

UNIVERSITI TEKNOLOGI MARA

**INTERACTION ANALYSIS AND
RANKING OF SUSTAINABLE
MANUFACTURING CRITERIA OF
AUTOMOTIVE INDUSTRY USING
FUZZY GRAPH AND LAPLACIAN
MATRIX**

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ABSTRACT

Sustainable Manufacturing (SM) involve the development of a standard framework whereby three domains are considered, namely economic, environmental, and social domains. Several known criteria (SM criteria) need to be included in each of the domains so that the developed framework becomes a completely standard framework. SM criteria are assumed to have an interrelationship to other criteria, and this interrelationship has been visualized in a directed graph and analyzed using Fuzzy DEMATEL, Fuzzy TISM, GTMA, etc. However, the graph is drawn in a vertex space known as immeasurable space, whereby not much information of the graph can explain the interrelationship between criteria and makes the analysis of prioritization of the criteria difficult to identify intuitively. In this study, the coordinated graph of the interrelationship between criteria for each domain of SM focusing on the automotive industry is developed by using fuzzy graph and Laplacian matrix whereby the graph invariant is used in the analysis of ranking of the criteria's. The methodology involved two stages. First, the domain of SM is prioritized using Laplacian energy. Secondly, criteria within the domain are ranked by using the average distance between criteria. The result shows that the economic domain is first ranked, followed by an environmental and social domain. Whilst Cost, Quality and Service are among the most important criteria to be considered in the Economic domain. Air Emission, Raw Material Usage and Water Usage are among the most important criteria for the Environmental domain. Training & development, Political and Community Satisfaction are among the most important criteria for the Social domain. The result is in line with the existing sustainable framework used in the automotive industry. In conclusion, it can be seen that the study could serve as an alternative tool of ranking criteria which provides the ranking procedure only by looking into the coordinated graph or by using graph invariant.

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