INTISARI

Construction and Demolition Waste (CDW) merupakan salah satu kontributor utama limbah padat global hingga mencapai 25–30%. Di Indonesia, timbulan CDW mencapai 29 juta ton pada tahun 2019 dan diproyeksikan meningkat hingga 82% pada 2030. Pertumbuhan ini belum diimbangi dengan strategi pengelolaan yang efektif sehingga berpotensi memperlambat transisi menuju ekonomi sirkular. Kondisi tersebut menegaskan perlunya pendekatan terpadu untuk mengatasi minimnya proses pemilahan, rendahnya tingkat daur ulang, serta tingginya ketergantungan pada *landfill*.

Penelitian ini bertujuan mengembangkan model sistem dinamik untuk mengevaluasi efektivitas berbagai strategi pengelolaan CDW dalam kerangka ekonomi sirkular. Model dikembangkan untuk memetakan keterkaitan antar variabel dan memahami perubahan aliran material dalam sistem. Proses validasi dilakukan melalui uji konsistensi struktur dan pola perilaku untuk memastikan bahwa model dapat merepresentasikan dinamika yang relevan. Setelah tervalidasi, model digunakan untuk menganalisis tiga skenario intervensi, yaitu: (1) adopsi *Building Information Modeling* (BIM), (2) integrasi BIM dengan *selective dismantling*, dan (3) penguatan kebijakan sistem daur ulang.

Hasil simulasi menunjukkan bahwa adopsi teknologi secara masif tidak cukup efektif tanpa peningkatan kapasitas pembelajaran stakeholder. Sinergi BIM dan selective dismantling memberikan dampak paling signifikan, dengan potensi pengurangan timbulan konstruksi sebesar 77,69% dan peningkatan efektivitas pembongkaran hingga 80,75%. Selain itu, kebijakan ekonomi berupa kenaikan biaya landfill hingga batas maksimum terbukti mendorong peningkatan daur ulang, menghasilkan penurunan volume pembuangan ke landfill hingga 60,74%. Penelitian ini menegaskan pentingnya strategi terintegrasi dari hulu hingga hilir untuk menekan timbulan CDW dan meningkatkan sirkularitas material secara berkelanjutan di sektor konstruksi Indonesia.

Kata Kunci: *Construction and Demolition Waste* (CDW); sistem dinamik; sirkularitas material; *Building Information Modeling* (BIM); *selective dismantling.*

ABSTRACT

Construction and Demolition Waste (CDW) is one of the major contributors to global solid waste, accounting for up to 25–30%. In Indonesia, CDW generation reached 29 million tons in 2019 and is projected to increase by up to 82% by 2030. This growth has not been met with effective management strategies, potentially slowing the transition toward a circular economy. These conditions highlight the need for an integrated approach to address limited waste sorting, low recycling rates, and continued reliance on landfilling.

This study aims to develop a system dynamics model to evaluate the effectiveness of various CDW management strategies within a circular economy framework. The model was constructed to map the interrelationships among variables and to understand changes in material flows within the system. Validation was conducted through structure and behavior consistency tests to ensure that the model adequately represents relevant system dynamics. Once validated, the model was used to assess three intervention scenarios: (1) adoption of Building Information Modeling (BIM), (2) integration of BIM with selective dismantling, and (3) strengthening of recycling-oriented policy instruments.

Simulation results indicate that large-scale technological adoption alone is insufficient without improvements in stakeholder learning capacity. The synergy between BIM and selective dismantling yields the most significant impact, with potential reductions in construction waste generation of up to 77.69% and improvements in dismantling effectiveness of up to 80.75%. Additionally, economic instruments such as raising landfill fees to their maximum level were shown to encourage higher recycling rates, reducing landfill disposal volumes by up to 60.74%. Overall, the study underscores the importance of integrated upstream–downstream strategies to reduce CDW generation and enhance material circularity in Indonesia's construction sector.

Keywords: *Construction and Demolition Waste (CDW); system dynamics; material circularity; Building Information Modeling (BIM); selective dismantling.*