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Evolving Procurement Methods in Housing Projects: Insights from a Narrative Review

Tajudeen Olawale AJAYI
Department of Architectural Technology,
The Federal Polytechnic,
Ado-Ekiti, Nigeria

Abumere AKHANOLU
Department of Architecture,
Ambrose Alli University,
Ekpoma, Nigeria

Burabari Akpe NWAKO
Department of Architecture,
Bamidele Olumilua University of Education, Science & Technology,
Ikere-Ekiti, Nigeria

Abstract:- Effective procurement strategies in housing projects are critical for enhancing project outcomes, particularly in cost efficiency, sustainability, and timely delivery. This narrative review examines various procurement approaches used in housing projects, drawing from 72 published journal articles from 2010 to 2023, marked by rapid technological advancement and an increasing focus on sustainability. The review systematically analyses the evolution of procurement strategies, highlighting key trends, challenges, and opportunities within the housing sector. The findings underscore the pressing need to adapt procurement methods to contemporary demands, such as integrating sustainable practices and technological advancements. This study contributes to the body of knowledge by providing a comprehensive overview of procurement strategies in housing projects and offers insights that could inspire future research and practice. The outcomes suggest that a strategic approach to procurement can significantly improve project performance, stakeholder satisfaction, and overall sustainability, offering a promising future for the field.

Keywords:- *Housing Projects; Procurement Strategies; Project Performance; Sustainability; Cost Efficiency; Technological Advancements.*

I. INTRODUCTION

The significance of effective procurement strategies in housing projects cannot be overstated, particularly in the urgent need for cost-effective, sustainable, and timely housing solutions. The escalating global population has made efficient housing delivery systems a pressing concern. This urgency underscores the crucial role of the audience's work in the field, as they are at the forefront of addressing this crisis [1]. Their expertise and dedication are key to finding solutions. The pressures of urbanisation, economic constraints, and environmental considerations further amplify this urgency. Consequently, procurement strategies have evolved to address these multifaceted challenges, aiming to optimise resource allocation, minimise waste, and enhance the overall quality of housing projects [2].

Procurement in housing projects refers to the process through which the various phases of a construction project are planned, negotiated, and executed [3]. This process encompasses everything from the initial design phase to the final construction and handover of the completed structure. The choice of procurement strategy can significantly impact a project's success, influencing factors such as cost, quality, time, and sustainability [4]. It is important to note that the success of a procurement strategy often depends on the collaboration and alignment of various stakeholders, including architects, contractors, clients, and regulatory bodies [5]. Given its critical role, understanding the evolution, application, and outcomes of different procurement strategies is essential for stakeholders in the housing sector.

Traditional procurement methods such as Design-Bid-Build (DBB) have dominated the construction industry [6]. The DBB method involves a linear process where the design is completed before the project is put out to bid, and the construction phase begins only after the bid has been awarded. However, these methods have often been criticised for inefficiency, particularly regarding time delays and cost overruns [7]. In response to these challenges, alternative procurement strategies have emerged, offering more integrated and collaborative approaches. For instance, Design-Build (DB) and Integrated Project Delivery (IPD) models have gained popularity for their ability to streamline stakeholder communication and reduce project timelines. These strategies emphasise collaboration and early involvement of key parties, which can lead to better project outcomes [8][9].

The increasing complexity of modern housing projects has also driven the shift towards more collaborative procurement methods. Contemporary architectural designs often incorporate advanced technologies and sustainable materials, requiring a more flexible and integrated approach to procurement [10]. This complexity is further compounded by the need to comply with stringent environmental regulations

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and to meet the expectations of increasingly informed and demanding clients. As a result, procurement strategies have had to adapt, becoming more dynamic and responsive to the changing landscape of housing projects [11][12][13].

Sustainability has become a crucial consideration in the procurement of housing projects. Adopting sustainable procurement strategies is a necessary response to the global challenge of climate change [14]. These strategies aim to reduce the environmental impact of construction activities by promoting the use of eco-friendly materials, energy-efficient designs, and waste-reduction practices [15]. In addition to environmental benefits, sustainable procurement can lead to long-term cost savings, offering a promising outlook for the future of housing projects as energy-efficient buildings typically have lower operational costs [16][17][18].

Challenges remain despite the progress in developing and implementing new procurement strategies. The construction industry is inherently risk-prone, and introducing innovative procurement methods can sometimes lead to unforeseen complications [19]. Misaligned incentives, communication breakdowns, and regulatory hurdles can undermine the effectiveness of even the most well-designed procurement strategies [20]. Therefore, ongoing research and adaptation are important to ensure that procurement practices continue to evolve in line with industry needs and societal expectations. This underscores the necessity of the audience's continued efforts in the field [21][22].

This narrative review aims to provide a comprehensive overview of the various procurement strategies employed in housing projects, focusing on their evolution, application, and impact. By synthesising findings from 72 journal articles published between 2010 and 2023, this study seeks to identify key trends, challenges, and opportunities within the field. The insights gained from this review will contribute to the academic discourse on procurement and offer practical recommendations for industry practitioners and policymakers.

II. METHODOLOGY

A. Research Design and Data Sources

The research design of this study is meticulously grounded in the narrative review research method, a qualitative approach ideal for synthesising knowledge across various studies and identifying trends, gaps, and consensus within the field. The narrative review method facilitates a comprehensive examination of procurement strategies in housing projects, drawing on literature published between 2010 and 2023. This period was chosen to capture the evolution of procurement strategies in the context of rapid technological advancements and growing sustainability concerns. Data sources included academic databases such as Google Scholar, JSTOR, Scopus, and the Web of Science. They were selected for their comprehensive coverage of scholarly literature in architecture, construction management, and procurement, ensuring a broad and representative collection of relevant literature.

B. Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were carefully defined to maintain the focus and quality of the review. The inclusion criteria required that the articles be peer-reviewed, published between 2010 and 2023, and relevant to procurement strategies in housing projects. Articles were selected based on their methodological rigour, significance of findings, and relevance to the topic. Studies focusing on procurement in contexts other than housing projects or lacking a robust methodological foundation were excluded. Additionally, the review aimed to include studies from diverse geographical contexts to account for variations in procurement practices and challenges across different regions and economic environments.

C. Data Collection and Analysis

Data collection involved a comprehensive search of the selected databases using carefully chosen search terms such as "procurement strategies," "housing projects," "construction management," "sustainable procurement," and "project delivery methods." The search yielded a wide range of articles screened for relevance and quality. Once the relevant articles were selected, a thematic analysis was conducted. This process involved coding the articles based on their findings, methodologies, and theoretical frameworks. The coded data were then organised into categories reflecting the primary themes in the literature, such as the evolution of procurement strategies, the role of technology, sustainability considerations, and the impact on project outcomes. This thematic analysis formed the basis for the narrative synthesis presented in the review.

D. Quality Assessment and Ethical Considerations

Quality assessment was an integral part of the methodology to ensure the reliability and validity of the findings. Each selected study was critically appraised based on factors such as sample size, research design, and the generalizability of the results. This appraisal helped identify strengths and limitations within the literature, allowing for a balanced discussion of the findings. Ethical considerations were also addressed by ensuring that all sources were properly credited and any potential biases in the selection and analysis of the literature were minimised.

E. Limitations

While the narrative review method provides a comprehensive understanding of procurement strategies in housing projects, it is not without limitations. The non-systematic nature of narrative reviews means that the selection of literature is subject to the researchers' interpretation, which could introduce bias. Additionally, the reliance on published literature may result in excluding relevant studies that are unavailable in the selected databases or published in languages other than English. Despite these limitations, the study offers valuable insights into the evolution, application, and impact of procurement strategies in housing projects, contributing to the broader discourse on optimising procurement practices in the sector.

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III. LITERATURE REVIEW

➢ *Evolution of Procurement Strategies in Housing Projects*

The evolution of procurement strategies in housing projects reflects broader shifts in the construction industry and responds to the growing complexity of housing projects. Historically, the construction industry relied heavily on traditional procurement methods, such as Design-Bid-Build (DBB), where the design and construction phases were distinct and sequential. While this method delineated responsibilities, it often led to inefficiencies, including prolonged project timelines, cost overruns, and adversarial relationships between contractors and designers. The limitations of traditional methods became increasingly evident as housing projects grew in scale and complexity, necessitating the development of more integrated and flexible procurement strategies [4][23].

One of the most significant shifts in procurement strategies occurred with the rise of Design-Build (DB) and Integrated Project Delivery (IPD) models. These approaches sought to address the inefficiencies of the traditional DBB model by fostering greater collaboration between all stakeholders from the outset of a project. In the DB model, a single entity is responsible for both the design and construction phases, which helps streamline communication, reduce conflicts, and accelerate project delivery. The IPD model takes this collaborative approach even further by integrating the owner, architect, and contractor into a single contractual arrangement. This structure is designed to align the interests of all parties, encouraging them to work together to achieve the best possible outcomes for the project [24][25].

The shift towards more integrated procurement strategies has been driven partly by technological advancements, which have transformed how housing projects are designed and managed. For example, Building Information Modelling (BIM) has become a critical tool in modern procurement, enabling real-time collaboration and coordination among project stakeholders. BIM facilitates the sharing of detailed project information, allowing for more accurate cost estimation, efficient scheduling, and early identification of potential issues [26]. This technological integration has made it easier to implement collaborative procurement models like DB and IPD, enhancing communication and reducing the likelihood of errors or misunderstandings during the project [27].

Sustainability has also played a key role in developing procurement strategies for housing projects. The growing emphasis on sustainable development has led to procurement practices prioritising environmental and social considerations alongside traditional economic factors [28]. Sustainable procurement strategies often involve using eco-friendly materials, energy-efficient designs, and construction methods that minimise waste and reduce the carbon footprint of housing projects [29]. Integrating sustainability into procurement has not only helped mitigate the environmental impact of construction activities. Still, it has also contributed to long-term cost savings through reduced operational expenses and improved building performance [30][31].

Another important development in the evolution of procurement strategies is the increasing use of Public-Private Partnerships (PPP) in housing projects. PPPs have become popular for financing and delivering large-scale housing developments, particularly in regions with limited public funds [32]. The private sector typically assumes significant financial and operational risks in a PPP arrangement. In contrast, the public sector provides regulatory oversight and ensures the project aligns with broader social and economic objectives. PPPs can offer significant benefits, including access to private capital, enhanced innovation, and leveraging private sector expertise [33]. However, they also pose challenges, such as clear contractual frameworks and effective risk management strategies to protect both parties' interests [34].

The evolution of procurement strategies in housing projects reflects the industry's ongoing efforts to address the challenges posed by increasing project complexity, technological advancements, and sustainability requirements [35]. As the housing sector evolves, procurement strategies will continue to adapt, incorporating innovative approaches and technologies to meet the demands of modern housing projects.

➢ *Key Procurement Approaches in Housing Projects*

The housing projects sector employs a variety of procurement approaches, each with distinct characteristics, advantages, and challenges. These approaches have evolved in response to the increasing complexity of construction projects, the demand for faster delivery, and the growing emphasis on sustainability and cost efficiency [2]. Stakeholders must understand the key procurement methods to select the most appropriate strategy for a given project, ensuring it meets the required objectives and constraints.

One of the most traditional and widely used procurement methods is the Design-Bid-Build (DBB) approach. DBB's project is divided into design, bidding, and construction [36]. The client first engages an architect or designer to develop detailed project plans and specifications. Once the design is complete, the project is put out to tender, and contractors bid on the work. The contractor with the winning bid then undertakes the construction phase. The primary advantage of DBB is the clear separation of responsibilities between the designer and the contractor, which can reduce conflicts of interest [37]. However, this method is often criticised for being time-consuming and prone to cost overruns, as the sequential nature of the process can lead to delays and a lack of flexibility to accommodate changes [38][39].

In contrast to DBB, the Design-Build (DB) approach integrates the design and construction phases under a single contract. This integration allows for greater collaboration between the designer and the contractor, leading to faster project delivery and reduced costs [40]. The DB approach is particularly well-suited to projects where time is of the essence or where the client prefers a single point of responsibility. By streamlining communication and decision-making, DB can also improve project outcomes by minimising disputes and ensuring the design is closely aligned

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with the construction process. However, the potential downside of DB is that it may limit the client's control over the design, as the contractor often has noteworthy influence over the final product [40][41].

Another procurement approach that has gained popularity in recent years is Construction Management at Risk (CMAR). Under CMAR, the client hires a construction manager (CM) early in the design phase to provide input on constructability, cost estimation, and scheduling [42]. The CM then acts as a consultant during the design phase and as the general contractor during construction. This dual role allows the CM to manage risks more effectively, particularly in cost and schedule control. CMAR is often used in complex or high-risk projects where the client seeks to retain more control over the design while benefiting from the expertise of the construction manager. However, the success of CMAR depends heavily on the CM's ability to manage the project effectively, and it can be challenging to balance the interests of the client, designer, and contractor [43][44].

Public-Private Partnerships (PPP) represent another significant procurement approach, especially for large-scale housing projects that require substantial investment. In a PPP, the public and private sectors collaborate to deliver a project, with the private partner typically responsible for financing, designing, constructing, and sometimes operating the facility [45]. PPPs can offer advantages such as access to private capital, innovation, and efficient project delivery. However, they also come with challenges, including complex contractual arrangements, risk-sharing mechanisms, and strong governance to protect public interests [33][34].

Integrated Project Delivery (IPD) is an emerging procurement approach that maximises collaboration among all project stakeholders. In IPD, the client, designer, contractor, and often key subcontractors enter a single, multi-party agreement that aligns their interests and goals. This collaborative approach is designed to foster innovation, improve efficiency, and enhance project outcomes by encouraging the early involvement of all parties [46]. IPD is particularly effective in complex projects where close coordination is required. However, it requires a prominent level of trust and commitment among stakeholders, and its success depends on the ability of all parties to work together cohesively [8][47].

- *Challenges in Implementing Procurement Strategies*

Implementing procurement strategies in housing projects is fraught with numerous challenges that can impact the success of projects. These challenges arise from the inherent complexities of construction projects, the dynamic nature of the housing market, and the diverse stakeholders involved. Understanding these challenges is crucial for developing effective strategies to mitigate risks and enhance project outcomes.

One of the primary challenges in implementing procurement strategies is cost management and budget constraints. Housing projects often involve significant financial investments, and managing these costs effectively is critical to success. However, unforeseen expenses, such as fluctuations in material prices, labour shortages, and changes in project scope, can lead to cost overruns [48]. These issues are exacerbated by the competitive nature of the construction industry, where contractors may be underbid to win contracts only to encounter financial difficulties later on [49][50]. To address these challenges, procurement strategies must incorporate robust cost estimation, risk assessment, and contingency planning processes to ensure that projects remain financially viable.

Stakeholder coordination and communication present another significant challenge in the procurement process. Housing projects typically involve many stakeholders, including clients, designers, contractors, suppliers, and regulatory bodies. Each stakeholder's objectives, priorities, and expectations can sometimes conflict. Effective communication and coordination are essential to align these interests and ensure the project progresses smoothly. However, miscommunication or a lack of coordination can lead to delays, rework, and disputes, compromising the quality and timeliness of the project [51][52]. To overcome this challenge, procurement strategies should emphasise the importance of clear communication channels, regular stakeholder meetings, and collaborative tools like Building Information Modelling (BIM).

Legal and regulatory barriers also pose challenges in the implementation of procurement strategies. The construction industry is heavily regulated, with various laws and standards governing issues such as safety, environmental impact, labour practices, and building codes. Navigating this complex regulatory landscape can be difficult, particularly in regions where regulations are frequently updated or inconsistently enforced. Moreover, legal disputes can arise over contractual terms, intellectual property rights, or project delays, further complicating the procurement process [53][54][55]. To mitigate these risks, procurement strategies must include thorough legal reviews, compliance checks, and standardised contracts that clearly define the roles and responsibilities of all parties involved.

Risk management is another critical challenge in the implementation of procurement strategies. Construction projects are inherently risky due to their complexity, the involvement of multiple stakeholders, and the potential for unforeseen events such as natural disasters, economic downturns, or political instability. Effective risk management requires identifying potential risks early in the project, assessing their likelihood and impact, and developing mitigation strategies. However, risk management is often overlooked or inadequately addressed in procurement planning, leading to project delays, cost overruns, and quality issues [19][56]. To address this challenge, procurement strategies should incorporate comprehensive risk management frameworks, including regular risk assessments, developing mitigation plans, and allocating appropriate contingency budgets.

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Sustainability challenges are increasingly important in the context of modern procurement strategies. As the demand for environmentally sustainable housing grows, procurement processes must adapt to include sustainability criteria, such as eco-friendly materials, energy-efficient designs, and waste reduction practices. However, implementing these sustainability measures can be challenging, particularly in regions with limited access to sustainable materials or where sustainable construction costs are prohibitively high [28][30][57]. To overcome these challenges, procurement strategies should prioritise sustainability from the outset, incorporating clear sustainability goals, engaging with suppliers who offer sustainable products, and considering the long-term benefits of sustainable construction in terms of reduced operational costs and environmental impact.

- *Opportunities for Enhancing Procurement Strategies*

In the rapidly evolving field of housing projects, there are several emerging opportunities to enhance procurement strategies driven by technological advancements, sustainability imperatives, and the need for improved stakeholder engagement. These opportunities are crucial for addressing the challenges that have historically hindered the successful implementation of procurement processes and for achieving more efficient, cost-effective, and sustainable housing projects.

One of the most significant opportunities for enhancing procurement strategies is leveraging technological innovations. Technologies such as Building Information Modelling (BIM), artificial intelligence (AI), and digital procurement platforms can transform how procurement is managed in housing projects [58]. In particular, BIM has revolutionised how design, construction, and procurement are integrated by enabling real-time collaboration among all project stakeholders. BIM facilitates the sharing of comprehensive project data, which helps in accurate cost estimation, scheduling, and risk management, thereby reducing the likelihood of errors and delays [27]. Conversely, AI can analyse large datasets, optimise procurement decisions, and predict potential risks. Digital procurement platforms streamline procurement by automating vendor selection, contract management, and supply chain coordination tasks. By adopting these technologies, stakeholders can enhance procurement strategies' efficiency, transparency, and accuracy, leading to better project outcomes [59][60][61].

Sustainability is another area where significant opportunities exist to enhance housing project procurement strategies. The growing emphasis on sustainable development has led to procurement practices prioritising environmental and social considerations alongside economic factors [28]. Sustainable procurement strategies involve selecting materials and construction methods that minimise environmental impact, reduce carbon footprints, and promote energy efficiency. These strategies also consider the social implications of procurement decisions, such as ensuring fair labour practices and supporting local communities. By integrating sustainability into procurement processes, housing projects can achieve long-term benefits, including reduced operational costs, enhanced building performance, and improved occupant well-being [57]. Moreover, sustainability in procurement can strengthen the reputation of developers and contractors, as there is increasing demand from clients and regulators for environmentally responsible construction practices.

Improving stakeholder engagement presents another critical opportunity for enhancing procurement strategies. Successful housing projects require the alignment of diverse stakeholder interests, including clients, designers, contractors, suppliers, and regulatory bodies. Engaging stakeholders early and continuously throughout the procurement process can lead to better decision-making, fewer conflicts, and increased project buy-in. One effective approach to improving stakeholder engagement is adopting Integrated Project Delivery (IPD) models, which encourage collaboration from the outset and align the goals of all parties involved [24][62]. Additionally, collaborative tools such as BIM and digital communication platforms can facilitate more effective coordination and information sharing among stakeholders, further enhancing engagement and reducing potential misunderstandings or disputes.

Policy and regulatory reforms also offer opportunities to enhance housing project procurement strategies. Governments and regulatory bodies play a crucial role in shaping the procurement landscape by setting standards, enforcing regulations, and providing incentives for sustainable and efficient construction practices. By reforming procurement policies to encourage innovation, sustainability, and transparency, policymakers can create an enabling environment that supports adopting best practices in housing projects. For example, policies that mandate the use of BIM in public housing projects or provide tax incentives for sustainable construction can drive widespread adoption of these practices and lead to more successful project outcomes [63][64]. Furthermore, regulatory reforms that simplify procurement processes and reduce bureaucratic barriers can help streamline project delivery and reduce costs.

- *Impact of Procurement Strategies on Project Performance*

Procurement strategies in housing projects significantly influence project performance, particularly in cost efficiency, timeliness, quality, sustainability, and stakeholder satisfaction. The choice and implementation of procurement strategies determine how effectively a project can meet its objectives, adapt to challenges, and deliver value to all stakeholders [65].

Cost efficiency is one of the most critical aspects of project performance affected by procurement strategies. The choice of procurement method can directly influence the economic management of a housing project, from the initial budgeting phase through to the final cost settlement. For instance, traditional procurement methods like Design-Bid-Build (DBB) often result in cost overruns due to the separation of design and construction phases, which can lead to misalignment between the design intent and the actual construction costs [37][39]. In contrast, integrated procurement strategies such as Design-Build (DB) and Integrated Project Delivery (IPD) can enhance cost efficiency

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by promoting better coordination between design and construction teams, reducing the likelihood of costly design changes and rework during the construction phase [43][44][66].

Timeliness, or the ability to complete a project within the scheduled time limit, is another key performance metric influenced by procurement strategies. Delays are common in housing projects, often resulting from poor communication, inadequate planning, or unforeseen site conditions. Procurement strategies that emphasise early involvement of all stakeholders, such as IPD, are more likely to result in timely project completion because they facilitate better planning and risk management from the outset. By contrast, procurement methods involving sequential phases, like DBB, can suffer delays due to the need for re-tendering or redesign when issues arise during construction [67][6]. Adopting digital procurement tools, such as Building Information Modelling (BIM), also improves timeliness by enabling real-time collaboration and faster decision-making processes [27].

Quality is another crucial aspect of project performance that is deeply influenced by procurement strategies. The quality of the final housing product depends on how well the procurement process aligns with the project's design, construction, and material standards. Procurement strategies that foster close collaboration between the client, designers, and contractors, such as the DB and IPD models, tend to produce higher-quality outcomes by ensuring all parties understand the project goals and quality expectations. Conversely, in procurement approaches where the contractor is selected based primarily on the lowest bid, such as in traditional DBB, there is a risk that quality may be compromised to reduce costs [21][68].

Sustainability has become an increasingly important performance criterion in housing projects, and procurement strategies are vital in achieving sustainable outcomes. Sustainable procurement involves selecting materials, construction methods, and processes that minimise environmental impact, promote energy efficiency, and ensure the long-term viability of the building. Procurement strategies that integrate sustainability considerations from the outset, such as those that mandate the use of green building certifications or prioritise lifecycle costing, are more likely to result in sustainable housing projects [30][35]. These strategies contribute to environmental goals and can enhance the property's long-term value by reducing operational costs and improving occupant satisfaction.

Finally, procurement strategies directly influence stakeholder satisfaction, a key measure of project performance. Successful procurement approaches ensure that the needs and expectations of all stakeholders, including clients, end-users, and contractors, are met throughout the project lifecycle. Strategies that encourage transparency, communication, and collaboration, such as IPD and certain Public-Private Partnerships (PPP), are more likely to result in high stakeholder satisfaction because they align the interests of all parties and foster a sense of shared responsibility for the project's success [24][69][70]. On the other hand, procurement methods that lack clear communication channels or fail to involve key stakeholders in decision-making can lead to dissatisfaction, disputes, and project failure.

IV. FINDINGS AND DISCUSSION

The exploration of procurement strategies in housing projects reveals several key findings that underscore the critical role these strategies play in determining the success of construction projects. Based on a comprehensive literature review, these findings highlight how procurement strategies influence cost efficiency, timeliness, quality, sustainability, and stakeholder satisfaction in housing projects. Discussing these findings provides insights into how different procurement approaches can be optimised to enhance project outcomes.

One of the most significant findings is the impact of procurement strategies on cost efficiency. The study highlights that traditional procurement methods, such as Design-Bid-Build (DBB), often lead to cost overruns due to the sequential nature of the process and the lack of integration between the design and construction phases. This disconnect can result in discrepancies between the initial design estimates and construction costs, leading to budget overruns. In contrast, integrated procurement approaches, such as Design-Build (DB) and Integrated Project Delivery (IPD), are shown to be more effective in controlling costs. These methods promote early collaboration between designers and contractors, allowing for more accurate cost estimation and better management of project budgets. Integrating design and construction processes also reduces the likelihood of costly changes and rework during construction, contributing to overall cost efficiency.

Timeliness is another critical aspect of procurement strategies and has a profound impact. The findings suggest that delays in housing projects are often associated with procurement methods that involve multiple, sequential phases, such as DBB. These methods can suffer delays due to the need for re-tendering or re-design when issues arise during construction. On the other hand, procurement strategies emphasising early and continuous involvement of all stakeholders, such as IPD, are more likely to result in timely project completion. Digital tools, particularly Building Information Modelling (BIM), further enhance the ability to manage timelines by providing real-time updates and facilitating faster decision-making processes. The findings suggest that procurement strategies that integrate these tools can significantly reduce the risk of delays and ensure that projects are completed on schedule.

Quality is another key finding of the study, with procurement strategies playing a crucial role in determining the final quality of housing projects. The literature indicates that procurement methods that promote collaboration and early involvement of contractors in the design phase tend to result in higher-quality outcomes. This is because these strategies ensure that the design is both practical and feasible from a construction standpoint, reducing the likelihood of errors and ensuring that the final product meets the desired

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standards. Conversely, procurement methods that prioritise cost over quality, such as selecting contractors based on the lowest bid, may compromise the quality of the project. This can lead to poor artistry, using substandard materials, and a final product that fails to meet the client's expectations.

Sustainability emerges as a critical consideration in the findings, with procurement strategies increasingly used to achieve environmentally sustainable outcomes in housing projects. The study highlights that sustainable procurement practices, which prioritise selecting eco-friendly materials and energy-efficient construction methods, can significantly reduce the environmental impact of housing projects. These practices contribute to environmental conservation and enhance the projects' long-term value by reducing operational costs and improving energy efficiency. The findings suggest that procurement strategies that integrate sustainability criteria from the outset are more likely to result in successful, sustainable housing projects.

Finally, stakeholder satisfaction is identified as a key measure of project success, and the findings indicate that procurement strategies play a crucial role in achieving this. Strategies that foster transparency, effective communication, and collaboration among all project stakeholders tend to result in higher satisfaction levels. This is particularly important in large and complex housing projects, where aligning interests among clients, contractors, and end-users is essential for project success. The findings suggest that procurement strategies that promote a shared sense of responsibility and mutual respect among stakeholders are more likely to lead to positive outcomes and long-term relationships.

V. RECOMMENDATIONS

Based on the findings of this study, several key recommendations emerge for enhancing procurement strategies in housing projects. These recommendations aim to address the identified challenges and optimise the performance of housing projects by focusing on cost efficiency, timeliness, quality, sustainability, and stakeholder satisfaction.

Firstly, it is recommended that stakeholders adopt integrated procurement strategies, such as Design-Build (DB) and Integrated Project Delivery (IPD), to improve cost efficiency and project timelines. These approaches foster early collaboration between designers and contractors, enabling more accurate cost estimation and streamlined project execution. Integrating design and construction phases reduces the likelihood of cost overruns and delays, leading to more efficient project delivery. Project managers must prioritise these integrated approaches, especially for complex housing projects where coordination among multiple stakeholders is critical.

Secondly, adopting advanced digital technologies, particularly Building Information Modelling (BIM), should be prioritised in procurement strategies. BIM facilitates real-time collaboration and decision-making, helping to manage timelines more effectively and improve the overall quality of the project. By incorporating BIM into procurement processes, stakeholders can enhance communication, reduce errors, and ensure that the final product aligns with the original design intent. It is recommended that industry professionals receive training in BIM and related digital tools to leverage their potential in fully optimising procurement strategies.

Sustainability should be a core consideration when selecting and implementing procurement strategies. It is recommended that procurement processes explicitly incorporate sustainability criteria, such as the use of eco-friendly materials, energy-efficient designs, and construction methods that minimise waste. By prioritising sustainable practices from the outset, stakeholders can achieve long-term environmental benefits and reduce operational costs. Additionally, promoting sustainability in procurement aligns with the growing demand from clients and regulators for environmentally responsible construction practices, enhancing the marketability and value of housing projects.

Procurement strategies should emphasise transparency, communication, and collaboration throughout the project lifecycle to improve stakeholder satisfaction. Early and continuous involvement of all stakeholders, including clients, contractors, and end-users, is crucial for aligning expectations and ensuring the project meets its objectives. It is recommended that procurement processes include regular stakeholder meetings, clear communication channels, and mechanisms for resolving conflicts efficiently. Procurement strategies can enhance stakeholder trust and cooperation by fostering a collaborative environment, leading to more successful project outcomes.

Finally, policymakers and regulatory bodies should consider reforming procurement policies to support innovation and best practices in the housing projects sector. This includes updating regulations to reflect the latest advancements in digital technology and sustainability and providing incentives for adopting integrated procurement approaches. By creating an enabling environment through supportive policies, governments can help drive industry-wide improvements in procurement practices.

VI. CONCLUSION

The study of procurement strategies in housing projects reveals their critical influence on the success of construction projects, particularly regarding cost efficiency, timeliness, quality, sustainability, and stakeholder satisfaction. As the housing sector faces increasing demands for more complex, sustainable, and timely project delivery, selecting and implementing appropriate procurement strategies have never been more vital.

This review has highlighted the strengths and limitations of various procurement approaches, emphasising the benefits of integrated strategies such as Design-Build (DB) and Integrated Project Delivery (IPD). These approaches significantly enhance project outcomes by fostering early collaboration, reducing the risk of cost overruns, and ensuring

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timely completion. Adopting digital technologies, particularly Building Information Modelling (BIM), further strengthens these strategies by improving accuracy, communication, and decision-making throughout the project lifecycle.

Sustainability has emerged as a central concern in modern procurement, with a clear need for strategies prioritising environmentally responsible practices. Sustainable procurement meets the growing regulatory and client demands for green construction and contributes to long-term cost savings and improved building performance. Moreover, stakeholder satisfaction is intricately linked to procurement practices, emphasising transparency, collaboration, and continuous engagement, ensuring that all parties are aligned and committed to the project's success.

In conclusion, the future of housing projects depends on the industry's ability to adapt and optimise procurement strategies to meet evolving challenges. The housing sector can achieve more efficient, high-quality, and sustainable outcomes by focusing on integrated approaches, leveraging technology, prioritising sustainability, and enhancing stakeholder collaboration. These strategies will address current demands and position the industry to respond effectively to future developments and opportunities.

REFERENCES

[1]. Cohen, M. (2020). New Conceptions of Sufficient Home Size in High-Income Countries: Are We Approaching a Sustainable Consumption Transition? Housing, Theory and Society, 38, 173 - 203. https://doi.org/10.1080/14036096.2020.1722218.

[2]. Ajayi, S., Oyedele, L., Akinadé, O., Bilal, M., Alaka, H., & Owolabi, H. (2017). Optimising material procurement for construction waste minimization: An exploration of success factors. Sustainable Materials and Technologies, 11, 38-46. https://doi.org/10.1016/J.SUSMAT.2017.01.001.

[3]. Mydin, A., Jalil, A., Jaafar, M., & Nuruddin, A. (2017). The Application of Procurement Systems in IBS Housing Project. International Journal of Supply Chain Management, 6, 299-307. https://core.ac.uk/download/pdf/230741836.pdf

[4]. Mosley, J., & Bubshait, A. (2019). Investigative study of project procurement methods and project performance indicators in Saudi Arabia. International Journal of Construction Management, 21, 845 - 857. https://doi.org/10.1080/15623599.2019.1588842.

[5]. Plane, C., & Green, A. (2012). Buyer-supplier collaboration: the aim of FM procurement? Facilities, 30, 152-163. https://doi.org/10.1108/02632771211202851.

[6]. Mosley, J., & Bubshait, A. (2019). Investigative study of project procurement methods and project performance indicators in Saudi Arabia. International Journal of Construction Management, 21, 845 - 857. https://doi.org/10.1080/15623599.2019.1588842.

[7]. Calahorra-Jimenez, M., Alarcón, L., Torres-Machí, C., Chamorro, A., & Molenaar, K. (2020). Improving cost performance in design-bid-build road projects by mapping the reasons for cost overruns into the project phases. Revista De La Construccion, 19, 334-345. https://doi.org/10.7764/rdlc.19.2.334-345.

[8]. Mesa, H., Molenaar, K., & Alarcón, L. (2016). Exploring performance of the integrated project delivery process on complex building projects. International Journal of Project Management, 34, 1089-1101. https://doi.org/10.1016/J.IJPROMAN.2016.05.007.

[9]. Tran, D., Nguyen, L., & Faught, A. (2017). Examination of communication processes in design-build project delivery in building construction. Engineering, Construction and Architectural Management, 24, 1319-1336. https://doi.org/10.1108/ECAM-12-2015-0192.

[10]. Anas, M., S., & Nisar, Z. (2017). Flexible Architecture: Optimization of Technology and Creativity. International journal of engineering and technology, 9, 510-520. https://doi.org/10.21817/IJET/2017/V9I3/170903S078.

[11]. Zhang, H., Wey, W., & Chen, S. (2017). Demand-Oriented Design Strategies for Low Environmental Impact Housing in the Tropics. Sustainability, 9, 1614. https://doi.org/10.3390/SU9091614.

[12]. Lucchi, E., & Delera, A. C. (2020). Enhancing the historic public social housing through a user-centered design-driven approach. Buildings, 10(9), 159. https://doi.org/10.3390/buildings10090159.

[13]. Nikezić, A., Trajković, J., & Milovanović, A. (2021). Future Housing Identities: Designing in Line with the Contemporary Sustainable Urban Lifestyle. Buildings, 11, 18. https://doi.org/10.3390/buildings11010018.

[14]. Alberdi, G., & Begiristain-Zubillaga, M. (2021). Identifying a sustainable food procurement strategy in healthcare systems: A scoping review. Sustainability, 13(4), 2398. https://doi.org/10.3390/SU13042398.

[15]. Sijakovic, M., & Peric, A. (2021). Sustainable architectural design: towards climate change mitigation. Archnet-IJAR: International Journal of Architectural Research, 15(2), 385-400. https://doi.org/10.1108/arch-05-2020-0097.

[16]. Roufechaei, K., Bakar, A., & Tabassi, A. (2014). Energy-efficient design for sustainable housing development. Journal of Cleaner Production, 65, 380-388. https://doi.org/10.1016/J.JCLEPRO.2013.09.015.

[17]. Cheng, L., Bae, Y., & Horton, W. T. (2019). A system-level approach for designing multi-family sustainable and energy-efficient housing communities. Sustainable Cities and Society, 44, 183-194. https://doi.org/10.1016/J.SCS.2018.09.017.

[18]. Nassar, R., Sediadi, E., & Elmenghawi, F. (2021). Sustainable, Energy Efficient and Economical Design of Single-Family Dwellings. Civil Engineering and Architecture, 9(4), 1048 - 1056. https://doi.org/10.13189/CEA.2021.090407.

[19]. Osipova, E., & Eriksson, P. (2011). How procurement options influence risk management in construction projects. Construction Management and Economics, 29, 1149 - 1158. https://doi.org/10.1080/01446193.2011.639379.

[20]. Wankmüller, C., & Reiner, G. (2021). Identifying Challenges and Improvement Approaches for More Efficient Procurement Coordination in Relief Supply Chains. Sustainability. 13(4), 2204. https://doi.org/10.3390/SU13042204.

[21]. Love, P. E., Edwards, D. J., & Irani, Z. (2011). Moving beyond optimism bias and strategic misrepresentation: An explanation for social infrastructure project cost overruns. IEEE transactions on engineering management, 59(4), 560-571. https://doi.org/10.1109/TEM.2011.2163628

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP218

[22]. Lind, H., & Brunes, F. (2014). Explaining cost overruns in infrastructure projects: a new framework with applications to Sweden. Construction Management and Economics, 33, 554 - 568. https://doi.org/10.1080/01446193.2015.1064983.

[23]. Mohammadhasanzadeh, S., Hosseinalipour, M., & Hafezi, M. (2014). Collaborative Procurement in Construction Projects Performance Measures, Case Study: Partnering in Iranian Construction Industry. Procedia - Social and Behavioral Sciences, 119, 811-818. https://doi.org/10.1016/J.SBSPRO.2014.03.091.

[24]. Kent, D., & Becerik-Gerber, B. (2010). Understanding Construction Industry Experience and Attitudes toward Integrated Project Delivery. Journal of Construction Engineering and Management-asce, 136, 815-825. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000188.

[25]. Trach, R., Połoński, M., & Hrytsiuk, P. (2019). Modelling of Efficiency Evaluation of Traditional Project Delivery Methods and Integrated Project Delivery (IPD). IOP Conference Series: Materials Science and Engineering, 471(11), 12043. https://doi.org/10.1088/1757-899X/471/11/112043.

[26]. Wang, K., Wang, W., Wang, H., Hsu, P., Wu, W., & Kung, C. (2016). Applying building information modeling to integrate schedule and cost for establishing construction progress curves. Automation in Construction, 72, 397-410. https://doi.org/10.1016/J.AUTCON.2016.10.005.

[27]. Azhar, S. (2011). Building Information Modeling (BIM): Trends, Benefits, Risks, and Challenges for the AEC Industry. Leadership and Management in Engineering, 11, 241-252. https://doi.org/10.1061/(ASCE)LM.1943-5630.0000127.

[28]. Meehan, J., & Bryde, D. (2011). Sustainable procurement practice. Business Strategy and The Environment, 20, 94-106. https://doi.org/10.1002/BSE.678.

[29]. Alwan, Z., Jones, P., & Holgate, P. (2017). Strategic sustainable development in the UK construction industry, through the framework for strategic sustainable development, using Building Information Modelling. Journal of Cleaner Production, 140, 349-358. https://doi.org/10.1016/J.JCLEPRO.2015.12.085.

[30]. Gluch, P., & Räisänen, C. (2012). What tensions obstruct an alignment between project and environmental management practices. Engineering, Construction and Architectural Management, 19, 127-140. https://doi.org/10.1108/09699981211206070.

[31]. Khahro, S. H., Memon, A. H., Memon, N. A., Arsal, A., & Ali, T. H. (2021). Modeling the factors enhancing the implementation of green procurement in the Pakistani construction industry. Sustainability, 13(13), 7248. Sustainability. https://doi.org/10.3390/su13137248.

[32]. Shvydenko, N., Axenov, A., Vinogradova, E., & Seferyan, L. (2020). Public-private partnership as a housing development tool. IOP Conference Series: Materials Science and Engineering, 913. https://doi.org/10.1088/1757-899X/913/5/052021.

[33]. Kraak, V., Harrigan, P., Lawrence, M., Harrison, P., Jackson, M., & Swinburn, B. (2011). Balancing the benefits and risks of public–private partnerships to address the global double burden of malnutrition. Public Health Nutrition, 15, 503 - 517. https://doi.org/10.1017/S1368980011002060.

[34]. Jayasuriya, S., Zhang, G., & Yang, R. (2019). Challenges in public private partnerships in construction industry. Built Environment Project and Asset Management. 9(2), 172-185. https://doi.org/10.1108/BEPAM-01-2018-0024.

[35]. Tang, Z., Ng, S., & Skitmore, M. (2019). Influence of procurement systems to the success of sustainable buildings. Journal of Cleaner Production, 218, 1007-1030. https://doi.org/10.1016/J.JCLEPRO.2019.01.213.

[36]. Ramsey, D., Asmar, M., & Gibson, G. (2014). Assessing the Performance of Two-Step Design-Build Procurement, 1369-1378. https://doi.org/10.1061/9780784413517.140.

[37]. Pishdad-Bozorgi, P., Garza, J., & Blvd, W. (2012). Comparative Analysis of Design-Bid-Build and Design-Build from the Standpoint of Claims., 21-30. https://doi.org/10.1061/9780784412329.003.

[38]. Park, H., Lee, D., Kim, S., & Kim, J. (2015). Comparing Project Performance of Design-Build and Design-Bid-Build Methods for Large-sized Public Apartment Housing Projects in Korea. Journal of Asian Architecture and Building Engineering, 14, 323 - 330. https://doi.org/10.3130/jaabe.14.323.

[39]. Park, J., & Kwak, Y. (2017). Design-Bid-Build (DBB) vs. Design-Build (DB) in the U.S. public transportation projects: The choice and consequences. International Journal of Project Management, 35, 280-295. https://doi.org/10.1016/J.IJPROMAN.2016.10.013.

[40]. Goftar, V., Asmar, M., & Bingham, E. (2014). A Meta-Analysis of Literature Comparing Project Performance between Design-Build (DB) and Design-Bid-Build (DBB) Delivery Systems., 1389-1398. https://doi.org/10.1061/9780784413517.142.

[41]. Ling, F., & Leong, E. (2012). Performance of Design-Build Projects in terms of Cost, Quality and Time: Views of Clients, Architects and Contractors in Singapore. Australasian Journal of Construction Economics and Building, 2, 37-46. https://doi.org/10.5130/AJCEB.V2I1.2885.

[42]. Shane, J., & Gransberg, D. (2010). A Critical Analysis of Innovations in Construction Manager-at-Risk Project Delivery., 827-836. https://doi.org/10.1061/41109(373)83.

[43]. Francom, T., Asmar, M., & Ariaratnam, S. (2016). Performance Analysis of Construction Manager at Risk on Pipeline Engineering and Construction Projects. Journal of Management in Engineering, 32, 04016016. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000456.

[44]. Informatics, 17, 746-756. https://doi.org/10.1109/TII.2020.3002197.

[45]. Xia, N., Zou, P. X., Griffin, M. A., Wang, X., & Zhong, R. (2018). Towards integrating construction risk management and stakeholder management: A systematic literature review and future research agendas. International journal of project management, 36(5), 701-715. https://doi.org/10.1016/J.IJPROMAN.2018.03.006.

[46]. Zhang, X., & Chen, S. (2013). A systematic framework for infrastructure development through public private partnerships. Iatss Research, 36, 88-97. https://doi.org/10.1016/J.IATSSR.2012.11.001.

[47]. Piroozfar, P., Farr, E. R., Zadeh, A. H., Inacio, S. T., Kilgallon, S., & Jin, R. (2019). Facilitating building information modelling (BIM) using integrated project delivery (IPD): A UK perspective. Journal of Building Engineering, 26, 100907. https://doi.org/10.1016/J.JOBE.2019.100907.

[48]. Pishdad-Bozorgi, P., & Beliveau, Y. (2016). Symbiotic Relationships between Integrated Project Delivery (IPD) and Trust. International Journal of Construction Education and Research, 12, 179 - 192. https://doi.org/10.1080/15578771.2015.1118170.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP218

[49]. Rahman, I., Memon, A., & Karim, A. (2012). Relationship between factors of construction resources affecting project cost. Mathematical Models and Methods in Applied Sciences, 7, 67. https://doi.org/10.5539/MAS.V7N1P67.

[50]. Nahyan, M., Sohal, A., Hawas, Y., & Fildes, B. (2019). Communication, coordination, decision-making and knowledge-sharing: a case study in construction management. J. Knowl. Manag., 23, 1764-1781. https://doi.org/10.1108/JKM-08-2018-0503.

[51]. Galli, B. (2020). How to Effectively Manage Communication on Project Teams. IEEE Engineering Management Review, 48, 21-23. https://doi.org/10.1109/emr.2020.2971668.

[52]. Mohammadi, S., & Birgonul, M. (2016). Preventing claims in green construction projects through investigating the components of contractual and legal risks. Journal of Cleaner Production, 139, 1078-1084. https://doi.org/10.1016/J.JCLEPRO.2016.08.153.

[53]. Li, J., Greenwood, D., & Kassem, M. (2019). Blockchain in the built environment and construction industry: A systematic review, conceptual models and practical use cases. Automation in construction, 102, 288-307. https://doi.org/10.1016/J.AUTCON.2019.02.005.

[54]. Belova, N., Vorona-Slivinskaya, L., & Voskresenskaya, E. (2019). The Current State and Development Prospects of Self-Regulation in the Russian Construction Industry. Economics and Management. https://doi.org/10.35854/1998-1627-2019-7-49-55.

[55]. Dixit, V. (2020). Risk assessment of different sourcing contract scenarios in project procurement. International Journal of Construction Management, 22, 1537 - 1549. https://doi.org/10.1080/15623599.2020.1728610.

[56]. Ghadimi, P., Azadnia, A., Heavey, C., Dolgui, A., & Can, B. (2016). A review on the buyer–supplier dyad relationships in sustainable procurement context: past, present and future. International Journal of Production Research, 54, 1443 - 1462. https://doi.org/10.1080/00207543.2015.1079341.

[57]. Pan, Y., & Zhang, L. (2021). Roles of artificial intelligence in construction engineering and management: A critical review and future trends. Automation in Construction, 122, 103517. https://doi.org/10.1016/j.autcon.2020.103517.

[58]. Oesterreich, T., & Teuteberg, F. (2016). Understanding the implications of digitisation and automation in the context of Industry 4.0: A triangulation approach and elements of a research agenda for the construction industry. Comput. Ind., 83, 121-139. https://doi.org/10.1016/j.compind.2016.09.006.

[59]. Alaloul, W., Liew, M., Zawawi, N., & Kennedy, I. (2020). Industrial Revolution 4.0 in the construction industry: Challenges and opportunities for stakeholders. Ain Shams Engineering Journal, 11, 225-230. https://doi.org/10.1016/j.asej.2019.08.010.

[60]. Turner, C., Oyekan, J., Stergioulas, L., & Griffin, D. (2021). Utilizing Industry 4.0 on the Construction Site: Challenges and Opportunities. IEEE Transactions on Industrial Informatics, 17, 746-756. https://doi.org/10.1109/TII.2020.3002197.

[61]. Ebrahimi, G., & Dowlatabadi, H. (2018). Perceived Challenges in Implementing Integrated Project Delivery (IPD): Insights from Stakeholders in the U.S. and Canada for a Path Forward. International Journal of Construction Education and Research, 15, 291 - 314. https://doi.org/10.1080/15578771.2018.1525446.

[62]. Santos, R., Costa, A., Silvestre, J., & Pyl, L. (2019). Informetric analysis and review of literature on the role of BIM in sustainable construction. Automation in Construction. https://doi.org/10.1016/J.AUTCON.2019.02.022.

[63]. Manzoor, B., Othman, I., Gardezi, S., & Harirchian, E. (2021). Strategies for Adopting Building Information Modeling (BIM) in Sustainable Building Projects—A Case of Malaysia. Buildings, 11, 249. https://doi.org/10.3390/BUILDINGS11060249.

[64]. Laryea, S. (2019). Procurement strategy and outcomes of a new universities project in South Africa. Engineering, Construction and Architectural Management, 26(9), 2060-2083. https://doi.org/10.1108/ECAM-04-2018-0154.

[65]. Govender, K., Nyagwachi, J., Smallwood, J., & Allen, C. (2018). The awareness of integrated project delivery and building information modelling - facilitating construction projects. International Journal of Sustainable Development and Planning, 13, 121-129. https://doi.org/10.2495/SDP-V13-N1-121-129.

[66]. Naoum, S., & Egbu, C. (2016). Modern selection criteria for procurement methods in construction. International Journal of Managing Projects in Business, 9, 309-336. https://doi.org/10.1108/IJMPB-09-2015-0094.

[67]. Cheaitou, A., Larbi, R., & Housani, B. (2019). Decision making framework for tender evaluation and contractor selection in public organizations with risk considerations. Socio-economic Planning Sciences, 68, 100620. https://doi.org/10.1016/J.SEPS.2018.02.007.

[68]. Lefebvre, F., & McAuley, B. (2019). An investigation into current procurement strategies that promote collaboration through early contractor involvement with regards to their suitability for Irish public work projects. Proceedings of the 4th CitA BIM Gathering, Galway, Ireland, September 26, 209-221. https://doi.org/10.21427/RCK5-E450.

[69]. Elghaish, F., Hosseini, M., Talebi, S., Abrishami, S., Martek, I., & Kagioglou, M. (2020). Factors Driving Success of Cost Management Practices in Integrated Project Delivery (IPD). Sustainability, 12, 9539. https://doi.org/10.3390/su12229539.

[70]. Purnuș, A., & Bodea, C. (2015). Financial Management of the Construction Projects: A Proposed Cash Flow Analysis Model at Project Portfolio Level. Organization, technology and management in construction: An international journal, 7, 1217-1227. https://doi.org/10.5592/OTMCJ.2015.1.6.

[71]. Choi, H., Son, H., & Kim, C. (2018). Predicting financial distress of contractors in the construction industry using ensemble learning. Expert Syst. Appl., 110, 1-10. https://doi.org/10.1016/J.ESWA.2018.05.026.