WP4-A9. Producing a scientific article related to results of WP4.

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Transilvania University of Brasov

Contents

1. INTRODUCTION

Within the RockChain project, WP4 placed a strong emphasis on transforming project outputs into scientifically robust, citable knowledge that can circulate beyond the consortium and remain accessible after the funding period. In this context, Task A9 focused on the production of scientific articles derived from WP4-related work and closely connected project results, with the dual objective of (i) strengthening the external credibility of RockChain's approaches through peer exchange and academic scrutiny, and (ii) expanding dissemination to audiences that typically influence standards, policy, and innovation uptake in the built environment, waste management and circular economy domains.

This deliverable document the scientific outputs generated under Task A9, covering two complementary routes. First, it compiles conference-related papers that enabled timely dissemination and dialogue with specialised communities, including contributions on the legal framing of construction and demolition (C&D) waste management and on RockChain as a blockchain-driven framework for circular waste management in construction. Second, it reports on journal articles aligned with WP4's ambition to anchor project results in high-quality publication channels: one article already published in Frontiers in Built Environment (WoS/Scopus indexed) and another submitted to Smart and Sustainable Built Environment (Emerald, IF = 4.6), demonstrating the project's capacity to address both technological and governance-oriented challenges in smart and sustainable construction.

Accordingly, the report is structured to provide:

(a) a concise overview of each output (title, venue, authorship and status);

(b) the associated abstracts to make the scientific focus and contribution immediately transparent, and

(c) an indicative timeline summarising when and how each result was disseminated.

Where relevant, the deliverable also points to complementary reporting (e.g., WP3-A6 for congress participation details) to avoid duplication while ensuring traceability across project documentation. Overall, WP4-A9 captures how RockChain results were consolidated into peer-facing formats that support reuse, replication and long-term impact within the broader ecosystem of circular economy innovation for the built environment.

2. ARTICLES LINKED TO CONFERENCES

2.1. 17th International Conference Exploration, Education and Progress in the Third Millennium: Challenges in Law and Public Administration

More information in "WP3-A6. Participation in a congress to disseminate the results"

Title: *Legal Perspectives regarding the Construction and the Demolition Waste Management.*

Presented at the 17th International Conference Exploration, Education and Progress in the Third Millennium: Challenges in Law and Public Administration (15-16 May 2025, Galați, Romania – online).

Abstract:

Protecting the environment remains one of the burning desires of our times and people has begun more and more concerned with finding concrete solutions in the direction of identifying, collecting and recycling different types of waste, including construction and demolition waste. All these public policies are based upon a principle in the European Union according to which the polluter is the one who pays, wanting responsibility for all those who generate residues. Therefore, in the framework of this analysis, the identification and the presentation of the main legal regulations regarding the construction and demolition waste management are necessary steps for improving the public awareness on the matter.

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Conference program:
https://www.fdsa.ugal.ro/images/UPDATE_DANA/Program_EEP_2025_6.pdf

https://www.gup.ugal.ro/ugaljournals/index.php/als/article/view/9140

Timeline of Outputs

Title	Type	Date	Status	Dissemination Channel
Legal Perspectives regarding the Construction and Demolition Waste Management	Conference paper	15 - 16 May 2025	Presented	EEP Conference, Galați

Cite of the article:

Dinu, C. G. and Muntean, R. (2025) "Legal Perspectives Regarding The Construction And The Demolition Waste Management", *The Annals of "Dunarea de Jos" University of Galati. Legal Sciences. Fascicle XXVI*, 8(1), pp. 184-193.

2.2. International conference "Biological Sciences and Environmental Solutions for the Achievement of Sustainable Development Goals (SDGs)"

Title: *RockChain: A Technological Framework for Blockchain-Driven Circular Waste Management in Construction.*

Submitted to the international conference "Biological Sciences and Environmental Solutions for the Achievement of Sustainable Development Goals (SDGs)" – Yerevan State University.

Abstract:

The construction industry is a major contributor to global resource consumption and waste generation, posing significant environmental challenges. Traditional waste management (WM) practices often fall short in ensuring transparency, traceability, and efficiency, which are essential for advancing sustainability. This paper introduces "RockChain," a technological framework that leverages blockchain technology to drive circular waste management in construction. By integrating blockchain with circular economy (CE) principles, the proposed framework addresses critical barriers such as data fragmentation, lack of accountability, and limited cross-industry cooperation. The study reviews the current state of construction waste management, explores the potential of blockchain-enabled solutions, and highlights the synergy between blockchain and digital innovations like Building Information Modeling (BIM) and the Internet of Things (IoT). The results demonstrate that blockchain can enhance transparency, automate waste tracking, and facilitate secure information sharing, thereby supporting the transition to a circular built environment. The paper concludes that adopting blockchain-driven circular waste management systems can significantly reduce environmental impacts, promote resource efficiency, and foster sustainable practices in the construction sector.

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Conference link and article:

https://www.ysu.am/en/conference/869

https://journals.ysu.am/index.php/jisees/article/view/SI_1_2025_p123

Timeline of Outputs

Title	Type	Date	Status	Dissemination Channel
RockChain: Blockchain-Driven Circular Waste Management in Construction	Conference paper	24 - 26 September 2025	Submitted	YSU Conference on SDGs

Cite of the article:

RockChain: A Technological Framework for Blockchain-Driven Circular Waste Management in Construction Sector. (2025). *Journal of Innovative Solutions for Eco-Environmental Sustainability*, 123.

3. SCIENCES ARTICLES

3.1. Published in Frontiers in Built Environment (indexed in WoS and Scopus)

Title: *Predicting mechanical properties of marble powder concrete using artificial neural networks and blockchain-rock for sustainable construction.*

Statistical data: already seen by 1200+ people and downloaded by 180+.

Figure 1: Statistical data. Source: https://www.frontiersin.org/journals/built-environment/articles/10.3389/fbuil.2025.1594735/full

Abstract:

Use of marble powder—an industrial by-product—serves as a supplementary cementitious material (SCM) and ensures sustainability by minimizing environmental impacts of cement manufacturing. This paper suggests a novel use of artificial neural networks (ANN) and Blockchain-Rock technology to enhance predictive accuracy and assure tracking of data in concrete mix optimization. Using an ANN model trained on 629 data sets, the proposed approach achieved high predictive accuracy for mechanical properties of marble powder concrete: Model I reached R2 = 0.99 and RMSE = 1.63 on the test set, while Model II achieved R2 = 1.00 and RMSE = 0.21. These results are superior or comparable to those of other machine learning models, such as a feedforward ANN (R2 = 0.985, RMSE = 1.12) and a general regression neural network (GRNN) (R2 = 0.92, RMSE = 4.83), highlighting the effectiveness of the proposed ANN architecture. This demonstrates the ANN's ability to efficiently predict compressive and tensile strength of marble powder concrete, substantially reducing the need for standard long-duration tests. Additionally, Blockchain-Rock ensures secure and tamper-free tracking of material origin and concrete mixes, enabling transparency and efficiency in the supply chain. Experiments demonstrate that the addition of marble powder improves concrete strength and durability. Furthermore, ANN-based predictions enable real-time optimization of the concrete mix design. This dual approach offers an extended solution for sustainable construction by leveraging AI-based efficiency and blockchain-based data security. Future work can explore additional enhancements by real-time IoT integration and larger data sets to further improve predictive accuracy and industrial applicability.

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Article link:

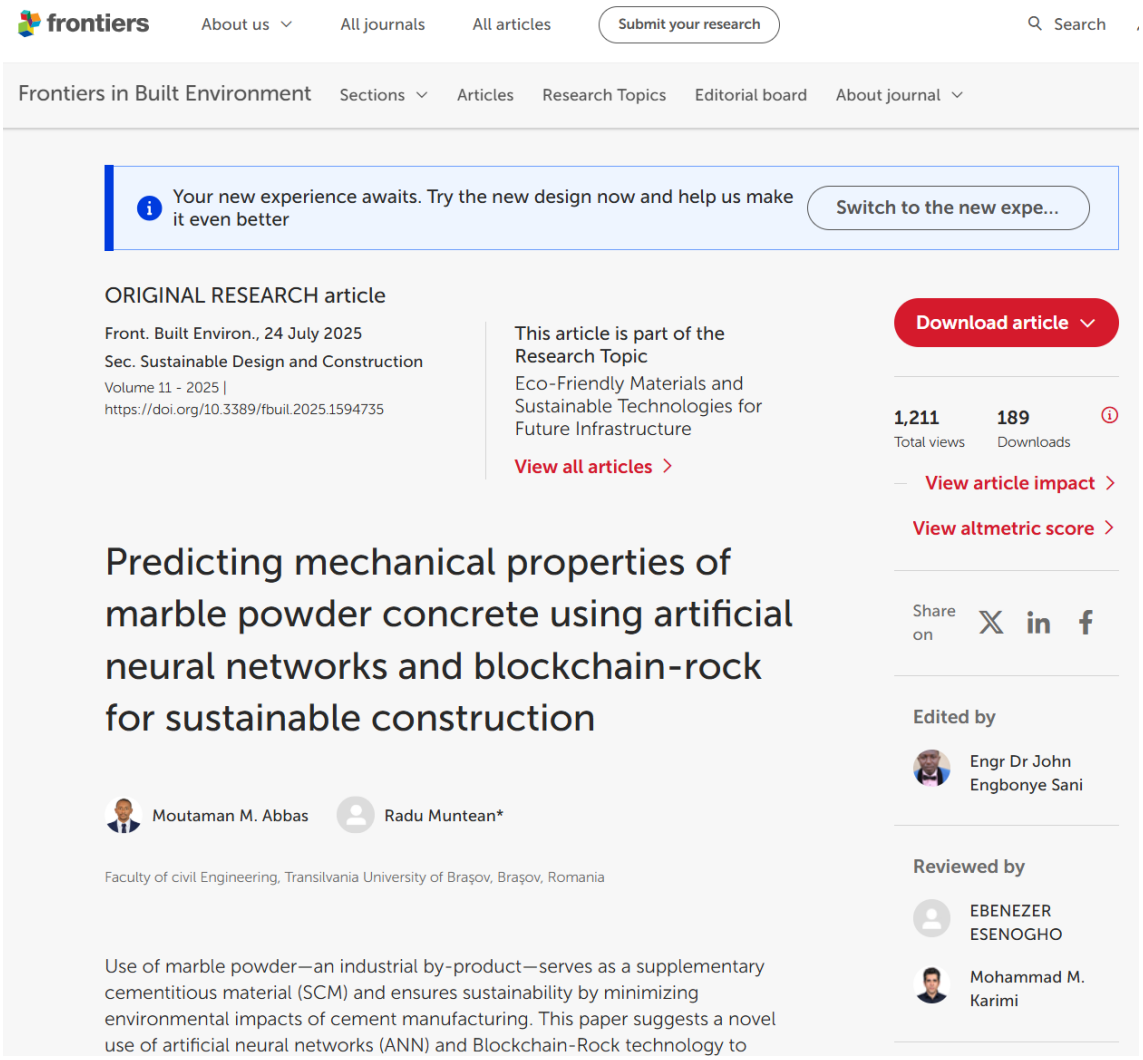
https://www.frontiersin.org/journals/built-environment/articles/10.3389/fbuil.2025.1594735/full

Timeline of Outputs

Title	Type	Date	Status	Dissemination Channel
Predicting mechanical properties of marble powder concrete using artificial neural networks and blockchain-rock for sustainable construction	Journal article	July 2025	Published	*Frontiers in Built Environment* *IF = 2.7*

Cite of the article:

Abbas MM and Muntean R (2025) Predicting mechanical properties of marble powder concrete using artificial neural networks and blockchain-rock for sustainable construction. *Front. Built Environ.* 11:1594735. doi: 10.3389/fbuil.2025.1594735



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Front. Built Environ., 24 July 2025
Sec. Sustainable Design and Construction
Volume 11 - 2025 |
https://doi.org/10.3389/fbuil.2025.1594735

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Predicting mechanical properties of marble powder concrete using artificial neural networks and blockchain-rock for sustainable construction

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Use of marble powder—an industrial by-product—serves as a supplementary cementitious material (SCM) and ensures sustainability by minimizing environmental impacts of cement manufacturing. This paper suggests a novel use of artificial neural networks (ANN) and Blockchain-Rock technology to

Figure 2: Publication. Source: https://www.frontiersin.org/journals/built-environment/articles/10.3389/fbuil.2025.1594735/full

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TYPE Original Research
PUBLISHED 24 July 2025
DOI 10.3389/fbuil.2025.1594735

OPEN ACCESS

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RECEIVED 16 March 2025
ACCEPTED 24 June 2025
PUBLISHED 24 July 2025

CITATION
Abbas MM and Muntean R (2025) Predicting mechanical properties of marble powder concrete using artificial neural networks and blockchain-rock for sustainable construction. *Front. Built Environ.* 11:1594735. doi: 10.3389/fbuil.2025.1594735

Predicting mechanical properties of marble powder concrete using artificial neural networks and blockchain-rock for sustainable construction

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Use of marble powder—an industrial by-product—serves as a supplementary cementitious material (SCM) and ensures sustainability by minimizing environmental impacts of cement manufacturing. This paper suggests a novel use of artificial neural networks (ANN) and Blockchain-Rock technology to enhance predictive accuracy and assure tracking of data in concrete mix optimization. Using an ANN model trained on 629 data sets, the proposed approach achieved high predictive accuracy for mechanical properties of marble powder concrete: Model I reached R^2 = 0.99 and RMSE = 1.63 on the test set, while Model II achieved R^2 = 1.00 and RMSE = 0.21. These results are superior or comparable to those of other machine learning models, such as a feedforward ANN (R^2 = 0.985, RMSE = 1.12) and a general regression neural network (GRNN) (R^2 = 0.92, RMSE = 4.83), highlighting the effectiveness of the proposed ANN architecture. This demonstrates the ANN's ability to efficiently predict compressive and tensile strength of marble powder concrete, substantially reducing the need for standard long-duration tests. Additionally, Blockchain-Rock ensures secure and tamper-free tracking of material origin and concrete mixes, enabling transparency and efficiency in the supply chain. Experiments demonstrate that the addition of marble powder improves concrete strength and durability. Furthermore, ANN-based predictions enable real-time optimization of the concrete mix design. This dual approach offers an extended solution for sustainable construction by leveraging AI-based efficiency and blockchain-based data security. Future work can explore additional enhancements by real-time IoT integration and larger data sets to further improve predictive accuracy and industrial applicability.

KEYWORDS

marble powder, artificial neural networks, blockchain-rock, mechanical properties, supplementary cementitious materials (SCMs), concrete durability, cement replacement, sustainable concrete

1 Introduction

Marble powder is one of the Supplementary Cementitious Materials (SCMs) that used to replace cement for more sustainable concrete, while compressive and Tensile concrete tests are important for us to know the quality of

Figure 3: PDF Publication. Source: https://www.frontiersin.org/journals/built-environment/articles/10.3389/fbuil.2025.1594735/full

3.2. Submitted to Smart and Sustainable Built Environment (Emerald, IF = 4.6)

Title: *Integrating Triple Helix Collaboration and Blockchain in Circular Economy Models for Enhanced Waste Recycling.*

Abstract:

This paper investigates how Triple Helix collaboration (industry–government–academia) can be operationalised within circular economy (CE) models for waste recycling by leveraging blockchain as a shared trust, traceability and coordination infrastructure, with particular relevance for built-environment value chains and construction and demolition (C&D) waste streams. It proposes an integrative framework and reference architecture that connect stakeholder roles, decision rights and governance arrangements to concrete blockchain functionalities—such as immutable chain-of-custody records, verifiable material passports, smart contracts for automated compliance checks and conditional payments, and tokenised or performance-based incentives tied to validated sorting and quality outcomes. The model specifies where data should be captured and verified (e.g., at collection, transfer, sorting, processing and secondary-material certification points), how responsibilities can be distributed across actors, and how auditable rules can be used to align objectives and reduce opportunistic behaviour. Using scenario-based analysis of representative recycling workflows, the study illustrates how the proposed integration can reduce information asymmetries, limit disputes, and strengthen accountability across fragmented recycling chains, while also improving material-quality assurance and the credibility of circularity claims—key barriers to higher recycling rates and stronger secondary-material markets. The paper further discusses implementation considerations including governance design (who validates what, and under which standards), interoperability with existing waste-management information systems, privacy and data-sharing boundaries, and regulatory alignment, concluding that blockchain is most valuable when embedded in well-defined collaborative governance rather than treated as a purely technical add-on, and that future empirical validation in multi-site deployments is needed to quantify impacts on yield, contamination rates, costs and stakeholder adoption.

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Article link (under reviewing):

STATUS	ID	TITLE	CREATED	SUBMITTED
Contact Journal RAE: Not Assigned EIC: Rahimian, Farzad • Awaiting Admin Processing	SASBE-08-2025-0474	Integrating Triple Helix Collaboration and Blockchain in Circular Economy Models for Enhanced Waste Recycling View Submission Submitting Author: M. Abbas, Moutaman	16-Aug-2025	16-Aug-2025

Figure 4: Publication. Source: https://www.emeraldgrouppublishing.com/journal/sasbe

Timeline of Outputs

Title	Type	Date	Status	Dissemination Channel
Integrating Triple Helix Collaboration and Blockchain in Circular Economy Models for Enhanced Waste Recycling	Journal article	August 2025	Under Review	*Smart and Sustainable Built Environment* *IF = 4.6*