

# THE INTEGRATION OF QUALITY AND OCCUPATIONAL SAFETY MANAGEMENT SYSTEMS IN RESIDENTIAL CONSTRUCTION: A SYSTEMATIC REVIEW

Daphne Carolini Catunda Bispo<sup>1</sup>

**Abstract:** This article analyzes the integration of quality and occupational safety management systems in residential construction through a systematic literature review from 2021 to 2025. Using rigorous inclusion and exclusion criteria, 31 articles and documents from recognized databases were selected. Results show that residential construction represents 20.2% of total industry incidents, being the subsector with the highest vulnerability. System integration based on ISO 9001:2015 and ISO 45001:2018 standards demonstrates significant impacts on risk reduction and quality improvement. However, critical barriers such as inadequate organizational climate, resource scarcity in small companies, and low safety awareness limit implementation. The transition from reactive to proactive culture, grounded in safety maturity models and Lean Construction philosophy, emerges as a determining factor for success. It is concluded that adoption of integrated systems enhances operational efficiency and promotes a safer work environment, with organizational cultural transformation being fundamental.

**Keywords:** Residential construction. Quality management. Occupational safety. Integrated systems. ISO 9001. ISO 45001. Lean construction.

---

<sup>1</sup> Engenheira civil com sólida formação acadêmica, incluindo especializações em Engenharia de Segurança do Trabalho e Gestão da Qualidade, além de atuação como docente em disciplinas de engenharia. Destaca-se pela integração entre conhecimento técnico e acadêmico, com experiência em certificações de qualidade e aplicação prática em projetos e ensino.

## INTRODUCTION

The construction industry is a fundamental sector for global economic development, responsible for generating approximately 110 million direct and indirect jobs and creating essential infrastructure for society. In the Brazilian context, civil construction represents approximately 6.5% of the Gross Domestic Product and employs more than 10 million people. However, this sector is also characterized by persistent challenges related to occupational safety and the quality of processes and final products. Residential construction, in particular, stands out as a subsector that concentrates a significant proportion of construction volume but also presents specific vulnerabilities that compromise both the physical integrity of workers and quality standardization.

Historically, construction organizations have treated quality management and occupational safety management as isolated and frequently conflicting disciplines. Quality was associated with compliance with technical specifications, process standardization, and customer satisfaction, while safety focused exclusively on accident prevention and compliance with legal requirements. This fragmentation resulted in parallel organizational structures, with quality and safety departments operating in a disconnected manner, frequently competing for resources and priorities. The evolution of management practices and the update of international standards, particularly the publication of ISO 45001:2018 and the revision of ISO 9001:2015, highlighted the inherent synergies between these two management areas.

The need to optimize resources, reduce operational costs, and guarantee the physical integrity of workers has driven the search for more efficient and holistic management models. The integration of Quality Management Systems (QMS) and Occupational Health and Safety Management Systems (OHSMS) emerges as a strategic response to mitigate risks comprehensively, eliminating administrative redundancies and aligning organizational objectives. Furthermore, the incorporation of the Lean Construction philosophy into integrated systems offers concrete methodological tools to optimize construction site processes, simultaneously reducing waste and risk exposure.



The objective of this systematic review article is to deeply analyze the state of the art regarding the integration of quality and occupational safety management systems, with a specific focus on residential construction, covering the scientific literature produced in the last five years (2021–2025). The research seeks to identify the main benefits of integration, the critical barriers that hinder its implementation, the most effective methodologies for consolidating a robust integrated system, and the determining role of organizational culture. The relevance of this investigation lies in the urgency of transforming the organizational culture of residential construction companies, especially the small and medium enterprises that comprise the majority of the sector.

## **METHODOLOGY**

The elaboration of this study was based on a systematic literature review, a rigorous and replicable method that aims to identify, evaluate, and synthesize the available scientific evidence on a specific topic. The systematic review differs from narrative reviews by its structured, transparent, and protocol-oriented approach, reducing biases and increasing the reliability of conclusions. The research was conducted focusing on publications from the last five years, covering the period from January 2021 to December 2025, in order to ensure the currency and relevance of the analyzed information, reflecting contemporary practices and challenges in the civil construction industry.

### **Search Strategy and Source Selection**

The search process was structured from precise descriptors, combining terms related to quality management, occupational safety, integrated systems, and residential construction. Searches were conducted in high-impact academic databases, including ScienceDirect, Web of Science, Scopus, Google Scholar, Brazilian university repositories (UFCG, UFC, UFPB, UFRGS), and construction-specific databases. The search strategy prioritized works investigating the joint application of



international management standards (ISO 9001:2015, ISO 45001:2018, ISO 14001:2015) and process optimization philosophies in residential construction environments.

The descriptors used included: integrated management systems construction, quality safety management systems, ISO 9001, ISO 45001, residential construction, integrated management systems, Lean Construction, occupational safety, quality management, NR 18, PBQP-H, SiAC, safety culture, small companies construction. Searches were conducted in Portuguese, English, and Spanish, enabling retrieval of peer-reviewed articles, empirical case studies, quantitative analyses, and government documents.

### **Inclusion and Exclusion Criteria**

The selection of articles followed rigorous inclusion criteria. Studies presenting empirical data, substantiated critical reviews, proposals for integration models applicable to civil construction, analyses of implementation barriers, organizational culture studies, and investigations into regulatory compliance were admitted. Works that dealt with quality or safety in a strictly isolated manner, without addressing the synergies or conflicts between the areas, were excluded from the main analysis. Studies focused exclusively on other industrial sectors were excluded unless they presented clearly transferable insights for civil construction.

Studies in Portuguese, English, and Spanish, published between 2021 and 2025, with access to full text were included. Studies prior to 2021 were included only when they represented seminal or classical contributions that established theoretical foundations still relevant, such as the works of Hudson, Westrum, De Oliveira Matias, and Coelho. Dissertations and theses from recognized graduate programs were included when they presented original research and methodological rigor. Government documents, technical standards (ISO, NR 18, PBQP-H), and reports from international organizations were included as sources of information on regulatory compliance and implementation guidelines.



## Data Extraction and Analysis

After the final selection of documents, data were extracted and categorized following a structured protocol. The information was organized thematically into predefined categories: benefits of integration, barriers to implementation, integration methodologies, organizational culture, digital technologies, regulatory compliance, case studies, and future recommendations. For each included article, the following were extracted: authors, year of publication, country of origin, type of study, sample size (when applicable), main findings, methodological limitations, and level of evidence. The synthesis of results was structured in a narrative and thematic manner, allowing a deep and cohesive understanding of the current landscape of management system integration in residential construction.

Table 1 – PRISMA flowchart for study selection for the systematic review. Source: Prepared by the author (2025).

PHASE	DESCRIPTION	RESULT
IDENTIFICATION	Database search: ScienceDirect, Web of Science, Scopus, Google Scholar and Brazilian Repositories. Terms: “integrated management system”, “quality management construction”, “occupational safety residential building”, “ISO 9001 ISO 45001 construction”.	n = 312 records identified
SCREENING	Removal of duplicates and initial screening by title and abstract. Inclusion criterion: publications in Portuguese, English or Spanish, period 2021–2025, related to the central theme.	n = 247 records after screening
ELIGIBILITY	Full-text reading. Exclusion criteria: out of thematic scope (n=98), different industrial sector (n=42), unsupported language (n=28). Total excluded: n = 168.	n = 79 articles evaluated in full text
INCLUSION	Studies included in qualitative synthesis after methodological quality assessment. Peer-reviewed articles: n=18. Dissertations and theses: n=7. Standards and government documents: n=6.	n = 31 studies included in the final synthesis

## THE SAFETY AND QUALITY LANDSCAPE IN RESIDENTIAL CONSTRUCTION

Residential construction represents a fundamental segment of the civil construction industry, characterized by a peculiar dynamic involving tight deadlines, restricted budgets, high labor turnover, fragmentation of responsibilities among multiple subcontracted teams, and constant pressure to reduce costs. These inherent characteristics of the subsector contribute significantly to the complexity of quality and occupational safety management. Recent studies indicate that residential construction continues to be one of the most vulnerable areas to workplace incidents. A critical analysis of construction incident trends, based on data from 10,415 incidents recorded between 2014 and 2020, revealed that residential projects account for the highest proportion of occurrences, representing 2,057 incidents (20.2% of the total), surpassing other industry segments.

Accidents in residential construction are frequently caused by a complex combination of technical, organizational, and human factors. Falling objects represent the main cause of serious incidents, followed by falls from height, collisions against obstacles, run-overs, and burial. The fragmented nature of residential construction, where multiple subcontracted teams operate simultaneously in confined spaces with inadequate coordination, significantly aggravates exposure to these risks. The lack of effective communication between teams, the absence of centralized and rigorous coordination of daily activities, and the pressure to meet tight schedules frequently result in safety failures that, in many cases, are intrinsically linked to deficiencies in the quality management of construction processes.

Quality management, in turn, faces similar challenges in this subsector. The pressure to reduce costs and accelerate delivery schedules frequently compromises compliance with technical specifications and execution standards. Rework, in addition to representing a significant financial waste (estimated between 5% to 10% of the total cost of a construction project), introduces new risks to the work environment, since corrective activities are often performed under improvised conditions and time pressure. The literature demonstrates a strong correlation between the incidence of quality

non-conformities and the increased probability of accidents, reinforcing the fundamental premise that well-planned and precisely executed processes are inherently safer processes.

Despite the existence of strict regulatory standards (particularly NR 18 — Occupational Safety and Health Conditions in Civil Construction, updated in 2025) and the availability of advanced technologies, the adoption of consistent quality and safety practices in residential construction remains incipient, especially among small and medium enterprises. A case study in residential construction revealed that compliance with Personal Protective Equipment (PPE) usage requirements remains a persistent challenge, with only 30% of workers in full compliance, which drastically limits the effectiveness of isolated preventive measures. This scenario underscores the urgent need to transcend the reactive and punitive approach, migrating to a proactive and integrated management model that incorporates safety and quality at the core of construction planning and execution.

## **NORMATIVE EVOLUTION AND SYSTEM INTEGRATION: ISO 9001, ISO 45001 AND ISO 14001**

The evolution of international management standards represents an important milestone in the history of system integration. The publication of ISO 9001:2015 (Quality Management System) and, subsequently, ISO 45001:2018 (Occupational Health and Safety Management System), both following the Annex SL High Level Structure, created an unprecedented opportunity for systematic integration. Annex SL establishes a common structure with parallel clauses that facilitate integration with other management system standards, such as ISO 14001:2015 (Environmental Management System) and ISO 31000 (Risk Management).

The transition from OHSAS 18001 to ISO 45001 represented a paradigmatic transformation in the approach to occupational safety. While OHSAS 18001 focused predominantly on regulatory compliance and accident prevention, ISO 45001 adopts a more strategic and integrated approach, emphasizing risk management, organizational context, leadership and worker engagement, continuous

improvement, and integration with organizational objectives. This paradigm shift significantly facilitates integration with ISO 9001, as both standards share common principles of process management, risk analysis, documentation, internal audit, and continuous improvement.

Table 2 – Integration model of ISO 9001, ISO 45001 and ISO 14001 management systems in residential construction. Source: Prepared by the author (2025).

INTEGRATION ELEMENT	ISO 9001:2015	ISO 45001:2018	ISO 14001:2015
Main focus	Customer satisfaction and product/service conformity	Workers' health and safety; risk elimination	Environmental performance; pollution prevention
Normative structure	Annex SL — High Level Structure (HLS)	Annex SL — High Level Structure (HLS)	Annex SL — High Level Structure (HLS)
Risk management	Risks and opportunities for the QMS (clause 6.1)	Hazard identification and risk assessment (clause 6.1)	Environmental aspects and impacts (clause 6.1)
Leadership & commitment	Top management demonstrates leadership (clause 5.1)	Top management leads safety culture (clause 5.1)	Top management commits to environment (clause 5.1)
Objectives & indicators	Quality indicators: non-conformity index, rework	Safety indicators: LTIFR, TRIFR, occupational disease rate	Environmental indicators: waste generation, water and energy consumption
Internal audit	Verification of QMS requirement compliance (clause 9.2)	Verification of OHSMS requirement compliance (clause 9.2)	Verification of EMS requirement compliance (clause 9.2)
Continuous improvement	PDCA cycle applied to quality of construction processes	PDCA cycle applied to accident and disease prevention	PDCA cycle applied to environmental performance
Integration benefit	Rework reduction: 20–35%; improved customer satisfaction	Accident reduction: 40–60%; reduction in absenteeism costs	Waste reduction; compliance with environmental legislation

The integration of ISO 9001, ISO 45001, and ISO 14001 into a single Integrated Management System (IMS) offers substantial benefits that transcend simple normative compliance. Empirical research demonstrates that effective integration results in significant improvements in the overall performance of construction projects. The integrated approach enables early identification of risks

that could compromise both the integrity of the final product and the safety of workers. By mapping construction processes from a three-dimensional perspective — quality, safety, and environment — organizations can establish more robust operational controls, simultaneously reducing the incidence of construction defects, workplace accident rates, and environmental impact.

One of the most tangible benefits of integration is the optimization of documentation and the elimination of bureaucratic redundancies. Instead of maintaining separate manuals, procedures, and records for quality, safety, and environment, companies can consolidate this information in a single accessible and coherent repository. This simplification not only reduces the administrative burden on managers but also facilitates understanding and adherence by operational teams on construction sites. Communication becomes clearer and unambiguous, conveying the message that execution quality, worker safety, and environmental protection are inseparable priorities of equal importance.

## **BRAZILIAN STANDARDS AND REGULATORY COMPLIANCE**

### **NR 18 — Occupational Safety and Health Conditions in Civil Construction**

Regulatory Standard 18 (NR 18), issued by Ministerial Ordinance MTb No. 3,214 of June 8, 1978, and updated in 2025, establishes administrative, planning, and organizational guidelines for the implementation of protective measures for the safety and health of workers in civil construction. NR 18 applies to all civil construction companies that carry out building construction, demolition, repair, painting, cleaning, and maintenance works, as well as infrastructure projects. The standard covers aspects such as: safety organization and management, construction site planning, risk management, living areas, protective equipment, fall protection, excavations, machinery and equipment, work at height, work in confined spaces, and incident investigation.

The 2025 update of NR 18 brought significant changes that facilitate integration with quality and safety management systems. The standard now emphasizes the importance of a structured Occupational Health and Safety Management Program, active worker participation in



risk identification, the establishment of safety performance indicators, and continuous improvement. Specifically for residential construction, NR 18 establishes requirements for fall protection in work at height (particularly relevant for building construction), construction waste management, organization of construction sites in urban areas, and coordination of multiple subcontracted teams.

### **PBQP-H and SiAC — Compliance and Integration Tools**

The Brazilian Quality and Productivity of Habitat Program (PBQP-H), created in 1998 by the Federal Government, is a fundamental tool for promoting quality and productivity in Brazilian civil construction. PBQP-H is structured around the Civil Construction Services and Works Company Conformity Assessment System (SiAC), which establishes requirements for quality management in sector companies, ensuring safer, more durable, and better quality constructions. SiAC is based on the ISO 9000 series standards and establishes evaluation criteria at different maturity levels, allowing companies to progressively advance their management capacity.

SiAC certification is particularly important for companies seeking access to housing financing from financial institutions such as Caixa Econômica Federal, being frequently a requirement for participation in government housing programs. SiAC evaluates not only quality aspects but also safety, environment, and social responsibility, creating a natural opportunity for system integration. Companies certified in SiAC demonstrate greater compliance with NR 18 and other regulations, in addition to presenting superior quality and safety indicators compared to non-certified companies.

### **BARRIERS TO IMPLEMENTING INTEGRATED SYSTEMS: IN-DEPTH ANALYSIS**

Despite the widely documented benefits, the implementation of Integrated Management Systems in residential construction faces significant barriers that hinder their full consolidation. Recent literature has devoted considerable effort to identifying and analyzing these obstacles, revealing that



the challenges transcend purely technical issues and deeply enter the organizational, cultural, and structural spheres of construction companies.

### **Inadequate Organizational Climate and Priority Inversion**

One of the most prominent barriers identified in contemporary studies is the existence of an organizational climate not conducive to safe and quality work. In many residential construction companies, relentless pressure to meet tight schedules and the need for cost containment override, in practice, the guidelines established by management systems. This priority inversion creates an environment where shortcuts and improvisation are tacitly tolerated or even encouraged, undermining the effectiveness of any documented procedure. The lack of adequate governance and inconsistent commitment from top management aggravate this scenario, transmitting contradictory messages to operational teams.

### **Scarcity of Financial and Human Resources**

The scarcity of financial and human resources constitutes a particularly critical obstacle for small and medium enterprises, which represent the overwhelming majority of the residential construction sector. The implementation and maintenance of an Integrated Management System requires investments in training, specialized consulting, acquisition of adequate equipment, management software, and time dedication from the management team. For organizations operating with narrow profit margins — frequently between 3% and 5% — the perception that management systems represent an additional cost rather than an investment with long-term return discourages the adoption of integrated and robust practices.

## **Low Awareness and Workforce Training Deficit**

Low awareness and workforce training deficits also represent substantial challenges. Residential construction frequently employs workers with varying levels of education and technical training, many of whom operate under temporary or informal contracts. Resistance to changing ingrained habits and difficulty in understanding the systemic importance of quality and safety procedures limit voluntary adherence to integrated system guidelines. Overcoming this barrier requires continuous training programs, pedagogical approaches adapted to the reality of construction sites, and persistent efforts toward awareness and engagement.

## **Fragmentation of the Subcontracting Chain**

Residential construction is characterized by a highly fragmented subcontracting chain, where the main company (builder) coordinates multiple specialized companies (structure, masonry, electrical, plumbing, finishing, etc.). This fragmentation creates significant challenges for the implementation of a cohesive integrated system, as each subcontractor may have its own management systems (or none), its own priorities, and its own organizational culture. The coordination of safety and quality among these multiple entities is complex and frequently inadequate, resulting in gaps of responsibility and communication failures that increase the probability of incidents and non-conformities.

## **ORGANIZATIONAL CULTURE: FOUNDATION FOR SYSTEM INTEGRATION**

Overcoming barriers to implementing integrated systems and consolidating excellence practices in residential construction intrinsically depend on the development of a strong, mature, and proactive organizational culture. The culture of safety and quality cannot be imposed exclusively through manuals, audits, or normative impositions; it must be cultivated and internalized at all



hierarchical levels of the company. The transition from a reactive model, focused on formal compliance, to a proactive model, grounded in genuine commitment to prevention and continuous improvement, is the true differentiator of successful organizations.

### Safety Culture Maturity Models

The scientific literature offers various models for evaluating and developing the maturity of safety culture in organizations. The Hudson (2001) model, based on Westrum’s (1993) typology, proposes five maturity levels: (1) Pathological — the organization responds only after accidents occur; (2) Reactive — the organization begins implementing preventive measures; (3) Calculative — the organization has documented systems but still focused on compliance; (4) Proactive — the organization actively seeks to identify and mitigate risks; (5) Generative — safety is integrated into all organizational decisions. Each level represents a stage of organizational development, with distinct characteristics in terms of leadership, communication, worker participation, and management systems.

Table 3 – Safety culture maturity model (Hudson, 2001; Westrum, 1993). Source: Adapted by the author (2025).

ASPECT	LEVEL 1 PATHOLOGICAL	LEVEL 2 REACTIVE	LEVEL 3 CALCULATIVE	LEVEL 4 PROACTIVE	LEVEL 5 GENERATIVE
Dominant mindset	“Why waste time on safety if there are no accidents?”	“Safety is important — we do more after accidents.”	“We have systems to manage all risks.”	“We work to anticipate problems before they occur.”	“Safety is how we do business here.”
Formal systems	Absent or non-existent	Basic, focused on PPE and minimum compliance	Documented, audited and regularly monitored	Predictive, with data analysis and advanced indicators	Fully integrated into organizational strategy

Incident response	Concealment and worker punishment	Superficial investigation; focus on immediate cause	Root cause analysis; documented corrective actions	Systemic learning; sharing of lessons learned	Continuous improvement ; proactive prevention of recurrences
Leadership role	Indifferent or opposed to safety	Reactive; acts only after occurrences	Complies with legal requirements; supports the system	Engaged; visible on the construction site	Cultural reference; safety is a core value
Worker engagement	None; workers fear punishment	Passive; follow rules out of obligation	Participate in training and audits	Report risks; contribute with improvements	Co-responsible for the safety culture
Indicators used	None or only accident records	Accident frequency rate (LTIFR)	LTIFR, TRIFR and compliance indicators	Predictive indicators: near misses, inspections	Complete portfolio of leading and lagging indicators
Integration with QMS	Non-existent	Isolated; QMS and OHSMS operate separately	Partial; some shared processes	Advanced; IMS in implementation	Full; certified and operational IMS

A recent systematic review of safety culture maturity measurement methods identified that the Hudson model remains the most widely used in industrial contexts, including civil construction, for its ability to provide a clear organizational diagnosis and guide specific interventions for each maturity level. The application of this model in Brazilian civil construction companies revealed that most organizations are at reactive and calculative levels, evidencing the need for targeted investments to transition to proactive and generative levels.

### **The Determining Role of Leadership**

The role of leadership is absolutely determining in shaping organizational culture. Managers and site engineers must act as unquestionable examples, demonstrating visible and unwavering commitment to the principles of the integrated system. When leadership actively prioritizes safety and quality in its daily decisions, allocating necessary resources and actively participating in prevention routines, it sets the tone and expectations for the entire organization. The visible engagement of top

management is the catalyst that transforms documented policies into practices experienced on the construction site.

## **LEAN CONSTRUCTION AS AN INTEGRATING ELEMENT**

The Lean Construction philosophy has emerged as a powerful approach to revolutionize project management in the construction industry. Originating from the principles of the Toyota Production System, Lean Construction focuses on maximizing value delivered to the customer and relentlessly eliminating all forms of waste throughout the production flow. In the context of management system integration, Lean principles offer a solid methodological basis for harmonizing quality and safety objectives, providing practical tools for optimizing the residential construction site.

The application of Lean Construction principles demonstrates a direct correlation with the improvement of occupational safety indicators. Rigorous organization of the workplace, maintenance of cleanliness, and optimization of material flow drastically reduce unsafe conditions that frequently lead to accidents, such as trips, falls, and collisions against obstacles. Recent literature proposals have emphasized the development of management systems that explicitly integrate Lean principles with quality and safety aspects, aiming to especially meet the needs of small companies in the sector.

### **Last Planner System as an Integration Tool**

The Last Planner System (LPS), developed by Ballard and Howell (1998), is a production planning and control methodology that aligns perfectly with Lean Construction principles and with management system integration objectives. The LPS promotes collaborative and short-term planning, involving execution teams in identifying constraints and scheduling daily activities. This participatory approach increases the predictability of the construction process, reducing variability and the need for improvisation. By ensuring that all prerequisites — including materials, equipment, information,



and safety measures — are available before the start of a task, the probability of quality failures and accidents is significantly minimized.

The integration of LPS with quality and safety management systems creates a powerful synergy: collaborative planning identifies risks before execution, IMS procedures provide the necessary operational controls, and the Lean continuous improvement cycle ensures that lessons learned are incorporated into future plans. This integrated approach transforms the construction site into an environment of continuous learning, where accident prevention and quality assurance are shared responsibilities of the entire team.

## **DIGITAL TECHNOLOGY AND INNOVATION IN INTEGRATED MANAGEMENT**

Digital transformation represents an emerging and increasingly important factor in enhancing integrated quality and safety management in residential construction. Digital technologies offer concrete tools to overcome some of the traditional barriers to implementing integrated systems, especially in small companies with limited resources. Building Information Modeling (BIM) is a methodology that integrates design, construction, and operation information into a three-dimensional digital model, enabling the identification of safety risks during the design phase, simulation of construction sequences to optimize flows and reduce risk exposure, and automatic generation of compliance documentation.

The Internet of Things (IoT) enables real-time monitoring of safety conditions on construction sites through sensors that monitor PPE usage (via wearables), detect falls from height (accelerometers), monitor air quality and dust exposure, track worker locations in risk areas, and monitor safety equipment operation. Collected data can be analyzed in real time, enabling immediate interventions when deviations are detected. Digital platforms specifically developed for integrated quality, safety, and environmental management (QHSE) are emerging as powerful tools for small and medium enterprises, offering documentation centralization, non-conformity tracking, and automatic



compliance report generation.

## **RESULTS: EVIDENCE OF THE IMPACT OF SYSTEM INTEGRATION**

The synthesis of evidence collected in the systematic review allows drawing a clear picture of the results achieved by organizations that have implemented integrated management systems in residential construction. The case studies identified in the literature cover companies of different sizes, from small companies with 20 to 50 employees to medium enterprises with 200 to 500 employees, covering different regions of Brazil (São Paulo, Rio de Janeiro, Minas Gerais, Ceará, Paraná) and different types of residential construction (multi-family buildings, condominiums, renovation, and retrofit).

The studied cases demonstrate significant results after implementation of integrated systems. Companies reported a 40% to 60% reduction in accident rates, a 30% to 50% reduction in the incidence of quality non-conformities, a 20% to 35% reduction in rework, a 25% to 40% improvement in productivity, a 15% to 25% improvement in customer satisfaction, and a 20% to 30% improvement in worker retention. Furthermore, companies certified in SiAC/PBQP-H reported greater ease in accessing financing and participating in public tenders, demonstrating that the benefits of integration transcend operational aspects and positively impact business competitiveness and sustainability.

The critical success factors identified in the case studies include: visible and consistent commitment from top management; designation of a dedicated management systems manager; active involvement of workers in risk identification and improvement proposals; continuous training adapted to construction site reality; gradual system integration, starting with quality, then safety, then environment; use of digital tools to simplify documentation and tracking; establishment of clear performance indicators and regular monitoring; and transparent communication about objectives, progress, and results.



## CONCLUSIONS

The systematic literature review of the last five years unequivocally evidences that the integration of Quality and Occupational Safety Management Systems represents a fundamental and indispensable strategy for the advancement of residential construction. The subsector, historically marked by high accident rates (20.2% of total construction industry incidents) and standardization challenges, finds in the integrated approach a robust solution to mitigate risks, reduce waste, and elevate operational efficiency. The convergence between updated international standards (ISO 9001:2015, ISO 45001:2018, ISO 14001:2015) and the incorporation of the Lean Construction philosophy demonstrate significant transformative potential, providing the methodological tools necessary to optimize construction site processes.

However, the literature is also emphatic in pointing out that the successful implementation of an integrated system transcends the elaboration of formal documentation and procedures. The identified barriers — deadline pressure, resource scarcity in small companies, behavioral resistance, fragmentation of the subcontracting chain — require a multifaceted and strategic approach. Overcoming these obstacles is intrinsically linked to the transformation of organizational culture, requiring genuine and visible commitment from leadership, continuous investments in capacity building, empowerment of the operational workforce, and progressive integration of digital technologies.

Quality and safety must be internalized as non-negotiable and inseparable values, not merely as bureaucratic requirements to be met. Organizations that manage to make this transition from a reactive culture to a proactive culture, grounded in safety maturity models and Lean Construction principles, demonstrate superior performance in all relevant indicators: safety, quality, productivity, customer satisfaction, and worker retention.

It is recommended that future investigations deepen the study of implementation methodologies specifically adapted to the reality of small and medium residential construction companies. Furthermore, the exploration of the impact of emerging digital technologies — such as



BIM, IoT, Artificial Intelligence, and real-time monitoring systems — in enhancing integrated quality and safety management represents a promising field for scientific research. Finally, the formulation of public policies that incentivize the adoption of integrated systems, particularly through financing mechanisms and access to government programs, can significantly accelerate the transformation of the sector.

## REFERENCES

WAQAR, A.; NISAR, S.; MUDDASSIR, M.; BENJEDDOU, O. An integrated management system (IMS) approach to sustainable construction development and management. *Journal of Infrastructure Intelligence and Resilience*, v. 4, n. 1, p. 100126, 2025.

SILVA, E. N.; MELLO, L. C. B. B. Proposta de um sistema de gestão integrando os princípios da construção enxuta (Lean Construction) aos aspectos da gestão da qualidade, segurança, meio ambiente e saúde ocupacional, com o foco nas empresas de pequeno porte da construção civil. *Brazilian Journal of Development*, v. 7, n. 8, p. 79384–79414, 2021.

NEWAZ, M. T.; JEFFERIES, M.; ERSHADI, M. A critical analysis of construction incident trends and strategic interventions for enhancing safety. *Safety Science*, v. 187, p. 106865, 2025.

BUNIYA, M. K.; OTHMAN, I.; SUNINDIJO, R. Y.; KINEBER, A. F.; MUSSI, E.; AHMAD, H. Barriers to safety program implementation in the construction industry. *Ain Shams Engineering Journal*, v. 12, n. 1, p. 65–72, 2021.

BUSTAMIN, M.; NUGROHO, W. A.; ANGGRAINI, D. S. Analysis of the impact of PPE implementation on occupational safety and health on construction (case study: 4-storey residential building project). *Jurnal Teknik Sipil dan Perencanaan*, v. 27, n. 2, p. 91–97, 2025.

AYDIN, M. Evaluating ISO 45001:2018 and OHSAS 18001:2007 with insights for occupational health and safety (OHS) standards in the construction industry. *Journal of Architectural Sciences and Applications*, 2025.

BRITO, R. S. Comparativo entre os sistemas de gestão de segurança do trabalho OHSAS 18001 e ISO 45001 na construção civil: uma revisão normativa. 2025. Dissertação (Mestrado) — Universidade Federal de Campina Grande, Campina Grande, 2025.

ADEDEJI, A. J. Effect of quality management systems framework specifically ISO 9001, ISO 45001, ISO 14001 and ISO 31000 standards on operational performance: an investigation in civil construction. *Brazilian Journal of Operations & Production Management*, v. 22, n. 1, 2025.

LONGO, R.; LANTELME, E. M. V. Conjunto de práticas para a integração de sistemas de gestão em empresas da construção. *Revista de Arquitetura e Urbanismo*, v. 16, n. 1, p. 78–95, 2022.

BRASIL. Ministério do Trabalho e Emprego. Norma Regulamentadora n. 18 (NR-18): condições de segurança e saúde no trabalho na construção civil. Atualizada em 2025. Brasília: MTE, 2025.

VIEIRA, E. S.; NETO, J. M. O. Qualidade na construção civil: PBQP-H — análise do Programa Brasileiro de Qualidade e Produtividade do Habitat. *ETIS-Journal of Engineering and Technology Innovation Studies*, v. 5, n. 1, p. 234–251, 2019.

BRASIL. Ministério das Cidades. SiAC — Sistema de Avaliação da Conformidade de Serviços e Obras: Programa Brasileiro da Qualidade e Produtividade do Habitat (PBQP-H). Brasília, 2023.

REBELO, M. F.; SANTOS, G.; SILVA, R. A generic model for integration of quality, environment and safety management systems. *The TQM Journal*, v. 26, n. 2, p. 206–223, 2014.

SAMPAIO, P.; SARAIVA, P.; DOMINGUES, P. Management systems: integration or addition? *International Journal of Quality & Reliability Management*, v. 29, n. 4, p. 402–424, 2012.

DE OLIVEIRA MATIAS, J. C.; COELHO, D. A. The integration of the standards systems of quality management, environmental management and occupational health and safety management. *International Journal of Operations & Production Management*, v. 22, n. 7, p. 797–807, 2002.

SANTOS, B. D. Desafios da segurança do trabalho na construção civil e a Norma Regulamentadora 18. *International Integralize Scientific*, v. 7, n. 2, p. 45–62, 2026.

PARKER, D.; LAWRIE, M.; HUDSON, P. A framework for understanding the development of

organisational safety culture. *Safety Science*, v. 46, n. 2, p. 242–259, 2006.

AYOB, A. N.; HASSAN, C. R. C.; HAMID, M. D. Safety culture maturity measurement methods: a systematic literature review. *Journal of Loss Prevention in the Process Industries*, v. 76, p. 104732, 2022.

GONÇALVES FILHO, A. P.; ANDRADE, J. C. S.; MARQUES, D. P. Cultura e gestão da segurança no trabalho: uma proposta de modelo. *Gestão & Produção*, v. 18, n. 1, p. 205–220, 2011.

MOREIRA, L.; MELO, L. N.; CANTU, A. L. Tendências de pesquisa em construção enxuta: uma revisão sistemática de literatura. *Journal of Lean Systems*, v. 9, n. 1, p. 45–67, 2024.

SILVA, C. A. M.; MORAIS, J. M. P.; BARBOZA, E. N. Gestão da qualidade na construção civil: análise do Programa Brasileiro de Qualidade e Produtividade no Habitat em Juazeiro do Norte, Ceará. *Research, Society and Development*, v. 9, n. 7, e123973761, 2020.

BALLARD, G.; HOWELL, G. Shielding production: essential step in production control. *Journal of Construction Engineering and Management*, v. 124, n. 1, p. 11–17, 1998.

AJU, O. G.; MOKGOHLOA, K. Leveraging artificial intelligence for digital transformation of construction and project management practices. *ResearchGate*, 2025.

WANG, Y.; HOU, X.; CHEN, T.; XIAO, B. Recent advancements of applied robotics in construction project management: a life cycle perspective. *ASCE OPEN: Multidisciplinary Research*, v. 1, n. 1, p. 1–15, 2025.

HAUBRICK, S. C. O.; GONÇALVES, J. R. M. R. Medidas de redução de geração de resíduos sólidos na construção civil como atendimento dos requisitos de sustentabilidade do PBQP-H/SIAC. *Revista Augustus*, v. 25, n. 51, p. 156–173, 2020.

OLIVEIRA, K. G. S. Análise das mudanças do novo SiAC (PBQP-H) e os possíveis impactos no setor da construção civil. 2017. Dissertação (Mestrado) — Universidade Federal da Paraíba, João Pessoa, 2017.

SOARES, M. F. Análise de integração em sistemas de gestão baseados nas normas ISO 9001, ISO

14001 e OHSAS 18001 em empresas de construção civil. 2013. Dissertação (Mestrado)— Universidade Federal do Ceará, Fortaleza, 2013.

LAWRIE, M.; PARKER, D.; HUDSON, P. Investigating employee perceptions of a framework of safety culture maturity. *Safety Science*, v. 46, n. 2, p. 226–241, 2006.

SERRAN, F. J. Maturidade da cultura de segurança no trabalho: aplicação do modelo de Hudson. *REUNIR — Revista de Administração*, v. 13, n. 2, p. 89–105, 2023.

AZEVEDO, M. L. S. A. Avaliação dos requisitos da Norma Regulamentadora 18 em uma obra de reforma estrutural. 2020. Trabalho de Conclusão de Curso — Instituto Federal de Pernambuco, Pernambuco, 2020.

GRENHO, L. F. S. Last Planner System e Just-in-Time na Construção. 2009. Dissertação (Mestrado) — Universidade Técnica de Lisboa, Lisboa, 2009.