American Railway Development Association

Technology Committee Feature:

## An Introduction to 3D Printing

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Think back to the years following the release of alternative-fueled automobiles in the United States. These hybrids certainly did not take the world by storm. At first, consumers struggled with the notion of a hybrid becoming their primary vehicle. Sure, Hollywood A-listers dabbling in environmental advocacy could afford to keep one in the garage in case they needed to be photographed arriving at an award show. But middle class Americans weren't yet convinced an overpriced battery with a lawnmower engine and four tires was the answer to their financial woes, let alone global warming.

Eventually technology, manufacturing techniques, and consumer demand application caught up to the point where automotive manufacturers could achieve economies of scale and lower price points. Consumers began to see economic and environmental benefits, making hybrids a practical choice even for skeptics.

While most design engineers would agree 3D printing hasn't quite reached this tipping point, it isn't that hard to imagine the technology having the ability to advance or improve an industry such as railroading. Before we dive into the nuts and bolts of this technology, let's brainstorm some potential applications of 3D printing.
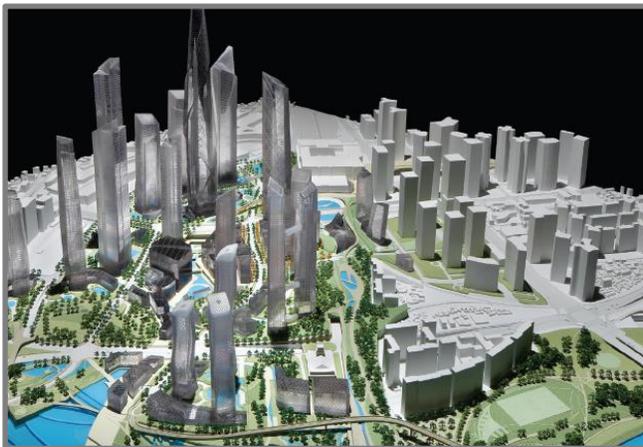
An automobile part manufacturing company is considering locating a one million square foot distribution facility at the end of your rail spur. The proposed location is a vacant tract of land situated between a public road and a residential neighborhood. Their hired design consultant has identified multiple internal and external obstacles. Does the proposed location have good access to primary transportation routes? Is the topography conducive to site development? Will the residential neighbors be negatively impacted by the 24/7/365 operation?

To address the last obstacle, most design consultants would utilize simulation or visualization software. However, your automobile part customer is hosting a meeting with the neighborhood homeowner's association and doesn't believe that a one-dimensional presentation is going to cut it. They need something the community stakeholders can see and touch. A 3D print model could reveal the industry's site contains a wider land buffer than they initially envisioned. And maybe that buffer is a 25' tall man-made berm that mitigates a considerable amount of the industry's sight and sound pollution.

Let's consider a second scenario. Your large steel manufacturing customer wants to add 15% additional capacity to the rail cars used to ship steel coil. Capital funding has already been secured to retrofit their existing fleet. You have a significant interest in presenting a design that can work - if capacity increases, revenues grow.

A cardboard model is an option, but you only have two weeks and a limited budget to present your customer with a design model. Relatively speaking, cardboard models are time consuming to create and expensive. Perhaps a 3D print model can more efficiently and cheaply give your steel customer something with substance to hold in their hands and help demonstrate the difference between the new and existing car designs.

So you've decided a 3D print model is the best way to sell your proposal. Currently there are two options.

The first option is to design the model yourself using design software. The design is created and saved into a stereolythographic (STL) file format. Next step is to upload and send your STL file to a 3D printing company such as Shapeways or 3D Systems. Perhaps this option is more economical for your company because you only need a prototype and can't justify purchasing a printer that costs more than your department's Christmas party.

The second option is to purchase a 3D printer from a company like MakerBot or Stratasys and handle the entire process from designing, slicing, and printing yourself. MakerBot specializes in desktop 3D printing, while the latter sells a range of printing equipment from home use to industrial, the main difference being the build envelope or build volume.

The DIY method starts with a digital model created in design software. Autodesk is one of the more well-known design software vendors, but SolidWorks, Catia and PTC offer similar software packages as well. Once the model is designed, slicing software, such as that sold by Stratasys or MakerBot, takes over. The model is sliced into hundreds or thousands of horizontal layers to prepare the file for printing.

After uploading the prepared file in the 3D printer, the object is created layer by layer. To create the object, a printer-type nozzle extrudes filament onto build plates.

Your design software controls the amount of material and placement of filament onto the build plate. The 3D printer simultaneously reads every slice (or 2D image) and proceeds to create the object. By moving along an X, Y axis, the extruder carefully blends each layer together, resulting in a three dimensional object.

At the end of the day, you have to determine if this product has the ability to make your company more successful. Depending on the nature of your business, success may be measured in cost savings, time savings, or new customers acquired. Certain technological innovations have been adopted by the railroad industry in the past 150 years. Some have been left behind. Time will tell with 3D printing.