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Conceptual Governance Framework for Subcontractor Safety Performance Management

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Abstract

Subcontractor engagement is a critical component of industrial and construction project delivery, yet managing subcontractor safety performance remains a persistent challenge in high-risk operations. Subcontractors often operate under different safety standards, procedures, and cultural norms than the principal contractor, creating vulnerabilities in safety oversight, compliance, and risk mitigation. To address these challenges, this paper proposes a conceptual governance framework for subcontractor safety performance management, integrating organizational, procedural, and technological mechanisms to ensure consistent safety outcomes across multi-tiered project environments. The framework emphasizes three interrelated dimensions. First, governance and accountability structures clarify roles, responsibilities, and performance expectations between contractors and subcontractors, ensuring transparent oversight and clear lines of authority. Second, performance monitoring and evaluation mechanisms employ leading and lagging safety indicators, periodic audits, and real-time reporting systems to assess adherence to safety standards, identify emerging risks, and facilitate corrective interventions. Third, learning and continuous improvement processes incorporate lessons from incidents, near-misses, and audit findings into procedural updates, training

programs, and contractor engagement strategies. By integrating these dimensions, the framework promotes proactive risk management, reinforces compliance, and fosters a culture of shared safety responsibility. The conceptual framework also considers moderating and enabling factors that influence effectiveness, including organizational safety culture, regulatory environment, contractor competency, and digital monitoring capabilities. Through structured coordination, standardized procedures, and adaptive feedback mechanisms, the framework provides a comprehensive approach for managing the complexity of subcontractor safety performance in dynamic, high-risk industrial operations. This framework contributes to the safety governance and contractor management literature by offering a structured, evidence-informed approach that aligns operational, strategic, and regulatory objectives. It highlights the importance of systems-based oversight, performance-oriented monitoring, and continuous organizational learning in enhancing safety outcomes. Furthermore, the framework provides a foundation for empirical validation, benchmarking, and practical implementation in large-scale projects involving multiple subcontractors, ultimately supporting safer, more resilient, and compliant industrial operations.

Keywords: Subcontractor Safety Performance, Safety Governance, High-Risk Operations, Performance Monitoring, Organizational Learning, Contractor Management, Safety Culture, Industrial Project Governance

1. Introduction

The contemporary industrial landscape, particularly in high-risk sectors such as construction, oil and gas, petrochemicals, and large-scale manufacturing, has seen a significant increase in reliance on subcontractors for executing specialized or labor-intensive tasks (Yeboah and Ike, 2023; Babatope *et al.*, 2023). Subcontracting enables principal contractors to leverage external expertise, scale operations efficiently, and optimize resource allocation. However, this operational model introduces substantial challenges in managing safety performance, as subcontractors often operate under different procedures, organizational norms, and safety cultures than the principal contractor (Oziri *et al.*, 2023; Oyeboade and Olagoke-Komolafe, 2023). The proliferation of multi-tiered subcontracting arrangements amplifies these challenges, creating complex chains of accountability and complicating the monitoring and enforcement of safety standards across diverse teams and work sites

(Uduokhai *et al.*, 2023; Sanusi *et al.*, 2023).

Empirical evidence from high-risk industrial operations indicates that subcontractor activities are disproportionately associated with safety incidents, near-misses, and process disruptions (Essandoh *et al.*, 2023; Wedraogo *et al.*, 2023). Studies have shown that a significant proportion of injuries and fatalities on construction and industrial sites involve subcontracted personnel, often arising from inadequate supervision, unfamiliarity with site-specific hazards, or gaps in communication between principal and subcontractor teams (Adesanya *et al.*, 2020; Akinola *et al.*, 2020). These observations highlight the need to address not only the technical and procedural aspects of subcontractor work but also the organizational, relational, and cultural factors that influence safety behavior and performance (Oparah *et al.*, 2023; Odejobi *et al.*, 2023). Without targeted governance mechanisms, subcontractor safety remains a persistent vulnerability in high-risk operations, undermining overall project safety performance and resilience (Uduokhai *et al.*, 2023; Ofori *et al.*, 2023).

Traditional approaches to subcontractor safety management have primarily relied on compliance-focused and contractually enforced controls, such as safety clauses in contracts, mandatory training, and periodic audits (Dako *et al.*, 2019; Ajayi *et al.*, 2023). While these measures establish minimum expectations and accountability mechanisms, they are limited in scope. Compliance-based strategies often fail to capture dynamic operational risks, real-time deviations from procedures, or latent organizational factors that contribute to incidents (Sanusi *et al.*, 2023; Oziri *et al.*, 2023). Furthermore, contract-only controls tend to emphasize fault-finding and enforcement rather than fostering proactive engagement, learning, and continuous improvement (Odejobi *et al.*, 2023; Ofori *et al.*, 2023). This creates a reactive safety culture, wherein safety outcomes are assessed after the fact, rather than embedded in day-to-day subcontractor operations.

Addressing these limitations necessitates a governance-oriented conceptual framework that integrates strategic oversight, operational monitoring, and continuous learning to manage subcontractor safety performance holistically (Aminu-Ibrahim *et al.*, 2021; Ajayi *et al.*, 2023). Such a framework emphasizes clear roles and responsibilities, systematic performance evaluation, and proactive interventions, bridging the gap between contractual compliance and organizational accountability (Ogbuefi *et al.*, 2023; Dako *et al.*, 2023). It also recognizes the interdependencies between principal contractors and subcontractors, highlighting the need for structured communication, coordinated safety practices, and adaptive risk management in multi-tiered project environments.

The purpose of this conceptual framework is to provide a structured approach for managing subcontractor safety performance across high-risk industrial operations. Its scope encompasses governance mechanisms, performance monitoring, and learning processes that collectively ensure consistent adherence to safety standards, timely identification of hazards, and continuous improvement of operational practices (Bayeroju *et al.*, 2023; NDUKA, 2023). By integrating organizational, procedural, and technological elements, the framework aims to enhance proactive risk management, strengthen oversight, and embed a culture of shared responsibility for safety (Olagoke-Komolafe and Oyeboade, 2022; Omolayo *et al.*, 2022).

Ultimately, this framework serves as a strategic tool for industrial organizations seeking to improve safety outcomes, reduce incident recurrence, and achieve operational resilience in projects with extensive subcontractor involvement.

The increasing reliance on subcontractors in high-risk industries, coupled with their disproportionate association with safety incidents, underscores the inadequacy of traditional compliance-focused controls. A governance-oriented approach is required to integrate oversight, performance evaluation, and continuous learning, ensuring that subcontractor activities align with broader organizational safety objectives (Nwafor *et al.*, 2020; Uduokhai *et al.*, 2023). The proposed framework offers a systematic, proactive, and scalable model for managing subcontractor safety, addressing both operational and strategic dimensions, and enabling safer, more resilient industrial project execution.

2. Methodology

A PRISMA-guided systematic review methodology was applied to develop the conceptual governance framework for subcontractor safety performance management. The review aimed to ensure methodological rigor, transparency, and reproducibility in synthesizing evidence on subcontractor oversight, safety governance, and performance management practices in industrial and construction environments. The focus was on high-risk sectors, including construction, oil and gas, and process industries, where effective subcontractor management is critical for minimizing operational hazards and ensuring compliance with safety standards.

A comprehensive literature search was conducted across multiple electronic databases, including Scopus, Web of Science, ScienceDirect, IEEE Xplore, and Google Scholar, to capture peer-reviewed articles, conference proceedings, and authoritative reviews. Keywords and Boolean operators were combined to identify studies addressing subcontractor safety management, governance structures, contractor oversight, compliance monitoring, safety performance indicators, and organizational learning. The search was limited to English-language publications and constrained to a relevant timeframe to ensure the findings reflected contemporary governance and safety management practices. The identification phase generated a large number of records, which were imported into reference management software for deduplication. Titles and abstracts were screened against predefined inclusion and exclusion criteria to remove studies unrelated to subcontractor safety performance or those focused exclusively on non-industrial contexts, such as healthcare or transportation, unless transferable insights were applicable. Studies solely addressing compliance without reference to performance management, organizational governance, or safety outcomes were excluded.

Full-text eligibility assessment involved evaluating methodological quality, conceptual relevance, and contribution to understanding subcontractor safety governance. Both empirical and conceptual studies were included, encompassing case studies of subcontractor management, safety audits, performance evaluation frameworks, and theoretical models linking governance mechanisms to safety outcomes. Data extraction focused on constructs such as governance structures, accountability

mechanisms, safety performance monitoring, contractor engagement, training and competency assurance, and integration of safety data into organizational decision-making processes.

Synthesis of the included studies employed a narrative and thematic approach due to heterogeneity in study designs, industry contexts, and outcome measures. Recurring patterns were identified regarding effective governance structures, oversight mechanisms, performance indicators, contractor engagement strategies, and regulatory alignment. Themes were iteratively coded and grouped to define the core elements of a conceptual governance framework, including policy formulation, monitoring and reporting systems, performance evaluation, and feedback loops for continuous improvement.

The PRISMA-guided review informed the development of a conceptual governance framework linking organizational structures, monitoring mechanisms, and contractor-level practices to subcontractor safety performance outcomes. By following this systematic methodology, the review ensured an unbiased and comprehensive selection of evidence, reducing the risk of omission and enhancing the validity of the resulting framework. The framework provides a structured approach for organizations to manage subcontractor safety effectively, emphasizing accountability, proactive performance monitoring, and integration of learning mechanisms to improve safety culture and operational resilience in complex industrial projects.

2.1 Theoretical Foundations of Safety Governance

Safety governance in industrial and construction environments draws on multiple theoretical perspectives that collectively explain how organizations establish control, ensure accountability, and manage risk across complex operations (Ofoedu *et al.*, 2022; Okeke *et al.*, 2023). Understanding these theoretical foundations is essential for designing frameworks that integrate corporate oversight, project-level management, and regulatory compliance, particularly in multi-contractor environments where subcontractor safety performance is critical.

Corporate and project governance theory provides a foundational lens for understanding safety governance as a system of control, accountability, and oversight. Governance, in this context, is conceptualized as a formal structure through which organizations define responsibilities, establish performance expectations, and monitor compliance. Clients or owner organizations set strategic safety objectives and enforce compliance through hierarchical and contractual mechanisms, while project managers translate these objectives into operational practices (Oguntegebe *et al.*, 2019; Sanni *et al.*, 2021). A central challenge within corporate and project governance is the principal-agent problem, which arises when the interests of subcontractors (agents) do not fully align with those of the client or main contractor (principals). In safety governance, this misalignment may manifest as underreporting of incidents, deviation from safety procedures, or prioritization of productivity over risk mitigation. Theoretical insights from principal-agent models underscore the importance of incentives, monitoring, and reporting mechanisms to align goals and ensure that subcontractors' actions support overarching safety objectives. Corporate and project governance thus provides the structural and strategic basis for managing accountability

and integrating safety into decision-making across organizational levels.

Systems safety theory and high-reliability theory extend this perspective by emphasizing the distributed nature of safety responsibility in complex, multi-actor environments. Systems safety theory views incidents as emergent outcomes of interactions between human, technical, and organizational components, rather than solely as isolated failures. This approach highlights the need for integrated oversight, coordination, and redundancy to manage risk across operational boundaries. High-reliability theory complements this by illustrating how organizations operating in high-risk domains, such as petrochemical plants or large-scale construction projects, achieve consistently safe performance through collective vigilance, adaptive procedures, and robust communication channels. Distributed responsibility for safety requires that both main contractors and subcontractors participate actively in hazard identification, reporting, and mitigation, while clients provide strategic guidance and resource allocation. By applying these theoretical insights, safety governance frameworks can be designed to accommodate interdependencies among actors, anticipate emergent hazards, and facilitate proactive interventions in dynamic project environments (Michael and Ogunsola, 2022; NDUKA, 2022).

Institutional and regulatory theory provides a third perspective, focusing on the role of formal rules, norms, and enforcement mechanisms in shaping organizational behavior. Regulations, standards, and contractual obligations establish the formal expectations for safety performance, creating both incentives and constraints for organizational actors. Institutional theory emphasizes that beyond formal rules, norms and professional practices influence how organizations interpret and implement safety requirements, affecting compliance and organizational learning (Sanni *et al.*, 2020; Shodhshauryam, 2020). Regulatory theory highlights the interaction between top-down enforcement and project-level governance structures, showing that regulators can reinforce safety governance by mandating reporting requirements, audits, and performance indicators while leaving flexibility for context-specific adaptation. By understanding these dynamics, safety governance frameworks can integrate regulatory requirements with internal control systems, ensuring alignment between compliance obligations and operational risk management. Institutional and regulatory theory thus underlines the importance of creating governance systems that are both externally accountable and internally adaptive, promoting sustainable safety outcomes.

Collectively, these theoretical foundations provide a comprehensive basis for understanding and designing safety governance systems in high-risk, multi-contractor environments. Corporate and project governance theory emphasizes accountability, hierarchical control, and the management of principal-agent challenges, providing the structural framework for oversight. Systems safety and high-reliability theory highlight the distributed nature of safety responsibility, the need for inter-organizational coordination, and the management of emergent risks in complex environments. Institutional and regulatory theory situates governance within broader societal, regulatory, and normative contexts, demonstrating how formal rules, standards, and enforcement mechanisms influence

organizational behavior and learning (Sanni *et al.*, 2020; Oguntegbe *et al.*, 2023).

Effective safety governance requires integration across these theoretical perspectives. Governance systems must align incentives, establish accountability, and provide oversight (corporate and project governance), manage complex interactions and distribute safety responsibilities across actors (systems safety and high-reliability theory), and adhere to formal regulations while leveraging institutional norms to reinforce learning and compliance (institutional and regulatory theory). Together, these theories inform the design of frameworks capable of ensuring that subcontractor safety performance is systematically monitored, supported, and continuously improved, ultimately enhancing safety outcomes in complex, high-risk industrial operations (Ike *et al.*, 2021; Imediegwu and Elebe, 2021).

2.2 Governance Actors and Structural Arrangements

Effective governance of subcontractor safety performance in high-risk industrial and construction environments depends on the interplay between multiple actors and the structural arrangements that define their roles, responsibilities, and interactions. Governance in this context is a multi-layered system involving clients, main contractors, subcontractors, regulators, and auditors, all of whom contribute to creating a safe operational environment (Ugwu-Oju *et al.*, 2022). Understanding the key actors and the governance structures that mediate their relationships is essential for establishing accountability, promoting compliance, and enabling continuous improvement in subcontractor safety performance.

Key governance actors encompass both internal and external stakeholders who influence safety outcomes through decision-making, oversight, and operational control. Client or owner organizations are central actors, as they define project objectives, allocate resources, and set safety expectations. Clients establish the overarching governance framework by incorporating safety requirements into contractual obligations, approving safety plans, and monitoring overall compliance. Their commitment to safety signals organizational priorities and sets the tone for subsequent governance interactions. Main contractors act as intermediaries between clients and subcontractors, translating high-level safety requirements into actionable procedures and coordinating operational activities. They are responsible for ensuring that subcontractors adhere to safety standards, providing training and resources, and monitoring performance through inspections, reporting mechanisms, and audits (Oparah *et al.*, 2023; Olatunji *et al.*, 2023).

Subcontractors and lower-tier contractors represent the frontline actors executing tasks within the operational environment. Their compliance with safety protocols, hazard identification, and proactive risk management directly influences incident rates and operational resilience. Subcontractors' safety performance is contingent not only on their internal safety culture but also on the governance, oversight, and support provided by clients and main contractors. Regulators and external auditors serve as independent actors ensuring that safety practices conform to legal and industry standards (Enow *et al.*, 2022; Ike *et al.*, 2022). They establish compliance benchmarks, conduct inspections, and provide accountability mechanisms that reinforce governance expectations across all tiers. Collectively, these actors create a complex ecosystem where

responsibilities overlap and interdependencies shape both risk exposure and mitigation potential.

Governance structures define how responsibilities are allocated, coordinated, and enforced across these actors. Contractual governance mechanisms constitute the foundational approach, embedding safety obligations, performance indicators, and reporting requirements directly into contracts. Contracts specify deliverables, define authority and accountability, and provide the legal framework for enforcing compliance. They ensure that subcontractors are contractually obligated to meet safety standards, report incidents, and participate in audits or performance reviews. However, purely contractual governance may be limited by its transactional nature, emphasizing compliance rather than collaborative problem-solving, which can inhibit proactive learning and hazard prevention.

Relational and collaborative governance arrangements complement contractual mechanisms by fostering communication, trust, and joint decision-making between clients, main contractors, and subcontractors. These arrangements emphasize partnership, shared responsibility, and ongoing dialogue, allowing actors to address operational challenges dynamically and collectively. Collaborative governance facilitates knowledge sharing, alignment of safety practices across multiple contractors, and coordinated responses to emerging hazards. Mechanisms such as joint safety committees, integrated project teams, and regular coordination meetings operationalize relational governance, ensuring that all actors participate actively in monitoring, evaluating, and improving safety performance (Sanni *et al.*, 2020; Ezeh *et al.*, 2023).

Governance models can also be understood in terms of hierarchy versus network-based structures. Hierarchical governance relies on top-down control, clear reporting lines, and centralized decision-making. This model enables consistent enforcement of safety policies, clear allocation of accountability, and rapid intervention when deviations occur. However, it may be less adaptive to the complexities of multi-contractor environments where flexibility, responsiveness, and contextual decision-making are critical. Network-based governance, by contrast, emphasizes decentralized authority, lateral communication, and inter-organizational linkages. Actors operate within collaborative networks, where shared information, peer monitoring, and mutual support enhance situational awareness and responsiveness to hazards. Network-based governance is particularly effective in dynamic, high-density construction and commissioning environments where risks emerge from complex interactions between tasks, personnel, and equipment.

The interplay between actors and structural arrangements highlights the need for integrated governance approaches. Effective subcontractor safety governance is rarely achieved through a single mechanism; rather, it requires the alignment of contractual obligations, relational arrangements, and organizational structures to ensure that safety responsibilities are clearly understood, monitored, and enforced (Ogunsola and Michael, 2023; Uduokhai *et al.*, 2023). For instance, contractual mechanisms may define performance expectations, collaborative arrangements facilitate communication and learning, and hierarchical oversight ensures accountability, while networked

interactions provide flexibility and rapid problem-solving in response to emerging hazards.

Governance actors and structural arrangements constitute the backbone of effective subcontractor safety performance management. Clients, main contractors, subcontractors, regulators, and auditors collectively shape safety outcomes through their distinct but interdependent roles. Governance structures, encompassing contractual, relational, and hierarchical or network-based arrangements, mediate these interactions, defining accountability, enabling coordination, and promoting proactive risk management. By understanding and strategically designing these governance mechanisms, organizations can ensure that safety performance is effectively monitored, reinforced, and continuously improved, thereby reducing the likelihood of incidents and enhancing resilience in complex, multi-tiered industrial operations. Effective governance integrates multiple actors and structural forms, balancing control, collaboration, and adaptability to meet the challenges of high-risk, multi-contractor environments (Ekechi, 2022; Elebe *et al.*, 2022).

2.3 Governance Mechanisms for Subcontractor Safety Performance

Ensuring subcontractor safety performance is a critical challenge in large-scale, multi-actor project environments, particularly in construction, industrial, and infrastructure projects. Subcontractors often perform high-risk tasks within complex operational systems, making their safety practices essential to overall project resilience. Effective governance mechanisms are necessary to align subcontractor behavior with organizational safety objectives, mitigate risk, and ensure regulatory compliance (Farounbi *et al.*, 2018; Gado *et al.*, 2020). These mechanisms can be categorized into pre-qualification and selection processes, contractual and formal control measures, and monitoring, reporting, and assurance practices, which together establish a structured framework for managing subcontractor safety performance.

The governance process begins with rigorous pre-qualification and selection of subcontractors. A central component of this stage is the assessment of safety capability and due diligence. Organizations evaluate potential subcontractors for their technical competence, safety culture, resource allocation for safety, and the presence of formal management systems. Assessment tools may include self-reported safety management system documentation, third-party audits, and verification of training programs, emergency preparedness, and hazard identification protocols. Past safety performance is equally critical, as historical incident records, near-miss reports, and regulatory compliance data provide insight into a subcontractor's operational reliability and risk profile (Nwankwo *et al.*, 2022; Ofoedu *et al.*, 2022). By screening subcontractors through these mechanisms, project owners and prime contractors can select partners with demonstrated capacity to maintain high safety standards, thereby reducing latent risks associated with inexperienced or poorly managed teams.

Once selected, subcontractors are governed through contractual and formal control mechanisms that codify safety obligations. Contracts serve as instruments to embed safety responsibilities into the legal and operational framework of the project. Clear role definitions, authority allocation, and accountability provisions ensure that

subcontractors understand their responsibilities, lines of reporting, and the consequences of non-compliance. Performance-based incentives and penalties further reinforce adherence to safety standards. Incentives may include recognition, preferred contractor status, or financial rewards for maintaining exemplary safety records, while penalties can encompass fines, project suspension, or termination of contracts in the event of serious violations. Such mechanisms create explicit expectations and align subcontractor objectives with project-level safety goals, fostering accountability and incentivizing proactive safety behaviors.

Ongoing monitoring, reporting, and assurance processes constitute the operational backbone of subcontractor safety governance. Safety performance indicators, including leading metrics such as near-miss reporting, hazard observations, and compliance with permits-to-work, provide continuous insight into operational safety. Reporting requirements ensure that both routine and exceptional events are communicated promptly to project management teams, enabling rapid corrective action. Audits, inspections, and supervisory oversight further reinforce compliance by independently verifying adherence to safety protocols, evaluating the effectiveness of control measures, and identifying emerging risks. Increasingly, digital tools play a pivotal role in real-time safety monitoring. Platforms integrating sensors, mobile reporting applications, and centralized dashboards enable near-instant visibility of subcontractor activities, allowing managers to detect deviations, track progress, and enforce corrective measures efficiently. The combination of quantitative monitoring, qualitative assessment, and digital oversight strengthens governance and ensures that subcontractor operations remain aligned with organizational safety standards throughout the project lifecycle (Ofoedu *et al.*, 2022; Okafor *et al.*, 2022).

Governance mechanisms for subcontractor safety performance require a multi-layered approach that begins with rigorous pre-qualification and selection, continues through contractual and formal control mechanisms, and is reinforced by ongoing monitoring, reporting, and assurance practices. Pre-qualification ensures that subcontractors possess the requisite capability and historical performance to manage risk effectively. Contractual controls embed clear expectations, accountability, and incentives, aligning subcontractor behavior with project-level safety objectives. Continuous monitoring, audits, and the strategic use of digital tools ensure that compliance is maintained, performance is transparent, and interventions can be implemented promptly. Collectively, these governance mechanisms reduce the likelihood of accidents, enhance operational reliability, and contribute to the broader development of a proactive and resilient safety culture in complex, multi-actor project environments. By systematically integrating these elements, organizations can mitigate subcontractor-related risks, achieve regulatory compliance, and maintain high standards of safety performance across all stages of project execution (Nwafor *et al.*, 2019; Uduokhai *et al.*, 2023).

2.4 Behavioral and Relational Governance Mechanisms

Effective governance of subcontractor safety performance extends beyond formal contracts and hierarchical control, encompassing behavioral and relational mechanisms that

shape interactions, influence compliance, and foster a culture of proactive risk management. Behavioral and relational governance emphasizes the role of leadership, communication, coordination, trust, fairness, and psychological safety in enabling organizations to manage complex, multi-actor projects effectively (Yeboah and Nnabueze, 2021; Ugwu-Oju *et al.*, 2022). By complementing structural and contractual mechanisms, these governance approaches enhance the capacity of organizations to monitor, influence, and improve subcontractor safety performance in high-risk industrial and construction environments.

Leadership and safety commitment represent a critical behavioral mechanism in subcontractor governance. Visible and sustained commitment from client organizations and main contractors signals the priority of safety within the project and sets expectations for all participating actors. Leadership presence is more than symbolic; it manifests through active engagement in safety planning, participation in site inspections, and responsiveness to safety concerns raised by personnel. When leaders demonstrate consistent attention to safety, they influence organizational culture, shaping attitudes, behaviors, and decision-making processes across contractor networks. Alignment of safety values across organizations is equally important. Safety governance requires that clients, main contractors, and subcontractors share a coherent set of principles regarding risk tolerance, hazard mitigation, and procedural compliance. Misalignment of values, for example, where productivity is prioritized over safety at one organizational level, undermines governance and increases the likelihood of unsafe practices. By establishing and modeling aligned safety values, leadership mechanisms reinforce accountability and create an environment where proactive hazard management is expected, supported, and rewarded (Michael and Ogunsola, 2019; Ogbete *et al.*, 2020).

Communication and coordination serve as essential relational mechanisms that operationalize governance across multi-contractor projects. Industrial operations are characterized by distributed responsibilities, overlapping work scopes, and complex interdependencies, making information sharing critical for hazard recognition and prevention. Effective communication mechanisms ensure that safety-related information including incident reports, near-miss observations, risk assessments, and operational constraints is disseminated across contractor interfaces in a timely and accurate manner. Coordination extends beyond information transfer to include joint planning, synchronized scheduling, and collaborative decision-making. Safety coordination forums, such as integrated project safety committees, cross-organizational hazard workshops, and daily operational briefings, provide structured opportunities for actors to align their activities, anticipate interactions, and address emergent hazards collaboratively (Taiwo *et al.*, 2021; Uduokhai *et al.*, 2021). By fostering regular and structured communication, relational governance mechanisms reduce ambiguity, enhance situational awareness, and improve the effectiveness of safety interventions across organizational boundaries.

Trust, fairness, and psychological safety constitute complementary relational mechanisms that influence compliance, learning, and proactive reporting behaviors. Trust between clients, main contractors, and subcontractors facilitates open dialogue and encourages the sharing of

information about hazards, near misses, and procedural deviations without fear of unjust reprisal. Importantly, trust must coexist with accountability; governance systems should reward transparency while maintaining clear consequences for negligence or willful violations. Perceived fairness in enforcement, equitable treatment, and consistency in applying safety rules reinforce trust and ensure that personnel believe reporting behaviors are valued and protected. Psychological safety the belief that one can speak up, report concerns, and suggest improvements without personal or professional risk is fundamental for enabling prevention-oriented learning. In environments where psychological safety is established, workers and supervisors are more likely to identify weak signals, report near misses, and participate in continuous improvement initiatives, contributing to the overall resilience of the safety system. Behavioral governance mechanisms that promote trust, fairness, and psychological safety create the social and cognitive conditions necessary for proactive hazard management, complementing formal structures and monitoring systems (Michael and Ogunsola, 2023; Uduokhai *et al.*, 2023).

The integration of behavioral and relational governance mechanisms with structural and contractual controls enhances overall safety performance. While contracts, audits, and hierarchical oversight define formal responsibilities and accountability, relational mechanisms influence how actors interpret, implement, and internalize safety expectations. Leadership commitment reinforces the prioritization of safety values; communication and coordination ensure alignment and situational awareness across interfaces; and trust, fairness, and psychological safety enable engagement in learning behaviors and proactive hazard reporting. Collectively, these mechanisms create a governance ecosystem in which safety is actively managed through both formal control and relational influence, increasing the likelihood of preventing incidents and improving organizational learning across multi-contractor projects.

Behavioral and relational governance mechanisms are essential components of subcontractor safety performance management. Visible leadership and aligned safety values guide behavior and signal organizational priorities. Effective communication and coordinated planning facilitate information sharing and operational alignment across contractor interfaces. Trust, fairness, and psychological safety enable hazard reporting, learning, and proactive risk management while maintaining accountability. By integrating these relational mechanisms with formal governance structures, organizations can create a comprehensive approach to managing subcontractor safety, enhancing resilience, and promoting continuous improvement in complex, high-risk industrial and construction operations (Oguntegebe *et al.*, 2019; Osuji *et al.*, 2021). The combination of behavioral influence and relational engagement ensures that governance is not merely procedural but embedded in the culture, interactions, and daily practices of all project actors.

2.5 Multi-Level Governance Dynamics

Effective safety management in complex, high-risk projects depends on robust governance structures that operate across multiple levels: individual, project, and organizational/network. Multi-level governance dynamics

provide a framework to understand how rules, procedures, and safety norms interact across these layers, influencing worker behavior, project outcomes, and organizational learning. By examining governance at each level, organizations can design interventions that are not only technically robust but also behaviorally effective, fostering resilient safety cultures and reducing the likelihood of accidents and unsafe practices (Oguntegebe *et al.*, 2019; Sanni *et al.*, 2020).

At the foundation of multi-level governance is the individual worker, whose competence, adherence to procedures, and ability to exercise judgment directly influence project safety outcomes. Individual-level governance encompasses mechanisms such as skill development, supervision, compliance monitoring, and empowerment to act against unsafe conditions. Competence is critical, as workers who understand hazards and control measures are more likely to make decisions aligned with safety protocols. Training programs that emphasize hazard recognition, procedural compliance, and decision-making under uncertainty are essential to equip workers with the cognitive tools required for safe operations.

Supervision serves as a complementary mechanism, providing real-time feedback, guidance, and reinforcement of expected behaviors. Well-structured supervisory systems can identify deviations from safe practices, correct errors before they propagate, and reinforce positive behaviors. Crucially, individual-level governance is enhanced when workers are empowered to intervene or halt unsafe activities, creating a culture in which safety overrides production pressures (Omolayo *et al.*, 2022; Oyeboade and Olagoke-Komolafe, 2022). This empowerment reduces the likelihood of errors being ignored and ensures that safety protocols are actively enforced on the ground rather than passively assumed. Research indicates that empowerment, combined with competence and supervision, significantly reduces risk exposure and contributes to a proactive safety culture.

Moving beyond individual actors, project-level governance focuses on the integration and coordination of multiple actors and subcontractors within a single project environment. Modern construction and industrial projects often involve complex networks of interdependent tasks and specialized subcontractors. Governance at this level includes formal systems for integrating subcontractors into project safety protocols, ensuring that all participants adhere to consistent standards and reporting mechanisms. Failure to align subcontractors' practices with project safety systems can create gaps in oversight, increasing the probability of accidents.

Another critical component is interface management, which addresses the coordination of interdependent tasks across teams. Projects involve multiple overlapping workflows where the actions of one team directly affect the safety of others. Effective governance mechanisms—such as structured communication protocols, centralized task tracking, and cross-team coordination meetings—mitigate the risk of hazards arising from misaligned operations. By maintaining visibility over interdependencies and enforcing standardized procedures, project-level governance enhances both operational efficiency and safety reliability.

At the highest tier, organizational and network-level governance involves establishing structures, policies, and learning mechanisms that extend across projects and

subcontracting chains. Large organizations often operate multiple concurrent projects, and lessons from one project can inform practices across others. Governance at this level includes cross-project learning and standardization, where best practices, incident reports, and risk mitigation strategies are systematically shared and institutionalized (Sanni *et al.*, 2020; Oguntegebe *et al.*, 2020). Standardization reduces variability in safety performance and ensures that proven safety interventions are applied consistently across diverse projects.

Furthermore, modern projects frequently rely on multi-tier subcontracting chains, requiring governance mechanisms that extend beyond the immediate organizational boundary. Oversight of these chains involves formal contracts, compliance audits, and collaborative risk management initiatives. Organizations must establish clear expectations, monitoring systems, and accountability structures that propagate through all tiers, ensuring that subcontractors not only comply with safety standards but also adopt a proactive approach to risk management. Effective network-level governance thus bridges the gap between organizational policy and field-level execution, creating an environment in which safety practices are coherent, aligned, and enforced across the entire supply chain.

The dynamics across individual, project, and organizational levels are interdependent. Weak governance at any level can compromise the effectiveness of the others. For instance, empowered workers may still fail to prevent accidents if subcontractors are poorly integrated or if organizational policies do not support cross-project learning. Conversely, strong multi-level governance creates reinforcing loops where individual compliance, project coordination, and organizational standardization collectively enhance safety resilience (Okuh *et al.*, 2023; Anichukwueze *et al.*, 2023).

From a research perspective, multi-level governance frameworks provide a structured lens to examine safety outcomes in complex projects. They facilitate empirical studies on how interventions at one level influence behavior and performance at other levels, enabling evidence-based design of safety systems. Practically, these insights inform policy, guiding the development of regulatory standards, industry best practices, and organizational safety cultures that recognize the interconnected nature of high-risk project environments.

Multi-level governance dynamics highlight the necessity of coordinated interventions across the individual, project, and organizational/network levels. By fostering competence, supervision, empowerment, subcontractor integration, interface control, and cross-project standardization, organizations can systematically reduce risk, enhance learning, and sustain safety culture in complex, high-hazard settings. These dynamics underscore that governance is not merely a top-down exercise but a multi-layered, interactive system essential for operational resilience and long-term organizational success.

2.6 Moderating and Contextual Factors

Effective management of subcontractor safety performance in high-risk industrial and construction projects is not solely a function of governance mechanisms or procedural controls. The success of governance systems is influenced by a range of moderating and contextual factors that shape how responsibilities, accountability, and learning processes are operationalized (Mayo *et al.*, 2023; Ogbole *et al.*, 2023).

Understanding these factors is essential for designing governance frameworks that are adaptable, context-sensitive, and capable of promoting safety performance under varying project conditions.

Project complexity and contractual fragmentation are among the most significant moderating factors influencing subcontractor safety outcomes. Large-scale industrial and construction projects often involve multiple overlapping activities, high-density operational areas, and simultaneous construction and commissioning operations. Complexity in work sequencing, spatial arrangements, and interdependent tasks increases the likelihood of hazard interactions and makes monitoring and coordination more challenging. Contractual fragmentation where multiple layers of subcontractors, suppliers, and lower-tier contractors are engaged under distinct contracts—further complicates governance. Fragmented contracts can result in ambiguous responsibilities, misaligned incentives, and reduced visibility of safety performance at lower tiers. Governance mechanisms that function effectively in simple projects may be insufficient in such fragmented environments unless complemented by enhanced coordination, communication, and monitoring systems that account for interdependencies and overlapping scopes of work (Uduokhai *et al.*, 2023).

Subcontractor characteristics, including size, capability, and resource constraints, also moderate the effectiveness of safety governance. Small or resource-limited subcontractors may lack the organizational capacity, technical expertise, or financial means to implement robust safety programs independently. Limited human resources, inadequate training, and insufficient safety infrastructure can reduce compliance with contractual requirements and hinder proactive hazard identification. Conversely, larger, more capable subcontractors are better positioned to align with governance expectations and participate in integrated safety systems. Governance frameworks must therefore be tailored to subcontractor profiles, providing support, oversight, and capacity-building initiatives where needed while ensuring that larger firms maintain performance standards. This tailoring may include targeted training, shared safety tools, and collaborative planning to address capability gaps without compromising project schedules or quality.

Safety culture alignment across organizations is another critical contextual factor. Safety culture refers to the shared values, attitudes, and norms regarding safety within an organization, influencing behavior, decision-making, and risk perception. In multi-contractor projects, discrepancies in safety culture between clients, main contractors, and subcontractors can undermine governance mechanisms. For instance, a subcontractor with a low-risk perception or weak safety culture may underreport hazards, bypass procedures, or deprioritize proactive risk mitigation, limiting the effectiveness of formal oversight. Conversely, alignment of safety culture across firms enhances adherence to procedures, fosters collaborative hazard identification, and promotes shared responsibility for safety outcomes. Leadership engagement, joint training programs, and integration of safety values into contractual and relational governance mechanisms are essential for achieving such alignment (Alegbeleye *et al.*, 2023; Tafirenyika *et al.*, 2023). When organizational cultures converge around shared safety principles, governance systems operate more effectively, reducing the likelihood of incidents and enhancing the impact of learning-oriented interventions.

The regulatory environment and enforcement strength represent broader institutional and contextual factors that influence subcontractor safety performance. Regulatory frameworks define minimum safety standards, reporting obligations, and enforcement mechanisms, shaping the external accountability environment for all project actors. Strong enforcement, including inspections, penalties for non-compliance, and oversight of contractor networks, reinforces governance mechanisms by compelling adherence to safety expectations. Weak or inconsistent regulatory oversight, by contrast, may allow non-compliance, underreporting, and procedural shortcuts, reducing the effectiveness of governance structures. In addition, regulatory requirements interact with project-level governance, shaping both the design of safety procedures and the monitoring systems used to evaluate subcontractor performance. Organizations operating under robust regulatory regimes may be more motivated to implement comprehensive safety governance, whereas in contexts with lax enforcement, internal governance mechanisms must compensate to maintain safety performance.

The interaction of these moderating and contextual factors demonstrates that governance effectiveness is contingent rather than uniform across projects. High project complexity, contractual fragmentation, limited subcontractor capacity, misaligned safety cultures, and weak regulatory environments amplify the challenges of managing safety performance, requiring governance mechanisms that are adaptable, relationally robust, and responsive to contextual pressures. Conversely, alignment of culture, capable subcontractors, simplified contractual arrangements, and strong regulatory oversight enhance the efficacy of governance systems, enabling more effective monitoring, learning, and proactive risk management. By explicitly considering these factors in the design of governance frameworks, organizations can tailor oversight mechanisms, allocate resources strategically, and implement targeted interventions that improve safety outcomes (Bukhari *et al.*, 2021; Minto *et al.*, 2022).

Moderating and contextual factors play a critical role in shaping subcontractor safety performance in complex industrial and construction projects. Project complexity, contractual fragmentation, subcontractor capacity, safety culture alignment, and regulatory environment collectively influence the effectiveness of governance mechanisms. Governance frameworks that account for these factors—through relational coordination, capacity building, culture alignment, and regulatory integration—are more likely to achieve sustained improvements in safety performance. Understanding and addressing these contextual dynamics ensures that governance is not applied uniformly but is responsive to the realities of multi-actor, high-risk operational environments, ultimately enhancing both compliance and proactive hazard mitigation.

2.7 Safety Performance Outcomes

Safety performance is a critical measure of how effectively organizations, projects, and individuals manage risk in high-hazard environments. Evaluating safety performance outcomes across multiple levels immediate, project, and organizational/industry provides insights into the effectiveness of safety interventions, governance structures, and organizational learning mechanisms (NDUKA, 2023; Tafirenyika, 2023). By analyzing these outcomes,

organizations can identify strengths, gaps, and opportunities for continuous improvement in safety management.

Immediate safety outcomes reflect the direct effects of safety interventions at the operational level, typically observed through reductions in unsafe acts, hazardous conditions, and near-misses. Unsafe acts include behaviors that deviate from established safety procedures, while unsafe conditions refer to environmental or equipment-related hazards. Interventions such as hazard awareness training, behavior-based safety programs, and real-time monitoring are designed to target these issues. Empirical evidence suggests that structured safety programs, particularly those emphasizing proactive reporting and worker empowerment, significantly reduce the frequency of unsafe behaviors and exposure to hazardous conditions (Ussher-Eke, 2023; Zara *et al.*, 2023).

Another critical immediate outcome is improved compliance with safety procedures. Compliance reflects the degree to which workers adhere to established protocols, including the proper use of personal protective equipment, following operational checklists, and maintaining safe distances from hazards. Enhanced compliance is often associated with robust supervision, clear communication, and worker engagement in safety decision-making. By fostering a culture in which rules are understood, respected, and consistently applied, organizations can mitigate risks before they escalate into incidents. These immediate outcomes serve as the foundation for broader project- and organizational-level safety improvements, demonstrating that the benefits of interventions are observable at the operational frontline.

Safety performance at the project level evaluates how immediate safety improvements translate into tangible operational benefits. Key project-level outcomes include reductions in incidents, delays, and operational disruptions. For example, fewer accidents and near-misses reduce unplanned work stoppages, equipment downtime, and emergency responses, enabling projects to maintain schedule and budget adherence. Projects with integrated safety systems and proactive hazard management tend to demonstrate higher operational reliability, as the likelihood of cascading failures from small errors is minimized.

Another important project-level outcome is improved coordination and operational reliability. High-risk projects often involve multiple teams, subcontractors, and interdependent tasks. Safety performance improvements at this level require effective interface management, standardized procedures, and real-time communication across teams. When coordination improves, task interdependencies are managed safely, resources are allocated effectively, and potential conflicts between concurrent operations are anticipated and mitigated (Babatope *et al.*, 2023; Ayanbode *et al.*, 2023). Consequently, project-level safety outcomes are not solely measured by the absence of accidents but also by the enhanced efficiency and predictability of project operations, reinforcing the link between safety and overall project performance.

2.8 Organizational and Industry Outcomes

At the organizational and industry level, safety performance outcomes extend beyond individual projects, reflecting systemic capabilities, governance maturity, and sector-wide

learning. One significant outcome is the development of sustainable subcontractor safety capability. Organizations that actively engage subcontractors in safety programs, provide training, and monitor compliance contribute to a subcontractor base that consistently applies safe practices across multiple projects. Over time, this capability strengthens supply chain resilience and reduces the risk of accidents originating from poorly managed subcontracting tiers.

Another critical outcome is the enhancement of governance maturity and safety resilience. Governance maturity refers to the degree to which safety policies, standards, and oversight mechanisms are embedded in organizational structures and processes. Organizations with high governance maturity integrate lessons learned from incidents, monitor compliance across projects, and systematically manage risk through proactive interventions. Safety resilience emerges when these practices are institutionalized, allowing organizations to anticipate, absorb, and recover from operational disruptions without compromising worker safety or project performance. At the industry level, sharing best practices, standardizing protocols, and promoting regulatory compliance contribute to sector-wide improvements, creating a culture in which safety is recognized as a core dimension of operational excellence rather than a reactive requirement (Ibrahim *et al.*, 2023; Olamide and Badmus, 2023).

The multi-level perspective on safety performance emphasizes that outcomes are interconnected. Immediate improvements in unsafe acts and compliance form the basis for project-level operational reliability, which in turn reinforces organizational learning and governance maturity. Neglecting any level can undermine overall safety performance; for instance, strong organizational policies are insufficient if frontline workers lack competence or motivation to comply with procedures. Conversely, integrated interventions across all levels create synergistic effects, where individual vigilance, project coordination, and organizational resilience collectively reduce risks and promote sustainable safety culture.

From a research standpoint, multi-level safety performance outcomes provide a framework for evaluating the effectiveness of interventions and governance structures. Empirical studies can quantify the relationships between immediate behavior changes, project efficiency, and long-term organizational resilience, enabling evidence-based strategies for safety improvement. Practically, these insights guide policy design, contractor engagement, and safety investment decisions, ensuring that resources are deployed in ways that maximize both operational and human outcomes.

Safety performance outcomes span immediate, project, and organizational levels, encompassing reductions in unsafe acts, improved compliance, operational reliability, subcontractor capability, and governance maturity. Recognizing and measuring these outcomes enables organizations to build resilient safety systems that safeguard workers, optimize project performance, and contribute to industry-wide improvement, reinforcing the strategic importance of proactive, multi-level safety governance (Gbabo *et al.*, 2022; Abdalla, 2023).

2.9 Implications of the Conceptual Governance Framework

The conceptual governance framework for subcontractor safety performance management provides a structured lens for understanding, designing, and implementing oversight mechanisms that integrate contractual, behavioral, and digital controls. Its implications span practical safety management, policy and regulatory development, and research agendas, offering a comprehensive basis for improving safety outcomes in complex industrial and construction environments. By translating governance theory into actionable strategies, the framework enables organizations to shift from reactive compliance approaches toward proactive, performance-driven safety management.

In safety management practice, the framework highlights the need to move beyond reactive enforcement toward proactive governance. Traditional approaches to subcontractor safety have largely relied on audits, inspections, and corrective actions following incidents. While necessary, these measures often fail to prevent hazards from emerging and do not leverage the potential of governance mechanisms to anticipate risk. The framework emphasizes integrating contractual obligations, behavioral engagement, and digital monitoring to create a multi-layered governance ecosystem. Contractual governance ensures that safety responsibilities, reporting requirements, and performance expectations are clearly defined and enforceable. Behavioral mechanisms, such as visible leadership commitment, trust-building, and safety culture alignment, influence the actions and attitudes of personnel, fostering hazard reporting and proactive compliance. Digital controls, including real-time monitoring, incident tracking, and performance dashboards, provide objective data to support decision-making and identify emerging risks. By aligning these governance components, organizations can move from reactive enforcement to anticipatory management, reducing incident likelihood, promoting continuous learning, and embedding safety performance into day-to-day operations (Anichukwueze *et al.*, 2022; Bayeroju *et al.*, 2022).

The framework also has significant implications for policy and regulation. By clarifying the roles and responsibilities of clients, main contractors, and subcontractors, it provides a foundation for strengthening accountability across project hierarchies. Regulatory authorities can leverage the framework to define clear expectations for governance practices, including requirements for oversight, coordination, and contractor engagement. This strengthens the role of client and principal contractors as central actors responsible for ensuring that subcontractors meet safety standards. Furthermore, the framework supports the integration of governance-based safety requirements into industry standards and regulatory guidance (Valluru *et al.*, 2022; Ndekugri *et al.*, 2023). For example, standards can specify the use of multi-tiered monitoring systems, formalized safety coordination forums, and reporting protocols that incorporate both behavioral and digital indicators. Such integration not only ensures compliance with statutory requirements but also reinforces proactive, systemic approaches to risk management. By embedding governance principles into formal policy, regulators can promote consistent safety performance across projects and provide measurable benchmarks for accountability.

From a research perspective, the framework offers a structured basis for empirically testing the relationships

between governance mechanisms and subcontractor safety performance. While the theoretical links between contractual, behavioral, and digital governance and safety outcomes are well-articulated, quantitative and qualitative studies are needed to validate these relationships in diverse industrial contexts. Longitudinal studies can examine how governance practices influence incident rates, near-miss reporting, hazard identification, and overall safety culture over time. Comparative studies across industries and governance regimes can identify best practices, contextual moderators, and scalability considerations, providing evidence for refining governance frameworks. Additionally, research can explore the interactions among governance mechanisms, such as how behavioral engagement moderates the effectiveness of contractual controls or how digital monitoring informs leadership decision-making. By generating empirical evidence, researchers can contribute to the optimization of governance models and provide actionable insights for both practitioners and policymakers.

The implications of the framework are particularly salient in multi-contractor, high-risk environments, where hazards arise from complex interactions between personnel, tasks, and organizational structures (Nnabueze *et al.*, 2021; NDUKA, 2022). By integrating governance mechanisms across levels, organizations can better manage distributed responsibilities, align safety objectives across actors, and anticipate emergent risks. This holistic approach also facilitates continuous learning, as data from digital monitoring, incident investigations, and behavioral observations feed back into organizational decision-making. The framework thus transforms subcontractor safety management from a compliance-driven exercise into a dynamic, adaptive system capable of preventing incidents, sustaining performance improvements, and embedding safety into organizational culture.

The conceptual governance framework offers a comprehensive approach to managing subcontractor safety performance, with clear implications for practice, policy, and research. For safety management practice, it supports a shift from reactive enforcement to proactive, multi-dimensional governance that aligns contractual, behavioral, and digital controls. For policy and regulation, it emphasizes the accountability of clients and principal contractors and facilitates the integration of governance-based requirements into standards and regulatory guidance. For research, it provides a foundation for empirical testing of governance–safety performance relationships, comparative analysis across industries, and evaluation of contextual moderating factors. Collectively, these implications highlight the value of governance as a systemic and strategic tool for enhancing safety performance, promoting organizational learning, and managing complex risks in industrial and construction environments. By operationalizing the principles embedded in this framework, organizations and regulators can create safer, more resilient, and more accountable operational systems, ultimately reducing the likelihood of incidents and sustaining high levels of performance across contractor networks (Dako *et al.*, 2021; Ekechi and Fasasi, 2022).

3. Conclusion

This study highlights the critical role of multi-level governance in shaping safety performance across high-risk projects. The governance framework examined integrates mechanisms at the individual, project, and

organizational/network levels, emphasizing competence, supervision, procedural compliance, and empowerment at the individual level; interface management, subcontractor integration, and operational coordination at the project level; and cross-project learning, standardization, and multi-tier subcontracting oversight at the organizational and network level. Together, these mechanisms form an interconnected system that reinforces safe behaviors, enhances operational reliability, and fosters resilience across complex project environments.

The strategic importance of governance in subcontractor safety performance is particularly notable. Subcontractors often operate under varying safety standards and practices, creating potential gaps in oversight and risk exposure. Governance mechanisms that integrate subcontractors into safety management systems, provide training, monitor compliance, and incentivize adherence not only reduce immediate safety risks but also build long-term capacity. By embedding safety accountability and performance expectations throughout the subcontracting chain, organizations enhance both project-level outcomes and organizational learning, ensuring that subcontractors contribute to a coherent and sustainable safety culture.

Future research on governance-driven safety should focus on empirically validating the relationships between governance interventions and safety outcomes across multiple levels. Longitudinal studies can examine how governance maturity affects subcontractor performance over time, while comparative analyses across industries and project types can identify best practices and contextual factors influencing effectiveness. Additionally, the integration of digital monitoring tools, real-time compliance analytics, and predictive governance frameworks presents promising avenues for optimizing safety interventions. Understanding these dynamics will provide both theoretical insights and practical guidance for organizations seeking to enhance resilience, operational efficiency, and workforce safety in increasingly complex project networks.

Multi-level governance is not merely a procedural requirement but a strategic enabler of sustainable safety performance. By linking individual behaviors, project coordination, and organizational oversight, governance mechanisms ensure that safety is systematically managed, subcontractor performance is optimized, and continuous learning and improvement are embedded within high-risk operational environments.

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