

Chapter 21

Big Data, 3D Printing Technology, and Industry of the Future

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ABSTRACT

This article describes how 3D printing technology, also referred to as additive manufacturing (AM), is a process of creating a physical object from 3-dimensional digital model layers upon layers. 3D printing technologies have been identified as an emerging technology of the 21st century and are becoming popular around the world with a wide variety of potential application areas such as healthcare, automotive, aerospace, manufacturing, etc. Big Data is a large amount of imprecise data in a variety of formats which is generated from different sources with high-speed. Recently, Big Data and 3D printing technologies is a new research area and have been identified as types of technologies that will launch the fourth industrial revolution (Industry 4.0). As Big Data and 3D printing technology is wide spreading across different sectors in the era of industry 4.0, the healthcare sector is not left out of the vast development in this field; for instance, the Big Data and 3D printing technologies providing needed tools to support healthcare systems to accumulate, manage, analyse large volume of data, early disease detection, 3D printed medical implant, 3D printed customized titanium prosthetic, etc. Therefore, this article presents the recent trends in 3D printing technologies, Big Data and Industry 4.0; including the benefits and the application areas of these technologies. Emerging and near future application areas of 3D printing, and possible future research areas in 3D printing and Big Data technologies as relating to industry 4.0.

1. INTRODUCTION

Wohlers (2010) based on ASTM F2792 standard, additive manufacturing is officially defined as the process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies. Additive manufacturing is also referred to as 3D printing technology. In this paper, 3D printing technology will frequently be used instead of additive manufac-

DOI: 10.4018/978-1-5225-9624-0.ch021

turing. The 3D printing technology uses .STL files which specifies the information about the objects to be printed, as shown in Figure 1 (Schubert et al., 2014). The 3D printing technology has already been applied in several sectors like automotive, aeronautic, medical and dental, manufacturing, academic, tooling, construction, electronic, moulding, etc. (Gross et al., 2014).

Industry 4.0 is one of the major discussed topics in the industry and academia, because of its great potential for the manufacturing industries and new opportunities for various applications (Foidl and Felerer, 2016). Several many years, organizations and businesses have been analysing data, but the advancements in computing have brought new opportunities and thereby unleashing the Big Data potentials (Eastwood, 2017). The IBM 2014 innovation report identifies 3D printing technology and Big Data as part of the emerging industries and IBM has been able to use Big Data technologies to detect flaws in their operations or gauge user's opinions on the products they buy (Parmar et al., 2014; Eastwood, 2017). Furthermore, from healthcare perspective, "Big data in health" encompasses high volume, high diversity biological, clinical, environmental, and lifestyle information collected from single individuals to large cohorts, in relation to their health and wellness status, at one or several time points" (Heinrich et al., 2016).

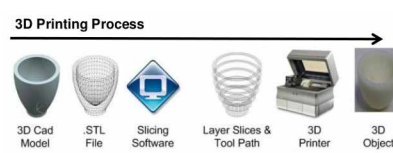
This paper is arranged as follows: the next section introduces the industry of the future known as industry 4.0 and its benefits; section 3 presents the key important areas of 3D printing in industry 4.0; section 4 briefly describes the emerging and near future applications of the 3D printing technology; Section 5 introduces an overview of the term 'Big Data', the V's of Big Data, the technologies behind Big Data and the Big Data challenges; Section 6 introduces possible Future Research for 3D Printing, Big Data and Industry 4.0 and the final section is conclusions.

2. THE INDUSTRY OF THE FUTURE - INDUSTRY 4.0

Industry of the future is referred to as the industry 4.0 which stands for the fourth industrial revolution and other terms used for Industry 4.0 are 'Industrial Internet', 'Smart Factory' or 'Digital Factory'. In 2011, the term industry 4.0 was originated from Germany at Hannover Messe; Hannover Messe is one of the world's largest trade fairs. Geissbauer et al. (2016) defined "Industry 4.0 as an industry that focuses on the end-to-end digitization of all physical assets and integration into digital ecosystems with value chain partners". Industry 4.0 has the potential to analyse, generate and communicate data smoothly and continuously thereby supporting the aim and purposes of Industry 4.0, which networks a wide range of novel technologies to create value".

Industry 4.0 is also referred to as "the digital transformation of manufacturing, leveraging third platform technologies, such as Big Data/Analytics and innovation accelerators, such as the Industrial Internet of Things; and requiring the convergence of IT (Information Technology) and OT (Operational

Figure 1. Generalized 3D Printing Processes (Chamberlin, 2014)



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