Journal of Project Management Practice
Faculty of Built Environment, Universiti Malaya.
E-ISSN: 2805-4768
https://ejournal.um.edu.my/index.php/JPMP/

Who Owns Construction Data?: Examining Governance and Accountability in Digital Construction Projects

Muhamad Syafiq Kamalruzaman[1], Zafira Nadia Maaz[2*], Norhazren Izatie Mohd[3], Shamsulhadi Bandi[4] and Amalina Azmi[5]

[1,3,4]Department of Quantity Surveying, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, Johor Bahru, Malaysia.
[2]Department of Quantity Surveying, Faculty of Built Environment, Universiti Malaya, Kuala Lumpur, Malaysia.
[2,5]Centre for Building, Construction & Tropical Architecture, Faculty of Built Environment, Universiti Malaya.
[5]Department of Real Estate, Faculty of Built Environment, Universiti Malaya, Kuala Lumpur, Malaysia.

*Corresponding author: zafiranadia@um.edu.my

Submission date:
14th April 2026

Revised date:
22nd May 2026

Acceptance date:
5th June 2026

How to cite this paper:

Kamalruzaman, M. S., Maaz, Z. N., Mohd, N. I., Bandi, S. & Azmi, A. (2026). Who Owns Construction Data?: Examining Governance and Accountability in Digital Construction Projects. Journal of Project Management Practice, 6(1), 36-50.

ABSTRACT

The rapid adoption of digital technologies such as Building Information Modeling (BIM), the Internet of Things (IoT), and data-driven platforms has significantly increased the volume and strategic value of project data in the construction industry. Despite these technological advancements, the ownership and governance of construction data remain unclear, creating potential disputes among project stakeholders and limiting effective collaboration in digitally enabled project environments. This study examines the governance challenges associated with construction data ownership and identifies suitable ownership models for managing digital project information. A systematic literature review was conducted using the Scopus and Web of Science databases following the PRISMA framework to ensure a transparent article selection process. Peer-reviewed publications from 2017 to 2025 were analyzed using thematic synthesis to identify recurring governance issues and ownership structures in construction data management. The findings reveal that data ownership challenges in construction arise from three key dimensions: legal ambiguity, ethical considerations related to stakeholder equity, and social within multi-stakeholder project environments. The review further categorizes governance approaches into centralized, decentralized, and hybrid ownership models, each reflecting different levels of control, transparency, and stakeholder participation. By integrating these governance models with utility theory, this study proposes a conceptual framework that explains how ownership arrangements influence collaboration, accountability, and the collective value of construction data. The study contributes to the growing discourse on digital construction governance by providing a structured understanding of data ownership dynamics and offering insights for developing clearer governance frameworks for digital construction projects.

Keywords*: Data Ownership, Data Governance, Construction Industry, Digital Construction*

1.0 INTRODUCTION

The construction industry is currently undergoing a significant digital transformation, shifting from traditional document-based project delivery toward increasingly data-driven project environments. This transformation is closely aligned with the concept of Construction 4.0, which promotes the integration of advanced digital technologies such as Building Information Modeling (BIM), Artificial Intelligence (AI), Internet of Things (IoT) sensors, robotics, big data analytics, and digital collaboration platforms to improve project performance and management (Shafei et al., 2022; Roslan et al., 2021; CIDB, 2020) As these technologies become more widely adopted, construction projects generate large volumes of digital data throughout the project lifecycle, including design information, cost data, monitoring records, and operational datasets.

Digital tools such as BIM, digital twins, and common data environments (CDE) allow project stakeholders to create, store, analyze, and exchange information continuously during project execution (Revolti et al., 2023; Shahzad et al., 2022; Ismail et al., 2018). As a result, project data is increasingly recognized as a valuable organizational asset that supports data-driven decision making, enhances coordination between project participants, and improves planning, forecasting, and risk management in construction projects (Li et al., 2023; Maass, 2022). However, while the generation and use of digital data continue to expand, the question of who owns the data produced in construction projects remains unclear.

Construction projects typically involve multiple stakeholders, including clients, consultants, contractors, subcontractors, and technology providers. These stakeholders contribute to the generation, modification, and use of project data through various digital platforms (Tan et al., 2022; Valra et al., 2021; Preidel et al., 2018). Digital collaboration tools such as BIM models, cloud-based systems, and IoT monitoring technologies facilitate real-time information exchange across project teams. Despite these technological advancements, the rights, responsibilities, and control mechanisms governing project data are often not clearly defined. Existing contractual arrangements and governance frameworks have not evolved at the same pace as digital technologies, resulting in ambiguity regarding data ownership, access rights, accountability, and control privileges (Ayodele & Kajimo-Shakantu, 2022; Demirkesen & Tezel, 2022; Jo et al., 2018).

The absence of clear data ownership structures may introduce several challenges for construction stakeholders. Unclear ownership rights may lead to disputes related to intellectual property, liability, and the reuse of project data across different projects or organizations (Ardani et al., 2021; Baharom et al., 2021; Alreshidi et al., 2017). Ownership ambiguity may also complicate the handover of digital assets such as BIM models and operational datasets during project completion. Furthermore, uncertainties regarding data governance may discourage stakeholders from openly sharing project information due to concerns about misuse, responsibility, or legal implications. These issues may ultimately limit collaboration and reduce trust among project participants, thereby restricting the potential benefits of digital construction technologies (Jou et al., 2026; Ardani et al., 2021; Jing et al., 2021).

Although digital transformation in construction has received considerable scholarly attention, existing research has largely focused on technology adoption rather than governance structures that regulate project data ownership. Limited studies have examined how ownership rights should be defined in multi-stakeholder construction environments or how governance mechanisms can ensure accountability when data is treated as an organizational asset. As construction projects increasingly rely on shared digital environments, the need to clarify ownership structures and governance mechanisms becomes increasingly important.

Therefore, this study aims to examine the challenges associated with data ownership in the construction industry and to identify suitable governance models that can support effective management of digital construction data. Using a systematic literature review approach, the study synthesizes existing research on data ownership, identifies key challenges related to governance and stakeholder responsibilities, and categorizes different ownership models relevant to construction projects. The findings contribute to a clearer conceptual understanding of construction data ownership and support the development of governance approaches that enhance transparency, accountability, and collaboration within digital construction environments.

2.0 METHODOLOGY

This study employed a systematic literature review (SLR) to examine research related to data ownership governance within the construction industry. The literature search was conducted using the Scopus and Web of Science (WoS) databases due to their extensive coverage of peer-reviewed academic publications. The review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to ensure transparency and replicability in the article selection process.

Keywords related to data ownership and digital construction were combined using Boolean operators (AND, OR), and the search was limited to English-language publications between 2017 and 2025. The initial search identified 61 records, comprising 39 publications from Scopus and 22 from Web of Science. After screening titles and abstracts for relevance to construction data ownership and governance, 18 studies were retained for further evaluation. Following the removal of duplicate records and full-text screening, seven articles were considered relevant and included in the final analysis.

Although the final number of studies appears relatively small, this reflects the emerging nature of research specifically addressing data ownership governance within the construction context. Many studies on data ownership originate from broader domains such as information systems, data governance, or digital ecosystems, while relatively few studies explicitly examine ownership issues within construction projects. Therefore, the selected studies provide an appropriate foundation for synthesizing current knowledge on construction data ownership governance.

Table 1. Literature Search Strategy

Component	Description
Database	Scopus, Web of Science
Time Range	2017–2025
Inclusion Criteria	Peer-reviewed journal articles and conference papers, English language, studies related to data ownership or governance in construction
Exclusion Criteria	Non-construction studies, duplicate records, non-English publications, conference abstracts without full papers
Analysis Method	Thematic synthesis
Analysis Tool	NVivo

Table 2. Search Strings Used

Database	Search Field	Search String
Scopus	TITLE-ABS-KEY	("data ownership" OR "data governance" OR "data control" OR "data rights") AND ("construction industry" OR "construction sector" OR "built environment" OR "construction project") AND ("data sharing" OR "open data" OR "information management" OR "digital construction" OR "BIM")
Web of Science	TS (Topic)	("data ownership" OR "data governance" OR "data control" OR "data rights") AND ("construction industry" OR "construction sector" OR "built environment" OR "construction project") AND ("data sharing" OR "open data" OR "information management" OR "digital construction" OR "BIM")

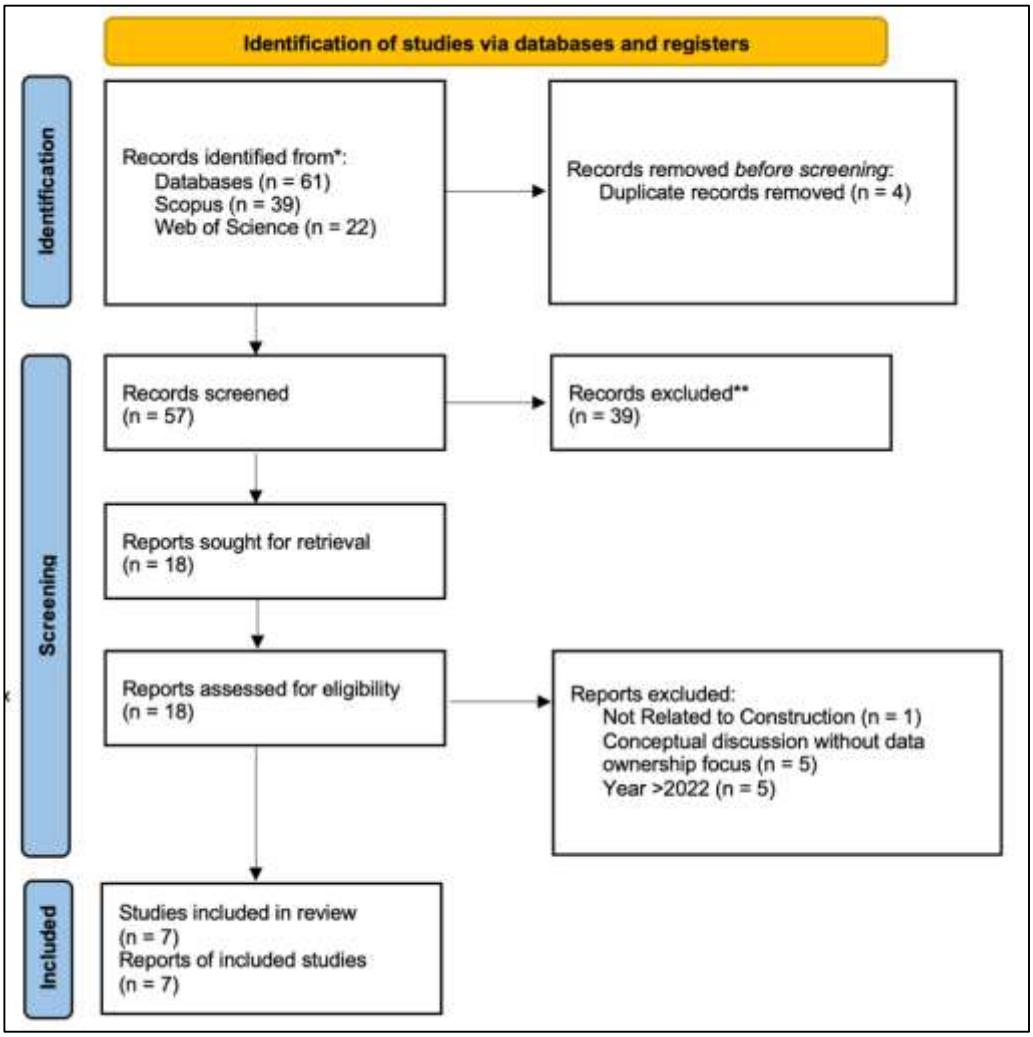

Figure 1. PRISMA Article Selection Process

3.0 OVERVIEW OF DATA OWNERSHIP DISCOURSE

3.1 Data Ownership Publications Trends

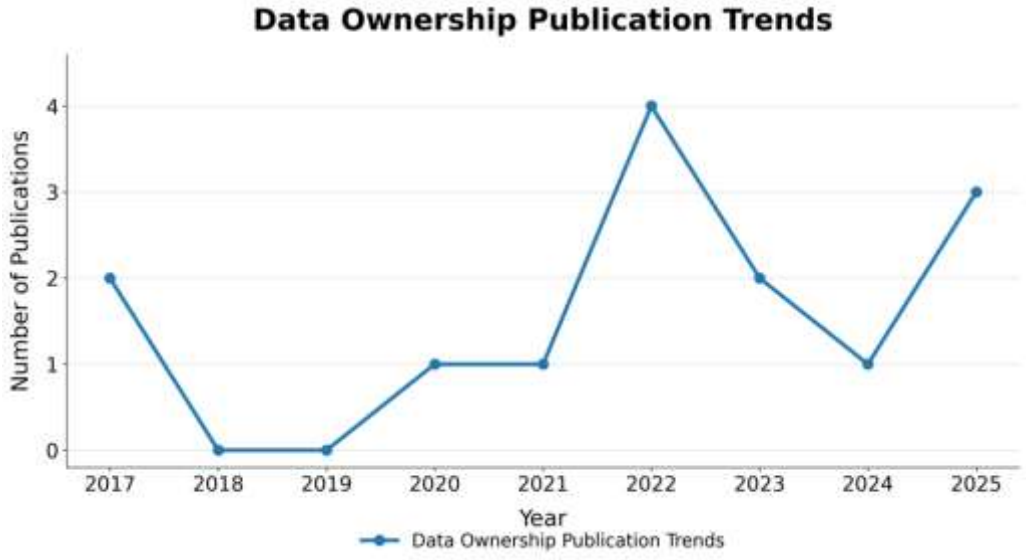

Figure 2. Data Ownership Publications Trends

The analysis of publication trends indicates that research on data ownership in the construction industry remains relatively limited but has gradually gained attention in recent years. The earliest publications identified in this study appeared in 2017, with two studies examining issues related to data governance and ownership in construction environments. However, no relevant publications were identified in 2018 and 2019, suggesting that the topic had not yet received sustained scholarly attention during that period.

Research activity began to increase after 2020, with one publication recorded in both 2020 and 2021. The number of publications reached its highest level in 2022, with three studies addressing issues related to data governance and ownership structures in digital construction environments. This increase may be associated with the growing adoption of digital technologies such as BIM, cloud-based collaboration platforms, and data-driven decision-making tools in construction projects.

As construction projects increasingly rely on shared digital platforms and collaborative information environments, the management and governance of project data have become more critical. The growing importance of digital collaboration has raised questions regarding data ownership, access rights, and accountability among project stakeholders. Consequently, research interest in data ownership governance has gradually expanded alongside the broader digital transformation of the construction industry.

4.0 SYNTHESIS OF DATA OWNERSHIP IN CONSTRUCTION

4.1 Dimensions of Data Ownership

As shown in Table 1.3, the academic literature review section specifically focuses on the study context area of data ownership and its various implications in the modern digital landscape. This section is pivotal for understanding data ownership's intricate legal, ethical, and technical challenges, particularly in emerging technologies like blockchain and the Internet of Things (IoT). The research papers mentioned delve into multifaceted issues, ranging from the legal and ethical dimensions of data ownership to the practicality of implementing ownership confirmation schemes in distributed data trading. The inclusion of blockchain technology suggests an interest in how distributed ledger technology can enhance data integrity and traceability while providing robust security mechanisms.

Moreover, the intellectual property rights associated with model ownership are highlighted, especially in collaborative construction projects like Building Information Modeling (BIM). This reflects the complexities of stakeholder collaboration and the need for clear legal frameworks to define and communicate ownership. Legal perspectives on data ownership present a dichotomy between top-down and bottom-up approaches, tackling the difficulties in controlling, protecting, valuing, and allocating personal data. This is particularly challenging given the current limitations of legal and technological frameworks, suggesting a need for innovative solutions that could improve data ownership mechanisms within the IoT space. The study extends this conversation into hybrid organizations by applying property theory to dissect ownership dynamics. It posits that shared ownership models could significantly enhance incentives for making specific investments, thus transforming hybrid organizations into vital commitment devices for involved parties. Each paper contributes to a composite understanding of the challenges and potential solutions in the digital transformation era, where distributed trust and hybrid governance models are becoming increasingly prevalent. Thus, this literature review section provides a foundational insight into the current scholarly discourse on data ownership.

Table 3. Themes of Data Ownership Research

Themes	Context	Authors
Exploration on legal & ethical data ownership	The legal and ethical dimension. Privacy and security.	Asswad & Gómez (2021)
Data integrity ownership	Blockchain technology. Data integrity and traceability. Security analysis	Liu et al. (2022)
Data ownership models	Model ownership challenges. Intellectual property rights. Legal and contractual frameworks. Stakeholder collaboration in construction. The evolution from centralized to decentralized information governance. Challenges of hybrid (partially decentralized) governance models.	Maaz et al. (2026); Ardani et al. (2021); Lemieux et al. (2020)
Technology effects on data ownership	Defining legal ownership using BIM. Implementing BIM and IoT for ownership clarification.	Atazadeh et al. (2019)
Data ownership challenges	Legal perspectives on data ownership: top-down vs. bottom-up approaches. Challenges in controlling, protecting, valuing, and allocating personal data. Limitations of current legal and technological frameworks in data ownership. Proposed solutions for improving data ownership mechanisms within IoT.	Janeček (2018)
Ownership in the context of hybrid organization	The paper leverages property theory to discuss ownership within hybrid organizations. Shared ownership can enhance the incentive for making specific iinvestments, making the hybrid organization a commitment device for the parties involved.	Jolink & Niesten (2012)

4.2 Multi-Dimensional Challenges of Data Ownership in Construction

Although digital technologies have significantly enhanced information sharing in construction projects, the literature identifies several challenges related to the implementation of data ownership governance. These challenges arise primarily from legal ambiguity, ethical tensions among stakeholders, and collaborative difficulties in multi-organizational project environments. Understanding these challenges is essential because unresolved ownership issues may reduce trust among stakeholders and limit the potential benefits of digital collaboration technologies. The following subsections discuss the key challenges highlighted in the literature

4.2.1 Legal & Regulatory Ambiguities

One of the most widely discussed issues in the literature is the absence of clear legal definitions governing data ownership in construction projects. Although digital data has increasingly become a critical project resource, legal frameworks regulating construction contracts have not evolved at the same pace as digital technologies. Many studies highlight that construction contracts rarely specify ownership rights over digital outputs generated during project execution (Maaz et al., 2026; Baharom et al., 2021; Jamil & Fathi, 2019; Vilminko-Heikkinen & Pekkola, 2019; Jo et al., 2018). This lack of contractual clarity creates uncertainty regarding who has the authority to access, modify, or reuse digital project data. In BIM-enabled projects, digital models are often developed collaboratively by multiple stakeholders, making it difficult to assign exclusive ownership to any single party.

At the regulatory level, frameworks governing digital data governance are still evolving. While broader legal debates on data ownership have emerged in areas such as intellectual property and data protection law, these discussions often overlook the project-based and multi-organizational nature of the construction industry (Atik, 2022; Gupta et al., 2022). As a result, construction practitioners frequently rely on informal agreements

or case-specific arrangements when managing digital project data. Moreover, strict legal control over data ownership may unintentionally hinder collaboration, as stakeholders may hesitate to share information due to concerns over losing proprietary knowledge or facing potential liability (Asswad & Gómez, 2021). These challenges indicate that legal ambiguity remains a key barrier to effective data governance in construction projects, highlighting the need for clearer contractual provisions and industry guidelines that balance ownership protection with collaborative data exchange.

4.2.2 Ethical Tensions and Stakeholders' Equity

Beyond legal challenges, ethical considerations also play an important role in the governance of construction data. In digital construction environments, project data is often generated through the collective contributions of multiple stakeholders, raising questions regarding fairness in allocating ownership rights and access privileges. Some scholars argue that assigning exclusive ownership to a single stakeholder may not accurately reflect the collaborative nature of digital construction workflows (Asswad & Gómez, 2021). For instance, BIM models developed during the design stage may later provide value for contractors during construction and facility managers during building operations. Under such conditions, rigid ownership structures may restrict the broader benefits that can be derived from shared project data.

Ethical concerns also arise regarding the responsible use of data collected through digital technologies. Technologies such as IoT monitoring systems and digital construction platforms increasingly capture information related to workforce activities, equipment performance, and environmental conditions. Without appropriate governance mechanisms, the use of such data may raise concerns related to privacy, transparency, and potential misuse of sensitive information (Atazadeh et al., 2019). These issues suggest that effective data governance in construction should incorporate ethical considerations alongside legal frameworks, ensuring equitable access to project data while maintaining safeguards that protect stakeholders from potential misuse.

4.2.3 Social and Collaborative Frictions

Social and organizational factors play an important role in shaping data ownership practices within construction projects. Construction projects typically involve temporary collaborations among multiple organizations with different interests, capabilities, and attitudes toward data sharing. The literature indicates that stakeholders' willingness to share data is strongly influenced by their perceptions of ownership and control (Yoon et al., 2022; Wang et al., 2022; Asswad & Gómez, 2021; Zhang et al., 2017;). When stakeholders believe that sharing information may expose them to risks or reduce their competitive advantage, they may restrict access to project data, thereby limiting the collaborative potential of digital construction technologies.

Conflicts may also arise regarding the ownership of derivative outputs generated from shared datasets. Digital models, simulations, and predictive analytics developed using project data may create additional value that stakeholders attempt to claim as proprietary assets (Ardani et al., 2021). In addition, complex authorization procedures may further restrict efficient data exchange among project participants, particularly when governance structures are unclear (Liu et al., 2022). These issues indicate that data ownership challenges are closely linked to the social dynamics of collaboration in construction projects, suggesting that improving trust and transparency among stakeholders is essential for enabling effective data sharing in digital construction environments.

4.3 Typologies of Data Ownership Models

Given the challenges associated with defining and managing ownership rights in collaborative digital environments, the literature has proposed several governance models that attempt to structure data ownership in construction projects. These models generally fall into three categories: centralized, decentralized, and hybrid ownership structures. Each model represents a different approach to balancing control, transparency, and stakeholder participation. Examining these governance models provides insight into how different ownership structures may influence collaboration and information management in digital construction environments.

Table 4. Data Ownership Model

Data Ownership Model	Construct	Author
Centralized Model Ownership	Authorise party filter information	Kiu et al. (2022)
	Conflict	Kiu et al. (2022); Sun et al. (2022)
	One Authority	Nizamuddin et al. (2019); Sun et al. (2019)
	Risk in Collaboration	Kiu et al. (2022)
	Trust enhancement	Tao et al. (2021)
Decentralized Model Ownership	Broader participation	Chen et al. (2020); Jnr (2022)
	Distributed authority	Chen et al. (2020); Lage et al. (2022)
	Diverse perspective	Gutschmidt et al. (2022)
	Knowledge sharing	Beach et al. (2017)
Hybrid Model Ownership	Being flexible	Lalmi et al. (2021)
	Collaborative partnership	Vining et al. (2020)
	Complexity	Lemieux et al. (2020)
	Distributed trust	Lemieux et al. (2020)
	Risk management	Lemieux et al. (2020)

4.3.1 Centralized Model Ownership

The centralized ownership model assigns primary authority over project data to a single entity, typically the client, project owner, or a designated data administrator. Under this governance structure, one organization controls data storage, access permissions, and information distribution throughout the project lifecycle. Supporters of centralized governance argue that concentrating authority can improve data consistency, accountability, and security (Kiu et al., 2022). When a single organization manages project data, it becomes easier to establish standardized data protocols and maintain version control of digital models such as BIM. However, the literature also highlights several limitations associated with this model. Centralized ownership may create power imbalances among project stakeholders, particularly when access to data is controlled by a single authority. In collaborative environments where multiple organizations contribute to project data, restricting control to a single entity may discourage information sharing and reduce transparency (Sun et al., 2022). From the perspective of this study, while centralized models may enhance control and accountability, they may not fully support the collaborative nature of digital construction projects where shared data creation is common.

4.3.2 Decentralized Model Ownership

In contrast to centralized governance structures, decentralized ownership models distribute control over project data among multiple stakeholders involved in the project (Hojati et al., 2023; Zhang et al., 2017). This approach reflects the collaborative nature of digital construction environments, where information is generated and updated by different participants throughout the project lifecycle. Decentralized governance structures may enhance transparency and encourage greater stakeholder participation in data management processes. By allowing multiple stakeholders to contribute to and access shared datasets, decentralized models may facilitate knowledge sharing and improve decision-making within digital project environments (Beach et al., 2017). Despite these advantages, decentralized ownership models also introduce several coordination challenges. When multiple stakeholders hold ownership rights, conflicts may arise regarding data modification, responsibility for maintaining data quality, and authority over derivative outputs generated from shared datasets (Piasecki & Cheah, 2022; Fontana et al., 2020). In complex projects, these coordination issues may reduce efficiency and increase governance complexity. These observations suggest that while decentralized governance may support collaboration, effective coordination mechanisms are necessary to prevent fragmentation in data management practices.

4.3.3 Hybrid Model Ownership

Given the advantages and limitations associated with both centralized and decentralized approaches, several studies suggest that hybrid ownership structures may provide a more balanced governance solution. Hybrid models combine elements of centralized control with distributed stakeholder participation in order to accommodate the collaborative characteristics of construction projects (Rowbottom et al., 2022; Leventon et al., 2019). Under hybrid governance structures, certain aspects of data management may remain centralized, such as regulatory compliance, cybersecurity, and data infrastructure management. At the same time, stakeholders may retain shared rights to access and contribute to project datasets. This arrangement allows projects to maintain accountability while still encouraging collaboration among participants. Hybrid models are often discussed in relation to property rights theory and collaborative governance frameworks, which emphasize the need to balance control and participation in shared resource environments (Brust et al., 2020). In construction projects where multiple organizations contribute to digital information, hybrid governance may provide a practical compromise between strict ownership control and open data sharing. From the perspective of this study, hybrid governance structures appear particularly suitable for digital construction environments where both coordination and collaboration are required to manage complex project data ecosystems.

4.4 Theoretical Integration: Utility Theory as an Interpretive Lens

The discussion of ownership dimensions, governance challenges, and alternative ownership models indicates that data ownership in construction projects involves balancing competing stakeholder interests. Construction data is typically generated collectively by multiple actors, including designers, contractors, consultants, and technology providers. As a result, determining ownership rights cannot be addressed solely through legal mechanisms or technological solutions. Instead, governance structures must also consider how ownership arrangements influence collaboration, resource allocation, and the overall benefits derived from project data.

To interpret these governance dynamics, this study adopts utility theory as an analytical lens. Utility theory, originally developed by Jeremy Bentham and further expanded by John Stuart Mill, emphasizes the principle of maximizing overall benefit or welfare when allocating rights and resources within a system (Daher, 2018). In the context of digital data governance, utility theory provides a useful framework for evaluating how ownership arrangements affect the collective value generated from shared information resources (Puaschunder, 2019; Warkentin et al., 2017). Applying utility theory to construction data ownership highlights an important governance dilemma. On one hand, assigning exclusive ownership to a single stakeholder may strengthen control, accountability, and data security. On the other hand, restricting access to project data may limit collaboration and reduce the collective value that could be generated through shared information. This tension is particularly evident in BIM-enabled projects where multiple stakeholders rely on shared datasets to coordinate project activities.

From a utility perspective, ownership structures should therefore be designed to maximize the overall benefits derived from project data rather than prioritizing the interests of individual stakeholders (Ibrahim et al., 2025; Marcucci et al., 2023; D'Hauwers et al., 2022). This implies that governance frameworks must balance control mechanisms with collaborative access arrangements. Such a perspective supports the development of ownership models that encourage data sharing while maintaining accountability for data management. Integrating utility theory into the analysis also helps explain why different governance models, such as centralized, decentralized, and hybrid, may produce different outcomes in digital construction environments. While centralized models may prioritize control and security, decentralized models may enhance collaboration and information exchange. Hybrid models may therefore provide a compromise by balancing both objectives.

From the perspective of this study, utility theory offers a valuable interpretive framework for understanding how ownership arrangements influence collaboration, trust, and knowledge sharing in digital construction projects. By emphasizing the maximization of collective benefits, the theory provides a

conceptual basis for developing governance frameworks that support both accountability and collaboration in construction data ecosystems.

4.5 Proposed Conceptual Framework for Construction Data Ownership

The findings from the literature review indicate that data ownership governance in construction projects is influenced by several interconnected factors. Specifically, the review highlights three key governance dimensions: legal clarity, ethical responsibility, and collaborative data management. These dimensions represent the primary conditions required to effectively manage digital construction data within multi-stakeholder project environments.

The legal dimension refers to the contractual and regulatory mechanisms that define ownership rights, access privileges, and responsibilities associated with digital project data. The literature consistently highlights the absence of clear contractual provisions regarding ownership of digital assets such as BIM models, project databases, and monitoring datasets. Establishing clearer legal definitions is therefore essential for reducing ambiguity and improving accountability among project stakeholders. The ethical dimension focuses on fairness, transparency, and responsible use of project data. Since construction data is typically generated through the collective contributions of multiple stakeholders, governance mechanisms must ensure that ownership arrangements do not unfairly privilege one party while excluding others who contribute to the data creation process. Ethical governance is also necessary to address privacy concerns related to workforce monitoring and data collected through IoT systems. The collaborative dimension reflects the organizational and social dynamics influencing how stakeholders share and utilize digital information. Construction projects often involve temporary collaborations among organizations with different interests and capabilities. Therefore, effective data governance requires mechanisms that promote transparency, trust, and knowledge sharing among participants.

Based on these dimensions, this study proposes a conceptual framework that integrates legal clarity, ethical responsibility, and collaborative governance to support effective management of construction data. Within this framework, alternative ownership models such as centralized, decentralized, and hybrid represent different approaches to structuring data governance in construction projects. Utility theory provides the interpretive foundation for the framework by emphasizing the need to maximize the collective value derived from shared project data while maintaining appropriate control and accountability mechanisms.

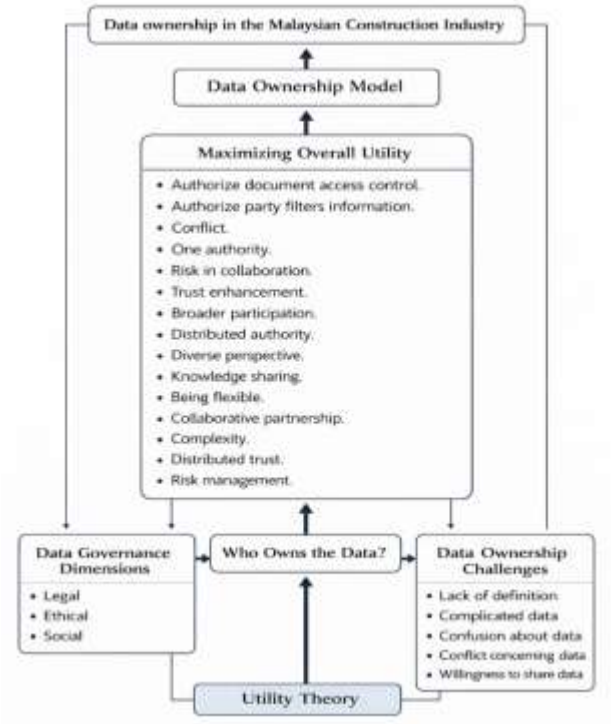

Figure 3. Proposed Framework

5.0 CONCLUSION

This study advances understanding of data ownership in the Malaysian construction industry by synthesizing the legal, ethical, and social dimensions of ownership discourse. Through a structured literature review, ten interrelated challenges related to data ownership were identified, revealing persistent ambiguities in ownership definition, accountability, and governance within multi-stakeholder construction environments. These ambiguities undermine collaboration, trust, and effective data-driven decision-making in digitally enabled projects. The review further categorizes data ownership governance into centralized, decentralized, and hybrid typologies, each reflecting different trade-offs between control, transparency, and stakeholder participation. By integrating these typologies with utility theory, the study provides a conceptual explanation of the tensions between individual control and collective benefits within construction data ecosystems.

Building on these insights, the study proposes a conceptual framework that integrates authorization mechanisms, conflict resolution processes, trust-building elements, and knowledge-sharing structures to support balanced data governance in project-based construction environments. Practically, the findings offer guidance for construction stakeholders, including regulatory agencies, industry bodies, software providers, and contracting organizations, in designing clearer contractual provisions, governance protocols, and BIM collaboration agreements. While the study is limited to SCOPUS-indexed English-language publications and adopts a conceptual synthesis approach, future research could empirically validate the proposed framework through case studies, contractual analysis, or stakeholder perception studies in live construction projects. Overall, clarifying data ownership governance is essential for strengthening trust, accountability, and sustainable digital transformation in the construction industry.

6.0 ACKNOWLEDGEMENT

The authors acknowledge Universiti Teknologi Malaysia for providing the facilities and environment to conduct this research.

7.0 AUTHOR CONTRIBUTIONS

Muhamad Syafiq Kamalruzaman is a PhD candidate who works on this topic, Norhazren Izatie Mohd, Shamsulhadi Bandi, and Zafira Nadia Maaz are the supervisors for the PhD candidate. Amalina Azmi is a research collaborator who provides advise on the overall contents of the paper.

8.0 CONFLICT OF INTEREST

The authors declare no conflicts of interest.

9.0 REFERENCES

Adeleke, A. Q., Mohd Nasrun, M. N., & Abd-Karim, S. B. (2020). Where Are We? The Level of Risk Management in Malaysian Construction Industries. In Int. J Sup. Chain. Mgt (Vol. 9, Issue 1). http://excelingtech.co.uk/Aims to Spur Good Policies. https://open.dosm.gov.my.

Ardani, J. A., Utomo, C., & Rahmawati, Y. (2021). Model Ownership and Intellectual Property Rights for Collaborative Sustainability on Building Information Modeling. Buildings, 11(8). https://doi.org/10.3390/buildings11080346

Asswad, J., & Gómez, J. M. (2021). Data Ownership: A survey. In Information (Switzerland) (Vol. 12, Issue 11). MDPI. https://doi.org/10.3390/info12110465

Atik, C. (2022). Towards Comprehensive European Agricultural Data Governance: Moving Beyond the "Data Ownership" Debate. IIC International Review of Intellectual Property and Competition Law, 53(5), 701–742. https://doi.org/10.1007/s40319-022-01191-w

Ayodele, T. O., & Kajimo-Shakantu, K. (2022). Challenges and Drivers to Data Sharing Among South African Construction Industry Stakeholders. Journal of Engineering, Design and Technology, 20(6), 1698–1715. https://doi.org/10.1108/JEDT-02-2021- 0074

Baharom, M., Habib, S., & Ismail, S. (2021). Building Information Modelling (BIM): Contractual Issues of Intellectual Property Rights (IPR) in Construction Projects. International Journal of Sustainable Construction Engineering and Technology. https://doi.org/10.30880/ijscet.2021.12.01.017.

Beach, T., Petri, I., Rezgui, Y., & Rana, O. (2017). Management of Collaborative BIM Data by Federating Distributed BIM Models. J. Comput. Civ. Eng., 31. https://doi.org/10.1061/(asce)cp.1943-5487.0000657.

CIDB. (2020). Construction 4.0 Strategic Plan (2021-2025) Next Revolution of the Malaysian Construction Industry.

Chen, Y., Richter, J., & Patel, P. (2020). Decentralized Governance of Digital Platforms. Journal of Management, 47, 1305 - 1337. https://doi.org/10.1177/0149206320916755.

D'Hauwers, R., Walravens, N., & Ballon, P. (2022). Data Ecosystem Business Models. Journal of Business Models. https://doi.org/10.54337/jbm.v10i2.6946.

Daher, H. Z. (2018). According to Bentham and Stuart Mill, International Journal for Empirical Education and Research Utilitarianism theory.

David, B., & Daniel, H. (2022). New Ways of Data Governance forConstruction? Decentralised Data Marketplaces as Web3 Concept is just around the corner. 29 Th International Workshop on Intelligent Computing in Engineering. https://doi.org/10.3929/ethz-b-000560904

Davies, K., McMeel, D. J., & Wilkinson, S. (2017). Making Friends with Frankenstein: Hybrid Practice in BIM. Engineering, Construction and Architectural Management, 24(1), 78–93. https://doi.org/10.1108/ECAM-04-2015-0061

Davis, J. F. (1997). Property Rights to Consumer Information. In Inc. JOURNAL OF DIRECT MARKETING (Vol. 11). John Wiley & Sons, Inc. and Direct Marketing Educational Foundation.

Demirkesen, S., & Tezel, A. (2022). Investigating major challenges for industry 4.0 adoption among construction companies. Engineering, Construction and Architectural Management, 29(3), 1470–1503. https://doi.org/10.1108/ECAM-12-2020- 1059

Fontana, G., Ghafur, S., Torne, L., Goodman, J., & Darzi, A. (2020). Ensuring that the NHS realises fair financial value from its data. The Lancet. Digital health, 2 1, e10-e12. https://doi.org/10.1016/s2589-7500(19)30225-0

Gupta, P., Dedeoglu, V., Kanhere, S. S., & Jurdak, R. (2022). TrailChain: Traceability of data ownership across blockchain-enabled multiple marketplaces. Journal of Network and Computer Applications, 203. https://doi.org/10.1016/j.jnca.2022.103389

Gutschmidt, A., Lantow, B., Hellmanzik, B., Ramforth, B., Wiese, M., & Martins, E. (2022). Participatory modeling from a stakeholder perspective: On the influence of collaboration and revisions on psychological ownership and perceived model quality. Software and Systems Modeling, 22, 13 - 29. https://doi.org/10.1007/s10270-022-01036-7.

Hojati, M., Feick, R., Roberts, S., Farmer, C., & Robertson, C. (2023). Distributed spatial data sharing: a new model for data ownership and access control. Journal of Spatial Information Science. https://doi.org/10.5311/josis.2023.27.220.

Ibrahim, N. E., Bandi, S., Maaz, Z. N., Mohd, N. I., & Ghesairi, M. (2025). Advancement of Big Data Analytics Capabilities in Construction Industry: A Resource-Based Theory and Dynamic Capabilities Perspective. International Journal of Integrated Engineering, 17(7), 326-338.

Ismail, S. A., Bandi, S., & Maaz, Z. N. (2018). An Appraisal into the Potential Application of Big Data in the Construction Industry. International Journal of Built Environment and Sustainability, 5(2). https://doi.org/10.11113/ijbes.v5.n2.274

Jamil, A., & Fathi, M. (2019). Contractual issues for Building Information Modelling (BIM)-based construction projects: An exploratory case study. IOP Conference Series: Materials Science and Engineering, 513. https://doi.org/10.1088/1757-899x/513/1/012035.

Jing, Y., Zhang, W., Ge, L., Li, N., Shang, X., & Ye, Y. (2021). Secure Sharing Method of Network Data Transmission Based on Multi- Layer Encryption Technology. E3S Web of Conferences, 252. https://doi.org/10.1051/e3sconf/202125201027

Jo, T., Ishak, S., & Rashid, Z. (2018). Overview of the Legal Aspects and Contract Requirements of the BIM Practice in Malaysian Construction Industry, 203, 02011. https://doi.org/10.1051/matecconf/201820302011.

Jou, T. S., Maaz, Z. N., Hanid, M., Choong, C. H., Bandi, S., Saar, C. C., Aminudin, E., & Darmansah, N. F. (2026). Trustworthy AI in Sustainable Building Projects: Prioritizing Data Quality for Risk Management Decisions. Buildings, 16(7), 1462. https://doi.org/10.3390/buildings16071462

Jnr., B. (2022). Toward a collaborative governance model for distributed ledger technology adoption in organizations. Environment Systems and Decisions, 42, 276 - 294. https://doi.org/10.1007/s10669-022-09852-4.

Kiu, M. S., Lai, K. W., Chia, F. C., & Wong, P. F. (2022). Blockchain integration into electronic document management (EDM)system in construction common data environment. Smart and Sustainable Built Environment. https://doi.org/10.1108/SASBE-12-2021-0231

Kostkova, P., Brewer, H., de Lusignan, S., Fottrell, E., Goldacre, B., Hart, G., Koczan, P., Knight, P., Marsolier, C., McKendry, R. A., Ross, E., Sasse, A., Sullivan, R., Chaytor, S., Stevenson, O., Velho, R., & Tooke, J. (2016). Who Owns the Data? Open Data for Healthcare. Frontiers in Public Health, 4.

Lalmi, A., Fernandes, G., & Souad, S. B. (2021). A Conceptual Hybrid Project Management Model for Construction Projects. ProcediaComputer Science, 181, 921–930. https://doi.org/10.1016/j.procs.2021.01.248

Lage, O., Saiz-Santos, M., & Zarzuelo, J. (2022). Decentralized platform economy: emerging blockchain-based decentralized platform business models. Electronic Markets, 32, 1707-1723. https://doi.org/10.1007/s12525-022-00586-4.

Lemieux, V. L., Rowell, C., Seidel, M. D. L., & Woo, C. C. (2020). Caught in the Middle?: Strategic Information Governance Disruptions in the Era of Blockchain and Distributed Trust. Records Management Journal, 30(3), 301–324. https://doi.org/10.1108/RMJ-09-2019-0048

Leventon, J., Schaal, T., Velten, S., Loos, J., Fischer, J., & Newig, J. (2019). Landscape-scale biodiversity governance: Scenarios for reshaping spaces of governance. Environmental Policy and Governance. https://doi.org/10.1002/eet.1845.

Li, H., Su, L., Zuo, J., An, X., Dong, G., Wang, L., & Zhang, C. (2023). The Framework of Data-Driven and Multi-Criteria Decision- Making for Detecting Unbalanced Bidding. Engineering, Construction and Architectural Management, 30(2), 598–622. https://doi.org/10.1108/ECAM-08-2020-0603

Liu, Y., Zhang, Y., Yang, Y., & Ma, Y. (2022). DOCS: A Data Ownership Confirmation Scheme for Distributed Data Trading. Systems, 10(6). https://doi.org/10.3390/systems10060226

Lou, P. and Lee, J. Y. (2009). Exact analytic result of contact value for the density in a modified poisson−boltzmann theory of an electrical double layer. Journal of Chemical Theory and Computation, 5(4), 1079-1083. https://doi.org/10.1021/ct800375t

Maass, W. (2022). Contract-based Data-Driven Decision Making in Federated Data Ecosystems.

Maaz, Z. N., Adediran, A. O., Mohamad Ramly, Z., & Darmansah, N. F. (2026). Artificial intelligence monetization model preference: supply and demand insights from the built environment sector. Built Environment Project and Asset Management, 1-19. https://doi.org/10.1108/BEPAM-04-2025-0108

Mahmudnia, D., Arashpour, M., & Yang, R. (2022). Blockchain in Construction Management: Applications, Advantages and Limitations. In Automation in Construction (V ol. 140). Elsevie B.V . https://doi.org/10.1016/j.autcon.2022.104379

Marcucci, S., Alarcón, N., Verhulst, S., & Wüllhorst, E. (2023). Informing the Global Data Future: Benchmarking Data Governance Frameworks. Data & Policy, 5. https://doi.org/10.1017/dap.2023.24.

Mills, S. (2019). Who Owns the Future? Data Trusts, Data Commons, and the Future of Data Ownership. https://ssrn.com/abstract=3437936

Nizamuddin, N., Salah, K., Ajmal Azad, M., Arshad, J., & Rehman, M. H. (2019). Decentralized Document Version Control Using Ethereum Blockchain and IPFS. Computers and Electrical Engineering, 76, 183–197. bhttps://doi.org/10.1016/j.compeleceng.2019.03.014

Pertusa-Ortega, E. M., Zaragoza-Sáez, P., & Claver-Cortés, E. (2010). Can formalization, complexity, and centralization influence knowledge performance? Journal of Business Research, 63(3), 310–320. https://doi.org/10.1016/j.jbusres.2009.03.015

Piasecki, J., & Cheah, P. (2022). Ownership of individual-level health data, data sharing, and data governance. BMC Medical Ethics, 23. https://doi.org/10.1186/s12910-022-00848-y.

Pranckutė, R. (2021). Web of Science (WoS) and Scopus: the titans of bibliographic information in today's academic world. In Publications (Vol. 9, Issue 1). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/publications9010012

Preidel, C., Borrmann, A., Mattern, H., König, M., & Schapke, S. (2018). Common Data Environment. , 279-291. https://doi.org/10.1007/978-3-319-92862-3_15.

Puaschunder, J. (2019). Towards a Utility Theory of Privacy and Information Sharing: The Introduction of Hyper-Hyperbolic Discounting. Int. J. Strateg. Inf. Technol. Appl., 10, 1-22. https://doi.org/10.4018/ijsita.2019010101.

Revolti, A., Gualtieri, L., Pauwels, P., & Dallasega, P. (2024). From building information modeling to construction digital twin: a conceptual framework. *Production & Manufacturing Research*, *12*(1). https://doi.org/10.1080/21693277.2024.2387679

Roslan, A. F., Baslan, N., Safura, N., Ghani, M. K., Mohd Jusoh, R., Abd. Hamid, Z., Syed Aluwi, S. N., Sundaraj, G., Aminuddin, E., Abidin, N. I., Nisa Lau, S. E., & Tan Sui Hong, H. (2021). Construction 4.0 to Transform the Malaysian Construction Industry. 88.

Rowbottom, J., Graversgaard, M., Wright, I., Dudman, K., Klages, S., Heidecke, C., Surdyk, N., Gourcy, L., Leitão, I., Ferreira, A., Wuijts, S., Boekhold, S., Doody, D., Glavan, M., Cvejić, R., & Velthof, G. (2022). Water governance diversity across Europe: Does legacy generate sticking points in implementing multi-level governance? Journal of environmental management, 319, 115598. https://doi.org/10.1016/j.jenvman.2022.115598.

Shafei, H., Radzi, A. R., Algahtany, M., & Rahman, R. A. (2022). Construction 4.0 Technologies and Decision-Making: A Systematic Review and Gap Analysis. In Buildings (Vol. 12, Issue12). MDPI. https://doi.org/10.3390/buildings12122206

Shahzad, M., Shafiq, M. T., Douglas, D., & Kassem, M. (2022). Digital Twins in Built Environments: An Investigation of the Characteristics, Applications, and Challenges. *Buildings*, *12*(2), 120. https://doi.org/10.3390/buildings12020120

Sun, J., Wang, C. C., Yang, Z., Yu, T., Li, J., & Xiong, X. (2022). Impact of organizational decentralization degree on job satisfaction and performance: a hierarchical linear model analysis for construction projects. Engineering, Construction and Architectural Management, 29(4), 1642–1660. https://doi.org/10.1108/ECAM-07-2020-0503

Sun, S., Du, R., & Chen, S. (2021). A Secure and Computable Blockchain -Based Data Sharing Scheme in IoT System. Information (Switzerland), 12(2), 1–20. https://doi.org/10.3390/info12020047

Tan, Y. J., Maaz, Z. N., Bandi, S., & Palis, P. A. (2022, September). Common data environment: Bridging the digital data sharing gap among construction organizations. In International Conference on Emerging Technologies and Intelligent Systems (pp. 333-342). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-25274-7_27

Tao, X., Das, M., Liu, Y., & Cheng, J. C. P. (2021). Distributed Common Data Environment using Blockchain and Interplanetary File\ System for Secure BIM-based Collaborative Design. Automation in Construction, 130. https://doi.org/10.1016/j.autcon.2021.103851

Valra, A., Madeddu, D., Chiappetti, J., & Farina, D. (2021). The BIM Management System: A Common Data Environment Using Linked Data to Support the Efficient Renovation in Buildings. , 65, 18. https://doi.org/10.3390/proceedings2020065018.

Vazquez-Brust, D., Piao, R., De Sousa De Melo, M., Yaryd, R., & Carvalho, M. (2020). The governance of collaboration for sustainable development: Exploring the “black box”. Journal of Cleaner Production. https://doi.org/10.1016/j.jclepro.2020.120260.

Vining, A., & Weimer, D. (2020). Public–private hybrids: a property rights perspective. https://doi.org/10.4337/9781785366116.00014.

Vilminko-Heikkinen, R., & Pekkola, S. (2019). Changes in roles, responsibilities and ownership in organising master data management. International Journal of Information

Wang, K., Zhang, C., Guo, F., & Guo, S. (2022). Toward an Efficient Construction Process: What Drives BIM Professionals to Collaborate in BIM-Enabled Projects. Journal of Management in Engineering. https://doi.org/10.1061/(asce)me.1943-5479.0001056.

Warkentin, M., Goel, S., & Menard, P. (2017). Shared Benefits and Information Privacy: What Determines Smart Meter Technology Adoption? J. Assoc. Inf. Syst., 18, 3. https://doi.org/10.17705/1jais.00474.

Yoon, J., Pishdad-Bozorgi, P., Sierra-Aparicio, M., & Quintana, E. (2022). Framework for Blockchain-Enabled Building Information Modeling (BIM) Data Sharing in Construction Supply Chain. Proc. 30th Annual Conference of the International Group for Lean Construction (IGLC). https://doi.org/10.24928/2022/0188.

Zhang, J., Liu, Q., Hu, Z., Lin, J., & Yu, F. (2017). A Multi-Server Information-Sharing Environment for Cross-Party Collaboration on A Private Cloud. ArXiv, abs/2411.13580. https://doi.org/10.1016/j.autcon.2017.06.021.