# Establishing a Replicable Process for Collecting Architectural Point Clouds and Processing Data into 3D Prints

**Billy L. Edenfield Jr., and Patrick C. Suermann PhD, PE, LEED AP**
United States Air Force Academy
Colorado Springs, Colorado

With the emergence of laser scanning point cloud technology in the construction field, it is important to find innovative ways to take advantage of the new data stream. Point clouds are often used as the basis for 3D prints in the manufacturing industry; however these are typically of small objects, and nothing as large as a full building made to scale. The objective of this research is to develop a process to take a full scale building scan and produce a scale model from the data. It is hypothesized that many of the processes used in the manufacturing of smaller scale parts, such as automotive pieces, will be the same but on a larger scale. Key questions are what programs are able to be used for this purpose, as well as if they will be able to process the hundreds of millions of point cloud data pieces that a building scan will produce. The first step is to find a process to convert the raw scan data into a useable format. After converting the data into a useable format, a solid mesh needs to be created from the data to be exported to a 3D printer. The most accessible file formats are .stl and .obj for the various 3D printing hardware released in the market. Preliminary results include prints derived from U.S. Air Force Academy Chapel scans. Working with Peterson's 21st Civil Engineering Squadron, scans of the chapel area were taken with a Leica C10 scanning station and exported as a .ptx or .pts file format. Afterwards, Autodesk Recap™ was used to do basic cleaning up of the cloud data, as well as select specific objects to print. Geomagic DesignX™ was then used to take the imported point cloud and create a usable mesh to be exported as an .stl file. With the completed mesh from Geomagic DesignX™ the .stl file was imported into the MakerWare™ software to scale the mesh and create 3D printed models with a MakerBot Replicator™. To date models of the U.S. Air Force Academy 9/11 Memorial and a wall sculpture extracted from the chapel area scans have been produced through this method. While the automatic mesh generation works for small sections, the software currently is unable to process point clouds of full building scales adequately. However, it is possible the point cloud data to manually create a high accuracy model of the building for the purposes of 3D printing. Currently, the impact of this research is beneficial primarily for historical preservation purposes or for creating highly accurate as-built data collection through reality capture. With these techniques, it is possible to create a physical model of a significant cultural structure with a very high level of accuracy. Secondarily, as the technology progresses and the sophistication of 3D printers continues to mature, complete facilities may be cloned or replicated through additive manufacturing processes on a large scale, with improved costs due to economies of scale of mass manufacturing and mass customization.

**Key Words:** Reality Capture, Point Cloud, 3D Print