

Triple Bottom Line Optimization for Sustainable Product Design

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Abstract. The triple bottom line concept is based on the evaluation of three criteria namely financial profitability, environmental integrity and social equity. Consideration of the financial profitability is critical in ensuring the economic sustainability. Environmental integrity considerations have become very crucial as the world communities have realized the necessity to meet the needs of the present generations without compromising the ability of future generations to meet their own needs. Social equity is difficult to identify but at the factory floor level it could imply the impact of manufacturing a product on workers health. In this paper the concept is applied in the manufacturing phase of a product taking into consideration the impact of the design on economics, environmental divided into energy consumed and carbon footprint and ergonomics effect. However it involves multi criteria decision making in the presence of multiple objectives. In this case the objectives being the four criteria. The objectives are usually conflicting and therefore, the proposed solution is highly dependent on the preferences of groups of decision makers and is developed within an understanding framework and mutual compromise. This paper presents a methodology using genetic algorithm and Fuzzy Analytical Hierarchy Process (Fuzzy AHP) at the product design stage in making decision based on the triple bottom line concept.

Keywords: Triple Bottom Line, Fuzzy AHP and Genetic Algorithm

1. INTRODUCTION

The cost of manufacturing is continuously increasing. This is because of increasing costs of raw materials, energy, coolant and lubricant and man power due to inflation, unfavorable exchange rates and higher government taxes. In addition manufacturers need to take into consideration the costs associated with environmental impact and workers wellbeing. There are several major stake holders interested in the economic profitability, environmental integrity, energy integrity and ergonomic equity aspects of a product. Client and user can be considered as one major stake holder which is interested in the economics aspects. On the other

hand, the trade associations are interested in the social aspects of the workers such as long term effect of the manufacturing process on the quality of life of the workers. The environmental and energy aspects would be of interest to the environmental agency, the community and private sector since the private sector need to fulfill the environmental regulation set by the European nation and the USA if they want to compete in the global market. However taking into consideration these four aspects in making any decision on the design of product is still a difficult task as it involves multiple objectives.

One approach is to use Genetic Algorithm (GA) and Fuzzy Analytical Hierarchy Process (Fuzzy AHP). In this