ADDITIVE MANUFACTURING (3D PRINTING) APPLICATIONS IN AUTOMOTIVE SECTOR

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ABSTRACT

The automotive sector is one of the sectors with high added value in terms of providing economic and social progress. The contribution of the sector to the country's economy is directly related to the followings: up-to-date technology, innovative production information and ability to design. In today's world, it is necessary to develop production systems that can adapt to rapidly changing technologies in order to reach targets such as producing competitive products and producing technology in the market. Additive manufacturing is a highly efficient and economical way to create customized car parts, prototype parts and components for small-sized vehicles. In this study, the following topics will be briefly discussed. These are (i) why the additive manufacturing technology is a promising method in the automotive sector, (ii) its suitability to the automotive sector, (iii) how to apply this technology to improve performance while reducing costs and (iv) its applications in this sector, and advantageous and disadvantageous of these applications.

Keywords: Additive manufacturing, 3D Printing, Automotive production

INTRODUCTION

For the automotive industry, the latest developments in the additive manufacturing industry have opened new doors for more flexible designs. Lighter, stronger and more reliable products, reduced delivery times, and reduced costs make layered manufacturing technology a good alternative to meet industry needs. An independent consultancy firm Wohlers Associates' report in 2017 stated that the automotive industry occupied 14.8% of all additive production spending as expressed in Figure 1 (Woehler, 2017).

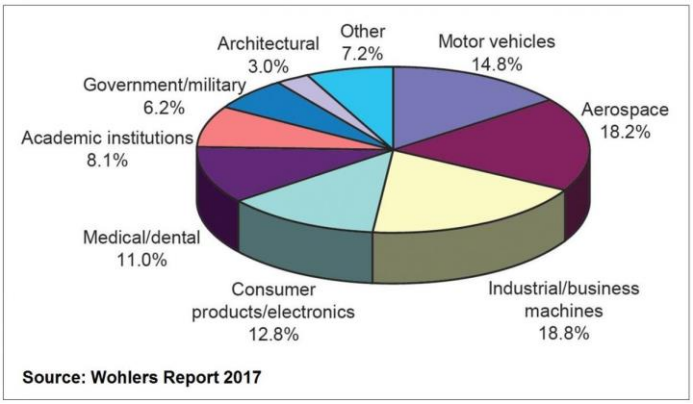

Figure 1: Sectoral distribution of the additive manufacturing technology in 2017 (Cadalyst, 2017)

The role and importance of the additive manufacturing in automotive design and manufacturing stages can be summarized as follows, according to various references in the literature. In this context, it is necessary to mention 5 stages: Design, Validation, Pre-production, Production, Customization and Personalization. The designs in the automotive industry usually start out as scale models that show the shape of a vehicle. The right models allow the design to progress smoothly and exhibit the general form of a concept. Furthermore, prototyping using additive manufacturing is now quite common in the automotive industry, and some engineering materials used in this manufacturing way provide full test and prototype performance validation. Moreover, this technology enables the automotive industry to produce high cost car parts quickly at low cost and then to produce small and medium-sized parts (Bhasin & Bodla, 2014). Added to them, the additive manufacturing has had a significant impact on the competitive automotive industry by making possible to produce customized car parts, which are personalized and adjusted according to a driver (Akben, 2017).

Sample applications in the automotive sector

Until recently, the most common use of the additive manufacturing technology in the automotive sector has been the rapid prototyping process of models and also to test different car parts. Today, the additive

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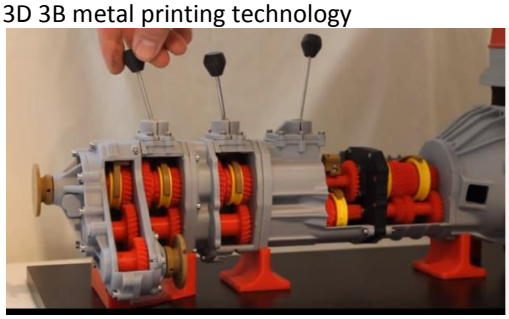
production has become a method used in the production of small parts and fully functional components. With this method, lighter, more durable profiles can be produced.

The following figure, Figure 2, illustrates some 3D printer aplications of various parts of different automobile brands. Apart from these, there are many more applications available which will be detailed in the full text version of this study and necessary explanations on these applications will be made.

a) Renault Truck DTI5 Euro 6 engine, 841 parts

b) Renault Truck DTI5 Euro 6 engine designed with 3D 3B metal printing technology

c)Toyota 4 Cylinder Engine 22RE Model



d) 4WD Toyota Transfer Box Model

e) Toyota's i-Road vehicle whose many parts were printed with 3D printer

f) Bugatti's brake calipers manufactured with the 3D printing technology

Figure 2: Sample applications of additive manufacturing technology in the automotive sector (Renault-Trucks, 2018) (Toyota, 2018) (Motor1, 2018)

CONCLUSION

Additive manufacturing technologies have many advantages, such as being more flexible than conventional manufacturing methods, not requiring special molds, allowing to reduce fuel expense and parts weights, especially offering rapid solution in prototype applications. However, not only the costs and small sizes of the workbenches but also raw material limitations prevent these methods from spreading rapidly in the heavily competitive automotive sector. The widespread use of additive manufacturing technologies offers the following advantages.

- Additive production frees us from design constraints and exposes the creativity of engineers.
- It limits spare part stock and transportation costs to enable production of the needed parts and makes customers happy and improves customer loyalty.
- It enables personalized production.
- Raw material usage is more economical than conventional methods and material waste is less.
- Improved accuracy and the long-run reproducibility of parts are good advantages.

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