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Conceptual Model of Safety Leadership Influence in Large Temporary Project Organizations

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Abstract
Safety leadership is a critical determinant of safety performance in large temporary project organizations, such as construction megaprojects, oil and gas facilities, and process plant commissioning projects. These environments are characterized by high complexity, multi-tiered subcontracting, transient workforces, and dynamic operational conditions, which collectively increase the likelihood of safety incidents. This develops a conceptual model to elucidate the mechanisms through which safety leadership influences safety outcomes in such organizations. The model integrates leadership behaviors, organizational culture, relational governance, and operational control mechanisms to explain how leaders shape safety perceptions, motivate compliance, and foster proactive hazard management. Key components include visible leadership engagement, alignment of safety values across clients, contractors, and subcontractors, and the establishment of trust and psychological safety that encourages reporting and learning behaviors. The model also incorporates communication and coordination processes that link safety information across project interfaces, ensuring that hazard knowledge is disseminated effectively and translated into preventive action. Moderating and contextual factors, including project complexity, subcontractor capability, resource constraints, safety culture alignment, and regulatory enforcement strength, are included to account for variations in leadership effectiveness across different project environments. By conceptualizing safety leadership as both a behavioral and relational influence, the model highlights the interplay between individual leader actions, team dynamics, and organizational structures in shaping safety outcomes. This framework provides both theoretical and practical insights: it informs empirical research on leadership–safety performance relationships and offers guidance for clients, main contractors, and subcontractors in designing leadership strategies, governance arrangements, and training interventions to enhance safety performance. Overall, the conceptual model advances understanding of safety leadership in temporary project organizations, emphasizing the importance of proactive, visible, and relational leadership in high-risk, multi-actor contexts.

Keywords: Safety Leadership, Temporary Project Organizations, Construction Safety, Organizational Governance, Behavioral Influence, Multi-Contractor Coordination, High-Risk Projects, Proactive Hazard Management

1. Introduction

Large temporary project organizations (LTPOs) are characterized by high complexity, fluid structures, and transient workforces. They often involve multiple contractors and subcontractors operating under tight schedules, high-risk activities, and geographically dispersed sites (Yeboah and Ike, 2023; Babatope *et al*., 2023). These organizations are assembled to deliver specific projects and are disbanded upon completion, making them distinct from permanent organizations in terms of hierarchy, coordination, and resource allocation. The temporary nature of LTPOs, combined with overlapping work scopes, multiple interfaces, and dynamic operational conditions, introduces unique safety challenges (Uduokhai *et al*., 2023; Sanusi *et al*., 2023). The interplay of diverse actors, high task interdependence, and rapidly evolving hazards increases the likelihood of incidents, near misses, and operational disruptions.

In such complex, time-bound environments, leadership influence extends beyond formal authority. Leaders play a critical role in establishing safety norms, promoting proactive hazard identification, and shaping behaviors across contractor networks (Oziri *et al*., 2023; Oyeboade and Olagoke-Komolafe, 2023). Their ability to model safe behaviors, communicate expectations,

and cultivate trust and psychological safety directly affects compliance and learning behaviors among workers and subcontractors. Conventional leadership models, derived from static, permanent organizational settings, often fail to capture the dynamics of LTPOs (Essandoh *et al*., 2023; Wedraogo *et al*., 2023). These models typically emphasize hierarchical control, formal authority, and routine management processes, which are insufficient for managing transient, multi-actor projects where authority is distributed and operational contexts evolve continuously (Oparah *et al*., 2023; Odejobi *et al*., 2023).

Despite the recognized importance of leadership in safety performance, existing frameworks do not adequately address the project-specific contingencies, relational interactions, and multi-tiered governance structures of LTPOs (Uduokhai *et al*., 2023; Ofori *et al*., 2023). This highlights a research gap in conceptualizing leadership mechanisms that are effective in temporary, complex, and high-risk project environments.

The present aims to develop a conceptual model of safety leadership influence tailored to LTPOs. Its objectives are to identify the behavioral and relational mechanisms through which leaders shape safety outcomes, explore contextual and moderating factors that affect leadership effectiveness, and provide a framework for guiding leadership practices and governance strategies to improve safety performance in large, temporary project-based operations.

2. Methodology

The development of a conceptual model examining the influence of safety leadership in large temporary project organizations followed a systematic review process guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology. This approach ensured rigorous identification, screening, and synthesis of relevant literature to support the construction of an evidence-based conceptual framework. A comprehensive search strategy was employed across multiple electronic databases, including Scopus, Web of Science, PubMed, and Google Scholar, to capture peer-reviewed articles, conference proceedings, and relevant gray literature. Search terms were carefully defined to encompass key constructs, including "safety leadership," "temporary project organizations," "construction safety," "project governance," "safety performance," and "behavioral safety." Boolean operators, truncations, and proximity searches were applied to maximize the inclusivity of the search while maintaining relevance.

Eligibility criteria were established a priori to ensure the selection of studies directly pertinent to safety leadership in high-risk, temporary project contexts. Included studies addressed leadership behaviors, safety culture, governance mechanisms, and performance outcomes within project-based organizations, while studies focused on permanent organizational settings, unrelated industries, or generic leadership without safety context were excluded. The initial search yielded a large number of records, which were subsequently deduplicated. Titles and abstracts were screened to remove irrelevant studies, followed by full-text assessments against inclusion criteria. Reference lists of included studies were examined to identify additional sources, enhancing the comprehensiveness of the review.

Data extraction was performed using a structured template capturing study characteristics, leadership dimensions, safety outcomes, organizational context, and methodological quality indicators. Extracted data were analyzed to identify recurring themes, relationships, and gaps in the literature. The synthesis emphasized the interaction between leadership behaviors, project-specific governance structures, and temporary organizational dynamics. Risk of bias and methodological quality were evaluated using established assessment tools, enabling the prioritization of high-quality evidence in the model development. The iterative synthesis of these findings informed the conceptualization of leadership influence pathways, illustrating how transformational, transactional, and safety-specific leadership behaviors impact safety compliance, hazard reporting, and safety culture within large temporary project organizations. The PRISMA flow of identification, screening, and inclusion ensured transparency, replicability, and methodological rigor in developing a conceptual model grounded in robust empirical evidence.

2.1 Theoretical Foundations

The study of safety leadership in large temporary project organizations (LTPOs) draws upon multiple theoretical perspectives that collectively explain how leaders influence safety outcomes in complex, high-risk, and transient operational environments (Adesanya *et al*., 2020; Akinola *et al*., 2020). Integrating safety leadership theory, temporary organization and project theory, and sociotechnical systems perspectives provides a comprehensive basis for understanding the mechanisms through which leadership shapes behavior, decision-making, and risk management in multi-actor projects.

Safety leadership theory provides the foundational lens for analyzing leader behaviors and their impact on safety performance. Transactional safety leadership emphasizes formal authority, rule enforcement, and corrective interventions to ensure compliance with safety procedures. It focuses on structured oversight, monitoring, and the application of rewards or sanctions to achieve desired behaviors. While transactional approaches are important for maintaining baseline compliance, they may be insufficient in LTPOs, where dynamic hazards, distributed authority, and rapidly changing operational conditions require flexibility and anticipatory action (Sanusi *et al*., 2023; Oziri *et al*., 2023). Transformational safety leadership, by contrast, emphasizes vision, inspiration, and motivation, encouraging workers and subcontractors to internalize safety values, engage in proactive hazard identification, and participate in continuous learning. Transformational leaders foster commitment through role modeling, individualized consideration, and intellectual stimulation, enhancing situational awareness and collective responsibility. Ethical and authentic leadership perspectives complement these approaches, highlighting the importance of moral integrity, consistency, and transparency in decision-making. Leaders who demonstrate ethical commitment to safety cultivate trust, psychological safety, and legitimacy, enabling open communication, reporting of near misses, and collective problem-solving. Leadership is also conceptualized as sense-making under uncertainty, where leaders interpret ambiguous information, anticipate emergent hazards, and guide action in contexts characterized by complexity, temporariness, and operational pressure.

Temporary organization and project theory provides a framework for understanding the structural and contextual

constraints of LTPOs. Projects are inherently temporary, assembling teams and resources for defined objectives and disbanding upon completion. This temporariness introduces unique challenges, including fragmented structures, shifting power dynamics, and fluid accountability. Leadership in LTPOs is complicated by the presence of multiple contractors and subcontractors, each with distinct priorities, norms, and reporting structures. Role ambiguity and fluid team boundaries can undermine traditional command-and-control approaches, requiring leaders to exercise influence through relational, behavioral, and informational mechanisms rather than relying solely on hierarchical authority (Odejobi *et al*., 2023; Ofori *et al*., 2023). Project theory also emphasizes the significance of interfaces and interdependencies, highlighting that leaders must coordinate across organizational boundaries to manage overlapping tasks, shared resources, and evolving hazards effectively.

Sociotechnical and systems perspectives extend the theoretical foundation by situating safety leadership within the interaction of human, technical, and organizational subsystems. LTPOs are socio-technical systems where safety emerges not only from individual behaviors but from the coordination of tasks, technologies, communication flows, and organizational processes. Leadership acts as a system-level control mechanism, influencing both the human and organizational subsystems to ensure alignment with safety objectives. Leaders shape workflow design, establish feedback loops, and guide the use of technological tools, including real-time monitoring, digital reporting systems, and coordination platforms. They also influence organizational routines, communication practices, and safety culture, reinforcing desired behaviors across multi-actor networks. Sociotechnical theory underscores the importance of viewing leadership as distributed and emergent, with influence extending through formal and informal networks, cross-organizational relationships, and dynamic interactions between project participants and technological systems (Dako *et al*., 2019; Ajayi *et al*., 2023).

Integrating these theoretical perspectives provides a multidimensional understanding of safety leadership in LTPOs. Safety leadership theory elucidates the behaviors and motivational strategies that drive compliance, learning, and proactive risk management. Temporary organization and project theory contextualize leadership within the unique structural, temporal, and relational challenges of projects, highlighting the need for flexibility, coordination, and influence beyond formal authority. Sociotechnical and systems perspectives frame leadership as a mechanism that shapes interactions between human, technical, and organizational subsystems, ensuring that safety objectives are maintained across complex, interdependent networks. Collectively, these theories support the development of a conceptual model in which leadership influences safety outcomes through behavioral, relational, and system-level mechanisms, moderated by project complexity, subcontractor capacity, and regulatory environment (Ogbuefi *et al*., 2023; Dako *et al*., 2023).

The theoretical foundations of safety leadership in LTPOs combine insights from leadership, project, and systems theory to explain how leaders shape safety outcomes in complex, temporary, and high-risk environments. Transactional and transformational behaviors, ethical and authentic practices, and sense-making under uncertainty provide the behavioral and cognitive mechanisms of influence. Temporary organization theory explains the structural and relational constraints within projects, while sociotechnical perspectives situate leadership within dynamic interactions between humans, technology, and organizational processes (Aminu-Ibrahim *et al*., 2021; Ajayi *et al*., 2023). By integrating these frameworks, researchers and practitioners can better understand, design, and implement leadership strategies that enhance safety performance, foster proactive hazard management, and build resilience across multi-actor, high-risk project organizations.

2.2 Safety Context in Large Temporary Project Organizations

Large temporary project organizations (LTPOs) are unique operational environments, characterized by their transient nature, complex structures, and high-risk activities. Understanding the safety context in these organizations is critical for designing effective leadership, governance, and management strategies that enhance safety performance and minimize incidents. LTPOs operate under conditions that combine temporary team structures, multiple organizational actors, and dynamic operational pressures, creating a distinctive safety landscape that differs significantly from permanent organizations (Bayeroju *et al*., 2023; NDUKA, 2023).

The structural characteristics of LTPOs contribute directly to the complexity of managing safety. These projects often involve multiple contractors, subcontractors, and joint ventures working collaboratively to deliver defined project objectives. Each organization brings its own systems, procedures, and priorities, which can lead to variation in safety practices and risk perception. The presence of multiple actors requires coordination across organizational boundaries, emphasizing the need for effective communication, interface management, and shared safety standards. High workforce turnover is another defining feature of LTPOs. Workers are often assigned on a temporary basis, leading to limited familiarity with site-specific hazards, procedures, and equipment. Coupled with cultural diversity in global projects, differences in language, work practices, and safety attitudes can affect compliance, situational awareness, and hazard recognition. Distributed leadership across organizational levels further complicates safety management. Clients, main contractors, and subcontractors each exercise authority within their domains, creating overlapping or fragmented responsibility for safety. The absence of a single, permanent organizational hierarchy necessitates that leadership influence be relational, behavioral, and system-oriented, rather than solely hierarchical, to ensure consistent safety outcomes across diverse actors (Nwafor *et al*., 2020; Uduokhai *et al*., 2023).

The safety risk profile in LTPOs is shaped by operational pressures, interface complexity, and behavioral norms. Schedule pressure and production–safety trade-offs are pervasive, particularly during peak construction or commissioning phases. The imperative to meet tight deadlines can lead to prioritization of productivity over procedural compliance, increasing the likelihood of unsafe acts or shortcuts. Interface risks are heightened due to overlapping work packages, simultaneous operations, and interdependencies between contractors and subcontractors. Hazards can propagate across organizational boundaries if coordination is weak or if communication of risk information is delayed. Such risks are compounded in high-

density work zones, where multiple activities occur in proximity, requiring careful management of access, sequencing, and hazard control measures. Normalization of unsafe practices is another significant factor. In fast-paced project environments, behaviors that deviate from standard procedures may become tolerated or even expected during peak activity periods. Workers and supervisors may adopt informal workarounds to maintain progress, which can inadvertently institutionalize unsafe practices and increase exposure to hazards (Olagoke-Komolafe and Oyeboade, 2023; Ofoedu *et al*., 2023).

The interplay between structural characteristics and the safety risk profile highlights the need for leadership and governance approaches tailored to LTPO contexts. Safety management cannot rely solely on formal rules, audits, or hierarchical authority. Instead, it requires proactive mechanisms that integrate behavioral influence, relational coordination, and system-level monitoring. Leaders must establish a shared understanding of safety expectations, facilitate communication across interfaces, and encourage reporting and learning behaviors that counteract the pressures and shortcuts associated with temporary, high-density operations. Attention to workforce orientation, cultural integration, and role clarity is also critical, given the high turnover and diversity inherent in LTPOs. Governance and oversight systems must be adaptable, enabling real-time identification and mitigation of emergent hazards while maintaining consistency in safety standards across multiple contractors and work packages (Oguntegbe *et al*., 2019; Sanni *et al*., 2021).

The safety context in large temporary project organizations is defined by complex structural characteristics and a dynamic risk profile. Multiple contractors, high workforce turnover, cultural diversity, and distributed leadership create structural complexity that requires relational and behavioral approaches to safety management. Schedule pressures, interface risks, and the normalization of unsafe practices introduce operational hazards that are distinct from those encountered in permanent organizations. Understanding this context is essential for designing effective leadership interventions, governance structures, and safety systems capable of mitigating risks, fostering proactive behaviors, and promoting learning across temporary project networks. By recognizing the unique challenges and risk dynamics of LTPOs, practitioners and researchers can develop targeted strategies to enhance safety performance, improve hazard management, and reduce incidents in high-risk, multi-actor project environments.

2.3 Core Components of the Conceptual Model

Understanding safety leadership in large temporary project organizations requires a multi-faceted conceptual model that integrates leadership levels, attributes, and the roles of informal and distributed leadership. High-risk, project-based environments are characterized by temporary organizational structures, fluid teams, and complex interdependencies among actors. The effectiveness of safety leadership in these contexts depends not only on formal authority but also on the behaviors, visibility, and informal influence of leaders across multiple levels (Okuh *et al*., 2023; Anichukwueze *et al*., 2023). The conceptual model identifies three primary dimensions: leadership levels and roles, leadership attributes and behaviors, and informal or distributed leadership, each contributing uniquely to safety outcomes and organizational resilience.

Leadership levels and roles form the structural backbone of the model. At the **strategic level**, leaders such as clients, project directors, or corporate executives set the overarching vision and priorities for safety. Their responsibilities include establishing governance frameworks, defining safety expectations, and allocating resources to support safety initiatives. Strategic leadership establishes the cultural tone of the organization, signaling the importance of safety and reinforcing its integration into project objectives. At the **tactical level**, project managers and construction managers operationalize strategic directives. They translate organizational policies into project-specific procedures, manage coordination across teams, and monitor compliance with safety standards. Tactical leaders play a critical role in bridging organizational intent with day-to-day operations, ensuring that safety goals are actionable and aligned with project realities. At the **operational level**, supervisors, foremen, and team leads directly influence frontline behaviors. These leaders monitor work execution, provide real-time feedback, enforce procedural compliance, and intervene in unsafe practices. Operational leadership is particularly significant in temporary projects, where rapid team mobilization and high task variability demand constant oversight and adaptive decision-making to maintain safety (Sanni *et al*., 2020; Shodhshauryam, 2020).

Equally important are **leadership attributes and behaviors**, which define how leaders enact their roles and influence safety outcomes. The model emphasizes visible safety commitment as a core attribute, reflecting leaders' proactive engagement with safety activities, presence on site, and direct interaction with workers. Consistency between safety rhetoric and action is critical; leaders who verbally emphasize safety but fail to model safe behaviors undermine credibility and reduce compliance among team members. In addition, fairness, trust, and just culture behaviors enhance psychological safety, enabling workers to report hazards, share near-miss information, and participate in safety initiatives without fear of retribution. Leaders who embody these behaviors foster an environment in which safety is perceived as a shared value rather than a top-down obligation, strengthening engagement and adherence at all organizational levels.

The conceptual model also incorporates **informal and distributed leadership**, recognizing that safety influence extends beyond formal hierarchical structures. Safety champions, peer leaders, and respected team members often emerge as key conduits for safety influence within temporary teams. These individuals reinforce formal directives, model safe behaviors, and motivate peers through credibility and personal example. Emergent leadership in temporary teams is particularly salient in high-turnover or project-specific task groups, where formal leaders may have limited interaction with all workers (Mayo *et al*., 2023; Ogbole *et al*., 2023). Distributed leadership enables collective responsibility for safety, where influence is exercised horizontally and vertically across the team, complementing formal governance structures. The interplay between formal authority and informal influence ensures that safety messages and behaviors are internalized, reinforced, and adapted to dynamic project conditions.

Collectively, these core components illustrate a **multi-dimensional conceptual model** in which leadership is both hierarchical and networked, formal and informal, behavioral

and structural. Strategic, tactical, and operational leadership levels provide the formal scaffolding for safety governance, while leadership attributes and behaviors ensure that authority translates into effective influence. Informal and distributed leadership expands the reach of safety influence, addressing the challenges of temporary project teams and dynamic work environments. The model emphasizes the synergistic interaction among levels, attributes, and emergent leadership, highlighting that effective safety leadership is not confined to positional authority but is realized through consistent behaviors, trust-building, and the mobilization of social influence throughout the project ecosystem.

The model offers practical and research implications. For practitioners, it provides a framework to design leadership development programs, allocate supervisory resources, and implement recognition systems for safety champions. For researchers, it establishes a basis for empirical studies exploring the relative contributions of leadership levels, behaviors, and informal networks to safety outcomes, enabling hypothesis testing across projects, industries, and cultural contexts (Alegbeleye *et al*., 2023; Tafirenyika *et al*., 2023). By integrating hierarchical, behavioral, and emergent dimensions, the conceptual model advances understanding of how leadership shapes safety culture, compliance, and performance in complex temporary project organizations, offering a roadmap for improving safety resilience and organizational learning.

2.4 Mechanisms of Leadership Influence

Leadership plays a central role in shaping safety performance in large temporary project organizations (LTPOs), where complex, high-risk operations, multiple contractors, and transient workforces create a dynamic and challenging environment. Effective safety leadership extends beyond formal authority, influencing individual, team, and organizational behavior through cognitive, social, and structural mechanisms. Understanding these mechanisms is critical for designing interventions, governance structures, and leadership strategies that enhance safety outcomes in temporary, multi-actor project environments.

Cognitive and psychological pathways represent one of the primary mechanisms through which leaders influence safety outcomes. Leaders shape risk perception by prioritizing safety over competing objectives, framing hazards as critical to operational success, and reinforcing the importance of compliance with safety procedures. By actively communicating the consequences of unsafe practices and highlighting potential hazards, leaders influence how workers and supervisors interpret risks and make decisions under uncertainty. Beyond risk perception, leadership fosters motivation and empowerment, encouraging personnel to take ownership of safety responsibilities and engage in proactive hazard management. Psychological safety, defined as the perception that one can speak up, report hazards, or question unsafe practices without fear of reprisal, is a critical aspect of this pathway. Leaders who model transparency, ethical decision-making, and fairness create an environment where workers feel empowered to act, report near misses, and participate in continuous improvement initiatives. In LTPOs, where workers are often unfamiliar with site-specific hazards or operate in culturally diverse teams, these cognitive and psychological influences are essential for aligning behavior with safety expectations and sustaining vigilance (NDUKA, 2023; Tafirenyika, 2023).

Social and cultural pathways constitute another key mechanism of leadership influence. Leaders establish safety norms and shape organizational culture by modeling desired behaviors, setting expectations, and reinforcing positive practices. Behavioral modeling occurs when leaders demonstrate adherence to safety procedures, participate in site inspections, and visibly engage with frontline personnel, signaling the importance of safety in everyday operations. Reinforcement through feedback and recognition further consolidates these norms. Positive reinforcement, such as acknowledgment of safe work practices, commendation for hazard reporting, or inclusion in decision-making processes, motivates continued compliance and engagement. Conversely, corrective feedback for unsafe behaviors communicates accountability while maintaining fairness. In LTPOs, where temporary teams may have limited pre-existing cohesion, social and cultural mechanisms are critical for establishing shared values and consistent safety behavior across contractors, subcontractors, and diverse workforces. Leadership influence through norm-setting and reinforcement helps to embed safety as a collective priority rather than an individual responsibility.

Structural and procedural pathways represent the third mechanism through which leaders shape safety performance. Leaders allocate resources, including personnel, equipment, training, and technological tools, to ensure that safety is operationalized effectively. Resource allocation signals organizational priorities and enables the practical implementation of safety procedures. Enforcement of rules and consequence management, including audits, inspections, and application of sanctions for non-compliance, ensures accountability and deters unsafe behaviors. Importantly, leadership integrates safety into planning and decision-making processes at both strategic and operational levels. For example, leaders may include safety assessments in project scheduling, design review, and coordination meetings, ensuring that risk mitigation is embedded in workflow decisions rather than treated as an afterthought. Procedural influence also involves establishing formal communication channels, reporting mechanisms, and coordination forums to manage hazards across multiple contractors and work packages. In LTPOs, where distributed leadership and temporary hierarchies create potential gaps in oversight, structural and procedural mechanisms provide the scaffolding that enables consistent, reliable, and enforceable safety practices (Sanni *et al*., 2020; Oguntegbe *et al*., 2023).

The interplay between cognitive, social, and structural mechanisms underscores the multidimensional nature of leadership influence in LTPOs. Cognitive and psychological pathways shape individual perceptions, motivation, and engagement; social and cultural pathways foster collective norms, trust, and behavioral consistency; and structural and procedural pathways ensure that safety objectives are embedded into operational processes, resources, and accountability systems. Effective safety leadership leverages all three mechanisms concurrently, aligning individual behavior, team dynamics, and organizational structures toward proactive hazard management. Leaders must tailor their influence strategies to the context-specific challenges of LTPOs, including high workforce turnover, fragmented contracts, cultural diversity, and schedule pressures, to

sustain safety performance throughout the project lifecycle (Babatope *et al*., 2023; Ayanbode *et al*., 2023).

Leadership influences safety in LTPOs through a combination of cognitive and psychological, social and cultural, and structural and procedural pathways. By shaping risk perception, motivation, and psychological safety, leaders guide individual decision-making. Through norm-setting, modeling, and reinforcement, they cultivate a culture of proactive safety behaviors. Through allocation of resources, enforcement of rules, and integration of safety into planning, leaders ensure organizational alignment and procedural consistency. Understanding these mechanisms provides both theoretical and practical insight into how leadership can enhance safety performance in complex, high-risk, and temporary project environments, offering a foundation for governance, training, and intervention strategies that improve outcomes across multi-contractor operations.

2.5 Moderating and Mediating Factors

The effectiveness of safety leadership in large temporary project organizations is not uniform; it is influenced by a set of moderating and mediating factors that shape how leadership behaviors translate into safety outcomes. These factors operate at multiple levels, affecting the relationship between leadership interventions and observed safety performance, and can either amplify or attenuate the impact of leadership on compliance, hazard reporting, and incident prevention. Understanding these factors is critical for both researchers and practitioners aiming to optimize safety strategies in complex, high-risk project environments.

Project complexity and phase serve as critical moderators of safety leadership effectiveness. Large temporary projects often involve overlapping work streams, interdependent tasks, and dynamic schedules. During early works, such as site preparation and foundation activities, hazards may be less visible but the groundwork for safety culture and procedural compliance is established. Safety leadership at this stage focuses on planning, hazard identification, and setting behavioral expectations. During peak construction, complexity intensifies, with multiple subcontractors, concurrent operations, and heightened risk exposure. Leadership influence may be challenged by operational pressures, requiring increased visibility, proactive coordination, and real-time decision-making. During close-out phases, hazards may shift toward finishing works, demobilization, and handover processes, demanding leadership attention to procedural compliance and safety continuity (Ibrahim *et al*., 2023; Olamide and Badmus, 2023). The project phase thus moderates how leadership behaviors affect safety outcomes, with varying levels of influence across the project lifecycle.

Workforce competence, experience, and fatigue represent another set of moderating factors. Workers with high skill levels and prior project experience are better equipped to interpret safety instructions, anticipate risks, and adopt safe behaviors. Conversely, inexperienced or fatigued workers are more prone to errors, reducing the immediate effectiveness of leadership interventions. Fatigue, stress, and physical strain can also mediate the relationship between leadership visibility and compliance, as workers under cognitive or physical strain may struggle to internalize guidance despite leadership presence. Targeted training, shift management, and workload planning can therefore enhance the mediating effect of workforce competence on safety outcomes.

Organizational safety culture and climate function as both moderating and mediating factors, shaping how leadership messages are received and enacted. In organizations with a strong safety culture, leadership behaviors such as visible commitment, fair enforcement, and just culture practices are reinforced by collective norms, resulting in higher compliance, reporting, and proactive hazard management. In contrast, in organizations with weak or inconsistent safety climates, leadership interventions may be undermined by entrenched practices, skepticism, or production pressures. Safety culture thus mediates the translation of leadership behaviors into observable safety outcomes, while also moderating the degree of influence leadership can exert across different teams and projects.

Communication quality across contractor interfaces is a critical mediator, particularly in temporary project environments involving multiple subcontractors and functional teams. Effective communication channels, clear reporting lines, and structured handovers ensure that safety expectations, procedures, and incident information are accurately conveyed. Poor communication can distort safety messages, delay corrective actions, and reduce the impact of leadership interventions (Olagoke-Komolafe and Oyeboade, 2022; Omolayo *et al*., 2022). Conversely, high-quality communication fosters shared understanding, reinforces safety norms, and facilitates timely responses to hazards, thereby mediating the relationship between leadership behaviors and safety compliance.

Finally, **regulatory pressure and client safety expectations** act as external moderators of leadership influence. Projects operating under stringent regulatory oversight or with clients emphasizing zero-tolerance safety policies may compel leaders to prioritize compliance, invest in training, and enforce procedural adherence more rigorously. These external pressures can amplify the effectiveness of safety leadership, ensuring that organizational policies are aligned with legal and contractual requirements. In contrast, low regulatory scrutiny or ambiguous client expectations may attenuate leadership influence, as compliance may be deprioritized in favor of production efficiency.

The interplay among these moderating and mediating factors highlights the **complex, contingent nature of safety leadership effectiveness**. Leadership behaviors alone are insufficient to guarantee positive safety outcomes; their impact is contingent upon workforce characteristics, project dynamics, organizational culture, communication practices, and external pressures. Conceptualizing these factors within a multi-level framework allows for a nuanced understanding of how safety interventions propagate across individual, project, and organizational contexts (Anichukwueze *et al*., 2022; Bayeroju *et al*., 2022). It also underscores the importance of adaptive leadership that accounts for the temporal, structural, and contextual variability inherent in large temporary projects.

From a research perspective, examining these factors provides opportunities for empirical testing of moderating and mediating relationships, enabling quantification of how project phase, workforce competence, culture, communication, and regulatory context influence safety outcomes. Practically, these insights inform targeted interventions, such as phase-specific safety programs,

fatigue management, culture-strengthening initiatives, and cross-contractor communication protocols, enhancing the likelihood of sustained safety performance. By integrating these factors, organizations can design more resilient, context-aware leadership strategies that maximize both compliance and proactive hazard management, contributing to safer, more reliable project delivery in high-risk, temporary organizational settings (Oparah *et al*., 2023; Olatunji *et al*., 2023).

2.6 Safety Outcomes and Performance Impacts

Safety leadership and governance mechanisms in large temporary project organizations (LTPOs) exert measurable influence on outcomes across multiple organizational levels. These outcomes extend from individual behavior to team performance and ultimately shape organizational learning and resilience. Understanding the linkages between leadership influence, governance structures, and safety outcomes provides insight into how proactive management strategies can mitigate risk, enhance compliance, and institutionalize safe practices across complex, multi-actor projects.

At the individual level, safety outcomes are primarily reflected in compliance with procedures and active participation in safety programs. Compliance involves adherence to established work instructions, use of personal protective equipment, and observance of hazard control measures. Safety participation extends beyond mere compliance to encompass voluntary behaviors, such as engaging in safety briefings, contributing to risk assessments, and proactively identifying potential hazards. Leaders who model safe behaviors, provide clear expectations, and foster psychological safety significantly increase the likelihood of these behaviors. Psychological safety, in particular, encourages individuals to report hazards, near misses, and unsafe practices without fear of reprisal. The reporting of near misses serves a dual function: it reduces the likelihood of future incidents and generates valuable data for organizational learning. Individuals who perceive that their observations are valued and acted upon are more likely to remain engaged and motivated to maintain high safety standards (Dako *et al*., 2021; Ekechi and Fasasi, 2022). Collectively, individual-level outcomes form the foundation for team- and organizational-level performance improvements.

Team and project-level outcomes emerge from the aggregation of individual behaviors and the effectiveness of relational and structural governance mechanisms. Effective safety leadership facilitates improved coordination across contractors, subcontractors, and multidisciplinary teams, ensuring that hazard information is shared promptly and operational decisions account for risk interactions. One tangible outcome is the reduction in accidents, injuries, and high-potential incidents, particularly during complex phases such as overlapping construction and commissioning operations (Ofoedu *et al*., 2022; Okeke *et al*., 2023). Coordinated leadership efforts, including joint safety planning and interface management, improve work reliability and minimize disruptions caused by unsafe practices or misaligned workflows. Teams that are aligned in their safety priorities exhibit enhanced communication, mutual support, and proactive intervention, mitigating risks associated with task interdependencies and shared resources. These project-level outcomes demonstrate that leadership influence extends beyond individual compliance to shape collective behavior and operational resilience.

Organizational learning outcomes reflect the long-term impact of safety leadership on institutional capacity and project continuity. Knowledge generated through incident reporting, near-miss analysis, and proactive hazard identification can be captured and transferred across project phases, supporting continuous improvement and reducing recurrence of similar risks. Institutionalization of effective safety leadership practices such as integrating safety into planning, enforcing consistent rules, and maintaining visible leadership engagement ensures that lessons learned are embedded in organizational routines, policies, and governance structures. In LTPOs, where temporary teams disband upon project completion, formalized mechanisms for knowledge transfer, such as handover protocols, documentation systems, and digital safety dashboards, are crucial for preserving safety intelligence. Institutional learning also supports the development of a shared safety culture across clients, main contractors, and subcontractors, reinforcing norms that prioritize proactive risk management and collaborative problem-solving (Sanni *et al*., 2020; Ezeh *et al*., 2023).

The interplay between individual, team, and organizational outcomes highlights the multi-level nature of safety performance impacts. Individual compliance and reporting behaviors provide the raw inputs for team coordination and risk mitigation. Effective team functioning reduces incidents and enhances operational reliability, while the capture and dissemination of lessons learned promote organizational learning and resilience across project lifecycles. Leadership mechanisms—cognitive, social, and structural—serve as the conduits for these effects, shaping perceptions, norms, and procedures that drive performance. By systematically linking leadership and governance interventions to outcomes at multiple levels, LTPOs can design integrated strategies that both prevent incidents and sustain high standards of safety performance (Nnabueze *et al*., 2021; NDUKA, 2022).

Safety outcomes and performance impacts in LTPOs manifest across individual, team, and organizational levels. At the individual level, leaders influence compliance, participation, and hazard reporting behaviors. At the team and project level, effective coordination, interface management, and relational mechanisms reduce accidents, injuries, and operational disruptions. At the organizational level, knowledge transfer and institutionalization of effective safety leadership practices enhance learning, resilience, and cultural alignment (Michael and Ogunsola, 2022; NDUKA, 2022). Recognizing and leveraging these interconnected outcomes allows organizations to develop targeted governance, leadership, and intervention strategies, ultimately improving safety performance, operational reliability, and long-term organizational capability in complex, high-risk, temporary project environments.

2.7 Model Dynamics and Feedback Loops

Understanding safety leadership in large temporary project organizations requires not only identifying the core components of leadership but also examining the **dynamics and feedback mechanisms** that govern how leadership behaviors influence safety outcomes over time. Leadership does not operate in a static environment; rather, it interacts with organizational culture, workforce behavior, and project conditions in dynamic ways. Feedback loops and temporal

effects play a critical role in shaping safety performance, influencing both the persistence and attenuation of safety interventions.

A central feature of these dynamics is the **reinforcing loop between leadership behavior and safety climate**. Visible and consistent safety leadership fosters a culture of compliance, hazard reporting, and proactive risk management. As workers observe leaders modeling safe behaviors and prioritizing safety in decision-making, trust in leadership credibility increases, encouraging adherence to safety procedures (Ike *et al*., 2021; Imediegwu and Elebe, 2021). Positive worker responses, such as increased reporting of near-misses and engagement in safety initiatives, further reinforce the leader's influence, creating a self-perpetuating cycle of safety improvement. Over time, this reinforcing loop strengthens both formal safety systems and informal behavioral norms, embedding safety as a shared organizational value rather than a set of rules imposed from above. Empirical studies in construction and industrial projects have demonstrated that reinforcing loops of this nature contribute to sustained reductions in unsafe acts and higher overall safety performance.

However, the **effects of leadership interventions are subject to temporal lag**, reflecting the complex nature of organizational learning and behavioral change. Implementing new safety policies, training programs, or leadership visibility initiatives does not instantly translate into improved safety outcomes. Workers require time to internalize behavioral expectations, observe consistent leadership modeling, and adjust routines accordingly. Lag effects may also arise at the project or organizational level, as improvements in operational coordination, communication, and culture accrue gradually (Omolayo *et al*., 2022; Oyeboade and Olagoke-Komolafe, 2022). Recognizing these temporal dynamics is essential for both practitioners and researchers; short-term evaluations may underestimate the impact of leadership interventions, while delayed effects highlight the importance of persistent, consistent leadership over the project lifecycle. Monitoring and feedback systems are therefore necessary to track progress, reinforce desired behaviors, and adjust interventions in response to observed performance trends.

Despite the potential for positive feedback, there is a **risk of leadership fragmentation and message inconsistency** that can undermine the reinforcing loops. Large temporary projects typically involve multiple leadership levels strategic, tactical, and operational with varying priorities, communication styles, and engagement levels. When leaders provide inconsistent messages, fail to model expected behaviors, or contradict each other's directives, workers may experience confusion, reduced trust, and selective adherence to safety procedures. Fragmented leadership can disrupt previously established reinforcing loops, weaken safety climate, and increase vulnerability to unsafe behaviors. Temporary teams, high subcontractor turnover, and project complexity exacerbate this risk, as frontline workers are exposed to multiple, sometimes conflicting, sources of authority. Mitigating leadership fragmentation requires deliberate alignment across hierarchical levels, structured communication protocols, and mechanisms for cross-level coordination, ensuring that safety expectations are consistently conveyed and reinforced throughout the project (Ogunsola and Michael, 2023; Uduokhai *et al*., 2023).

The interaction of these dynamics highlights the **nonlinear and contingent nature of safety leadership**. Reinforcing loops, lag effects, and fragmentation interact in ways that can amplify or diminish the impact of leadership on safety performance. For instance, a consistent and visible leadership presence can generate rapid reinforcement in small teams but may take longer to influence safety culture at the organizational level. Conversely, inconsistencies in leadership behavior during critical phases of a project can temporarily reverse gains, highlighting the sensitivity of safety systems to leadership alignment and behavioral integrity. Conceptualizing safety leadership as a dynamic system, rather than a static intervention, allows for a more realistic understanding of how behaviors propagate, feedback effects accumulate, and organizational learning occurs (Wu *et al*., 2021; Ni *et al*., 2022).

From a practical perspective, understanding model dynamics and feedback loops informs the design of interventions that are both **sustained and adaptive**. Leaders should anticipate lag effects by maintaining visibility, reinforcement, and engagement over time, while actively monitoring behavioral responses to adjust strategies. Cross-level alignment mechanisms, such as coordinated leadership meetings, safety briefings, and shared performance dashboards, reduce the risk of fragmentation and ensure that safety messages are coherent and consistent (Farounbi *et al*., 2018; Gado *et al*., 2020). For researchers, modeling these dynamics using systems thinking, simulation, or longitudinal studies enables the quantification of feedback effects, identification of tipping points, and evaluation of the persistence of leadership influence under varying conditions.

The dynamics of safety leadership in large temporary project organizations are governed by reinforcing loops, lag effects, and the potential for fragmentation. Positive feedback loops between leadership behavior and safety climate strengthen compliance and cultural embedding of safety values, while lag effects necessitate sustained and patient leadership intervention (Ugwu-Oju *et al*., 2022). Conversely, fragmentation and inconsistent messaging can disrupt these loops and compromise performance. Understanding and managing these dynamics are critical for designing effective, resilient safety leadership strategies that ensure long-term safety performance, organizational learning, and workforce engagement in complex, high-risk project environments.

2.8 Practical Implications

The conceptual understanding of safety leadership in large temporary project organizations (LTPOs) has significant practical implications for safety management practice, policy development, and governance. LTPOs are characterized by complexity, transient workforces, multi-tiered contractor networks, and high-risk operational environments, which together necessitate tailored leadership approaches (Taiwo *et al*., 2021; Uduokhai *et al*., 2021). Translating theoretical insights into actionable strategies is critical for improving safety performance, reducing incidents, and sustaining organizational learning across temporary projects.

In safety management practice, one key implication is the need to design leadership roles specifically for temporary project contexts. Unlike permanent organizations, LTPOs operate under fluid hierarchies, distributed authority, and transient teams. Traditional leadership positions may lack

the flexibility and relational reach required to influence safety behaviors across diverse contractor networks. Designing leadership roles for temporary contexts involves defining responsibilities that go beyond formal authority, emphasizing relational influence, proactive hazard management, and coordination across organizational boundaries. Leaders must be capable of modeling safe behavior, setting norms, and facilitating communication among multiple contractors and subcontractors. Role clarity is also critical to ensure that leaders understand the scope of their influence, including interfaces with other teams, reporting structures, and accountability mechanisms (Nwafor *et al*., 2019; Uduokhai *et al*., 2023). Temporary-specific leadership roles can therefore provide continuity, oversight, and relational coherence in environments where teams frequently disband and reassemble.

Leadership development and onboarding constitute a second practical consideration for LTPOs. High workforce turnover, cultural diversity, and transient project teams mean that safety leadership competencies must be developed rapidly and systematically. Structured onboarding programs, including site-specific hazard awareness, interface management training, and coaching on relational leadership strategies, can equip leaders to navigate complex, multi-actor project environments effectively. Ongoing development, through mentoring, scenario-based exercises, and performance feedback, reinforces leadership behaviors that promote safety compliance, participation, and proactive hazard reporting (Chine *et al*., 2022; Davies *et al*., 2023). Developing leaders who can integrate cognitive, social, and structural mechanisms of influence ensures that safety performance is maintained even in high-pressure, temporary work environments.

From a policy and governance perspective, practical implications center on client-led safety leadership requirements. Clients and principal contractors hold strategic influence over project execution and have the authority to define safety expectations across all tiers of contractors. By embedding leadership requirements into project contracts, clients can formalize responsibilities, accountability measures, and performance criteria for safety leadership roles (Enow *et al*., 2022; Ike *et al*., 2022). These requirements ensure that leaders at all levels prioritize safety, align behaviors across organizational boundaries, and actively facilitate proactive hazard management. Incorporating client-led leadership criteria into governance frameworks signals the organizational importance of safety and reinforces consistent expectations across temporary project networks.

Standardization of leadership accountability across contractors represents another governance-focused implication. In multi-contractor environments, inconsistent approaches to safety leadership can create gaps in oversight, reduce hazard visibility, and weaken compliance. Standardized frameworks establish consistent roles, responsibilities, reporting lines, and performance evaluation criteria for safety leaders, regardless of the organization they represent. Standardization also enables more effective monitoring of leadership effectiveness, facilitates knowledge transfer, and promotes shared safety culture across contractor networks (Yeboah and Nnabueze, 2021; Ugwu-Oju *et al*., 2022). By providing clear and consistent leadership expectations, LTPOs can reduce ambiguity, enhance coordination, and ensure that all project actors contribute to hazard prevention and proactive risk management.

The integration of these practical strategies supports a proactive, system-level approach to safety in LTPOs. Leadership roles designed for temporary contexts, supported by structured development and onboarding, ensure that leaders can exercise relational, cognitive, and procedural influence effectively. Client-led requirements and standardized accountability frameworks embed leadership within governance structures, reinforcing consistent safety expectations and reducing variability in performance across contractors. Together, these measures enhance operational reliability, reduce the likelihood of accidents and near misses, and promote the institutionalization of safety practices and learning mechanisms across project phases (Michael and Ogunsola, 2019; Ogbete *et al*., 2020).

The practical implications of safety leadership in LTPOs encompass both management and governance dimensions. For safety management practice, designing leadership roles tailored to temporary project conditions and implementing structured development programs ensure that leaders can influence behavior and foster proactive hazard management. For policy and governance, client-led requirements and standardized leadership accountability across contractors establish clear expectations, promote alignment, and reinforce a consistent safety culture. By operationalizing these strategies, organizations can bridge the gap between theoretical insights and actionable practices, enhancing safety outcomes, supporting learning, and sustaining performance across complex, high-risk, and temporary project environments (Li *et al*., 2021; Basiru *et al*., 2023).

2.9 Research Implications and Future Directions

The conceptual model of safety leadership in large temporary project organizations provides a structured framework for understanding how leadership behaviors influence safety outcomes across multiple levels. However, translating this framework into actionable insights and robust empirical evidence requires targeted research that examines the causal pathways, temporal dynamics, and contextual factors shaping leadership effectiveness (Uduokhai *et al*., 2023). This discusses the research implications of the model and outlines directions for future inquiry, emphasizing methodological rigor, multi-level analysis, and cross-contextual comparability.

A primary research implication is the need for **empirical testing of leadership influence pathways**. The conceptual model identifies multiple mechanisms through which leadership behaviors—such as visible commitment, procedural enforcement, and empowerment—affect individual compliance, team coordination, and organizational safety culture. Empirical studies should examine these pathways, quantifying the strength and direction of relationships between leadership actions and safety outcomes. Mixed-method approaches, combining observational data, surveys, and incident reporting records, can provide nuanced evidence of both behavioral and operational impacts (Ofoedu *et al*., 2022; Okafor *et al*., 2022). Experimental or quasi-experimental designs in controlled project settings can further isolate the effects of specific leadership behaviors, enabling researchers to distinguish between direct, mediated, and moderated influences.

Closely related is the importance of **longitudinal studies across project lifecycles**. Temporary project organizations operate under dynamic conditions, with hazards, team composition, and operational priorities changing throughout the lifecycle from early works to peak construction and close-out phases. Longitudinal research enables tracking of leadership influence over time, capturing lag effects, reinforcement loops, and potential decay in behavioral compliance. By examining the evolution of safety outcomes across multiple project phases, researchers can identify critical intervention points, evaluate the persistence of leadership impact, and understand how organizational learning and culture develop in response to sustained leadership behaviors (Michael and Ogunsola, 2023; Uduokhai *et al*., 2023). Such studies also facilitate the assessment of cumulative effects, providing insight into whether early-stage leadership interventions have lasting implications for overall project safety.

Another critical avenue is **multi-level modeling of leadership effects**. Leadership influence operates across hierarchical levels strategic, tactical, and operational and interacts with individual, team, and organizational factors. Multi-level statistical models, such as hierarchical linear modeling or structural equation modeling, can quantify cross-level relationships and partition variance in safety outcomes attributable to each leadership layer. This approach allows researchers to examine how strategic directives interact with frontline supervision, peer influence, and distributed leadership to shape compliance, reporting, and hazard mitigation behaviors. Multi-level modeling also facilitates the identification of moderating factors, such as workforce competence, project complexity, and organizational safety climate, providing a comprehensive understanding of the contingencies that enhance or attenuate leadership effectiveness (Ekechi, 2022; Elebe *et al*., 2022).

Comparative research across industries and cultures represents an additional imperative. Large temporary projects occur in diverse sectors, including construction, oil and gas, infrastructure, and industrial manufacturing, each with distinct risk profiles, governance structures, and workforce characteristics. Similarly, cultural norms influence leadership perception, authority acceptance, and safety engagement. Comparative studies enable identification of generalizable principles of effective safety leadership while highlighting contextual differences that require tailored interventions. Cross-cultural analyses also inform the adaptation of leadership development programs, communication strategies, and governance frameworks to align with local norms and expectations, thereby improving the transferability and applicability of safety leadership models (Sanni *et al*., 2020; Oguntegbe *et al*., 2020).

Collectively, these research directions emphasize **methodological rigor, contextual sensitivity, and temporal awareness**. They highlight the need to move beyond descriptive studies of leadership practices toward evidence-based evaluation of causal mechanisms and dynamic interactions. By integrating longitudinal, multi-level, and comparative approaches, future research can provide actionable insights for both theory development and practical safety management (Oguntegbe *et al*., 2019; Sanni *et al*., 2020). Findings from such studies will inform the design of leadership training programs, governance policies, and behavioral interventions that are empirically validated and responsive to project-specific and cultural contingencies.

Additionally, the integration of emerging digital tools and real-time monitoring systems presents a promising frontier for research. Technologies such as wearable sensors, digital reporting platforms, and predictive analytics can capture behavioral and environmental data in real time, enabling high-resolution tracking of leadership influence on safety compliance and incident occurrence. Combining these data-driven approaches with conceptual modeling offers opportunities to simulate feedback loops, anticipate hazards, and test the resilience of leadership interventions under different scenarios (Nwankwo *et al*., 2022; Ofoedu *et al*., 2022).

The conceptual model provides a roadmap for systematically investigating the dynamics of safety leadership in temporary project organizations. Empirical testing of influence pathways, longitudinal analyses across project lifecycles, multi-level modeling, and comparative studies across industries and cultures are essential to validate and refine the model (Oguntegbe *et al*., 2019; Osuji *et al*., 2021). These research endeavors will not only advance theoretical understanding of leadership in high-risk, temporary organizations but also generate evidence-based strategies to enhance safety performance, operational resilience, and organizational learning. The pursuit of these directions positions safety leadership research to deliver tangible benefits for both practitioners and the wider field of project safety management.

3. Conclusion

This study presents a conceptual model of safety leadership influence in large temporary project organizations (LTPOs), integrating cognitive, social, and structural mechanisms to explain how leaders shape safety outcomes across individual, team, and organizational levels. The model emphasizes that leadership in LTPOs extends beyond formal authority, leveraging relational influence, behavioral modeling, and system-level control to foster compliance, proactive hazard identification, and continuous learning. Cognitive and psychological pathways highlight the role of risk perception, motivation, and psychological safety in guiding individual behaviors. Social and cultural pathways demonstrate how leaders establish safety norms, model expected behaviors, and reinforce positive practices through feedback and recognition. Structural and procedural pathways illustrate how resource allocation, enforcement, and integration of safety into planning ensure consistent operational alignment and accountability across multi-actor networks.

The conceptual model contributes to the literature on safety leadership and project organization by contextualizing leadership influence within temporary, high-risk project settings. Unlike traditional leadership frameworks developed for permanent organizations, this model accounts for the unique structural characteristics of LTPOs, including distributed authority, high workforce turnover, cultural diversity, and fragmented contractor networks. It also incorporates insights from systems and sociotechnical theory, highlighting the interdependencies between human behavior, organizational processes, and technical systems in shaping safety outcomes. By situating leadership as both a behavioral and relational mechanism that interacts with governance and operational structures, the model provides a comprehensive framework for understanding how leadership

drives proactive safety performance in temporary project contexts.

Strategically, the model underscores the value of safety leadership as a critical lever for managing risk in high-pressure, time-bound, and complex projects. Leaders who can influence perception, behavior, and organizational processes effectively enhance compliance, reduce incidents, and support knowledge transfer across project phases. By operationalizing this understanding, clients, contractors, and project managers can design leadership roles, development programs, and governance mechanisms that embed safety into temporary project organizations, creating resilient systems capable of sustaining high safety performance despite the inherent challenges of transient, multi-actor, and high-risk environments.

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