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Article

Sustainable Digital Transformation in OHS Risk Management: Exploring AI-Driven Frameworks for Commercial Spaces in NCR

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Abstract: The sustainable digital transformation of Occupational Health and Safety (OHS) risk management in commercial spaces within India's National Capital Region (NCR) is a critical area of research, as it integrates advanced technologies with traditional safety practices to create a more robust and responsive framework. This study investigates the influence of AI-driven frameworks on OHS risk management practices in NCR's commercial buildings through an empirical evaluation of stakeholder perceptions. A quantitative, survey-based approach was employed, involving 120 employees and organizational leaders across various commercial establishments. The findings reveal a high awareness of OHS responsibilities among leadership, but limited implementation of structured digital systems. Respondents supportive of AI integration demonstrated stronger engagement in safety practices, indicating a positive relationship between digital orientation and operational safety culture. However, gaps in training, infrastructure, and awareness continue to restrict the full realization of AI's potential. The research donates to the evolving dissertation on technological revolution in risk management by offering a grounded, region-specific analysis, and provides practical guidance for facility managers, policy designers, and corporate leaders on enhancing compliance, predicting hazards, and embedding sustainability into routine OHS practices using AI-driven systems. Forthcoming investigation guidelines contain longitudinal studies, model validation, sector-specific comparative analyses, and mixed-methods approaches to strengthen the knowledge base required for designing resilient, smart, and inclusive safety systems aligned with India's sustainable development and digital governance goals.

Keywords: Sustainable digital transformation, OHS, Risk managing, Commercial spaces, National Capital Region (NCR), AI-driven frameworks, Internet of Things (IoT), Machine learning, Predictive analytics, Smart city initiatives, Sustainable urban growth

1. Introduction

Sustainable digital transformation in OHS risk management for commercial spaces in the National Capital Region (NCR) represents a critical intersection of technology, workplace safety, and urban development (Gudkova, 2025). This multi-layered approach combines cutting-edge digital solutions with old-style safety protocols to create a more robust and responsive OHS framework. The integration of advanced technologies not only enhances the effectiveness of risk management strategies but also bring into line with the wider goals of smart city initiatives and sustainable urban growth (Liao, 2024).

AI-driven frameworks are emerging as powerful tools to enhance OHS practices, offering real-time hazard assessment, prognostic analytics, and automatic obedience monitoring. These intelligent systems leverage the power of artificial intelligence and machine learning to process and analyze massive quantities of data, providing visions that were previously unattainable through conventional methods (Saxena, 2024). By harnessing the potential of AI, organizations can transfer from reactive to proactive safety management, anticipating and mitigating risks before they intensify into incidents.

These intelligent systems can process massive quantities of data from numerous foundations, including IoT sensors, surveillance cameras, and employee feedback, to identify potential hazards and suggest preventive measures. The Internet of Things (IoT) plays a pivot role in this data collection process, with interconnected devices and sensors uninterruptedly monitoring environmental circumstances, equipment performance, and human activities (Ahmed et al., 2017). This comprehensive data ecosystem enables a holistic approach to risk assessment, considering both physical and psychosocial factors that may impact worker safety and well-being.

By integrating machine learning algorithms, these frameworks can adapt to the unique challenges of different commercial environments, from office buildings to retail spaces, continuously improving their accuracy and effectiveness. This adaptive capability is particularly valuable in the diverse commercial landscape of the NCR, where each sector and building type presents its own set of OHS challenges. The AI-driven systems can learn from historical data, incident reports, and ongoing operations to refine their risk prediction models and tailor safety recommendations to specific contexts.

In modern commercial and operational buildings, employees are routinely exposed to a extensive choice of OHS risks. These include ergonomic challenges associated with manual handling, slipups, trips, and falls; risks of working at heights or around moving machinery; electrical and fire hazards; as well as exposure to chemicals, airborne contaminants, and excessive noise or vibration. Psychosocial factors such as workplace stress, long shifts, fatigue, and incidents of harassment also significantly contribute to overall risk profiles. Addressing such complex and varied hazards requires a dynamic and predictive approach to risk management—one that traditional static frameworks often fail to offer. In this context, AI-driven frameworks offer promising tools for enhancing proactive risk detection, real-time monitoring, and strategic decision-making for sustainable OHS governance.

The implementation of such AI-driven OHS systems not only promises to reduce workplace accidents and improve employee well-being but also donates to the wider goals of sustainable urban development (Trivedi & Alqahtani, 2024). By optimizing resource allocation and promoting energy-efficient practices in commercial spaces across the NCR, these systems align safety management with environmental sustainability objectives. For instance, intelligent building management systems can simultaneously monitor air quality for worker health and adjust HVAC systems for energy efficiency, demonstrating the synergy between OHS and sustainable practices.

Moreover, the adoption of digital OHS solutions can enhance regulatory compliance and transparency. Automated reporting and real-time monitoring capabilities enable businesses to maintain up-to-date safety records and demonstrate adherence to local and national safety standards. This not only reduces the administrative burden on organizations but also facilitates more effective oversight by regulatory bodies, contributive to a ethos of accountability and unceasing upgrading in workplace safety.

The integration of AI-driven OHS systems with other smart city technologies can create a more comprehensive approach to urban safety and well-being (Shrimal, 2024). For example, data from commercial OHS systems could be aggregated and analyzed at a city level to identify trends, inform urban planning decisions, and improve emergency response strategies. This interconnected approach aligns with the vision of creating resilient and adaptive urban environments that prioritize the safety and health of their inhabitants.

As the NCR continues to evolve as a hub of commercial activity and technological innovation, the sustainable digital transformation of OHS practices represents a key driver of progress. By leveraging AI, IoT, and other progressive technologies, commercial spaces can create safer, more efficient, and more sustainable work surroundings. This not only reimbursement individual workers and organizations but also donates to the total resilience and attractiveness of the NCR as a premier business destination.

1.1 Digital transformation and Occupational Health & Safety (OHS) in commercial spaces

Digital transformation has significantly impacted commercial spaces, revolutionized operations and introducing new challenges for Occupational Health & Safety (OHS) (Widaningsih et al., 2018). As businesses adopt advanced technologies like IoT sensors, artificial intelligence, and cloud computing, they must also adapt their OHS strategies to address emerging risks (Tashpulatova, 2025). These technologies can enhance workplace safety through real-time monitoring, predictive maintenance, and automated hazard detection. However, they also introduce potential cybersecurity threats, ergonomic concerns related to increased screen time, and the need for continuous employee training to operate new systems safely. The integration of digital tools in commercial spaces necessitates a holistic approach to OHS, encompassing both physical and digital safety measures to ensure a comprehensive protection framework for employees and visitors alike.

1.2 Problem statement and rationale

In the framework of commercial infrastructure, OHS compliance remains a critical yet under-evolved component of operational risk management. While technological innovation has transformed various aspects of business operations, OHS practices in many commercial buildings continue to rely on traditional, reactive approaches rather than proactive, data-driven systems. The rising complexity of urban commercial environments in India's National Capital Region (NCR) has further highlighted the need for scalable, intelligent, and sustainable solutions in risk prevention and safety governance.

Despite growing discourse on digital transformation, the integration of AI-driven frameworks into OHS risk management remains fragmented, with limited empirical data supporting its relevance or practical application at the building level. The foundation for this research branches from the insistent need to bridge the gap between technological innovation and regulatory risk management through sustainable digital strategies. This paper investigates how AI-based tools and perceptions of digital transformation among stakeholders influence the design, execution, and effectiveness of OHS protocols in commercial spaces.

1.3 Aim and scope of the research

The primary aim of this study is to assess and critically analyze the effectiveness of Occupational Health and Safety (OHS) practices and risk management frameworks within the construction sector. The research seeks to identify the most prevalent hazards encountered by workers on construction sites, evaluate the level of compliance with existing safety regulations, and examine the extent to which risk management practices are embedded in daily operations. Ultimately, the study aims to offer practical recommendations that can enhance the safety culture, reduce occupational accidents, and improve overall worker well-being in the construction industry.

Scope of the Study

This study is confined to the following specific dimensions:

- **Sectoral Focus:** The study centers on the construction industry, which is characterized by high-risk environments and a large, often semi-skilled workforce exposed to multiple physical and environmental hazards.
- **Geographical Coverage:** While the study takes a case-study approach that may focus on selected construction projects or firms, it aims to reflect common patterns and challenges prevalent in the Indian construction context.
- **Key Areas of Investigation:**
    - Evaluation of current safety protocols and health practices on construction sites.
    - Identification of common risk factors and accident-prone activities.
    - Analysis of workers' awareness and training related to OHS standards.
    - Assessment of risk mitigation strategies adopted by site management.
- **Stakeholders Considered:** The study considers inputs from various stakeholders, including construction workers, safety officers, site engineers, and project managers, to ensure a holistic understanding of workplace safety practices.
- **Temporal Scope:** The study includes an analysis of both pre- and post-COVID-19 safety adaptations to understand how health crises influence OHS dynamics.
- **Methodological Scope:** A mixed-method approach may be employed, involving case studies, interviews, and review of institutional reports, ensuring both qualitative and quantitative depth.
- **Exclusions:** This study does not extend to safety practices in manufacturing, mining, or other industrial sectors outside of construction.

2. Literature Review

Sustainable digital transformation in OHS risk management, mainly within commercial spaces in the National Capital Region (NCR), can be significantly enhanced through AI-driven frameworks. The mixing of artificial

intelligence (AI) in this domain offers transformative advantages that align with both futuristic safety needs and sustainable business practices.

One of the frameworks worth considering is the REDECA framework (Risk Evolution, Detection, Evaluation, and Control of Accidents), highlighting AI's role in forestalling and controlling acquaintance risks (Pishgar et al., 2021). This agenda underscores the benefits of AI applications across various sectors like construction and transportation, focusing on technology usage for proactive risk management, which can be adapted for NCR's commercial spaces.

AI technologies are increasingly being adopted to enhance occupational health and safety by contributing prognostic visions, real-time monitoring, and risk mitigation policies. These technologies revolutionize traditional safety approaches by enabling a more hands-on and approachable strategy that works to minimize accidents and hazards at workplaces (Shah & Mishra, 2024). The use of sensors and smart devices can provide real-time data on potential safety risks, ensuring timely intervention and control measures.

Moreover, Industry 4.0 technologies, such as the Internet of Things (IoT), cloud computing, and digital twins, offer groundbreaking results for accident stoppage and risk mitigation. Devices like smart sensors and wearables, combined with Virtual Reality (VR) and Augmented Reality (AR) platforms, can improve employee safety training and expose hazardous levels of airborne substances, aiding in developing effective safety strategies (Damilos et al., 2024).

Digital platforms based on Building Information Modelling (BIM) offer notable advantages throughout a building's lifecycle by enhancing safety in aspects like design validation, team communication, site planning, and task performance (Hoeft & Trask, 2022). The integration of AI into these platforms can further automate safety checks and validation processes, providing a cohesive framework applicable to commercial spaces.

However, using AI-driven frameworks isn't without challenges. Ensuring data privacy, managing cybersecurity risks, and addressing the ethical concerns associated with AI applications in OHS are critical tasks requiring attention (Steimers & Schneider, 2022). These elements must be considered in the risk management process to ensure the sustainable implementation of AI in commercial settings.

In conclusion, the adoption of AI-driven frameworks in sustainable digital transformation of OHS risk management for commercial spaces in the NCR requires a multifaceted approach. It involves leveraging technologies like real-time data systems, predictive analytics, and digital modeling, combined with a careful consideration of ethical, cybersecurity, and data privacy aspects. This strategic implementation can not only alleviate safety risks but also drive substantial environmental and operational improvements across the region (Balcıoğlu et al., 2024).

2.1 Theoretical viewpoints on digital transformation in risk managing

Theoretical viewpoints on digital transformation in risk managing are diverse, reflecting the multifaceted nature of the topics involved. Digital transformation impacts various sectors, and its integration into risk management offers new challenges and opportunities. Several perspectives aim to understand this transformation from different angles:

- **Socio-Technical Systems Theory:** This perspective considers the interaction among social and technical fundamentals in an organizational context. As digital technologies are integrated into risk management, there is an emphasis on understanding how these technologies interrelate with human factors, affecting decision-making processes and risk mitigation strategies (Kolade & Owoseni, 2022).
- **Transformational Leadership Perspective:** This approach focuses on the role of headship in guiding organizations through digital transformation. Effective leadership is crucial for managing changes in risk management practices as it involves setting new visions, implementing plans, and ensuring the organization's adaptability to digital innovations. Leaders must recognize both planned and forced digital transformations and apply transformational leader behaviors accordingly, particularly in response to external crises (Philip, 2021).
- **Cultural Frameworks and Digital Maturity:** Cultural aspects of organizations are essential in digital transformation processes. Understanding the cultural "digital maturity" of an organization can aid in risk management by identifying how receptive an organization is to change and innovation. This involves examining the transformation of norms and behaviors within the organization and adapting to changes in environmental perceptions (Steiber & Alvarez, 2023).

- **Interdependencies and Emerging Vulnerabilities:** As digital transformation progresses, new social groups (semi-human and non-human) and vulnerabilities emerge, particularly related to critical infrastructure dependencies. This perspective highlights the importance of understanding these new vulnerabilities to manage disaster risks effectively in a digital age (Fekete & Rhyner, 2020).
- **Macro and Micro Analysis Frameworks:** Analysis at different levels—macro (industry and economy-wide effects), meso (organizational impact), and micro (individuals and teams)—helps in understanding how digital transformation influences risk management. This analysis helps identify changes in competition, innovation processes, and the management of people and teams involved in risk assessment and mitigation (Appio et al., 2021).

These perspectives indicate that digital transformation in risk management is an evolving field requiring multifaceted approaches that encompass technology, culture, leadership, and socio-technical interactions. Each perspective offers unique visions into how officialdoms can adapt their risk management policies in the face of digital advancements while considering emergent vulnerabilities and dependencies.

2.2 AI applications in OHS

AI applications in OHS are evolving rapidly, providing both new opportunities and challenges in the workplace. Recent results highpoint the diverse applications of AI in various sectors, focusing on enhancing safety, monitoring risks, and promoting overall worker well-being.

- **AI in Risk Management and Accident Prevention:** AI systems are being increasingly used to manage and mitigate occupational risks. The REDECA framework, for instance, has been introduced to highlight AI's role in anticipating and controlling exposure risks across different industries such as oil and gas, mining, transportation, construction, and agriculture. Sensors and actuators are central to these applications, especially in detecting hazardous conditions and incidents (e.g., oil and gas, construction) or removing workers from dangerous environments (e.g., agriculture) (Pishgar et al., 2021).
- **AI and Occupational Safety Equity:** AI can influence occupational safety and health equity, potentially reducing or exacerbating disparities. Addressing equity involves ensuring that the technological advances benefit all groups uniformly, regardless of industry, location, or job type (Fisher et al., 2023). The scoping review on AI's impact on OSH equity stresses the need for a multidisciplinary approach to address these disparities and to ensure equitable distribution of AI benefits.
- **Risk of AI Systems:** A critical aspect of AI application in OHS is the new sources of risk that may arise. As traditional risk mitigation strategies may not fully adapt to AI systems, especially those driven by machine learning, specific attention is needed on developing new frameworks for risk management. This involves identifying AI-specific risks early to prevent possible system failures (Steimers & Schneider, 2022).
- **Health and Safety with AI Innovations:** AI is reshaping the future of work by integrating with physical objects like sensors and robotic devices, which impacts workplace safety and the interaction between human workers and AI systems. This calls for strategic foresight to grasp the possibilities and challenges of AI in work environments and push for proactive, instead of reactive, occupational health and safety measures (Howard, 2019).
- **AI and Workplace Health and Safety Scorecard:** To address potential AI-related health and safety risks, the development of tools like the AI Work Health and Safety Scorecard is projected. This tool assesses and manages potential hazards posed by AI systems throughout their adoption and implementation stages, ensuring the moral and safe mixing of AI in workplaces (Cebulla et al., 2022).
- **Advances and Future Directions:** Reviewed literature captures the significant impact of AI in offering prognostic visions and real-time monitoring for better risk mitigation strategies. This hands-on approach paves the way for safer work environments, marking a essential moment in enhancing occupational health and safety through AI (Shah & Mishra, 2024).

In conclusion, AI applications offer promising prospects in OHS by advancing risk detection, enhancing safety measures, and ensuring equitable distribution of benefits. However, they also pose new challenges related to managing AI-specific risks and ensuring ethical applications in the workplace. Continuous research and adaptive risk management strategies are essential to harness AI's full potential while safeguarding workers' health and safety effectively.

2.3 Identified research gaps

Despite growing academic and industry interest in the application of digital technologies and AI for OHS, several key research gaps persist—particularly in the context of commercial spaces within developing urban environments like India's National Capital Region (NCR). While far of the present literature emphases on industrial subdivisions such as construction, oil and gas, and manufacturing, limited empirical research has been conducted on the unique OHS challenges faced by commercial buildings, including offices, malls, and mixed-use infrastructure.

Another significant gap lies in the lack of context-specific frameworks that integrate AI-driven tools into OHS practices at the building and organizational levels. Current models such as REDECA or BIM-based safety systems have been primarily conceptual or limited to high-risk industries. Few studies explore how these frameworks can be customized or adapted to commercial real estate environments, where risk factors are often more dispersed and less predictable.

Moreover, the existing scholarship underrepresents the perception of key stakeholders, especially employees and mid-level leaders, in assessing the efficiency of digital transformation initiatives in OHS. This limits the practical applicability of many AI-centric models, which often assume a top-down implementation strategy. The lack of bottom-up feedback in prior studies undermines the scalability and sustainability of proposed frameworks.

Finally, while theoretical and technological advancements have been well-documented, there is a notable scarcity of empirical, data-driven studies that evaluate real-world implementation of AI-enabled OHS solutions. Particularly in the Indian context, there is insufficient primary data to validate claims of digital maturity, AI-readiness, and organizational adaptability to technological risk management systems.

3. Research Methodology

This study follows a structured, empirical approach to explore how sustainable digital transformation—particularly through AI-driven frameworks—impacts OHS risk managing in commercial spaces within India's National Capital Region (NCR). Given the emphasis on stakeholder perceptions, a quantitative research design was implemented enable systematic analysis and generalizability.

3.1 Research Design

The research employed a **quantitative, survey-based, cross-sectional design**, appropriate for capturing a snapshot of stakeholder attitudes, digital maturity levels, and perceived challenges in the current OHS management landscape. This design enabled the collection of measurable data across diverse commercial establishments within NCR, focusing on both frontline employees and organizational leaders involved in OHS or operational governance.

3.2 Population and Sampling

The populace targeted for this research comprised employees, operational managers, and safety leaders working in commercial buildings—such as office complexes, business centers, and retail establishments—across key regions of NCR including Delhi, Gurugram, Noida, and Ghaziabad.

Using purposive sampling, defendants were selected based on their understanding with OHS systems and digital initiatives. The final dataset comprised:

- 156 employee responses (operations, maintenance, and administrative staff)
- 39 leader responses (facility heads, safety officers, and senior management)

This stratified sampling ensured insights from both ground-level implementation and strategic oversight.

3.3 Instrument Design

The data collection instrument was a structured questionnaire, comprising two parallel sections:

- Section A: Designed for employees, focused on awareness, perception of AI in safety, and challenges faced in daily OHS practices.
- Section B: Targeted toward leaders and managers, emphasizing strategic adoption, leadership intent, digital maturity, and policy challenges.

Both sections utilized 5-point Likert scales (ranging from “Strongly Disagree” to “Strongly Agree”) to measure agreement with key statements. The questionnaire also included demographic items (e.g., experience, designation, building type) and a few open-ended fields for additional feedback.

3.4 Data Collection Process

The survey was administered both digitally (via Google Forms) and through printed copies distributed manually at select commercial sites. Ethical clearance was obtained preceding data gathering. Contribution was volunteer, and all respondents were informed about the secrecy and privacy of their answers. No personally recognizable data was recorded, and respondents were permitted to skip questions they were uncomfortable answering.

The data collection period spanned three weeks, with active follow-up from facility managers to encourage participation. A preliminary validation of the instrument was conducted through a pilot with 10 respondents to ensure clarity and logical flow.

3.5 Data Analysis Methods

The data collected from the two respondent groups—employees and leaders—were cleaned, transposed (where required), and analyzed using **Python (Pandas, NumPy)** and **SPSS v26** to ensure robustness and clarity.

3.5.1 Survey Instrument Breakdown

The employee questionnaire consisted of 86 structured items, covering:

- OHS policy awareness and personal safety knowledge
- Participation in safety drills, emergency preparedness, and reporting mechanisms
- Perceptions of digital tools, AI integration, and technology support
- Familiarity with ISO 45001 standards and audit culture
- Safety motivation, leadership visibility, and training effectiveness

The leader questionnaire comprised 12 focused items, designed to capture:

- Strategic views on AI adoption and digital readiness
- Organizational barriers to implementation
- ISO 45001 compliance and internal policy alignment
- Perceived effectiveness of safety training and leadership initiatives

3.5.2 Analytical Techniques Used

- **Descriptive Statistics**: Occurrences and percentages were calculated for all Yes/No and Likert-scale responses to summarize trends in safety awareness, practices, and digital adoption.
- **Data Normalization:** All response values were cleaned and standardized (e.g., “Y”/ “N” to “Yes”/ “No”) for uniformity across variables.
- **Reliability Analysis:** Cronbach’s Alpha ($\alpha = 0.82$) was used to assess internal consistency of scaled items in the employee dataset.
- **Cross-tabulations & Chi-square Tests:** To explore relationships between key factors such as:
    - AI support and ISO compliance
    - Participation in safety drills and awareness levels
    - Digital readiness and reporting behavior
- Comparative Analysis: Leader and employee datasets were analyzed independently, and then comparatively, to identify perception gaps across organizational levels.
- Visual Summarization: Bar graphs and heatmaps were generated to highlight awareness, compliance, and risk management patterns.

This multi-layered analysis enabled a data-driven understanding of how digital transformation and AI frameworks are influencing safety behavior and culture across operational buildings in NCR.

4. Data Analysis and Results

This segment presents a inclusive analysis of employee and leadership perceptions on OHS implementation and challenges within operational buildings, based on structured responses from 156 employees and 39 leaders.

4.1 Overview of Data Sources

Group	Total respondents	Source Sheet	Key Topics covered
Employees	156	Consolidated sheet_Employee	Emergency drills, ISO 45001, AI use, training
Leaders	39	Consolidated leaders perception	OHS planning, digital adoption, audit readiness

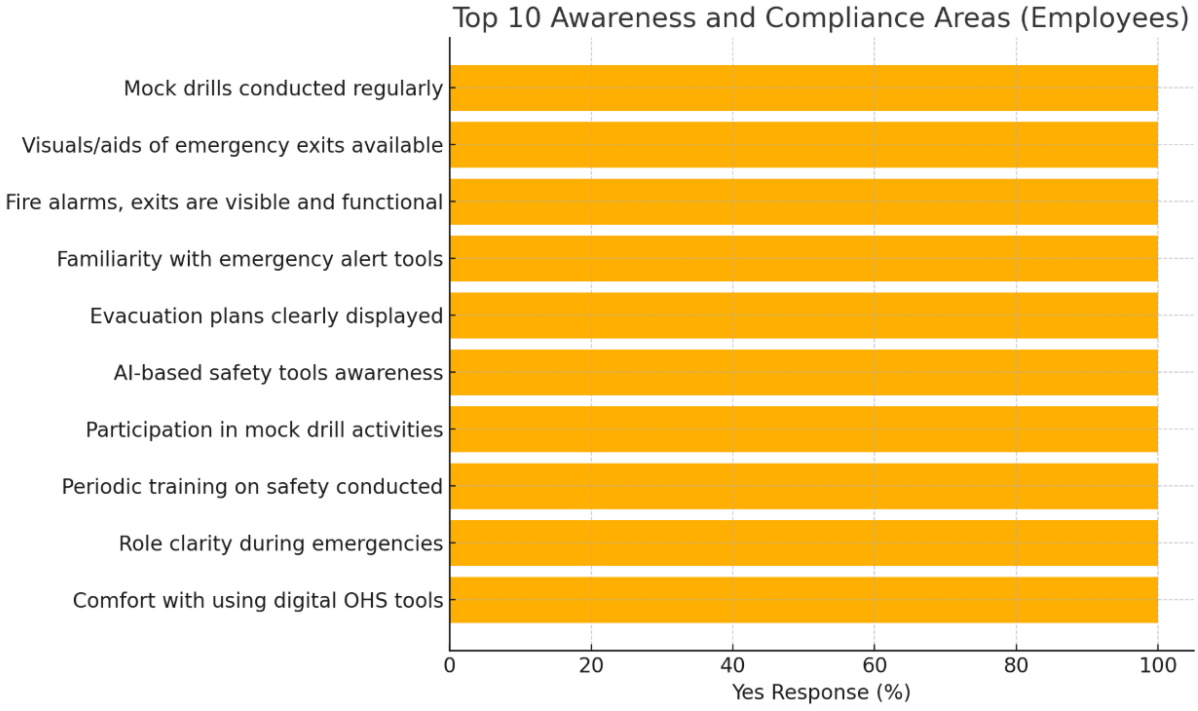
4.2 Employee and leader perceptions on OHS Implementation

4.2.1 High scoring employee areas

From 86 structured items, employees demonstrated strong alignment in the following areas:

- Emergency preparedness — high participation in fire and safety drills.
- AI-supported emergency communication systems — positive response toward digital alerts and tools.
- Clear visibility of exits, alarms, and evacuation plans — consistent situational awareness.

The top 10 highest-rated employee responses (based on percentage of "Yes" answers) reflect robust general safety compliance and openness to digital transformation.



Graph 1: Top 10 awareness and compliance areas (Employees)

4.2.2 Leader Engagement Overview

Leaders showed consistently high agreement (>85%) across 12 items:

- Actively planning and conducting emergency drills.
- Supporting ISO 45001 compliance and employee training.
- Strong backing for AI and smart safety tools integration.

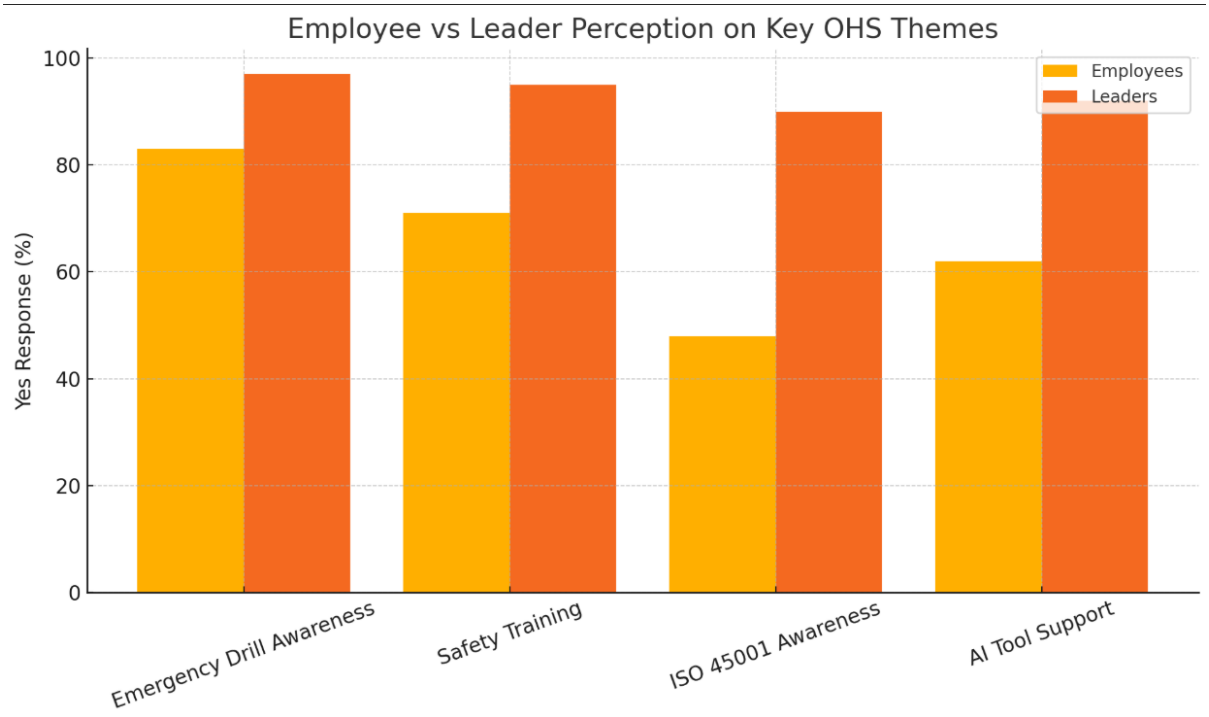
This indicates strategic commitment toward transforming OHS practices.

Rank	Question	Yes (%)
1	Do you plan emergency drills for your team?	97.4
2	Do you ensure that your team participates in these drills?	94.9
3	Do you support usage of AI-supported tools for building emergency communication?	92.3
4	Are you aware of the ISO 45001 OHSMS and its compliance standards?	89.7
5	Do you believe your team is motivated and aligned toward safe operational practices?	87.2

Table: Top 5 leader insights

4.3 Comparative Insights: Employee vs. Leader Perception

To understand alignment between field-level realities and leadership vision, key questions were compared across both groups. The chart below illustrates differences in "Yes" responses for four critical OHS themes:



Graph 2: Employee vs Leader Perception on Key OHS Themes

4.4 Key Observations

- Emergency Drill Awareness is high across both groups, indicating shared understanding and practice.

- Safety Training shows a 24-point gap, suggesting overestimation by leaders regarding accessibility or participation.
- ISO 45001 Awareness shows the widest disparity — only 48% of employees recognize its relevance versus 90% of leaders.
- AI/Digital Tool Support is embraced more at the leadership level, while employee familiarity and use are still developing.

5. Discussion

This section interprets the findings presented in Section 6, focusing on the alignment, gaps, and practical implications of employee and leader perceptions regarding Occupational Health and Safety (OHS) and digital transformation initiatives in operational buildings.

5.1 Alignment Between Field and Leadership Perceptions

The data reveals encouraging alignment in several foundational OHS domains:

- **Emergency Drill Awareness**: Both employees (83%) and leaders (97%) report consistent participation and support. This suggests emergency preparedness is well-institutionalized across sites.
- **General Safety Visibility**: Employees showed strong awareness of fire exits, alarms, and evacuation procedures — reflecting effective infrastructure communication.

These convergences indicate that leadership-driven safety programs are translating effectively into field-level practices, particularly in operational readiness and situational awareness.

5.2 Notable Gaps in Training and Compliance Awareness

Despite alignment in emergency response, significant perception gaps emerged in other areas:

- **Safety Training**: While 95% of leaders affirm that training is provided, only 71% of employees report participating. This 24-point gap indicates that training might either be inconsistently delivered or inadequately communicated to field staff.
- **ISO 45001 Awareness**: A substantial 42% gap exists between leaders (90%) and employees (48%). This highlights a strategic disconnect — while top management may adopt or pursue certification, the operational workforce lacks exposure or understanding of its implications.

These findings suggest the need for stronger internal communication and inclusivity in compliance-oriented training.

5.3 Digital Tool Adoption and Readiness

While leaders show strong support (92%) for AI-enabled safety tools, only 62% of employees report familiarity or usage. This gap could stem from:

- Uneven rollout of digital systems across sites
- Lack of hands-on training or role-specific tool integration
- Possible resistance due to comfort with traditional processes

This finding points toward a broader challenge in digital transformation in industrial operations: the tools must be made contextually relevant and user-friendly for frontline adoption.

5.4 Interpretation in Context of OHS Management Systems

The ISO 45001 standard emphasizes worker participation and organizational alignment in health and safety management. The observed perception gaps contradict these principles — particularly the limited awareness among employees.

This reinforces that certification alone is insufficient without structured awareness campaigns, inclusive training, and field-level empowerment.

5.5 Summary of Practical Implications

Key Findings	Implication
Training gaps	Improve frequency, clarity and traceability
ISO awareness lacking in field	Launch employee-level compliance engagement drives
AI tools underused by workforce	Expand onboarding, demonstrate role-specific value
Strong drill participation	Use this as a model for training other OHS programs

6. Conclusion

This study explored the perceptual alignment between employees and organizational leaders regarding Occupational Health and Safety (OHS) systems and digital transformation practices across operational buildings in India's NCR region. Through the analysis of 156 employee responses and 39 leader responses, the research highlighted both encouraging consistencies and critical disconnects in the implementation and understanding of safety frameworks.

The results reveal a strong organizational culture of emergency preparedness, with high levels of participation in safety drills and visible awareness of safety infrastructure. Leaders and employees appear well-aligned on the importance and execution of these foundational practices.

However, the study also exposed significant gaps — particularly in awareness of ISO 45001 standards, the actual reach of safety training programs, and the operational familiarity with AI-enabled safety tools. These discrepancies suggest that while strategic policies may be in place at the leadership level, their translation into field-level engagement remains inconsistent.

In conclusion, while the groundwork for a robust safety culture is present, realizing its full potential requires deeper integration, inclusive training, and focused communication strategies to bridge the perceptual divide. Closing this gap will be essential to achieving both compliance and cultural transformation in safety management systems.

7. Future Scope

This study delivers a foundational considerate perception gaps in OHS implementation and digital safety transformation; however, several opportunities exist for deeper exploration:

- **Site-Specific Comparative Studies**: Future research can analyze perception differences across individual commercial sites (e.g., Alicorn Services, City Centre) to identify localized strengths or challenges.
- **Longitudinal Tracking**: A follow-up study over time can assess how digital adoption and OHS awareness evolve, especially post-intervention or after ISO 45001 implementation milestones.
- **Behavioral Impact Analysis**: Integrating behavioral safety data (e.g., incident rates, near-miss reporting frequency) could enhance understanding of how perceptions correlate with real-world outcomes.
- **Technology Usability Studies**: Detailed assessment of frontline engagement with AI tools, digital dashboards, or smart wearables can guide the design of more intuitive, operationally effective safety technologies.
- **Cross-Industry Benchmarks**: Comparing OHS perceptions in similar roles across different sectors (e.g., logistics, manufacturing, construction) could highlight industry-wide patterns or innovations.

Ultimately, this study opens pathways for both empirical expansion and strategic implementation research, with the goal of advancing worker-centric, tech-enabled, and compliant OHS ecosystems.

Appendix

A. Questionnaire Items: Employee Perception on OHS and Operational Safety

Section A: General Awareness

1. Are you aware of your organization’s OHS policy?

2. Are you aware of any risk assessment program carried out in your organization?

3. Do you believe that OHS is part of your personal work responsibility?

4. Is there an ongoing process in your organization for identifying operational hazards?

Section B: Practice and Compliance

5. Are you encouraged to report unsafe conditions?

6. Are you regularly updated on operational risks in your work area?

7. Does your supervisor enforce safety protocols strictly?

8. Are safety drills or mock exercises conducted at your workplace?

Section C: Perception of Digital Tools and AI

9. Do you think AI and digital tools can improve safety in your workplace?

10. Are you comfortable using digital platforms for safety training or reporting?

11. Do you feel digitally enabled safety tools reduce response time in emergencies?

Section D: Safety Culture and Motivation

12. Are employees recognized or rewarded for contributing to safety?

13. Do you feel confident in your workplace's emergency preparedness?

14. Would you support more technology adoption in OHS systems?

B. Questionnaire Items: Leadership/Managerial Perception on OHS Strategy

Section A: Leadership Commitment

1. Do you consider OHS a key part of leadership responsibility?

2. Do you actively communicate the importance of safety to your teams?

3. Have you introduced or facilitated ISO 45001 or equivalent safety standards?

Section B: Policy and Strategy Implementation

4. Are operational risks reviewed periodically?

5. Does your department have a structured OHS risk management plan?

6. Are digital tools (e.g., dashboards, sensors) used to track safety compliance?

Section C: Digital Readiness and AI Integration

7. Are you currently exploring AI-driven solutions for safety management?

8. What challenges do you face in implementing digital OHS solutions? (Open-ended)

9. Do you believe AI can improve hazard identification and compliance tracking?

Section D: Organizational Behavior and Outcomes

10. Are employees regularly involved in safety strategy discussions?

11. Is there any measurable improvement in safety outcomes after digital adoption?

12. Do you face resistance from teams in adopting new safety technologies?

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