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Reverse Engineering Based Methodology for Modeling of Cutting Tool

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Abstract: ***Reverse Engineering is the method of obtaining information and the study of manufactured products. The various parameters and the intricate observations can be collected with the methodology of reverse engineering. RE in simple words can be defined as the disassembling of the assembled of manufactured component. The 3-D scanning techniques that are associated with the RE process help in the visual analysis of the component. The modeling of cutting tool can be studied with the technique of reverse engineering; the structure and the geometry of the component can be studied in an elaborated manner. This article presents the study of modeling of cutting tool on the basis of reverse engineering.***
Keywords: Reverse engineering, modeling, cutting tool, 3-D scanning, and rapid prototyping.

I. INTRODUCTION

Machining of tools has been the most widely implemented method for the manufacturing and production process. The high temperatures generated at the tool – work piece interface during machining operations, especially as they are performed under dry cutting condition, strongly affect the tool life [1-4]. Due to the high temperature the geometry and the mechanical properties of the tool also alters and there for result in poor machining. Same process is applied for conventional machining methods. Reverse Engineering is a technique with which the shape, composition, orientation, tolerance of the cutting tool can be analyzed and its modeling can be studied in a broader manner. The accurate and precise evaluation of the cutting tool is necessary for the modelling of the tool. Thus consists in analyzing the procedure of design and manufacturing process of a product, not only with regard to geometries, but also materials and functionality [5, 6]. Currently, there are several RE techniques widely used and known but many of them still leave the object unusable to analyze or future use. Nevertheless, other alternative to this problem can be a kind of Three-Dimensional Scanning, which allows for obtaining a Digital or Virtual Model (VM) [7]. Getting the scan (VM) of an item makes it possible to redesign it, perform virtual testing, check its geometry and features, get conceptual physical models, or even perform functional prototypes for actual tests [8-10]. In order to design a model there are two methods or engineering processes namely Forward Engineering and Reverse Engineering processes. Forward Engineering usually called traditional engineering, it starts from the sketch design, then forming a slightly complete solutions, and start drawing three-dimensional diagram, after the market research and making the demand schedule, and then according to the drawing effect chart, three view or creating a simple model after finalizing the design [11]. In order to cope with the increasing requirements of measurement and calibration within the industry, a new approach for the design of measurement standards is suggested which utilizes reverse engineering [12]. The underlying study presents the modelling of cutting tools based on the methodology of reverse engineering. It presents the physical reproduction and digitization of various cutting tools.

II. METHODOLOGY

Reverse Engineering is the technique of extracting data by reversing the processes of engineering that have been implemented in the process of manufacturing of designing of a product. Forward engineering is also one of the methods that are used for the designing of a model.

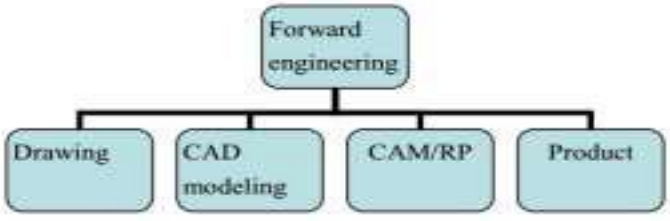

Fig. 1: Forward engineering scheme [11].

In this article we are mainly concerned with the methodology of reverse engineering for the modelling of cutting tool.

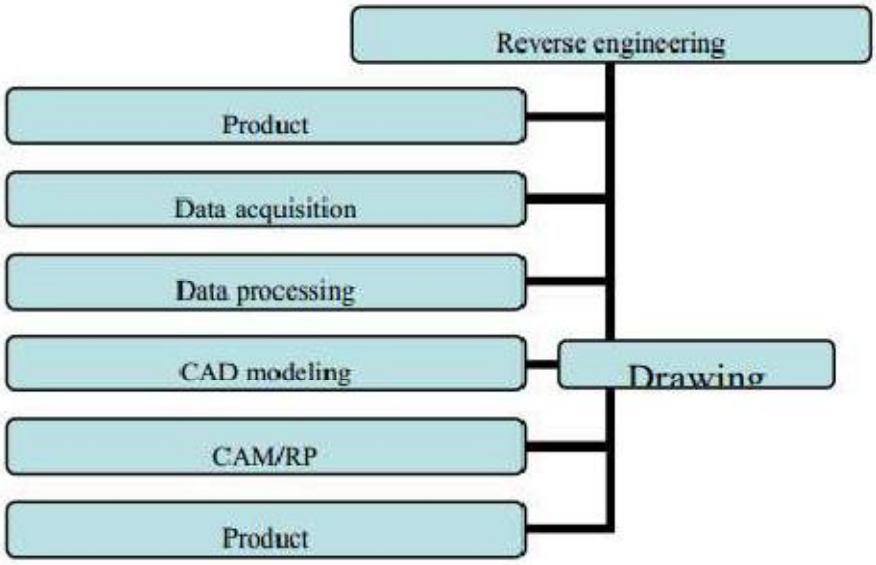

Fig. 2: Reverse engineering scheme [11].

In the process of reverse engineering various steps are required for the modelling. It includes acquiring the data for the product under the scope of study followed by the processing of data. Once the data has been processed then Computer Aided Modelling (CAD) of the product is done. After the data has been modelled using CAD then the machining or rapid prototyping of the product is done after which the model is prepared under the process of reverse engineering. In the process of design, it needs the united strength to other staff and worker, engineering and technical personnel, to express the designer's idea with samples or physical model. But traditional product design makes samples of each scheme and pays a lot of labor with low precision [13]. It is difficult to adjust and modify the problem higher long design cycle and higher cost [14]. On the other hand if forward engineering has to be considered then it involves firstly the drawing the model of the component under study then the CAD modelling of the tool is done, after that Rapid prototyping is done then finally the product is done. All this process has to be performed when forward engineering has to be implemented.

III. EXPERIMENTAL PROCEDURE

In order to follow a procedure for the performing of experiments there are various methods which can be adopted. First of all a model is selected for the experiments. When the model is selected there are multiple problems that are encountered such as color, design, geometry, finishing of the tool. Then the model is treated or redesigned and a virtual model is created through scanning. Then the digitizing of the tool is performed. The resulting model is reproduced using additive manufacturing technique.

Fig. 3: Chart-flow of the Experimental Procedure [7].

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IV. DIGITIZING

The process of digitizing allows us the transfer of the real part surfaces to the digital format. Main type of digitizing processes is the 3D scanning [15]. 3D scanning is a method which allows us transferring scanned points from space to CAD software and to utilize them. There are more types of digitizing devices that allow this transfer. Main types are:
Optical
Laser
Contact
Destructive [16].
Optical scan and laser devices are the most widely used scanning devices in the industries.

Fig. 4: Laser beam projection line [16]

V. RAPID PROTOTYPING

Rapid prototyping is the method of the fast production of the prototypes. There are various rapid prototyping processes known. Most used are [17]

A. Stereo lithography SLA

an additive manufacturing process which employs a vat of liquid ultraviolet curable photopolymer "resin" and an ultraviolet laser to build parts' layers one at a time.

B. Selective laser sintering SLS

An additive manufacturing technique that uses a high power laser (for example, a carbon dioxide laser) to fuse small particles of plastic, metal (direct metal laser sintering), ceramic, or glass powders into a mass that has a desired 3-dimensional shape.

C. Fused deposition modeling FDM

An additive manufacturing technology commonly used for modelling, prototyping, and production applications.

D. 3D printing – InkJet, Z Corporation

Laminated object manufacturing LOM layers of adhesive-coated paper, plastic, or metal laminates are successively glued together and cut to shape with a knife or laser cutter.

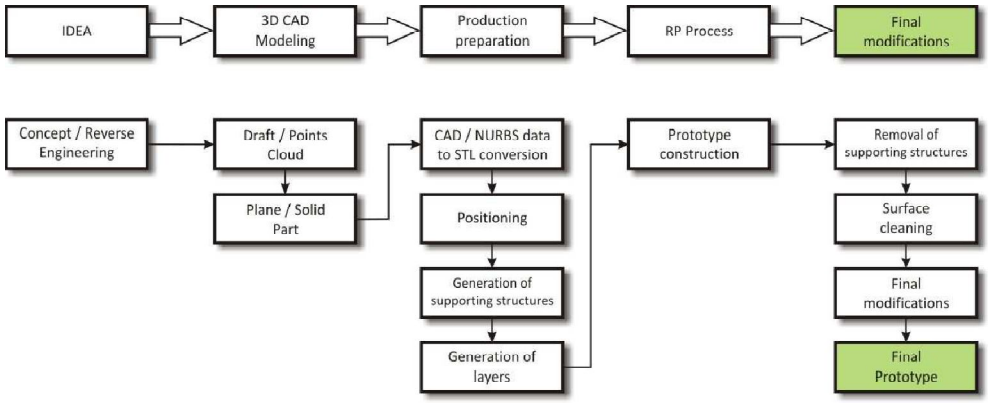

Fig. 5: Rapid prototyping methods progress [17].

VI. 3-D SCANNING

3-D Scanning is one of the most widely used techniques for the scanning purposes. First step of replacing the damaged gear wheel is to get his CAD model. Our example study assumes absence of original part CAD model. There are many factors that are affecting 3D scanning processes. One from them is reflective ability of components surface. Expectation for quality 3D scan is matt, bright surface. Problem of optical scanning systems are for example high shine of surfaces like chrome-plated surfaces or also black surfaces that doesn't reflect laser ray [16].

VII. CONCLUSIONS

In this article a general methodology has been proposed and implemented for the modelling of cutting tool called Reverse Engineering. The process of reveres engineering has been explored and are presented in a sequence manner. Digitization of the model, implementation of rapid prototyping and 3-D scanning techniques help in the better and accurate modelling of the tool which further would not result in failure and frequent wear and tear.

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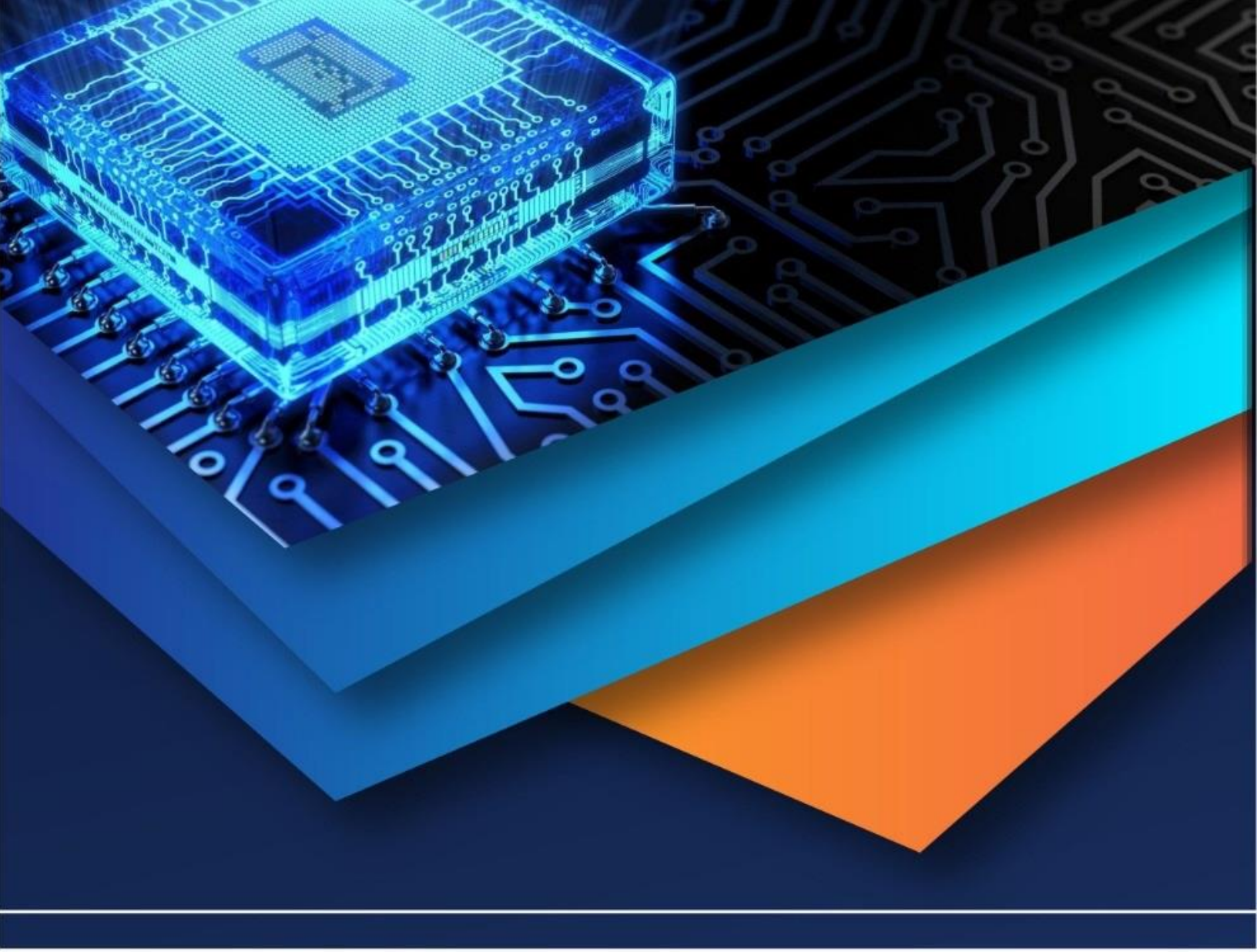

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