



HAVE WE ENTERED THE FOURTH ERA OF BIM? FROM THE ERA OF OPEN STANDARDS TO THE ERA OF ARTIFICIAL INTELLIGENCE

CZY WKROCZYLIŚMY W CZWARTĄ ERĘ BIM? OD ERY OTWARTYCH STANDARDÓW DO ERY SZTUCZNEJ INTELIGENCJI

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Abstract

Building Information Modeling (BIM) has been the hottest topic in the construction sector over the last decade. The evolution from CAD to BIM systems has been going on for over 40 years. The current periodization indicates that we are now in the third era of BIM development, the era of open standards, which was initiated by the idea of openBIM in 2012. Earlier evolutionary periods included the model federation (second era) and CAD3D (first era). Since 2022, there has been extremely dynamic development of artificial intelligence (AI), especially generative AI. AI tools automate some of the tasks that were previously performed by humans. Thus, the research question is: are we entering the next, fourth era of BIM development? The era of artificial intelligence? This chapter attempts to answer this reflective question. During an in-depth literature review, the directions of current and future research on BIM development are discussed.

Keywords: building information modeling, BIM, artificial intelligence, AI, development, periodization

Streszczenie

Modelowanie informacji o budynku (BIM) było najgorętszym tematem w branży budowlanej w ciągu ostatniej dekady. Ewolucja od systemów CAD do systemów BIM trwa już ponad 40 lat. Obecna periodyzacja wskazuje, że znajdujemy się w trzeciej erze rozwoju BIM, erze otwartych standardów, zapoczątkowanej ideą openBIM w 2012 roku. Wcześniejsze okresy ewolucji obejmowały federację modeli (druga era) oraz CAD3D (pierwsza era). Od 2022 roku obserwuje się niezwykle dynamiczny rozwój sztucznej inteligencji (AI), zwłaszcza generatywnej. Narzędzia AI automatyzują niektóre zadania, które wcześniej były wykonywane przez ludzi. W związku z tym pojawia się pytanie badawcze: czy wkraczamy w kolejną, czwartą erę rozwoju BIM? Erę sztucznej inteligencji? W niniejszym artykule podjęto próbę odpowiedzi na to refleksyjne pytanie. W trakcie dogłębnego przeglądu literatury omówiono kierunki obecnych i przyszłych badań nad rozwojem BIM.

Słowa kluczowe: modelowanie informacji o budynku, BIM, sztuczna inteligencja, AI, rozwój, periodyzacja

REFERENCES

- [1] Alavi H., et al.: AI-Driven BIM Integration for Optimizing Healthcare Facility Design. *Buildings*, 2024, 14.8: 2354.
- [2] Bassir D., et al.: Application of artificial intelligence and machine learning for BIM. *International Journal for Simulation and Multidisciplinary Design Optimization*, 2023, 14: 5.
- [3] Borkowski A.Sz., Nowakowski P.: Use of applications and rendering engines in architectural design—state-of-the-art. *Construction and Architecture*, 2023, 22.1.

- [4] Borkowski A.Sz.: Evolution of BIM: Epistemology, genesis and division into periods. *Journal of Information Technology in Construction*, 2023, Vol. 28, 646-661.
- [5] Borkowski A.Sz., Brożyna J., Lesiuk J.: Implementation of the telemetric integration of the BIM-RFID in context of access control. *Buildings*, 2024, 14.11: 3356.
- [6] Cao Y., Abdul A.A., Mohd A., Wan N.R.: Stable diffusion in architectural design: Closing doors or opening new horizons? *International Journal of Architectural Computing*, 2024, 14780771241270257.
- [7] Cecon L., Villa D.: AI-BIM interdisciplinary spill-overs: prospected interplay of AI and BIM development paradigms. In: *From Building Information Modelling to Mixed Reality*. Springer International Publishing, 2021. p. 195-217.
- [8] Chen J., et al.: Defect digital twinning: A technical framework to integrate robotics, AI and BIM for facility management and renovation. In: *IOP Conference Series: Earth and Environmental Science*. IOP Publishing, 2022. p. 022041.
- [9] Croce V., et al.: H-BIM and artificial intelligence: classification of architectural heritage for semi-automatic scan-to-BIM reconstruction. *Sensors*, 2023, 23.5: 2497.
- [10] Du S., et al.: BIM and IFC Data Readiness for AI Integration in the Construction Industry: A Review Approach. *Buildings*, 2024, 14.10: 3305.
- [11] Elagiry M., et al.: IFC to Building Energy Performance Simulation: A systematic review of the main adopted tools and approaches. In: *BauSim Conference 2020*. IBPSA-Germany and Austria, 2020, pp. 527-534.
- [12] European Union. Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence (Artificial Intelligence Act). Official Journal of the European Union, 2024, L 1689: 1-144.
- [13] Fawad M., et al.: Automation of structural health monitoring (SHM) system of a bridge using BIMification approach and BIM-based finite element model development. *Scientific Reports*, 2023, 13.1: 13215.
- [14] Gil A.: Limitations of contemporary AI-based image generators in the architectural design process. *Builder*, 2024, 320.3: 28-33.
- [15] Heidari A., Peyvastehgar Y., Amanzadegan M.: A systematic review of the BIM in construction: From smart building management to interoperability of BIM & AI. *Architectural Science Review*, 2024, 67.3: 237-254.
- [16] ISO. ISO 19650-1:2018 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling – Part 1: Concepts and principles. International Organization for Standardization, 2018.
- [17] Mitera-Kielbasa E., Zima K.: BIM Policy Trends in Europe: Insights from a Multi-Stage Analysis. *Applied Sciences*, 2024, 14.11: 4363.
- [18] Noardo F., et al.: An inspection of IFC models from practice. *Applied Sciences*, 2021, 11.5: 2232.
- [19] Pan Y., Zhang L.: Integrating BIM and AI for smart construction management: Current status and future directions. *Archives of Computational Methods in Engineering*, 2023, 30.2: 1081-1110.
- [20] Ploennigs J., Berger M.: Automating computational design with generative AI. *Civil Engineering Design*, 2024, 6.2: 41-52.
- [21] Rane N., Choudhary S., Rane J.: Integrating Building Information Modeling (BIM) with ChatGPT, Bard, and similar generative artificial intelligence in the architecture, engineering, and construction industry: applications, a novel framework, challenges, and future scope (November 22, 2023), 2023.
- [22] Rangasamy V., Yang J-B.: The convergence of BIM, AI and IoT: Reshaping the future of prefabricated construction. *Journal of Building Engineering*, 2024, 108606.
- [23] Saleh F., et al.: A Framework for Leveraging the Incorporation of AI, BIM, and IoT to Achieve Smart Sustainable Cities. *Journal of Intelligent Systems and Internet of Things*, 2024, 11.2: 75-84.
- [24] Shamreeva A., Doroschkin A.: Analysis of the influencing factors for the practical application of BIM in combination with AI in Germany. In: *ECPPM 2021-eWork and eBusiness in Architecture, Engineering and Construction*. CRC Press, 2021. p. 536-543.
- [25] Sresakoolchai J., Kaewunruen S.: Integration of building information modeling (BIM) and artificial intelligence (AI) to detect combined defects of infrastructure in the railway system. In: *Resilient Infrastructure: Select Proceedings of VCDRR 2021*. Singapore: Springer Singapore, 2021, p. 377-386.
- [26] Urbieta M., et al.: Generating BIM model from structural and architectural plans using Artificial Intelligence. *Journal of Building Engineering*, 2023, 78: 107672.
- [27] Xiang Y., et al.: An extension of BIM using AI: A multi working-machines pathfinding solution. *IEEE Access*, 2021, 9: 124583-124599.
- [28] Yönder V.M.: Understanding the Impact of Deep Learning Models on Building Information Modeling Systems: A Study on Generative Artificial Intelligence Tools. *Engineering Proceedings*, 2023, 53.1: 57.

- [29] Zima K., Wieczorek D.: Przegląd możliwości wykorzystania sztucznej inteligencji w modelowaniu BIM. *Przegląd Budowlany*, 2024, 95. (in Polish).
- [30] Zipf G.K.: Human behavior and the principle of least effort: An introduction to human ecology. Ravenio books, 2016.