Report 2020

Additive Manufacturing in SLS Technology

IN THE CONTEXT OF COVID-19 PANDEMIC

TECHNOLOGY APPLIED™

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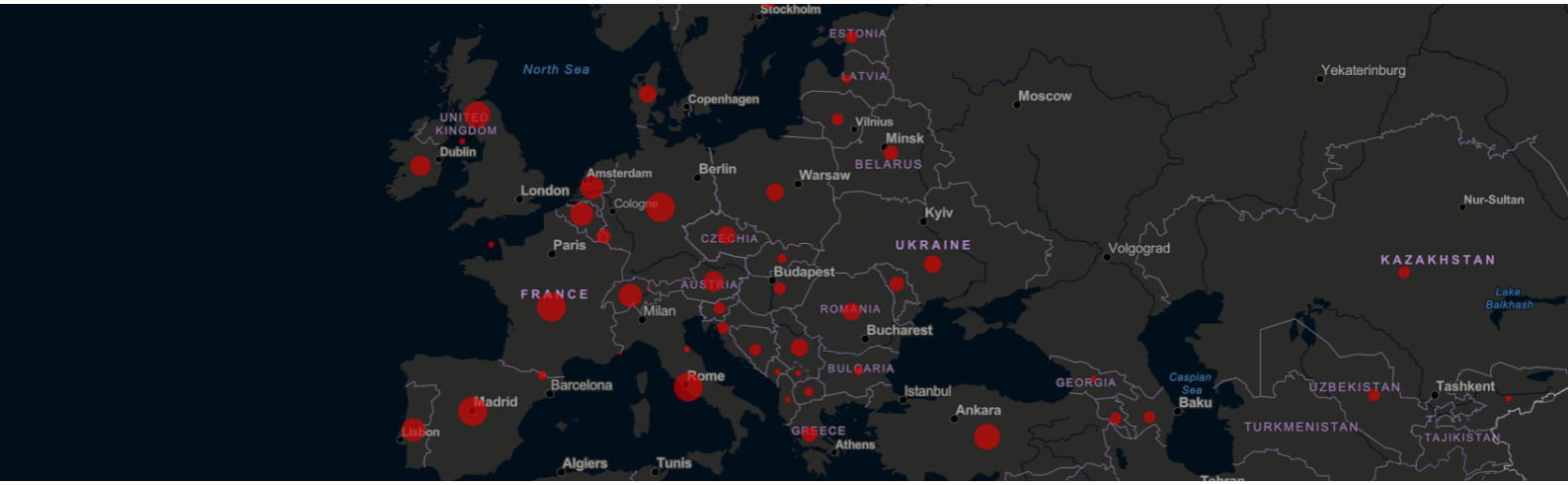
The Beginning of The Epidemic



1st December

CHINA

First mentions of the new disease appear in China. The number of new infections increases dramatically over the following weeks

30th January

ITALY

Italy is becoming the second epicenter of the disease, which WHO gives the official name COVID-19 on February 12.

13th January

THAILAND

The first case outside of China, in Thailand

3rd March

POLAND

The first positive result for the presence of the virus in Poland

24th January

FRANCE

The first case of coronavirus in Europe

1st April

POLAND

Introduction of restrictions in the functioning of enterprises

Supply Chains

The growing number of new cases in pracitcally all countries is quickly overwhelming the health care system. Hospitals report problems regarding the lack of basic personal protective equipment such as gloves, masks, visors or suits. One source of this situation is dependence on the supply of equipment from Chinese manufacturers, mainly from the Hubei province, most affected by the epidemic.

The COVID-19 pandemic has exposed many of the weaknesses of modern supply chains, including:

Concentration

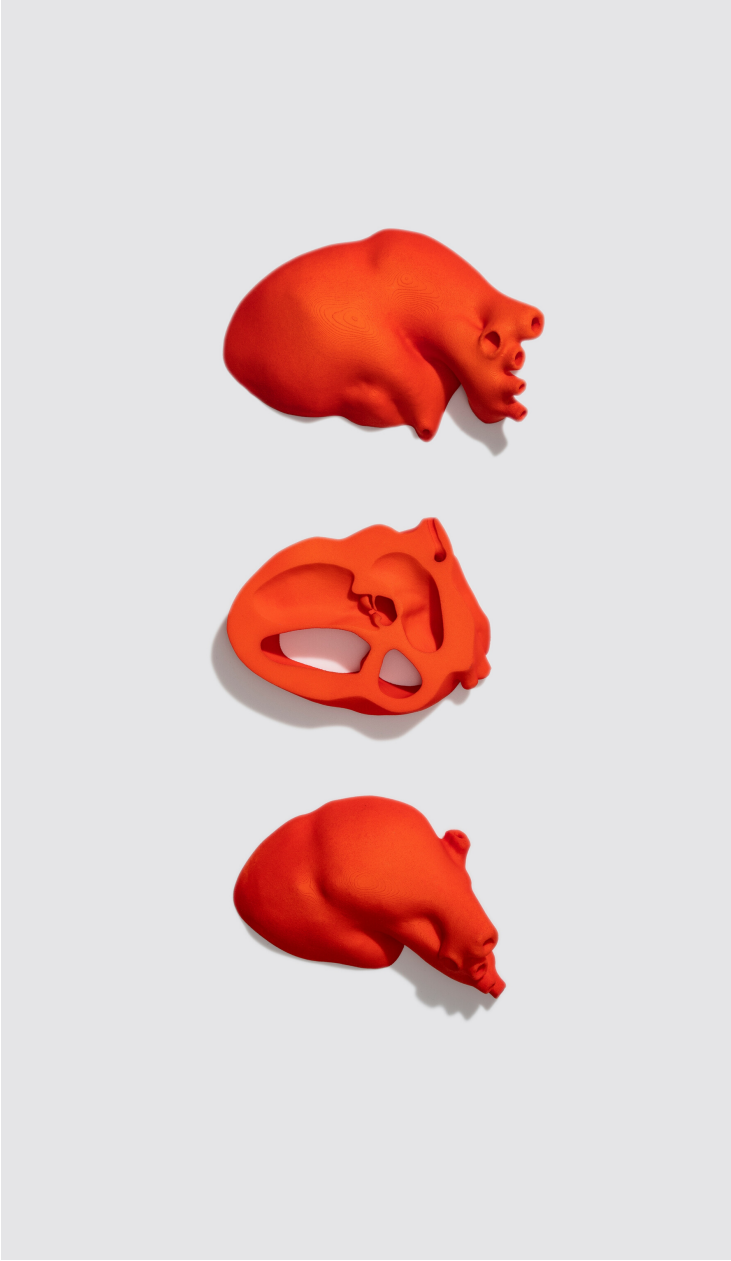
Growing concentration of production not only in one country, but in one region, cut off the world from the supply of necessary goods, in the situation then that region is closed off.

Rigidness

Traditional production methods cannot dynamically change the product they produce. The preparation stage lasts up to several months. Additive manufacturing allows the production of various elements in one process.

Cost

Launching production using traditional methods requires high initial costs in the form of creating tools. 3D printing does not require these costs at all.



Additive Manufacturing

IN CRISIS MANAGEMENT PLANNING

Additive manufacturing has proven to be a answer to these weaknesses in supply chains. We believe that additive manufacturing should become a permanent element of modern supply chains and should be included in the crisis management planning of the state administration to support, supplement and in many cases replace traditional production methods, especially in such a critical area as health system, as it is:

Decentralised

Disabling one entity due to failure or disaster will not harm production in a meaningful way.

Local

The proximity of production makes delivery faster and cheaper.

Flexible

No upfront costs associated with the necessary tooling to manufacture the product and freedom in modifying part's geometry.

Fast

No need to prepare tools for a specific detail means that production can be started immediately.

On the following pages we present examples of applications widely described in the media

SLS Technology

AND BIOCOMPATIBLE MATERIALS

SLS (Selective Laser Sintering) technology allows 3D printing of up to several hundred parts, models or finished products at the same time. No need to use supports means that the printed models do not require subsequent processing and can be used as a final product right after the 3D printing process. Thanks to this advantage, designers and engineers can design models with complex geometries without the need for special adaptation of the model to the 3D printing process.

The advantages of using this technology include:

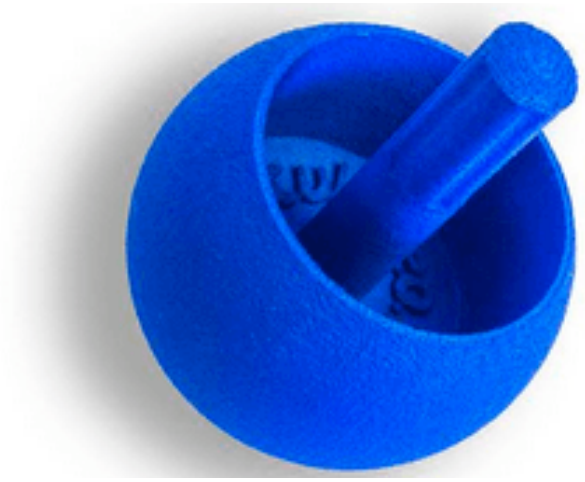
- creating complex geometries of objects (e.g. with internal cooling channels, lattice structures),
- the possibility of short, medium-series production in one production cycle (up to several hundred at a time),
- speed (from the moment the order is placed, the production begins - no tooling / mold for production is needed to start the manufacturing process),
- ecological - the possibility of reusing the powder in the next technological process.

SLS Technology

COMPARISON

www.pinshape.com

FDM

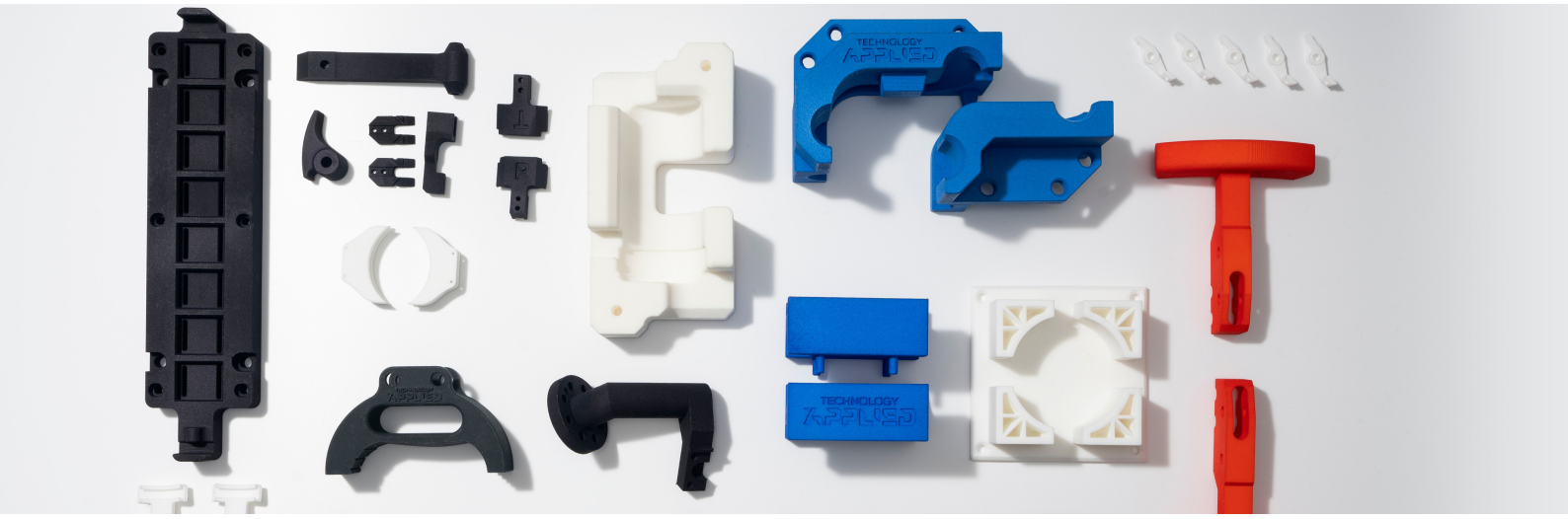


SLS

Another very important element that distinguishes industrial 3D printing technologies such as SLS, DMLS or SLA from FDM hobby technologies (we are talking about low-budget printers for home applications, not industrial versions of the described equipment) is the tightness of the details made. It is extremely important in the production of details such as respirator distributors, protective half masks, adapters for all types of masks. The FDM technology, due to the nature of detail production, i.e. applying plastic material to the manufactured detail with a lower temperature, causes worse bonding of the detail layers. In mechanical terms, this results in a decrease of about 30% in the strength of the detail in the construction axis (Z axis) compared to the other axes (X and Y) in the case of industrial equipment of this type. The values in various hobby equipment are unknown. However, it should be assumed that a non-standardized process may cause a greater than 30% weakening of the detail. In the case of mechanical parts, this knowledge was common and had to be taken into account when designing the detail. In most cases, however, aerosol permeability through the details was not taken into account, which in the case of current epidemic is of great importance.

SLS Technology

KEY PARAMETERS



Making ventilator expansions, adapters and masks in FDM technology gives a false sense of protection against the virus. In some cases, this may be worse than being aware of the lack of such protection. The SLS technology, however, due to the process of selective fusing of layers with a laser and melting of the material at the edge of its softening temperature results in the production of a detail with much better mechanical parameters but also with much better transmission and hygroscopicity parameters.

In standardized conditions, fluid permeability tests using SLS technology using the PA2200 material showed that by maintaining a 2mm thick wall and using a laser exposure consisting of thickening the contours of the manufactured detail. This detail is impervious to liquid at 6 bar. It is a pressure that significantly exceeds the pressure of human exhaled air. This makes it possible to believe that the details made in this technology maintain aerosol tightness and provide protection both for the pressure of the exhaled air and the force of the inhaled air. In contrast to FDM technology, which simply cannot guarantee such tightness. Hence the conclusion that key details such as masks, adapters or splitters should be made in SLS technology.

Application

MEDICINE

Medicine is one of the areas where SLS technology has found its application, where it is used for the production of prostheses, orthoses and pre-operative anatomical models. The Covid-19 epidemic interrupted many supply chains, and hospitals lacked the appropriate equipment to counter the pandemic. SLS technologies have been used to manufacture valves, ventilator expansions and adapters, and to mass-produce visors, masks and door handles to reduce contact with components by many people.

Machines operating in SLS technology by EOS processing polyamide PA12 are suitable for making elements for the medical industry.

"PA12 polyamide material has a certificate of biocompatibility and contact with food (approval for contact with food in accordance with European Directive 2002/72 / EC (except for alcoholic products) and is biocompatible (in accordance with EN ISO 10993-1 and USP / level VI / 121 ° C). This material is suitable for steam autoclave sterilization, which is extremely important in the context of maintaining medical requirements. "
EOS Product Manager Michał Pęczek.

Implementations

VALVES AND EXPANSION DEVICES

The first widely known example of using 3D printing during an epidemic was the creation of ventilator valves. The previous supplier could not deliver them on time. The Italian company responsible for this initiative designed and printed 100 valves within 24 hours.

www.3dprintingindustry.com

www.prismahealth.org

The non-governmental organization Prisma Health has received permission to use the ventilator expansion devices they created, which allows the use of one respirator for up to four patients. Orders for similar adapters have also been placed by Polish hospitals.

Implementations

FACE SHIELDS, MASKS AND GOGGLES

The production of these elements was most often described in the Polish media. To date, Poland has not experienced a high increase in the number of patients requiring intensive care, and therefore there was no need to supply components for ventilators. The situation is different in the case of personal protective equipment. The aforementioned dependence on supplies from China led to a deficit of these basic personal protective products very quickly. Within a few days, designs for these products appeared on the internet and the finished products began to reach hospitals.

As part of the 'We Print for Medics' initiative, 22,000 face shield were printed within 14 days.

www.prusa3d.com

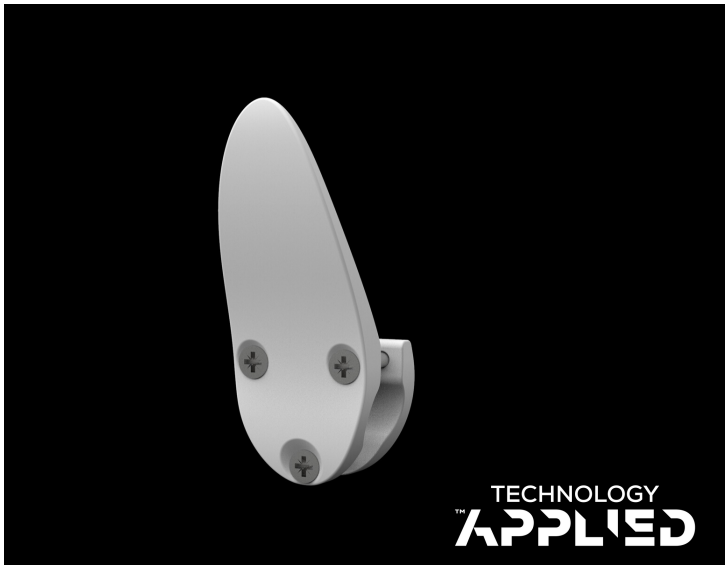
www.3dprintingindustry.com

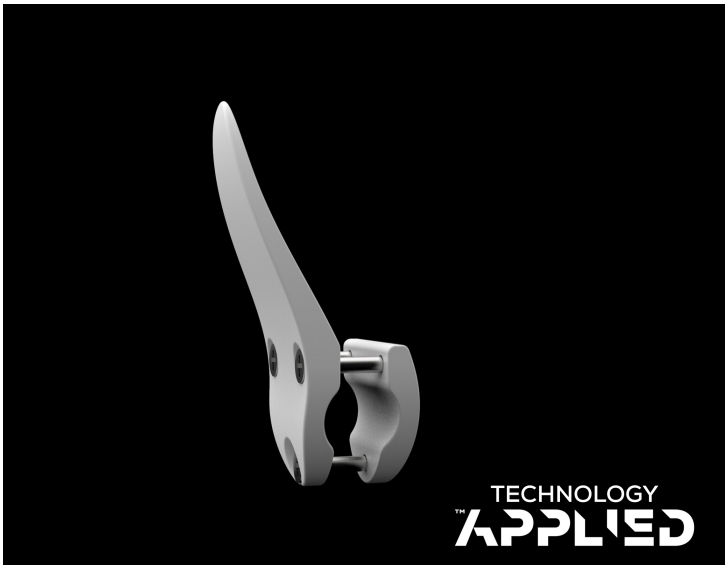
www.china.org.cn

Implementations

DOOR HANDLES

Door handles in public places / workplaces / hospitals are touched by many people. There is a concern that as a result of touching the handle, we can transfer microorganisms such as a virus to it. There is a solution for this in the form of a special handle attachment that is used to open the door with a covered forearm. The purpose of using such attachments is to prevent the spread of coronavirus (it can survive several hours on the door handle). The attachment consists of two elements screwed together with bolts and nuts. In SLS technology it is possible to print several hundred of such sets at a time.

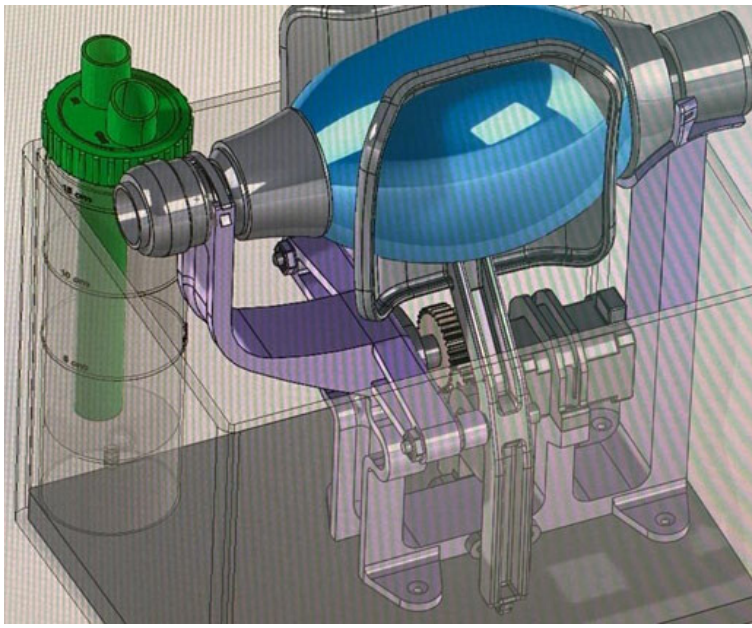




Implementations

VENTILATORS AND CPAP MASKS

A consortium of HP, Seat, Airbus and others has created a ventilator design that can be produced very quickly using 3D printing. A similar consortium, called VentilatorChallengeUK, was established in Great Britain. The British government has ordered around 10,000 ventilators.



www.3dprintingindustry.com/

www.isinnova.it/easy-covid19-eng/

In addition to ventilators, an adapter design was also developed that allows the use of Decathlon diving masks as CPAP masks. It should be emphasized that designing, testing and producing such adapters using traditional production methods would take much longer. The use of 3D printing in such a process allows implementation in just a few days until mass production has not yet started.

Capabilities

TECHNOLOGY APPLIED

Capabilities of Technology Applied sp.z o.o. for the medical industry (adaptation of the production process in SLS technology together with the PA12 polyamide material for medical devices production):

Available machines: EOS P395 with 340 x 340 x 600 mm working area EOS P396 with 340 x 340 x 600 mm working area.

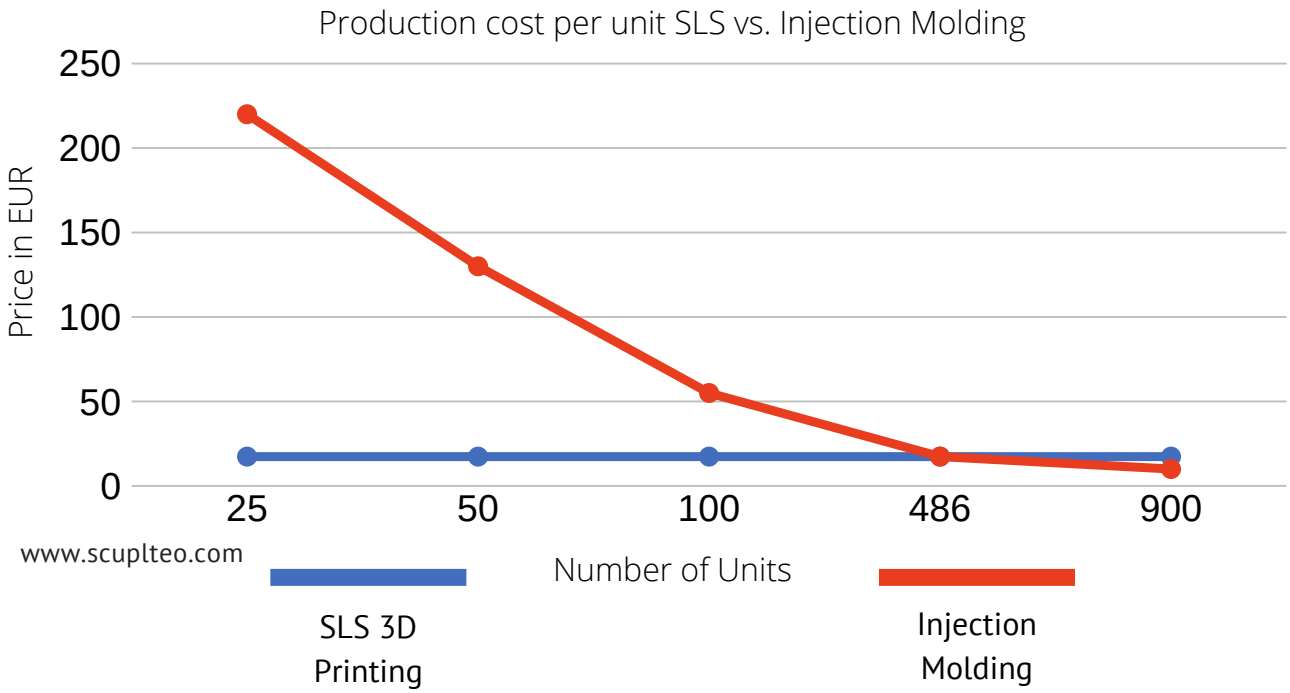
"Material Polyamide PA12 (PA2200) has a certificate of biocompatibility and contact with food (approval for contact with food in accordance with European Directive 2002/72 / EC (except for alcoholic products) and is biocompatible (in accordance with EN ISO 10993-1 and USP / level VI / 121 ° C.) This material is adapted for steam autoclave sterilization, which is extremely important in the context of maintaining medical requirements."

Machines operating in SLS technology by EOS processing polyamide PA12 are suitable for manufacturing elements for the medical industry due to their certificates and process parameters.

www.eos.info

Data

COST ADVANTAGE

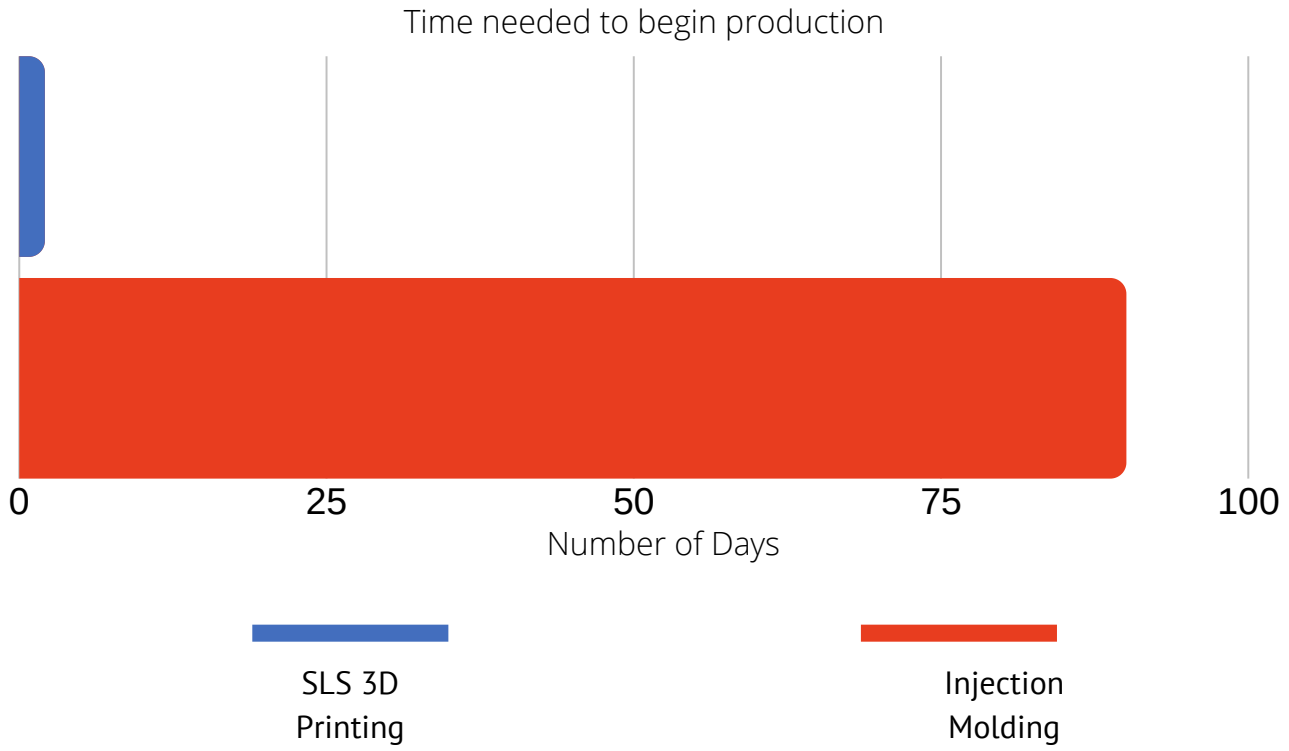


The above graph shows a comparison of SLS printing with the traditional production method, i.e. injection molding. Below a certain number of elements, printing has a huge cost advantage. It mainly results from the lack of tooling costs.

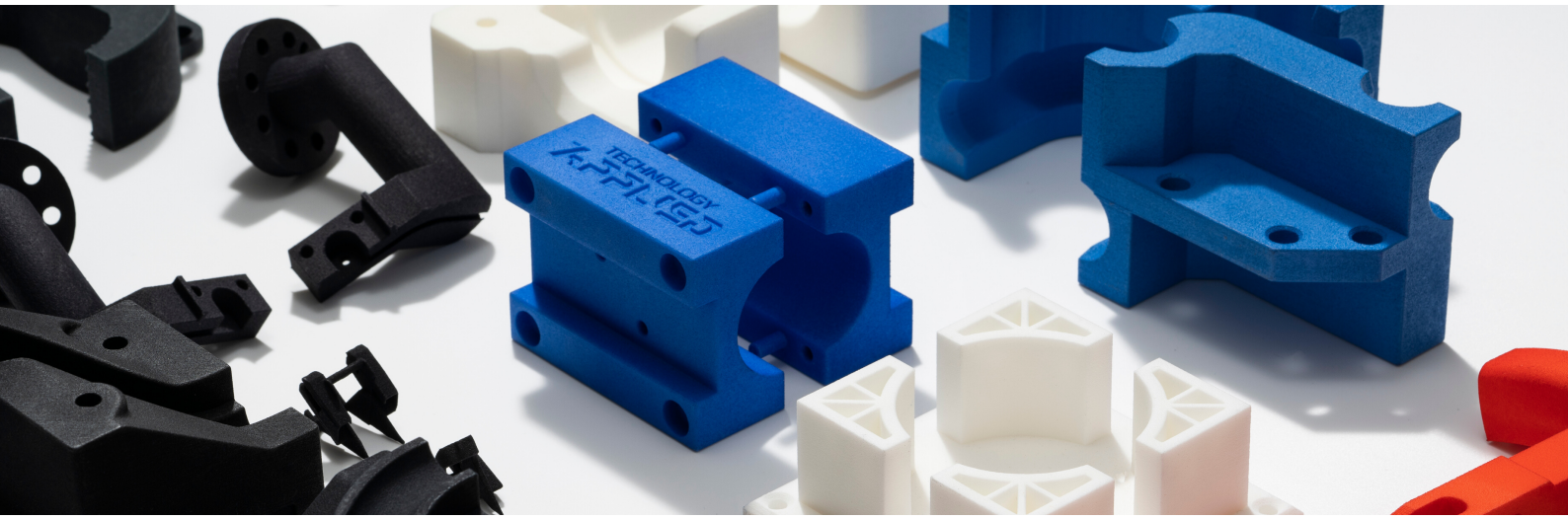
Data

TIME ADVANTAGE

The above advantage is additionally supported by another important feature of 3D printing, especially in the context of rapid response in the face of crisis, namely time. Below is the lead time in both technologies.



Summary



Technology Applied expresses admiration for many owners of 3D printers who have become so involved in the production of many of the described elements. Nevertheless, one should be aware of the risks associated with such a large dispersion of such production. Thousands of people who have printers in their homes and in small non-specialized enterprises operate on very different, often amateur equipment (hobbyists). This means that the parameters of these printouts cannot be maintained, and the number of producers alone does not allow tracing the origin of the printouts, which in the event of infection of one of such persons and transmission of the virus on the printouts becomes an unnecessary risk. We believe that the potential of specialized enterprises should be used first.

Thanks to the initiative of using additive technologies as a method of rapid production, we have seen in front of our eyes how 3D printing allows the preparation and development of the concept of the first products or the production of medium-sized batches in the fight against COVID-19. Based on the collected information, tests performed using 3D printers, we could begin to design solutions that allow mass production (injection molding) and provide proven solutions to those in need.

Further Steps/Cooperation

"We believe that additive manufacturing should become a permanent element of modern supply chains and should be included in the crisis management planning of the state administration to support, supplement and in many cases replace traditional production methods, especially in such a critical area as health system"

Technology Applied is ready to start a discussion on building a Polish additive production network in order to define the needs of not only health care but also other critical areas of the state.