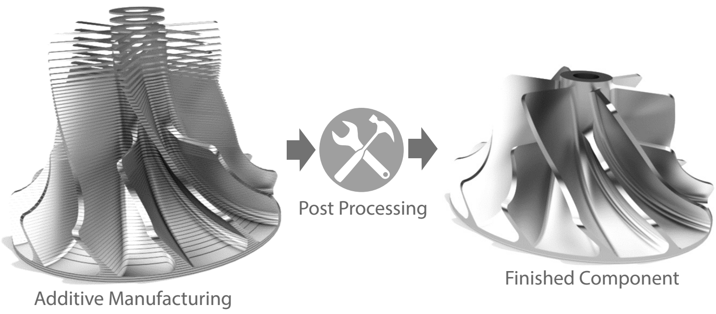
Additive Manufacturing in Production – *for the Automotive Industry*

Additive manufacturing (also known as 3D printing and abbreviated AM) opens up for numerous opportunities in increasing business profit while perhaps also improving sustainability. There are some knowledge gaps though in how and when AM could be implemented successfully for production purposes, and as AM is quite information intensive it is also problematic to keep track of advances in technology or even to find possible uses to begin with.

AM provides a design freedom that is unmatched by other manufacturing methods, while perhaps at the same time entirely eliminating the need of expensive tools or tooling and developing thereof, and lessening the need of labour intensive manufacturing. However, just because AM can be used in a specific project does not necessarily mean that it should be. The quality of the printed part needs to be verified to make sure the requirements are met for the specific application and the value of the product enhancements needs to outweigh the costs without compromising with neither environment nor safety in a life cycle perspective.



AM is a process where a part is built additively, often in a layerwise fashion. This allows for complex shapes, with some AM limitations.

Modelling and prototyping have long been the most typical applications of AM. Over time, AM technology has gradually matured to a level where it might be good enough to use for some production purposes. This is indicated in public statements from other industries as well as competitors where they often either admit to already be using AM for production purposes, are committed to take further leaps or are just looking into it. For production purposes, the emphasis is most often on parts with complex shapes and or low volume production.

From a value perspective, it is helpful to distinguish between a conventional design intended for other manufacturing methods and a geometry which has been designed for AM. While both of these alternatives could bring additional value in certain scenarios, the origin of the added value differs. For example, a complex design might allow an improvement in performance and thereby perhaps increase customer value, while benefits in the lower series (AM’s tooling-free-nature could result in lead-time and cost reduction) and environmental benefits might exist in both cases – which also could increase customer value.

As long as the product requirements (cost, tolerances, strength, perceived quality, etc.) could be fulfilled, very diverse projects can benefit from AM. Applications could be found in modelling and prototypes, tools and tooling, and even in direct part manufacturing of end products. Though for some applications it is unclear whether AM really is a suitable alternative, the limits in possible outcome is not always obvious and will more or less differ between each AM machine, material and the chosen settings.

Some applications of AM will perhaps never be practical due to barriers such as a low speed, high cost, need of post processing and even quality issues. Even if using AM for a specific application might not be a viable option today, it could be in the future with additional advances in technology.

There is more to a successful implementation (either in printing a part or an investment of an AM system) than the maturity of technology. The decision to use AM needs to align with the specific organisation’s needsand a certain level of preparedness should preferably be at place as AM has a steep learning curve. It helps to have a supportive culture of AM were knowledge is cultivated and captured efficiently on various aspects of using AM; such as knowledge on various machines and materials, relevant benchmark material, how it adds value, how it changes work at R&D, strategy aspects, etc.

To decrease knowledge gaps, a wisely chosen case study could provide valuable info on these areas and enable application areas. Three case studies were carried out in this thesis. A metal component was redesigned for AM. In plastic AM different combinations of machines and material were tested – a complex part was tested for ease of post processing and test specimens were tested for strength.

Ultimately, the question when AM should be used can only be answered vaguely without knowing which machines and materials are available, the alternative solution, product specification, in which way AM can add value, etc. No definitive answer could be given from a holistic perspective as the technology might improve further and thereby change the viewpoint, but also as all aspects which affect the answer might not be fully understood yet. The goal of this master thesis is therefore to present conclusions from both a literature review and case studies that aid in defining when AM is suitable for production purposes in the automotive industry in a context that could easily be built upon.

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