(RESEARCH ARTICLE)

Evaluating the awareness and use of predictive analytics in construction project planning

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Abstract

The construction industry is starting to adopt predictive analytics to improve decision-making and optimize project outcomes. This research aims to investigate the perception and utilization of predictive analytics within construction project scheduling and planning. For this, a quantitative research design was implemented, utilizing structured questionnaires to collect data from multi-sector construction practitioners. The results indicated a moderate to high level of awareness, with 65% of the respondents aware of the tools. However, the actual utilization of predictive analytics was quite low at 15%. This was attributed to several factors, including a lack of requisite skills, high implementation costs, and entrenched organizational inertia. Nonetheless, 75% of respondents indicated a high willingness to adopt predictive analytics given favorable change management conditions. This research indicated that there is still a lack of proactive educational programs to foster comprehensive predictive analytics within construction project planning. Proposed strategies include the creation of comprehensive training courses tailored to construction industry needs, gradual and staged strategies for adoption, and proactive advocacy at policy-making levels to reduce utilization barriers. These findings underscore the need for strategic initiatives to bridge the gap between awareness and implementation of predictive analytics in construction planning.

Keyword: Predictive Analysis; Project; Construction; Project Planning

1. Introduction

Digital transformation is slowly being used in the construction industry to aid in risk management, lower costs, and boost efficiency. This adaptation is being done through the use of new technology such as predictive analytics (PA)—a modern approach based on the analysis of historical and current data to make accurate future forecast (Hofmann, & Rutschmann, 2018). Predictive analytics is essential in project planning, as it helps reduce delays as well as budget and time overruns. Stakeholders can make well-timed, efficient decisions to prevent issues with the help of predictive tools.

The construction sector, particularly in developing countries and small-to-medium enterprises, lacks awareness and practical use of predictive analytics. This can be due to a digital illiteracy, lack of adequate data technology, a general skepticism of new innovations, and slow adaptation to new ideas (Ahmed et al., 2022). Recognizing the awareness gap regarding the use of predictive analytics in construction planning is important in promoting strategic change.

This study seeks to evaluate the extent to which construction professionals are aware of and utilize predictive analytics tools in their project planning activities. It also aims to explore the key enablers and barriers that influence adoption. By doing so, the research will contribute to the growing body of knowledge on digital readiness in the construction

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sector and inform policy, training, and investment strategies for enhancing project performance through advanced data analytics.

2. Literature Review

2.1. Overview of Predictive Analytics in Construction

Predictive analytics (PA) is a field that encompasses the application of statistical methods, data mining, and machine learning to current and historical data to extract insights for forecasting upcoming events (Kelleher, Mac Namee, & D'arcy, 2020). In the construction industry, foresight is applied to predict potential project delays, budget overruns, safety risks, and even deficits in resources. In construction project planning, the most valuable predictive analytics offer is the optimization of data processing to facilitate improved actionable insights and project decisions (Lin, & Golparvar-Fard, 2018)

Ofori (1980) noted that the application of PA in construction management is a relatively new field of study, particularly in emerging economies. These researchers further note that there is a growing trend among larger industry players to utilize predictive technologies, while small to medium construction enterprises, which are relatively common in developing countries, are still lagging due to lack of adequate resources and technical skills.

2.2. Applications of Predictive Analytics in Construction Planning

The foremost use of PA in construction pertains to scheduling forecasting. Akintoye and Main (2007) noted construction projects often experience delays because of inadequate planning and unforeseen interruptions. Love et al. (2016) noted that predictive analytics, through the use of regression models and neural networks, is capable of forecasting delays and suggesting preemptive corrective measures well in advance of the project execution phase. Similarly, models that predict future costs based on historical cost data have been proven to bolster the accuracy of budgets (Park et al., 2011).

Within the area of risk management, PA assists in risks identification and quantification through the analysis of prior projects data patterns. Predictive analytics is also helpful in infrastructure maintenance. Shohet and Paciuk (2006) demonstrated the significance of predictive modeling in maintenance planning, which subsequently minimized infrastructure downtime and costs. Khosrowshahi and Arayici (2012) more recently described the integration of PA with Building Information Modeling (BIM) for real-time project risk analytics.

2.3. Adoption Barriers in the Construction Industry

Even though the advantages of predictive analytics (PA) are acknowledged, many researchers have reported significant barriers to its adoption. In the case of construction markets in the Middle East and Africa, Ahmed et al. (2022) showed that lack of awareness, inadequate training, and organizational resistance were major hurdles. Gledson and Greenwood (2017) cited lack of managerial engagement and a lack of commitment to change as barriers in the UK.

Accessibility and the quality of construction have put significant limitations to the industry. The effectiveness of PA is contingent upon the vast amount of construction data, which is often scattered across numerous platforms, and in many cases, not available in a digital form (Succar et al., 2013). Due to this, the process of model training and validation becomes a challenge.

2.4. Drivers of Adoption

Conversely, a number of construction professionals have noted that PA can be adopted due to some enablers. Primarily, a strong organizational commitment to innovation and collaborative project delivery. Additonally, leadership commitment to training and digital infrastructure are crucial. According to Chan et al. (2016), collaborative project delivery methods, in particular, Integrated Project Delivery (IPD), create a more favorable context for the application of predictive tools due to the strong shared data system and open communication channels.

Government backing is equally as important. As Arditi and Gunaydin (2005) point out, national policies aimed at digital transformation with funding and standards infrastructure are vital for adoption at scale.

2.5. Theoretical Perspectives and Frameworks

Construction technology adoption is often studied with the Technology Acceptance Model (TAM) and Diffusion of Innovation (DOI) Theory. Users' willingness to adopt newer technologies is largely influenced by perceived ease of use

and perceived usefulness (Davis, 1989). On the contrary, DOI theory focuses on the characteristics of the innovation, the means of communication, time, and the social structure (Rogers, 2003).

These models are useful in the construction industry for understanding the differences in the adoption of predictive analytics tools. Ogunsemi et al. (2019) studied the adoption of digital instruments in Nigeria with TAM and found perceived usefulness as the foremost influencing factor.

3. Methodology

3.1. Research Design

This research uses a quantitative approach to measure awareness and utilization of predictive analytics in construction project planning. The purpose of this research is to obtain objective information from construction practitioners using a systematic method that can be analyzed and drawn conclusions statistically.

3.2. Study Population and the Sample Selection Method

Considered in this study are APEC Professionals regularly working as project managers, engineers, architects, and quantity surveyors as members of the construction industry and staff in private and public construction firms. To identify individuals matching the purpose of the study, a purposive sampling technique with particular criteria or selection was applied, especially to those with exposure or experience to information technology relating to planning and project management. The total number of distributed structured questionnaires was 120, out of which 100 were completed in a valid way, which represents a response rate of 83.3%.

3.3. Tools for the Data Collection

Information was gathered for the purpose of this research by means of a structured questionnaire containing close-ended questions. The questionnaire was composed of closed questions as well as Likert scale questions to gauge the following:

- Respondents awareness of the predictive analytics importance
- The utilization in planning its frequency, and type
- Perceived advantages and disadvantages
- Readiness of the organization and willingness to adopt

The questionnaire was pre-tested with a small group of construction professionals to ensure clarity and relevance.

3.4. Data Analysis Technique

The data collected was analyzed manually using frequency distribution tables and percentages. This method provides a straightforward way to summarize and interpret the responses. Each question's frequency of response was tabulated and converted into percentages to identify dominant trends and insights across the sample.

4. Results and discussion

Data collected through structured questionnaires has been analyzed manually using frequency and percentage distributions.

Table 1 Respondents' Level of Awareness of Predictive Analytics

Awareness Level	Frequency	Percentage (%)
Highly Aware	20	20%
Moderately Aware	45	45%
Slightly Aware	25	25%
Not Aware	10	10%
Total	100	100%

From the responses, 65% of participants reported being either moderately or highly aware of predictive analytics, indicating a promising baseline awareness in the industry. However, 35% of respondents were either only slightly aware or not aware at all, suggesting a need for industry-wide sensitization and training programs.

Table 2 Use of Predictive Analytics in Project Planning

Usage Frequency	Frequency	Percentage (%)
Frequently Used	15	15%
Occasionally Used	30	30%
Rarely Used	35	35%
Never Used	20	20%
Total	100	100%

Only 45% of respondents confirmed using predictive analytics at all, and only 15% used it frequently. This points to a significant gap between awareness and actual adoption. Potential causes might include organizational resistance, lack of skilled personnel, or limited access to relevant tools.
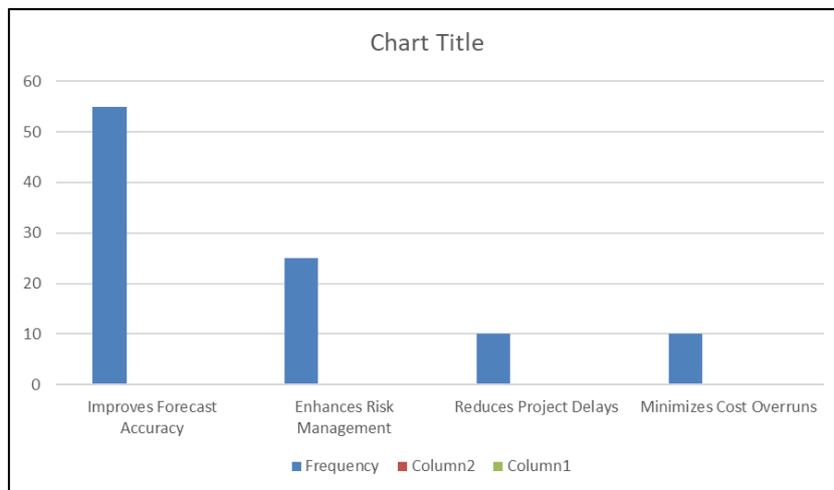

Figure 1 Perceived Benefits of Predictive Analytics in Construction Planning

The majority (55%) agreed that predictive analytics primarily improves forecast accuracy, followed by its contribution to risk management (25%). This affirms literature suggestions that predictive tools can lead to better decision-making, though implementation remains lacking in practice.
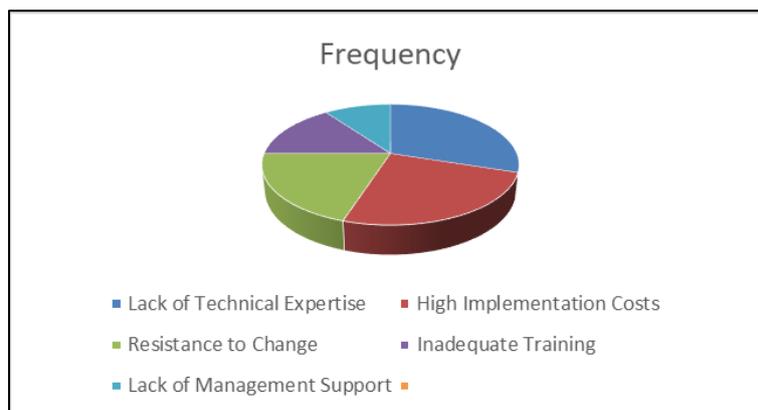

Figure 2 Barriers to Adoption of Predictive Analytics

A combination of internal (lack of expertise and training) and external (cost and management support) factors hinder adoption. This confirms observations in prior studies that organizational inertia and digital skill gaps are critical constraints.
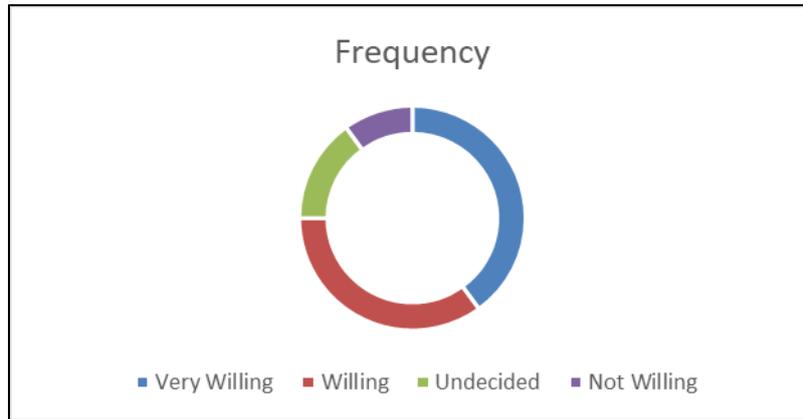

Figure 3 Willingness to Adopt Predictive Analytics Tools

A combined 75% of respondents are willing or very willing to adopt predictive analytics tools. This shows significant potential for uptake if awareness and training efforts are intensified, and organizational support structures are improved.

5. Conclusion

This research evaluated the awareness and utilization of predictive analytics in construction project planning from the perspective of professionals from different construction companies. The results indicated a noteworthy level of awareness with 65% of respondents moderately or highly aware of the tools available. However, actual adoption remained low, with only 15% of respondents reporting frequent use of the tools. Most participants perceived the benefits associated with predictive analytics, especially in improving forecast precision and risk management. However, there are other barriers to its broader use such as lack of technical know-how, high costs, entrenched organizational inertia, and poor training systems. Respondents showed a positive disposition towards the adoption of predictive analytics, with 75% expressing willingness to use the tools in their companies. This indicates that adoption could be accelerated with the right initiatives.

Recommendations

- **Focused Training Programs:** Construction firms should develop focused training programs that teach employees how to use predictive analytics. Collaboration with educational or technological organizations could help with this.
- **Initiatives for Tools Testing:** Organizations should test predictive tools on small-scale projects as part of pilot programs. This could help validate their usefulness and alleviate worries about expense or intricacy.
- **Support from Top Management:** Strong managerial support is needed for adoption. Engaging leaders in workshops or forums that share success stories and ROI from predictive analytics helps ROI drives adoption.
- **Early Adoption Benefits:** Industry regulators and policy makers can encourage early adoption by providing financial incentives or grants to firms that invest in predictive technologies.
- **Campaign for Greater Awareness:** Professional organizations should launch awareness campaigns focused on webinars and publish case studies on the importance of predictive analytics to broaden understanding.

Predictive tools should be developed specifically for construction to help automate processes and reduce the barriers for the non-tech-savvy users working in this field.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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