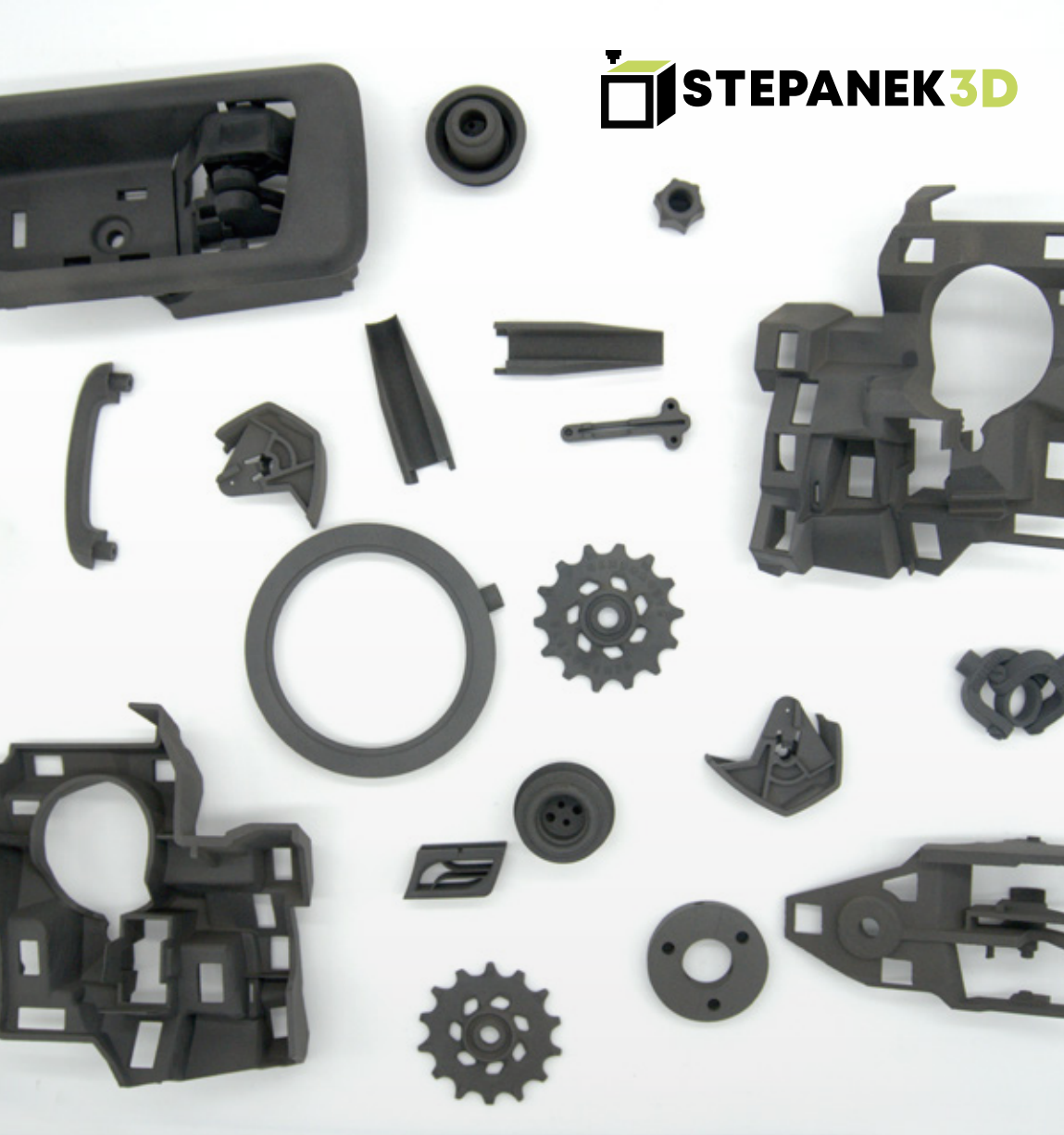
STEPANEK3D

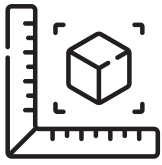


UNIQUENESS OF 3D PRINTING

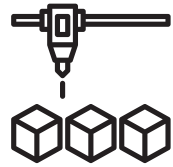
CONTENT

- BENEFITS OF 3D PRINTING
- MATERIAL REDUCTION OF PARTS
- TECHNOLOGIES
- CASE STUDIES
- THE FUTURE OF 3D PRINTING

SERVICES



Modeling and development



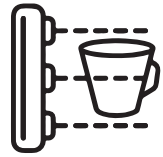
Aditive manufacturing



Consulting and training



CNC machining



3D scanning and tomography



3D printer repair and service

BENEFITS OF 3D PRINTING

Production time reduction
usually in small series production,

Reduced production costs
usually for complex parts and smaller parts up to 40 cm,

Lightweight and optimized parts
significant volume and weight savings as a benefit of topological optimization and generative design,

Assembly consolidation
assemblies into a single component,

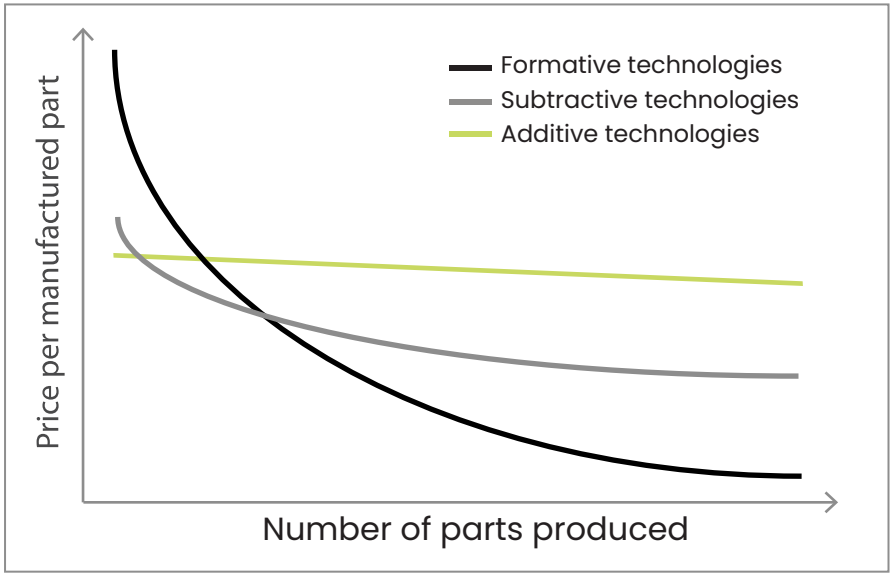
Production of unique parts, that are otherwise non-manufacturable e.g. with shaped internal channels.



WHEN TO CHOOSE 3D PRINTING?

The decision to prefer 3D printing over other technologies depends on several factors, such as cost, time, complexity of production, material requirements, number of pieces and others.

The general trend of the economy can be assessed by the graph:



3D printing is usually most suitable **when you need to quickly produce small series or prototypes**, when the parts are complex in shape or personalized. Or when it is appropriate to minimize waste and material costs.

It is also advantageous in situations where a quick response to changes in demand is needed or when producing spare parts.

On the other hand, where high precision and large volumes are required, traditional manufacturing methods may be more efficient.

The appropriately selected technology therefore depends on the specific characteristics of each project and its life cycle.

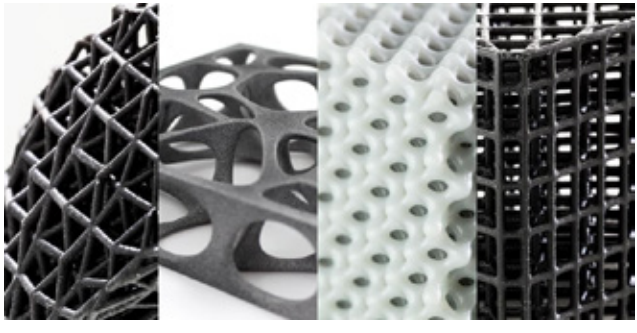
REVERSE ENGINEERING

To create an accurate digital copy, we use 3D scanners and manual adjustment of models based on measurements. In this way, we can convert a 3D surface scan into an accurate volumetric reconstruction, suitable for creating technical drawings.

The advantage is the relatively high speed of the entire process. For parts with simpler shapes, it is possible to express process models or even drawings within 24 hours. For parts with complex shapes, **we offer volumetric CT scanning**, where it is possible to scan the internal structures and porosity of various materials.

Specifics of models for 3D printing

- Shape complexity is **"free".** The more complex the part is in terms of geometry, the more suitable it is for 3D printing.
- In addition to the external shape, we can **adjust the infill** of the part with different types of infill geometries.
- The **fewest production restrictions** of all production technologies enable a high degree of shape freedom.



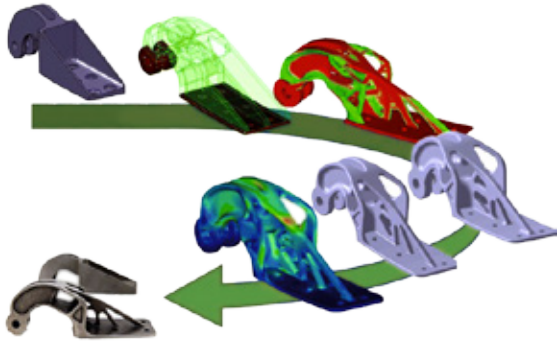
TOPOLOGY OPTIMIZATION



This is an **advanced calculation method**, by which we can achieve the ideal shape of the body (given the specified conditions - material, load, attachment of the part, etc.), with such speed and precision that no designer or even entire development teams can achieve.

What parts or assemblies are suitable for optimization?

- Parts or assemblies where the lowest possible weight is required for function or durability,
- Parts or assemblies produced in high production quantities, where optimization will bring significant long-term benefits material savings,
- Assemblies that contain a large number of components, which should be reduced to smaller assemblies or 1 component,
- Parts that are supposed to be visually different and have a futuristic effect,
- Parts or assemblies that need to be developed efficiently and quickly.



GENERATIVE DESIGN

Compared to topology optimization, the difference is that the **volume gradually creates and iterates in space**, while in topological optimizations are only taken from the already existing and in advance defined volume.

The output of generative design is usually dozens of different ones design options, which the designer just evaluates based on various criteria and chooses the most suitable design.

What are the benefits of generative design?

- Ideal shape with the minimum possible weight,
- Long-term cost savings related to material savings,
- Increasing the efficiency of equipment,
- Consolidation of sets into smaller units,
- Advanced bionic and organic design.



COMBINING PARTS INTO ONE WHOLE

is one of the less obvious benefits of advanced computational methods.

It is in combination with additive technologies (3D printing) that we get a very powerful tool not only for saving the weight of the entire assembly.

By appropriately combining parts, we can, under optimal project circumstances, connect and integrate dozens of components into a single one.



INTERNAL CONFORM CHANNELS

are the result of the main benefit of 3D printing - freedom of design.

By choosing the optimal channel position, we can achieve increased production efficiency and overall improvement of the manufacturing process of tools that can benefit from internal geometry.

Additive technologies have the fewest manufacturing limitations, therefore they are in most cases the only available technology for the production of shaped internal geometry.



DIVISION OF 3D PRINTING TECHNOLOGIES

In the following table, we divide the 5 most widely used additive technologies in industry in terms of **their tolerances, surface roughness and use:**

Technology	General tolerance *	General surface roughness Ra [µm]*	Typical area of use
FDM / FFF	< 100 mm ± 0,5 mm, > 100 mm ± 0,5 %	10 ÷ 250	Prototypes functional parts, wide material portfolio
SLA / UV LCD	< 100 mm ± 0,2 mm, > 100 mm ± 0,2 %	0,5 ÷ 10	Detailed prototypes, master models, etc.
SLS / MJF	< 100 mm ± 0,3 mm, > 100 mm ± 0,3 %	5 ÷ 20	Functional parts, fixtures, etc.
SLM / DMLS	< 100 mm ± 0,3 mm, > 100 mm ± 0,3 %	6 ÷ 20	Metal production of functional parts, tools, etc.
Binder Jetting	< 100 mm ± 1 mm, > 100 mm ± 1 %	5 ÷ 20	Small-scale production of functional parts, usually semi-finished products

* Tolerances and surface roughness depend on the specific geometry, printer used, material, part orientation in the print chamber and many other variables. Therefore, it is safe to assume tolerances for all additive technologies and materials in the range: < 100 mm ± 1 mm, > 100 mm ± 1% and surface roughness from Ra = 50 µm.

METAL 3D PRINTING

DMLS/SLM

(Direct Metal Laser Sintering)

Laser sintering technology of metal powder.



Advantages: Production of metal parts with difficult or otherwise unmanufacturable geometries.

Disadvantages: Relatively coarse tolerances, different surface structure depending on the orientation of the part.

Binder Jetting

Technology of bonding metal powder with a binder followed by sintering.



Advantages: High productivity, lower price.

Disadvantages: Low printing accuracy, higher porosity. Suitable for less precise parts or for the production of semi-finished products. Properties comparable to powder metallurgy.

Materials for DMLS/SLM:

- **Stainless Steel 316L**
- **Aluminum Alloy AlSi10Mg**
- **Titanium Ti64 Grade 23**
- **INCONEL 718 Alloy**
- **Tool Steel**

Materials for Binder Jetting:

- **Stainless Steel 316L**
- **Brass**
- **Bronze**
- **Copper**

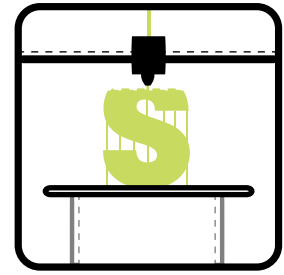
FFF/FDM

Thermoplastics made by melting plastic string.

Advantages: Low price, versatility. Suitable for printing large-scale prototypes, functional parts or presentation models.
Disadvantages: Lower strength in the direction of the fibers and different surface structure depending on the orientation of the part.

Materials:

- **PLA, PETG**
- **ABS, ASA,**
- **TPU**
- **PA12, PA12 CF**
- **PEEK, ULTEM**
- **and ohthers...**



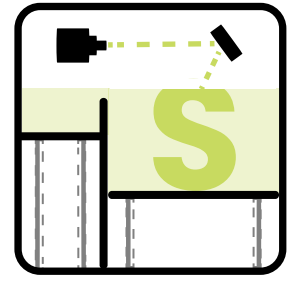
MJF/SLS

Thermoplastics made by laser **sintering polymer powder.**

Advantages: Higher precision and strength, high freedom of design.
Disadvantages: Less abrasive and absorbent surface (in the version without chemical polishing).

Materials:

- **Nylon PA12, PA12 GB**
- **Nylon PA11**
- **Guma TPU 95A**
- **PP**
- **and ohthers..**



SLA/UV LCD

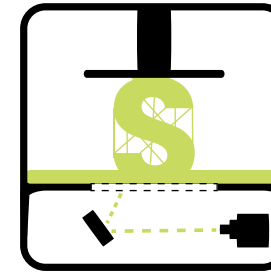
Thermoplastics made using **resin curing technology**.

Advantages: High surface quality and large print volume (up to 800 mm).

Disadvantages: Higher fragility and low resistance to UV light.

Materials:

- **Prototype resin**
- **Technical resin rigid**
- **Technical resin flexible**
- **Temperature resistant**
- **Transparent, ESD and ohthers...**



Casting using 3D printing

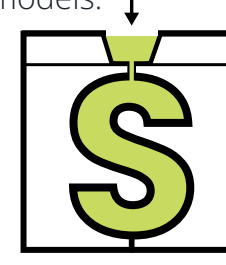
Thanks to the very fine resin and precisely defined geometry, we can efficiently produce master **models for mold production**.

Advantages: Traditional and proven materials and technological processes to shorten and streamline the master model production process.

Disadvantages: Lower accuracy and higher surface roughness compared to conventionally produced master models.

Materials:

- **Aluminum castings,**
- **Steel castings,**
- **and ohthers...**



ADDITIONAL MODIFICATION, MACHINING AND ASSEMBLY OF PARTS

CNC machining



The combination of CNC machining and 3D printing is suitable for the production of parts with high shape complexity and at the same time the requirement for narrow tolerance fields of selected parts elements. This combination saves costs and production time.

Electroplating



Electroplating can achieve higher surface, thermal and electrical conductivity. Mechanical properties, specifically tensile strength and elastic modulus, are also significantly improved.

Threaded insert pressing



Whether it is metric, pipe or other types of threads that are available in the form of threaded inserts, we can integrate them into our plastic products by hot pressing.

Hybrid assemblies



Another interesting use is hybrid assemblies, where we can again combine the best of both worlds. This means we get relatively cheap and fast production of assembly parts that will be made by 3D printing and the precision and strength of parts with CNC machining of aluminum, duralumin or plastics.

Chemical polishing



Chemical polishing uses chemicals to smooth the surface of 3D printed parts, thereby reducing surface roughness and improving appearance and functional properties. Such as airtightness and waterproofness for hydraulic and pneumatic applications and higher wear resistance.

Coloring, varnishing and impregnation



Since plastics generally degrade under the influence of long-term exposure to UV light, it is appropriate to treat them adequately for these applications by varnishing or dyeing.

CASE STUDIES

CONFORMAL CHANNELS

PNEUMATIC CYLINDER
AND INJECTION INSERT

- Production from various metals or polymers,
- Production of otherwise non-manufacturable geometries,
- Design optimization and increased cooling efficiency.





FUNCTIONAL PARTS

PLANETARY GEAR WHEEL

- Excellent method for creating spare parts,
- 3D modeling and delivery of the part within 24 hours,
- Weight reduction compared to aluminum by about 60% of the original weight.





SMALL SERIES PRODUCTION

SCREW HEADS
AND GEAR WHEELS

- Economical production for smaller batches of up to 5000 pieces,
- Immediate start of production without the need for tools,
- Sufficient quality and accuracy even without additional machining for many parts.





USE OF CARBON FIBERS

BICYCLE FOOT, BENDING JIG

- Combination of polymer and continuous fibers,
- Products are 20% stronger than aluminum at half weight,
- Time and financial savings compared to CNC production.





METAL 3D PRINTING

HYDRAULIC FEEDER AND A METAL NEEDLE

- On average, the price is lower compared to CNC machining by up to 30-40% in terms of shape also dimensionally suitable parts.
- Thanks to additive technologies, it was internal channels can be integrated for hydraulic control of the feeder.
- Prints can be additionally heat-treated and on critical surfaces also machined with chips.





PRODUCTION OF PARTS USING LOST WAX

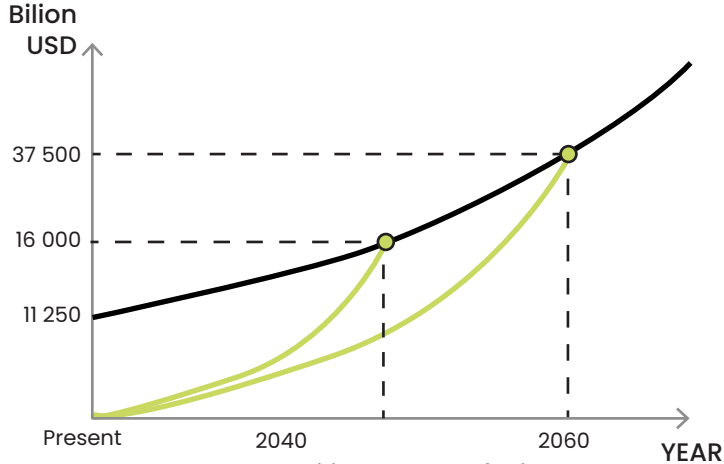
SHAPED WAX FLANGE
AND PENDULUM BOX

- A very fast and efficient method of producing wax master models intended for casting from metal materials.
- The shaped flange was made of wax material by FDM technology.
- The pendulum box was made from precision wax resin and then cast.





THE FUTURE OF 3D PRINTING



Source: Wohlers report, Oxford

Wohlers has been evaluating current data related to the use of additive technologies for over 27 years. Based on all historical data, it has created an estimated graph of future development, where two possible scenarios may occur:

- **Scenario 1 (realistic prediction)** - If the market develops at the same pace as before, in 2060, production using additive technologies will be at the level of 50% (from the current 0.1%) of total global production, i.e. a 500-fold increase with the current status in the **next 40 years**.

- **Scenario 2 (optimistic prediction)** - If the market develops at a faster pace than before (assuming an increased rate of investment in additive technologies), production using additive technologies will be at the level of 50% of total global production in 2040. This scenario therefore estimates a 500-fold increase with the current status in the **next 20 years.**



REFERENCES FROM CUSTOMERS

In our company MTS, we have invested in 3D printing technology. Therefore, we turned to Stepanek3D with a request to optimize and fine-tune the print. Counseling helped us understand some of the processes we didn't understand before. Our company still benefits from extraordinary know-how and experience.

Peter Jamriška, Business and technical consultant| MTS, spol. s r.o.

I would like to thank Stepanek3D for professional training in the field of 3D printing, which helped us to streamline our work in production and also in the design of parts. We also recommend attending the training to other companies that want to start dealing with or improve in the use of these technologies.

Dávid Rodina, Quality Engineer | AAH PLASTICS Slovakia s. r. o.

When using 3D printing services, we especially appreciate the professional and fast approach. We will definitely use these services again and we will also recommend them further.

Dalibor Doboly, Executive Manager| GATYS, s.r.o.

We used a 3-day training for advanced 3D printing and we were given know-how, which saved us a lot of time and resources. The training provided us with a comprehensive view of 3D printing technology and the possibilities of its use in specific applications. The approach to training was excellent.

Filip Beňák, Engineer| Manz Slovakia, s r.o.

Our main mission is to minimize your costs, shorten production time and innovate.

We will help you with design, production and consulting in the field of additive technologies. We have already helped more than **350 companies** with the implementation of over **1000 unique projects**.

Clients and Partners



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