Viability of Distributed Manufacturing of Bicycle Components with 3-D Printing:

CEN Standardized Polylactic Acid Pedal Testing

Summary Paper

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1 TARGET AUDIENCE

Individuals, businesses and organisations working in less developed regions and isolated communities. Humanitarian engineering educators looking for interesting case studies of open source appropriate technology and the value of open source 3-D printing for sustainable development

2 BACKGROUND

Recent advancements in open-source self-replicating rapid prototypers (RepRap) have radically reduced costs of 3-D printing. The cost of additive manufacturing enables distributed manufacturing of open source appropriate technologies (OSAT) to assist in sustainable

development. This potential has not yet been fully explored, particularly in regards to the technical replacement ability of products from distributed manufacturing.

3 PURPOSE

In order to investigate the potential this study makes a careful investigation of the use of RepRap 3-D printers to fabricate widely used Black Mamba bicycle components in the developing world.

5 METHOD

A CAD model of a bicycle pedal was created using parametric open source software (FreeCAD) to enable future customization. Then poly-lactic acid, a biodegradable and recyclable bioplastic was selected among the various commercial 3-D printable materials based on strength and cost. The pedal was 3-D printed on a commercial RepRap and tested following the CEN (European Committee for Standardization) standards for racing bicycles for 1) static strength, 2) impact, and 3) dynamic durability.

6 RESULTS

The results show the pedals meet the CEN standards and can be used on bicycles. The 3-D printed pedals are significantly lighter than the stock pedals used on the Black Mamba, which provides a performance enhancement while reducing the cost using raw PLA or recycled materials, which assists in reducing bicycle costs even for those living in extreme poverty.

7 IMPLICATIONS FOR TARGET AUDIENCES

There is significant profit potential even from manufacturing this single low-value product. Other bicycle parts could also be manufactured using 3-D printers for a return on investment on the 3-D printer indicating that this model of distributed manufacturing of OSAT may be technically and economically appropriate through much of the Global South. This provides opportunities for small businesses to prosper as either bicycle shops using this method to provide replacement parts or as stand-alone 3-D printing shops offering many varied products. Humanitarian engineering educators have an opportunity to use this model of free and open source design to be digitally replicated in the developing world as a means to effect positive change.