Chapter 16
3D Printing in Healthcare: Opportunities, Benefits, Barriers, and Facilitators

Nilmini Wickramasinghe
https://orcid.org/0000-0002-1314-8843
Swinburne University of Technology, Australia & Epworth HealthCare, Australia

ABSTRACT

3D printing has developed as a modification of an old injection printer. Today, it is rapidly expanding offering novel possibilities as well as new exciting applications for various sectors including healthcare, automotive, aerospace, and defense industries. This chapter presents key application areas within the healthcare sector. In medicine, 3D printing is revolutionizing the way operations are carried out, disrupting prosthesis and implant markets as well as dentistry. The relatively new field of bioprinting has come to be because of advances with this technology. As will be discussed, numerous applications of 3D printing in healthcare relate to personalized medicine. For instance, implants or prostheses are 3D printed for a specific user's body, optimizing the technology to work for an individual, not an average user as with most mass-produced products. In addition, 3D printing has applications on the nanoscale with printing of drugs and other smaller items. Hence, 3D printing represents a disruptive technology for healthcare delivery.

INTRODUCTION

Chuck Hall is credited with the invention of 3D printing (Valchanov, 2017); he made the first 3D printer and used it to print a tiny cup. These were the first steps towards a revolution that would see major changes in the health sector over the years. Technology has played a key role in ensuring that the medical field continues to thrive. It therefore means that with the increasing needs in the market, engineers and other stakeholders have a sole responsibility of ensuring that more products are invented for better healthcare. The use of 3D printers has been one of the ways in which revolution has occurred in the healthcare system. 3D printing enables medical professionals to provide treatment for their patients

DOI: 10.4018/978-1-7998-1371-2.ch016

in different ways depending on their ailments. 3D printing is used to create replicas of organs, blood vessels, and bones to specific patients' specifications (Valchanov, 2017). In addition, it is important for developing new surgical cutting and drill guides, and prosthetics. Recently, inventions in 3D has contributed to stronger, lighter, and safer products. This in turn has lowered the overall costs and the amount of time spent during treatment. Benefits have been accrued as the parts are tailored to fit each individual's requirements. As such, patients are comfortable with their medical personnel interactions as they are assured of products that fit their anatomies (Wen & Korakianitis, 2018). Research has been conducted on 3D printing inventions with many scholars making several conclusions. In this literature review, the chapter will focus on the opportunities, benefits, challenges, and facilitators in 3D printing, an evolving area in supporting superior healthcare delivery.

BACKGROUND

3D printing is also known as additive manufacturing and has developed from rapid prototyping techniques of the 1980s (Gibson et al., 2015). The drivers to change the design and manufacturing process are around new requirements such as a better integration on production line, a larger series of manufacturing and/or the need to reduce weight of products due to heavy costs of machines and materials (ibid). The ability to produce complex geometries allows proposing of design and manufacturing solutions in the industrial field in order to be even more effective (Gibson et al., 2015). The additive manufacturing (AM) technology has thus, developed rapidly with new solutions and markets which sometimes need to demonstrate their reliability. One developing market is the healthcare sector.

3D APPLICATIONS

Additive manufacturing, also referred to as 3D printing, has been used by different industries since its inception. Medical technology has however applied it extensively and this is an excellent opportunity to help patients with speciifc needs. Medical imaging techniques including computed tomography (CT) scans, X-rays, ultrasounds, and magnetic resonance imaging (MRI) scans are used in the production of the original digital model (Barrow, 2018). The produced model is then fed into the 3D printer which manufactures an excellent replica of the organ (ibid). The growth of additive manufacturing has been forecasted to increase in the future since the medical field comprises of numerous cases that need more inventions (Wen & Korakianitis, 2018). However, 3D printing offers opportunities in four core areas in the medical field that are important. These areas are the leading cause of its introduction into the medical field.