Analysis of the use of AI in Construction

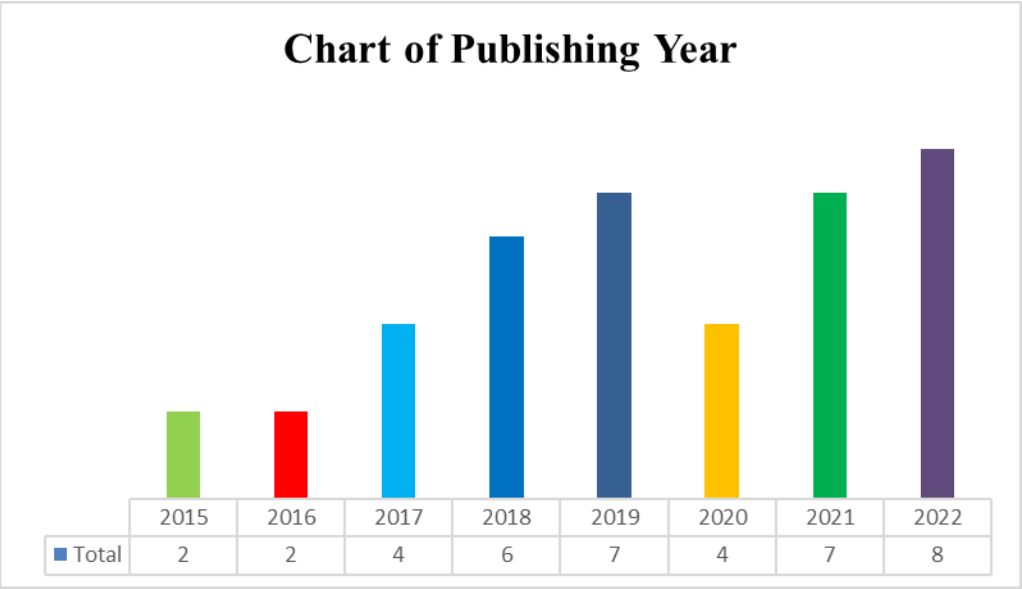

Figure 1: Chart of publishing years

A total of 40 papers were sourced from reliable journals, conference papers, and educational e-paper sites such as Google Scholar, Science Direct, and Scopus for the study. The selected papers were published between the years 2015 and 2022, with the year 2022 having the highest number of papers reviewed.

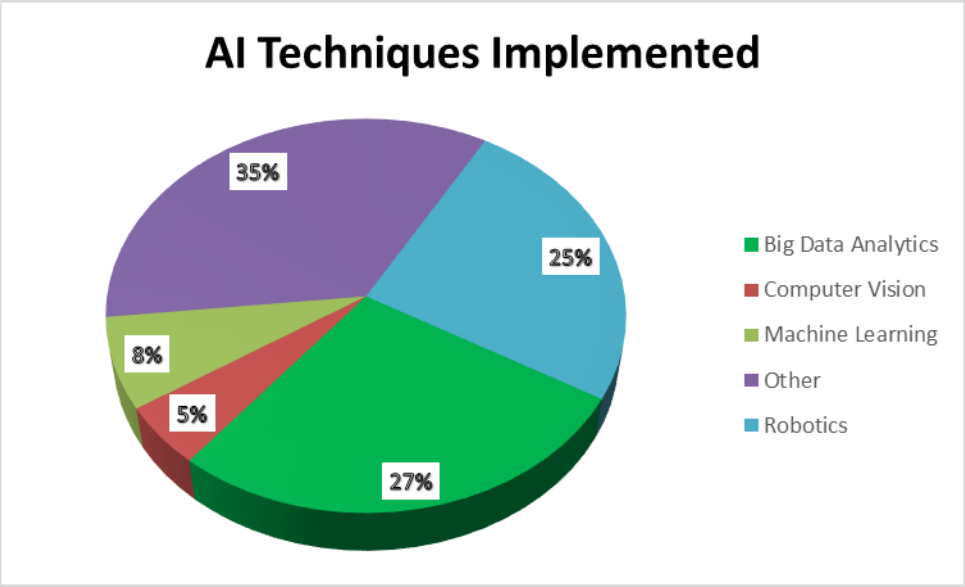

Figure 2: AI Techniques Implemented in Case Studies

52% of the implemented cases studies made use of Big Data Analytics and Robotics. Big Data Analytics was used for information sharing, scheduling and planning as well as for the design phase of construction. Software such as BIM, ALICE, VINNE, Touchplan, and, Synchro was

utilized in making optimal decisions and managing project delays due to miscommunication or unavailable information and materials. Robotic Systems such as integrated unmanned aerial vehicles (UAVs), cable-driven parallel robots, robotic manipulator GCGR, mobile masonry robots, and mobile bricklaying robot were used for automatic construction and demolition, construct the soffit, an exterior (a glass ceiling) of large and tall building, construction of bricks, and brick laying. 8% made use of machine Learning and 5% used computer vision Technique while, 35% of the case studies implemented other AI Techniques such fuzzy logic systems, neural networks, and natural language processing.

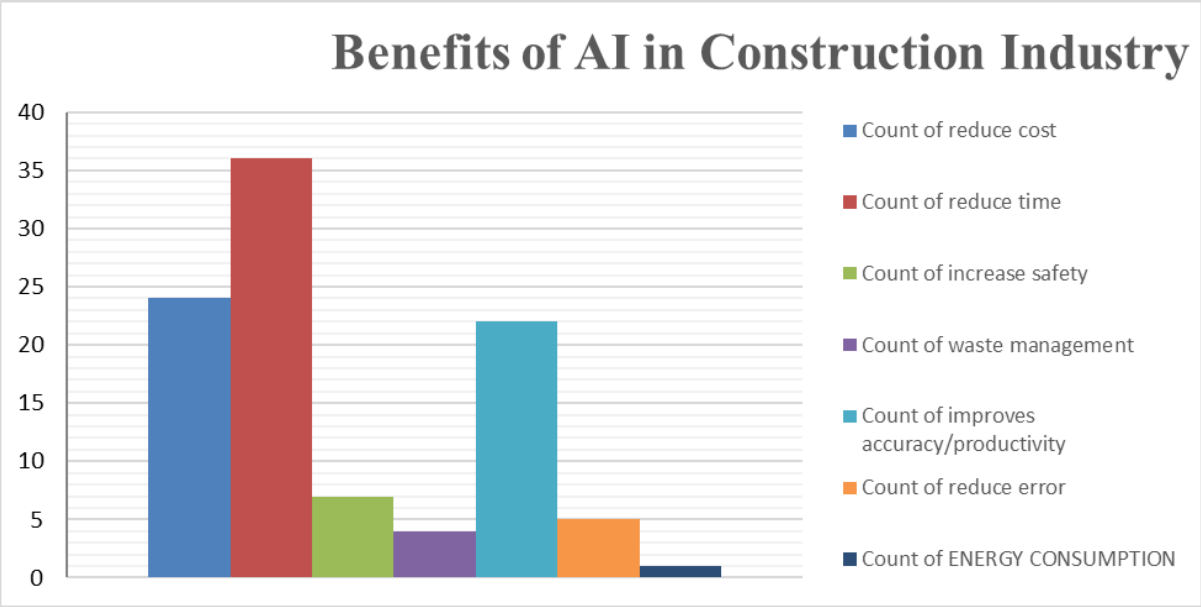

Figure 3: Benefits of AI in Construction Industry identified by Case Studies

36 papers out of the 40 papers reviewed mentioned that implementing AI in building Construction reduces project time delivery, 24 papers mentioned that utilizing AI in building construction helped in reducing cost, 21 papers mentioned that AI helped in improving accuracy and productivity, 7 papers mentioned that the safety of workers was increased, 4 papers mentioned that AI helped in waste management, 1 paper mentioned that energy consumption was decreased, and 5 papers mentioned that errors including human errors was reduced due to the use of artificial intelligence for building projects.

Conclusion

The aim of this research was to provide answers to questions related to the use of artificial intelligence (AI) in the field of building construction. The study analyzed existing use cases and reports on AI in this field, resulting in successful accomplishment of its objectives and providing valuable insights to the academic community. This information contributes to the ongoing discussion on the potential impact of AI on building construction.

The research results showed that 90% of reviewed papers and use cases recognize the time-saving benefits of AI in construction. AI was found to be helpful in various construction phases

such as planning, design, execution, and monitoring. While AI technology has been utilized in many areas, more exploration is needed as the limited number of use cases remains a challenge (Rampini et al.,2022).

The outcome of the study indicated that a quarter (25%) of the innovations were focused on Robotics and almost a third (27%) were in Big Data Analytics. The construction sector generates vast amounts of information, and the failure to properly manage and organize this data has been revealed as a significant reason (90%) for project delays (Berggren et al., (2022). The study results also revealed that 7% of the innovations were related to Machine Learning and 5% focused on Computer Vision. These areas represent untapped potential in the construction industry, where automation can help minimize waste, save time, reduce cost, improve energy efficiency, and enhance work safety, accuracy, and project quality. Despite these benefits, complete attainment of automation goals has not yet been achieved in all use cases. The research identified several uses of AI in the construction industry, including:

- Automatic disassembling and reconstruction of prefabricated construction
- Determining optimal activity schedules based on activity relationships
- Assisting with masonry work and brick laying
- Streamlining cash flow analysis
- Predicting project delays
- Facilitating the construction of exterior soffits
- Assisting with brick and block construction.
- Modeling building construction management systems and creating progress reliability control systems
- Evaluating different construction plans in real-time and assessing the impact of key decisions on cost and schedule
- Using vision and speech recognition to tag construction data and suggest safety measures
- Reducing requests for information and miscommunication among stakeholders
- Automating or semi-automating information sharing processes
- Identifying cost and schedule planning indicators
- Monitoring project plans and documentation
- Detecting design changes to prevent delays.
- Creating a conceptual framework for the building life cycle
- Automatically calculating the cost impact of productivity loss
- Providing decision support for property development and facility management
- Digital fabrication of building data on site
- Predicting delays
- Converting verbal requests and retrieving information into CSV files
- Designing buildings.

The study also highlighted major limitations such as the trustworthiness of third-party cloud service providers and the fragmented nature of the construction industry leading to inconsistent pricing of AI products. (Abanda et al., 2018; Regona et al., 2022). The study concluded that AI in the construction industry has shown significant progress and potential benefits in all stages

of construction especially, it has significantly reduced the time it takes to complete a building project. However, further advancements in AI technologies are needed to address key challenges such as project delays, energy consumption, worker safety, and project cost.

Recommendations

Based on the insights derived from this research and as a proposed solution to the limitation identified, the following outlines have been formulated to aid the implementation of AI in the construction Industry and guarantee quality projects that are delivered in time without delays, accurate, safe at a reduce cost, waste and energy consumption:

- Expand collaboration and partnerships between construction companies, technology providers, and universities to drive innovation and the integration of AI in the construction industry.
- Invest in infrastructure and hardware to support AI technologies, such as high-speed internet, cloud computing and storage, and data centers.
- Create a standard set of data protocols and sharing methods to ensure interoperability and data integration among various AI systems and platforms.
- Encourage the adoption of AI in construction through government initiatives and financial incentives for companies.
- Regularly review and update AI algorithms and models to keep up with the latest technological advancements and changing industry needs.
- Standardizing the pricing of AI products as a pricing control measure within the industry.
- Designers, Estimators, Safety Managers, Project Managers, Foremen and all professionals involved should be educated and include AI Technology in their workspace.

References

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