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A LEAN AND GREEN APPROACH TOWARDS REMANUFACTURING

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ABSTRACT

Remanufacturing holds a remarkable promise of waste reduction, by not having to fully disintegrate whole functional products and parts into their most basic materials. Recovered materials through recycling processes would need to again undergo most stages of a product life-cycle to aggregate functionality/aesthetics and the corresponding value. This both adds-up on the environment and decreases product realisation effectiveness and translates into huge amounts of different types of wastes arising at several stages of the life-cycle, that otherwise could be avoided or minimised. Such a challenge could be tackled by using well established Lean principles and tools, such as those of waste elimination, workflow and value creation. Other meaningful actions might include the application of LCA studies to accrue the product environmental profile and the introduction of dismantling and remanufacturing considerations right at the product design stage. Remanufacturing is by definition a green approach towards manufacturing activity. However, such activity fails to deliver an organized framework towards efficient and clean operations. The rationale is that poor efficiency in operations cannot deliver the benefits that would be possible otherwise. The present work explores and develops a number of aspects akin to Lean and Green Manufacturing intended to promote and advance further the Remanufacturing strategy.

Keywords: remanufacturing, lean manufacturing, cleaner production, end-of-life, LCA.

INTRODUCTION

Remanufacturing encompasses a series of possible transformation alternatives that delivers functional parts and products to the marketplace at a competitive price (Souza et al., 2002). Unintelligently designed products however, usually created for single life cycles, might pose remarkable challenges to the economic realisation of remanufacturing activities at end-of-life (EOL). Thus, the most frequent alternative is the recovery of its raw materials by way of recycling processes. Most recycling activities bring about a number of economic and environmental benefits that are undisputable. For instance, it is widely known that the process of recycling aluminium is cheaper and requires only a small fraction of the energy involved on mining and processing bauxite ore to produce new aluminium ingots and blank sheets. Furthermore, energy savings are only one of such benefits. Other benefits include savings in GHG emissions, lower rates of disposal of chemicals, lower soil erosion, lower levels of extraction of scarce minerals, less use of fossil fuels. Recycling activities normally require the destruction of the product into its most basic materials which are subsequently transformed into a basic physical state and specific shape. The savings that materials recycling process can bring is capped by the respective recycling rate. For instance, only about 1/3 of the recycled metals have a recycling rate above 50% (Graedel et al, 2011). Many raw materials also loose quality on each recycling stage ("*downcycle*"), and therefore the raw materials are subsequently used in lower added-value transformation.

The total savings potential for remanufactured parts and products are higher than that of recycling since recycling implies the total loss of all aggregated value on the final product (except materials content value). By the other side, parts and products have an aggregated value that was introduced over a chains of manufacturing steps that have formed, shaped, assemble, hardened or introduced any other feature that added value to the parts in the way. These are rather independent features of EOL products to those of quantities and quality of the materials which make up products. A US study from 2010 points out that remanufacturing is a labor intensive activity, that promotes the domestic economy and employment, while reducing the need for capital intensive plants (Lund and Hauser, 2010). Remanufacturing also improves competition by making cheaper products and broadening its availability, promotes materials and energy conservation and boosts know how on product technical details and processes technology. The same study reports that the sector is characterized by small to medium companies with labor costs representing about 34% to 45% of the product cost.

RESULTS AND CONCLUSIONS

Considering that remanufactured products are generally about 60% to 70% cheaper than new ones (Ilgin and Gupta, 2012) and that remanufacturing is more profitable than that of recycling, not accounting for the environmental benefits, it might bring attractive benefits that justify the widespread adoption of such a strategy prior to recycling EOL products. However, a basic requirement for introduction and dissemination of remanufacturing practices across most industries is that product design should incorporate features that, not only facilitate dismantling and part identification, but also simplify and promote component remanufacturing. On the top of that, a number of operational features have to be improved regarding the effectiveness of the remanufacturing activities. Here, it is suggested that a number of Lean principles and tools are applied at remanufacturing shopfloors, to pursue high quality standards and reliable products at an attractive price.

Product design does not usually take into account the EOL stage. In consequence disassembly, remanufacture and reassembly could be made easier than current practice, which translates into higher operational costs and increased scrap rates. Performance metrics are common for traditional companies manufacturing new and mostly similar products, but less attention is put on productivity on remanufacturing activities, which is broadly regarded has a craft industry.

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