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Common Data Environments in Construction Project Management

Understanding the Impacts of CDE Adoption and Developing Guidelines for Industry Implementation

Master's thesis in Design and Construction Project Management

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ABSTRACT

The construction industry continues to face significant challenges related to fragmented information management, inefficient communication and limited coordination between project stakeholders. Although digitalization has increased in. recent years, the adoption of Common Data Environments (CDEs) remains inconsistent, particularly among small and medium-sized enterprises (SMEs). Many construction projects still operate through disconnected systems and informal communication practices, contributing to delays, rework and information loss. This study investigates how the adoption of a CDE influences information flow, coordination and project practices within construction teams, while also examining the main needs and expectations of SMEs regarding more accessible CDE implementation. The research was conducted using a qualitative approach that combined a systematic literature review with semi-structured interviews with contractors operating in Spain and Mexico. The theoretical framework focused on digitalization, project information management, fragmentation and CDE implementation in construction projects. Interview data were analyzed through thematic analysis to identify recurring patterns related to communication, coordination and digital system adoption. The findings indicate that information fragmentation continues to affect project performance across companies of different sizes. While contractors using CDEs reported improvements in document control, traceability and information accessibility, many organizations still depend on hybrid systems that combine digital platforms with traditional communication methods. The study also identified barriers limiting wider adoption, including implementation costs, resistance to change, lack of standardization and difficulties adapting digital systems to practical site workflows, particularly within SMEs. The research contributes by providing empirical insights into current industry practices and highlighting the need for more flexible and accessible information management systems. Future research should further investigate the economic impact and long-term implementation of CDE solutions within SMEs.

Key words:
Common Data Environment (CDE), construction project management, information management, digitalization, SMEs, project coordination, construction industry.

Vanliga datamiljöer inom byggprojektledning

Förstå effekterna av CDE-implementering och utveckla riktlinjer för branschimplementering

Examensarbete inom mastersprogrammet Design- och konstruktionsprojektledning (MPDCM)

JOSÉ LUIS FERNÁNDEZ ALCOCER

Institutionen för arkitektur och samhällsbyggnadsteknik
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SAMMANFATTNING

Byggbranschen fortsätter att stå inför betydande utmaningar relaterade till fragmenterad informationshantering, ineffektiv kommunikation och begränsad samordning mellan projektets intressenter. Trots att digitaliseringen har ökat under de senaste åren är användningen av gemensamma datamiljöer (Common Data Environments, CDE) fortfarande inkonsekvent, särskilt bland små och medelstora företag (SMF). Många byggprojekt drivs fortfarande genom frånkopplade system och informella kommunikationsmetoder, vilket bidrar till förseningar, omarbetningar och informationsförlust. Denna studie undersöker hur införandet av en CDE påverkar informationsflöde, samordning och projektmetoder inom byggteam, samtidigt som de främsta behoven och förväntningarna hos SMF gällande en mer tillgänglig CDE-implementering granskas. Forskningen genomfördes med ett kvalitativt tillvägagångssätt som kombinerade en systematisk litteraturstudie med semistrukturerade intervjuer med entreprenörer verksamma i Spanien och Mexiko. Det teoretiska ramverket fokuserade på digitalisering, projektinformationshantering, fragmentering och CDE-implementering i byggprojekt. Intervjudata analyserades genom tematisk analys för att identifierar återkommande mönster relaterade till kommunikation, samordning och införande av digitala system. Resultaten tyder på att informationsfragmentering fortsätter att påverka projektprestationen i företag av olika storlekar. Medan entreprenörer som använder CDE rapporterade förbättringar inom dokumentkontroll, spårbarhet och tillgång till information, är många organisationer fortfarande beroende av hybridsystem som kombinerar digitala plattformar med traditionella kommunikationsmetoder. Studien identifierade också barriärer som begränsar en bredare användning, inklusive implementeringskostnader, förändringsmotstånd, brist på standardisering och svårigheter att anpassa digitala system till praktiska arbetsflöden på byggplatsen, särskilt inom SMF. Forskningen bidrar med empiriska insikter i nuvarande branschpraxis och belyser behovet av mer flexibla och tillgängliga system för informationshantering. Framtida forskning bör ytterligare undersöka den ekonomiska påverkan och den långsiktiga implementeringen av CDE-lösningar inom SMF.

Nyckelord:
Gemensam datamiljö (CDE), projektledning inom byggsektorn, informationshantering, digitalisering, SMF, projektsamordning, byggbranschen.

Contents

Preface

This thesis was developed as part of the master's Programme in Design and Construction Project Management at Chalmers University of Technology. The motivation behind this research comes largely from my professional experience within the construction industry and from observing how information management directly affects the success of construction projects.

Throughout my experience working with construction companies of different sizes, ranging from small teams of only a few people to medium-sized organizations, I noticed that many project problems were not necessarily caused by technical construction issues, but by the way information was managed, communicated and controlled. At the same time, I became interested in understanding how information processes could be simplified for the people who use them daily, particularly site teams and project managers who often work under time pressure and constantly changing project conditions.

This interest led me to explore CDEs and the broader topic of digital information management in construction projects. While digitalization continues to advance across the industry, I believe there is still a significant gap between many existing digital systems and the practical realities faced by contractors, especially small and medium-sized enterprises (SMEs). For this reason, this thesis is primarily intended for construction companies seeking more practical and accessible approaches to information management, but also for professionals and software developers interested in creating digital solutions that better respond to the needs of this large but often overlooked sector of the industry.

I would like to sincerely thank Dimosthenis Kifokeris for this guidance and support throughout this research process. I would also like to thank all the professionals who participated in the interviews and shared their experiences openly, as their insights were essential for the development of this study. Finally, i would like to thank everyone who supported me throughout this journey and during the completion of this thesis. The contribution, time and support received from many people made this research possible.

Göteborg June 2026

JOSÉ LUIS FERNÁNDEZ ALCOCER

Notations

This section presents the main abbreviations and technical terms used throughout the thesis. These abbreviations are used to improve readability and maintain consistency within the document.

Abbreviations:

BIM: Building Information Modeling
CDE: Common Data Environment
GDP: Gross Domestic Product
ICT: Information and Communication Technology
ISO: International Organization for Standardization
RFI: Request for Information
SLR: Systematic Literature Review
SMEs: Small and Medium-sized Enterprises

1 Introduction

This chapter introduces the research by outlining key challenges in construction information management, particularly fragmentation and the uneven adoption of digital solutions. It presents the aim and research questions, focusing on the role of Common Data Environments (CDEs), and defines the scope and limitations of the study.

1.1 Background

The construction industry plays a significant role in national economies, contributing to economic growth, employment and industrial development. In Spain, the sector accounted for approximately 5.3% of national GDP in 2024 and employed around 1.41 million people (Eje Prime, 2025). Similarly, in Mexico, construction represented approximately 6.61% of GDP and accounted for a considerable share of total employment, highlighting its relevance as a driver of economic activity and infrastructure development (Monex, 2025). However, despite its economic importance, the industry continues to face persistent structural challenges that affect project performance. Construction projects are delivered within complex and dynamic environments, where multiple stakeholders must coordinate activities under conditions of uncertainty, tight schedules and continuous change (Aigbavboa & Kissi, 2025).

One of the main contributors to those structural challenges is the fragmentation of project information. Construction projects involve multiple stakeholders who generate and exchange large volumes of data, often across disconnected systems and communication channels (Bello, et al., 2024). This makes it difficult to ensure consistency, accessibility and reliability of information, leading to inefficiencies such as errors, delays and rework (Musonda, et al., 2019) (Mbazor, et al., 2025). In recent years, the industry has faced increasing pressure to improve performance due to factors such as rising costs, labor shortages and supply chain disruptions, which continue to affect project delivery across different markets (Autodesk, 2026). At the European level, digitalization and the structural transformation are increasingly considered essential to enhance productivity and long-term competitiveness in the construction sector (European Comission, 2025).

However, despite its recognized potential, the adoption of digital technologies remains inconsistent. Evidence indicates that digitalization has plateaued in recent years, with limited expansion across project functions and varying levels of implementation across organizations (RICS, 2024). As a result, many projects continue to operate in hybrid environments where digital tools coexist with traditional practices such as spreadsheets and document-based communication (Autodesk, 2026). In many cases, these systems are implemented as isolated tools rather than as structured information management processes, limiting their effectiveness and contributing to ongoing fragmentation (Construction Management, 2025).

At the same time, there is a growing shift toward more connected and data-driven project delivery. Emerging approaches emphasize integrated workflows and shared digital platforms that link different phases of the project lifecycle. However, the coexistence of advanced tools and traditional practices highlights an ongoing gap between the potential of digitalization and its implementation in practice (Autodesk, 2026).

Digitalization in construction is generally understood as the use of digital tools to manage and exchange project-related information across different stages of the project lifecycle (Al Omari, et al., 2023); (Zimmerman & Pettersson, 2020). Among these, the Common Data Environment (CDE) has emerged as a centralized approach for storing, managing and sharing project data, enabling a more structured and coordinated information flow (Werbrouck, et al., 2023).

In Europe, SMEs represent approximately 99% of construction companies, making them the backbone of the sector (European Comission, 2025). These organizations often operate with limited financial and technical resources, which can restrict their ability to adopt complex digital solutions (Jaskula, et al., 2024).

However, despite the increasing adoption of digital tools and the recognized potential of CDEs, there is limited understanding of how these systems are applied in practice by contractors, particularly within SMEs operating under different levels of digital maturity. This highlights a gap between the theoretical potential of digitalization and its practical implementation in real project environments.

1.2 Aim and Objectives

Given the background above, the aim of this thesis is to examine how different approaches to information management, specifically the use of CDE versus non-centralized practices, affect information flow and coordination in construction projects within the Spanish and Mexican context. Particular attention is given to SMEs, considering their dominant presence within the construction industry.

To achieve this, the study compares construction companies that operate with and without a CDE, analyzing how these approaches influence communication, coordination and project control. The research seeks to identify the main challenges associated with information fragmentation and its impact on project performance, with particular attention to small and medium-sized enterprises (SMEs). Based on these findings, the study aims to define the key needs and characteristics required for more effective and accessible CDE implementation across the industry.

1.3 Research Question

This study is guided by the following research question:

How does the adoption of a Common Data Environment (CDE) as a centralized digital project management system influence information flow, coordination and project practices among construction project teams in the Spanish and Mexican context?

And the following research sub-question:

What are the key needs and expectations of small and medium-sized construction companies when considering the adoption of CDEs, and how can these support a more widespread and accessible use across the industry?

1.4 Scope and Limitations

This study focuses on the perspective of contractors operating in Spain and Mexico. It examines construction projects that use a CDE and those that do not, analyzing perceived benefits and challenges related to information flow, coordination, document control and rework. The research is limited to understanding practices and experiences in information management from the contractor's viewpoint, particularly in relation to project delivery and on-site coordination.

This thesis does not provide a detailed evaluation of specific CDE software platforms or vendors. It concentrates on perceived impacts and organizational practices rather than on precise quantitative measurements of cost savings or financial losses associated with rework or information fragmentation. Furthermore, the findings are based on a limited number of case studies and participant perspectives. For this reason, the results are not intended to be universally generalizable, but rather to offer transferable insights and practical guidance for similar construction contexts.

Although sustainability is not the primary focus of this research, the study acknowledges that improved information management and coordination may indirectly contribute to more sustainable construction practices. For example, reducing rework, improving communication and enhancing project efficiency can support better use of resources and reduce operational inefficiencies. However, environmental performance and sustainability metrics are not directly evaluated within the scope of this thesis.

2 Method

This chapter outlines the research methodology, including the research strategy, data collection through interviews and the approach to data analysis. It also outlines the methodological limitations (not to be confused with the limitations in the thesis scope outlined earlier) and ethical considerations of the study.

2.1 Research Strategy

This research adopts a qualitative and comparative design to explore how general contractors in Spain and Mexico address the selected research topic. Qualitative research is defined as an approach focused on exploring and understanding the meanings individuals or groups assign to social phenomena (Creswell, 2014). A qualitative approach was chosen because the study aims to understand organizational practices and perceptions rather than measure variables statistically. The objectives are to generate in-depth insights grounded in real industry context.

The research is structured in two main phases. First, a systematic literature review (SLR) was conducted. An SLR is a structured research methodology used to identify, evaluate and synthesize existing literature through a systematic and replicable process (Carrera-Riveraa, et al., 2022). Academic articles, industry reports and relevant standards were analyzed to identify key themes and current challenges. This phase helped define the research focus and guiding questions.

Second, semi-structured interviews were conducted with representatives of general contracting companies in Spain and Mexico. Semi-structured interviews are a widely used qualitative research technique based on a flexible interaction guided by a predefined set of themes or questions (Pin, 2023). The study prioritized small and medium-sized enterprises (SMEs), while also considering companies of different sizes to provide comparative insights. This format allowed flexibility while ensuring that core topics were consistently addressed.

Finally, findings from both phases were examined through thematic analysis, used to identify, analyze and interpret recurring patterns within datasets (Ahmed, et al., 2025). The identified themes were used to examine how the findings from the interviews aligned with the issues and concepts discussed in the literature.

2.2 Time Frame and Research Process

The research was conducted between January and May 2026 following a structured process to ensure coherence between theoretical and empirical components.

The initial phase focused on the systematic literature review (SLR), which informed the research framework and guided the development of interview questions. As described by Carrera-Rivera et al. (2022), an SLR provides a structured approach for identifying and synthesizing relevant literature. This phase was followed by the empirical stage, during which semi-structured interviews were conducted with industry professionals. Semi-structured interviews were selected due to their flexibility in exploring participants experiences while maintaining consistency across key research topics (Pin, 2023).

Subsequently, the collected data were analyzed using thematic analysis to identify patterns across different cases. Thematic analysis is commonly used to examine and interpret themes within qualitative datasets (Ahmed, et al., 2025). The final phase involved integrating theoretical insights with empirical findings to develop conclusions and practical recommendations.

2.3 Literature Review

The literature review aimed to construct a theoretical foundation for the study using academic articles, industry reports and relevant standards. A systematic literature review (SLR) approach was adopted to identify, evaluate and synthesize existing research related to the research topic, while also helping to identify current knowledge gaps and areas for further investigation (Carrera-Rivera, et al., 2022). A structured search strategy was applied to ensure relevance and quality.

A set of keywords related to construction management, general contractors, CDEs and related concepts was defined. Different combinations of these keywords were used in academic databases to identify potential sources. Example of key words use:

- *Digitalization; construction; construction management; management*
- *Construction projects AND (information management OR document management) AND communication*
- *"Information management" AND "construction projects" AND coordination AND (current practices OR empirical study)*
- *("common data environment" OR "CDE") AND "construction" AND (definition OR concept OR principles OR role)*
- *("common data environment" OR "CDE") AND "construction"*
- *("Common data environment" OR "CDE") AND construction AND benefits NOT sustainable*
- *("Common data environment" OR "CDE") AND ("construction" OR "management") AND ("benefits" OR "functions")*
- *common data environments AND construction AND CDE AND barriers AND adoption*
- *Successful implementation AND Construction management AND CDE*

Titles and abstracts were screened to assess relevance. Only publications directly linked to the research objectives were selected. After this filtering process, 71 academic articles were retained for detailed review.

A reading was conducted to extract key ideas and arguments. Main points were summarized in bullet form to facilitate comparison. Based on recurring themes, subheadings were created to group related information into categories.

Relevant sections were highlighted and organized according to these themes. This structured synthesis allowed identification of patterns and differences within the literature. The grouped information was then developed into coherent paragraphs, forming the theoretical framework that supports the empirical study.

2.4 Empirical Study: Interviews

The empirical component of this research is based on semi-structured interviews with general contractors operating in Spain and Mexico, primarily within the private residential sector. Semi-structured interviews are widely used in qualitative research because they allow researchers to explore participants experiences and perspectives through a flexible conversational approach guided by predefined themes (Pin, 2023). This method was considered appropriate for the study as it enabled participants to describe practical experiences related to information management and digital workflows within construction projects.

Companies were selected according to defined criteria: they had to be general contractors, operate in both countries, and be involved in construction activities. Firms of different sizes (small, medium, big, corporate) were considered to obtain varied perspectives, although the focus of the study is on SMEs. In qualitative research, participant selection is commonly based on the relevance of the cases to the research problem rather than statistical representativeness (Creswell, 2014).

A structured database was developed to organize and manage company information and selection criteria. The primary source for identification was the "El Economista" ranking, which classifies companies by annual turnover with the CNAE 4121 sector (residential construction). From this list, companies were filtered by size and confirmed to be engaged in active construction works rather than only maintenance.

Up to five companies per size category were contacted, depending on accessibility. Interviews were conducted with professionals in managerial or technical roles. Following the principles of semi-structured interviewing described by Pin (2023), the interviews were guided by predefined themes while allowing flexibility for participants to elaborate on relevant experiences and operational challenges.

All interviews were recorded with participant consent and transcribed for analysis.

2.4.1 Data Processing and Analysis

Interview data were transcribed using the automatic transcription function of Microsoft Teams and subsequently reviewed to ensure accuracy. The analysis followed a thematic approach aimed at identifying recurring patterns in participants responses. Thematic analysis seeks to identify and describe patterns and themes within qualitative data (Creswell, 2014), supporting the systematic organization and interpretation of interview findings.

An initial coding process was conducted by selecting and labeling relevant quotations from the interviews based on key topics related to information management, communication practices and system use. These codes were then grouped into broader categories according to shared themes and common patterns across different participants.

Through this process, main thematic areas were identified and used to structure the presentation of results. The findings were then developed into coherent analytical narratives, linking empirical observations with the research objectives and theoretical framework.

2.5 Methodological Limitations

This study presents several limitations that should be considered when interpreting the findings. The research is based on a limited number of interviews, which may not fully represent the diversity of practices across the construction industry.

The qualitative nature of the study focuses on perceptions and experiences rather than quantitative measurement, which may introduce subjectivity in the interpretation of results. Additionally, access to companies and participants was influenced by availability, which may have affected the composition of the sample.

Despite these limitations, the study provides valuable insights into current practices and challenges in information management, offering transferable findings relevant to similar contexts.

2.6 Ethical Considerations

Ethical principles were considered throughout the research process. Before each interview, participants were informed about the purpose of the study and the topics to be discussed. Participation was voluntary and interviewees could decline to answer any question.

Confidentiality was ensured by anonymizing personal and company information. Names are not disclosed in the thesis and findings are presented in a way that prevents identification. The handling and storage of personal data followed the principles established by the General Data Protection Regulation (GDPR), including confidentiality, secure storage and restricted access to collected information (European Union, 2016)

Audio recordings and transcripts were stored securely and accessed only by the researcher. The analysis was conducted objectively, without judging participants practices or opinions. The aim was to represent their perspectives accurately and responsibly.

2.6.1 Use of AI tools

AI tools were used to support specific stages of the research while maintaining academic integrity. Their use focused on organizing literature findings, reviewing interview transcripts and improving clarity in writing.

During the literature review, AI tools assisted in structuring information previously extracted through manual reading. In the empirical phase, they supported transcription review and translation of interview excerpts from Spanish to English when required. All thematic coding and interpretation were conducted by the researcher.

AI tools were also used to refine grammar and academic expression. The intellectual analysis, critical thinking and conclusions remain entirely responsibility of the author.

2.7 Validity and reliability

According to Creswell (2014), validity in qualitative research refers to the accuracy and credibility of the findings, while reliability relates to the consistency of the research procedures and analytical process.

The validity of this study was supported through the comparison of findings from the systematic literature review with empirical evidence obtained from industry interviews. By examining recurring themes across both sources, the research sought to strengthen the credibility of the findings through triangulation, a strategy recommended by Creswell (2014 for enhancing qualitative validity.

Reliability was addressed using a structured and transparent research process. All interviews were recorded, transcribed and analyzed following the same coding and thematic grouping procedure. Consistency was further supported by maintaining common interview themes across participants and applying the same analytical approach throughout the study. Creswell (2014) highlights the importance of documenting research procedures and maintaining consistency during coding and analysis as key elements of qualitative reliability.

As this research is based on a qualitative sample and focuses on specific organizational contexts, the findings are not intended to be statistically generalizable. Instead, they provide transferable insights that may be relevant to similar construction environments.

3 Literature review and theoretical grounding

This chapter reviews the literature on digitalization and information management in the construction industry, with a particular focus on the challenges of fragmented information and coordination. It introduces the concept of CDEs and examines their intended functions, benefits and limitations. The chapter aims to establish a theoretical foundation for understanding the gap between the potential of digital solutions and their practical implementation in construction projects.

3.1 Digitalization in the construction industry

3.1.1 Concept and scope

Digitalization in the construction industry is commonly described in the literature as the use of digital technologies to convert, manage and exchange information throughout project-related processes, rather than merely adopting isolated software tools (Al Omari, et al., 2023);(Zimmerman & Pettersson, 2020) ;(Khoshkenar, et al., 2025);(Marnewick & Marnewick, 2022). Several studies emphasize that digitalization encompasses document management, workflow coordination, monitoring of project activities and data processing across different phases of the project lifecycle, including design, construction and operations (Al Omari, et al., 2023);(Jahanger, 2024);(Aigbavboa & Kissi, 2025); (Yoon, et al., 2025). In this sense, digitalization is positioned as a foundational step toward broader digital transformation, which additionally involves organizational, cultural and operational change (Lima, et al., 2026);(Khoshkenar, et al., 2025).

The scope of digitalization extends beyond technical functions and affects how construction projects are planned, coordinated and administered (Aigbavboa & Kissi, 2025);(Papadonikolakia, et al., 2025). Research highlights that digital technologies are most frequently applied to scheduling, documentation, cost control and project administration, while their use remains limited or uneven in other areas such as safety management, stakeholder coordination and resource logistics (Aigbavboa & Kissi, 2025);(Marnewick & Marnewick, 2022).

3.1.2 Digital maturity

A recurring theme across the literature is the low level of digital maturity in the construction industry when compared to other economic sectors. Multiple studies characterize construction as one of the least digitalized industries globally, with slow adoption of integrated digital solutions and a continued reliance on spreadsheets, paper-based documentation and disconnected systems for project management (Jahanger, 2024);(Bajpai & Misra, 2022). This low digital maturity is reported across different regions, although its severity varies between countries, indicating a global digital divide within the sector (Lima, et al., 2026).

The lack of digital maturity is closely linked to long-standing productivity challenges in construction. Empirical evidence indicates that construction productivity growth has remained significantly lower than that of other industries over recent decades, despite increasing project complexity and capital intensity

(Khoshkenar, et al., 2025). Several studies associate this productivity gap with limited automation, fragmented information flows and insufficient use of real-time data for decision-making (Bajpai & Misra, 2022);(Zimmerman & Pettersson, 2020). As a result, digitalization is frequently discussed in the literature as a necessary but underdeveloped response to structural inefficiencies within the sector (Al Omari, et al., 2023);(Aigbavboa & Kissi, 2025).

3.1.3 Drivers and strategic motivations

The literature identifies multiple drivers motivating the construction industry to pursue digitalization, most of which are linked to persistent challenges related to cost overruns, schedule delays and coordination inefficiencies. Increasing project complexity, combined with the involvement of numerous stakeholders and contractual fragmentation, has intensified the need for improved collaboration and information management (Aigbavboa & Kissi, 2025);(Khoshkenar, et al., 2025);(Lima, et al., 2026). Digital technologies are therefore framed as strategic enablers to support more efficient project delivery and administrative control (Jahanger, 2024);(Bajpai & Misra, 2022).

In addition, several studies report that organizations adopt digitalization initiatives with the aim of improving internal processes, enhancing data and information management and supporting more informed decision-making (Bajpai & Misra, 2022);(Lima, et al., 2026). Strategic motivations also include improving overall organizational performance, strengthening cost control and responding to competitive pressures within the market (Lima, et al., 2026);(Aigbavboa & Kissi, 2025). These motivations suggest that digitalization is increasingly viewed not only as a technological upgrade but as a strategic response to systemic performance challenges in construction projects (Khoshkenar, et al., 2025).

3.1.4 Digitalization barriers

Despite its perceived importance, the adoption of digitalization in construction is consistently reported as being constrained by a combination of organizational, cultural and structural barriers. These challenges are often reinforced by traditional management practices, hierarchical organizational structures and siloed decision-making processes that limit cross-functional collaboration (Aigbavboa & Kissi, 2025).

Regulatory uncertainty and the lack of standardized guidelines for the use of digital technologies in construction are also reported as barriers, particularly in environments where industry-wide frameworks are underdeveloped (Aigbavboa & Kissi, 2025);(Subbotin, et al., 2023). Together, these factors contribute to fragmented and inconsistent digital adoption across projects and organizations (Al Omari, et al., 2023);(Lima, et al., 2026).

3.2 Project Information Management in Construction Projects

3.2.1 Project fragmentation

Construction projects operate within highly fragmented organizational structures involving multiple stakeholders, including clients, main contractors, subcontractors, consultants and suppliers, each with distinct responsibilities and interests (Bello, et al., 2024) (Naveed & Khan, 2022);(Chen, et al., 2022);(Fulford & Standing, 2013). This multiplicity of actors generates dispersed decision-making processes and decentralized information ownership, which complicates the alignment of project objectives (Bello, et al., 2024);(Mbazor, et al., 2025). The prevalence of subcontracting and the separation of functional disciplines further contribute to segmented project environments in which participants frequently operate independently, limiting integrated information exchange (Mbazor, et al., 2025);(Martina & Benson, 2021); (Fulford & Standing, 2013).

In addition, formal contractual hierarchies do not always reflect actual communication practices on site (Radziszewska-Zielina, et al., 2019);(Bello, et al., 2024). Project participants often establish informal networks to facilitate faster problem-solving under conditions of uncertainty, which may bypass official reporting lines (Radziszewska-Zielina, et al., 2019);(Naveed & Khan, 2022). These informal structures coexist with formal arrangements, creating parallel information pathways that are difficult to monitor and coordinate (Mbazor, et al., 2025). As a result, information flows become unevenly distributed across project teams, reinforcing fragmentation and increasing the risk of coordination breakdowns.

3.2.2 Information flow

Construction projects continuously generate diverse forms of information, including drawings, technical specifications, schedules, correspondence, photographs and progress reports throughout the project lifecycle (Naveed & Khan, 2022);(Mbazor, et al., 2025);(Fulford & Standing, 2013). This information originates from multiple sources and evolves as projects move from planning to execution and completion. Effective project delivery depends on the timely dissemination and accurate interpretation of these data among internal team members and external stakeholders (Aziz, et al.);(Musonda, et al., 2019);(Naveed & Khan, 2022). However, the volume and diversity of information complicate its systematic processing and circulation (Naveed & Khan, 2022);(Mbazor, et al., 2025).

Communication mechanisms in construction include formal procedures, such as meetings and documentation systems, as well as informal exchanges through direct interactions and personal networks (Aziz, et al.);(Radziszewska-Zielina, et al., 2019). Internal communication supports coordination within project teams, while external communication facilitates engagement with stakeholders (Aziz, et al.). Gatekeeping practices determine which information is collected, analyzed and transmitted influencing who has access to critical knowledge (Aziz, et al.). When communication channels are unclear or inconsistently applied, information dissemination becomes delayed or distorted, contributing to misunderstandings and operational inefficiencies (Musonda, et al., 2019);(Mbazor, et al., 2025).

3.2.3 Information complexity

The dynamic and non-linear nature of construction projects generates high levels of information complexity and uncertainty (Naveed & Khan, 2022). Information flows are influenced by changing site conditions, design modifications, regulatory requirements and stakeholder interactions, making them difficult to predict and control (Bello, et al., 2024); (Naveed & Khan, 2022). Many practitioners underestimate the implications of this complexity, which can result in information overload, incomplete understanding and inconsistent decision-making (Naveed & Khan, 2022). Uncertainty further intensifies these challenges by limiting the reliability of available data during critical project stages (Naveed & Khan, 2022).

Construction organizations also face difficulties in capturing, storing and reusing project knowledge (Ferradaa, et al., 2016). Most industry knowledge is created within individual projects and remains embedded in personal experience rather than institutional systems (Ferradaa, et al., 2016). Although lessons-learned databases and documentation tools exist, their adoption is limited by time constraints, insufficient management support and lack of incentives (Ferradaa, et al., 2016). Consequently, valuable insights are frequently lost after project completion, weakening organizational learning processes and reinforcing repetitive coordination problems (Ferradaa, et al., 2016);(Hinton, 2005).

3.2.4 Information governance

Information governance in construction is shaped by contractual frameworks, organizational policies and technological systems that regulate access, accountability and control (Bello, et al., 2024);(Fulford & Standing, 2013);(Hinton, 2005). Transparency depends on the availability and clarity of project data related to cost, schedule, performance and safety (Bello, et al., 2024). However, complex contractual arrangements and ambiguous communication protocols often obscure responsibilities, limiting stakeholders' ability to verify information and evaluate performance (Bello, et al., 2024). These conditions contribute to information asymmetry, in which some actors possess greater informational advantages than others, affecting trust and collaboration (Bello, et al., 2024).

Technological infrastructure plays a central role in supporting information management (Fulford & Standing, 2013);(Hinton, 2005). Despite the availability of digital tools and communication technologies, many construction firms continue to rely on manual and paper-based methods (Mbazor, et al., 2025);(Ferradaa, et al., 2016). Limited system integration and low information system maturity restrict the standardization of data formats and workflows (Fulford & Standing, 2013). Although mobile devices and cloud platforms offer opportunities to enhance data accessibility and security, their implementation remains uneven across organizations (Ferradaa, et al., 2016). As a result, information governance frameworks often lack coherence, reducing the effectiveness of formal control mechanisms (Hinton, 2005).

3.2.5 Project performance

Deficiencies in information generation, communication and control have direct consequences for project outcomes. Poorly managed information processes are associated with delays, cost overruns, design errors, rework and reduced productivity (Aziz, et al.);(Musonda, et al., 2019);(Naveed & Khan, 2022);(Mbazor, et al., 2025). Inadequate communication and delayed dissemination of instructions contribute to uncertainty in task execution and weaken coordination between project participants (Musonda, et al., 2019);(Naveed & Khan, 2022). These disruptions accumulate over the project lifecycle, undermining schedule reliability and quality performance (Aziz, et al.); (Naveed & Khan, 2022).

Empirical studies indicate that ineffective communication constitutes a major factor in project failure and underperformance (Musonda, et al., 2019). The need for project managers to manually compile and reconcile fragmented data further increases administrative burdens and diverts resources from strategic coordination activities (Fulford & Standing, 2013). Moreover, disputes arising from insufficient documentation and unclear information trails generate additional legal and financial risks (Bello, et al., 2024);(Mbazor, et al., 2025).

3.3 Common Data Environment (CDE): Definition and Purpose

3.3.1 CDE definition

The concept of CDE is widely described in the literature as a centralized and agreed source of project information intended to support the management and exchange of data throughout the lifecycle of a construction project. According to ISO-based definitions, a CDE represents a single source of information for a project or asset where information containers are collected, managed and disseminated through a controlled process (Werbrouck, et al., 2023); (Jaskula, et al., 2024). Several studies emphasize that this environment serves as a digital repository where project documentation, models and associated data are stored and made accessible to project participants in a coordinated manner (Institution of Civil Engineers, 2015). Within this context, the CDE functions as a unified platform that integrates different forms of project information, including graphical models, documents and other digital records used by multidisciplinary teams (Institution of Civil Engineers, 2015);(Henry, et al., 2025).

The notion of a "single source of truth" is frequently used to describe the fundamental objective of a CDE (Henry, et al., 2025);(Klaudia, et al., 2025). Research indicates that the environment is designed to ensure that project stakeholders access consistent and up-to-date information, reducing inconsistencies that often arise when information is stored in multiple disconnected systems (Henry, et al., 2025);(Cheng, et al., 2025). By centralizing project data within a shared environment, the CDE aims to establish a reliable reference point for all project information, supporting coordination among different actors involved in design, construction and asset management (Silva & Boton, 2025); (Jaskula, et al., 2024).

3.3.2 CDE workflows

Beyond its role as a centralized repository, the literature describes the CDE as a structured system designed to manage project information through defined workflows and procedures. According to (Henry, et al., 2025), a CDE integrates both technical components and procedural workflows that regulate how information is created, stored and exchanged. Information is typically organized in the form of "information containers" which include documents, models or datasets accompanied by metadata that enables classification, traceability and controlled access to project information. These containers allow project teams to manage data systematically while maintaining clarity regarding the status and ownership of information throughout the project lifecycle (Cheng, et al., 2025);(Henry, et al., 2025).

The management of information within a CDE is commonly organized through predefined stages that govern the progression of project data. Literature based on ISO 19650 describes four main states of information: work in progress, shared, published and archived, with formal review and approval procedures required for information to move between these stages (Mervyn, 2010); (Jaskula, et al., 2024). These structured workflows ensure that project information is validated, version-controlled and authorized before being used by other stakeholders (Bimal, 2015);(Mervyn, 2010).

3.3.3 Project collaboration

A key purpose of the CDE identified in the literature is to facilitate collaboration among the multiple stakeholders involved in construction projects (Klaudia, et al., 2025). Construction projects typically involve multidisciplinary teams that generate large volumes of information, making effective communication and coordination essential for project delivery (Institution of Civil Engineers, 2015); (Silva & Boton, 2025). The CDE supports this collaborative environment by providing a shared platform where project participants can access, review and exchange information in a controlled and coordinated manner (Henry, et al., 2025) (Mervyn, 2010). By ensuring that information is consistently available to authorized users, the CDE enables stakeholders from different organizations to work with the same set of project data (Silva & Boton, 2025);(Henry, et al., 2025).

Several authors emphasize that the shared environment provided by a CDE helps coordinate the contributions of different disciplines involved in design and construction processes (Silva & Boton, 2025);(Mervyn, 2010). The ability to collects and distribute project information within a common platform reduces the need for fragmented communication channels and helps align the work of project participants (Barnes, et al., 2015);(Cheng, et al., 2025). As noted in (Mervyn, Richards, 2010), the management of design documentation within a common environment supports the progressive integration and coordination of information produced by various actors across the project supply chain.

3.3.4 CDE implementation

The implementation of a CDE relies on both technological infrastructure and organizational governance structures (Silva & Boton, 2025);(Werbrouck, et al., 2023). From a technological perspective, CDEs are typically supported by digital platforms that provide data storage, database management, communication tools and functionalities for tracking issues and managing documents (Werbrouck, et al., 2023);(Klaudia, et al., 2025). These platforms may be implemented through server-based or cloud-based systems that allow project teams to store and retrieve information within a centralized digital environment (Barnes, et al., 2015); (Jaskula, et al., 2024). In practice, commercial platforms such as integrated construction management systems often serve as the technological backbone supporting CDE functionality (Werbrouck, et al., 2023).

However, the literature also emphasizes that a CDE is not solely a technological tool but rather an organizational framework that requires defined roles, procedures and governance structures to operate effectively (Silva & Boton, 2025). The management of a CDE often involves designated roles responsible for overseeing compliance with agreed protocols and ensuring that information is properly controlled and validated (Barnes, et al., 2015). International standards such as ISO 19650 and related guidelines provide structured approaches for defining responsibilities, information requirements and procedures for managing project information within a CDE (Silva & Boton, 2025);(Henry, et al., 2025).

3.3.5 Integration challenges

The intended role of a CDE in construction project management is to support integrated project information management across the lifecycle of a built asset (Klaudia, et al., 2025); (Jaskula, et al., 2024). By consolidating project data with a structured environment, the CDE aims to ensure that stakeholders can access accurate and current information when required for project activities and decision-making processes (Henry, et al., 2025);(Silva & Boton, 2025). Centralized information management also contributes to maintaining records of project changes, revisions and communication exchanges, enabling traceability and transparency through the development of the project (Klaudia, et al., 2025);(Bimal, 2015).

Despite the intended purpose, the literature also acknowledges practical difficulties in fully achieving the concept of a single integrated information environment (Jaskula, et al., 2024). Some studies report that project teams often rely on multiple digital tools simultaneously, which can lead to fragmented information flows and challenges in maintaining a single authoritative data source (Jaskula, et al., 2024).

3.4 Intended Functions and Benefits of a CDE

3.4.1 Centralized information management

Several studies further emphasize that the centralized structure of a CDE facilitates the continuity of information throughout the project lifecycle (Cheng, et al., 2025). Information generated during planning design and construction phases can be preserved and transferred to later stages such as asset management and facility operations (Seyis & Özkan, 2024). The ability to maintain historical records and standardized data repositories enables stakeholders to access previous project information, monitor project evolution and support future decision-making processes (Abdelalim, et al., 2024);(Seyis & Özkan, 2024).

3.4.2 Team collaboration

The collaborative capability is particularly relevant in BIM-based projects where multiple actors contribute to federated models and integrated project information (Arachchi, et al., 2025). Research indicates that the CDE facilitates coordination by enabling project teams to work with interconnected digital models and datasets, allowing project participants to review information, detect potential design conflicts and integrate contributions from various disciplines (Schlachter, et al., 2022). Through cloud-based systems and shared information platforms, geographically dispersed project teams can collaborate more effectively and maintain continuous communication throughout the project lifecycle (Zima & Mitera-Kiełbasa, 2021);(Borkowski, et al., 2023). As a result, the CDE is frequently described as a key mechanism for enabling interdisciplinary coordination and improving collaboration in complex construction projects (Seyis & Özkan, 2024).

3.4.3 Process standardization

In addition to supporting collaboration, the literature identifies the CDE as a mechanism for improving the efficiency and organization of project workflows (Borkowski, et al., 2023).

Furthermore, the integration of digital workflows within the CDE can automate certain project management processes and reduce manual information handling. For example, automated updates of BIM models, structured approval processes and digital management for request for information can streamline administrative procedures and reduce the time required for information exchange (Abdelalim, et al., 2024);(Seyis & Özkan, 2024). By minimizing duplicate document handling and enabling faster access to project information, CDE platforms contribute to improved operational efficiency and support the timely execution of project activities (Zawada, et al., 2024);(Borkowski, et al., 2023).

3.4.4 Decision support

Another function attributed to CDE platforms in the literature is their role in supporting decision-making and monitoring project performance (Abdelalim, et al., 2024). By aggregating project data within a centralized environment, the CDE provides projects teams with access to structured information that can by analyzed to support planning, evaluation and management decisions (Zawada, et al., 2024). In some cases, integrated analytical tools and data-processing techniques can be applied to the information stored in the CDE to identify patterns, evaluate alternatives and support decision-making processes during project development (Abdelalim, et al., 2024);(Zawada, et al., 2024).

The availability of structured project data within the CDE also enables the monitoring of project performance indicators and operational risks (Seyis & Özkan, 2024). Studies report that CDE platforms allow project teams to track key metrics such as productivity, safety indicators, communication performance and project progress through the systematic collection of project information (Seyis & Özkan, 2024). Additionally, the preservation of audit trails and historical records within the CDE can facilitate the identification of project issues, support dispute resolution processes and provide transparency in project documentation (Zawada, et al., 2024); (Seyis & Özkan, 2024). Through these mechanisms the CDE contributes to improved oversight of project activities and supports proactive management of potential risks.

3.4.5 Value creation

Beyond operational improvements, the literature also highlights broader organizational benefits associated with the implementation of CDE platforms (Seyis & Özkan, 2024). By improving coordination, information accessibility and workflow efficiency, the use of CDE systems has been associated with improvements in key project performance indicators such as productivity, schedule performance, quality outcomes and cost control (Seyis & Özkan, 2024) (Cheng, et al., 2025). For instance, studies report that the availability of accurate and coordinated information can reduce rework, improve schedule adherence and support more efficient project execution (Seyis & Özkan, 2024); (Cheng, et al., 2025).

The CDE also contributes to knowledge management by preserving project information and organizational experience within structured digital repositories (Seyis & Özkan, 2024). Historical project data stored within the CDE can support the identification of recurring issues, facilitate lessons learned processes and enable organizations to build institutional knowledge for future projects (Seyis & Özkan, 2024). In addition, the ability to demonstrate efficient digital information management and collaborative project delivery may strengthen organizational reputation and competitiveness within the construction industry (Seyis & Özkan, 2024).

3.5 Barriers to CDE Adoption and Use

3.5.1 Technological limitations

Several studies identify technological limitations as a key factor hindering the effective adoption of CDEs (Jaskula, et al., 2024);(Abma, et al., 2024). Interoperability challenges are frequently reported, as project stakeholders often rely on different software systems that are not fully compatible with each other, making seamless data exchange difficult (Jaskula, et al., 2024). The coexistence of multiple data formats and software platforms across project teams further complicates information integration and can require manual data transfers between systems (Pinnacle Infotech, 2021). These interoperability limitations are particularly problematic during later project stages, such as operations and maintenance, where information must be transferred from design and construction systems to facility management platforms (Jaskula, et al., 2024).

In addition to interoperability issues, the technical infrastructure supporting CDE platforms can also create barriers (Abma, et al., 2024). Limited access to adequate hardware, unstable internet connections and unreliable server performance may restrict consistent access to shared project data (Abma, et al., 2024). The complexity of managing large volumes of project information can also overwhelm users, particularly in large- scale projects where stakeholders must navigate extensive datasets and frequent system notifications (Jaskula, et al., 2024). Furthermore, implementing CDE platforms may require complex IT procurement processes and integration with existing organizational systems, which can slow adoption and complicate implementation efforts (Scottish Future Trust (SFT), 2018).

3.5.2 Lack of standardization

Challenges related to information governance and the absence of standardized practices are widely recognized as barriers to the effective use of CDEs (Jaskula, et al., 2024). Several studies highlight that construction projects often lack clearly defined information requirements, standardized terminology and consistent data structures, which can result in disorganized project information and difficulties in managing digital documentation (Jaskula, et al., 2024). The absence of unified standards across organizations also contributes to the use of multiple document management systems and inconsistent approaches to information exchange (Jaskula, et al., 2024). These issues make it difficult to establish structured information workflows that support reliable data management across project teams (Jaskula, et al., 2024).

Inefficiencies in document control processes further complicate the management of project information (Jaskula, et al., 2024). Studies report that many CDE workflows still depend heavily on manual procedures, including document verification, approval cycles and version control processes that may take several weeks before information is formally shared with project stakeholders (Jaskula, et al., 2024). Manual handling of documents and the continued reliance on file-based information exchange increase the risk of errors, duplication and loss of information throughout the project lifecycle (Jaskula, et al., 2024).

3.5.3 Organizational fragmentation

The fragmented organizational structure of the construction industry presents another significant barrier to the effective adoption of CDE platforms (Jaskula, et al., 2024). Differences in organizational structures and communication hierarchies may limit the ability of teams to coordinate their use of shared platforms and align their information management practices (Jaskula, et al., 2024).

Managerial and governance issues can further limit effective CDE use (Abma, et al., 2024). In some cases, limited cooperation among project participants, inconsistent leadership support and insufficient monitoring of platform use can reduce the effectiveness of CDE implementation (Abma, et al., 2024). The persistence of informal communication channels, such as email, instead of structured workflows within the CDE platform also contributes to fragmented information management practices (Jaskula, et al., 2024). Additionally, conflicts related to access control and data ownership may emerge when multiple organizations collaborate within a shared digital environment, particularly if governance structures and responsibilities are not clearly defined (Roberts, 2024); (Pinnacle Infotech, 2021).

3.5.4 Resistance to change

Human and organizational factors also play an important role in limiting the adoption of CDE systems (Abma, et al., 2024). Several studies emphasize that many construction professionals lack sufficient digital competencies, particularly in relation to cloud- based systems, BIM platforms and structured information management processes (Jaskula, et al., 2024). Small and medium-sized enterprises (SMEs) may face additional challenges due to limited technical capabilities and lower levels of digital maturity, which can make the adoption of complex information management platforms more difficult (Jaskula, et al., 2024). Insufficient training and limited understanding of the functionalities of CDE platforms often lead to improper use of these systems or reduced confidence among users (Pinnacle Infotech, 2021);(Abma, et al., 2024).

Resistance to organizational change also contributes to slow adoption (Pinnacle Infotech, 2021). Many project participants remain accustomed to traditional documented management methods and may prefer familiar communication tools such as email, rather than structured digital workflows with CDE platforms (Jaskula, et al., 2024). The transition from conversational working practices to centralized digital systems can therefore be perceived as disruptive, particularly when teams are not adequately preparing of support through training and change management initiatives (The AEC Associates, 2025) (Pinnacle Infotech, 2021). As a result, some organizations use CDE platforms primarily as document storage systems rather than fully integrated collaborative environments (Jaskula, et al., 2024).

3.5.5 Economic barriers

Economic constraints represent another significant obstacle to widespread CDE adoption (Jaskula, et al., 2024). The implementation of enterprise-level platforms often requires substantial investment in software licenses, system configuration and staff training which may be difficult for smaller firms to justify (Jaskula, et al., 2024);(The AEC Associates, 2025). Several studies note that construction companies, particularly SMEs, may perceive the adoption of CDE platforms as financially risky, especially when the benefits are not clearly understood or when traditional document management practices appear less costly in the short term (Jaskula, et al., 2024);(Seyis & Özkan, 2024). In addition, the concentration of the software market among a limited number of large vendors may further increase costs and limit accessibility for smaller organizations (Jaskula, et al., 2024).

Concerns related to data security and trust also influence the willingness of stakeholders to share information through centralized digital platforms (Jaskula, et al., 2024). Because many CDE systems are managed by a single authorized party, project participants may worry about issues such as data ownership, unauthorized modifications and restricted access to project information (Jaskula, et al., 2024). The possibility of cyber-attacks, data manipulation or intellectual property theft may further discourage stakeholders from fully relying on centralized information systems (Jaskula, et al., 2024) (Scottish Future Trust (SFT), 2018). These concerns can reduce trust among project participants and limit the extent to which CDE platforms are used as collaborative environments for project information management (Jaskula, et al., 2024).

3.6 Enablers for Successful CDE Implementation

3.6.1 Organizational readiness

Successful CDE implementation is strongly associated with an organizations ability to align the system with its operational needs and strategic objectives (Trimble, 2021). Evidence suggests that firms benefit from first analyzing their internal workflows and identifying specific requirements before selecting a platform, ensuring that the chosen solution supports existing processes rather than imposing misaligned functionalities (Trimble, 2021). This includes evaluating the needs of different departments, such as procurement, legal and site teams and understanding how information is accessed and used across the project lifecycle (Trimble, 2021). Similarly, a pragmatic and cost-conscious approach to technology selection has been identified as a key enabler, particularly when organizations prioritize essential functionalities and compatibility and existing digital ecosystems over complex or overly comprehensive systems (Adam, 2021).

Organizational readiness also involves recognizing the level of planning, structure and discipline required to operate within a CDE environment (Adam, 2021). Compared to traditional information management approaches, CDE implementation demands a more structured and standardized way of working, which must be anticipated during the early stages of adoption (Adam, 2021). Additionally, implementation strategies that avoid rigid, one-size-fits-all solutions and instead account for the diversity of tools and practices already in use across project teams are more likely to succeed (BIM Launcher Ltd, 2023).

3.6.2 Governance frameworks

Governance frameworks and formal standards play a central role in enabling effective CDE implementation (Dolla, et al., 2024). The literature emphasizes the importance of structured information management systems aligned with established standards such as ISO 19650, which defines the CDE as a coordinated environment for managing and exchanging project information (Dolla, et al., 2024). Key governance instruments, including client information requirements and BIM execution plans, provide the foundation for defining how information is produced, shared and controlled throughout the project lifecycle (Dolla, et al., 2024). These mechanisms ensure consistency and clarity in information delivery, supporting collaboration across multiple stakeholders (Dolla, et al., 2024).

In addition to formal standards, contractual arrangement and institutional contexts significantly influence how CDEs are implemented in practice (Dolla, et al., 2024). Studies indicate that organizational and regulatory pressures can shape adoption processes, often leading to adaptations or partial implementations of intended workflows (Dolla, et al., 2024). Furthermore, national or organizational standards, such as predefined file structures and naming conventions, contribute to more consistent information management practices and facilitate coordination among project participants (SA & ALFARO, 2021). Legal obligations to share project information have also been identified as a driver for adopting centralized data environments, reinforcing the role of governance in supporting implementation (Wallbank, 2022).

3.6.3 Change management

The transition to a CDE requires significant organizational change, making leadership and change management critical enablers of successful implementation (Adam, 2021) (Dolla, et al., 2024). This transformation can challenge existing work practices and requires clear communication of the purpose and value of the system to facilitate acceptance among users (Adam, 2021). Approaches that focus on explaining the relational behind the change, rather than only the technical aspects, have been shown to support engagement and understanding (Adam, 2021).

Resistance to change and lack of trust in new systems are common barriers that must be actively managed (Dolla, et al., 2024). Evidence indicates that stakeholders may maintain existing practices or partially adopt new processes, leading to hybrid and adapted implementations of CDE workflows (Dolla, et al., 2024). The presence of leadership roles, such as CDE champions, and targeted strategies to address organizational inertia can help overcome these challenges (Dolla, et al., 2024). Additionally, differing priorities among stakeholders, such as the need for control over information before sharing it, can affect collaboration and require careful coordination to align expectations (BIM Launcher Ltd, 2023).

3.6.4 System integration

Effective CDE implementation depends on the ability to integrate the system within existing technological environments and project workflows (SA & ALFARO, 2021);(BIM Launcher Ltd, 2023). Interoperability with commonly used BIM tools and other digital platforms is essential, as project information is generated and managed across multiple software systems (SA & ALFARO, 2021). The ability to connect the CDE with design, coordination and site management tools supports continuous information flow and reduce fragmentation (BIM Launcher Ltd, 2023)(SA & ALFARO, 2021). Features such as version control, automated notifications and cloud-based access further enhance process efficiency by ensuring that stakeholders can access up-to-date information from any location (Trimble, 2021).

The selection of technologies that align with existing digital infrastructures also facilitates implementation (Adam, 2021). For example, solutions that build upon widely used platforms or cloud ecosystems can reduce the need for additional infrastructure and improve accessibility (Adam, 2021). At the same time, avoiding vendor lock-in and ensuring flexibility in data management are important considerations when integrating CDE systems (Adam, 2021). Given the diversity of tools used across the construction industry, successful implementation often requires balancing standardization with the ability to accommodate different platforms and workflows (BIM Launcher Ltd, 2023).

3.6.5 Training programs

Training and capacity building are essential components of successful CDE implementation, supporting both technical proficiency and user acceptance (Adam, 2021) (Dolla, et al., 2024). Implementation processes that incorporate structured training programs allow organizations to gradually introduce new practices while enabling staff to adapt to the system over time (Adam, 2021). In some cases, training is delivered in stages, focusing on specific functionalities to facilitate incremental learning and improve engagement (Dolla, et al., 2024). External support, such as involvement from software providers during the early stages of adoption, can also enhance user understanding and system utilization (Dolla, et al., 2024).

Beyond technical training, developing broader digital competencies across stakeholders contributes to long-term adoption (SA & ALFARO, 2021). Educational initiatives and exposure to CDE platforms in academic or professional setting can strengthen users' ability to operate within digital environments and support collaboration between individuals with different levels of expertise (SA & ALFARO, 2021). Additionally, building confidence in the system is critical, as a lack of trust can lead to reluctance in relying on the CDE for information management (Dolla, et al., 2024). Ensuring that all stakeholders understand how to use and benefit from the system promotes more consistent and effective engagement throughout the project lifecycle (Adam, 2021);(Trimble, 2021).

4 Empirical results

This chapter presents the findings obtained from the analysis of the ten conducted interviews. The results are organized thematically to reflect the main aspects related to information management practices, digital tools and common data environments within the construction industry. The sections aim to describe the current practices, challenges and variations observed across different organizational contexts. All findings are based exclusively on the information provided by the interviewees.

The following table summarizes the key characteristics of the interview sample, including the interview identifier, company size classification, number of employees and the role of each participant. Company size has been categorized into small, medium, large and corporate based on the number of employees, to facilitate comparison across different organizational contexts. This classification provides a general overview of the diversity of perspectives included in the study.

Table 1: Summary of interview participants by company size, number of employees and roles

#	Company Size	# Employees	Job Position
1	Medium	60	Senior Project Manager
2	Big	200	Construction Project Manager
3	Corporate	250	Construction Manager
4	Corporate	250	Quality Control Lider
5	Small	12	Interior Designer
6	Big	220	Chief Information Officer
7	Medium	60	Chief Operating Officer
8	Small	4	Construction Project Manager
9	Big	200	Project Manager Junior
10	Corporate	250	Design Manager

4.1 Structure of information management systems

The interviews reveal a wide range of approaches to managing project information, from structured and standardized systems to informal and fragmented practices. Across the cases, the organization of information is commonly described using multiple platforms, attempts at centralization and in some cases, fully standardized internal systems.

A recurrent aspect across several interviews is the use of multiple platforms simultaneously. Interview (2) describes a system in which construction information is managed through Autodesk Construction Cloud, while financial processes are handled in internal systems and connected through an ERP. Similarly, interview (6) states that “there are multiple platforms depending on the type of information”, including separate systems for engineering, health and safety and financial management. In the same line, interview (10) reports the use of three different environments: a client-imposed platform for official communication, an internal platform (Aconex) and BIM 360 for technical coordination. In this case, it is explicitly stated that information is not centralized in a single system.

The use of multiple platforms is also linked to external requirements. Interview (6) explains that “we work for different clients that ask for things in different ways”, while interview (10) states that the use of the client’s platform is mandatory by contract. This leads to situations where companies must adapt their internal processes to different systems depending on the project.

Despite the presence of multiple platforms, several interviewees describe attempts to centralize information, although these are not always achieved in practice. Interview (8) states that “we try to centralize everything in Drive, but it is not always achieved”. Similarly, interview (9) explains that the “official repository was BIM”, but in practice “someone saves a version on their desktop, and you have to go ask for it”. In contract, interview (7) describes a transition from dispersed tools such as Dropbox, One Drive and WeTransfer to a centralized system (Procore), where “everything is uploaded there”.

A different situation is described in interview (1), where the system is characterized by a high level of structure and standardization. The interviewee reports the existence of defined procedures, internal and external servers and strict workflows. In this case, issues related to version control or missing information are described as not occurring.

Some interviews describe efforts to reduce the number of systems used. Interview (2) explains that the company has reduced the number of platforms from approximately ten to six, with the objective of reaching two or three systems in order to simplify daily operations. Similarly, interview (6) mentions the development of and internal platform designed to connect different systems and avoid “having people moving data manually from one place to another”, although it is stated that this objective is not always achieved. In contrast, interview (5) describes a much simpler structure based on a shared server connected to office computers, where folders and subfolders are used to organize information, although issues arise when synchronizations fail.

4.2 Communication and information flow

The interviews show that communication practices vary significantly, ranging from informal methods to platform-based communication systems.

Several interviewees describe the use of informal communication channels, particularly in smaller organizations. Interview (8) states that information is managed through “Drive and WhatsApp, unfortunately we still have that problem”. Interview (3) explains that information is often shared through phone calls and on-site conversations, which can result in a lack of formal records. Similarly, interview (5) reports that communication with clients is mainly conducted through in-person meetings and printed drawings.

At the same time, emails are consistently described as a primary communication tool. Interview (3) states that “we receive all the information through email”, while interview (9) explains that communication with clients is “always through email”. Interview (10) also reports that communication with contractors who do not have access to platforms is carried out through email or shared links.

In contrast, some interviews describe platform-based communication environments. Interview (10) states that communication with the client is conducted “only through the client’s platform” Interview (7) explains that all participants interact through a centralized platform, where it is possible to track who accessed, edited or received information and when these actions occurred.

Details highlight differences in how communication is formalized. Interview (8) explains that meeting minutes are sometimes went through WhatsApp immediately after meetings to “have it in writing”, although it is also stated that this practice is not consistently followed. Interview (4) describes the use of formal reports on a weekly or monthly basis depending on client requirements, while interview (7) mentions the use of structured modules such as RFIs, submittals and transmittals within the platform to formalize communication. These practices coexist with informal exchanges, showing variation in how communication is recorded and managed.

4.3 Version control and information reliability

Issues related to version control appear consistently across the interviews, particularly in environments where multiple users interact with shared information.

Several interviewees explicitly describe lack of control over versions. Interview (8) states that “there are too many versions” and that “you don´t find out that something was modified”. Interview (9) explains that “you did not always have the latest version”, while interview (4) states that “versions are not updated”. Interview (2) highlights that the absence of standardized naming conventions makes it difficult to identify correct files within the system.

The consequences of these situations are also described. Interview (5) explains that contractors executed work based on incorrect drawings, which required rework. Similarly, interview (3) describes cases where work was carried out based on drawings that did not match site conditions, leading to the need to redo tasks.

In contrast, some interviews describe environments with controlled version management. Interview (7) states that “the only valid version is the one in Procore”, while interview (1) reports that issues related to outdated information do not occur due to the existence of structured processes and strict documentation practices.

Further examples describe how version control issues are directly linked to system behavior and file management practices. Interview (5) explains that to avoid losing information, manual backups were created, which resulted in "three drawings of the same things but with different details". Additionally, interview (2) highlights that even when information is centralized, inconsistent file naming prevents users from identifying correct versions. Interview (8) also emphasizes that changes may occur without notification, stating that "if I don´t tell you, you don´t find out", reinforcing the absence of automated tracking mechanisms in some systems.

Information reliability also emerges as a concern across several interviews. In some cases, participants indicate that the latest version available in the system cannot always be trusted, leading to the need to verify information manually. For example, interview (9) explains that updates were not always performed in real time, while interview (8) states that "you don´t find out that something was modified". As a result, project teams may rely on direct confirmation with other stakeholders to validate information before proceeding.

4.4 Human factor in information management

The role of user behavior is repeatedly mentioned across the interviews as a relevant aspect in the management of information

Several interviewees explicitly refer to dependence on how individuals use systems. Interview (9) states that "the problem is how people work", describing situations where users download files, modify them locally and forget to upload them again. Interview (4) explains that some project managers do not consistently updated documentation, while interview (6) states that the main issue is not the tools themselves but "data governance".

The lack of discipline in following processes is also mentioned. Interview (8) states that the problem lies in "being disciplined", while interview (4) reports that new employees are sometimes not aware of existing processes, leading to inconsistent documentation practices.

Additionally, resistance to adopting digital tools is described. Interview (7) explains that some users preferred to continue working with Excel or email, and that the adoption of the platform required making its use mandatory.

Individual working habits influence information management. Interview (9) explains that some users prefer working on local desktops because the platform may be slow of difficult to use and only upload information later. Similarly, interview (5) states that lack of trust in the system led to reliance on printed documents and in-person validation. Interview (10 also highlights that learning platforms through manuals and sel-training can lead to mistakes, indicating that user experience and training methods influence how systems are used in practice.

Additional examples indicate that digital platforms are not always used as intended. Interview (9) states that the system was sometimes used "just to comply", while work was carried out outside the platform and uploaded later.

Similarly, interview (6) describes situations where decisions are made on site before information is formally updated in the system.

4.5 Gap between digital systems and site reality

Several interviews describe a difference between the information available in digital systems and the reality of construction site operations.

Interview (9) explains that updates were sometimes performed "at the end" rather than in real time. Similarly, interview (6) describes a gap between platform information and actual site conditions, indicating that decisions may be taken on site before the information is updated in the system.

At the same time, the continued use of physical documentation is reported. Interview (10) states that "paper is still widely used", particularly for site operations. Interview (9) explains that printed drawings are required for audits, while interview (5) describes the use of printed drawings for construction execution.

Additional examples reinforce the coexistence of digital and physical workflows. Interview (3) describes situations where decisions are taken on site without full information, leading to rework, while interview (10) explains that contractors on site often do not have access to platforms and therefore rely on printed drawings or shared files. Interview (6) also mentions the use of augmented reality to compare built work with digital models, noting that discrepancies may appear when updates are not reflected in the system.

4.6 Implementation and adoption of digital systems

The implementation of digital platforms is described as a process that requires time, training and adaptation. Interview (2) reports that the implementation of a new platform required approximately two years, including evaluation and deployment. Interview (7) states that around 1.5 years were needed to achieve adoption across projects.

Training and learning processes are also described. Interview (10) explains that training is necessary and requires time, while interview (9) states that learning was carried out "on the go", without formal training.

Challenges during adoption are mentioned in several cases. Interview (7) describes initial resistance from users, while interview (6) explains that some individuals continue using previous tools such as Excel despite the availability of new systems.

Further details show variation in how implementation processes are experienced. Interview (7) explains that initial implementation was voluntary and later made mandatory to ensure adoption across projects. Interview (10) describes learning through manuals and self-study, while interview (2) highlights that user initially questioned the system but later recognized its value after adoption. These examples show differences in how training and enforcement are applied during implementation processes.

Also, the adoption requires enforcement in some cases. Interview (7) explains that initial implementation was voluntary but later became mandatory to ensure consistent use across projects. This process required time, with adoption taking approximately 1.5 years. Similarly, interview (2) describes an initial period in which users questioned the system before recognizing its benefits.

4.7 Needs and desired improvements

Across the interviews, several needs and desired improvements are identified, covering aspects related to system structure, usability, communication and integration of information.

A recurring aspect is the desire to reduce fragmentation and work within fewer platforms. Interview (10) explicitly states a preference for "working in one platform", while interview (6) explains efforts to centralize information and reduce the need to move data manually between systems. Interview (2) also describes an ongoing process of reducing the number of platforms used within the company to simplify workflows.

Another frequently mentioned need is related to notifications and awareness of changes in information. Interview (8) suggest the implementation of a system that alerts users when a file is modified, including visibility of what has changed. Similarly, interview (4) proposes automatic notifications when reports are uploaded or changes are approved, so that all team members are informed without the need for manual communication.

The need for real-time information and continuous updating is also described. Interview (3) proposes a system where daily site progress can be uploaded, including photos and details of execution, allowing verification of work and early detection of errors. Interview (6) also highlights the importance of aligning digital information with site reality, suggesting that information should be updated in line with actual progress.

Several interviewees refer to improvements in usability and system performance. Interview (5) emphasizes that a digital system is only useful "if it works correctly", highlighting the importance of reliability. Interview (9) mentions that platforms may be slow or difficult to use, which leads users to work outside the system. Interview (8) also states that ease of use is more important than cost when adopting new tools.

The need for better integration of processes and reduction of duplicated work is also identified. Interview (3) describes situations where financial information must be entered into multiple systems, suggesting the integration of platforms to avoid repetition. Similarly, interview (6) explains efforts to automate the transfer of information between systems to reduce manual work.

Another aspect relates to visibility and access to information for different stakeholders. Interview (8) suggest providing clients with access to project progress, including images and updates, while maintaining a private internal section for sensitive information. Interview (3) also proposes improving visibility of project statues to reduce the need for constant follow-up.

Improvements in functionalities for project management and tracking are also mentioned. Interview (8) suggests tools that include calendars, timelines and deliverables organized per project. Interview (10) propose more advanced markup tools that allow precise annotations directly on drawings, like design software in order to facilitate as-built documentation.

Several interviewees highlight the importance of reliability, simplicity and accessibility. Interview (5) emphasizes that need for automatic backups and stable systems, while interview (8) highlights the importance of intuitive navigation, especially in situations where information is needed quickly.

Across multiple interviews, particular emphasis is placed on the need for greater visibility and control over changes in project information. Interview (8) explicitly highlights the need to know when information has been modified and what has changed, while interview (9) describes the need to constantly verify updates with other team members. Additionally, interview (3) proposes more continuous and structured updates of site progress to detect issues earlier.

4.8 Cost perception of digital platforms

Across the interviews, most participants were asked to estimate a reasonable monthly cost per user for a digital platform for project information management. The responses vary depending on company size and context but provide a range of perceived acceptable costs.

Interview (5) estimates a cost of approximately 20 USD per user per month, noting that this reflects that scale of a small company. Interview (8) suggests a range between 50-100 USD per user per month, stating that cost is not the main concern if the tool is effective and easy to use. Similarly, interview (10) proposes a broader range between 100-500 USD per user per month, depending on the level of functionality provided.

Interview (3) estimates a range of 100-150 USD per user per month, linking the cost to potential time savings and reduction of manual work. Interview (2) mentions a reference value of approximately 50 USD per user per month, based on previous licensing experience. Interview (9) when considering an induvial perspective, suggest a cost like a subscription service, approximately 20-25 USD per month.

In contrast, some interviewees indicate that they do not have sufficient information to define a cost. Interview (1) and interview (6) state that they are not aware of pricing structures, while interview (7) explains that pricing in their case is based on company revenue rather than per-user cost, having as a result 20 USD per month.

The following table presents the cost estimates provided by the interviewees regarding a potential monthly subscription per user for a digital platform aimed at improving project information management. The values are based on the ranges or references explicitly mentioned during the interviews. In cases where no specific figure was provided, this is indicated accordingly. The responses reflect different perspectives depending on the role of the interviewee and their organizational context.

Table 2: Estimated monthly cost per user for digital information management platforms based on interview responses.

#	Estimated Cost (USD/month/user)	Notes
1	Not specified	No reference given
2	50	Based on licensing experience
3	100 – 150	Linked to efficiency gains
4	Not specified	No clear value provided
5	20	Small company context
6	Not specified	Depends on licensing model
7	20	Based on company revenue
8	50 – 100	Based on usability
9	20 – 25	Individual perspective
10	100 - 500	Depending on functionality

4.9 Differences according to company size

Differences in information management practices, tools and workflows are observed across the interviews when considering company size classifications, including small, medium, large and corporate organizations. These differences are reflected in the types of systems used, the level of structure in processes and the way information is managed and accessed.

In smaller organizations, as described in interviews (5) and (8) information management is carried out using basic tools such as shared servers, Google Drive and WhatsApp. Interview (8) states that information is managed through "Drive and WhatsApp, unfortunately we still have that problem", while interview (5) describes the use of a shared server connected to office computers. In these cases, challenges are reported in relation to version control, duplication of files and system reliability. Interview (5) explains that manual backups resulted in "three drawings of the same thing but with different details", while interview (8) states that "you don´t find out that something was modified" when changes occur.

Differences are also observed in how digital systems are used in practice. In smaller companies, information management is more dependent on informal communication and direct coordination, as described in interviews (5) and (8). In contrast, larger organizations report the use of multiple structured platforms; however, interview (9) indicates that these systems are not always used in real time and may serve primarily as repositories rather than active coordination tools.

5 Analysis and discussion

This chapter examines the research findings to understand current information management practices and their impact on project performance. It also explores digital adoption, identifies key barriers and industry needs, and proposes a framework to support more effective and accessible use of CDEs.

5.1 Current practices in information management

The findings show that information management in construction projects continues to be highly fragmented, despite the increasing use of digital tools. This reflects what is described in the literature, where the construction industry is characterized by low digital maturity and reliance on disconnected systems (Jahanger, 2024) (Bajpai & Misra, 2022).

The interviews confirm that companies use a wide range of tools to manage project information, including shared servers, cloud storage platforms, emails and messaging applications. Rather than working within a single system, information is often distributed across multiple platforms depending on its type or purpose. For example, some companies use specific systems for technical documentation, while financial information and communication are managed separately (2).

This situation leads to fragmented workflows, where information is not stored or accessed in a consistent way. In smaller companies, this is often reflected in the use of tools such as Google Drive and WhatsApp, which, although practical, do not provide structured control over information. As one participant explained, "Drive and WhatsApp… we still have that problem" (8). These tools support day-to-day communication but limit traceability and version control.

In larger companies, more structured systems are sometimes implemented, but fragmentation still exists. Even when a central platform is used, it is often complemented by other systems that are not fully integrated (2,6). This creates parallel information flows, where different versions of the same data may exist in different locations.

These findings are consistent with the literature, which highlights that construction projects involve multiple stakeholders and decentralized decision-making processes, leading to dispersed information ownership and limited integration (Bello, et al., 2024) (Mbazor, et al., 2025).

Overall, the results suggest that current practices in information management are not defined by the absence of digital tools, but by the lack of integration between them. Companies are using digital solutions, but these are not implemented as part of a unified system. This creates a fragmented environment that limits coordination and increases the complexity of managing project information.

5.2 Fragmentation and its impact on project performance

The findings show that information fragmentation is not only a structural characteristic of the construction industry, but also a key factor affecting project performance. While the literature describes fragmentation as a result of multiple stakeholders and decentralized information flows (Bello, et al., 2024) (Mbazor, et al., 2025), the interviews provide clear evidence of how this translates into practical challenges during project execution.

One of the main issues identified is the lack of consistent version control. Several participants reported difficulties in ensuring that all team members are working with the latest version of project documents, which leads to confusion and coordination problems (2,4,8,9). In fragmented environments, information is often stored in different locations, making it difficult to verify which version is correct.

This lack of control has direct consequences on project performance. In some cases, construction activities were carried out using outdated or incorrect drawings, resulting in rework and delays (3,5). These situations not only affect the timeline of the project but also increase costs and reduce overall efficiency.

In addition, the absence of standardized processes for naming, storing and sharing information increases the complexity of managing project data. Participants described situations where finding the correct document required additional time and effort, especially when information was distributed across multiple platforms (2). This reflects the challenges identified in the literature related to inefficient information flows and limited standardization (Jaskula, et al., 2024).

This lack of standardization also reflects broader challenges related to information governance, where responsibilities, access and control over project data are not always clearly defined (Bello, et al., 2024) (Fulford & Standing, 2013). In addition, fragmented information environments limit the ability of organizations to capture and reuse knowledge across projects, reinforcing the loss of valuable experience and reducing opportunities for organizational learning (Ferradaa, et al., 2016).

Fragmentation also affects communication between project stakeholders. When information is not centralized, updates are not always shared consistently, which can lead to misunderstandings and errors. This aligns with previous research showing that unclear communication channels and delayed information exchange contribute to coordination breakdowns and reduced project performance (Musonda, et al., 2019) (Naveed & Khan, 2022).

The findings suggest that fragmented information management creates a chain of operational problems that directly impact project outcomes. Rather than being a purely organizational issue, fragmentation influences how decisions are made, how tasks are executed and how effectively teams can coordinate their work. This reinforces the need for more integrated approaches to information management, as proposed in the literature through systems such as CDEs.

5.3 Adoption of digital systems across companies

The findings show that the adoption of digital systems in construction varies significantly across companies, particularly depending on their size, structure and level of organization. While digital tools are widely used across all cases, their level of integration and alignment with structured information management practices differs considerably.

In larger companies, there is a stronger tendency to adopt more structured digital platforms that resemble the concept of a CDE. For example, some participants described the use of centralized systems such as Autodesk Construction Cloud, where project documentation, communication and coordination processes are managed within a single platform (2). In these cases, access control, document management and workflows are more clearly defined, allowing for improved traceability and organization of information.

These structured environments reflect the benefits described in the literature, where CDEs are associated with better coordination, improved access to information and reduced inconsistencies (Henry, et al., 2025) (Silva & Boton, 2025). In practice, participants working within these systems reported fewer issues related to version control and clearer understanding of project information.

In addition, the availability of structured and centralized information supports more informed decision-making, as project teams can rely on consistent and up-to-date data when evaluating project conditions (Abdelalim, et al., 2024).

However, even in these cases, full centralization is not always achieved. Many companies still rely on additional platforms for specific functions such as financial management or client communication, which creates partial fragmentation within otherwise structured systems (2,6). This suggests that the adoption of CDE principles is often incomplete, limiting the full realization of their intended benefits.

In contrast, small and medium-sized companies tend to rely on simpler and more informal tools, such as shared drives, emails and messaging applications (5,8). While these tools are accessible and easy to use, they do not provide the structure required for consistent information management. As a result, issues related to version control, traceability and coordination are more common.

This difference highlights that the adoption of digital systems is not only a matter of availability, but also a capability and resources. Larger companies are more likely to invest in structured platforms and define formal processes, while smaller companies often prioritize practicality and ease of use.

The findings indicate that the adoption of CDE-like systems can improve information flow and coordination when implemented in a structured and consistent way. However, this adoption is uneven across the industry, with many companies operating in hybrid environments that combine structured platforms with informal tools. This reinforces the idea that the impact of CDEs depends not only on their presence, but on the extent to which they are fully integrated into project workflows.

5.4 Barriers and limitations of current CDE adoption

The findings show that although digital tools and CDE-like systems are available, their adoption is still limited across the construction industry. This supports the literature, which identifies multiple barriers that restrict the effective implementation of digital information management systems (Jaskula, et al., 2024) (Abma, et al., 2024).

One of the main barriers identified is system complexity. Several participants reported that some platforms are difficult to use, which leads users to avoid them or use them only partially. In these cases, information is often managed outside the system and uploaded later, reducing the benefits of real-time coordination (5,9). This reflects the literature, which highlights that complex systems can discourage adoption and limit effective use (Pinnacle Infotech, 2021).

Cost is another important factor, particularly for small and medium-sized companies. While larger organizations are more likely to invest in structured platforms, smaller companies often rely on simpler and more accessible tools such as shared drives and messaging applications (5,8). This suggests that the perceived cost of implementing CDE systems can act as a barrier, especially when the benefits are not clearly understood or when existing methods appear sufficient for daily operations.

Lack of training and user knowledge also affects adoption. Some participants explained that systems are not always introduced with proper training, which leads to inconsistent use and reduced confidence among users (10). As a result, teams may revert to familiar tools such as email or Excel, even when more advanced systems are available. This aligns with the literature, which identifies insufficient training and limited digital skills as key barriers to adoption (Abma, et al., 2024).

Another important limitation relates to the lack of standardized information practices. Without clear naming conventions, structured workflows and defined information requirements, the use of digital platforms becomes inconsistent and difficult to manage across project teams (Jaskula, et al., 2024).

Resistance to change is another recurring issue. Even when systems are implemented, some users prefer to continue using traditional methods, particularly when new workflows re perceived as more demanding time-consuming (7-9). In some cases, the use of digital platforms had to be enforced to ensure consistency.

Integration challenges limit the effectiveness of CDE systems. Many companies use different platforms for different functions and these systems are not always compatible. As a result, information must be transferred manually between systems, increasing workload and the risk of errors (3,6). This reflects the interoperability issues widely discussed in the literature (Jaskula, et al., 2024).

The findings suggest that the limited adoption of CDEs is not caused by a single factor, but by a combination of technological, organizational and human barriers. These challenges explain why many companies operate in hybrid environments, where structured systems are used alongside informal tools. This highlights the need for more accessible, user-friendly and integrated solutions that can better align with the realities of construction projects.

5.5 Misalignment between digital tools and site practices

The findings reveal a clear gap between the use of digital systems and the realities of construction site operations. While digital platforms are intended to support real-time information management and coordination, their use in practice is not always aligned with on-site workflows. This reflects the literature, which highlights that formal information systems often coexist with informal communication practices in construction projects (Radziszewska-Zielina, et al., 2019) (Naveed & Khan, 2022).

Several participants reported that project information is not always updated in real time. Instead, updates are often made after activities are completed, which creates a delay between what is recorded in the system and what is happening on site (6,9). This delay can affect decision-making, as teams may rely on outdated or incomplete information, a challenge also identified in previous studies on information flow and coordination (Musonda, et al., 2019).

The continued use of physical documents further reflects this gap. Printed drawings and documents are still commonly used on site, even in projects where digital systems are available (5,9,10). In some cases, site teams do not have direct access to digital platforms, which requires information to be transferred manually. This limits the effectiveness of centralized systems and reduces the consistency of information flow.

In addition, informal communication remains an important part of daily operations. Decisions are often made through direct conversations, phone calls or messaging applications, rather than through structured digital workflows (3,8). While this can improve speed and flexibility, it also reduces traceability ad makes it more difficult to maintain a consistent record of project information. This supports the literature, which describes the coexistence of formal and informal communication channels in construction projects (Radziszewska-Zielina, et al., 2019).

Participants also highlighted situations where digital information does not fully reflect actual site conditions. For example, updates to drawings are models may not be immediately reflecting in the system, leading to differences between digital data and on-site reality (6).

These findings suggest that digital tools are not fully integrated into the operational environment of construction projects. The effectiveness of systems such as CDEs depends not only on their technical capabilities, but also on their ability to support the daily practices on site teams. Without this alignment, even well-implemented systems may not achieve their intended benefits.

5.6 Key industry needs for effective information management

The analysis of the interviews, supported by the coding results, reveals a set of recurring needs across companies regarding how project information should be managed. These needs are consistent across different types of organizations, although their level of importance varies depending on company size and level of digital maturity.

A primary need identified is the centralization of information. Many participants described working with multiple platforms for different types of data, which creates confusion and reduces visibility across project teams (2,6,10). This reinforces the need for a single environment where project information can be stored and accessed in a consistent way. This aligns with the concept of a CDE as a "single source of truth" described in the literature (Henry, et al., 2025), although the findings show that this is a rarely achieved in practice.

Another key need is simplicity and ease of use. Several participants emphasized that systems must be intuitive and easy to navigate to be adopted consistently. When platforms are perceived as complex or time-consuming, users tend to avoid them and rely on alternative tools (5,9). In smaller companies, ease of use was considered more important than cost, as systems must support daily operations without adding complexity (8). This reflects the importance of usability in digital adoption, as highlighted in the literature (Abma, et al., 2024).

The need for real-time and reliable information was also strongly identified. Participants reported issues related to outdated data and lack of synchronization between systems, which affects decision-making and coordination (6,9). This confirms the challenges described in the literature regarding delays in information flow and their impact on project performance (Musonda, et al., 2019).

Communication and visibility across teams represent another important need. Several participants highlighted that information is not always shared consistently, and that there is a lack of clear notifications or tracking of changes (4,8). This creates gaps in coordination, especially in projects involving multiple stakeholders. These findings support previous research on the importance of clear communication channels and structured information exchange (Naveed & Khan, 2022).

Integration between systems is also a critical requirement. Companies often use different tools for different functions, which requires manual transfer of information between platforms (3,6). This increases workload and introduces potential errors. The literature identifies interoperability as a key challenge in digital construction environments, particularly when multiple systems are used simultaneously (Jaskula, et al., 2024).

Accessibility across different working environments is essential. Participants highlighted the need for systems than can be used both in the office and on site, allowing teams to access and update information in real time (6,10). This is particularly important for improving coordination between field and office teams, and for reducing the gap between digital systems and actual site practices.

The findings highlight the need for solutions that are accessible to SMEs. While larger companies are more likely to implement structured systems, smaller organizations rely on simpler tools due to cost, complexity and resource limitations (5,8). This suggest that existing solutions do not fully address the needs of a significant portion of the industry.

Overall, these findings indicate that companies are not lacking digital tools, but rather solutions that align with their operational needs. The recurring themes identified: centralization, simplicity, integration, real-time access and usability, represent the key expectations required to support wider and more effective adoption of CDE systems across the construction industry.

This suggests that the challenge is not the absence of digital solutions, but the lack of alignment between existing systems and the operational realities of construction projects. As a result, improving adoption requires not only technological development, but a better understanding of how companies manage information in practice.

5.7 Market gap and need for more accessible solutions

The findings indicate a clear gap between the needs of construction companies and the solutions currently available in the market. While the literature presents CDEs as effective tools for improving information management and coordination (Henry, et al., 2025) (Silva & Boton, 2025), the results show that their adoption remains limited, particularly among small and medium-sized enterprises.

This gap becomes evident when comparing the widespread use of fragmented systems with the consistent need for more integrated solutions. As identified in the previous section, companies across different contexts express similar needs. However, these needs are not typically addressed through a single system, but through the combined use of multiple tools that support different aspects of project management (3,8).

Rather than indicating a lack of digitalization, this behavior suggest that companies are actively compensating for the limitations of existing solutions. By combining platforms such as shared drives, messaging applications and specialized tools, they create working environments that respond to their immediate needs, but that do not provide full control or consistency of information.

The limited adoption of CDEs among many companies therefore reflects a broader mismatch between available solutions and industry practices. Existing systems do not fully align with how project teams operate daily, particularly in environments with less formal structures. As a result, a significant portion of the industry continues to operate outside fully integrated digital environments, despite facing similar coordination and information management challenges.

Overall, these findings point to a clear opportunity to develop more accessible and adaptable solutions that better reflect the diversity of the construction sector. Addressing this gap requires moving beyond a single model of implementation and considering how systems can be designed to support different levels of complexity, resources and organizational needs.

This indicates that the gap is not temporary, but structural, and reflects a misalignment between how solutions are designed and how the industry operates.

5.8 Towards more flexible and scalable CDE solutions

The gap identified between industry needs and existing solutions suggest that current approaches to CDE implementation do not fully reflect the diversity of the construction sector. While CDEs are defined in the literature as centralized and structured systems for managing project information (Henry, et al., 2025), their practical application often assumes a level of organizational structure and digital maturity that is not present across all companies.

The findings show that companies operate with different levels of complexity, resources and internal organization. As discussed in previous sections, some organizations can implement structured systems with defined workflows, while other rely on simpler tools to support their daily operations. This variation indicates that a single approach to Cde implementation is not suitable for all cases.

To support wider adoption, CDE solutions need to become more flexible and adaptable to different contexts. Rather than requiring companies to adjust their processes to fit a predefined system, digital platforms should be designed to align with existing workflows and gradually support their improvement. This aligns with the literature, which highlights the importance of organizational readiness and alignment between systems and operational needs for successful implementation (Trimble, 2021) (Adam, 2021).

Scalability is also an important consideration. The findings suggest that companies, particularly SMEs, may benefit from starting with basic functionalities focused on document management and communication, and then expanding to more advanced features as their needs evolve. This approach allows organizations to adopt digital systems progressively, reducing the risk associated with complex implementations.

More structured and integrated systems can support better information governance and improve the reliability of project data, which is essential for effective coordination and decision-making processes (Fulford & Standing, 2013) (Abdelalim, et al., 2024).

In addition, flexibility in system design can support better integration with existing tools. As many companies already rely on multiple platforms, the ability to connect systems and allow information to flow between them becomes more relevant than replacing all tools with a single platform. This reflects the importance of interoperability identified in the literature (Jaskula, et al., 2024).

Overall, these findings suggest that moving towards more effective CDE adoption requires a shift from rigid and standardized systems to more flexible and scalable solutions. By adapting to different organizational contexts and supporting gradual implementation, these approaches can better respond to the needs identified across the industry.

5.9 Proposed framework for more universal CDE adoption

The findings of this study indicate that improving the adoption of CDEs requires moving beyond the implementation of complex digital platforms and focusing instead on how these systems align with the actual needs and practices of construction companies. Based on the analysis of the literature, interview results and coding's, this study proposes a framework to support a more accessible and scalable approach to CDE adoption.

The framework is structured around four key dimensions: simplicity, centralization, integration and accessibility. These dimensions reflect the recurring needs identified across companies and represent the main factors influencing the effective use of digital systems in construction projects.

Simplicity is a fundamental requirement for adoption. The findings show that when systems are perceived as complex or difficult to use, users tend to avoid them and rely on alternative tools (5,9). Therefore, CDE solutions should prioritize intuitive interfaces, clear workflows and minimal training requirements. This allows companies to adopt systems more easily and supports consistent use across project teams.

Centralization addresses the need to reduce fragmented information environments. As identified through the analysis, companies often manage project data across multiple platforms, which limits visibility and coordination (2,6,10). CDE solutions should therefore provide a structured environment where project information can be stored and accessed in a consistent way, supporting the concept of a single source of truth described by (Henry, et al., 2025).

Integration is essential to reduce inefficiencies caused by disconnected systems. The findings show that companies frequently transfer information manually between platforms, increasing workload and risk of errors (3,6). As a result, CDE systems should be designed to connect with existing tools and allow information to flow across different processes, rather than operating as isolated systems. This aligns with the importance of interoperability highlighted in the literature (Jaskula, et al., 2024).

Accessibility ensures that digital systems can be used effectively across different project environments. The analysis revealed a gap between digital platforms and site practices, where information is not always updated in real time and physical documents are still widely used (6,9,10). To address this, CDE solutions should be accessible both in office and site conditions, enabling real-time updates and supporting coordination between teams.

In addition to these dimensions, the framework recognizes that companies differ in their capacity to adopt digital systems. Smaller organizations may require simple and cost-effective solutions focuses on basic coordination, while larger companies may benefit from more advanced functionalities and structured workflows. This suggest that CDE systems should be scalable, allowing companies to adopt functionalities progressively based on their needs and resources.

Overall, the proposed framework highlights that the effective adoption of CDEs depends not only on technology, but on the alignment between systems and the way construction projects are managed. By focusing on simplicity, centralization, integration and accessibility, this approach supports a more universal adoption of CDEs across companies of different sizes and levels of digital maturity.

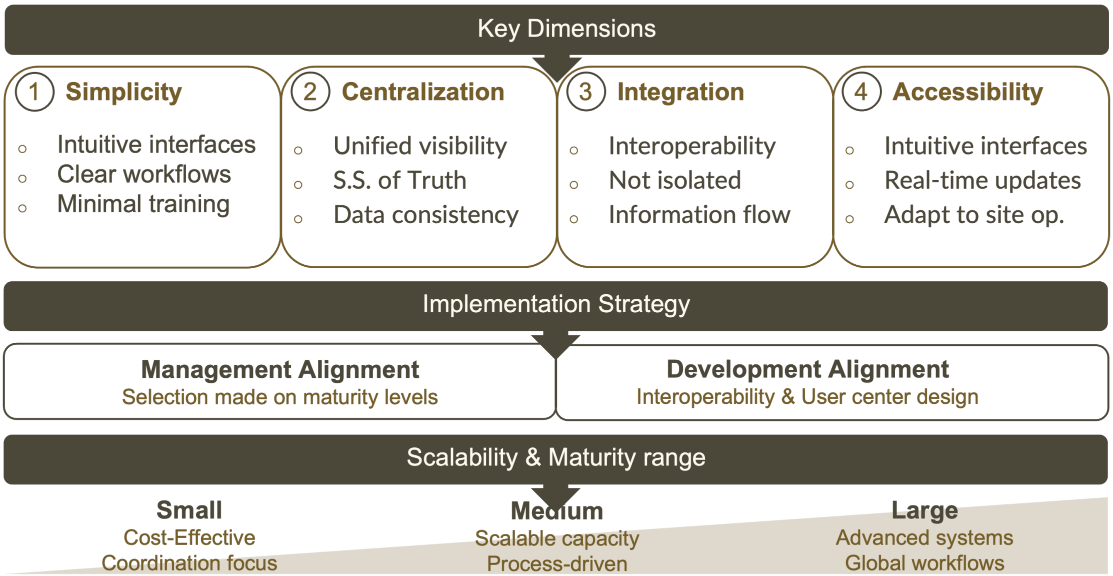

Figure 1: Visual representation for the proposed framework for more universal CDE adoption

6 Conclusion

This study examined how different approaches to information management, specifically the use of Common Data Environments (CDEs) versus noon-centralized practices, affect information flow, coordination and project practices in construction projects. Based on a qualitative analysis of interviews with construction professionals, the findings provide empirical insight into how these systems are implemented in practice and how they influence project performance, particularly from the perspective of contractors and small and medium-sized enterprises (SMEs).

The results indicate that the adoption of a CDE can significantly improve the organization, accessibility and traceability of project information. By providing a centralized platform, CDEs support more structured workflows, reduce the risk of working with outdated information and enhance coordination among project participants. In this sense, the concept of a "single source of truth" represents a valuable framework for addressing long-standing issues related to information fragmentation in construction projects.

However, the findings also reveal that the effectiveness of CDEs is highly dependent on their practical implementation within organizational contexts. Despite the availability of digital tools, many companies continue to operate in hybrid environments where formal digital systems coexist with informal communication channels such as emails phone calls and messaging applications. This coexistence often undermines the intended benefits of centralized systems, as critical information may still be exchanged outside the platform, leading to inconsistencies and reduced transparency.

A key insight from the study is that information fragmentation remains a persistent challenge, not only due to the absence of digital tools, but also due to the way in which these tools are used. In many cases, CDEs are implemented as isolated solutions rather than as part of a broader information management strategy. This limits their potential impact, as the lack of standardized processes and clear governance structured reduces their effectiveness in practice.

The research also highlights the significant influence of organizational and human factors in shaping information management practices. The adoption of digital systems is not solely a technical decision, but also a cultural and operational one. Resistance to change, lack of training and misalignment between digital workflows and site practices were identified as key barriers to effective implementation. As a result, even when digital platforms are available, their use may remain partial or inconsistent across project teams.

From the perspective of SMEs, these challenges are further intensified. Limited financial resources reduced technical capacity, and less formalized organizational structures make it more difficult for smaller companies to adopt a fully utilize complex digital systems. Cost perception plays an important role, as many SMEs view digital platforms as an additional expense rather than as a strategic investment. Furthermore, existing solutions are often perceived as overly complex or not sufficiently adapted to the operational realities of smaller organizations.

These findings highlight a clear gap between the theoretical potential of CDEs and their practical application in construction projects. While the literature emphasizes the benefits of centralized information management and integrated digital workflows, the empirical evidence suggest that real-world implementation is shaped by contextual factors that limit these outcomes. In particular, the needs of SMEs are not always adequately addressed by current digital solutions, indicating a mismatch between market offerings and industry requirements.

This study contributes to the existing body of knowledge by providing an empirical perspective on how information management systems are used in practice within construction projects. It reinforces the relevance of CDEs as a tool for improving coordination and information flow, while also emphasizing the importance of organizational alignment, user adoption and practical applicability. By focusing on contractors and SMEs, the research adds to the understanding of how digital transformation is experienced at different levels of the industry.

From a practical standpoint, the findings suggest that successful CDE implementation requires more than the adoption of digital platforms. Organizations need to align their workflows, processes and communication practices with the capabilities of the system. This includes establishing clear information management protocols, ensuring consistent use across project participants and adapting digital tools to fit the realities of on-site operations. Training and user engagement are also critical factors, as they directly influence the extent to which systems are effectively used.

In addition, there is a need for more flexible and scalable solutions that can accommodate the varying capacities of construction companies, particularly SMEs. Rather than relying on complex, one-size-fits-all systems, the industry may benefit from more modular approaches that allow gradual adoption and adaptation over time. This would enable companies to integrate digital tools into their processes without requiring significant upfront investment or major organizational restructuring.

Overall, the study demonstrates that while CDEs have the potential to improve information management in construction projects, their impact is contingent on how they are implemented and integrated into everyday practices. Addressing the gap between technological potential and practical use remains a key challenge for the industry, particularly in supporting more inclusive and accessible digital adoption.

6.1 Future Research

Future research should focus on assessing the economic impact of implementing CDEs in construction projects. There is a need to evaluate the return of investment (ROI) by comparing implementation costs with measurable benefits such as reduced rework, improved productivity and time savings. This would provide clearer evidence to support decision-making, especially for SMEs.

In addition, further studies could explore the integration of artificial intelligence (AI) into CDE platforms to increase their flexibility and adaptability. AI could enable more dynamic workflows and better alignment with project-specific needs, helping to reduce the gap between digital systems and on-site practices.

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8 Appendix

8.1 Questions for interviews

Background questions:

1. What is your role within the company?
2. Approximately how many employees does the company have?

General questions:

1. How do you currently manage project documentation and technical information in your residential projects (drawings, revisions, contracts, site reports, communications)?
2. In your construction projects, is project information typically centralized in a single platform, or distributed across different tools and individuals?
3. How would you assess the current level of digitalization in your company regarding project management?
4. What are the main challenges you face in managing and controlling project information during a project?
5. Do you currently use any specific software to centralize and manage project information? If yes, which one(s)?

Questions for companies using CDEs:

1. What motivated your company to implement this information management platform or software?
2. How was the implementation process carried out, and how did the organization adapt to it?
3. Is the software used consistently across all projects, or does its use depend on the type of project or team? Why?
4. From your experience, what tangible benefits has the software brought to your projects, and what difficulties or limitations have you encountered?
5. Which functionalities are used most frequently, and what additional features or improvements would you consider valuable?

Questions for companies not using CDEs:

1. In your current way of working, which aspects of information management generate the most rework, errors, or loss of time?
2. Which project management processes would you most like to see become more automated or digitally supported?
3. How do you currently manage communication and coordination with clients, contractors, and internal teams? What difficulties do you find?
4. If your company were to implement a digital tool to centralize project information, what key functionalities would it need to include?
5. Would your company be willing to assume a monthly cost per employee for a software tool that improves project information management? If so, what range would you consider reasonable?

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