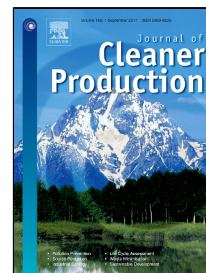


Accepted Manuscript

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PII: S0959-6526(17)31373-2
DOI: 10.1016/j.jclepro.2017.06.204
Reference: JCLP 9954
To appear in: *Journal of Cleaner Production*

Received Date: 11 April 2017
Revised Date: 13 June 2017
Accepted Date: 23 June 2017

Please cite this article as: Van Thao Le, Henri Paris, Guillaume Mandil, Environmental impact assessment of an innovative strategy based on an additive and subtractive manufacturing combination, *Journal of Cleaner Production* (2017), doi: 10.1016/j.jclepro.2017.06.204

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Abstract

Recently, the combination of additive and subtractive manufacturing technologies is gaining significant attention from both the industrial and academic sectors. Due to consolidated advantages of individual techniques, this combination provides the capability of producing innovative products, and opens new perspectives for developing new remanufacturing/manufacturing strategies. In this paper, an innovative strategy is proposed. The strategy aims to manufacture a new part directly from an EoL part (or existing part), using a sequence of additive and subtractive manufacturing processes. The existing part is transformed into the new part without involving the material recycling phase. This paper particularly focuses on the environmental assessment of the proposed strategy. For this purpose, a methodology based on the life cycle assessment method is developed. The environmental trade-offs between the proposed strategy and the conventional strategy are also discussed through the case study. The conventional strategy uses conventional processes (such as material recycling, casting and machining) to manufacture the new part, whereas the proposed strategy is based on combining electron beam melting (EBM) and CNC machining processes. The results show that the proposed strategy becomes more environmentally friendly when the material volume of existing part reused increases more than 60%. The proposed methodology can help designers and manufacturers to select the most suitable strategy to manufacture new parts from existing parts with minimum environmental impacts.

Keywords: Life cycle assessment; End-of-life product; Additive manufacturing; CNC machining; Remanufacturing.

Nomenclature

EoL	End-of-life	LDD	Laser Direct Deposition
CNC	Computer Numerical Control	DMD	Direct Material Deposition
CAD	Computer-Aided Design	SLM	Selective Laser Melting
AM	Additive Manufacturing	DALM	Direct Additive Laser Manufacturing
FFF	Fused Filament Fabrication	CLAD	Construction Laser Additive Deposition
EBM	Electron Beam Melting	LCA	Life Cycle Assessment
DMLS	Direct Metal Laser Sintering	LCI	Life Cycle Inventory

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