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ADVANCING SUSTAINABLE CONSTRUCTION: A FRAMEWORK FOR ASSESSING REUSABILITY OF CONSTRUCTION AND DEMOLITION WASTE

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ABSTRACT: The construction sector is a major contributor to global waste generation, particularly through construction and demolition (C&D) activities. With growing pressure to reduce environmental impact and transition toward a circular economy, material reuse has emerged as a critical strategy for sustainable development. This paper addresses the need for a structured approach to evaluating the reusability of C&D waste by developing a robust assessment framework. The primary objectives of this study are twofold: (1) to consolidate and classify key construction materials based on their reuse potential, and (2) to develop a comprehensive set of Key Performance Indicators (KPIs) to assess the reusability of these materials across seven categories—health and safety, quality, market demand, quantity, value, environmental impact, and costs. Methodologically, the paper draws on a detailed literature review to identify relevant KPIs and integrates them into a four-step decision-making framework. This framework includes data collection, KPI scoring using a qualitative scale, rule-based aggregation, and interpretation of results. The framework is designed to support scenario-based decision-making and aligns with industry practices in sustainable demolition and material recovery. This research is a practical decision support system that can guide stakeholders—including contractors, municipalities, and developers—in making informed decisions about material reuse. The framework supports alignment with UN Sustainable Development Goals (SDGs) 11 and 12 and offers a pathway for reducing C&D waste, conserving resources, and lowering greenhouse gas emissions through enhanced material circularity.

Keywords: Circular Economy, Construction and Demolition Waste, Reuse, Decision Making

1. INTRODUCTION

As the shift toward reducing carbon emissions and adopting a circular economy accelerates, reuse and reclamation become crucial. Reuse involves repurposing products that would otherwise be discarded, conserving resources, cutting costs, and preventing waste and pollution. This practice supports a circular economy, where materials are continuously reused to maximize their value while minimizing waste, reducing greenhouse gas (GHG) emissions and raw material consumption (Yrjölä & Wanjala, 2022). However, conventional demolition practices often neglect the potential for material reuse, as buildings are typically crushed with limited regard for reclaiming usable materials. In contrast, deconstruction focuses on dismantling buildings thoughtfully to preserve and reuse materials, promoting environmental benefits and reducing costs. Scholars increasingly advocate for the transition from demolition to deconstruction, demonstrating that this approach conserves resources, cuts waste, and minimizes environmental harm (Fraunhofer IRB, 2023). To effectively implement reuse, it is essential to establish key performance indicators (KPIs) that assess the reusability of building materials based on factors like health and safety, material integrity, market demand, economic value, and environmental impact. This manuscript explores the potential of material reuse in construction, establishing a structured framework for evaluating reuse strategies, identifying knowledge gaps, and promoting the integration of circular economic practices within the construction industry. Its goal is to shift industry paradigms, contributing to climate change mitigation and sustainable development by emphasizing the significant role of material reuse.

Reuse and reclamation are now more crucial than ever as efforts to cut carbon emissions and move toward a circular economy intensify. North Carolina State University defines reuse as repurposing items that would otherwise be discarded—often in their current state or with minimal repairs. This approach reduces costs, conserves resources, minimizes waste, and lowers pollution, thereby extending the lifecycle of valuable materials. These benefits underpin the circular economy model, where materials are continually repurposed rather than disposed of after one use, decreasing greenhouse gas emissions and raw material consumption (NC State, n.d.; Yrjölä and Wanjala, 2022).

Traditional demolition methods typically involve crushing entire buildings, which prevents material recovery. In contrast, deconstruction dismantles buildings piece by piece to maximize the reuse potential of materials. Although deconstruction requires more time, it often results in lower overall costs by preserving materials on-site and reducing the environmental impact of manufacturing new ones (Fraunhofer IRB, 2023). Academic research increasingly supports shifting from conventional demolition to sustainable deconstruction practices. Scholars advocate for developing comprehensive key performance indicators (KPIs) to evaluate the reusability of construction waste, addressing aspects such as health and safety, material durability, market demand, economic value, and environmental impact. Yet, no frameworks have been proposed in the published literature that aid reusability assessment (Saad et al 2024).

This manuscript consolidates current insights on construction material reuse and proposes a structured KPI framework to guide stakeholders toward more sustainable and resilient construction practices. The outcomes of this research support the implementation of a circular economy in the construction sector.

2. LITERATURE REVIEW

When considering reuse of construction and demolition material, it is vital to look at incentives for reuse. Incentives for reuse are broadly categorized into six groups: economic/financial, environmental, social, technological, legal, and market. Each category encompasses multiple factors that can either drive or hinder reuse, depending on the local context.

- Economic and financial incentives are most influential in business decision-making (Past et al., 2023). Reuse can significantly alter cost structures by creating jobs—from dismantling and reclamation audits to transporting materials—and by reducing material expenses while increasing resale revenue. Additionally, cost reductions in material purchases, and profits from reselling reclaimed materials (Past et al., 2023) can incentivise the construction stakeholders. But challenges like labor costs can influence the feasibility of extensive deconstruction, with higher labor costs deterring some from adopting reclamation practices (Stockmans, 2016).
- Environmental incentives also play a major role. Reuse conserves scarce non-renewable resources, cuts energy consumption by avoiding new material production, and lowers CO_2 emissions. Moreover, it helps reduce construction and demolition waste, thereby mitigating water, soil, and air pollution and preserving local ecosystems (Rakhshan et al., 2020; Yeheyis et al., 2013). Reclamation contributes to waste prevention, lowering pollution, and protecting ecosystems (Deweerdt et al., 2020; Yeheyis et al., 2013).
- Social incentives include heightened awareness of reuse benefits, the formation of long-term partnerships, and improved public health through reduced pollution (Deweerdt et al., 2020; Rakhshan et al., 2020).
- Technological incentives spur innovation in deconstruction methods and facilitate the emergence of a new market for reclaimed materials (Knoth et al., 2022; Unuode, 2021). Technological incentives encompass advancements in deconstruction methods, which can include innovations in material information systems and markets (Knoth et al., 2022). However, such methods can also represent barriers to adoption.
- Legal incentives involve policy mandates and financial benefits, such as waste audits and reduction plans enforced through regulations, though barriers like hazardous waste and asbestos guidelines may restrict reuse (Deweerdt et al., 2020; e-Laws | Ontario.ca., 2020, 2024). Building certifications like LEED, BOMA BEST, Energy Star, and CASBEE not only enhance a building's marketability and value by awarding points for material reuse but also support sustainable practices (Greenly, 2023; ENERGY STAR, 2022).

- Market incentives emphasize the value of promoting a green image and designing buildings with reuse in mind, which attracts eco-conscious buyers and encourages innovative practices. Certifications such as Cradle to Cradle, ECOLOGO, and Passive House further underscore a commitment to environmental responsibility (Build Reversible and Circular, 2023; Cradle to Cradle Products Innovation Institute, 2025; UL Solutions, 2025; Passive House Canada Conference, n.d.). Furthermore, salvaging historic or culturally significant elements can enhance a building's uniqueness and market value (Deweerdt et al., 2020; Rakhshan et al., 2020).

Table 1 lists indicators for reusability assessment of construction and demolition waste. According to published literature, there are seven categories namely, health and safety, quality market demand, quantity value, environmental impact, and costs. KPIs have been identified for each category. References for KPIs are included in Table 1.

Table 1: General parameters for reusability along with the key performance indicators.

Parameter	Requirements/preferences	KPIs	Source
Health and Safety	No asbestos, heavy metals, or toxic/ hazardous substances Must be able to be safely extracted from building Must have an easy deconstruction and be easily accessible	Percentage of hazardous materials in the building Number of accidents that occurred on site Good construction and Demolition practices Different waste types present on site Properly educated workers	(Economie Circulaire, no date) (Deweerdt et al., 2020) (Crimmins, 2023) (Dodd et al., 2020) (Kim et al., 2020)
Quality	Meets current safety standards and regulations Cannot be significantly damaged Is standard sizing for the material Is not reaching nor has reached its end of life	Quality issues Number of defects Number of impurities in material	(Deweerdt et al., 2020) (Crimmins, 2023) (Jiménez-Rivero and García-Navarro, 2016)
Market Demand	Cannot be obsolete or out of fashion No outdated technology Must have a market available Cannot be outperformed by current products	Availability of materials	(Deweerdt et al., 2020)
Quantity	Larger quantities are better	Tonnes of waste generated per $$ amount of construction value Building was designed for disassembly	(Deweerdt et al., 2020) (The Construction Commitments: Halving Waste to Landfill, no date) (Jiménez-Rivero and García-Navarro, 2016)
Value	A historic or famous piece increases value Can be unlike new products or have an interesting aesthetic or an overall uniqueness	Social impact Historical value Economic viability	(Deweerdt et al., 2020) (Crimmins, 2023) (Kim et al., 2020)

Environmental Impact	The impact of deconstruction and transport must be less than the creation of a new product Result in a carbon savings	Waste generation Carbon footprint Energy consumption Pollution indicators GHG emissions Ecological systems impact Waste recovery rate Percent of reused material Site waste management plan Amount of construction and demolition waste created Water usage Global warming potential Percent of CO2 reductions Emissions from transportation of waste comparison	(Deweerdt et al., 2020) (Crimmins, 2023) (The Construction Commitments: Halving Waste to Landfill, no date) (Dodd et al., 2020) (Lozano, 2019) (Jiménez-Rivero and García-Navarro, 2016)
Costs	Low labour and transportation costs No or low storage fees for materials Overall cost must be lower than cost of new products	Time taken Travel distances Cost for demolition Cost for labour Pre-demolition audit Amount of landfill costs avoided Level of deconstruction Overall budget	(Deweerdt et al., 2020) (Balodis, 2017) (Crimmins, 2023) (Dodd et al., 2020) (Kim et al., 2020)

3. PROPOSED FRMEWORK

Figure 1 presents the framework for decision making. Information from Table 1 was used in developing this framework. The proposed decision-making framework includes 4 following steps. Details of each step is explained in detail below.

Step 1: Data collection: Collecting comprehensive data from demolition projects is essential for ensuring effective decision-making and sustainable material reuse. A robust data collection methodology combines on-site inspections, advanced sensor technology, and rigorous documentation reviews to capture key performance indicators (KPIs) across health and safety, quality, market demand, value, environmental impact, and costs. By integrating various data sources into a centralized system, project managers can monitor progress, evaluate risks, and identify opportunities for improvement.

As an example for health and safety metrics, data collection begins with on-site surveys and hazardous material assessments. Inspectors evaluate the percentage of hazardous materials present in the building through laboratory testing and review of material safety data sheets. In parallel, incident reporting systems are used to record the number of accidents occurring on site, while audit checklists ensure that construction and demolition practices adhere to industry standards. Additionally, systematic observations document the different waste types generated during demolition, and human resources records verify that workers are properly educated and trained.

Quality is monitored through regular inspections and defect tracking systems that record the number of defects and impurities found in recovered materials. These assessments are complemented by quality assurance reports that help identify and mitigate potential issues. Market demand is evaluated by conducting surveys with local suppliers and recycling experts to determine material availability, while financial records are used to calculate the quantity of waste generated by construction value. Furthermore, the design documents are reviewed to ascertain if the building was constructed with disassembly in mind, providing insights into reuse potential. Social impact, historical value, and economic viability are assessed through community surveys, heritage evaluations, and detailed cost-benefit analyses that consider both project expenditures and potential revenues.

Environmental impact data is gathered using a combination of IoT sensors and third-party environmental assessments. These methods track waste generation, carbon footprint, energy consumption, pollution indicators, and greenhouse gas emissions. Ecological surveys and waste recovery logs further quantify the percentage of reused materials and the effectiveness of the site’s waste management plan. Monitoring water usage, global warming potential, and transportation emissions ensures that environmental performance is thoroughly documented. Finally, cost data is collected by tracking project timelines, travel distances, demolition and labor costs, and overall budget expenditures. Pre-demolition audits and comparative analyses of landfill cost avoidance further support cost optimization strategies.

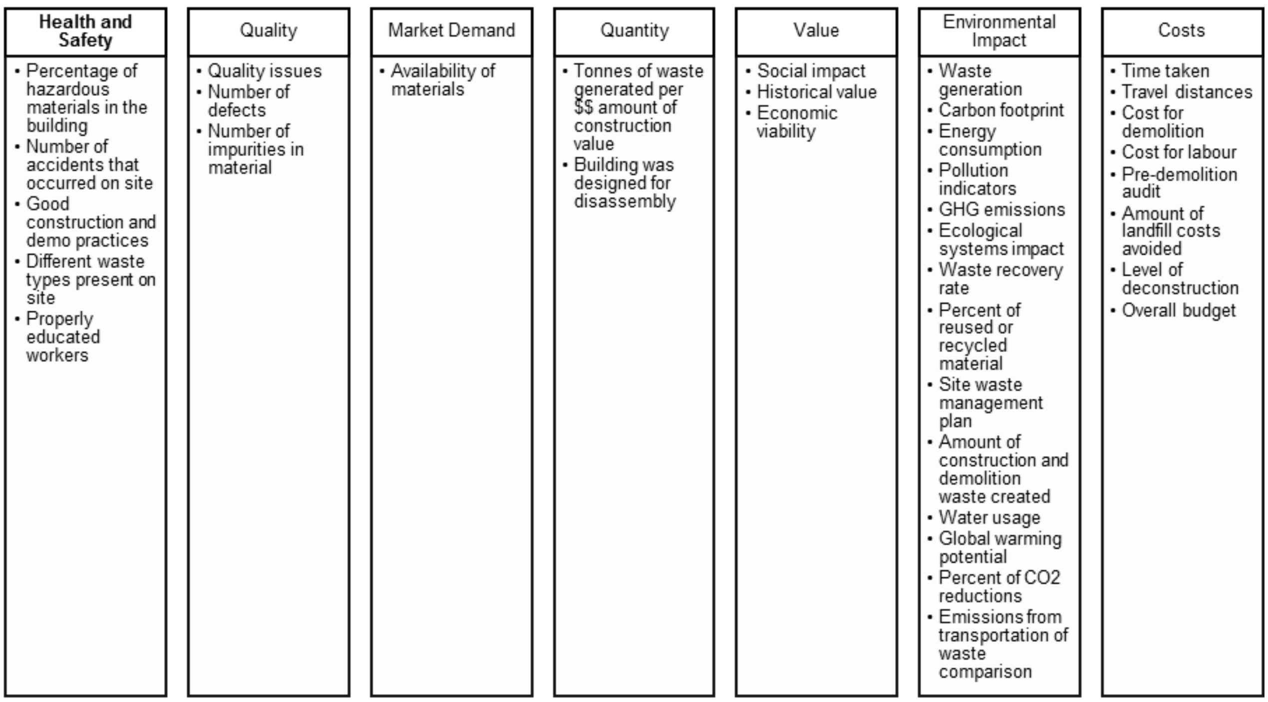

Figure 1: KPIs for reusability assessment

Step 2: Scoring of KPIs: Rule-based decision support systems enable more realistic decision-making, extending beyond the capabilities of traditional numerical multi-attribute decision-making methods. The proposed method builds upon the approach introduced by Canfora and Troiano (2003). The proposed decision framework adopts qualitative scale for scoring KPIs. The KPIs can be scored on a qualitative scale by first normalizing each metric to a common scale and then mapping these values to predefined qualitative categories such as "High," "Medium," or "Low." For instance, numerical data from health and safety inspections, quality checks, market assessments, environmental monitoring, and cost analyses are standardized using min-max scaling. For each KPI with a raw value x_i *where,* i=1,2,n, the normalized score is computed as:

$$y_i = \frac{x_i - \min(x_i)}{\max(x_i) - \min(x_i)}$$

This transformation scales x_i *to* a value between 0 and 1.

Predefined thresholds delineate the qualitative bands: scores above a certain threshold might indicate "High" performance, mid-range scores "Medium," and scores below a minimum threshold "Low." These thresholds can be flexible and should be updated using industry relevant data. These thresholds should be defined for all KPIs.

Step 3: Aggregation: In a rule-based aggregation method for this decision framework, each normalized KPI is first converted into a qualitative rating (e.g., High, Medium, Low) based on predetermined thresholds. Let x_i represent the normalized value for each KPI (e.g., Health and Safety, Quality, Market Demand, Quantity, Value, Environmental Impact, and Cost), scaled between 0 and 1. For each x_i, define a rating function $R(x_i)$ that maps these values to qualitative ratings such as "High," "Medium," or "Low" based on predetermined thresholds θ_i^L and θ_i^H:

$$R(x_i) = \begin{cases} "Low" & if\ x_i \le \theta_i^L, \\ \text{"Medium"} & if\ \theta_i^L < x_i < \theta_i^H, \\ "High" & if\ x_i \ge \theta_i^H \end{cases}$$

A set of if-then rules, $\{r_j\}_{j=1}^M$, is then defined, where each rule r_j is modeled using an indicator function δ_j that equals 1 if the rule's conditions are met and 0 otherwise. For example, one rule might state: if $R(x_{EI}) =$ "$High$" for Environmental Impact and $R(x_{HS}) =$ "Low" for Health and Safety, then flag the project as high risk, i.e., $\delta_j(R(x_{EI}), R(x_{HS})) = 1$.

The overall decision score, *S*, aggregates the individual KPI scores and the outputs of these rule evaluations. This is mathematically represented as:

$$\mathrm{S} = \sum_{i=1}^{N} w_i x_i + \sum_{j=1}^{M} \gamma_j \delta_j\big(R(x_1), R(x_2), \ldots, R(x_N)\big),$$

where w_i and γ_j are weights that reflect the relative importance of each KPI and rule, respectively. In this framework, a higher *S* may indicate a favorable outcome for material reuse, whereas a lower *S* might trigger further review or corrective actions. This structured approach converts complex, multi-dimensional KPI data into a single, aggregated metric that incorporates both quantitative performance and qualitative expert judgment. It provides clear, actionable insights for decision-makers regarding demolition material reuse strategies.

Step 4: Interpretation

The aggregated results provide a comprehensive snapshot of the demolition project's performance by converting quantitative data into clear, qualitative ratings across various KPIs. A high overall score indicates robust performance in critical areas such as health and safety, quality, environmental impact, and cost management, suggesting that the project is well-positioned for effective material reuse. Conversely, lower scores highlight areas where risks or inefficiencies prevail—such as inadequate safety measures or significant environmental concerns—prompting immediate attention and corrective measures. Intermediate scores reveal mixed performance, where some aspects may be strong while others require improvement. By mapping numerical data to qualitative categories like "High," "Medium," and "Low," stakeholders can quickly grasp the project's strengths and weaknesses, prioritize resource allocation, and make informed decisions about proceeding with, modifying, or halting material reuse initiatives. This interpretative framework ultimately enhances transparency and supports strategic planning for sustainable demolition practices.

Implementation of the Proposed Decision Support Framework

Figure 2 presents the proposed decision support framework for demolition projects, which adopts a multi-layered and technology-integrated approach to enable informed material reuse decisions. Implementation begins with the development of a centralized digital platform designed to collect and aggregate data from diverse sources, including manual inspections, sensor networks, and document reviews.

Health and safety information is captured through hazardous material surveys, incident reports, and compliance audits, while quality-related data is obtained via defect tracking systems and material testing. Environmental metrics—such as waste generation, emissions, and energy usage—are monitored using IoT devices. Market demand insights are derived from supplier surveys and financial analysis, and project management tools contribute cost, schedule, and KPI data.

The framework supports decision-making by integrating expert systems, real-time dashboards, and stakeholder engagement, allowing project teams to continuously evaluate conditions, identify strengths and weaknesses, and implement improvements. Ultimately, this structured and data-driven process enhances the efficiency of material recovery, reduces environmental impact, and contributes to more sustainable demolition practices.

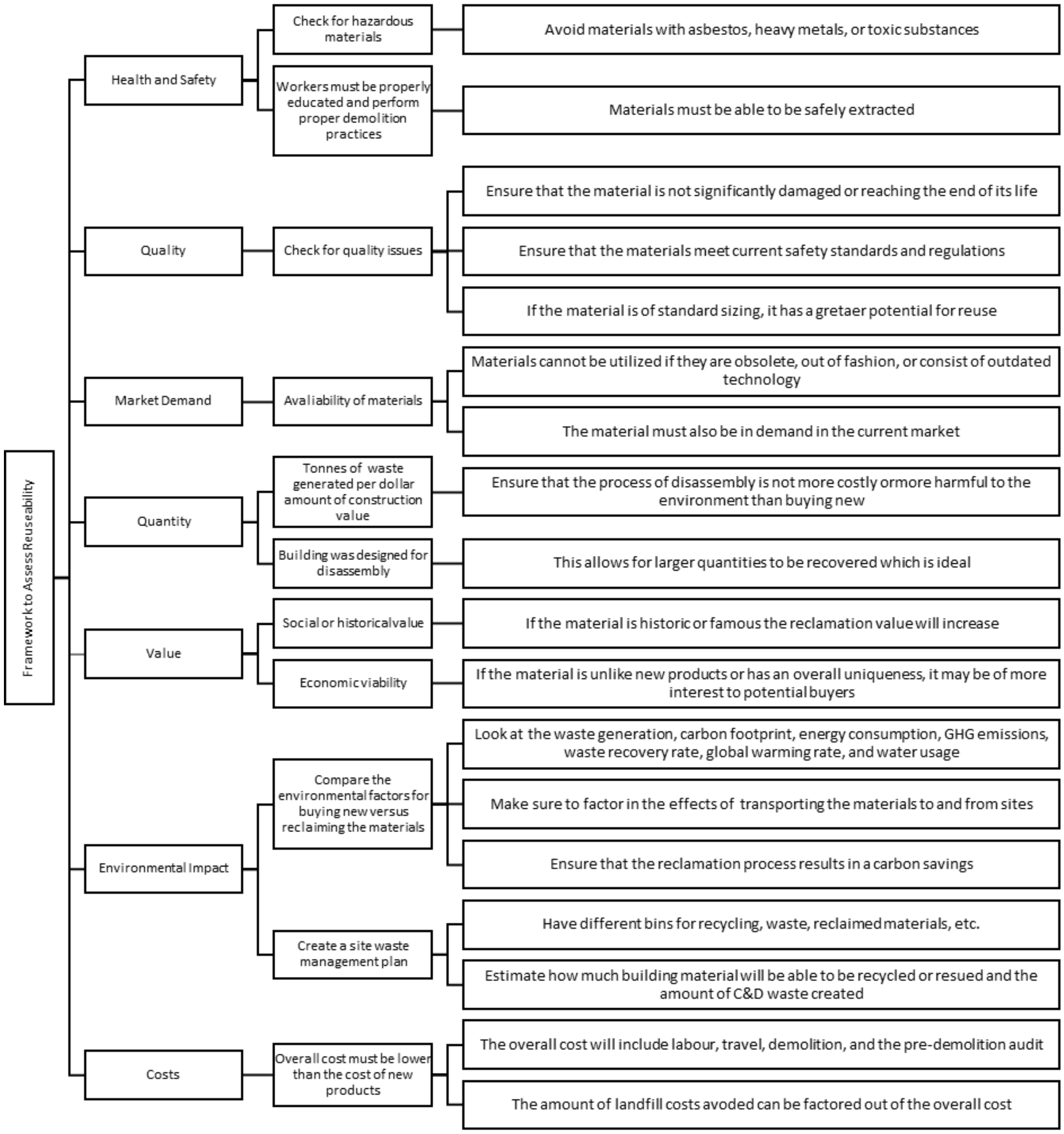

Figure 2: Decision support framework for reusability assessment

4. DISCUSSION AND CONCLUSIONS

The viability of reusing construction materials can be evaluated using seven key performance indicator (KPI) categories. Health and Safety, for example, ensures that reclaimed materials meet established safety standards, thereby protecting both end-users and the environment. Quality assessments gauge the condition and durability of these materials, directly influencing their suitability for reuse. Market Demand and Quantity together assess not only the potential for reclaimed materials to be effectively integrated into current projects but also the practical availability of these materials on-site. Value examines the economic benefits and cost savings associated with reuse, providing an important incentive for stakeholders, while environmental Impact measures reductions in greenhouse gas emissions and waste, underscoring the ecological advantages of material reclamation. Finally, the Costs category evaluates the financial implications, weighing the expenses of reclaiming materials against those of disposal, ensuring a sustainable balance between economic feasibility and environmental responsibility.

The literature review conducted reveals that economic factors—such as job creation, reduced material costs, and the fostering of a circular economy—are the primary drivers behind the reuse of construction materials. Nonetheless, reuse processes face challenges, including labor intensiveness, higher initial investments, and the complexity of reclaiming materials from buildings not originally designed for disassembly. The integration of the seven KPIs into a decision support framework effectively captures these practical, economic, and environmental dimensions, providing a robust basis for assessing the feasibility of material reuse. By incorporating metrics related to Health and Safety, Quality, and Environmental Impact, the framework not only ensures compliance with rigorous safety and sustainability standards but also highlights the economic rationale for reuse through the evaluation of Value and Costs.

A notable advancement in the proposed system is the use of rule-based aggregation methods. In practice, normalized KPI values are processed through a hierarchy of if-then rules that mirror expert judgment, resulting in qualitative ratings such as "High," "Medium," or "Low." This structured approach facilitates prompt decision-making by clearly delineating strengths and weaknesses across the project's performance areas. However, further research is needed to refine these rules. In particular, developing precise threshold values for each KPI could enhance the accuracy of the system's assessments. Additionally, incorporating fuzzy logic stands for a promising research direction, as it would allow the framework to handle data uncertainty more effectively. With fuzzy logic, the system could provide smoother transitions between qualitative categories, thus avoiding abrupt shifts in classification due to minor variations in numerical scores. Although this method addresses data uncertainty, model uncertainties related to key performance indicators (KPIs) should be further examined for verification.

As future research, the proposed decision support tool should be validated using a real-life case study. Its findings should be compared with those of traditional practices to identify and analyze any differences. By systematically integrating key performance indicators with advanced rule-based methods—and with future research focused on threshold development and fuzzy logic—the framework holds significant promise for driving more sustainable and economically practical demolition practices that align with global sustainability goals. Moreover, integrating the decision support framework with Building Information Modeling further enhances its utility by embedding KPI data directly into digital models, enabling scenario analysis and promoting sustainable, circular construction practices.

REFERENCES

Akanbi, L., Oyedele, L., Davila Delgado, J. M., Bilal, M., Akinade, O., Ajayi, A., & Mohammed-Yakub, N. (2019). Reusability analytics tool for end-of-life assessment of building materials in a circular economy. *World Journal of Science, Technology and Sustainable Development*, *16*(1), 40–55. https://doi.org/10.1108/wjstsd-05-2018-0041

Anderson, K. (2023) *LEED certification: Meaning and requirements*. Greenly. https://greenly.earth/en-us/blog/company-guide/leed-certification-meaning-and-requirements

Applications of reinforced concrete in construction. The Constructor. (2019, July 19). https://theconstructor.org/concrete/applications-reinforced-concrete/6732/

Arora, M., Raspall, F., Cheah, L., & Silva, A. (2020). Buildings and the circular economy: Estimating urban mining, recovery and reuse potential of building components. *Resources, Conservation and Recycling*, *154*, 104581. https://doi.org/10.1016/j.resconrec.2019.104581

Balodis, T. (2017). *Deconstruction and Design for Disassembly: Analyzing Building Material Salvage and Reuse*. https://doi.org/10.22215/etd/2017-11923

Bennett, P. (2022, April 15). *What is Engineered Wood, anyway? here's what to know*. Angi. https://www.angi.com/articles/what-is-engineered-wood.htm

BigRentz. (2023). *Bigrentz*. BigRentz: https://www.bigrentz.com/blog/types-of-steel

Boma Best Home. BOMA BEST - English. (2023). https://bomabest.org/

BREEAM - Bre Group. BRE Group - Building a better world together. (2023, May 10). https://bregroup.com/products/breeam/

Brussels-Capital Region. (2015). *Homepage | Opalis*. How can reusable materials be extracted from public buildings?. https://opalis.eu/sites/default/files/2022-02/Vademecum_offsite_reuse-Rotor.pdf

Canada ranks 3rd in the world for LEED Certified Buildings in 2022. Canada Green Building Council (CAGBC). (2023, February 23). https://www.cagbc.org/news-resources/cagbc-news/canada-ranks-3rd-in-the-world-for-leed-certified-buildings-in-2022/

Canada, N. R. (2022). *Energy Star certification for commercial and institutional buildings in Canada*. Natural Resources Canada. https://natural-resources.canada.ca/energy-efficiency/energy-star-canada/energy-star-for-buildings/energy-star-certification-for-commercial-and-institutional-buildings-canada/20258

Canfora, G., Troiano, L. (2003). A Rule-Based Method to Aggregate Criteria with Different Relevance. In: Bilgiç, T., De Baets, B., Kaynak, O. (eds) Fuzzy Sets and Systems — IFSA 2003. IFSA 2003. Lecture Notes in Computer Science, vol 2715. Springer, Berlin, Heidelberg. https://doi.org/10.1007/3-540-44967-1_37

National Research Council (2023). *Government of Canada*. National Research Council Canada. https://nrc.canada.ca/en/certifications-evaluations-standards/codes-canada/codes-canada-publications/national-building-code-canada-2020

Clint. (2014, December 30). *4 reasons why brick remains the best construction material*. Tuck Pointing, Brick and Chimney Repair Toronto | Turnbull Masonry Ltd. https://www.turnbullmasonry.com/4-reasons-brick-remains-best-construction-material/

Crimmins, C. (2023). *Construction KPI examples: Construction industry kpis*. Construction KPI Examples | Construction Industry KPIs. https://www.spiderstrategies.com/kpi/industry/construction/

Deweerdt, M., & Mertens, M. (2020). A guide for identifying the reuse potential of construction products. https://vb.nweurope.eu/media/10132/en-fcrbe_wpt2_d12_a_guide_for_identifying_the_reuse_potential_of_construction_products.pdf

Deweerdt, M., Mertens, M., Vrijders, J., Poncelet, F., & Bernair, C., et al. (2020, March 29). *FCRBE - facilitating the circulation of reclaimed building elements in Northwestern Europe*. Interreg NWE. https://vb.nweurope.eu/projects/project-search/fcrbe-facilitating-the-circulation-of-reclaimed-building-elements-in-northwestern-europe/?tab=&page=2

Dodd, N., Donatello, S., & Cordella, M. (2020). Level(s) indicator 2.2: Construction and Demolition waste and materials. *JRC Technical Reports*. 2020-10/20201013%20New%20Level(s)%20documentation_2.2%20C&d_Publication%20v1.0.pdf

Duprat, S. (2022, December 20). *Cycle up: The company to facilitate reuse of materials*. Cycle Up EU. https://cycle-up.eu/

ECOLOGO® Certification. UL Solutions. (2025). https://www.ul.com/services/ecologo-certification

Economie Circulaire. Economie circulaire | Guide Bâtiment Durable. (n.d.). https://www-guidebatimentdurable-brussels.translate.goog/economie-circulaire?page=2&_x_tr_sl=fr&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=sc

Field Guide Home. BOMA Field Guide - English. (2025). https://bomabestfieldguide.org/

Gálvez-Martos, J.-L., Styles, D., Schoenberger, H., & Zeschmar-Lahl, B. (2018). Construction and demolition waste best management practice in Europe. *Resources, Conservation and Recycling*, *136*, 166–178. https://doi.org/10.1016/j.resconrec.2018.04.016

Girão Coelho, A. M. (2020). *ECCS - European Convention for Constructional Steelwork*. EUROPEAN RECOMMENDATIONS FOR REUSE OF STEEL PRODUCTS IN SINGLE-STOREY BUILDINGS. https://www.steelconstruct.com/wp-content/uploads/PROGRESS_Design_guide_final-version.pdf

Gondu, Venkata & Paul, Sarojini & Murthy, V. & Kola, Vikas. (2022). Reuse of Demolished Old Brick Powder in Brick Making. 10.1007/978-981-19-6513-5_29. https://www.researchgate.net/publication/335966850_Reuse_of_waste_bricks_a_new_generation_of_geopolymer_bricks

Jagadish K. S. Reddy B. V. V. & Rao K. S. N. (2007). Alternative building materials and technologies (1st ed.). New Age International. Retrieved May 31, 2023, from https://library.dctabudhabi.ae/sirsi/detail/294451

Jani, Yahya & Hogland, William. (2014). Waste glass in the production of cement and concrete – A review. Journal of Environmental Chemical Engineering. 2. 1767-1775. 10.1016/j.jece.2014.03.016. https://www.researchgate.net/publication/261103380_Waste_glass_in_the_production_of_cement_and_concrete_-_A_review

Knoth, K., Fufa, S. M., & Seilskjær, E. (2022). Barriers, success factors, and perspectives for the reuse of construction products in Norway. *Journal of Cleaner Production*, *337*, 130494. https://doi.org/10.1016/j.jclepro.2022.130494

LEED. Canada Green Building Council (CAGBC). (2022, December 13). https://www.cagbc.org/our-work/certification/leed/

Lozano, S. M. (2019). D2.3: Reference methodologies and KPIs in circular economy analysis. Houseful.

Minunno, R., O'Grady, T., Morrison, G. M., & Gruner, R. L. (2020). Exploring environmental benefits of reuse and Recycle Practices: A circular economy case study of a modular building. *Resources, Conservation and Recycling*, *160*, 104855. https://doi.org/10.1016/j.resconrec.2020.104855

O'Connor, S. (2021, June 9). *What is an engineering brick and what are the applications of an engineering brick*. Likestone. https://likestone.ie/2018/08/23/purpose-and-specification-of-an-engineering-brick/

Ontario Sand, Stone & Gravel Association. (2023). *Aggregates specifications: Ontario sand, Stone & Gravel Association*. Aggregates Specifications. https://www.ossga.com/app_aggregates_specifications/

Passive House Canada Conference. Passive House Canada Maison Passive Canada. (n.d.). https://www.passivehousecanada.com/

Past, V., Yaghmaeian, K., Naderi, M., & Naderi, N. (2023). Management of the construction and demolition waste (CDW) and determination of the best disposal alternative by FAHP (Fuzzy Analytic hierarchy process): A case study of tehran, Iran. *Journal of the Air & Waste Management Association*, *73*(4), 271–284. https://doi.org/10.1080/10962247.2023.2178542

Reuse Toolkit: Material Sheets. Interreg NWE. (2021, November 9). https://vb.nweurope.eu/projects/project-search/fcrbe-facilitating-the-circulation-of-reclaimed-building-elements-in-northwestern-europe/news/reuse-toolkit-material-sheets/

Réemploi du matériel de construction – manuels de démontage avec une finalité de réemploi. (n.d.). https://reuse-brussels.translate.goog/?_x_tr_sl=fr&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=sc

Rogers, E. (2022, December 9). *How to recycle old windows: Glass.com*. Glass.com Inc. https://info.glass.com/how-to-recycle-old-windows/

R.R.O. 1990, Reg. 347: GENERAL - WASTE MANAGEMENT. e-Laws | Ontario.ca. (2024). https://www.ontario.ca/laws/regulation/900347#BK27

Sagan, J., & Sobotka, A. (2021). *Analysis of factors affecting the circularity of building materials*. Materials (Basel, Switzerland). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8658276/

Saad, M., Ruparathna, R., Biswas, N., & Tam, E. (2024). Developing a Reclamation Framework to Promote Circularity in Demolition Projects. *Recycling*, *9*(6), 114. https://doi.org/10.3390/recycling9060114

Sarah. (2017). *When should you use reinforced concrete? - eka concrete: Direct? supplier of ready mix and site Mix Concrete*. EKA Concrete | Direct Supplier of Ready Mix and Site Mix Concrete. https://ekaconcrete.com/use-reinforced-concrete/

Synergy Foundation. (2023). *RDN*. Construction Waste Best Practices Guide. https://www.rdn.bc.ca/sites/default/files/inline-files/A%20Guide%20to%20the%20New%20Automatic%20Curbside%20Collection%20Service.pdf

The concrete recycling processes. TRP READY MIX. (2018, December 12).https://trpreadymix.com/how-concrete-gets-recycled/

Tobias, M. (2022). *Recycling and reusing concrete*. MEP Engineering & Design Consulting Firm. https://www.ny-engineers.com/blog/recycling-and-reusing-concrete

Unuode, M.A. (2021). *ECO-FRIENDLY DEVELOPMENT: REUSE OF BUILDING MATERIALS (Emphasis on Barriers and Drivers of Reuse of Building Materials)*.

Van Marcke de Lummen, G., & Schreuder, N. (2013). *Recycling of glass from construction and demolition waste - AGC flat to ...* AGC Glass Europe. https://www.agc-flattoflat.eu/wp-content/uploads/2017/01/Recycling-of-Glass-from.pdf

What is engineered wood? advantages and disadvantages. MT Copeland. (2023,). https://mtcopeland.com/blog/what-is-engineered-wood/

Yeheyis, M., Hewage, K., Alam, M. S., Eskicioglu, C., & Sadiq, R. (2012). An overview of construction and Demolition Waste Management in Canada: A lifecycle analysis approach to sustainability. *Clean Technologies and Environmental Policy*, *15*(1), 81–91. https://doi.org/10.1007/s10098-012-0481-6

Yrjölä, J. (2022). *Peikko brings reuse of concrete structures to the level of practice by introducing a new white paper: Dismount and reuse of precast concrete structures*. Peikko.com. https://www.peikko.com/blog/new-white-paper-dismount-and-reuse-of-precast-concrete-structures/