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DESIGN MANAGEMENT IN HIGH-RISE BUILDING PROJECTS IN CHILE

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ABSTRACT

Low productivity in high-rise building projects represents a recurring challenge in Chile, often linked to deficiencies in management during the design phase. This process, crucial for project coordination and success, is affected by fragmented roles, lack of integrated methodologies, and limited adoption of internationally recommended practices. Despite its relevance, little research has addressed how this stage is currently managed in the Chilean context. This study evaluates the design management of high-rise building projects by identifying design processes, characterizing the temporary organization formed by professionals, and analyzing their role participation. The methodology included a literature review, expert validation, surveys, and interviews with industry professionals. A total of 22 specific processes were identified across Preliminary, Basic, and Detailed design phases, and 12 roles were mapped to these processes. The study compares current practices with good practices from the literature, including project management standards and Lean, BIM, and Agile methodologies. The results reveal discrepancies between ideal and actual role involvement, operational fragmentation, and limited application of management tools. These findings highlight key areas for improvement in the Chilean construction sector and provide a foundation for future research.

KEYWORDS

Management Approaches; Design Process; High-rise Construction.

INTRODUCTION

High-rise building projects have variable definitions depending on the context—structures that require mechanical elevation systems to access their levels (Craighead, 2009). Chile also establishes that a high-rise building corresponds to those that equal or exceed six levels of height, according to the General Ordinance of Urbanism and Construction (Ministerio de Vivienda y Urbanismo de Chile, 2020). This type of project has experienced a significant increase in the main metropolitan areas and intermediate areas in the process of metropolization in Latin America (Link et al., 2023). In the case of Chile, this phenomenon is closely linked to the relaxation of urban regulation instruments and policies that encourage investment in high-rise buildings (Abramo, 2012). In cities such as Santiago, Valparaíso, and Concepción, these buildings have accounted for more than 74% of construction permits in the last two decades, reaching 94%, 83%, and 69%, respectively, by 2020 (Vergara Vidal, 2017). Over the last few decades, this type of project's price per square meter has tended to increase. The growth of this

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sector is accompanied by an increase in the cost per square meter, driven by factors such as migration to urban areas and the preference for vertical projects, which has increased urban density (Vergara-Perucich1 & Aguirre-Nuñez, 2020). This densification process is promoted by organizations such as the Organization for Economic Cooperation and Development (OECD) due to its benefits in terms of connectivity and reduction of socio-spatial segregation (S. Baeriswyl, 2019). However, the architecture, engineering, and construction (AEC) industry faces significant challenges related to productivity, cost overruns, and project delays (Knotten et al., 2017). Chile is estimated to be 53% less productive than OECD standards, with 71% of high-rise building projects delivered late, resulting in higher costs and lower profit margins (Matrix Consulting, 2020). The design phase is critical in this context, as it determines a large part of the project life cycle (Abou-Ibrahim & Hamzeh, 2020). Deficiencies at this stage are associated with ineffective management practices and a lack of coordination among stakeholders (Olanrewaju & Lee, 2022). The design phase involves the interaction of multiple disciplines that form temporary organizations, a distinctive feature of the AEC industry. Effective communication and coordination among these stakeholders are essential for a coherent design, as changes in one discipline can impact other disciplines (Svalestuen et al., 2015). Also, the modifications made during this stage have a lower impact on costs than later stages, which underlines the need for efficient management (Koo et al., 2024). Proper design reduces costs and ensures quality, safety, and functionality (Islam et al., 2021).

Lean, BIM, and Agile methodologies have shown potential to enhance efficiency and management in construction projects (Project Management Institute, 2021), but their adoption in Chile remains limited. While studies like phase (Herrera et al., 2023) address participant interactions in the design phase, there is little analysis of specific design processes and role involvement. Despite extensive documentation on the AEC industry's performance (Giménez et al., 2024) understanding the management of roles in the design phase of high-rise projects in Chile remains incomplete. This study evaluates the management of Chile's design phase in high-rise building projects by identifying design processes, assessing participation perceptions, and analyzing trends. It contextualizes current practices, compares them with best practices, and identifies shortcomings linked to low productivity. The findings aim to develop strategies for improving efficiency and quality in the design process, contributing to the construction sector's progress and competitiveness in Chile.

RESEARCH METHOD

The research was divided into three stages (Figure 1): (1) characterize the temporal organization present in the design process; (2) identify processes, practices, methodology, and tools used for the design process; (3) compare actual management and good practices recommended by the literature. The first stage, corresponding to the characterization of the design process, was divided two steps. The first step focused on identifying the processes and roles in the design phase through a literature review between 2010 and May 2024, using the Scopus and Web of Science databases. The keywords used were: "Building Design," "Preliminary Design," "Basic Design," "Detailed Design," "Information Flow," and "Design Phase." Roles were obtained following the work of Herrera and Galaz (2023a). The search related to the description of roles focused on the terms: "Roles," "Role Name," and "Building Design.". This review identified 20 design processes and 13 roles, along with their descriptions, validated by a panel of five experts in high-rise building design with more than seven years of experience. They were asked to confirm or correct the proposed assignments, and their recommendations were integrated into an iterative process until all experts agreed. The second step consisted of creating and applying a questionnaire to measure the perception of role participation in the design process. This instrument was directed to AEC industry professionals with experience in the design phase of high-rise buildings in Chile, with 12 responses for analysis. Each participant was associated with a role and its corresponding description. The questionnaire comprises five sections: (1) general background, (2) role, (3) participation in preliminary design, (4) participation in basic design, and (5) participation in detailed design. The level of participation was assessed using a six-level ordinal scale: (1) no participation; (2) observer; (3) sent information; (4) received information; (5) active participant; and (6) design leader.

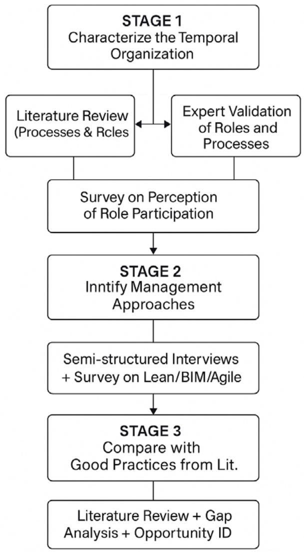

Figure 1: Research method flowchart

The second stage focused on identifying management approaches through semi-structured interviews with seven civil engineering professionals (5–15 years of experience) performing roles such as Client Representative or Project Manager in high-rise building projects in Chile. The interviews, conducted remotely, explored the context of the design phase, the use of practices, methodologies, and tools, and the reasons behind their use or absence. Content analysis (Namey et al., 2008), grouped responses by frequency and relevance. A second survey assessed the knowledge and application of Lean, BIM, and Agile practices across roles identified in the design phase, using a six-level ordinal scale ranging from "completely unknown" to "deep knowledge with regular use." The third stage aimed to identify trends in management approaches and compare them with Chilean practices. This involved four steps: (1) reviewing project management standards to highlight their academic impact (Pohle et al., 2018). (2) conducting a literature search in journals and congresses (2014–2024) using Scopus and Web of Science, guided by specific search criteria to focus on the AEC industry and design phase, (3) analyzing gaps between Chilean practices and best practices from the literature, and (4) identifying opportunities to align current practices with emerging strategies and innovations in high-rise building design management.

RESULTS AND DISCUSSIONS

DESIGN PHASE

The design phase processes from requirements assessment to documentation to building. Different roles execute these processes, and each contributes uniquely with varying degrees of participation and knowledge of management tools or methodologies (Zeiler, 2014).

Design stages

Table 1 shows the design stages identified through a literature review of five documents and the Chilean BIM standard (PlanBim, 2019). Three main stages were identified: 1) Preliminary Design, 2) Basic Design, and 3) Detailed Design. Additionally, the descriptions of each stage were made based on the literature. The most recurrent roles in the design phase of buildings and the associated descriptions were identified in the work of Herrera and Galaz (2023a) from a workshop. A total of 12 roles present in the design were identified: client representative (CR), architect (ARCH), project manager (PM), BIM coordinator (BIM), electrical design (FR), weak current electrical design (WK), plumbing designer (PLUM), geotechnical engineer (GEO), structural designer (SD), surveyor (SUR), mechanical designer (MECH), construction representative - planning (CP), which were complemented with feedback provided by five experts in high-rise building design, whose experience enriched and validated the information gathered. However, for this research, the 12 roles defined are sufficient to cover the design phase processes described in Table 2. Although more roles could increase specialization, they would also complicate project coordination and management (Herrera et al., 2023; Project Management Institute, 2021)

Table 1: Design Stages description

Stage	Description
Preliminary Design (PD)	The early design phase establishes regulatory and legal criteria, identifies customer requirements, prioritizes value-generating features, eliminates non-value-adding elements, and identifies improvement opportunities to create a robust design strategy (Orihuela et al., 2015; PlanBim, 2019).
Basic Design (BD)	In this phase, detailed design solutions for architecture, structure, plumbing, mechanical, and electrical systems are developed, alongside a cost-value analysis to identify and implement design optimizations (Orihuela et al., 2015; PlanBim, 2019).
Detailed Design (DD)	The advanced design phase finalizes detailed documentation for all project elements, including architecture, structure, plumbing, mechanical, and electrical systems. It produces construction documents, conducts a final cost-value analysis, ensures constructability, and establishes quality and sustainability requirements (Orihuela et al., 2015; PlanBim, 2019).

Design processes

Table 2 presents design processes identified from a literature review of five documents, grouped to support analysis. Feedback from five experts added two new processes with descriptions and clarified ideal roles for participation in each process. These processes align with the design stages outlined in Table 1. Table 2 provides a structured framework that defines the essential processes to consider in the design phase of high-rise buildings. Identifying and categorizing these processes allows for contextualizing this phase. It also allows structuring the investigation and analysis of each design stage, ensuring that all basic aspects are addressed.

PERCEPTION OF ROLE PARTICIPATION IN THE DESIGN PHASE

Figure 2 shows a bubble chart of the distribution of participation in the processes of the different roles. Each bubble represents, together with its color and size, a degree of involvement. The larger the bubble, the darker the color and the greater the degree of participation. Conversely, the smaller the bubble, the more it will tend to be white and represent a lower degree of involvement. In addition, an asterisk denotes the recommendation for participation in any of the degree's experts recommend.

Figure 2 presents a high level of non-participation of the GEO, MECH, WK, FR, PLUM, and SD roles in various processes of the design phase. In contrast, the CR, ARCH, PM, BIM, and CP roles highly participate in the processes in any of their degrees. In addition, 75% of the roles participate in some design processes, either preliminary, basic, or detailed, and the remaining 25%, corresponding to GEO, FR, and PLUM, do not participate in detailed design. This is largely consistent with the study by Herrera et al., (2023a) that measured participation ideally by design phase. However, there are differences only for detailed design, where FR and

PLUM participate. If analyzed by processes, unlike Herrera, precarious participation of the GEO, MECH, WK, FR, PLUM, and SD roles in the preliminary design processes is observed. The low involvement of GEO, MECH, WK, FR, PLUM, and SD Roles may be due to the work modality present in Chile. Professionals' knowledge and skills gaps may justify this situation as they may feel unable or insecure to contribute effectively (Robinson et al., 2005). Another important factor to consider is the ambiguity in delegating responsibilities to professionals, which can lead to low participation in design project activities (Dainty et al., 2003).

Table 2: Design process and design roles

ID	Roles
PD1: Evaluation of client requirements and site condition	ARCH; CR; SD; PM; SUSM; GEO; LAND; SUR
PD2: Initial architectural layout and preliminary BIM modeling.	ARCH; LAND; SUR; SD; INTD; BIM; PM
PD3: Definition of power and low-voltage electrical systems.	FR; WK; ARCH; INTD
PD4: Preliminary design of potable water and pumping systems.	PLUM; MECH
PD5: Preliminary design of fire protection and evacuation routes.	PLUM; WK; FR;
PD6: Structural system definition and load analysis.	SD; ARCH; INTD
PD7: Preliminary design of ventilation, elevators, and waste disposal.	MECH; ARCH
PD8: Initial BIM coordination and clash detection.	BIM; ARCH; SD; FR; WC; PLUM; FIRE
PD9: Preliminary constructability assessment.	CP; RM; PM
D10: Geotechnical study for foundation design.	GEO
BD1: Electrical circuits and grounding system design.	FR; WC; ARCH; SD; BIM
BD2: Design of potable water, wastewater, and stormwater systems.	PLUM; ARCH; BIM
BD3: Fire protection system and evacuation route design.	FIRE; PLUM; WC; FR; RM
BD4: Structural detailing (reinforcement, concrete, stairs).	SD
BD5: Design of retaining walls and slopes.	GEO
BD6: Mechanical systems and elevator capacity design.	MECH
BD7: BIM coordination for clash detection.	BIM
BD8: Cost, cash flow, and profitability evaluation.	PM; ARCH; CR; CP
DD1: Construction planning, scheduling, risk, and sustainability.	CP; RM; SUSM; PM
DD2: Final models and drawings for construction documentation.	BIM; ARCH; SD; PLUM WC; FR; MECH
DD3: Financial adjustment based on construction planning.	PM; CR; CP

This lack of involvement can lead to significant errors, given how crucial their participation is in the early stages of design. Herrera et al., (2023a) analyzed requirements for information (RFI) of more than 17 high-rise building projects. These were mainly associated with the GEO, MECH, WK, FR, PLUM, and SD roles, which coincidentally have the lowest participation identified in Figure 2. RFI can directly impact poor design (O'Connor & Koo, 2021), causing cost increases and schedule delays (F. Morales et al., 2022). Thus, there is a low concordance between the experts' recommendations and the perception of participation in the design phase of the different roles. One of the reasons is that the experts usually refer to an ideal scenario, while the responses reflect the perception of the current situation, evidencing the existing deficiencies. Figure 2 shows fragmentation throughout the design phase, one of the problems associated with this process (Galaz-Delgado et al., 2021). This fragmentation is particularly noticeable in the GEO, MECH, WK, FR, and PLUM roles, which causes inefficient design management (Lappalainen et al., 2022).

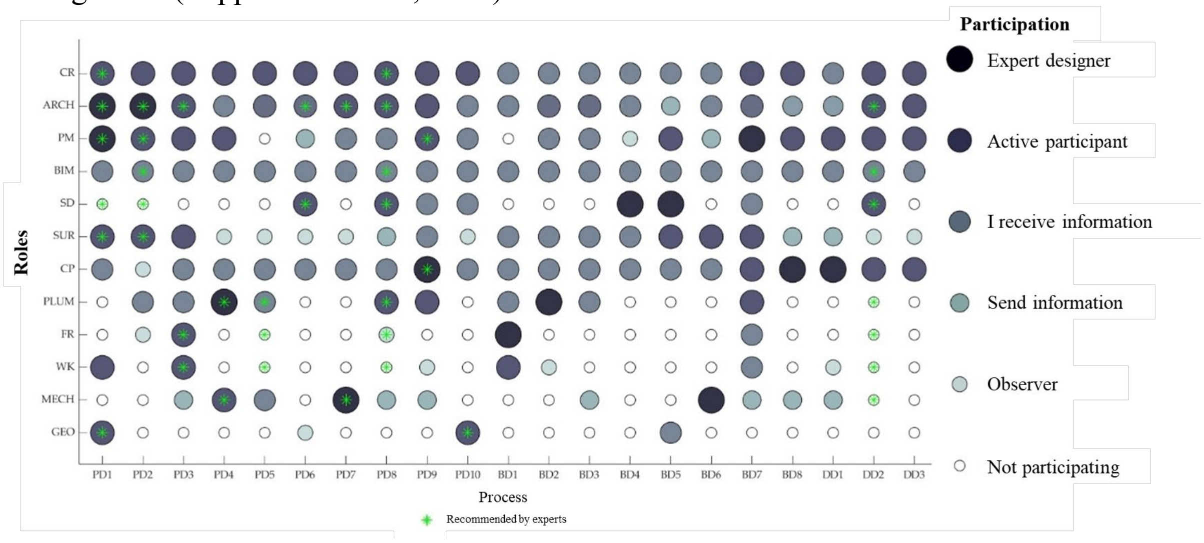

Figure 2: Perception of role participation in the design phase

CHILEAN CONTEXTUALIZATION AND COMPARISON WITH THE LITERATURE

This chapter presents findings from interviews and surveys on the knowledge and use of management approaches in Chile's high-rise building design phase, compared to best practices. Results reveal limited knowledge and application of Lean, Agile, and BIM methodologies. Subcontracting specialties, low investment in the design phase, and resource limitations in real estate companies contribute to poor management and limited role participation.

Interviews, Identification of Work Modalities, and Applied Practices.

In Chile, the primary work modality involves subcontracting specialties, except for Architecture and Structural Design, which are typically handled in-house. Most contracts follow a business model where payment is made after delivering the design. Firms often work with the same designers due to established trust. Designers are generally involved only during the design phase, sometimes limited to specific processes, highlighting the fragmentation shown in Figure 2. Additionally, knowledge and application of BIM, Lean, and Agile management approaches were assessed, as illustrated in Figure 3, categorizing them into unknown, known but not applied, or applied.

A null application of Agile Methodology was identified, and one of the reasons is its recent application to project management. There is a great knowledge of Lean and BIM methodologies; however, there is a low application. For this reason, the reasons for the low use were identified. In the first instance, there is no clear involvement of the designer, given the main modality of work, which makes it difficult to bring these methodologies closer to the designers. This outsourcing modality implies that hiring a designer with knowledge of these methodologies is more expensive than hiring one without experience. Also, the interviewees expressed resistance to change and a lack of need to apply new methods. However, this non-necessity stems from the habit of design delays, cost overruns, and errors. Other interviewees have tried the application of these methodologies without the expected results. For example, an attempt was made to adopt BIM, which entails an additional cost in the design, but the problems after the application were the same or even greater. The companies did not meet their expectations when applying for it, so they opted not to use it. The literature shows that it reduces errors and problems such as interference (F. Morales et al., 2022). Table 3 shows the practices identified in the interviews to avoid or mitigate the most recurrent issues in the design phase identified in the work of O'Connor et al. (O'Connor & Koo, 2021). The number of answers for each practice is indicated in parentheses. In most problems, there are three practices, but in others, there may be fewer.

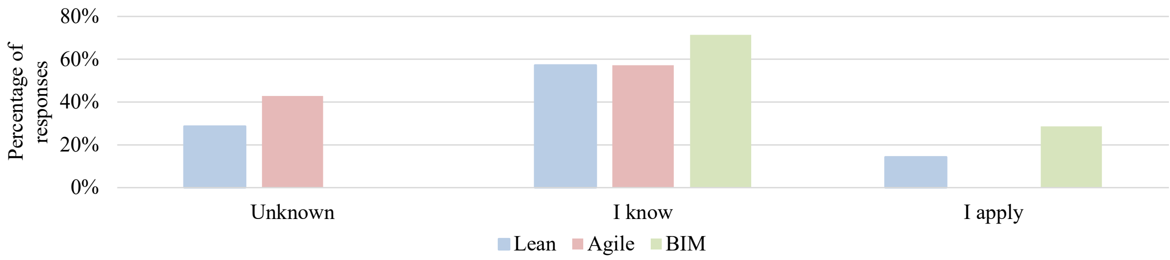

Figure 3: Respondents' Knowledge and Application of Tools

Only 2 of the seven interviewees claimed to use management tools consciously, evidencing their low utilization. Communication, crucial in the design phase (Listyaningsih et al., 2020), relies mainly on email (P10.1, P10.2), which can hamper accuracy, generate information overload and delays in problem-solving (Debs & Shaurette, 2021). In addition, it can lead to information overload and delays in troubleshooting (Debs & Shaurette, 2021). When requesting information, there are no stipulated maximum response times (P11.1), which impairs the flow of information and consequently increases design times. The interviewees pointed out coordination problems (P2.1), excessive trust in the designers (P5.2, P6.1), fragmentation, and low cohesion in the design team. Trust can be considered a crucial factor that allows for better knowledge exchange between the design teams; however, from the interview perspective, it generates low control and revision in the delivered designs. The interviewees confirm the design phase's fragmentation and the design team's low cohesion. The commitment of the designers is encouraged by the way the companies work. Galaz & Herrera (2021) identified the co-occurrence of problems found in the literature in the design phase. Concordantly, the issues identified above, communication, trust, coordination, commitment, fragmentation, and team cohesion, are the ones that appear most frequently in literature. This situation evidences the limited evolution of the industry in Chile in terms of management. These problems in the design phase generate impacts at the design stage and throughout the project. These impacts tend to be cost increase delay of the schedule (Peansupap & Ly, 2015) design efficiency, construction impacts commissioning, impact on the operation (Islam et al., 2021). In the study of the productivity of high-rise projects developed in Chile (Matrix Consulting, 2020), the cost increases, construction impacts, and schedule delays are evidenced by the background information gathered in the interviews. The findings presented in Table 3 reveal structural issues in the Chilean design process, including limited collaboration, delayed involvement of key design professionals, and the absence of formal systems for managing change and information flow. These issues align with deficiencies commonly addressed in international literature. Several tools and practices—such as Last Planner System (LPS), Target Value Design (TVD), Integrated Project Delivery (IPD), and structured BIM coordination protocols—are consistently recommended to improve collaboration, promote early engagement, and formalize processes like change management. Therefore, linking these tools directly to the issues identified in Table 3 provides a framework for future implementation.

Knowledge and Application of Role Management Approaches and Comparison

A survey was conducted to assess the level of knowledge of the roles and their perspective on the importance of the management approaches found. Twenty-eight responses were obtained, five corresponding to the construction phase and the rest to the design phase. One was discarded because it does not work in the Chilean industry.

Table 3: Management practices

Issue	ID	Practices (number of answers)
Transmitting client requirements to designers and delegating responsibilities	P1.1	Individual meeting with project explanation (3)
	P1.2	Sending contextual information via email (3)
	P1.3	Group meeting with project explanation (1)
Coordination among different specialties	P.2.1	Meetings only when information is required (5)
	P.2.2	Regular virtual meetings (2)
Timely delivery of specialty designs	P3.1	Penalty clauses for late delivery (3)
	P3.2	Constant monitoring with progress reports (3)
	P3.3	Deadlines are established from the beginning (1)
Managing design changes	P4.1	Focused on an entity that facilitates communication between designers (4)
	P4.2	Focused on a BIM coordinator acting as a bridge between designers (2)
	P4.3	Cloud-based modeling, allowing continuous updates on design changes (1)
Technological capability of designers	P5.1	Work done in two dimensions, requiring basic tool knowledge (3)
	P5.2	Extending trust to designers without requiring additional studies (2)
	P5.3	Requiring verifiable modeling studies (2)
Meeting design requirements	P6.1	Minimal/low review, relying on trust in the designer (3)
	P6.2	Non-exhaustive review by the coordinating entity (2)
	P6.3	The BIM coordinator reviews designs to ensure they meet requirements (2)
Cost control in design	P7.1	Low control due to constant changes in requirements (5)
	P7.2	Focused on a cost manager issuing early warnings before exceeding the budget (2)
Meeting deadlines	P8.1	Stipulated at the time of the contract
	P8.2	Varies depending on the process's progress
Meetings	P9.1	Online modality (4)
	P9.2	Online modality, with the most important meetings in person (2)
	P9.3	Mixed modality, mostly structured (1)
Information delivery	P10.1	Via email (4)
	P10.2	Not stipulated or defined (5)
Waiting times	P11.1	Not stipulated or defined (5)
	P11.2	Stipulated at the time of requesting information (2)

Figure 4 shows the level of importance perceived by the roles of the management approaches identified in literature. BIM stands out with a high perception of relevance: more than 82% of the respondents consider its application High or Very High, while the remaining 18% rate it as Moderate importance. In addition, the perceived importance of Agile is more moderate. 56.5% of respondents rate it as Moderate, and only 30.4% rate it as High or Very High. This perception can be attributed to its limited research and the scarcity of successful case studies specific to the AEC industry. This is because Agile is still an emerging methodology, not only in the AEC arena but also in project management in general. Agile methodology, originally developed for software development, emphasizes iterative progress, flexibility, and close collaboration among team members. Its application is still emerging in the AEC context, particularly in design phases where adaptability and client involvement are critical. Agile promotes practices such as short work cycles (sprints), frequent feedback, and cross-functional teams, which can enhance responsiveness and reduce rework. In this study, respondents showed a general awareness of Agile principles but limited practical application. Figure 4 illustrates that only 35.3% of participants reported deep knowledge of Agile, with project managers (PM) and architects (ARCH) being the roles most familiar with its concepts. This suggests that the strategic and planning aspects of Agile are more accessible to roles with broader project oversight. However, operational aspects—such as sprint planning, daily stand-ups, or backlog management—were less understood, reflecting the lack of formal training or implementation in current project environments. This gap reinforces the need to promote targeted education and case-based learning in the AEC industry to support the integration of Agile practices in the design process. None of the respondents claimed to be unaware of the BIM methodology, which is evidence of its growing trend in the industry. 29.4% of the participants reported having in-depth knowledge and regular application of BIM, with the most representative roles being BIM, ARCH, and PM. However, 41.2% indicated not applying it consistently, while 29.4% indicated not using it. Roles such as WK, SD, GEO, and MECH show the lowest usage frequency, while BIM adoption is projected to reach 70% in Chile by 2028, driven by initiatives like Plan BIM, which mandated BIM in public projects from 2020 and targets full industry integration by 2025. According to the "BIM 2022 National Survey," 63% of recent graduates learned BIM during their training. Agile methodology has moderate importance, with only 35.3% of respondents having deep knowledge, 58.8% basic knowledge, and 5.9% none, and its practical application is minimal. PM and ARCH roles show the greatest knowledge of Agile, likely due to their cross-cutting design management responsibilities and project management training. Figure 4 shows that lean has a 60.8% to very high application recommendation. This methodology, introduced in the 1990s (Formoso et al., 1998), has a higher level of study, which could justify its level of acceptance. This fact motivated the inclusion of more Lean tools in the analysis compared to Agile. However, the results in Figure 5 reflect a low adoption of Lean tools. Only 5 out of 170 possible answers checked the option “I know in-depth and apply it regularly,” equivalent to 2.9%. These responses were distributed among four tools: CBA (for the GEO role), LPS and IPD (for the PM role), and VM (for the PLUM and ARCH roles). The cross-sectional analysis shows a low knowledge of tools such as A3 Report, 5 Why, VSM, SBD, CBA, and LAP. Also, tools such as TVD (88%) and LPS (76%) show a higher degree of knowledge, coinciding with the study by Luna and Herrera (2023).

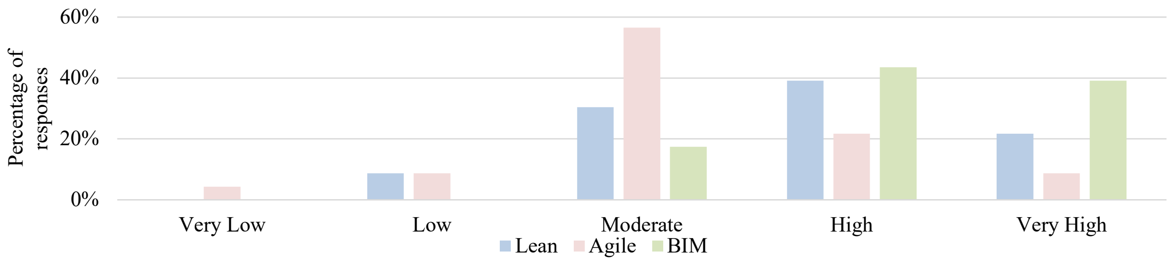

Figure 4: Perceived Level of Importance by Roles

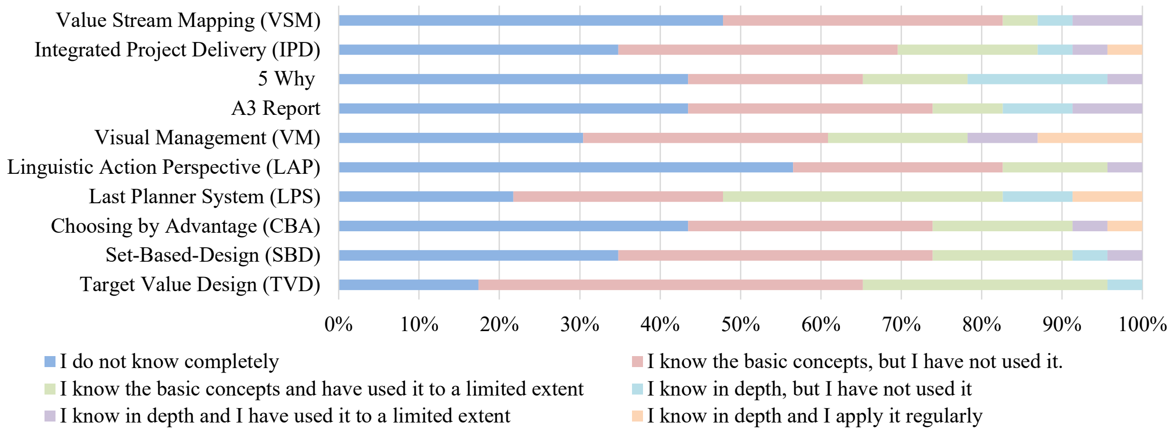

Figure 5: Level of Knowledge and Application of Lean Tools

CONCLUSIONS

This study examined the design phase management in high-rise building projects in Chile, highlighting challenges such as role fragmentation, limited collaboration, weak change management systems, and low application of Lean, BIM, and Agile methodologies. The identification of 22 design processes and 12 key roles provided a structured framework for evaluating participation and management practices. Results revealed a gap between professionals' ideal and actual involvement in the design process, especially among technical roles. This misalignment contributes to coordination failures, design errors, and inefficiencies. The lack of structured practices—particularly in early engagement and interdisciplinary coordination—was evident across all design stages. Both quantitative and qualitative data supported these findings. Although Lean, BIM, and Agile offer complementary benefits—value generation, process coordination, and adaptability—their adoption in Chile remains limited. Lean and Agile, while often confused, are distinct and independently valuable in design management. Their combined use, alongside tools like the Last Planner System (LPS), Target Value Design (TVD), and Integrated Project Delivery (IPD), has strong potential but requires contextual adaptation. A notable gap was observed between self-reported knowledge and actual application of management tools. While many professionals claimed familiarity with methodologies such as Lean, their practical use was inconsistent. This disconnect justifies the recommendation to implement targeted training programs to strengthen methodological competencies, especially among underrepresented roles like MEP engineers. The study also contributes to understanding how organizational fragmentation and limited systems impact performance. Though benchmarks for efficiency or quality were not established, the research highlights key performance gaps that future studies should quantify through direct observation.

Limitations include the small sample size and the predominance of civil engineering professionals. Broader perspectives from professionals with over 20 years of experience and from other disciplines such as mechanical, electrical, plumbing, and architecture would enhance future analyses. The exclusion of document management systems is also a relevant omission, given their importance in coordination and information flow. Future research should (1) further explore the integration of Lean, BIM, and Agile methodologies; (2) develop training programs to support their application; (3) evaluate their impact on efficiency, quality, and cost with measurable benchmarks; and (4) propose national guidelines to support widespread adoption.

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