ABSTRACT

An integrated design approach for rapid part development: application of reverse engineering, re-engineering and fast prototyping tools

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Contemporary design and manufacturing situations require agile methods to realize the goals of better quality and productivity for rapid part development. Integration of non-conventional techniques such as Reverse Engineering (RE), Re-engineering (ReE) and Fast Prototyping (FP) together with conventional Computer Aided Design (CAD)/ Computer Aided Manufacturing (CAM) practices offer/display the required capabilities for fulfillment of these goals. This research seeks to propose an integrated design approach for rapid part development with primary focus on the RE scenarios of inspection and recovery of worn/broken part data through case studies. A detailed investigation of operations at the data acquisition, data editing and data fitting phases of the integrated RE workflow is performed to determine their effect on the accuracy of digitized data. Furthermore, a proposed tangential plane sketching method is presented as an alternative for parametric CAD model development from the digitized data, to link with ReE and FP phases. Validation through Geometric Design and Tolerancing (GD&T) together with Finite Element Analysis (FEA) supported ReE tasks for evaluation of the generated digitized and parametric

CAD models and for selection of a feasible design alternative. Rapid Protoyping (RP) and Computer Numerical Control (CNC) machining facilitated FP operations for prototype and part development.

The study found some contributors to enhance the quality of the digital model that can be used in the "first article inspection" and also supported that agility in part design and development (PDD) stages can be advanced through integration of RE, ReE and FP techniques. The proposed integrated approach can provide solutions to similar industrial situations wherein agility in the PDD process is necessary so that the developed part can be delivered quickly to the customer at reduced time and costs.

Keywords: Fahraz Ali; Rapid part development; Parametric CAD model; Reverse engineering; Re-engineering; Fast prototyping; Data acquisition; Data editing; Data fitting; Agility.