

## Decision Support Model for Selecting Construction and Demolition Waste Management Alternatives: A Life Cycle-Based Approach

**Authors :** Yanqing Yi, Maria Cristina Lavagnolo, Alessandro Manzardo

**Abstract :** Construction and demolition waste (C&DW) represents a pressing concern within the European Union, underscoring the urgent need for effective waste management strategies. The selection of these solutions constitutes a complex task, entailing the identification of efficient C&DW management strategies that balance appropriate practices, regulatory compliance, resource conservation, economic viability, and environmental considerations. Techniques for evaluating different types of criteria enable the application of multi-criteria analysis in life cycle assessment (LCA). LCA is widely utilized to assess environmental impact, yet the economic aspect has not been adequately incorporated into the LCA process in the field of C&DW management. The life cycle costing (LCC) methodology has been tailored to assess economic performance in conjunction with LCA. The selection of an appropriate multi-criteria decision-making (MCDM) method is vital for the C&DW system. This study seeks to propose a model that employs MCDM to integrate the LCA and LCC results, thereby augmenting both environmental and economic sustainability. A widely used compensatory MCDM technique, TOPSIS, has been chosen to identify the most effective C&DW management scheme by comparing and ranking various scenarios. Our study introduces a framework for C&DW management by integrating LCA and LCC factors into MCDM, using AHP for weight determination, and applying TOPSIS for alternative ranking. Four waste management alternatives were examined in the Lombardy region of Italy, namely, (i) landfill; (ii) recycling for concrete production and road construction, incineration with energy recovery; (iii) recycling for road construction; (iv) recycling for concrete production and road construction. We determine that, with the implementation of various scenarios, the most suitable scenario emerges to be recycled for concrete production and road construction, with a score of 0.711/1; recycling for road construction, with a final score of 0.291/1, ranks second; recycling for concrete production and road construction, incineration with energy recovery scores 0.002/1, ranks third; and landfill (scores: 0/1) is the worst choice, signifying it has the highest environmental impacts and the least economic benefits. Lastly, recommendations were formulated to enhance the environmental performance of the system.

**Keywords :** life cycle assessment, construction and demolition waste, TOPSIS, multi-criteria decision making

**Conference Title :** ICELCA 2024 : International Conference on Environmental Life Cycle Assessment

**Conference Location :** Rome, Italy

**Conference Dates :** July 22-23, 2024