

Proceedings of the 8th Annual World Conference  
of the Society for Industrial and Systems Engineering,  
Baltimore, MD, USA  
October 17-18, 2019

## A Qualitative and Quantitative Inspection Analysis of 3D Printed Prototype Parts

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**Author Note:** Rawan Alkhasawneh recently completed the Master of Science in Industrial and Systems Engineering of the SSIE Department at Binghamton University. Daryl Santos is a Professor in the SSIE Department and advised Rawan on her master's thesis, upon which this paper is based.

**Abstract:** Three-dimensional (3D) printing plays a vital role in the continual cycle time reduction of product development through rapid prototyping. Nonconformities in the printing process could slow down this phases of product development. In this research, quantitative and qualitative studies are carried out on prototypes that are 3D printed both with and without support material on different parts of the design. Fused deposition modeling, or FDM, is the method of fabrication used in this study. These prototypes are studied in a non-destructive manner. The qualitative investigation examined aesthetical issues on small prototypes printed with and without support material. The quantitative study investigated the specimens' bases to explore the effect of the item's design on the foundation pieces. The results show that, the smaller the pieces printed over the foundation, the closer to target value the foundation measures. Elements of the 3D printed items, not directly connected to support material, were not affected by using the support materials. Furthermore, for portions of the design with overhangs (parts that used support), no evidence was found of a geometrical effect of using support. However, the visual appearance of the items was affected. Aesthetical issues studied on the items were Sagging, Bulging, Z-Wobbling and Base Surface Imperfection. Results showed that using support material did alleviate the Sagging defect. However, all the other defects were exacerbated with the use of support material.

*Keywords:* FDM 3D Printing, Quality Inspection, Prototypes, Quality Control