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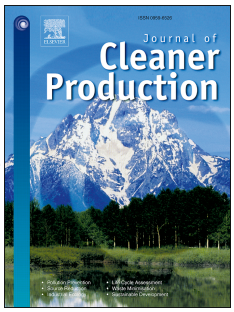

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A Design of Experiments Approach for the Optimisation of Energy and Waste During the Production of Parts Manufactured by 3D Printing

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Abstract

Direct digital manufacture and additive manufacture has expanded from rapid prototyping into rapid production and has the possibility to produce personalised high quality products with the batch size of one. Affordable additive manufacturing machines and open source software enables a wide spectrum of users. With a populace empowered with the possibility of producing their own products, this disruptive technology will inevitably lead to a change in energy and material consumption. With such an unpredictable impact on society it is timely to consider the economic and environmental issues of growth in this sector. This work demonstrates a Design of Experiments approach for part optimisation with a consideration of scrap weight, part weight, energy consumption and production time. The main conclusion of this study was that through optimisation of machine build parameters a desired response is possible and compromises between output responses such as scrap and production time can be identified. The research also showed that identical build parameters for different designs can yield different output responses, highlighting the importance of developing design specific models. The scientific value of the work lies in the contribution of new data sets for models in additive manufacturing. Together with the optimisation method adopted, the results allow for a more detailed and accurate assessment of the economic and environmental impact of 3D printed products at the design stage.