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Title: Role of Projet 3D Printing and 3D Scanner in Product Design and Development

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ABSTRACT

Additive manufacturing (AM) has an excellent capability to enhance its application in different fields due to its efficient production of customised parts. It produces 3D physical objects directly from the digital 3D model layer by layers. As compared to the subtractive manufacturing process, it has various advantages like customisation, design freedom, flexibility, product design and development, waste reduction, manufacturing of medical implants, tools, devices, concept model with different shape and size, master patterns, and functional prototypes. AM used different 3D printing, 3D scanning technologies and associated designing software. Projet 3D printing is a type of binding jet process of additive manufacturing used in this work which is commonly known as Colour- Jet 3D Printing (CJP). The manufacturing is done through Computer Aided Design (CAD) 3D file which is imported in Standard Triangulate Language (STL) format. Steinbichler 3D scanner is also used to perform this work. It is blue light 3D scanner with scan products in different rotation using Colin software.

Additive manufacturing uses a wide range of material that includes metal alloys, thermoplastic composites, ceramics, pure metals and various form of food. Design and development of a product, medical implants, tools and devices are easily possible. AM provides different flexibilities to achieve high performance and innovation in the manufacturing area. Seven significant flexibility of AM are identified and ranked these flexibilities by using Analytical Hierarchy Process (AHP) technique.

Steinbichler 3D Scanner is used to compare dimensional accuracy, and errors occurred during scanning of product. The input parameters during scanning are appropriately applied to achieve good accuracy. 3D scanners also provide flexibilities which help to achieve different applications and concept developments. The five significant flexibilities achieved using 3D scanner is identified and determined their weight using the AHP method.

Critical success factors (CSFs) for the effective adoption of Projet 3D printing/ Colour-Jet 3D printing technology have been identified through an extensive literature

review, complimented with expert opinion. Further, a hierarchy structural model of the CSFs to the adoption of CJP is developed using Interpretive Structural Modeling (ISM).

Two case studies were conducted focuses on regeneration/modification of cars design and handheld equipment using reverse engineering. The modifications were done to incorporate significant technological changes. TRIZ is used to the idea and problem solving of these two cases.

Additive manufacturing solves present-day challenges in medical because, the data of every patient is different. It is now implemented in different field of medical, dentistry, engineering, aerospace, architecture, design, research and development, food, agriculture, education and training.

The main limitations of this technology are the low mechanical strength, limited material changing options and not economical for a mass production system. Post processing is also another issue which possess extra cost. Further, our Steinbichler 3D scanner is monochrome, which does not provide full-colour information of the product.

In future, one can print with smart material using 4D printing which is an advanced technique of 3D printing. This technology has also another modified version of printing called 5D printing. During the printing process, the print plate also moves along with the print head. This technology provides significant impacts on different areas of Industry 4.0 commonly known as the fourth industrial revolution. In future, AM will provide new customised products at a cheaper and faster rate.

Keywords:- 3D Printing; 3D scanner; 3D scanning; Additive Manufacturing (AM); Analytical Hierarchy Process (AHP); Application; Artificial heart; Cardiology; Colour-Jet-Printing (CJP); Computed tomography (CT); Critical Success Factors (CSF); Customisation; Dentistry; Design; Development; Dimensional Accuracy; Flexibility; Implant; Industry 4.0; Interpretive Structural Modelling (ISM); Magnetic resonance imaging (MRI); Manufacturing; Medical; Medical image; Medical Models; Orthopaedics; Polyether ether ketone (PEEK); Product Design and Development; Projet 3D Printing; Rapid Prototyping (RP); Reverse Engineering; Steinbichler 3D Scanner