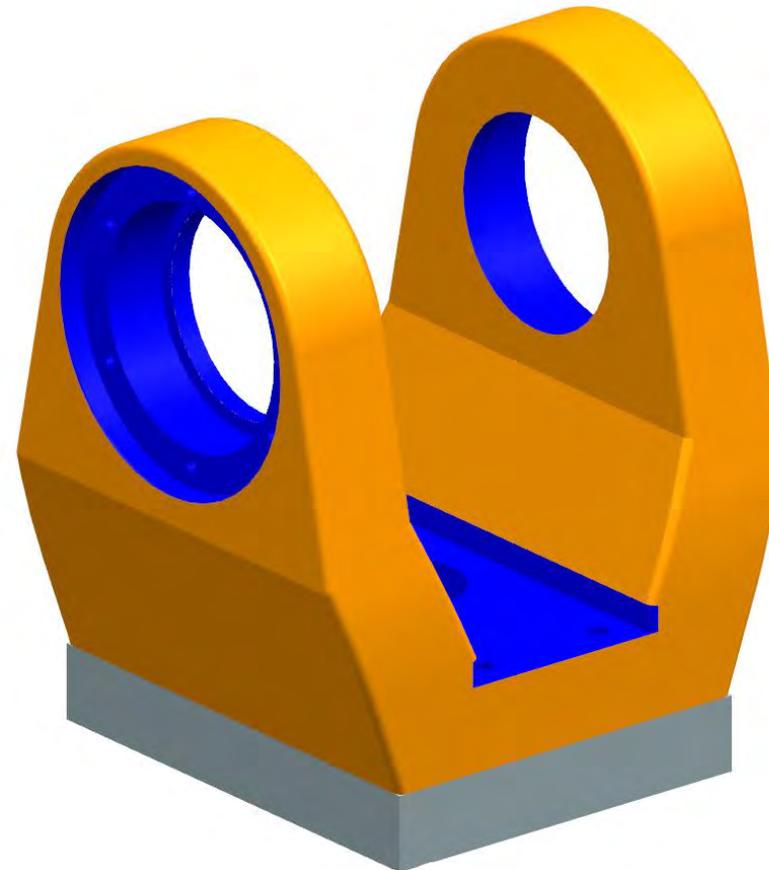


■ Technology of **welding** and **machining** allows these strategies:

✓ Creating full parts



Machining



■ Technology of **welding** and **machining** allows these strategies:

✓ Creating full parts with internal channels



Machining

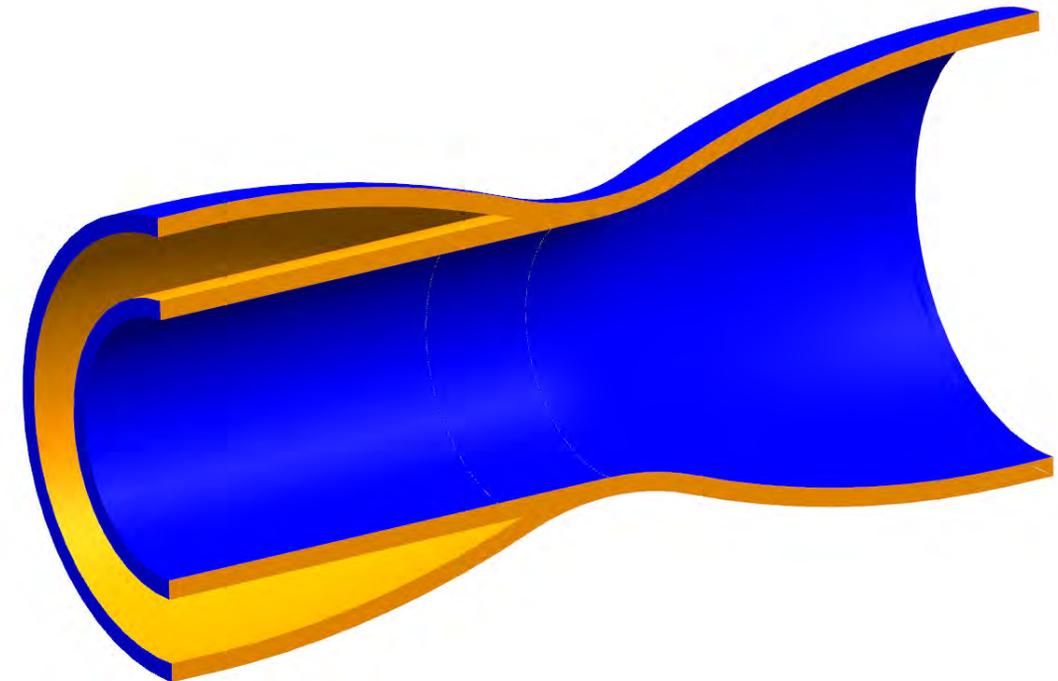
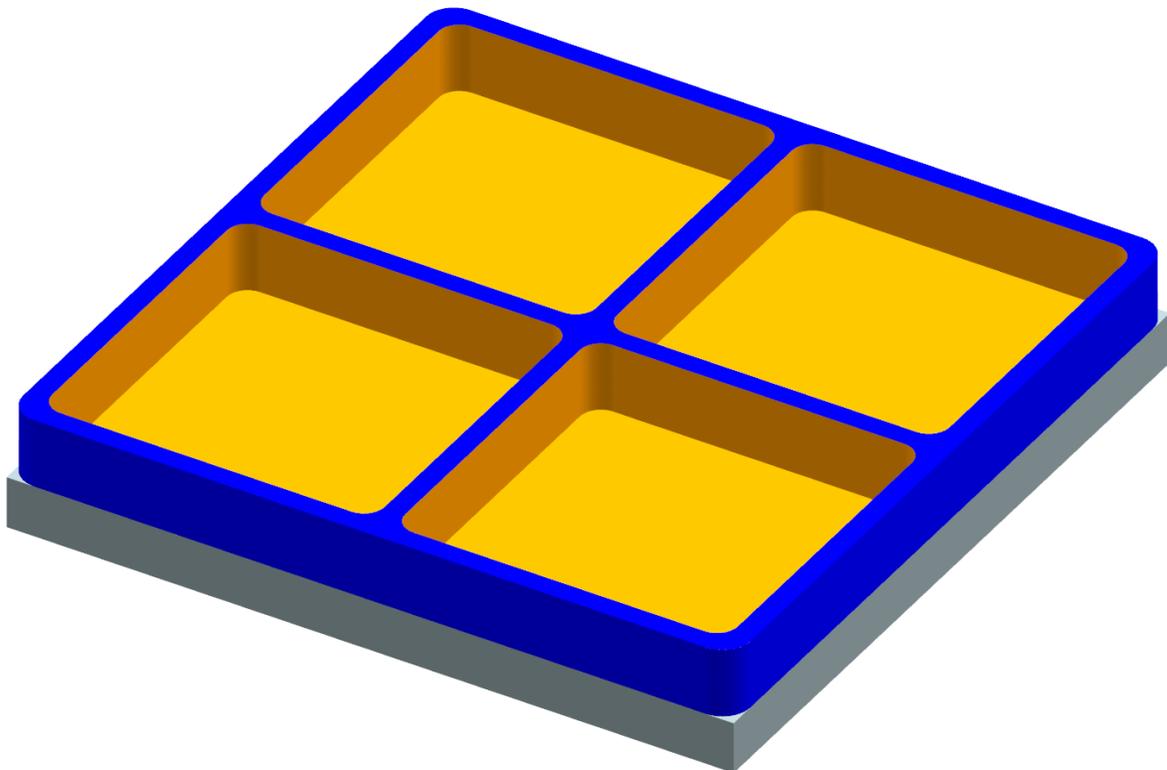


■ Technology of **welding** and **machining** allows these strategies:

✓ Creating shell parts



Machining

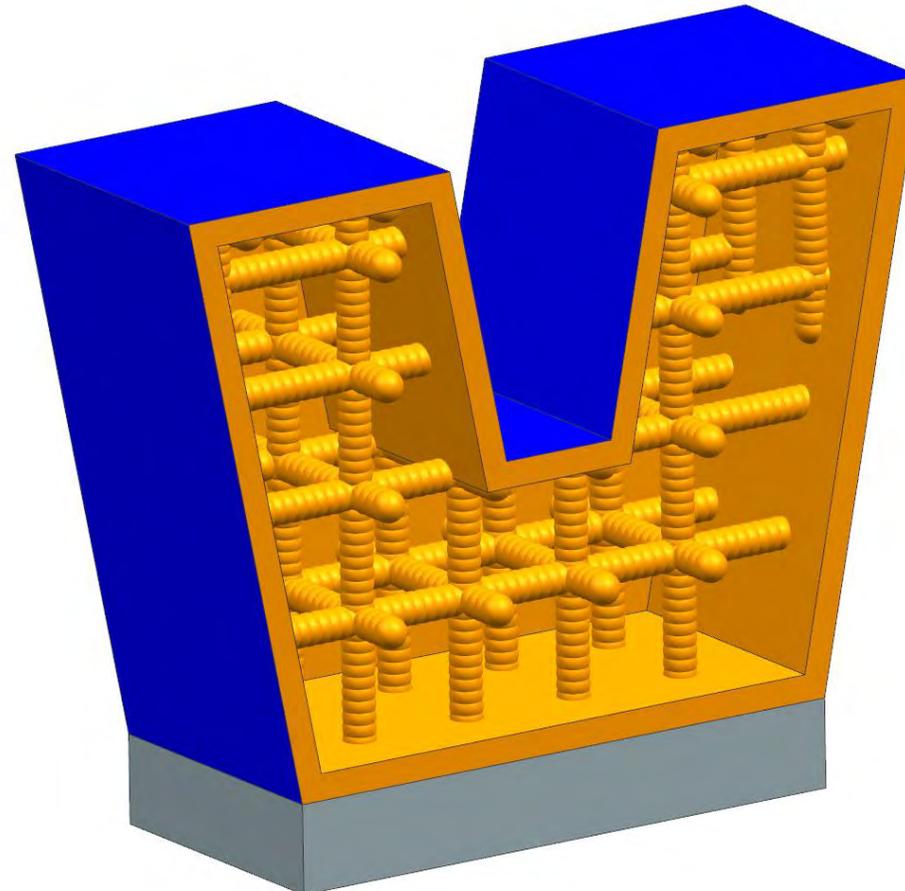


■ Technology of **welding** and **machining** allows these strategies:

✓ Creating hollow parts with internal support structure



Machining



■ HYBRID MANUFACTURING

examples of components

■ Examples of volume parts made of carbon steel



Weight: 16 kg
Building speed: 420 g/h

Weight: 19 kg
Building speed: 470 g/h

■ Examples of thin-walled parts made of carbon steel



Weight: 2,33 kg
Building speed: 300 g/h



Weight: 4,961 kg
Building speed: 400 g/h

■ Examples of small design components made of stainless steel

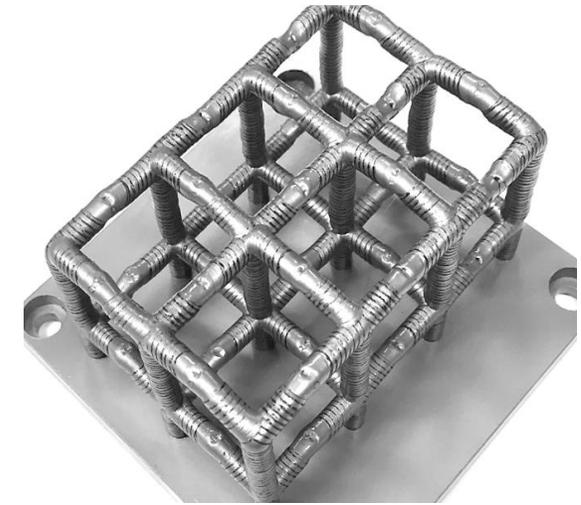
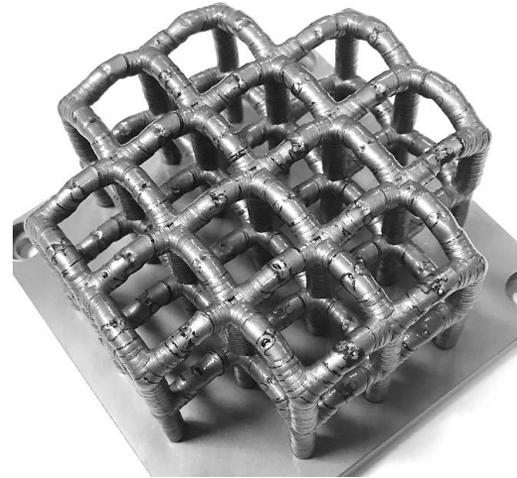
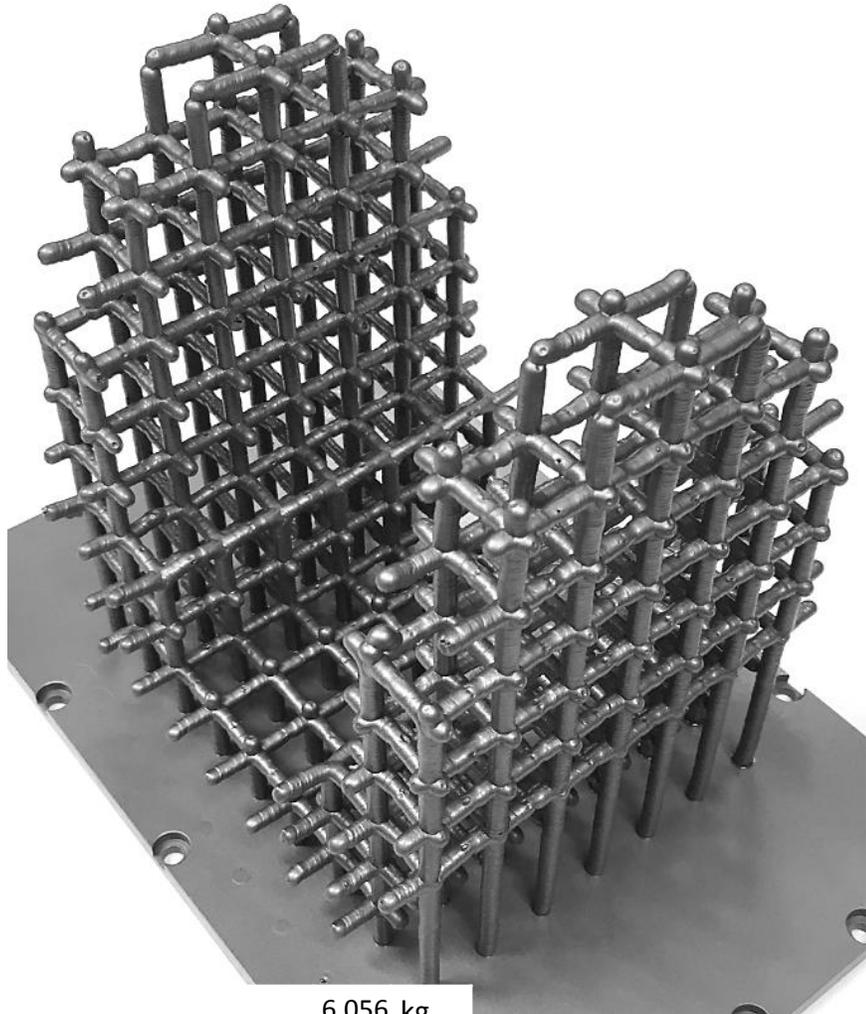


Weight: 2 g
Building speed: 100 g/h

Weight: 0,4 kg
Building speed: 240 g/h

Weight: 0,17 kg
Building speed: 240 g/h

■ Examples of support and internal structures



Weight: 6,056 kg
Building speed: 200 g/h

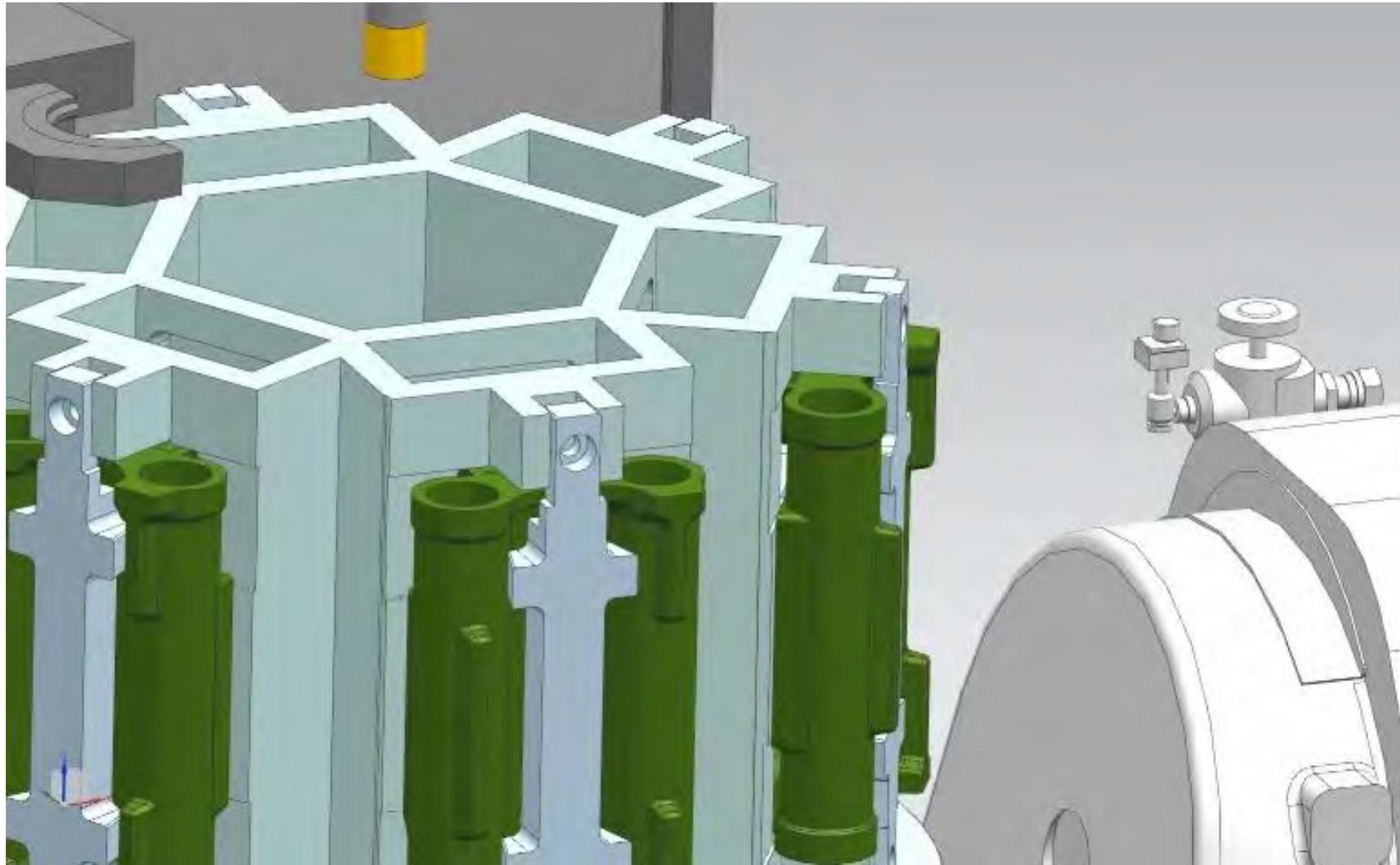
■ Samples of different materials



■ Repair of worn belt of armored vehicle BMP 1

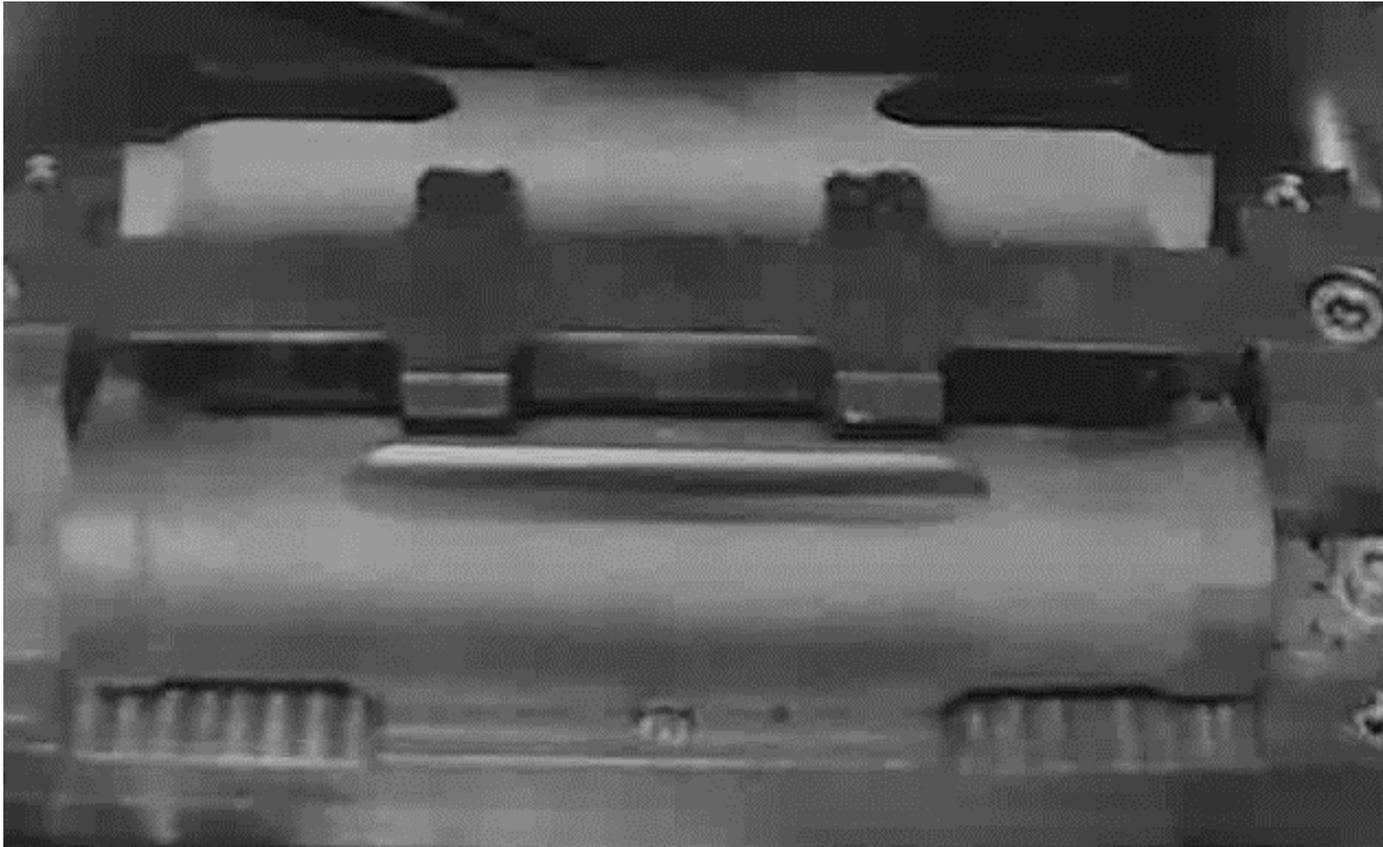


- Simulation of worn belt of armored vehicle BMP 1 repairing

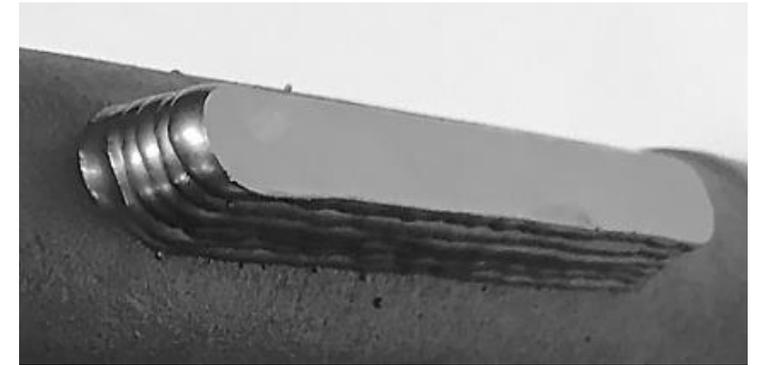


■ Worn belt of armored vehicle BMP 1 repairing

Abrasion resistant materials 50 HRC, part reparation about 35 minutes.



Without sides machining



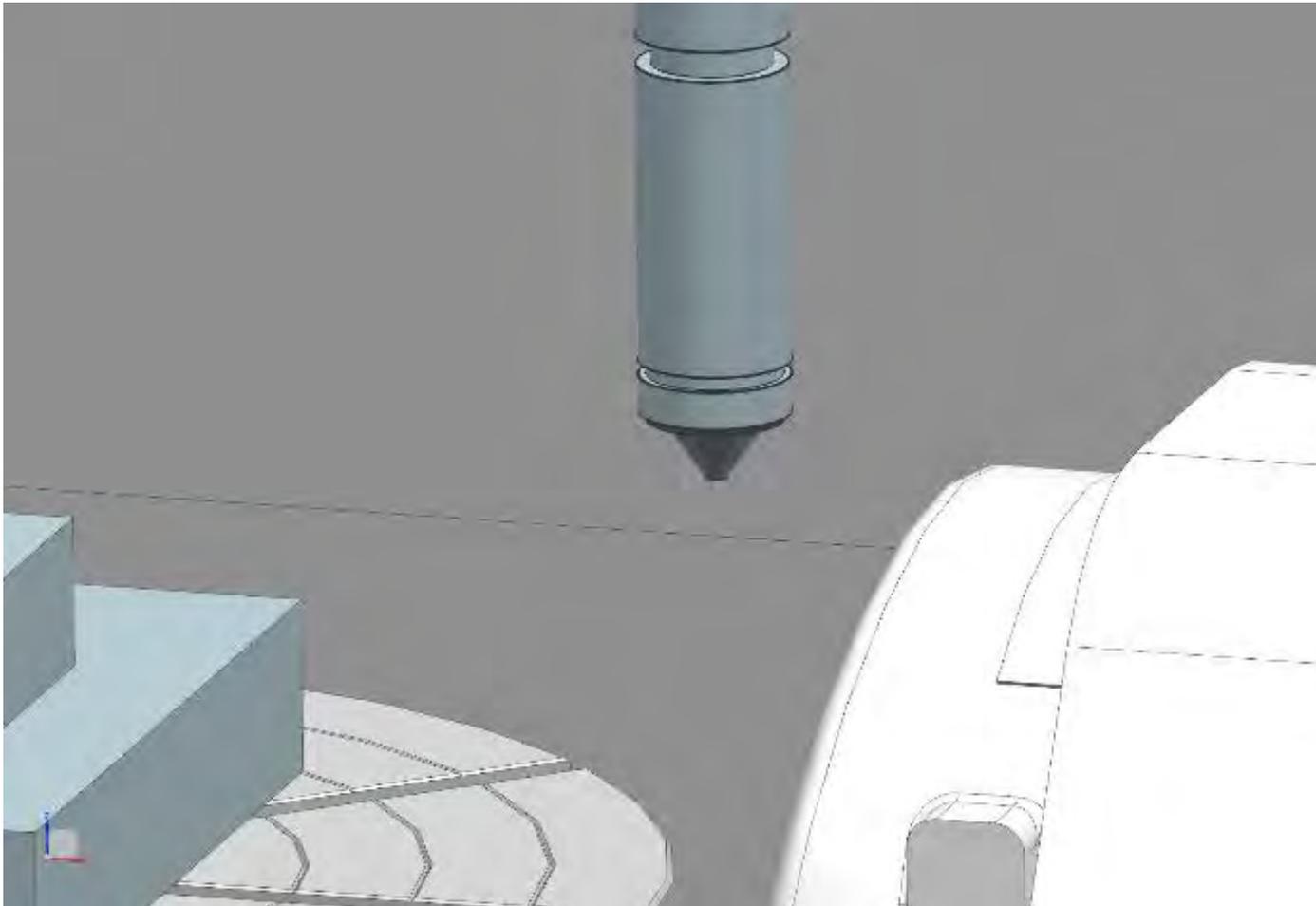
With sides machining



■ Remanufactured belt load test on the vehicle



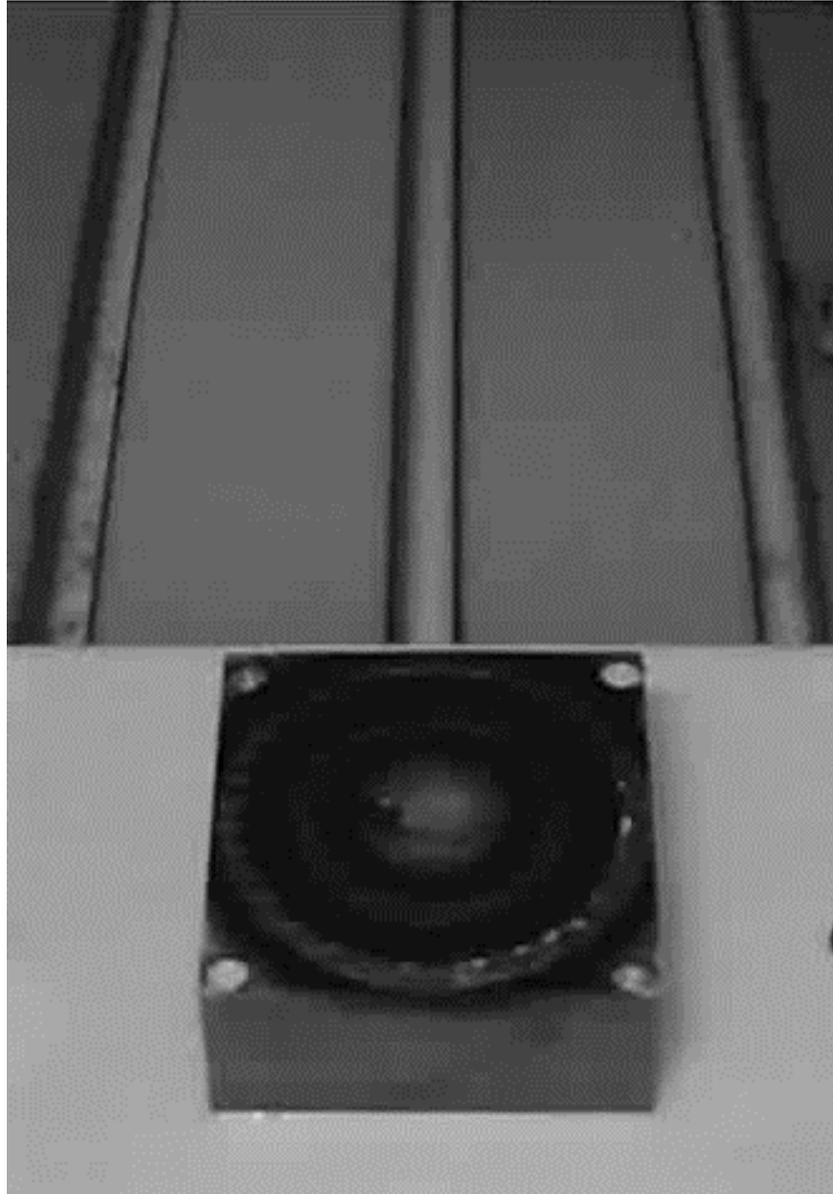
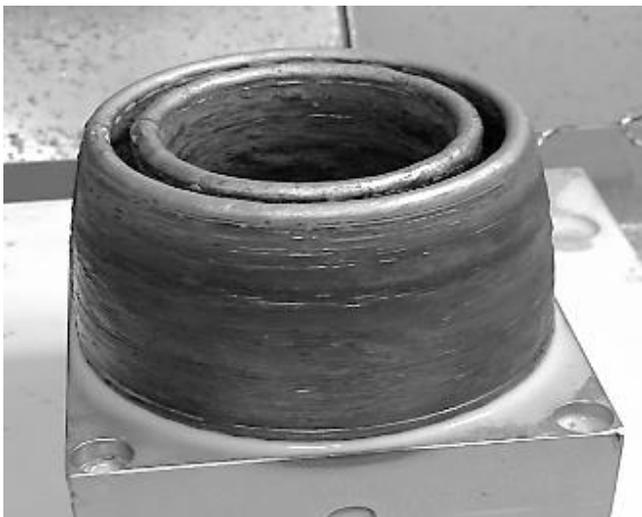
- Simulation of manufacturing a thin-walled steel parts with variable cross-section and the join of two contours



Member of the INDUSTRY INNOVATION a.s. and partner of



- Steel thin-walled part with variable cross-section and join two contours

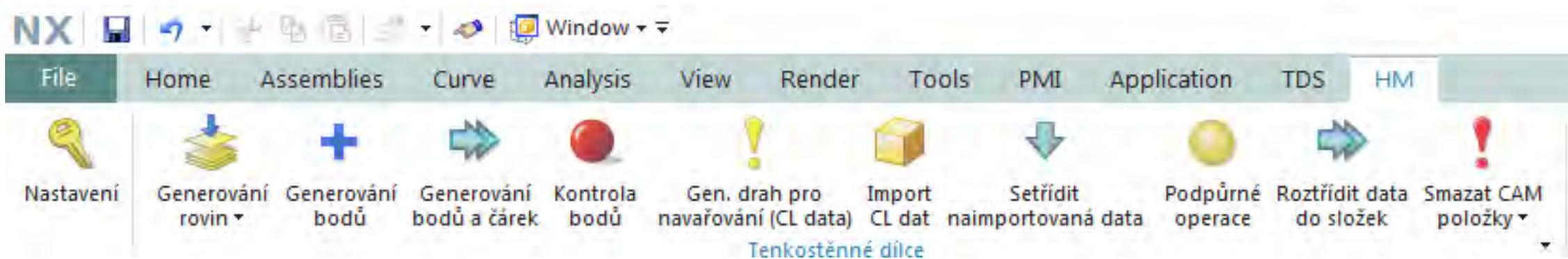


■ Creation of clamping table for CNC machine

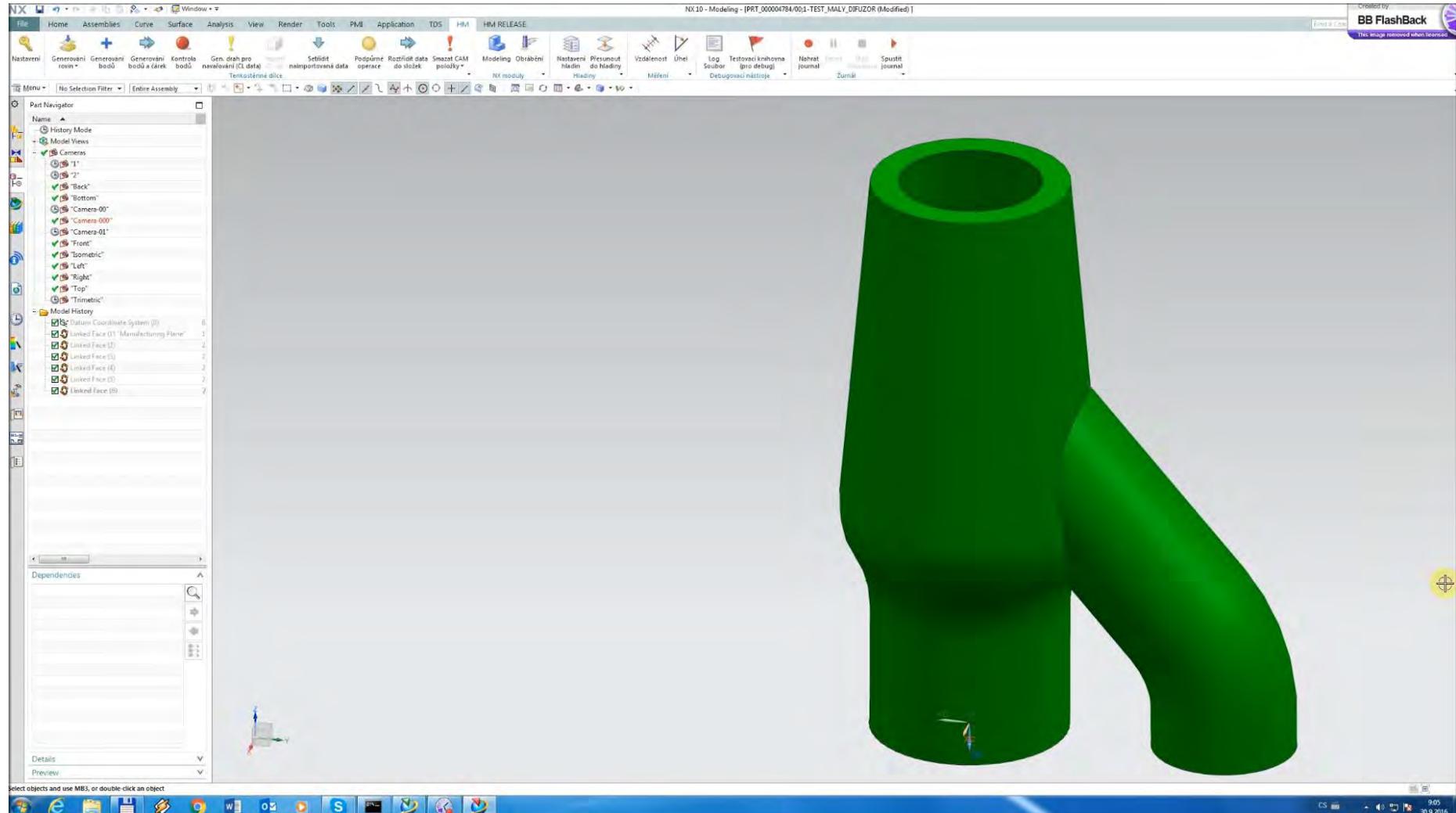


■ Own developed CAD / CAM HM module NX

The upcoming production machine will be supplied primarily with control system Heidenhain TNC 640 with its own software module HM support for programming the machine, which is integrated into the CAD / CAM system NX. Technological CAM processing technology developed jointly HM KOVOSVIT MAS, Inc. and RCMT and will be automatically included with every installation of future machines.



- Demonstration of work created a hybrid module NX, including postprocessor creation and NC data



■ Machine tool for HM will be introduced in 2017

- ✓ 5 controlled axes for welding
- ✓ 5 axes machining
- ✓ The working area of 500 x 500 x 400
- ✓ Control system TNC 640 Heidenhain
- ✓ CAM software, Siemens PLM NX + HM module Kovosvit MAS



- KOVOSVIT MAS, Inc. looking for potential serious interest in technology and machines
- Based on the requirements and feedback can be oriented further research and development.



Thank you for your attention and look forward to cooperating

For more information, please contact:

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