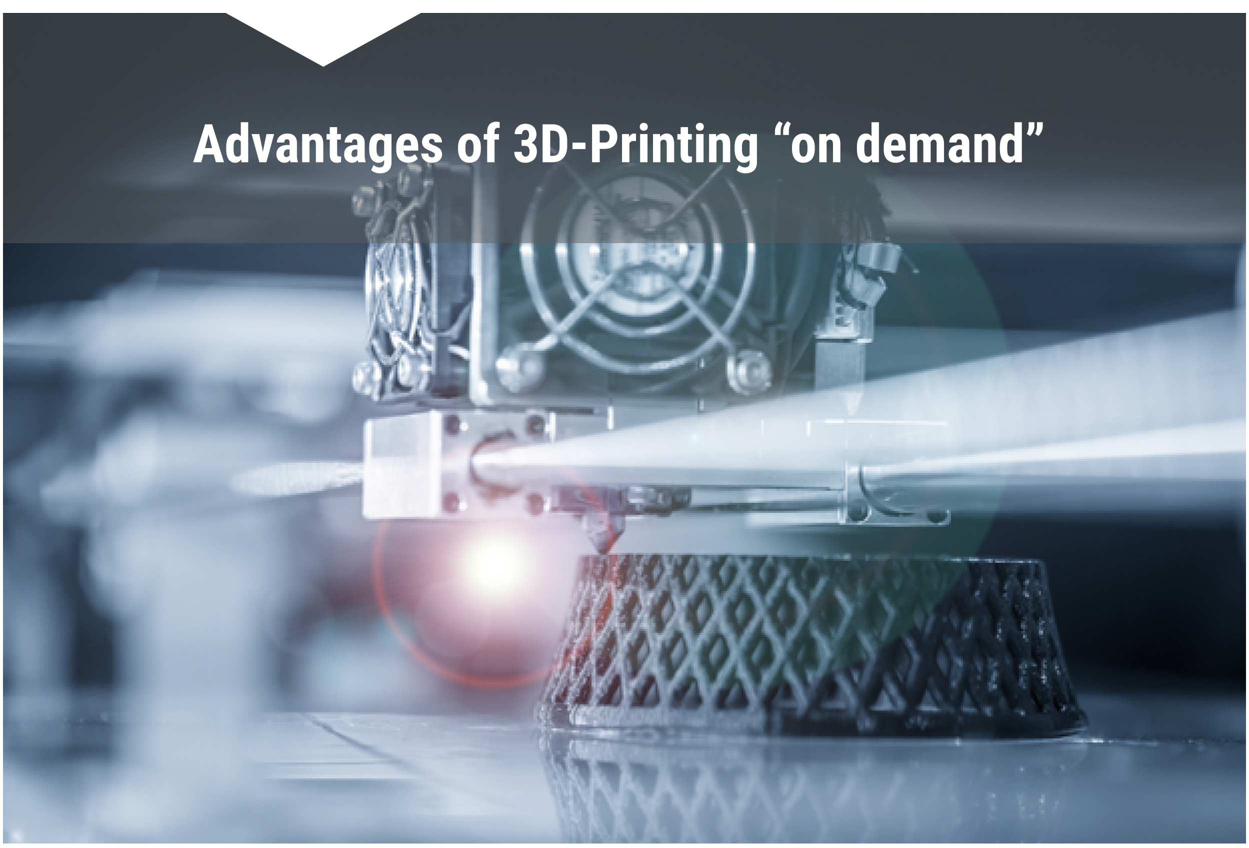
Whitepaper

Reducing Stock Levels and Lead Times with 3D-Printing



Industry 4.0

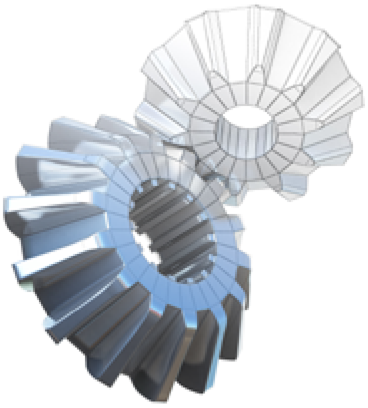
Improving Supply Chains through 3D-Printing

Optimizing stock levels and cashflow management become increasingly important in times of extreme economic challenges like the ones we are facing today. This is even more true when many companies see themselves confronted with a situation which is characterised by great uncertainty and a poor ability to plan on the demand side.

On the other hand, it can be assumed that operating lifetimes of stationary and mobile machines will be extended while investments in new machines will be postponed, thus leading to increased demand for spare parts

The production of spare parts “on-demand” is certainly one of the interesting levers to optimize processes and financials. The idea behind this is both simple as well as illuminating: Instead of physical inventories, product data are made available as well as diversely-usable 3D-printing raw materials and the required parts are produced as required. The advantages are evident:

- Reduced costs for supply readiness
- Reduces lead times to customers
- Positive effects on cash-flows



There were naturally also unstable and strongly-volatile requirements precisely in the replacement part segment and among other slow-moving goods (keyword: obsolescence management) already before the Corona pandemic and the implications associated with it. However, because currently challenges such as inventory management and the optimisation of cash-flows are clearly gaining in importance, the idea is obvious to increasingly examine the possibilities of additive processes.

In the following whitepaper we want to illuminate some financial aspects of the technology in detail and, in so doing, concentrate on the 3D-printing of metal parts.

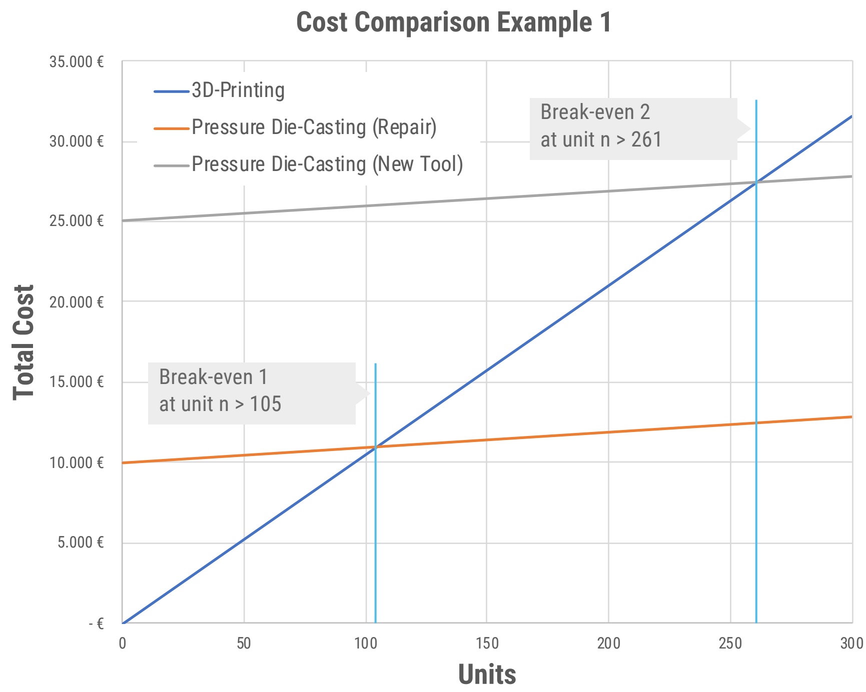
On the basis of two practical examples we will elaborate on the total manufacturing costs of spare parts comparing conventional technologies and 3D-printing while also considering the influence of minimum order quantities.

Break-Even Analysis of 3D-Printing and Conventional Technologies in Comparison

EXAMPLE 1: Lock screw, manufactured as a die-cast component and 3D-priting (SLM)

Component weight: 90 g

Measurements: Ø 60 mm, height 25 mm



We have calculated two scenarios for the conventional production and compared them with manufacturing in 3D-printing:

Scenario 1: The die-casting tool is still available, but must be repaired

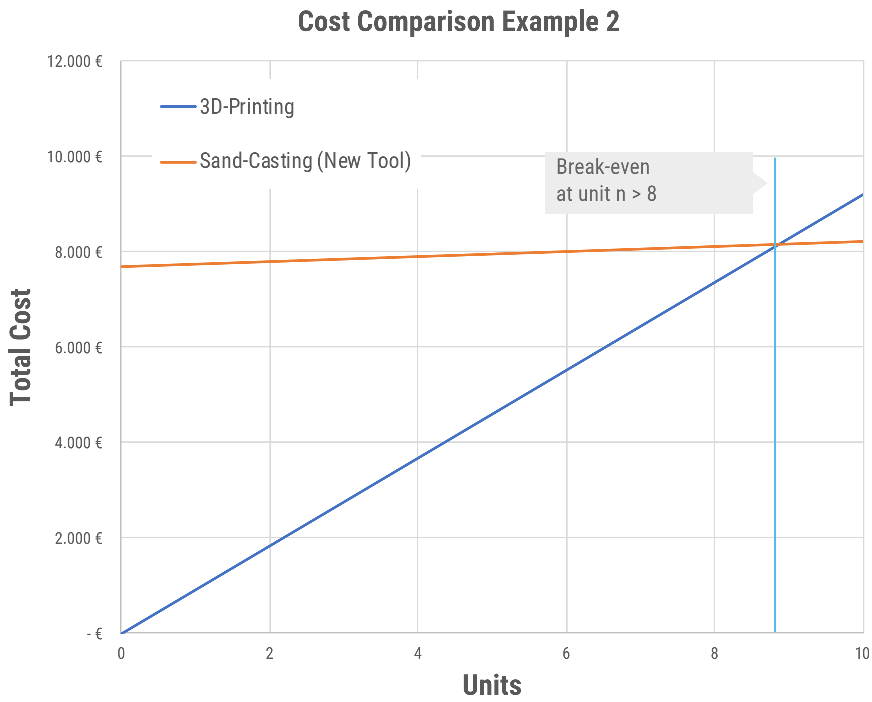
Scenario 2: The die-casting tool is no longer available and must be created anew.

As one can recognise in Diagram 1, the break-even point in Scenario 1 lies at approx. a threshold unit figure of > 105 units and in Scenario 2 at approx. > 261 units. Economies of scale, which are naturally also derived during additive manufacturing, have not been taken into consideration for reasons of sim-plicity.

Example 2: Air duct component of an industrial engine, manufactured as a sand-casting component and 3D-printing (SLM)

Component weight: 2.360 g

Measurements: 350 x 180 x 145 mm



As one can recognise in Diagram 2, the break-even point here lies at approx. a threshold unit figure of > 8 units. Here as well, the economics of scale for additive manufacturing have not been taken into consideration.

Discussion of the Results

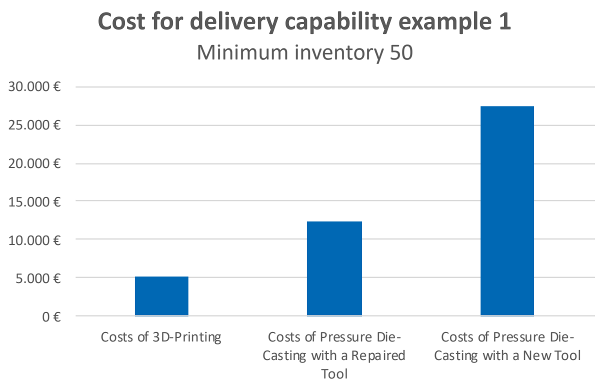
One can very clearly recognise from the break-even points that the 3D-printing is then particularly cost-effective if the components are rather small or the unit figures are rather small.

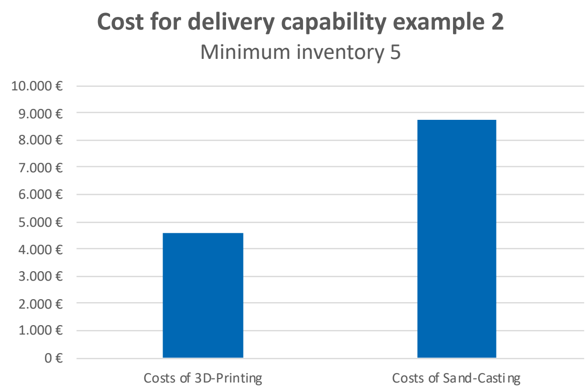
But what if the actual requirements are not known and cannot be predicted based upon historical data owing to the past volatility or the current customer situation with sufficient precision?

Oftentimes, with replacement parts and slow-moving products, it is indeed primarily a matter of being able to deliver at all without knowing the actual quantities. Because the additive manufacturing is not bound to minimum batch sizes, this process constitutes a sensible option for becoming able to deliver at all with minimal costs (keywords: inventories and cash flow) without knowing whether the inventories will even be sold (keywords: inventory risk and instability).

During the economic analysis of these scenarios, the minimum order quantity and/or the concluded ac-ceptance of the competing conventional process play a role.

In our Example 1, this amounts to 250 units; conversely, in Example 2, 20 units. As a sensible quantity for the minimum inventory, in Example 1, a quantity of 50 units was prescribed; in Example 2, a quantity of 5 units. If one now compares the costs for ensuring the delivery capability, then one obtains the following comparison:





As one readily recognises, the costs for the ensuring of the delivery capability – and thus the inventory risks – can be substantially reduced through additive manufacturing processes.

Depending on the delivery timeframe that has been promised or is expected by the customer, one can even – as already discussed at the outset – go so far as to only then commence the production of the components after orders have been made – thus actually set the order quantity at “0” and produce “on-demand” whereby the inventory risks will be able to be reduced even more.

Moreover, mixed scenarios are also conceivable whereby initially the delivery capability is ensured at low costs via 3D-printing and conventional processes can also be used for substantially larger demand. In this regard, it must be kept in mind that the delivery timeframes in 3D-printing are customarily in the range of only a couple of days; however, in the case of pressure die-casting with tool production – depending on the supplier, the range is 10 – 15 weeks.

What to do when there are no product data available?

Reverse Engineering as the Pre-Requisite for Success

However, the pre-requisite for the utilisation of the aforementioned advantages of additive processes is the availability of corresponding product data (3D-data, sketches with additional data). Whenever one speaks about replacement parts and slow-moving products, it namely very often concerns older components for which no 3D-data are currently available. In addition, the relevant 2D-sketches are not always up-to-date insofar as they are even available at all in a legible form. Thus, as a rule, the starting basis is fragmented.

Via upstream reverse engineering, suitable steps are utilised in order to initially generate data which are 3D-printing-compatible. These steps encompass conducting measurements via 3D-laser scanning and tactile (automated and manual) measuring processes (e.g. for deep drillings and hollow cavities) as well as then subsequently the conversion of the 3D-point cloud generated in the scan into so-called NURBS areas and the creation of the – ideally parametric – 3D-volume model. This 3D-model constitutes the starting basis for the further work, e.g. the determination of fits, tolerances, surface finishes and addi-tional features as well as the conducting of calculations and component strength verification by FEM.

Thus, reverse engineering for 3D-printing definitely entails a complex task which far exceeds mere measuring work.

Screening the Component Spectrum

For logical reasons, the reverse engineering – including the corresponding component approvals – is implemented proactively based upon the concrete example in order to be able to act quickly as required. In this regard, it is necessary to assess the existing component spectrum with regards to its suitability for 3D-printing and to correspondingly prepare the relevant parts via reverse engineering. The criteria for the selection of parts are, for example:

- Requirements situation and/or sales history
- Material
- Component size
- Current production process
- Condition of the current operational equipment and/or tools
- Assessment of the current suppliers

Many of these criteria can be assessed during initial research via the analysis of any available data from the respective ERP and PDM systems. This initial research is then sensibly supplemented in an addition-al step by workshops with knowledge carriers from the engineering and supply chain management seg-ments. Thus, one obtains a good starting basis for exploiting the advantages of additive processes at manageable expenditures.

“One-Stop Shop” End-to-End Solutions

At ANTARES Life Cycle Solutions GmbH, we regard ourselves as being highly-specialised solution pro-viders for the aforementioned themes regarding replacement parts, other slow-moving products and ob-solescence management.

We can offer you the following solutions in this regard:

- Product assortment optimisation (analysis of your entire product assortment including the designing of corresponding measures such as, for example, product assortment streamlining and cost optimisation and/or outsourcing)
- Screening your component spectrum regarding its suitability for 3D-printing
- Reverse engineering upon the basis of your template (model, sketch) which includes the current and complete product data
- Supplying products from additive and conventional processes including the mounting of assembly units and creation of replacement part kits

We would be glad to support you with our expertise and look forward to receiving your inquiry

Founder: Dipl.-Ing. Jens Hähn und Dipl.-Ing. Ralf Bauder

ANTARES LIFE CYCLE SOLUTIONS

ANTARES Life Cycle Solutions GmbH
Sophienstraße 2
69469 Weinheim
Germany

Phone: 0621 8757345

www.antares-lcs.de/en
info@antares-lcs.de

Certified according to ISO 9001:2015

Follow us on LinkedIn and Facebook

ANTARES LIFE CYCLE SOLUTIONS