

# Integrated Decision-Making in Aec-Em: Mechanisms, Pathways, And Value Enhancement

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**Abstract.** The architecture, engineering, construction, and economic management (AEC-EM) sectors are to incorporate integrated decision-making (IDM) for project value enhancement (PVE). In this paper, it is conducted with the view of consolidating research on the mechanisms and pathways through which IDM achieves PVE. The study builds a theoretical basis for core IDM and PVE concepts from system integration, value engineering, and stakeholder theory. Among other factors, the paper identified key mechanisms contributing to the effect: reduced information asymmetry, lower coordination costs, optimized design and construction, and general performance of the project in resources utilization. Among others, the primary pathways of implementing IDM are discussed: integrated project delivery (IPD), building information modeling (BIM), early contractor involvement (ECI) and relational contracting. Another novelty of the review is the consideration of multi-dimensional project value assessment above traditional metrics. Research focus of the current studies is also unveiled: digitalization and sustainability. Lastly, it indicates the research voids, like the measure of intangible value and the socio-technical IDM, suggesting the directions of future studies to bridge the theory-practice divide and foster more value creation in AEC-EM projects

**Keywords:** Integrated Decision-Making (IDM); Project Value Enhancement (PVE); AEC-EM Integration; Building Information Modeling (BIM); Integrated Project Delivery (IPD).

## 1. Introduction

The need for escalating complexity heightened by the technological intensity of modern architecture, engineering, construction, and economic management (AEC-EM) projects results in diverse stakeholder landscapes while responding to pressing demands for sustainability and efficiency [1]. Therefore, alternative project delivery models that foster creativity and collaboration among the fragmented and isolated stakeholders in the industry are necessary. The challenges of the AEC-EM industry can thus better be ameliorated by embracing change and encouraging innovation and collaboration among the various stakeholders. This should be systematic throughout the project lifecycle, from architectural design to engineering disciplines and economic management [2]. The shift in the planning and design of facilities from a static consideration of design and construction as separate and discrete undertakings to a dynamic consideration of these activities as an integrated system is of great importance. This paradigm shift is essential for the modern built environment, with its ever-increasing complexity and changing value propositions.

The “project value” has expanded itself well past the traditional “iron triangle” of cost, time, and quality [3]. Therefore, in an integrated context with interests from diverse stakeholders, project value enhancement (PVE) embraces a multi-dimensional view. This comprises economic benefits (cost saving, return on investment, (ROI)), timely delivery, and quality service, as well as sustainability (in environmental, social, and economic terms), innovation and client satisfaction, and meeting ever-widening stakeholder expectations [4]. The objective of PVE is to maximize the holistic lifecycle value of a project for owners, end-users, and the community at large. Such a broadened definition is fundamentally related to integrated methodologies since comprehensive decision-making processes would naturally account for a broadened set of value considerations.

The link between integrated decision-making (IDM) and project value improvement is an area of focus by scholars and practitioners, where studies are conducted to examine its principles, practices, and supportive technologies [5]. This article attempts to aggregate existing knowledge comprising the mechanisms and pathways by which IDM results in AEC-EM for PVE. It intends to bring together

key conceptual underpinnings, relevant theories, and empirical evidence, spot current under-researched areas, and suggest future research directions that can help develop this subject for scholarly and professional activities.

## **2. Core Concepts and Theoretical Foundations**

### **2.1. Defining IDM in AEC-EM**

IDM in AEC-EM is the collaborative process of different project disciplines that create and implement decisions across the lifecycle of the project [6]. This serves to break down the traditional professional silos and linear workflows by encouraging a synchronized collaboration of knowledge and expertise from different domains and phases of the project. The scope of IDM covers organizational structures, information systems, commercial frameworks, and operational practices where the interdependency of decisions can be realized at every level. The importance of IDM impact is realized in the early stages of the project as timely integrated decisions can pre-empt substantial downstream costs and erosion of value.

### **2.2. Defining PVE**

PVE in the AEC-EM sector means enhancing the overall worth of a project by improving its cost, quality, and performance and other sought outcomes for all stakeholders [7]. This requires the fulfillment of necessary project functions at the lowest feasible whole-life cycle cost. A dimension of the project value is very financial-metric; it normally means economic benefits such as savings, profitability, and ROI, and optimized life-cycle costs. It also relates to time and schedule performance, with the core element being on-time delivery and the active management of delays. Further critical components are quality performance that complies with the standard, structural durability, and functional and aesthetic results. In addition, the consideration of the environment, resource efficiency, social sensitivity, and the long-term economic feasibility of the project form sustainability as a whole [8]. PVE includes creativity by putting in place new technologies that work, how processes are improved, or using new materials, putting first the satisfaction of the customer and all others involved by meeting and going beyond what they expect. More parts that make the project valuable can be safety, how much it lowers risks, and how well the general operation works. The main goal of PVE is to increase value for the project's buyers or users. This means looking at the building's whole life in a complete way.

### **2.3. Key Theoretical Foundations**

The capacity of IDM to drive PVE is underpinned by several key theories that provide conceptual frameworks and analytical tools. Projects are viewed under the system integration theory (SIT) as complex wholes of interacting subsystems such as design, construction, and economic management; integration is supposed to result in a synergistic performance making the whole greater than the sum of its parts [9]. This theory further guides the amalgamation of processes, technologies, and teams for improved efficiency [10]. The other foundational theory is value engineering (VE), a systematic, function-oriented methodology focused on achieving necessary functions at the lowest life-cycle cost [11], often expressed as  $V=F/C$ , thereby enhancing value; IDM can facilitate VE through providing a platform for early and multidisciplinary creativeness and value-based solutions. The success of a project, according to stakeholder theory (ST), is leveraged on meeting a sustainable equilibrium of the interests of every concerned party—client, employee, and community, not just shareholder [12]. Because IDM by nature integrates a plurality of stakeholders, the theory efficiently molds relationship management while encouraging a more holistic approach to value creation. The underpinning of project management theory (PMT) also forms a part of the basis, as it plans, organizes, executes, and controls projects [13]. IDM extends the management theory by considering it an advanced application and requires very intensive integration across all knowledge areas and phases of a project to surmount the conventional constraints. Transaction cost theory (TCT), finally, brings the nature of the theory

of the costs involved in all forms of economic exchange through contracting and monitoring [14]. IDM approaches, such as integrated project delivery (IPD), are considered governance innovations that, by synthesizing trust and coordination, diminish these transaction costs in complex projects and thereby enhance the value of the project directly [15]. These theories are not isolated but are very much connected, together giving strong theoretical support for IDM-driven PVE, and the evolution toward multi-dimensional project value itself shows the deepening application of systemic and stakeholder-oriented views in project management.

### **3. Intrinsic Mechanisms of IDM's Impact on Project Value**

IDM enhances project value through several interrelated mechanisms that optimize processes, improve interactions, and boost resource efficiency.

#### **3.1. Reducing Information Asymmetry**

Conventional projects are typically plagued by a lack of information transparency, which effectively means that the involved parties have unequal levels of information, thus often resulting in misunderstandings, bad decisions, and even opportunistic behavior [16]. IDM creates avenues for the transparency and timeliness of shared information through collaborative workflows and, for example, building information modeling (BIM) and common data environments (CDEs) which would reduce errors and disputes and lead to building trust for better-aligned problem-solving - the very definition of value - by increasing decision quality and lessening rework [17].

#### **3.2. Lowering Coordination Costs**

Without integration there would be high coordination cost emanating from misaligned objective plans, poor communication, and disjointed workflows [18]. The IDM involves the key participants with early interaction and continuous interface, streamlines workflows and communications. Centralized information about platforms like BIM reduces manual coordination as well as errors, leading to fewer delays and reduced administrative overhead and improved overall efficiency [19].

#### **3.3. Optimizing Design and Construction Processes**

Designs may have constructability or economic viability issues under linear project flows and expensive changes during the construction phase. The IDM encourages the practice of early contractor involvement (ECI) and similar practices so that construction expertise is integral to the design phase early on [20]. This includes constructability reviews, value engineering, and pre-construction design optimization, often supported by BIM and AI for simulation and analysis—leading to more buildable designs, fewer changes, reduced costs, and improved quality.

#### **3.4. Enhancing Resource Utilization Efficiency**

The major source of waste and delays is inefficient use of resources (personnel, materials, equipment, funds). IDM, along with BIM and advanced scheduling software, supports an enterprise plan with real-time tracking and dynamic resource allocation. Need forecasting and optimization on a continuously available data-driven decision support reduces idle time, material waste, costs, and improves productivity — thus, sustainability goals as well [21].

#### **3.5. Improving Overall Project Performance and Outcomes**

IDM leads to comprehensive improvements in overall project performance through the synergistic effect of the above mechanisms. Better outcomes in cost, schedule, quality, safety, and stakeholder satisfaction come with reduced disputes. It is a direct consequence of effectively integrating the project facets and stakeholder contributions. Holistic improvement can be undertaken by almost every involved firm if clear contractual obligations favoring proactive management get established and followed by all parties throughout the project life [22]. These mechanisms are interdependent and

mutually reinforcing, driven by a foundational shift to collaborative work and trust, enabled by technology but fundamentally human-centric.

#### **4. Pathways and Methods for Implementing IDM**

Several project deliveries models, technological tools, and organizational approaches facilitate IDM. These include IPD, the application of BIM as an integration technology, the use of cross-professional collaboration platforms (CPCP), ECI, and various relational approaches. Each of these pathways offers distinct advantages and faces particular challenges in promoting integration and value. A comparative summary of these key integrated decision-making pathways and methods is presented in Table 1, which outlines their core principles, primary advantages and disadvantages, typical contractual forms, and main levers for value enhancement.

##### **4.1. IPD**

IPD is a method that joins people, systems, business ways, and habits into a team effort to reach goals and get the most value [23]. Basic ideas include respect, sharing risks and gains, getting important people on board at the start, and usually having more than one group involved. IPD spurs new ideas, cuts waste, and lines up money goals, but it often means a big early spending on building the team and changing old ways.

##### **4.2. BIM as an Integration Technology**

BIM offers a digital view of a building's features, acting as a known information source for all its time [24]. Its skills in 3D show, spotting problems, 4D/5D use, and info links help much more with working together, rightness, and choices. Problems include setup prices, working with other systems, and not wanting to change, but its worth in cutting down mistakes and bettering control is mostly agreed upon.

##### **4.3. CPCP**

CPCP web-powered digital tools offer instant talk, file share, and group work help for different project teams, sometimes linked with BIM [25]. It helps work together, makes things faster, and makes work better though their success needs many people using it and watching data closely.

##### **4.4. ECI**

ECI should require that contractors be brought in at the early design stages so that their construction expertise helps in optimizing design, constructability, and risk management [26]. This should be a collaborative approach that can lead to cost savings, schedule reductions, and improved quality, but however, requires careful management of conflicts and compensation for early input.

##### **4.5. Relational Approaches**

Relational approaches mean that there is an emphasis on building strong, trustworthy inter-organizational relationships with a view to creating an integrative environment [27]. One such approach is that of partnering, which involves two or more organizations committing themselves to sharing common business objectives by maximizing the effectiveness of the resources of each participant; it focuses strongly on shared objectives and resources, and open communication, usually introduced by a 'partnering charter' in addition to the traditional contracts [28]. Another significant type of relationship is alliance contracting (AC), which is a collaborative form of contract in which all the key players in a project (owner, designer, and contractor) join in sharing the risks and opportunities in the project, and operate as an integrated management team with common interests between their commercial considerations and the ultimate outcomes of the project [29]; alliances usually advocate a corporate 'no-blame' culture and open-book financial arrangements. A third significant relational approach is the joint venture (JV), where two or more independent companies

form a temporary legal entity or partnership to undertake a specific project, sharing resources, risks, and profits [30]; this model is particularly suitable for large, complex endeavors requiring a broad range of expertise and substantial resource pooling.

These pathways, as detailed in Table 1, are not mutually exclusive and can be adapted to project needs. While technology like BIM is the crucial enabler, the success of those approaches depends on collaborative mindset, trust, and aligned incentives.

**Table 1.** Comparison of Key Integrated Decision-Making Pathways and Methods.

Feature/Pathway	Integrated Project Delivery (IPD)	BIM as an Integration Technology	Cross-Professional Collaboration Platforms (CPCP)	Early Contractor Involvement (ECI)	Relational Approaches (Partnering/Alliance/JV)
<b>Core Principles/Characteristics</b>	Multi-party contract, risk/reward sharing, early involvement, collaborative innovation, lean principles	Digital model, information sharing, lifecycle data integration, visualization, parametric design	Cloud-based, real-time collaboration, centralized data management, task & process automation	Introducing construction expertise in design, focus on constructability & cost optimization	<b>Partnering:</b> Trust, common goals, open communication. <b>Alliance:</b> Risk/opportunity sharing, no-blame culture, integrated team. <b>JV:</b> Resource sharing, risk sharing.
<b>Main Advantages</b>	Enhanced efficiency, reduced waste & changes, optimized cost & schedule, innovation, improved communication	Improved design quality & accuracy, reduced errors & rework, enhanced collaboration, supports sustainability analysis	Improved team communication & collaboration efficiency, streamlined processes, real-time information sharing	Enhanced design constructability, optimized cost estimation, reduced construction changes, shorter schedule	<b>Partnering/Alliance:</b> Reduced conflict, improved relationships, joint problem-solving, risk sharing. <b>JV:</b> Pooled resources & expertise, capacity for large/complex projects.
<b>Main Disadvantages/Challenges</b>	High upfront investment, requires cultural change & high trust, deep owner involvement, complex contracts	High implementation cost, learning curve, standardization & interoperability, data security & ownership	Relies on universal adoption, information overload risk, security & integration issues	Potential conflicts of interest, may limit competition, determining early contractor compensation	<b>Partnering/Alliance:</b> Relies on sustained trust & commitment, goals may diverge. <b>JV:</b> Potential partner conflicts, complex governance.
<b>Typical Contractual Form</b>	Multi-Party Agreement	(Technology, not contract; often combined with IPD, DB contracts)	(Technology platform, not contract; supports collaboration under various contracts)	Can be embedded in various contract models (e.g., DBB+ECI clause, CM@Risk, DB)	<b>Partnering:</b> Partnering Charter. <b>Alliance:</b> Alliance Agreement. <b>JV:</b> Joint Venture Agreement.
<b>Primary Value Enhancement Levers</b>	Cost, time, quality, innovation, risk sharing, collaboration efficiency	Quality, efficiency, cost (via error reduction), visual decision-making, information management	Communication efficiency, coordination costs, information transparency	Constructability, cost, time, quality (via design optimization)	<b>Partnering/Alliance:</b> Risk management, relationship quality, innovation, problem-solving efficiency. <b>JV:</b> Resource integration capacity, risk-sharing capacity.

## 5. Measuring and Evaluating Project Value in an Integrated Context

### 5.1. Multi-Dimensional Value Framework

The traditional 'iron triangle' of cost, time, and quality still provides a baseline reference for assessing any project. The philosophy of IDM, however, requires the consideration of a wide and more balanced scope of dimensions. The framework should include several key aspects. Economic and financial performance are based on the real ROI, actual cost savings, and optimized life cycle costs (LCC) [31]. Other performances include schedule performance (on-time project completion and adherence to the timelines) and quality performance (compliance to the specifications and/or defects and functionality and durability of the completed project). More importantly, however, is sustainability performance, taking into account environmental impacts (i.e., reduction of emissions and resource utilization), social impacts (i.e., occupational health and safety and community benefits), and long-term economic viability. In addition to the value dimensions outlined above, innovation performance and satisfaction of the client and other key stakeholders add another layer of value [32]. Effective team performance is another significant contribution to the holistic value of the project, including the efficiency of collaboration and the overall team morale and success of the risk mitigation strategy [33]. The underpinning dimensions are viewed with varying degrees of importance by different stakeholder groups. This highlights the need for a balanced and flexible assessment approach. Table 2 illustrates these value dimensions together with common key performance indicators (KPIs) and assessment methodologies.

### 5.2. Project Value Assessment Methods

As outlined in Table 2, different methods used to assess these values include earned schedule management (ESM) as a traditional method that integrates earned value with schedule performance [34]. VE compares function with cost. This is in addition to life cycle cost analysis (LCCA) that was already mentioned in the text which compares project costs over its objective lifecycle [31]. More other extended methodologies comprise the analytical hierarchy process (AHP) for value dimension weighting [35], and the entropy weight method (EWM) for objective weighting [36] among others. Even further, the concept of the balanced scorecard was a further means of applying an integrated approach to project assessment [37]. Assessment frameworks of sustainability such as leadership in energy and environmental design (LEED) [38], building research establishment environmental assessment method (BREEAM) [39] can provide detailed measures on environmental and social performances. Results of one study detail how the utilization of model data can greatly simplify the assessment of added benefits brought about by value systems, mostly on error reduction and enhanced coordination. The value of perceived results is further detailed through quality research and stakeholder interviews. A big part of it is putting into numbers the values that can't be touched, like improved teamwork or the ability to innovate, and bringing together different views to make a complete assessment. Technology, especially BIM and data analytics, is very important for getting the information needed for these full checks.

**Table 2.** Multi-Dimensional Project Value Framework, Indicators, and Assessment Methods.

<b>Value Dimension</b>	<b>Key Performance Indicators (KPIs) / Specific Metrics</b>	<b>Common Assessment Methods/Tools</b>
<b>Economic/Financial Performance</b>	ROI, cost savings, profit margin, LCC, cost performance index (CPI), cost variance (CV), net cash flow,	earned value management (EVM), LCCA, financial statement analysis, economic benefit evaluation models
<b>Schedule Performance</b>	On-time completion rate, Schedule Variance (SV), schedule performance index (SPI), key milestone achievement	EVM, critical path method (CPM), project schedule review
<b>Quality Performance</b>	Specification compliance, defect density, rework rate, functional satisfaction, durability, non-conformance reports (NCR) count	Quality audits, NCR analysis, client/user acceptance testing, expert review
<b>Sustainability - Environmental</b>	Energy/water consumption intensity, material recycling rate, carbon emissions, waste generation	environmental impact assessment (EIA), life cycle assessment (LCA), green building rating systems (LEED, BREEAM)
<b>Sustainability - Social</b>	lost time injury (LTI) rate, employee satisfaction, community complaint rate, public participation	Safety audits, employee/community surveys, social impact assessment (SIA)
<b>Innovation Performance</b>	New tech/process adoption, patent applications, innovation solution contribution, R&D input-output ratio	Innovation audits, expert assessment, case studies, innovation output statistics
<b>Client/Stakeholder Satisfaction</b>	Client satisfaction score (CSS), net promoter score (NPS), repeat business rate, complaint resolution	Client surveys, focus group interviews, after-sales service record analysis
<b>Team Collaboration &amp; Comm. Perf.</b>	Team member satisfaction, communication effectiveness, conflict resolution efficiency, knowledge sharing	Team surveys, network analysis, meeting efficiency assessment
<b>Risk Reduction Performance</b>	Risk mitigation effectiveness, unforeseen risk occurrence, risk response cost-benefit	Risk register review, risk audits, scenario analysis

## 6. Current Research Landscape, Hotspots, and Frontiers

Work on IDM and PVE is vibrant and increasingly embraces emerging collaborative delivery approaches like IPD, BIM, and ECI as essential enablers of the removal of hitherto sacrosanct project boundaries. A smaller, but increasing, body of work reflects the growing synergies between IPD and BIM, establishing a robust method for assessing benefits and paying heed to long-sought "soft" factors like trust and collaboration [40]. Sustainability improvement of integrated practice receives heightened research attention.

But there is an “implementation gap” between the theoretical advantages of IDM and its widespread practical adoption, particularly in developing country and small and medium-sized enterprises (SMEs) contexts [41]. There are major directions in current research hotspots and frontier discussions. Another critical area is that of the sustainability and circular economy, which deepens the integration of sustainable development and circular economy concepts into the IDM framework [42]. Such concepts may include, but are not limited to, design for disassembly and material passports [43]. Others include the human factors and organizational change that presumes the enduring consideration of the critical roles of leadership and organizational culture in the post-implementation success of new trust-building mechanism and integrated practice/technology applications [44]. Most interest, besides that which falls on the methodologies of project monitoring in real time, comes under the digital transformation whereby IoT is applied for optimizing design and risk management, and where AI is applied for optimizing design and risk management [45]. And data integration and management present continuous challenges and opportunities, especially in issues of interoperability and making big data analytics valuable for actionable insights to improve decision making in integrated environments [46]. Lastly, contractual innovation is to remain a leading topic, with efforts in improving legal and commercial frameworks for relational contracts like IPD and alliancing, to better manage risks, align interests among stakeholders, and support collaborative execution of projects [47]. These frontiers together indicate a move toward more holistic, data-informed, and human-focused practice and value creation across the architecture, engineering and construction (AEC) industry [48].

## 7. Future Challenges and Potential Innovations

The challenges in the research of and, consequently, the implementation of IDM for PVE lie in the persistent significant gaps that exist, though with some progress. The major of these gaps is in the ability to quantify intangible values, and therefore a more granular insight into mechanisms of value creation for specific IDM practices, and culture resistance and lack of trust within the highly fragmented AEC industry. There is a lag in contractual and legal frameworks behind collaborative ideals, and technological interoperability and costs against the required widespread implementation, especially by SMEs who have not conducted explicit research on scalable IDM. Most of the rest of the research is cross-sectional and, therefore, cannot demonstrate the longitudinal effects that the lack of delivery on promised value has struck.

Future innovative research should focus on developing strong models for quantifying total project value with intangibles included and conducting empirical studies on the socio-technical factors that mediate IDM success. Leadership and team dynamics are examples of such factors, as well as the integration of AI. An in-depth exploration of the dynamic incorporation of economic management principles (beyond cost control) into the processes of IDM demands further research. Further research is required to assess the incorporation of principles of a circular economy in IDM, and further to make IDM frameworks flexible for use in different contexts and particularly to implement it in SMEs. Development of real-time, digital-tool-based, agile, multi-dimensional models for assessing value is a significant opportunity for advancing theory and bridging the gap in practice to move the AEC industry further toward being a value-driven industry.

## 8. Conclusion

IDM explores its core concepts, theoretical underpinnings, operational mechanisms, and implementation pathways for multi-dimensional value addition. In the complex AEC-EM environment, the IDM process serves as an efficient approach to enhance project value delivery. This paper synthesizes the core concepts, theoretical foundations, operational frameworks, and implementation strategies of IDM to achieve value creation beyond traditional metrics. While alternative approaches like IPD, BIM, and ECI have clarified much of the IDM process, challenges

persist in addressing cultural barriers and developing scalable methodologies for value quantification, particularly for SMEs. The study aims to bridge this gap by innovatively examining socio-technical dynamics, advanced digital integration, and economic management, while proposing longitudinal research to establish and disseminate evidence-based IDM principles that drive the AEC industry toward greater efficiency, sustainability, and stakeholder value creation.

## References

- [1] Kamara J. M., Augenbroe G., Anumba C. J., et al. Knowledge management in the architecture, engineering and construction industry. *Construction Innovation*, 2002, 2(1): 53-67.
- [2] Shen W., Hao Q., Mak H., et al. Systems integration and collaboration in architecture, engineering, construction, and facilities management: A review. *Advanced Engineering Informatics*, 2010, 24(2): 196-207.
- [3] Pollack J., Helm J., Adler D. What is the Iron Triangle, and how has it changed. *International Journal of Managing Projects in Business*, 2018, 11(2): 527-547.
- [4] Staniškis J. K., Staniškienė E., Stankevičiūtė Ž., et al. Socio-environmental-economic transformations towards sustainable development. *Transformation of Business Organization Towards Sustainability: Systems Approach*, 2022, 12(3): 81-165.
- [5] Wang W. M., Lee A. H., Peng L. P., et al. An integrated decision making model for district revitalization and regeneration project selection. *Decision Support Systems*, 2013, 54(2): 1092-1103.
- [6] Fewings P., Henjewe C. *Construction project management: An integrated approach*. Routledge, 2019.
- [7] Kelly J., Male S., Graham D. *Value management of construction projects*. John Wiley & Sons, 2014.
- [8] Rosengart A., Granzotto M., Wierer R., et al. The green value engineering methodology: A sustainability-driven project management tool for capital projects in process industry. *Sustainability*, 2023, 15(20): 14827.
- [9] Rajabalinejad M., van Dongen L., Ramtahaling M. Systems integration theory and fundamentals. *Safety and Reliability*, 2020, 39(1): 83-113.
- [10] Rebentisch E., Prusak L. *Integrating program management and systems engineering: Methods, tools, and organizational systems for improving performance*. John Wiley & Sons, 2017.
- [11] Bageis A. An extensive literature review on value engineering/management in the construction industry of Saudi Arabia: Identifying future research directions. *Construction Innovation*, 2022, 12(3): 45-56.
- [12] Uribe D. F., Ortiz-Marcos I., Uruburu Á. What is going on with stakeholder theory in project management literature? A symbiotic relationship for sustainability. *Sustainability*, 2018, 10(4): 1300.
- [13] Igberaese D. A. *Introduction to project management: A source book for traditional PM basics*. Routledge, 2022.
- [14] Cuypers I. R., Hennart J. F., Silverman B. S., et al. Transaction cost theory: Past progress, current challenges, and suggestions for the future. *Academy of Management Annals*, 2021, 15(1): 111-150.
- [15] Pishdad-Bozorgi P. Case studies on the role of integrated project delivery (IPD) approach on the establishment and promotion of trust. *International Journal of Construction Education and Research*, 2017, 13(2): 102-124.
- [16] Bello A., Abdurraheem A. A., Afolabi O. P., et al. Assessing the underlying factors affecting trust and transparency in the construction industry: A mixed method approach. *Construction Economics and Building*, 2024, 24(1-2): 9-28.
- [17] Oliver S. *Integrated facilities management using digital twinning and distributed ledgers*. Teesside University, 2023.
- [18] Bick S., Spohrer K., Hoda R., et al. Coordination challenges in large-scale software development: A case study of planning misalignment in hybrid settings. *IEEE Transactions on Software Engineering*, 2017, 44(10): 932-950.
- [19] Li C. Z., Zhong R. Y., Xue F., et al. Integrating RFID and BIM technologies for mitigating risks and improving schedule performance of prefabricated house construction. *Journal of Cleaner Production*, 2017, 165: 1048-1062.

- [20] Rahmani F., Khalfan M., Maqsood T. A conceptual model for selecting early contractor involvement (ECI) for a project. *Buildings*, 2022, 12(6): 786.
- [21] Rane N. Integrating building information modelling (BIM) and artificial intelligence (AI) for smart construction schedule, cost, quality, and safety management: Challenges and opportunities. *Cost, Quality, and Safety Management: Challenges and Opportunities*, 2023.
- [22] Kivilä J., Martinsuo M., Vuorinen L. Sustainable project management through project control in infrastructure projects. *International Journal of Project Management*, 2017, 35(6): 1167-1183.
- [23] Viana M. L., Hadikusumo B. H., Mohammad M. Z., et al. Integrated Project Delivery (IPD): An updated review and analysis case study. *Journal of Engineering, Project & Production Management*, 2020, 10(2).
- [24] Eastman C. M. *BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors*. John Wiley & Sons, 2011.
- [25] Wang Y., Wang Y., Yang Z., et al. A hybrid building information modeling and collaboration platform for automation system in smart construction. *Alexandria Engineering Journal*, 2024, 88: 80-90.
- [26] Rahmani F. Challenges and opportunities in adopting early contractor involvement (ECI): Client's perception. *Architectural Engineering and Design Management*, 2021, 17(1-2): 67-76.
- [27] Agostini L., Nosella A., Teshome M. B. Inter-organizational relationships: Toward a reconceptualization of constructs. *Baltic Journal of Management*, 2019, 14(3): 346-369.
- [28] Espach J., Bekker M. C. Defining the relational charter for commercial project contracts. *Procedia Computer Science*, 2023, 219: 2051-2057.
- [29] Davis P., Love P. Alliance contracting: Adding value through relationship development. *Engineering, Construction and Architectural Management*, 2011, 18(5): 444-461.
- [30] Beamish P. W., Lupton N. C. Managing joint ventures. *Academy of Management Perspectives*, 2009, 23(2): 75-94.
- [31] Spickova M., Myskova R. Costs efficiency evaluation using life cycle costing as strategic method. *Procedia Economics and Finance*, 2015, 34: 337-343.
- [32] Cegarra-Navarro J. G., Reverte C., Gómez-Melero E., et al. Linking social and economic responsibilities with financial performance: The role of innovation. *European Management Journal*, 2016, 34(5): 530-539.
- [33] Abejide F. Exploring team performance, collaboration and their impact on project success. Cardiff Metropolitan University, 2024.
- [34] Yang J. B., Lai T. H. Selecting EVM, ESM and EDM (t) for managing construction project schedule. *Engineering, Construction and Architectural Management*, 2024, 31(12): 4988-5006.
- [35] Tavana M., Soltanifar M., Santos-Arteaga F. J. Analytical hierarchy process: Revolution and evolution. *Annals of Operations Research*, 2023, 326(2): 879-907.
- [36] Mukhametzyanov I. Specific character of objective methods for determining weights of criteria in MCDM problems: Entropy, CRITIC and SD. *Decision Making: Applications in Management and Engineering*, 2021, 4(2): 76-105.
- [37] Kaplan R. S. Conceptual foundations of the balanced scorecard. *Handbooks of Management Accounting Research*, 2009, 3: 1253-1269.
- [38] Council U. G. B. *Leadership in energy and environmental design*. Washington, DC: US Green Building Council, 2008. Available at: <http://www.usgbc.org> (Accessed November 2009).
- [39] Agha A., Shibani A., Hassan D. H., et al. Building research establishment environmental assessment methodology on the UK residential projects. *International Journal of Construction Engineering and Management*, 2020, 9(6): 183-189.
- [40] Kumaraswamy M. M. Innovative procurement and delivery approaches and digital aids. In *Routledge Handbook of Construction Project Procurement and Delivery*, 2024: 200-219. Routledge.
- [41] Gherghina Ş. C., Botezatu M. A., Hosszu A., et al. Small and medium-sized enterprises (SMEs): The engine of economic growth through investments and innovation. *Sustainability*, 2020, 12(1): 347.
- [42] Akter M. M. K., Haq U. N., Uddin M. A. Sustainable development and circular economy. In *Waste Management in the Circular Economy*, 2024: 133-152. Cham: Springer International Publishing.
- [43] Sanchez B., Honic M., Leite F., et al. Augmenting materials passports to support disassembly planning based on building information modelling standards. *Journal of Building Engineering*, 2024, 90: 109083.

- [44] Appelbaum S. H., Cameron A., Ensink F., et al. Factors that impact the success of an organizational change: A case study analysis. *Industrial and Commercial Training*, 2017, 49(5): 213-230.
- [45] Aldoseri A., Al-Khalifa K. N., Hamouda A. M. A framework for building resilience through innovation and process optimization in AI-powered digital transformation. In *Handbook of Digital Innovation, Transformation, and Sustainable Development in a Post-Pandemic Era*, 2025: 3-33. CRC Press.
- [46] Ambasht A. Real-time data integration and analytics: Empowering data-driven decision making. *International Journal of Computer Trends and Technology*, 2023, 71(7): 8-14.
- [47] Akpobome O. The impact of emerging technologies on legal frameworks: A model for adaptive regulation. *International Journal of Research Publication and Reviews*, 2024, 5(10): 5046-5060.
- [48] Correa J. G. A., Alves J. L., Homrich A. S., et al. Evolving skillsets of architecture, engineering and construction sector: Unveiling the interplay between project management, BIM, strategic and operational skills. *Engineering, Construction and Architectural Management*, 2025, 25(12): 4988-5006.