www.ricuc.cl
LinkedIn Revista Ingeniería de Construcción
ISSN: 0718-5073

Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

Advancing digital construction management in Latin America through drones (UAVs): benefits, challenges, and future directions

Avanzando la gestión digital de la construcción en américa latina MEDIANTE drones (UAVs): beneficios, desafíos y tendencias tendencias FUTURAS

Concha, Alexis*; Dragoni, Enzo*; Forcael, Eric[1]; González Retamal, Marcelo**; Pérez-Fargallo, Alexis*****

* Master's Student, Facultad de Arquitectura, Arte y Diseño, Universidad San Sebastián.
** Profesor Titular, Facultad de Ingeniería, Arquitectura y Diseño, Universidad San Sebastián.
*** Professor, Facultad de Arquitectura, Arte y Diseño, Universidad San Sebastián.

Fecha de Recepción: 28/08/2025
Fecha de Aceptación: 20/12/2025
Fecha de Publicación: 22/12/2025
PAG: 1-21

Abstract

Relevant developments within the field of digital construction management have been proposed in recent years to solve the industry's problems. Construction in Latin America faces challenges that demand innovation and the integration of new technologies. In this context, this research focused on analyzing the impact of implementing drones in digital construction management, identifying their benefits, challenges, and opportunities for future development. The use of drones in Latin America is a field that, although there has been progress, remains underexplored, representing an opportunity to understand their contribution to construction projects. Thus, the objective of this research is to identify synergies with other technologies and their potential to make a significant step forward for digital management in Latin America. The study was conducted through a systematic literature review, using specialized databases. Documents published in recent years, contextualized within the Latin American context, were prioritized. As a result, the research demonstrated that drones contribute to the development of digital construction project management, optimizing timelines and quality control, improving scheduling, and increasing efficiency in construction inspection processes. The study also highlights the importance of thoroughly investigating the costs associated with implementing these technologies in the region.

Keywords: Construction 4.0; Digital Management; Drones in Construction; Productivity; Project Management; Safety; Quality and Inspection.

Resumen

En los últimos años se han propuesto desarrollos relevantes en el ámbito de la gestión digital de la construcción para abordar los desafíos de la industria. La construcción en América Latina enfrenta problemas que requieren innovación y la integración de nuevas tecnologías. En este contexto, esta investigación se enfocó en analizar el impacto de la implementación de drones en la gestión digital de la construcción, identificando sus beneficios, desafíos y oportunidades para futuros desarrollos. El uso de drones en América Latina es un campo que, si bien ha mostrado avances, sigue siendo poco explorado, lo que representa una oportunidad para comprender su contribución a los proyectos de construcción. Así, el objetivo de este estudio es identificar sinergias con otras tecnologías y su potencial para impulsar significativamente la gestión digital en la región. La investigación se llevó a cabo mediante una revisión sistemática de la literatura utilizando bases de datos especializadas. Se priorizaron documentos publicados en los últimos años y contextualizados en el entorno latinoamericano. Como resultado, el estudio demostró que los drones contribuyen al desarrollo de la gestión digital de proyectos de construcción, optimizando los plazos y el control de calidad, mejorando la programación y aumentando la eficiencia en los procesos de inspección. Asimismo, se destaca la importancia de investigar en profundidad los costos asociados a la implementación de estas tecnologías en la región.

Keywords: Construcción 4.0; Gestión Digital; Drones en la Construcción; Productividad; Gestión de Proyectos; Seguridad; Calidad e Inspección.

Corresponding author: eric.forcael@uss.cl
Profesor Titular, Facultad de Ingeniería, Arquitectura y Diseño, Universidad San Sebastián.

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

1. Introduction

1.1 Context

The construction industry faces significant challenges, such as cost overruns and delays, despite the adoption of new technologies (Alaloul et al., 2020; Alzahrani & Emsley, 2021). To address this issue, there has been growing interest in implementing disruptive technological solutions, such as Unmanned Aerial Systems (UAS), Artificial Intelligence (AI), and Building Information Modeling (BIM) (Caballero-Martin et al., 2024; Olawumi & Chan, 2019).

In this context, the digitalization of the construction sector presents an opportunity to increase productivity and efficiency. Devices such as drones (UAVs–Unmanned Aerial Vehicles) not only facilitate real-time data collection but also enable more precise and safe monitoring, especially in complex environments (Baghalzadeh Shishehgarkhaneh et al., 2022; Forcael et al., 2024; Paneru & Jeelani, 2021; Perera et al., 2020). This trend, known as Construction 4.0, necessitates robust scientific and technological support, including qualified personnel and up-to-date legal frameworks (Acosta García, 2023; Forcael et al., 2020).

Globally and in Latin America, recent literature (2020-2024) highlights the effectiveness of drones in the construction industry (Girgin et al., 2025; Mendu & Mbuli, 2025; Molina et al., 2023; Rakha & Gorodetsky, 2018). Their use has been consolidated in tasks such as photogrammetry, construction monitoring, safety inspections, and the detection of structural failures (Gheisari & Esmaeili, 2016; González Herrera et al., 2019; Hasa, 2024). Specific studies have shown that UAVs can enhance the accuracy of topographic surveys, improve the efficiency of monitoring the physical progress of construction works, and even facilitate thermographic detection of structures (Choi et al., 2023; Terutsuki et al., 2021). Other studies have proposed integrating drone images and BIM to support the maintenance management of educational public buildings with low digital maturity (Oliveira et al., 2024). In Latin America, some research has shown that drones provide a viable and efficient alternative for quality control and detailed terrain visualization, outperforming satellite imagery (Calderón Aragón et al., 2022; Molina Martínez, 2019).

However, the implementation of these technologies faces significant barriers. International studies highlight the need for robust regulatory frameworks and a shortage of specialized personnel to operate drones and analyze the data they collect (Agapiou, 2021; Olawumi & Chan, 2019). In Latin America, and particularly in countries like Chile, the construction industry has experienced a contraction due to factors such as rising costs and low productivity (Alsamarraie et al., 2022). In this scenario, technological innovation is considered an urgent need to reverse the situation (Gunduz & Yahya, 2022; Künzel et al., 2023; Ravishankar et al., 2022). The integration of drones is seen as a way to boost productivity, cut costs and turnaround times, and improve safety on projects (Alsehaimi et al., 2024; PwC Drone Powered Solutions, 2021).

Additionally, topics related to digital construction management pose several challenges and offer opportunities for multidisciplinary research in Latin America, particularly in identifying synergies with other methodologies and exploring their potential to improve productivity, reduce costs, and optimize timelines. Accordingly, the primary research objective of this study is to identify, through a systematic literature review, the key benefits, challenges, and opportunities associated with the integration of drones as a technological tool in the Latin American construction industry over the last five years (2020–2024).

2. Methodology

2.1 Scope, focus, and type of research

This study employs a qualitative, descriptive, and secondary approach, based on a systematic literature review, to analyze the phenomenon of drone implementation in the construction sector in depth (Hernández Sampieri et al., 2014).

As pointed out by Tawfik et al. (2019), systematic reviews provide a transparent and rigorous structure for the search, selection, and document analysis processes. In this context, the present study adheres to the guidelines of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which organizes the review into four phases: identification, selection, eligibility, and inclusion (Moher et al., 2009; Page et al., 2021).

The PRISMA method is a guideline that establishes a set of standards and a structure to improve the quality and transparency of systematic reviews and meta-analyses. It was developed to ensure that authors clearly and thoroughly report on how the review was conducted, the

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

existence and access to the review protocol, and a detailed description of the literature search strategies, among other key aspects (Moher et al., 2009).

On the other hand, it is worth noting that regional representativeness is a crucial aspect. However, the current study followed the standard PRISMA selection process (identification, screening, eligibility, and inclusion), in which an initially large set of records is gradually filtered based on predefined eligibility criteria, removing duplicates, screening titles and abstracts, assessing full-text eligibility, and applying inclusion/exclusion criteria (Garcés et al., 2025). This funneling process is the accepted method for transparent and reproducible systematic reviews and is explicitly recommended in the PRISMA guidelines (Page et al., 2021). Through this systematic search process, a large number of bibliographic sources worldwide related to the use of drones in the construction industry were identified, and from this search, the main aspects that correspond to the Latin American reality were extracted.

2.2 Characteristics of the systematic review

The objective of this systematic review is to analyze the scientific literature on the implementation of drones in the construction industry, identifying the benefits, costs, and opportunities presented by the implementation of technological innovation in the construction sector.

The research focuses on studies conducted in Latin America, with an emphasis on countries like Chile, given its active participation in innovation and digital transformation policies within the construction sector. Scientific articles, technical documents, and theses that provide empirical evidence or thoughtful analysis on the use of drones in civil engineering and construction are considered. The timeframe defined for the review encompasses publications from 2020 to 2024, ensuring that it includes up-to-date technology, regulations, and construction practices. The literature search was performed solely using the Scopus and Web of Science (WoS) databases. These scientific sources were selected because they are widely recognized for their rigorous indexing standards, comprehensive disciplinary coverage, and inclusion of high-impact, peer-reviewed journals. Their organized metadata and citation data provide dependable and repeatable information for both quantitative and qualitative analyses. This choice follows standard practices in systematic and bibliometric research, ensuring consistency in methodology and comparability with other studies in the field.

In line with the PRISMA methodology, the following criteria were established:

Inclusion criteria:

• Publications between 2020 and 2024.
• Studies conducted in Latin America or relevant to its context.
• Publications mainly in English.
• Scientific articles, reviews, technical reports, or applied theses.
• Documents that address the benefits, challenges, or opportunities of using drones in construction.

Exclusion criteria:

• Studies before 2020.
• Documents outside the Latin American context without evident applicability.
• Publications in languages other than those defined.
• Works that do not address the use of drones in the construction sector.

2.3 Stages of the review procedure

The research is based on a systematic review of the literature (Codina, 2020). It uses the PRISMA methodology, which guarantees transparency, rigor, and replicability in the search, selection, evaluation, and synthesis of documents (Page et al., 2021). The methodology was carried out in three phases:

Phase 1. Selection and Search Criteria

Inclusion and exclusion criteria were established using four filters: temporality (2020–2024), region (Latin America or studies applicable to its context), thematic relevance, and strategic representativeness. The search was conducted in Scopus and Web of Science-indexed publication databases, as well as in scientific journals and online libraries related to the construction industry. The search used the following keyword combinations: "Technological Tools," "Drones in Construction," "Productivity," "Project Management," "Safety," "Quality," and "Inspection." The

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

selection process involved reviewing titles and abstracts, as well as reading the full documents. Regarding the databases' query logic, here is an example of a Boolean search string used as part of the PRISMA process. Based on an initial total of 1,747 and 1,169 documents in Scopus and WoS, respectively, Figure 1 shows the full set of combined keywords that yielded the initial 512 documents considered in the bibliographic search.

Example of a Boolean algorithm used in the review search:

("drones" AND "construction")
OR
("unmanned Aerial Vehicle" AND "construction industry")
OR
("UAV" AND "construction").

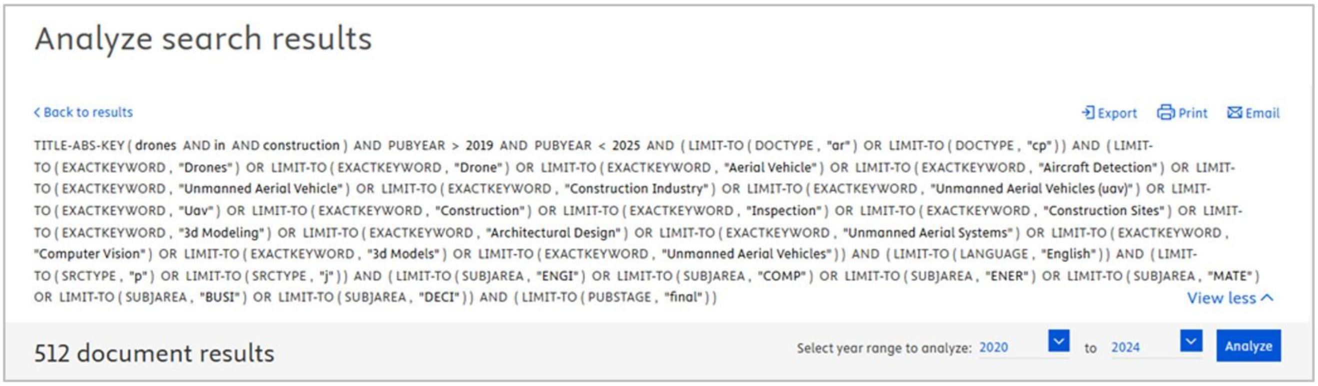

Figure 1. Result of keyword filters applied to the bibliographic search.

Phase 2. Quality Criteria
Criteria were applied to ensure the internal and external validity of the material, such as publication in indexed scientific journals, clarity of objectives, and argumentative coherence (Manterola & Otzen, 2014).

A systematic literature review was carried out using the PRISMA methodology (Figure 2), starting with the initial total of 1,747 documents in Scopus and 1,169 in WoS previously mentioned. After applying successive filters, the number of documents was reduced to 512, and then to 120 relevant studies related to drones in Latin American construction. Consequently, the PRISMA flowchart, illustrated in Figure 2, details the number of studies identified at each stage, the number excluded, the reasons for exclusion, and the final count of studies included. The outcome of this process was a set of 10 articles.

Phase 3. Export and processing of filtered databases
For the bibliometric and thematic analysis of the research, the filtered databases were exported and processed using VOSviewer software. This software enables the creation of a keyword co-occurrence map to identify thematic branches and links between articles. Closeness of keywords on the map indicates a strong correlation, while a greater distance reflects a weaker correlation (Sánchez Benítez, 2023; van Eck & Waltman, 2010).

Thematic analysis, also conducted using VOSviewer, aimed to identify key recurring themes that connect research on the use of drones in construction. The most relevant terms were identified by their significant co-occurrence, represented by the size of the nodes in the bibliographic map (Garcés et al., 2025). Interactions or clusters were then analyzed to identify the most significant relationships between themes and to gain a deeper understanding of the research field's structure.

Phase 4. Results Analysis
The selected articles were coded and analyzed using ATLAS.ti software. The thematic analysis was complemented by word clouds, conceptual networks, and a coding matrix to facilitate the comparison of the results and generate cross-referenced evidence.

Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

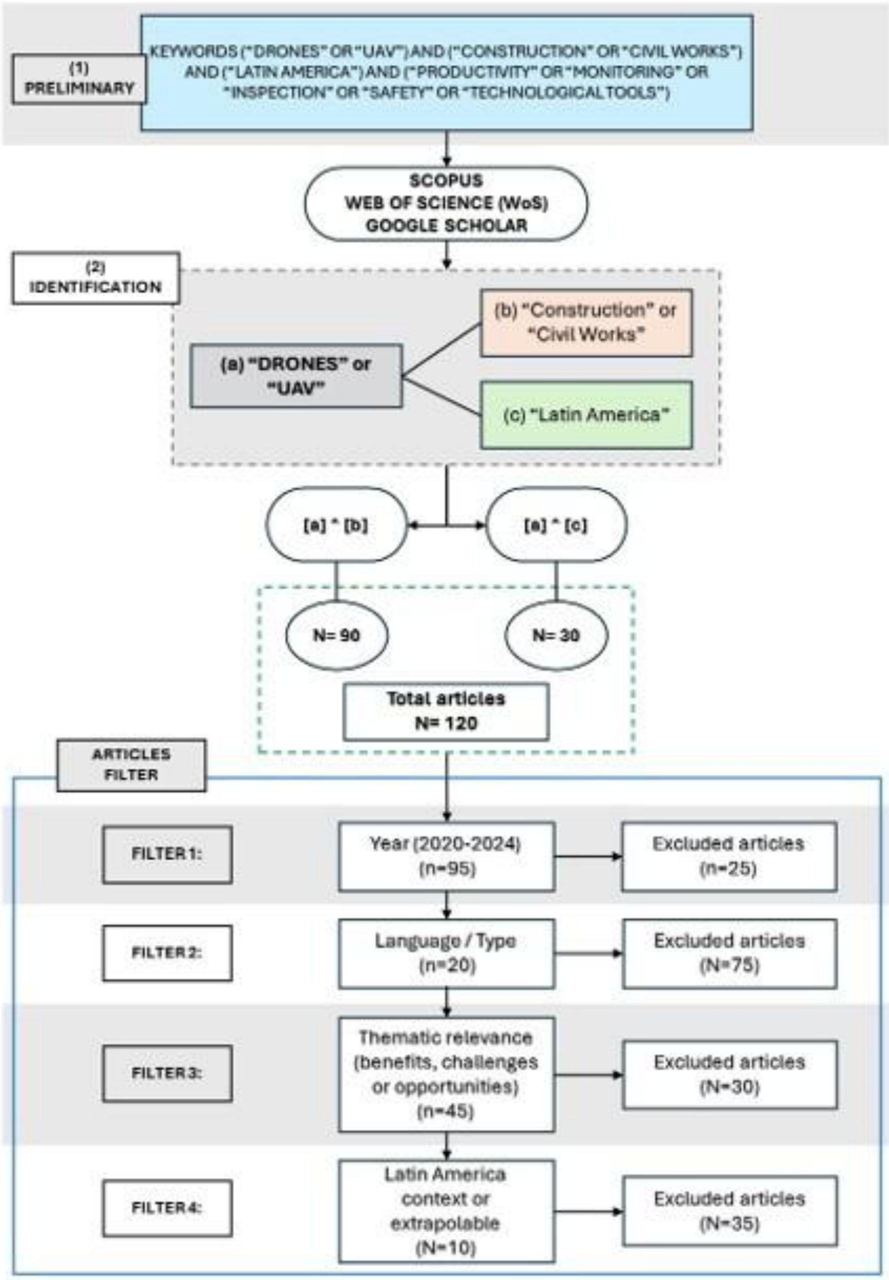

Figure 2. PRISMA flowchart, including inclusion and exclusion filters.

3. Results

3.1 Search documents

Initially, the search returned a total of 1,747 and 1,169 documents in Scopus and WoS, respectively. After applying the filters, the number of records was reduced to 512 and 409 on each platform. The documents are organized by subject area, providing a multidisciplinary perspective on drone research in construction. The "Engineering" field is dominant, accounting for 27.3% of the total. This highlights the direct importance of this technological area across various branches of civil and construction engineering. The "Computer Science" field follows with a significant presence at 21.4%, emphasizing the reliance on drones and their applications in developing algorithms, image processing, artificial intelligence, and autonomous systems. Other key areas include "Mathematics" (7.0%), "Physics and Astronomy" (6.0%), and "Earth and Planetary Sciences" (5.9%), which provide the theoretical foundations and tools for modeling, navigation, and geospatial analysis, leading to numerous drone

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

applications in engineering and construction. Lastly, the participation of "Social Sciences" (4.7%), as an application area for drones, indicates an emerging interest in aspects related to human impact, regulations, and acceptance of this technology, areas also relevant to engineering and construction. Furthermore, the distribution by document type retrieved using the TITLE-ABS-KEY (drones AND construction) search for the period 2020-2024 shows that "Articles" make up the largest share of publications, accounting for 45.0%. "Conference Papers" follow closely at 41.9%. The prominence of these two types suggests that research on drones in construction is a highly active field, with findings quickly shared through scientific journals and conference presentations. The smaller share of "Book Chapters" (4.4%) and "Reviews" (4.0%) could indicate that, while the field is developing, it is still focused on generating primary knowledge, which limits the work related to reviews, books, and book chapters.

The following figures present the results of the search analyses performed in Scopus, along with the statistical data generated after applying the exclusion filters, which are shown in Figures 3 and Figure 4.

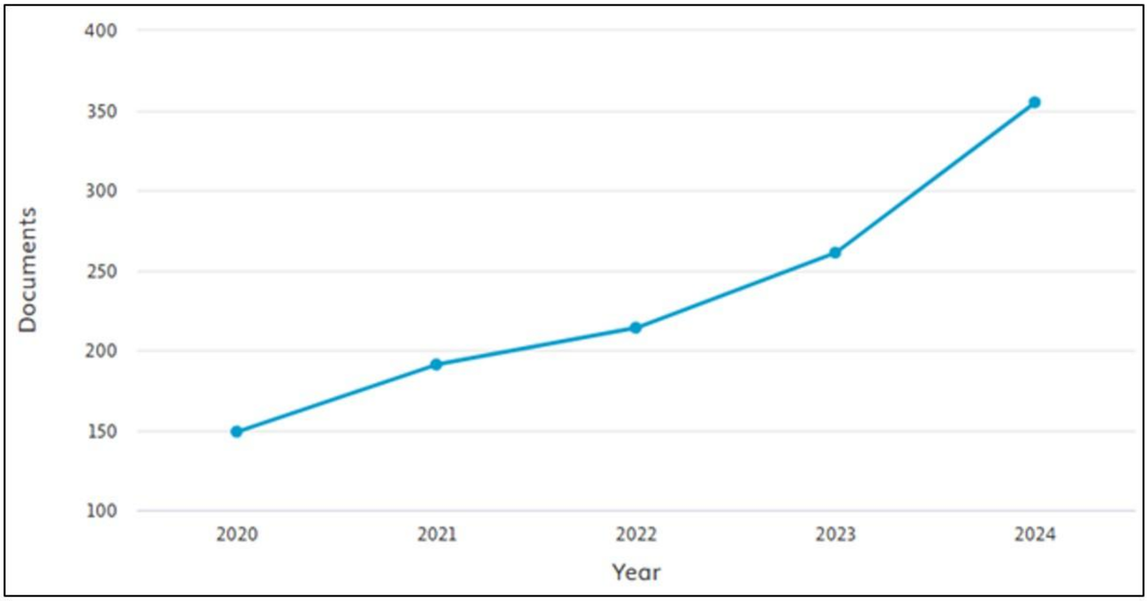

Figure 3. Documents from 2020 to 2024.

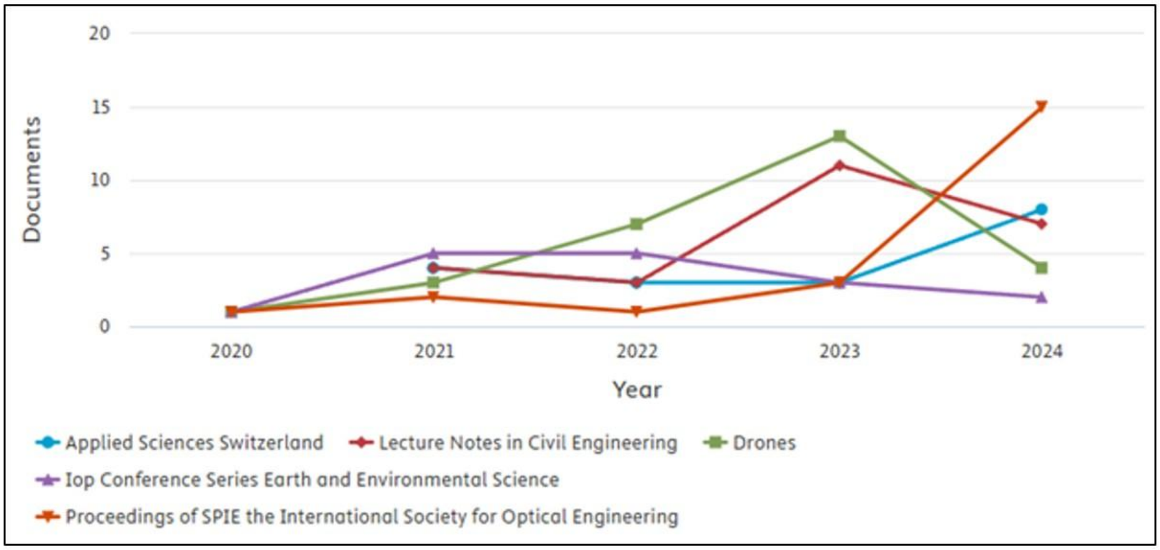

Figure 4. Documents per year by source.

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

3.2 Drones in construction in Latin America

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology was applied to ensure a systematic and transparent selection of the literature. This approach provided a structured process for identifying, screening, and assessing relevant studies, thereby ensuring the inclusion of high-quality and contextually relevant research. The PRISMA matrix, illustrated in Figure 2, details the number of studies identified in each phase, the number excluded, and the reasons for exclusion, as well as the final number of studies included.

The systematic review focused on identifying documents that analyze the incorporation of drones in construction from various perspectives, resulting in ten key articles after applying successive filters, which are shown in Table 1. Research conducted in Latin American contexts was selected, as well as those that, due to their methodology or applicability, were directly applicable to the region. This criterion encompasses diverse perspectives, ranging from technical and operational to normative and organizational, as well as strategic.

Table 1. Articles selected on drones in construction in the Latin American context published between 2020 and 2024.

Article Title	Author(s)	Country / Context
Estimation of the Physical Progress of Work Using UAV and BIM in Construction Projects	(Palomino Ojeda et al., 2024)	Peru-Chile/ Latam
Drones in Construction: Unpacking the Value that Drone Technologies Bring to the Construction Sector Across Latin America	(Rufino et al., 2023)	Dominican Republic /applicable to Latam
An Overview of Drone Applications in the Construction Industry	(Choi et al., 2023)	Korea/extrapolable to Latin America
A Review of the Benefits, Barriers of Drone Employment in the Construction Site	(Alsamarraie et al., 2022)	Latam applicable
Applications of Drones in Infrastructures: Challenges and Opportunities	(Fan & Saadeghvaziri, 2019)	USA /applicable to Latin America
The Use of Unmanned Aerial Vehicles for Dynamic Site Layout Planning in Large-Scale Construction Projects	(Hammad et al., 2021)	Brazil/ Latam
Unmanned Aerial Vehicles (UAVs) for Physical Progress Monitoring of Construction	(Jacob-Loyola et al., 2021)	Chile-Spain/applicable to Latin America
Unmanned Aircraft Systems: A Latin American Review and Analysis from the Colombian Context	(Sánchez-Zuluaga et al., 2023)	Colombia/ Latam
Applications of Drone Technology in the Construction Industry: A Study 2012-2021	(Mahajan, 2021)	India/extrapolable to Latin America
Digital Model of the University of Sonora Campus through Photogrammetry with Drones	(Ramos Corella et al., 2023)	Mexico/ Latam

3.3 Bibliometric and Vosviewer Thematic Analysis

The bibliometric analysis, as shown in Figure 5, presents a co-occurrence map of keywords in the scientific literature on the use of drones (UAVs) in the construction sector. This map, generated using VOSviewer, highlights the most common terms and their interrelation in the research, allowing the identification of the most relevant thematic areas and their connections.

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

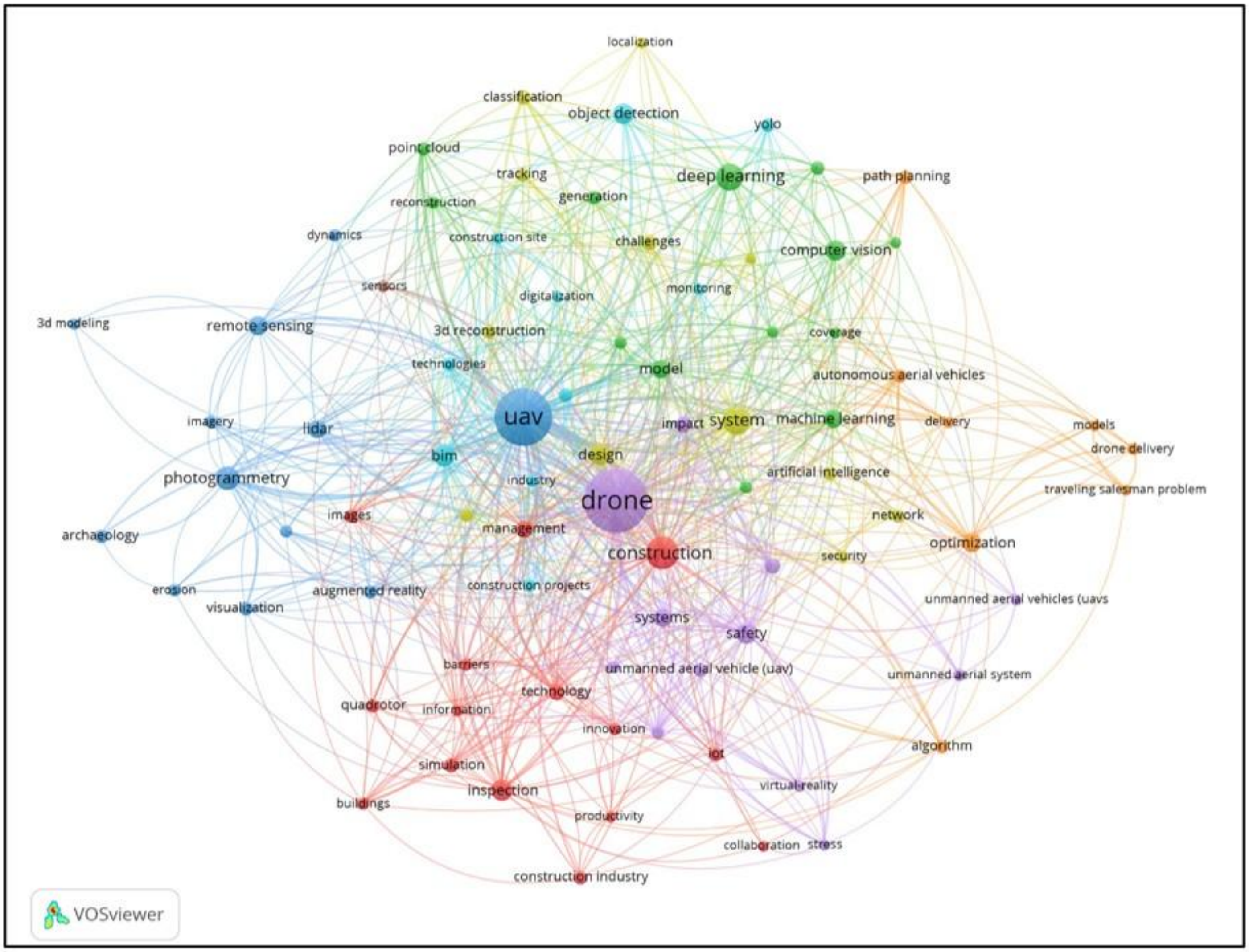

Figure 5. Keyword co-occurrence map with relationships and thematic clusters related to unmanned aerial vehicles (UAVs-Drones) in the construction industry.

The terms "drone" and "UAV" stand out in the center of the graph, confirming their key role in the analyzed studies. Other key terms, such as "construction," "inspection," "safety," "Deep learning", "optimization", and "photogrammetry," are grouped around these central nodes, which suggests that the research not only addresses the use of drones as an emerging technology, but also its impact on multiple construction and development processes.

The map presents different thematic groupings. The blue cluster, located on the left, is mainly related to the mapping and documentation of the site, including terms such as photogrammetry, remote sensing, lidar, and 3D modeling. This group reflects the more traditional and consolidated use of drones to capture and process visual and topographical data.

The green cluster, at the top right, groups terms related to artificial intelligence and automation, including machine learning, deep learning, computer vision, and optimization. This finding highlights a growing trend towards the integration of advanced data analysis and automatic learning algorithms, with applications ranging from object recognition to autonomous route planning.

As for the red cluster, located in the lower center area, this focuses on management and improvement processes for construction, including concepts such as inspection, innovation, productivity, and technology. This group demonstrates how drones are becoming key tools for optimizing project management and decision-making. The orange cluster, on the far right, is associated with applications for logistics and distribution,

www.ricuc.cl
LinkedIn Revista Ingeniería de Construcción
ISSN: 0718-5073

Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

including terms such as drone delivery and algorithms, which suggests an emerging area that may have an impact on material and supply management for construction projects. Finally, the purple cluster, located near the middle, connects concepts such as systems, unmanned aerial vehicles (UAVs), safety, and collaboration. This group appears to serve as a bridge between technological and management approaches, highlighting how drones are integrated into broader digital, collaborative, and safety management systems for the construction industry.

As a whole, the map reflects an evolution in the research approach, from basic capture and 3D modeling applications to more complex digital management, optimization, and automation. This transition suggests technological progress where drones have become key tools to improve productivity, safety, and innovation in construction projects, particularly in regions such as Latin America.
This analysis confirms that drones are a transformative technology for the construction industry. Keywords from this analysis were then used in a second coding process using ATLAS.ti software to make a descriptive analysis that resulted in an interpretive relational network model (Bonilla Castro; Rodriguez Sehk, 2005).

3.4 Thematic and co-occurrence analysis

Thematic and keyword co-occurrence analysis in ATLAS.ti reveals a strong focus on the use of drones for data collection, project monitoring, and control. The terms “Drones,” “Construction,” “UAV,” “Monitoring,” and “Data” are the most frequent. The literature also shows a strong connection with digital modeling technologies such as “3D,” “BIM,” “Photogrammetry,” and “Lidar.” The co-occurrence with words such as “Safety,” “Efficiency,” “Cost,” and “Quality” demonstrates that the positive impacts of drones are addressed. Additionally, challenges and barriers to adoption, such as “Legal” and “Organizational” aspects, are analyzed and graphically shown in Figure 6.

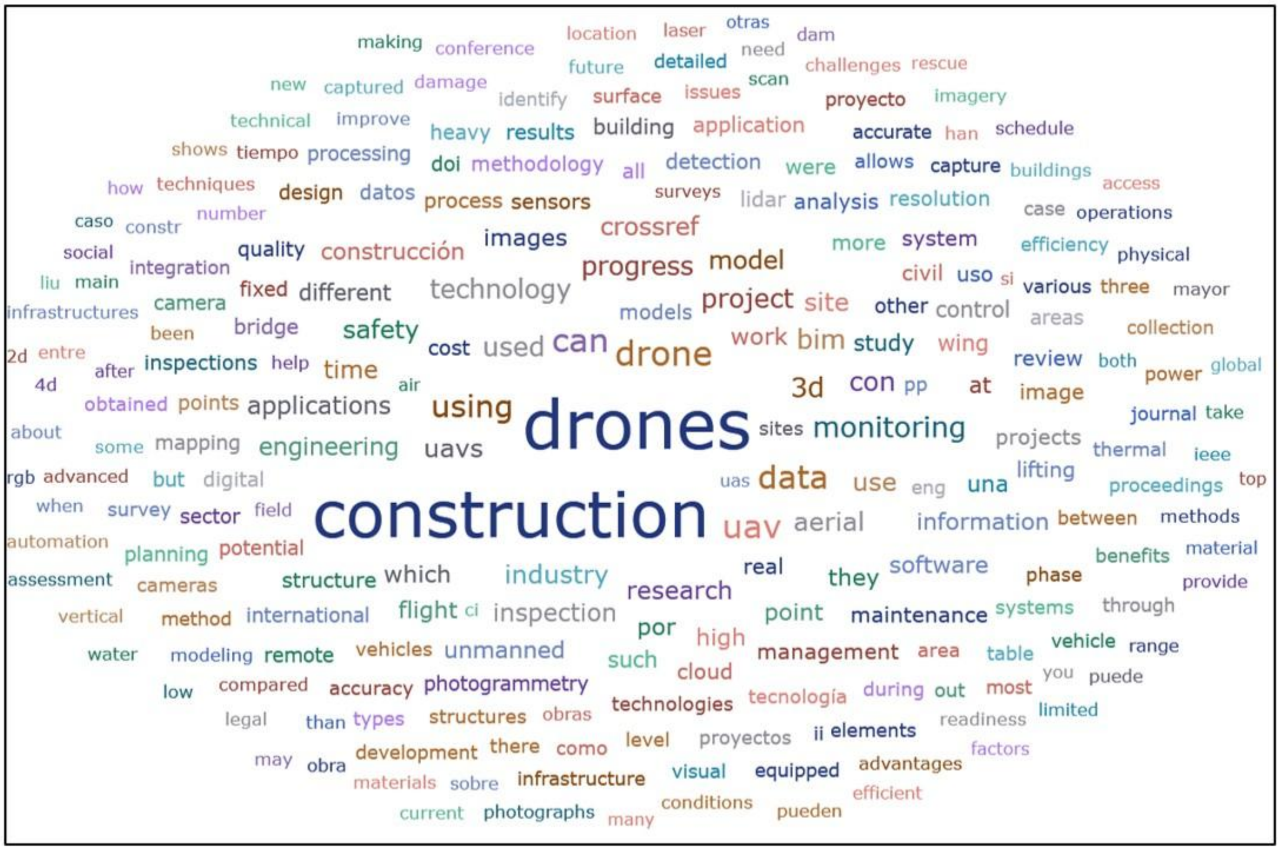

Figure 6. Keyword co-occurrence map.

In the thematic distribution of the coding shown in Figure 7, “Benefits” and “Opportunities” are the most frequently coded themes, suggesting a predominantly positive perception. “Challenges” have a lower count, but are crucial to understanding obstacles.

www.ricuc.cl
LinkedIn Revista Ingeniería de Construcción
ISSN: 0718-5073

Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

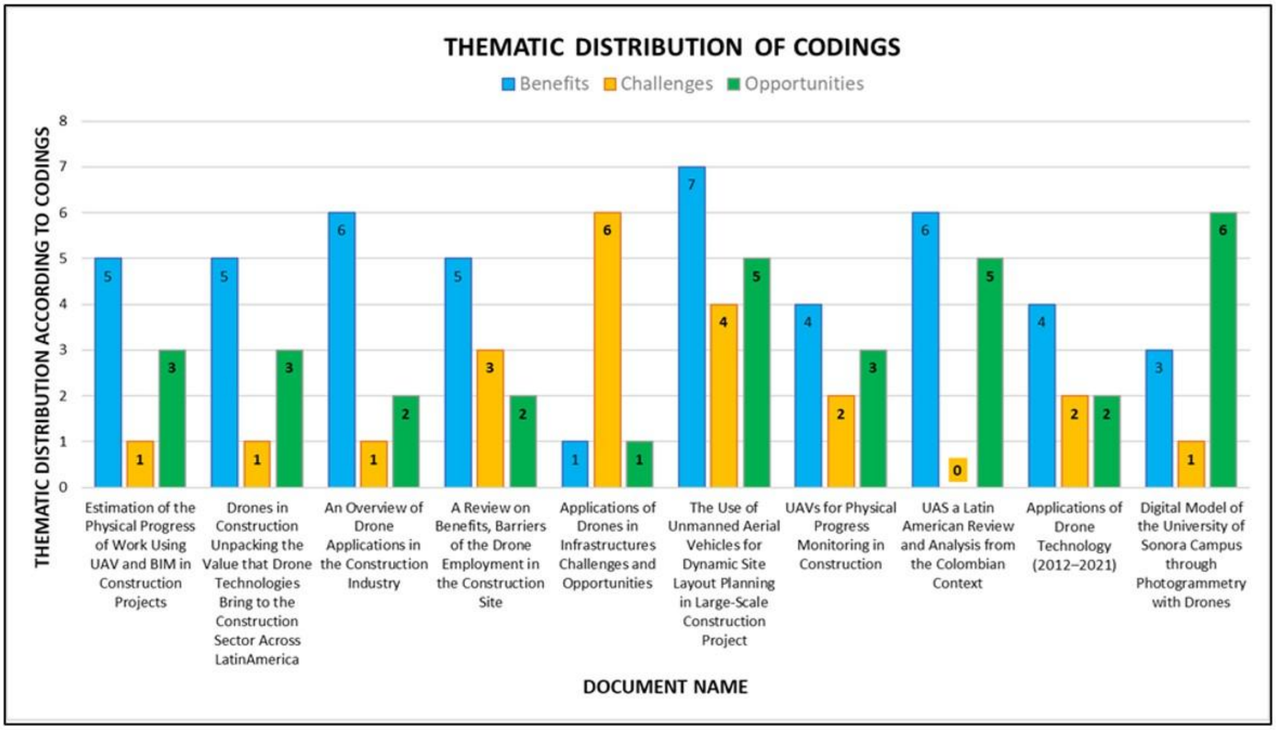

Figure 7. Thematic distribution according to the coding, showing the benefits, challenges, and opportunities.

Complementarily, a code frequency analysis (Figure 8) reveals a predominance of benefits, such as time reduction (85 citations) and traceability (71 citations). The most frequently cited challenges are adoption costs (50 citations) and technical issues (23 citations). The most commonly cited opportunities are institutional visibility (53 citations) and pilot programs (50 citations).

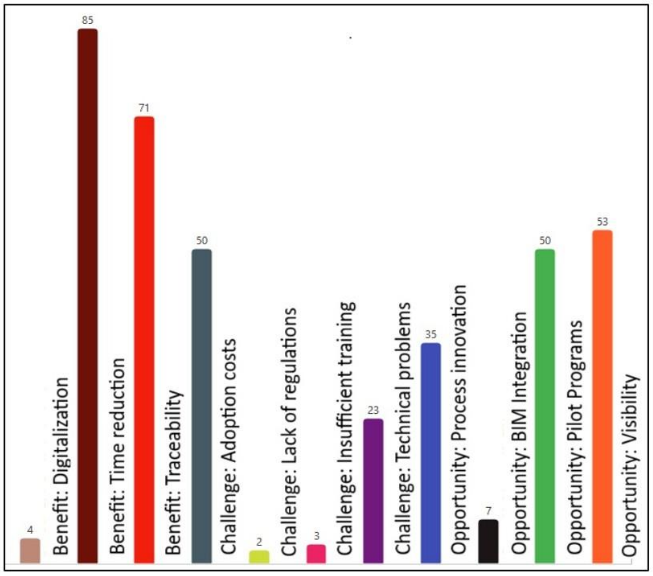

Figure 8. Codes by frequency.

Furthermore, the Sankey diagrams shown in Figures 9, 10, 11, and 12 illustrate the relationships between challenges and benefits of drones in construction, as well as between opportunities and benefits. They demonstrate that, despite initial barriers, the documents reveal significant benefits in terms of time reduction and improvements in traceability. A strong connection is also observed between strategic opportunities (such as integration with BIM and pilot programs) and projected benefits.

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

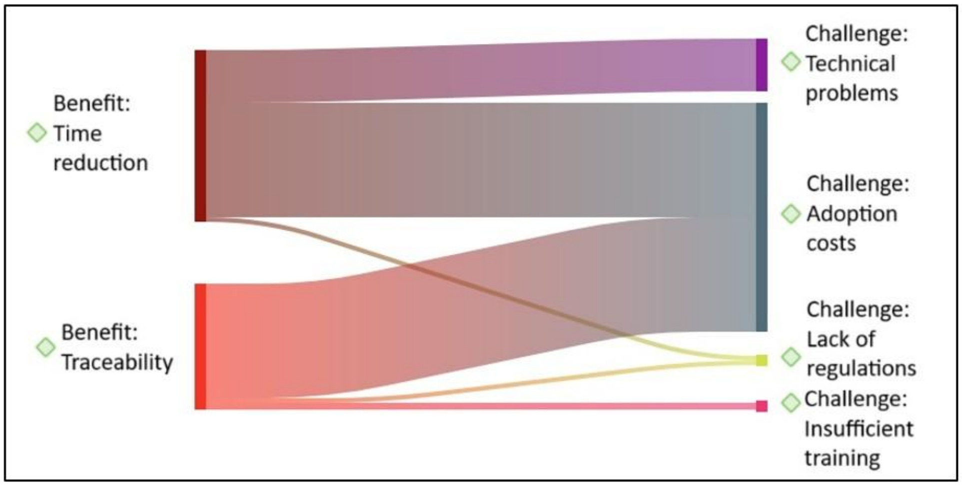

Figure 9. Relationships between challenges and benefits that were identified in the literature.

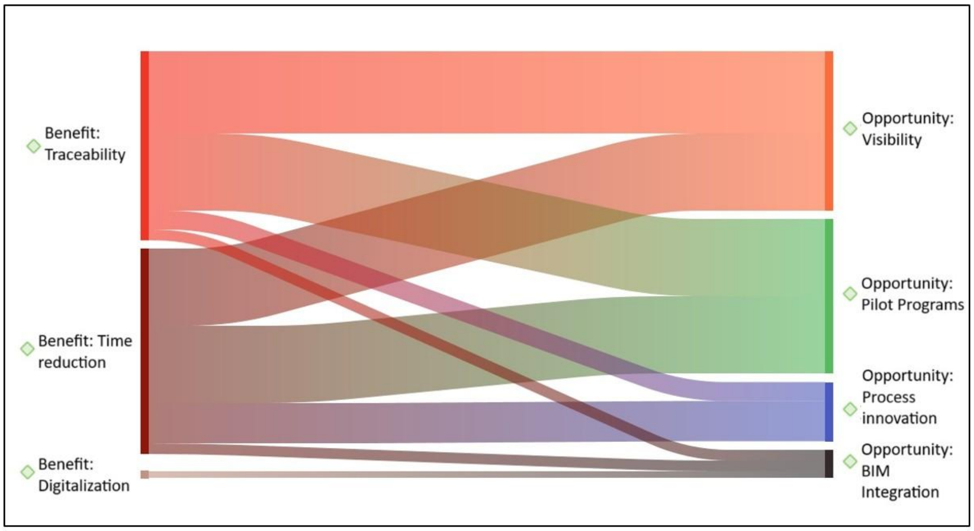

Figure 10. Connections between detected opportunities and projected benefits.

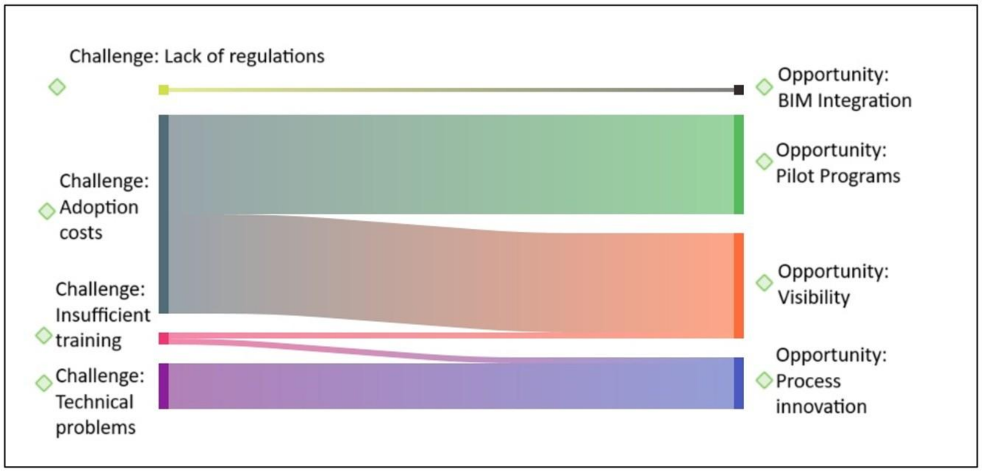

Figure 11. Interaction between emerging opportunities and persistent challenges.

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

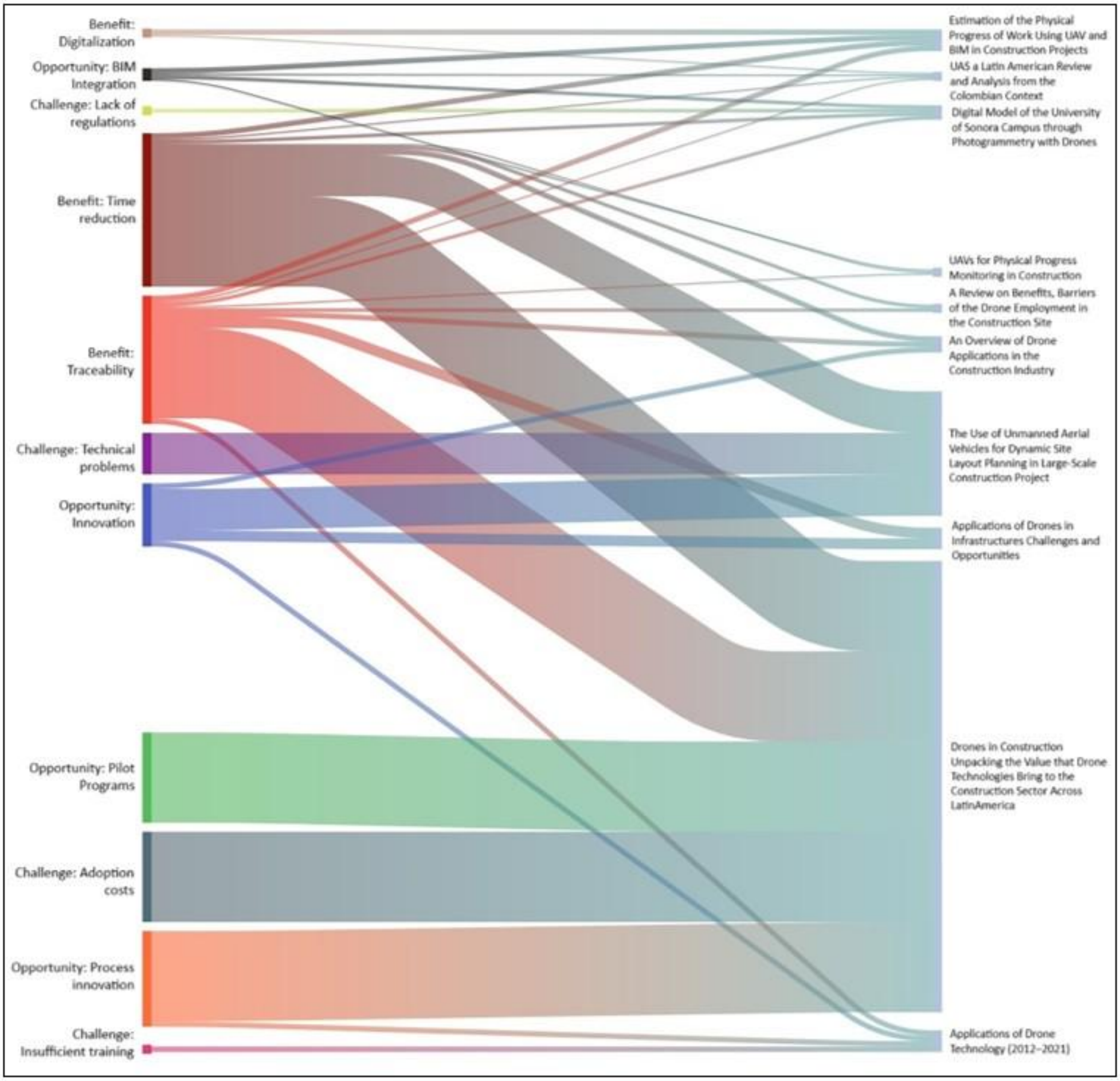

Figure 12. Global map of relationships between codes, thematic axes, and analyzed documents.

Global analysis suggests that the incorporation of drones in the region is predominantly experimental, with limited applications confined to pilot projects or large companies. The effectiveness of drones depends on the existence of internal capabilities to process and utilize information, as technology alone is not sufficient. A gap has been identified between available technology and human capabilities, with the underutilization of the analytical potential of drones due to a lack of specialized training (Choi et al., 2023; Jacob-Loyola et al., 2021; Palomino Ojeda et al., 2024; Zhong et al., 2025).

At the regulatory level, the lack of sector-specific regulatory frameworks creates operational uncertainty and discourages investment. This finding also limits the validation of georeferenced information as evidence in audits. Drone adoption also requires transformations in project management and organizational culture. The benefits only materialize when there is an operational structure that translates data into concrete decisions (Alsamarraie et al., 2022; Hammad et al., 2021; Ramos Corella et al., 2023).

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

3.5 Reflexive analysis of the incorporation of drones in the construction industry in Latin America

Globally, the study by Albeaino et al. (2019) analyzed the trends, benefits, and barriers of UAS in construction, revealing that the most common applications of UAS were progress monitoring, site planning, and surveying/mapping. The main benefits identified were time savings, improved accessibility, and cost reduction. Barriers included adverse weather conditions, operating in confined areas, and legal challenges.

Vargas-Ramirez & Paneque-Gálvez (2019) studied community drones, highlighting their versatility in acquiring high-resolution images at low cost and their application in urban planning. Their review highlights the importance of establishing effective practices for drone use, taking into account ethical, safety, and privacy considerations relevant to the construction industry.

On the other hand, Villarino et al. (2025) reviewed the applications of drones in monitoring and managing civil infrastructure, including buildings and bridges. They emphasized that drones reduce human intervention, increase occupational safety, and obtain accurate information at a lower cost. However, they mentioned limitations such as operating in adverse weather conditions and having limited flight autonomy.

From a Latin American perspective, integrating drones with technologies such as BIM, LiDAR, and photogrammetry software provides solutions that range from real-time visualization to millimetric progress quantification (Mahajan, 2021). The combination of drones with BIM-4D models is one of the most reported applications in the region. One such example is a study by Palomino Ojeda et al. (2024), which demonstrated that the use of drones with scheduled flights enabled the quantification of physical progress with an accuracy of less than five centimeters, thereby improving supervision and efficiency. Similarly, Jacob-Loyola et al. (2021) implemented a weekly survey protocol that helped anticipate delays and readjust schedules with objective data. This practice has been identified by Mahajan (2021) as one of the most established globally, with accelerated adoption in emerging countries such as Chile and Perú.

Regarding technical inspection, drones have minimized operational risks and reduced supervision times. For example, Jacob-Loyola et al. (2021) achieved a 40% reduction in façade inspection times by using drones instead of scaffolding. In Brazil, Hammad et al. (2021) combined LiDAR sensors and automated flights to optimize material flow in an industrial plant. In Colombia, Sánchez-Zuluaga et al. (2023) indicate that drones contribute to cost reduction and increased accuracy, facilitating informed decision-making. However, effective adoption requires staff training, regulatory compliance, and technological integration. Ramos Corella et al. (2023) identified barriers in Mexico, including a lack of regulations, a shortage of certified operators, and high acquisition costs, and suggested the establishment of public-private partnerships to standardize permits and generate training programs (Alsamarraie et al., 2022).

In terms of sustainability, the incorporation of drones also promotes sustainable processes in construction by reducing the ecological footprint, optimizing the use of materials and energy, and preventing failures early. A planned and regulated implementation of drones leads to more effective and sustainable processes in the sector (Sánchez-Zuluaga et al., 2023).

Finally, Emimi et al. (2023) presented an overview of drones, classifying them and highlighting the importance of sensor technology for navigation and detailed data collection. While they recognized benefits, they also pointed out challenges such as payload capacity, range, and regulatory frameworks.

3.6 Benefits of incorporating drones in construction in Latin America

The implementation of drones in Latin American construction goes beyond task automation, redefining the planning, control, and execution of projects. The benefits, identified through the review using the PRISMA methodology, are structural and are grouped into five main categories, which are shown in Table 2. It should be noted, however, that the results presented in Table 2 are based on isolated case studies; therefore, they do not serve as comprehensive evidence but rather as context-specific examples whose benefits could potentially be replicated in Latin America.

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

Table 2. Main benefits identified in the reviewed studies.

Identified benefit	Articles	Empirical evidence
Improvement in traceability and progress control.	(Jacob-Loyola et al., 2021; Mahajan, 2021; Palomino Ojeda et al., 2024)	BIM-4D tracking with an error of < 5 cm; volumetric comparison; 3D models updated regularly.
Reduction of inspection and monitoring times.	(Choi et al., 2023; Hammad et al., 2021; Jacob-Loyola et al., 2021; Sánchez-Zuluaga et al., 2023)	Up to 40% inspection time savings; accurate and rapid visual detection.
Increased safety in high-rise construction projects.	(Alsamarraie et al., 2022; Fan & Saadeghvaziri , 2020; Sánchez-Zuluaga et al., 2023)	Eliminating physical risk to personnel during vertical inspections by using drones as a replacement.
Logistics optimization and cost overrun reduction.	(Choi et al., 2023; Fan & Saadeghvaziri, 2019; Rufino et al., 2023; Sánchez-Zuluaga et al., 2023)	Up to 12% reduction in supervision costs; efficient material flow planning.
Institutional strengthening and digital transition.	(Alsamarraie et al., 2022; Ramos Corella et al., 2023; Rufino et al., 2023)	Creation of protocols, pilots, and regulations; promotion of technical training and public policies.

One of the most notable benefits is the improved traceability and control of the physical progress of construction projects. Several studies have demonstrated that comparing drone-generated 3D models with BIM-4D models enables accurate progress monitoring, with a margin of error of less than 5 cm, thereby reducing uncertainty and facilitating informed decision-making. For example, Palomino Ojeda et al. (2024) reported an error of less than 5 cm in a residential project in Peru. This precision enables the justification or guidance of rescheduling decisions and the validation of progress with technical evidence (Jacob-Loyola et al., 2021; Mahajan, 2021; Palomino Ojeda et al., 2024).

In addition to traceability, drones have significantly reduced inspection and technical supervision times. A study by Fan & Saadeghvaziri (2019) demonstrated that the use of drones reduced the time required to verify seals and expansion joints in high-rise projects by 40% compared to traditional methods. This advantage extends to industrial environments, where LiDAR modeling has optimized logistics and material distribution (Hammad et al., 2021).

Increased operational safety is another strategic benefit, as drones replace tasks that previously required human intervention in risky areas (Sánchez-Zuluaga et al., 2023). Reducing personnel exposure to hazardous conditions is a significant advance in the sector’s safety culture. According to Alsamarraie et al. (2022), this factor is one of the main incentives for investing in drone technology.

From a more strategic perspective, drones have optimized logistics processes and reduced cost overruns. According to Rufino et al. (2023), in social housing, weekly drone inspections decrease the costs associated with field supervision by 12%, thanks to the ability to consolidate visual information and generate automated reports.

These benefits are not just operational advances, but reflect a structural transformation in the construction management model in Latin America. Drones are introducing a new management logic based on empirical data, replacing reactive monitoring and subjective observation (Sánchez-Zuluaga et al., 2023).

Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

3.7 Challenges and opportunities of incorporating drones in Latin American construction

The challenges identified are classified into five main categories: technical-operational, normative-regulatory, professional training, cultural-organizational, and economic scalability, as shown in Table 3.

Table 3. Main challenges and opportunities identified.

Classification	Identified Challenges	Associated Opportunities	Authors
Technical-Operational	Low interoperability between UAV platforms and BIM software. Steep learning curve for analysis and modeling.	Opportunity for focused technical training. Integration with open platforms and applied training.	(Alsamarraie et al., 2022; Jacob-Loyola et al., 2021; Palomino Ojeda et al., 2024)
Normative-Regulatory	Lack of specific regulatory frameworks for drones in construction. Rules are poorly differentiated between recreational and industrial uses.	Development of sectoral regulations. Regional approval of operating criteria and permits.	(Ramos Corella et al., 2023; Rufino et al., 2023; Sánchez-Zuluaga et al., 2023)
Vocational Training	Lack of training for operators and construction personnel. Underutilization of the drone's potential as an analytical tool.	Partnerships with technical training centers. Internal ongoing training protocols.	(Fan & Saadeghvaziri , 2020; Rufino et al., 2023)
Organizational Culture	Resistance to change. Perception of drones as a non-essential complementary technology.	Visibility of successful cases. Incorporation into public bidding processes.	(Hammad et al., 2021; Ramos Corella et al., 2023)
Economic Scalability	Dependence on external consulting and high initial costs. Difficulty of mass adoption in small and medium-sized businesses.	Cost reduction in implementation. Public and private incentives. Shared use across projects.	(Mahajan , 2021; Rufino et al., 2023; Sánchez-Zuluaga et al., 2023)

The research highlights the promising contribution of drones to the Latin American construction industry, as well as the challenges that limit their widespread adoption. These findings outline future lines of research to enhance the knowledge and application of drones in the sector (Alsamarraie et al., 2022; Alzahrani & Emsley, 2021; Choi et al., 2023; Fan & Saadeghvaziri, 2019; Jacob-Loyola et al., 2021; Mahajan, 2021; Palomino Ojeda et al., 2024; Rufino et al., 2023).

It is crucial to conduct quantitative case studies to measure the reduction in costs, execution times, and workplace accidents attributable to the use of drones. It is also essential to research and propose models for specific regulatory frameworks, as well as develop specialized training programs. Another relevant line of research is the analysis of interoperability between drone-generated data and other Construction 40 technologies, such as BIM, IoT, and artificial intelligence (Sánchez-Zuluaga et al., 2023).

4. Discussion

Although the limited number and regional distribution of studies may introduce some bias, the consistency of results across the selected papers supports the robustness of the conclusions and provides valuable evidence for understanding the benefits, challenges, and future directions to advance digital construction management in Latin America through drones.

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

First, the implementation of drones in Latin American construction has demonstrated significant technical and operational benefits, but also faces regulatory, organizational, and social challenges. On large projects, drone photogrammetry enables detailed progress monitoring, and in urban buildings, drones provide comprehensive visibility, preventing height hazards (Acosta García, 2023; Calderón Aragón et al., 2022; Eyzaguirre Silva, 2023; Rufino et al., 2023).

Drone adoption in the region is not homogeneous. Countries with larger economies, such as Brazil, Mexico, and Argentina, have made notable progress, while smaller nations are in their early stages. Within each country, large construction firms and large-scale projects lead innovation, while SMEs face greater challenges. These factors, along with geographic and socioeconomic gaps, exacerbate inequalities in productivity and competitiveness. In conclusion, the potential of drones has been validated; however, their benefits are not distributed equitably due to regulatory and organizational obstacles that disproportionately affect different actors and countries (Bolaji et al., 2024; Calderón Aragón et al., 2022; Eyzaguirre Silva, 2023).

The use of drones in Latin American construction has shown notable technical and operational advantages, but also encounters regulatory, organizational, and social hurdles. On large projects, drone photogrammetry enables detailed progress tracking, and in urban buildings, drones provide comprehensive visibility, helping to prevent height-related hazards (Acosta García, 2023; Calderón Aragón et al., 2022; Eyzaguirre Silva, 2023; Rufino et al., 2023). Although the adoption of drones in Latin American construction clearly offers practical technical benefits, such as improving site monitoring, safety, and efficiency, the speed and level of integration vary greatly between countries. This variability is not only technological but also structural, reflecting differences in economic capacity, regulatory maturity, and workforce digital readiness. The literature highlights that the implementation of UAVs tends to grow where digital transformation is strategically emphasized and where companies can manage the investment and operational costs associated with emerging technologies (Golizadeh et al., 2020; Nwaogu et al., 2023).

Drone adoption in the region varies significantly. Larger economies, such as Brazil, Mexico, and Argentina, have made notable progress, while smaller countries are still in the early stages. Within each country, large construction firms and major projects tend to lead innovation, whereas SMEs face more challenges. These differences, along with geographic and socioeconomic gaps, increase inequalities in productivity and competitiveness. Economic scale greatly influences adoption patterns. In larger economies, construction markets show higher capital intensity and stronger links with international suppliers and tech ecosystems, making it easier to access advanced UAV systems and data analytics services (Rufino et al., 2023; Villarino et al., 2025). Conversely, smaller economies face resource limitations that restrict hardware purchases and training for digital integration. The cost of UAV platforms and post-processing software remains a major hurdle for small and medium-sized enterprises (SMEs), which dominate the regional construction sector.

Regulatory environments also influence adoption paths. Latin American countries differ greatly in their UAV laws, from relatively advanced systems in Brazil and Chile to restrictive or unclear regulations in others. According to Golizadeh et al. (2020), the lack of regulatory harmonization can discourage investment and limit drone operations in construction, especially in urban areas where safety and privacy are major concerns. Countries with transparent certification procedures and risk-based frameworks tend to have higher rates of professional UAV use, which boosts industry confidence and standardization. Another key factor is human capital and institutional capacity. As Elghaish et al. (2020) and Ejaz & Choudhury (2024) state, digitalization relies on organizational learning and cooperation across disciplines, including engineers, data scientists, and construction managers. In many parts of Latin America, the absence of structured training programs in drone data management and computer vision restricts the potential for scalable innovation. This skills gap creates a dual-speed digitalization pattern: large firms with training resources and R&D partnerships progress quickly, while SMEs depend on manual or outsourced services, maintaining productivity gaps.

Beyond these structural factors, socioeconomic inequalities and territorial disparities worsen technological gaps. Geographic barriers hinder real-time UAV data transmission and cloud-based analysis. As a result, drone integration in regional construction systems becomes uneven, focusing on metropolitan areas and large infrastructure projects, leaving outlying regions underserved (Eyzaguirre Silva, 2023; Villarino et al., 2025). In summary, the potential of drones has been confirmed; however, their benefits are not shared equally due to regulatory and organizational challenges that disproportionately impact different actors and countries (Bolaji et al., 2024; Calderón Aragón et al., 2022; Eyzaguirre Silva, 2023).

Finally, some studies, specifically conducted in Latin America, have shown the impact of drones on the construction industry. For example, Oliveira et al. (2024) examined the integration of drone imagery with Building Information Modeling (BIM) to improve maintenance management of educational buildings, especially in low-digital-maturity contexts common in Latin America. Based on a systematic literature review and a case

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

study at a public educational institution, their findings revealed ongoing challenges related to limited preventive maintenance, workforce shortages, and low levels of digitalization. Accordingly, drones proved to be an efficient and accessible method of data collection, offering a cost-effective alternative to complex capture technologies for enhancing maintenance practices in the regional construction sector. However, certain physical obstacles, such as surrounding structures (e.g., towers), were identified as limiting factors for optimal drone image collection.

4.1 Implications for practitioners

This study provides practical insights for construction professionals and organizations aiming to integrate drone technologies effectively in Latin America. Given the region's diverse levels of digital maturity, a phased, purpose-driven implementation approach is advisable. Practitioners should begin with high-impact, low-complexity tasks, such as routine aerial inspections of façades and roofs, photogrammetric monitoring of progress, and volumetric comparisons with BIM-4D models. Evidence from reviewed studies indicates these practices can significantly enhance traceability and accuracy, achieving deviations under five centimeters, while reducing inspection and supervision times by as much as 40%. These improvements support better decision-making and project control. For resource-limited organizations, focusing on affordable, user-friendly UAV platforms and standardized workflows offers immediate benefits without requiring substantial investments in advanced sensors or automation systems.

On the other hand, successful implementation relies not only on adopting new technology but also on enhancing human and institutional capacities to ensure ongoing operation. Practitioners should develop standardized procedures for flight planning, data storage, image processing, and safety checks to ensure consistency and efficiency. Building multidisciplinary teams with expertise in engineering, data analytics, and digital modeling is crucial for leveraging drone data in construction management. Training should extend beyond basic drone use to include photogrammetry, LiDAR analysis, and data integration into BIM systems. Addressing regulatory and ethical challenges, such as complying with aviation laws, safeguarding privacy, and ensuring data security, is vital for gaining trust in UAV workflows. In this sense, public-private partnerships and collaborations can help overcome challenges related to certification, costs, and operator training.

Finally, practitioners should view drone adoption as more than just an innovation; it should be seen as a catalyst for broader digital transformation and sustainability efforts in the construction sector. Implementing pilot projects with specific performance metrics, such as reduced inspection times, lower supervision costs, and decreased worker exposure, can help organizations assess the true benefits of drones and plan for their expanded implementation. Attention should also be paid to environmental and operational hurdles, such as power lines, busy urban environments, and airspace restrictions, which may hinder image collection. In such cases, hybrid inspection solutions or tethered UAVs can be effective. Additionally, ensuring drone data compatibility with other digital tools (BIM, IoT, and AI analytics) will promote data integration and reduce dependence on proprietary systems. Incorporating sustainability metrics, such as material savings, energy efficiency, and reduced emissions, into project assessments can strengthen the connection between drone technology and the overarching goals of sustainable and efficient construction management in Latin America.

5. Conclusions

This review has revealed some interesting insights into the impact of drones on advancing digital construction. However, it has also highlighted the limitations imposed by insufficient regulatory frameworks, a lack of specialized human capital training, and organizational barriers in small and medium-sized businesses, which restrict the use of drones in the construction industry.

Documentary research suggests that drones are a valuable tool for improving efficiency and safety. It highlights the need to improve the industry's technical capabilities through training programs and the integration of technology into higher education. To facilitate their integration, it is recommended that clear regulatory frameworks be developed, specialized training be invested in, and international cooperation be fostered to harmonize regulations.

Limitations of the study, such as the partial scope of regional sources and the lack of generalizable quantitative data, may affect the representativeness of some findings. It is also acknowledged that the current study is limited to a systematic literature review, and its scope could be expanded in future research by incorporating expert surveys or other field studies. Accordingly, based on the findings on the use of drones in the Latin American construction industry, some future lines of research are identified aimed at boosting their adoption, such as exploring interoperability with technologies such as BIM, IoT, and artificial intelligence, as well as investigating the factors that influence their adoption in

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

SMEs. Other relevant areas include the study of innovative business models (such as "Drone as a Service"), the role of drones in sustainability and resilience, automation and applied artificial intelligence, impacts on occupational safety, technical improvements in hardware, and the expansion of applications to tasks such as thermal inspection, quality control, or materials logistics.

6. Declaration of generative AI and AI-assisted technologies

During the preparation of this work, the authors used Grammarly to enhance readability, spelling, and grammar. After utilizing this tool, they reviewed and edited the content as needed and assumed full responsibility for the publication's content.

7. Acknowledgements

The authors thank the College of Engineering and the College of Architecture, Art, and Design at Universidad San Sebastián, Chile.

8. Notes on Contributors

Alexis Concha, Master's Student, Facultad de Arquitectura, Arte y Diseño, Universidad San Sebastián. Chile. **ORCID** https://orcid.org/0009-0005-9541-5341	**Enzo Dragoni**, Master's Student, Facultad de Arquitectura, Arte y Diseño, Universidad San Sebastián.Chile. **ORCID** https://orcid.org/0009-0009-8763-3436
Eric Forcael, Profesor Titular, Facultad de Ingeniería, Arquitectura y Diseño, Universidad San Sebastián. Chile. **ORCID** https://orcid.org/0000-0002-3036-4329	**Marcelo González Retamal**, Profesor Titular, Facultad de Ingeniería, Arquitectura y Diseño, Universidad San Sebastián. Chile. **ORCID** https://orcid.org/0000-0002-9010-430X
Alexis Pérez-Fargallo, Professor, Facultad de Arquitectura, Arte y Diseño, Universidad San Sebastián. Chile. **ORCID** https://orcid.org/0000-0001-7071-7523	

9. References

Acosta García. (2023). The use of drones in construction: Advances, applications, and challenges. https://www.researchgate.net/publication/375765569_El_uso_de_los_drones_en_la_construccion_Avances_aplicaciones_y_desafios_The_use_of_drones_in_construction_Advances_applications_and_challenges

Agapiou, A. (2021). Drones in construction: an international review of the legal and regulatory landscape. Proceedings of the Institution of Civil Engineers - Management, Procurement and Law, 174(3), 118–125. https://doi.org/10.1680/jmapl.19.00041

Alaloul, W. S.; Liew, M. S.; Zawawi, N. A. W. A.; Kennedy, I. B. (2020). Industrial Revolution 4.0 in the construction industry: Challenges and opportunities for stakeholders. Ain Shams Engineering Journal, 11(1), 225–230. https://doi.org/10.1016/J.ASEJ.2019.08.010

Albeaino, G.; Gheisari, M.; Professor, A.; Franz, B. W. (2019). A systematic review of unmanned aerial vehicle application areas and technologies in the AEC domain. In Journal of Information Technology in Construction (ITcon) (Vol. 24). https://www.itcon.org/2019/20

Alsamarraie, M.; Ghazali, F.; Abdul-Ghani, Zaid; Maeni, Alhamza (2022). A review on the benefits, barriers of the drone employment in the construction site. Jurnal Teknologi, 84(2), 121–131. https://doi.org/10.11113/jurnalteknologi.v84.17503

Alsehaimi, A.; Waqar, A.; El Aal, S.H.; Hayat, S.; Ahmed Waris, F.; Benjeddou, O. (2024). Optimising construction sector performance: A study of the rapidly growing global drone industry using smart PLS approach. Journal of Engineering Research. https://doi.org/10.1016/j.jer.2024.08.004

Alzahrani, J. I.; Emsley, M. W. (2021). The impact of contractors' attributes on construction project success: A post construction evaluation. International Journal of Project Management, 31(2), 313–322. https://doi.org/10.1016/j.ijproman.2012.06.006

Baghalzadeh Shishehgarkhaneh, M.; Keivani, A.; Moehler, R. C.; Jelodari, N.; Roshdi Laleh, S. (2022). Internet of Things (IoT), Building Information Modeling (BIM), and Digital Twin (DT) in Construction Industry: A Review, Bibliometric, and Network Analysis. Buildings, 12(10), 1503. https://doi.org/10.3390/buildings12101503

Bolaji, W. A.; Olatunde, O. T.; Valentine, N. N.; Fatai, O. B. (2024). Investigation of the Use of Drones by Construction Professionals in Addressing Built Environment Tasks. Green Building & Construction Economics, 1–16. https://doi.org/10.37256/gbce.5120243819

Bonilla Castro; Rodriguez Sehk. (2005). Mas allá del dilema de los métodos. La investigación en ciencias sociales. Editorial Norma, 3era Edición. https://doi.org/10.13140/RG.2.2.25697.94563/1

Caballero-Martin, D.; Lopez-Guede, J. M., Estevez, J., & Graña, M. (2024). Artificial Intelligence Applied to Drone Control: A State of the Art. Drones, 8(7), 296. https://doi.org/10.3390/drones8070296

Calderón Aragón, G., Cubillos Rodríguez, J. P.; Delgado niño, P. (2022). Use of Unmanned Aerial Vehicles (drones) for the Collection of Primary Information in Environmental Studies by Environmental. Avances Investigación En Ingeniería, 19(1 (Enero-Junio)). https://doi.org/10.18041/1794-4953/avances.1.7575

Choi, H. W.; Kim, H. J.; Kim, S. K.; Na, W. S. (2023). An Overview of Drone Applications in the Construction Industry. Drones 2023, Vol. 7, Page 515, 7(8), 515. https://doi.org/10.3390/DRONES7080515

Codina, L. (2020). How to conduct traditional or systematic bibliographic reviews in master's degree final projects and doctoral theses. Revista ORL, 11(2), 139–153. https://doi.org/10.14201/orl.22977

Ejaz, N.; Choudhury, S. (2024, July 1). Computer vision in drone imagery for infrastructure management. Automation in Construction. Elsevier B.V. https://doi.org/10.1016/j.autcon.2024.105418

Elghaish, F.; Matarneh, S.; Talebi, S.; Kagioglou, M.; Hosseini, M. R.; Abrishami, S. (2020). Toward digitalization in the construction industry with immersive and drones technologies: a critical literature review. Smart and Sustainable Built Environment, 10(3), 345–363. https://doi.org/10.1108/SASBE-06-2020-0077

Emimi, M.; Khaleel, M.; Alkrash, A. (2023). International Journal of Electrical Engineering and Sustainability (IJEES) The Current Opportunities and Challenges in Drone Technology. 1(3), 74–89. https://ijees.org/index.php/ijees/index

Eyzaguirre Silva. (2023). Study of the impact of technological advances on the productivity of the construction industry.

Fan, J.; Saadeghvaziri, M. (2019). Applications of Drones in Infrastructures: Challenges and Opportunities. https://doi.org/10.5281/zenodo.3566281

Forcael, E.; Ferrari, I.; Opazo-Vega, A.; Pulido-Arcas, J. A. (2020). Construction 4.0: A Literature Review. Sustainability, 12(22), 9755. https://doi.org/10.3390/su12229755

Forcael, E.; Román, O.; Stuardo, H.; Herrera, R. F.; Soto-Muñoz, J. (2024). Evaluation of Fissures and Cracks in Bridges by Applying Digital Image Capture Techniques Using an Unmanned Aerial Vehicle. Drones, 8(1). https://doi.org/10.3390/drones8010008

Garcés, G.; Forcael, E.; Osorio, C.; Castañeda, K.; Sánchez, O. (2025). Systematic review of Lean Construction: an approach to sustainability and efficiency in construction management. Journal of Infrastructure Preservation and Resilience, 6(1), 6. https://doi.org/10.1186/s43065-025-00119-1

Gheisari, M.; Esmaeili, B. (2016). Unmanned Aerial Systems (UAS) for Construction Safety Applications. Construction Research Congress 2016: Old and New Construction Technologies Converge in Historic San Juan - Proceedings of the 2016 Construction Research Congress, CRC 2016, 2642–2650. https://doi.org/10.1061/9780784479827.263

Girgin, E.; Candan, A. T.; Zaman, C. A. (2025). EdgeAI Drone for Autonomous Construction Site Demonstrator. http://arxiv.org/abs/2505.09837

Golizadeh, H.; Hosseini, M. R.; Martek, I.; Edwards, D.; Gheisari, M.; Banihashemi, S.; Zhang, J. (2020, March 25). Scientometric analysis of research on "remotely piloted aircraft": A research agenda for the construction industry. Engineering, Construction and Architectural Management. Emerald Group Holdings Ltd. https://doi.org/10.1108/ECAM-02-2019-0103

González Herrera, R.; Ucán Navarrete, J. P.; Sánchez Pinto, I.; Medina Escalante, R.; Árcega Cabrera, F.; Zetina Moguel, C.; Casares Salazar, R. (2019). Drones. Aplicaciones en ingeniería civil y geociencias. Interciencia: Revista de Ciencia y Tecnología de América, ISSN 0378-1844, Vol. 44, No. 6, 2019, Págs. 326-331, 44(6), 326–331. https://dialnet.unirioja.es/servlet/articulo?codigo=7011689&info=resumen&idioma=ENG

Gunduz, M.; Yahya, A. M. A. (2022). Analysis of project success factors in construction industry. Technological and Economic Development of Economy, 24(1), 67–80. https://doi.org/10.3846/20294913.2015.1074129

Hammad, A.; da Costa, B.; Soares, C.; Haddad, A. (2021). The Use of Unmanned Aerial Vehicles for Dynamic Site Layout Planning in Large-Scale Construction Projects. Buildings, 11(12), 602. https://doi.org/10.3390/buildings11120602

Hasa, X. (2024). Drone Usage in Civil Engineering - A Case Study of the Pristina-Gjilan Highway. Engineering, 16(06), 167–180. https://doi.org/10.4236/eng.2024.166013

Hernández Sampieri, R.; Feránadez Collado, C.; Baptista Lucio, M. D. P. (2014). Metodología de la investigación. Metodología de La Investigación, 91. https://dialnet.unirioja.es/servlet/libro?codigo=775008&info=resumen&idioma=SPA

Jacob-Loyola, N.; Muñoz-La Rivera, F.; Herrera, R. F.; Atencio, E. (2021). Unmanned Aerial Vehicles (UAVs) for Physical Progress Monitoring of Construction. Sensors, 21(12), 4227. https://doi.org/10.3390/s21124227

Künzel, J.; Vehar, D.; Nestler, R.; Franke, K.-H.; Hilsmann, A.; Eisert, P. (2023). System for 3D Acquisition and 3D Reconstruction Using Structured Light for Sewer Line Inspection. Proceedings of the 18th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications, 997–1006. https://doi.org/10.5220/0011779900003417

Mahajan, G. (2021). Applications of Drone Technology in Construction Industry: A Study 2012-2021. International Journal of Engineering and Advanced Technology, 11(1), 224–239. https://doi.org/10.35940/IJEAT.A3165.1011121

Manterola, C.; Otzen, T. (2014). Análisis Crítico de la Literatura Biomédica. International Journal of Morphology, 32(2), 599–607. https://doi.org/10.4067/S0717-95022014000200037

Mendu, B.; Mbuli, N. (2025). State-of-the-Art Review on the Application of Unmanned Aerial Vehicles (UAVs) in Power Line Inspections: Current Innovations, Trends, and Future Prospects. Drones, 9(4), 265. https://doi.org/10.3390/drones9040265

Moher, D.; Liberati, A.; Tetzlaff, J.; Altman, D. G. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Medicine, 6(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

Molina, A. A.; Huang, Y.; Jiang, Y. (2023). A Review of Unmanned Aerial Vehicle Applications in Construction Management: 2016–2021. Standards, 3(2), 95–109. https://doi.org/10.3390/standards3020009

Molina Martínez. (2019). Monitoreo de obra mediante modelos digitales de elevación generados por fotogrametría con drones. Uniandes. http://hdl.handle.net/1992/45465

Nwaogu, J. M.; Yang, Y.; Chan, A. P. C.; Chi, H. (2023, June 1). Application of drones in the architecture, engineering, and construction (AEC) industry. Automation in Construction. Elsevier B.V. https://doi.org/10.1016/j.autcon.2023.104827

Olawumi, T. O.; Chan, D. W. M. (2019). Building information modelling and project information management framework for construction projects. Journal of civil engineering and management, 25(1), 53–75. https://doi.org/10.3846/jcem.2019.7841

Oliveira Sena, R.; Souza Silva, A.; Sávio Sampaio De Melo, R.; Bastos Costa, D. (2024). Proposal for integrating drone images and BIM in educational public buildings to support maintenance management. Revista Ingenieria de Construccion, 39(3). https://doi.org/10.7764/RIC.00115.21

Page, M. J.; McKenzie, J. E.; Bossuyt, P. M.; Boutron, I.; Hoffmann, T. C.; Mulrow, C. D.; Shamseer, L.; Tetzlaff, J. M.; Akl, E. A.; Brennan, S. E.; Chou, R.; Glanville, J.; Grimshaw, J. M.; Hróbjartsson, A.; Lalu, M. M.; Li, T.; Loder, E. W.; Mayo-Wilson, E.; McDonald, S.; … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ, Volume 74, Issue 9, 790–799. https://doi.org/10.1016/j.recesp.2021.06.016

Palomino Ojeda, J. M.; Quiñones Huatangari, L.; Cayatopa Calderon, B. A.; Piedra Tineo, J. L.; Apaza Panca, C. Z.; Milla Pino, M. E. (2024). Estimation of the Physical Progress of Work Using UAV and BIM in Construction Projects. Civil Engineering Journal, 10(2), 362–383. https://doi.org/10.28991/CEJ-2024-010-02-02

Paneru, S.; Jeelani, I. (2021). Computer vision applications in construction: Current state, opportunities & challenges. Automation in Construction, 132, 103940. https://doi.org/10.1016/j.autcon.2021.103940

Perera, S.; Nanayakkara, S.; Rodrigo, M. N. N.; Senaratne, S.; Weinand, R. (2020). Blockchain technology: Is it hype or real in the construction industry? Journal of Industrial Information Integration, 17, 100125. https://doi.org/10.1016/j.jii.2020.100125

PwC Drone Powered Solutions. (2021). Drones General Assessment in Latin America and the Caribbean.

Rakha, T.; Gorodetsky, A. (2018). Review of Unmanned Aerial System (UAS) applications in the built environment: Towards automated building inspection procedures using drones. Automation in Construction, 93, 252–264. https://doi.org/10.1016/j.autcon.2018.05.002

Ramos Corella, M. A.; Ibarra Duarte, D. A.; Ramírez Uribe, G.; Ibarra Torúa, G. K.; Miranda Torres, I. E. (2023). Digital Model of the University of Sonora Campus through Photogrammetry with Drones. EPISTEMUS, 17(34). https://doi.org/DOI:https://doi.org/10.36790/epistemus.v17i34.263

Ravishankar, P.; Hwang, S.; Zhang, J.; Khalilullah, I. X.; Eren-Tokgoz, B. (2022). DARTS—Drone and Artificial Intelligence Reconsolidated Technological Solution for Increasing the Oil and Gas Pipeline Resilience. International Journal of Disaster Risk Science, 13(5), 810–821. https://doi.org/10.1007/s13753-022-00439-w

Rufino, S. R.; Porcel, M. R.; Richiez, O. P.; Seré, J.; Buczkowski, A.; Morales, M.; Bieniek, K. (2023). Drones in Construction: Unpacking the Value that Drone Technologies Bring to the Construction Sector Across Latin America. https://doi.org/10.18235/0004748

Sánchez Benítez, G. Z. (2023). La tragedia silente del desplazamiento forzado: una violación sistemática de los derechos humanos. CIID Journal, 4(1), 44–64. https://doi.org/10.46785/ciidj.v4i1.102

Sánchez-Zuluaga, G. J.; Isaza-Giraldo, L.; Zapata-Madrigal, G. D.; García-Sierra, R.; Candelo-Becerra, J. E. (2023). Unmanned Aircraft Systems: A Latin American Review and Analysis from the Colombian Context. Applied Sciences, 13(3), 1801. https://doi.org/10.3390/app13031801

Tawfik, G. M.; Dila, K. A. S.; Mohamed, M. Y. F.; Tam, D. N. H.; Kien, N. D.; Ahmed, A. M.; Huy, N. T. (2019). A step by step guide for conducting a systematic review and meta-analysis with simulation data. Tropical Medicine and Health, 47(1), 46. https://doi.org/10.1186/s41182-019-0165-6

Terutsuki, D.; Uchida, T.; Fukui, C.; Sukekawa, Y.; Okamoto, Y.; Kanzaki, R. (2021). Real-time odor concentration and direction recognition for efficient odor source localization using a small bio-hybrid drone. Sensors and Actuators B: Chemical, 339, 129770. https://doi.org/10.1016/J.SNB.2021.129770

ISSN: 0718-5073
Vol. 40
Special Issue 2025
DOI: https://doi.org/10.7764/RIC.00163.21

van Eck, N. J.; Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics, 84(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

Vargas-Ramírez, N.; Paneque-Gálvez, J. (2019). The Global Emergence of Community Drones (2012–2017). Drones, 3(4), 76. https://doi.org/10.3390/drones3040076

Villarino, A.; Valenzuela, H.; Antón, N.; Domínguez, M.; Méndez Cubillos, X. C. (2025). UAV Applications for Monitoring and Management of Civil Infrastructures. Infrastructures, 10(5), 106. https://doi.org/10.3390/infrastructures10050106

Zhong, W.; Rasouli, S.; Singh, A. K.; Mohandes, S. R.; Antwi-Afari, M. F.; Cheung, C.; Manu, P.; Agrawal, U. (2025). The Adoption of UAVs for Enhancing Safety in Construction Industry: A Systematic Literature Review. Intelligent Infrastructure and Construction, 1(1), 3. https://doi.org/10.3390/iic1010003