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Organizational Learning-Based Conceptual Maturity Model for Continuous Safety Performance Improvement

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Abstract
Continuous improvement of safety performance in high-risk, project-based organizations requires more than ad hoc interventions; it necessitates the systematic integration of organizational learning into safety management. This study proposes an organizational learning-based conceptual maturity model for continuous safety performance improvement, designed to guide project-based organizations in advancing from reactive, isolated safety practices toward proactive, sustainable safety cultures. The model integrates the principles of organizational learning, behavioral safety, and project governance, providing a staged pathway for achieving progressively higher levels of safety maturity. It identifies five maturity levels initial, managed, defined, quantitatively managed, and optimizing each reflecting the extent to which learning mechanisms, leadership engagement, safety culture, and technological tools are embedded into organizational processes. Core dimensions of the model include knowledge capture, dissemination, and application; leadership and governance; culture and climate; competency and training systems; and digital monitoring and feedback tools. Moderating and mediating variables, such as team collaboration, cross-project knowledge sharing, and real-time analytics, influence the effectiveness of learning and improvement at each stage. The framework emphasizes the codification of lessons learned into organizational standards, the integration of safety into project lifecycle processes, and continuous improvement loops to ensure that insights gained from incidents, near-misses, and operational experience are systematically applied. By linking organizational learning to measurable safety outcomes, the model offers both a theoretical and practical framework for enhancing safety performance, reducing incident recurrence, and fostering resilience in complex project environments. Future research can empirically validate the model across industries and explore longitudinal impacts on safety culture, risk reduction, and project performance. The proposed framework provides actionable guidance for managers, safety professionals, and policymakers seeking to institutionalize continuous safety improvement and embed life-preserving practices as a core organizational capability.

Keywords: Organizational Learning, Safety Performance, Maturity Model, Continuous Improvement, Project-Based Organizations, High-Risk Operations, Safety Culture, Risk Management

1. Introduction
Safety performance is a critical determinant of operational success in high-risk and project-based organizations (PBOs), where the complexity of tasks, temporary organizational structures, and dynamic work environments significantly increase exposure to hazards (Erigha *et al*., 2019; Anichukwueze *et al*., 2019). Industries such as construction, oil and gas, chemical processing, and heavy industrial manufacturing routinely face high-risk operations, where lapses in safety can result in severe injuries, fatalities, financial losses, and reputational damage (Ugwu-Oju *et al*., 2018; Ekechi, 2019; Ayanbode *et al*., 2019). Despite widespread adoption of safety management programs, many organizations continue to experience incidents and near-misses, suggesting that conventional safety interventions, often implemented on an ad hoc or one-off basis, are insufficient for ensuring sustained safety improvement (Badmus and Olamide, 2018; Okeke *et al*., 2019). These episodic approaches typically address immediate hazards or respond to specific incidents but fail to embed learning mechanisms that reinforce long-term, life-preserving behaviors across individuals, teams, and projects. Consequently, there is a growing recognition of the need for systematic, learning-based approaches that enable organizations to institutionalize safety practices, adapt to evolving risks, and

cultivate a proactive culture of continuous improvement (Seyi-Lande *et al*., 2018; Badmus and Olamide, 2019). Organizational learning offers a theoretical and practical foundation for addressing these challenges. By capturing, disseminating, and applying knowledge gained from past experiences, near-misses, and operational observations, organizations can enhance decision-making, reduce the recurrence of unsafe behaviors, and foster adaptive capabilities (Odejobi and Ahmed, 2018; Ugwu-Oju *et al*., 2018). Single-loop learning allows organizations to correct immediate deviations, while double-loop learning encourages reflection on underlying processes, assumptions, and norms, driving systemic improvements. Integrating organizational learning into safety management provides a mechanism for codifying lessons learned, aligning safety practices with strategic objectives, and promoting the diffusion of knowledge across projects and teams (Ugwu-Oju *et al*., 2018; Seyi-Lande *et al*., 2019). Despite its recognized importance, organizational learning is rarely formalized in a manner that directly links to structured safety performance enhancement or maturity assessment.

In practice, safety interventions often remain reactive and episodic, implemented in response to incidents or regulatory pressures rather than as part of a continuous improvement strategy (NDUKA, 2020; Oshoba *et al*., 2020). Existing approaches frequently lack a clear framework for measuring progress, assessing maturity, or embedding learning into project and organizational processes. As a result, safety improvements are inconsistent, project-specific, and vulnerable to regression following personnel turnover, organizational changes, or project transitions. There is a critical need for a systematic, maturity-based approach that integrates organizational learning with safety performance, providing structured pathways for continuous improvement at the individual, team, and organizational levels (Aminu-Ibrahim *et al*., 2020; Nwankwo *et al*., 2020).

The primary objective of this, is to develop a conceptual maturity model that links organizational learning processes with safety performance outcomes. The model aims to identify mechanisms and stages that guide organizations from reactive, ad hoc practices toward proactive, optimized, and resilient safety systems. Specifically, it seeks to delineate pathways for continuous safety improvement by incorporating leadership engagement, training and competency development, knowledge management, communication and coordination, and feedback systems, thereby operationalizing learning principles within safety-critical project environments (Okeke *et al*., 2020; Dako *et al*., 2020).

The significance of the study is twofold. From a theoretical perspective, it enhances understanding of how organizational learning mechanisms can be systematically applied to improve safety performance in high-risk, project-based contexts. From a practical standpoint, the study provides an actionable framework for organizational leaders, project managers, and safety practitioners, enabling them to implement structured maturity pathways, institutionalize life-preserving behaviors, and foster a culture of continuous improvement (Kerzner, 2018; Coates and Martin, 2019). By integrating organizational learning with safety performance maturity, the study offers a robust foundation for reducing incidents, improving operational resilience, and promoting sustainable safety outcomes across diverse projects and organizational structures.

2. Literature Review

Organizational learning plays a pivotal role in enhancing safety performance within high-risk and project-based organizations (PBOs). The literature highlights that systematic learning mechanisms, knowledge retention, and knowledge transfer are essential for sustaining safety improvements and reducing the recurrence of unsafe behaviors (Ekechi and Fasasi, 2020; Omotayo *et al*., 2020). In this context, organizational learning theories provide foundational insights for understanding how safety knowledge can be captured, disseminated, and applied across projects and teams.

Organizational learning theories distinguish between single-loop and double-loop learning, both of which are critical for safety performance improvement. Single-loop learning involves the correction of errors to ensure compliance with existing procedures without questioning underlying assumptions or systemic practices. It is typically reactive, addressing immediate deviations and reinforcing procedural adherence (NWAFOR *et al*., 2018; Bayeroju *et al*., 2019). Double-loop learning, by contrast, challenges existing norms, policies, and assumptions, allowing organizations to re-evaluate the effectiveness of safety strategies and address root causes of incidents. Empirical studies indicate that double-loop learning is essential for fostering resilient safety cultures, particularly in environments characterized by complex, high-risk operations. Knowledge creation, retention, and transfer mechanisms, including documentation of near-misses, lessons learned repositories, and standardized procedures, facilitate organizational learning by ensuring that insights are applied across projects. Learning from near-misses, incidents, and best practices allows organizations to anticipate potential hazards and implement proactive measures, preventing recurrence and promoting continuous improvement (Frempong *et al*., 2020; Farounbi *et al*., 2020).

Safety performance management relies on systematic measurement and evaluation to monitor the effectiveness of interventions and guide improvement (Stolzer *et al*., 2018; Schleicher *et al*., 2019). Key indicators include incident rates, near-miss frequency, compliance metrics, and assessments of safety culture and climate. Monitoring these indicators provides both quantitative and qualitative evidence of safety performance, enabling organizations to identify trends, detect latent conditions, and prioritize corrective actions. Continuous improvement frameworks, such as Plan-Do-Check-Act (PDCA), Lean, and Six Sigma, have been increasingly applied to safety management. These frameworks provide structured methodologies for iterative improvement, emphasizing hazard identification, process standardization, root cause analysis, and performance evaluation. Integrating these approaches with organizational learning mechanisms allows organizations to systematically capture operational knowledge, assess the effectiveness of interventions, and iteratively refine safety practices (Yeboah and Ike, 2020; Onovo *et al*., 2020).

Maturity models offer structured approaches to assess and guide organizational development across multiple dimensions. Principles of maturity models involve staged progression, with organizations evolving from ad hoc

practices to optimized, evidence-based systems characterized by integration, standardization, and continuous improvement. Dimensions commonly assessed in maturity models include leadership, process standardization, competence, measurement and feedback, and organizational culture. Applications of maturity models in project management, quality management, and safety management demonstrate their utility in providing roadmaps for systematic improvement. In safety contexts, maturity models have been used to assess compliance, safety management system implementation, and organizational readiness. However, gaps remain in integrating organizational learning explicitly with safety maturity. Existing models often emphasize procedural compliance and technical controls while underrepresenting mechanisms for knowledge capture, cross-project learning, and adaptation based on feedback from incidents or near-misses. These limitations underscore the need for a conceptual maturity model that explicitly links organizational learning processes with progressive safety performance improvement (Ekechi and Fasasi, 2020; NDUKA, 2020).

The interplay of learning and safety culture is critical in translating organizational knowledge into sustained behavioral change. Leadership engagement, clear communication, and feedback loops are instrumental in reinforcing life-preserving behaviors and encouraging proactive hazard reporting. Studies indicate that visible leadership commitment to safety strengthens employee perception of priority, motivates adherence to procedures, and fosters accountability. Feedback loops, including incident reviews, lessons learned dissemination, and performance reporting, create continuous learning cycles that prevent recurrence of unsafe practices. Psychological safety, defined as the perception that employees can report hazards, voice concerns, and share insights without fear of reprisal, is a key enabler of knowledge sharing and learning. High levels of psychological safety encourage collaborative problem-solving and facilitate the diffusion of best practices across teams and projects. Moreover, organizations that successfully integrate learning mechanisms with a positive safety culture demonstrate enhanced resilience, adaptive capacity, and sustained improvements in safety outcomes (Dako *et al*., 2020; Bayeroju, 2020).

The literature establishes the critical role of organizational learning in enhancing safety performance within PBOs. Single-loop and double-loop learning provide complementary mechanisms for immediate correction and systemic improvement, while knowledge capture, retention, and transfer ensure lessons are applied across projects. Safety performance management frameworks, including PDCA, Lean, and Six Sigma, provide structured approaches for monitoring, evaluation, and iterative improvement (Sreedharan and Sunder, 2018; Nascimento *et al*., 2020). Maturity models offer staged pathways for systematic development but currently lack explicit integration with learning mechanisms, highlighting a gap for further research. The interplay between organizational learning and safety culture, mediated by leadership, communication, feedback, and psychological safety, underscores the importance of embedding learning into organizational routines to sustain life-preserving behaviors (NDUKA, 2020; Nwafor *et al*., 2020). These insights provide the theoretical and empirical foundation for developing a conceptual maturity model that links organizational learning with continuous safety performance improvement, guiding project-based organizations toward proactive, resilient, and systematically improved safety outcomes.

3. Methodology

This study employed a systematic literature review guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology to develop a conceptual maturity model for continuous safety performance improvement based on organizational learning. A comprehensive search was conducted across multiple electronic databases, including Scopus, Web of Science, PubMed, and Google Scholar. Keywords and Boolean operators were used to capture relevant studies, including "organizational learning," "safety performance," "maturity model," "continuous improvement," "project-based organizations," "high-risk operations," and "safety culture." Additional sources were identified through backward and forward reference tracking to ensure a comprehensive literature base.

The initial search identified 1,834 records, which were screened for duplicates, yielding 1,526 unique publications. Titles and abstracts were independently reviewed by two researchers to assess relevance, focusing on studies addressing the integration of organizational learning with safety performance, maturity frameworks, and continuous improvement processes in high-risk or project-based contexts. Studies that did not address organizational learning mechanisms, safety improvement, or maturity assessment were excluded. Full-text screening applied inclusion criteria such as peer-reviewed publications, conceptual frameworks, empirical studies, and case studies that explicitly discussed learning-based safety interventions and organizational maturity. Exclusion criteria included non-English publications, conference abstracts lacking sufficient methodological detail, and studies focused solely on technical or engineering safety interventions without organizational or learning components.

Following full-text evaluation, 128 studies were retained for data extraction. Key information captured included organizational learning processes, maturity assessment criteria, safety performance outcomes, leadership and governance mechanisms, training and competency systems, knowledge management practices, and digital monitoring or feedback tools. The extracted data were synthesized to identify recurring themes, critical dimensions, and staged processes of safety maturity, forming the basis of the proposed conceptual model. The PRISMA flow diagram was employed to document the identification, screening, eligibility, and inclusion stages, ensuring transparency, reproducibility, and methodological rigor. This structured approach enabled the development of a robust, evidence-informed maturity model that links organizational learning with continuous improvement of safety performance in project-based organizations.

3.1. Conceptual Framework

The proposed conceptual framework for an Organizational Learning-Based Conceptual Maturity Model integrates staged development, organizational learning processes, and measurable safety outcomes to provide a structured pathway for continuous improvement in high-risk, project-based organizations (PBOs) (Rahmah *et al*., 2018; Lau *et al*., 2019; Belinski *et al*., 2020). The framework conceptualizes safety

performance enhancement as a progressive journey through five maturity levels Initial, Managed, Defined, Quantitatively Managed, and Optimizing each reflecting the degree to which learning, leadership, culture, and technological systems are embedded in organizational safety practices. The framework emphasizes the interplay between knowledge capture, dissemination, and application, and the resultant improvement in safety performance, positioning learning as the primary driver for advancing through maturity stages.

The core model structure is characterized by staged maturity levels. At the Initial stage, organizations operate with ad hoc safety processes, minimal knowledge retention, and reactive learning limited to immediate corrective actions. Safety performance metrics are inconsistent, and interventions are largely event-driven. The Managed stage reflects the adoption of standardized procedures, formal documentation of lessons learned, and project-level learning initiatives. The Defined stage introduces structured organizational learning mechanisms, including cross-project knowledge sharing, systematic training programs, and integration of leadership oversight (Frempong *et al*., 2020; Aifuwa *et al*., 2020). At the Quantitatively Managed stage, safety performance is actively monitored using metrics and predictive analytics, enabling data-driven decisions and proactive interventions. Finally, the Optimizing stage represents a fully institutionalized learning-oriented safety culture, where continuous improvement, double-loop learning, and organizational resilience are fully embedded, resulting in sustained reduction of incidents and enhanced operational efficiency. Across all stages, safety performance outcomes such as reductions in incidents, near-misses, and procedural deviations serve as primary indicators for progression to higher maturity levels.

The framework comprises multiple dimensions that interact to support learning-based safety improvement. Learning processes encompass the systematic capture, dissemination, and application of knowledge derived from incidents, near-misses, operational experience, and best practices (Stemn *et al*., 2018; Griffey *et al*., 2019). Codified knowledge is integrated into standard operating procedures and shared across projects to prevent recurrence of unsafe behaviors. Leadership and governance provide the strategic direction and accountability mechanisms for safety, embedding learning into decision-making processes. Leaders set expectations, allocate resources, monitor safety performance, and reinforce life-preserving behaviors, ensuring that organizational learning is translated into practice. Culture and climate reflect safety-oriented norms, values, and attitudes, shaping employee perception and behavior. A strong safety culture encourages reporting of hazards, collaboration, and adherence to procedures, creating an environment conducive to learning. Systems and tools, including digital platforms, incident reporting systems, and real-time analytics, enable efficient knowledge management, facilitate monitoring, and provide actionable insights for proactive interventions (Oshoba *et al*., 2020; Olatunde-Thorpe *et al*., 2020). Together, these dimensions create an integrated ecosystem that operationalizes learning and supports continuous safety improvement.

The effectiveness of the framework is influenced by several moderating and mediating factors. Project complexity and resource availability can affect the organization's ability to implement learning processes and adhere to standardized procedures. Highly complex projects may require more advanced knowledge management systems, increased training, and enhanced coordination to maintain safety performance. Team collaboration and cross-functional knowledge sharing mediate the translation of learning into behavior; teams that effectively communicate lessons learned, share insights, and coordinate activities are more likely to adopt best practices and reduce safety incidents. Technological enablement, including dashboards, predictive analytics, and real-time monitoring systems, further mediates the impact of organizational learning by providing actionable intelligence and facilitating timely decision-making. Organizations that effectively leverage technology can detect latent risks, evaluate intervention effectiveness, and enhance situational awareness, thereby accelerating advancement through maturity stages (Day and Schoemaker, 2019; Oliver *et al*., 2020).

Integration of these dimensions and factors creates a dynamic framework that aligns organizational learning with measurable safety outcomes. Knowledge capture and dissemination mechanisms provide the content, leadership and governance provide strategic oversight, culture and climate shape behavioral adoption, and systems and tools operationalize monitoring and feedback. The staged maturity levels offer a roadmap for incremental development, enabling organizations to assess their current capabilities, identify gaps, and implement targeted interventions for continuous improvement. Moderating and mediating variables ensure that the model remains adaptable to project-specific conditions, workforce composition, and technological capabilities, promoting resilience and sustainability (Moss *et al*., 2019; Islam, 2020).

The conceptual framework presents a comprehensive approach to continuous safety performance improvement in PBOs, linking organizational learning processes with maturity levels and measurable outcomes. By integrating learning processes, leadership, culture, and technological systems, and by accounting for contextual and mediating factors, the model provides a structured pathway for organizations to progress from reactive, ad hoc practices to optimized, resilient safety systems (Anichukwueze *et al*., 2020; Pamela *et al*., 2020). This framework not only guides the institutionalization of life-preserving behaviors but also establishes a foundation for empirical validation, benchmarking, and strategic planning, offering both theoretical and practical contributions to safety management, organizational learning, and project governance in high-risk operational environments.

3.2. Mechanisms for Continuous Safety Performance Improvement

Effective mechanisms for continuous safety performance improvement in project-based organizations (PBOs) hinge on the systematic integration of organizational learning, leadership engagement, competency development, and technology. These mechanisms operationalize the conceptual maturity model, enabling organizations to translate knowledge into actionable safety practices, sustain life-preserving behaviors, and progressively advance through maturity stages. By embedding structured processes for learning, leadership, training, and digital enablement, organizations can achieve measurable improvements in safety outcomes while fostering resilience in high-risk operational environments.

Learning integration is the foundational mechanism for

continuous improvement. Feedback loops derived from incidents, near-misses, audits, and operational data provide critical information on organizational vulnerabilities and the effectiveness of existing safety interventions. By systematically analyzing this data, organizations can identify patterns, latent hazards, and systemic gaps that may otherwise go unnoticed. Codification of lessons learned into standard operating procedures (SOPs), training materials, and knowledge repositories ensures that insights are institutionalized and applied consistently across projects. This process enables organizations to move from reactive, event-driven safety responses toward proactive, anticipatory strategies. The integration of learning into daily operations also promotes double-loop learning, allowing organizations not only to correct immediate errors but also to reassess underlying assumptions, policies, and practices that influence safety performance (Onovo *et al*., 2020; Okonkwo *et al*., 2020).

Leadership plays a critical role in embedding organizational learning into safety practices. Project managers, safety officers, and executive leadership are responsible for promoting a culture of learning, accountability, and continuous improvement. Leaders provide strategic direction, set safety performance expectations, and model life-preserving behaviors, reinforcing the importance of proactive risk management. Resource allocation is a key component of leadership effectiveness, encompassing investments in training programs, technology, and process improvements that facilitate continuous learning. Leadership oversight ensures that safety initiatives are prioritized alongside operational objectives, and that learning mechanisms such as incident reviews and lessons learned sessions are actively integrated into governance and decision-making processes (Moffatt-Bruce *et al*., 2018; Auraaen *et al*., 2020). Studies indicate that visible, engaged leadership enhances employee perception of safety commitment, increases participation in knowledge-sharing activities, and strengthens adherence to standardized procedures.

Training and competency development form another essential mechanism for sustaining continuous safety improvement. Simulation-based and scenario-driven learning provides personnel with realistic exposure to potential hazards, enabling them to practice responses in a controlled environment. Reflective learning, including post-task debriefings and incident analysis exercises, reinforces understanding and encourages behavioral adaptation. Continuous assessment and skill reinforcement through certification, competency evaluations, and refresher programs ensure that personnel maintain the knowledge and skills necessary to perform tasks safely, particularly in dynamic and high-risk project environments (Sullivan *et al*., 2019; Srivastava *et al*., 2020). Integrating training with lessons learned and operational data ensures that learning is iterative and responsive, supporting the organization's progression through maturity stages from reactive to optimized safety performance.

Technology and digital enablers enhance the effectiveness of learning, leadership, and training mechanisms by providing real-time monitoring, predictive insights, and centralized knowledge management. Digital dashboards and safety analytics platforms allow project managers and executives to visualize key safety indicators, detect deviations, and implement timely corrective actions. Predictive safety analytics leverage historical incident data, near-misses, and operational metrics to forecast potential hazards, enabling proactive intervention before incidents occur. Knowledge management systems serve as repositories for lessons learned, SOPs, training materials, and project-specific safety insights, facilitating cross-project learning and dissemination of best practices (Chakkol *et al*., 2018; King *et al*., 2020). The integration of technology into organizational learning mechanisms ensures that knowledge is accessible, actionable, and systematically applied, enhancing consistency and reliability in safety performance.

The combined implementation of these mechanisms creates a dynamic system for continuous safety improvement. Feedback loops inform leadership decisions, training content, and procedural updates; leadership ensures accountability, resource support, and cultural reinforcement; training equips personnel with the skills and competencies to act on learning; and technology operationalizes monitoring, analytics, and knowledge transfer (Gado *et al*., 2020; Nwafor *et al*., 2020). These interdependent mechanisms enable project-based organizations to institutionalize life-preserving behaviors, reduce incident recurrence, and sustain continuous improvement across multiple projects and operational contexts.

Moreover, these mechanisms are adaptable to contextual factors such as project complexity, team composition, and resource availability. For instance, high-complexity projects may require more advanced simulation exercises, integrated dashboards for multi-site monitoring, and intensified leadership oversight. Cross-functional collaboration and knowledge sharing are reinforced through structured communication channels, ensuring that learning is not siloed within individual projects but disseminated organization-wide (Anderson, 2018; Saha and Kumar, 2020). This adaptability enhances the resilience and responsiveness of PBOs in dynamic and high-risk environments.

Mechanisms for continuous safety performance improvement operationalize the principles of the organizational learning-based maturity model by linking feedback, leadership, training, and technology into an integrated system. Learning integration ensures that knowledge from incidents, audits, and operational experience is codified and applied; leadership fosters accountability, culture, and resource support; training develops and reinforces competencies through realistic and reflective exercises; and technology provides real-time monitoring, predictive analytics, and knowledge management (Seyi-Lande *et al*., 2018; Odejobi *et al*., 2019). Collectively, these mechanisms enable organizations to progress through maturity stages, achieve measurable improvements in safety performance, and embed continuous, organization-wide learning that supports resilience, proactive risk management, and sustainable life-preserving practices across projects.

3.3. Maturity Levels and Indicators

The proposed organizational learning-based conceptual maturity model delineates a staged pathway for continuous safety performance improvement, providing a structured framework to assess and advance the capabilities of project-based organizations (PBOs) in high-risk environments. The model comprises five sequential maturity levels Initial, Managed, Defined, Quantitatively Managed, and Optimizing each characterized by specific mechanisms, learning processes, and performance indicators. Progression through these stages reflects increasing integration of organizational

learning, enhanced leadership oversight, robust training systems, and technological enablement, ultimately resulting in proactive, organization-wide safety practices and sustained improvement (Basten and Haamann, 2018; Lau *et al*., 2019).

The Initial Stage represents organizations with ad hoc and reactive safety practices. At this level, safety interventions are typically implemented in response to incidents, near-misses, or regulatory enforcement rather than through systematic planning. Learning mechanisms are limited, often confined to informal discussions among team members without formal codification or dissemination. Knowledge gained from incidents is rarely recorded or shared across projects, resulting in repeated errors and high vulnerability to safety lapses. Key indicators of the Initial Stage include high incident rates, inconsistent reporting of hazards, minimal use of standard operating procedures (SOPs), and a lack of structured feedback loops. Safety performance at this stage is largely reactive, and the organization relies heavily on individual initiative rather than integrated systems or leadership guidance (Sanusi *et al*., 2020; Farounbi *et al*., 2020).

The Managed Stage is characterized by the adoption of standardized safety procedures and basic incident tracking mechanisms. Organizations at this level implement formal documentation for tasks, establish routine reporting of near-misses and incidents, and introduce project-level safety reviews. Learning primarily occurs within individual project teams, with limited sharing of lessons learned across projects. Safety performance indicators include improved adherence to SOPs, reduced incident recurrence within teams, and the establishment of baseline reporting metrics. While safety management becomes more structured, organizational learning is still localized, and interventions are primarily corrective rather than predictive. Leadership involvement increases but remains focused on ensuring compliance rather than fostering a culture of continuous improvement (Morton *et al*., 2018; Khattak *et al*., 2020).

At the Defined Stage, organizations formalize organizational learning processes and integrate knowledge management into their policies and procedures. Lessons learned from incidents, audits, and operational experience are systematically codified into training programs, SOPs, and cross-project repositories. Knowledge sharing occurs across project teams, and safety practices are embedded within project lifecycle processes. Safety indicators at this stage include consistent reporting across projects, documented cross-project learning, formalized training completion, and visible application of lessons learned. Leadership emphasizes not only compliance but also proactive risk identification, and learning loops are used to anticipate hazards, reduce recurrence of unsafe behaviors, and inform strategic safety planning (Cowley, 2020; Ojuola, 2020). The Defined Stage represents a transition from project-centric learning to organizational-level knowledge integration.

The Quantitatively Managed Stage emphasizes metrics-driven safety performance and predictive interventions. Safety performance is monitored using quantitative indicators such as incident frequency, near-miss rates, compliance scores, and behavioral assessments. Predictive analytics are employed to forecast potential hazards based on historical data, enabling proactive interventions before incidents occur. Organizational learning is fully operationalized through data-driven feedback loops, supporting continuous improvement. Safety indicators include measurable reductions in incident rates, predictive risk assessments guiding operational decisions, and demonstrable improvements in compliance and procedural adherence (NDUKA, 2020; Farounbi *et al*., 2020). Leadership leverages these insights to allocate resources strategically, and teams are empowered to act on data-informed guidance. The Quantitatively Managed Stage represents an integration of advanced learning, measurement, and technology for systematic, proactive safety management.

At the Optimizing Stage, organizations achieve continuous, organization-wide learning and demonstrate a culture of innovation and resilience in safety practices. Lessons learned are not only codified and applied internally but also benchmarked against industry standards, enabling organizations to adopt best practices and achieve leading performance. Feedback loops are fully embedded, supporting real-time learning, adaptation to new risks, and dynamic improvements. Safety indicators at this level include sustained low incident rates, organization-wide adoption of best practices, proactive mitigation of emerging risks, and recognition as an industry leader in safety performance. Leadership fosters a culture that prioritizes life-preserving behaviors, encourages innovation, and ensures accountability at all levels. Employees actively participate in cross-project learning, knowledge sharing, and reflective practices, strengthening psychological safety and collaboration. The Optimizing Stage represents the highest level of maturity, where organizational learning, leadership, culture, and technology converge to sustain continuous improvement, resilience, and excellence in safety performance (Romero *et al*., 2019; Morah *et al*., 2020).

The progression through these maturity levels provides a roadmap for organizations seeking to enhance safety performance systematically. Each stage is associated with clearly defined indicators—ranging from incident rates and reporting consistency to predictive analytics utilization and benchmarking against industry standards—that allow organizations to assess their current capabilities, identify gaps, and implement targeted interventions. The model also reinforces the centrality of organizational learning, ensuring that lessons from both successes and failures inform continuous improvement. By linking learning processes, leadership engagement, cultural norms, and technological enablers to measurable safety outcomes, the maturity model provides actionable guidance for sustaining life-preserving practices across projects, teams, and organizational levels (Knode, 2020; Anichukwueze *et al*., 2020).

The five-stage maturity model offers a structured and evidence-informed pathway for continuous safety performance improvement in PBOs. From ad hoc and reactive practices in the Initial Stage to data-driven, organization-wide learning in the Optimizing Stage, each level delineates mechanisms, processes, and indicators for advancing safety maturity (Ekechi and Fasasi, 2020; Sanusi *et al*., 2020). By systematically embedding organizational learning, leadership oversight, and technological enablers into safety management, organizations can reduce incidents, enhance resilience, and achieve sustainable, industry-leading safety outcomes across complex and high-risk project environments.

3.4. Evaluation and Application

Evaluation and application are critical components of the organizational learning-based conceptual maturity model for

continuous safety performance improvement. Effective evaluation mechanisms allow project-based organizations (PBOs) to measure the impact of learning processes, leadership, training, and technological interventions on safety outcomes, identify gaps, and refine strategies to advance through maturity stages. By systematically assessing both the efficacy of learning mechanisms and resultant safety performance, organizations can ensure that continuous improvement is not only achieved but also sustained.

Assessment methods form the backbone of evaluation. Self-assessment tools enable organizations to reflect on their current capabilities relative to the defined maturity levels, examining leadership engagement, learning processes, safety culture, and technological infrastructure (Teichert, 2019; North *et al*., 2020). Audits, both internal and external, provide structured verification of safety processes, incident management, and adherence to standard operating procedures (SOPs). Performance dashboards integrate quantitative metrics and qualitative insights to offer real-time visualization of safety performance, highlighting areas of strength and potential improvement. Key performance indicators (KPIs) are essential for evaluating the effectiveness of learning mechanisms and safety outcomes, encompassing metrics such as incident and near-miss rates, compliance scores, training completion, behavioral adherence, and knowledge dissemination across projects. By combining self-assessment, audits, and KPI tracking, organizations obtain a comprehensive understanding of their maturity level, the functionality of learning processes, and the effectiveness of interventions in achieving measurable safety outcomes (Yeboah and Enow, 2018; Nwafor *et al*., 2019).

The model has significant implications for practice. It provides a clear roadmap for organizations to advance systematically through maturity stages, from ad hoc, reactive safety practices to fully optimized, organization-wide learning and resilience (Ahmed and Odejobi, 2018; Michael and Ogunsola, 2019). By delineating the mechanisms, processes, and indicators associated with each stage, the model guides managers and safety professionals in prioritizing interventions, allocating resources, and embedding life-preserving behaviors into daily operations. Alignment of learning mechanisms with organizational strategy and safety goals ensures that safety improvement initiatives are not isolated tasks but integral to broader operational objectives. For instance, incident feedback loops, codified lessons learned, and scenario-based training can be strategically integrated with project governance, risk management, and leadership oversight, creating a cohesive and proactive approach to safety performance. This alignment facilitates sustainable improvements, encourages employee engagement, and enhances organizational resilience in high-risk environments.

The conceptual model also carries important implications for policy and regulation. By providing standardized maturity levels and associated indicators, the model offers a benchmark for evaluating safety capabilities across industries. Regulatory bodies and industry associations can utilize the framework to develop compliance standards that incorporate learning-based safety metrics, emphasizing not only procedural adherence but also organizational capability for continuous improvement. Benchmarking safety maturity facilitates comparative evaluation, encourages the adoption of best practices, and incentivizes organizations to move toward higher maturity stages. Incorporating learning-focused criteria in compliance and certification standards ensures that organizations are assessed not only on reactive incident management but also on proactive learning, risk anticipation, and organizational resilience (Ugwu-Oju *et al*., 2018; Okeke *et al*., 2019). Such regulatory integration reinforces the strategic importance of institutionalized, learning-driven safety practices.

From a research perspective, the model provides a foundation for empirical validation and longitudinal study. Cross-sector empirical studies can examine the applicability and effectiveness of the maturity model in diverse high-risk, project-based contexts, including construction, oil and gas, manufacturing, and chemical processing industries. These studies can assess the relationship between learning mechanisms, maturity progression, and measurable safety outcomes, providing evidence to refine the model and identify best practices. Longitudinal research is particularly valuable for exploring the sustainability of safety performance improvements over time, evaluating how iterative learning processes, leadership engagement, and technological enablers contribute to persistent reductions in incidents, improved compliance, and enhanced organizational resilience (Phipps *et al*., 2018; Almost *et al*., 2019; Tortorella *et al*., 2020). Furthermore, research can investigate moderating and mediating factors, such as project complexity, team cohesion, and resource availability, to determine how contextual variables influence the effectiveness of the maturity model. Such insights support both theoretical advancement and practical application, ensuring that the model remains adaptive and relevant across varying organizational contexts.

In practical application, organizations can integrate evaluation and learning processes into daily operations to create a continuous improvement loop. For example, incident reports and near-miss data can feed into lessons learned repositories, which inform training programs, SOP updates, and leadership decision-making. Performance dashboards and predictive analytics allow managers to monitor progress toward maturity stage goals, assess the impact of interventions, and allocate resources effectively. Regular audits and self-assessment exercises provide ongoing validation of the organization's learning capabilities and safety performance, enabling early identification of gaps and timely corrective actions. This integrated approach ensures that the conceptual maturity model is operationalized, promoting consistent advancement through stages and embedding life-preserving behaviors across teams and projects (Zitron, 2018; Turcotte-Tremblay, 2020).

Evaluation and application are essential for translating the organizational learning-based conceptual maturity model into measurable improvements in safety performance. Assessment methods, including self-assessment tools, audits, dashboards, and KPIs, provide organizations with the data necessary to understand current capabilities and identify improvement opportunities (Oguntegbe *et al*., 2019; Dako *et al*., 2019). The model offers practical guidance for advancing through maturity stages, aligning learning mechanisms with organizational strategy, and institutionalizing safety practices. At the policy level, it supports benchmarking, regulatory integration, and the adoption of learning-based safety standards, promoting consistency and excellence across industries. Finally, the model establishes a foundation for empirical validation and longitudinal research, enabling systematic study of how organizational learning drives

continuous improvement, resilience, and life-preserving outcomes. By linking evaluation, practice, policy, and research, the model provides a comprehensive, actionable framework for sustaining safety performance in high-risk, project-based environments (Losos *et al*., 2019; Potts *et al*., 2020).

4. Conclusion

This study has presented a comprehensive conceptual maturity model designed to integrate organizational learning with safety performance in project-based organizations (PBOs). The model delineates five progressive maturity levels—Initial, Managed, Defined, Quantitatively Managed, and Optimizing providing a structured framework for guiding organizations from reactive, ad hoc safety practices toward fully institutionalized, organization-wide learning and resilience. Each stage incorporates mechanisms for knowledge capture, dissemination, and application, reinforced by leadership engagement, safety-oriented culture, and technological tools, ensuring that lessons learned from incidents, near-misses, and operational experience are systematically codified and applied. Progression through these maturity levels is measured using safety performance indicators such as incident rates, compliance metrics, behavioral adherence, and learning effectiveness, offering both qualitative and quantitative evidence of organizational improvement.

The strategic value of the model lies in its ability to operationalize organizational learning as a core driver of safety performance. By embedding feedback loops, cross-project knowledge sharing, reflective practices, and predictive analytics into daily operations, the model enables organizations to anticipate hazards, implement proactive interventions, and reduce the recurrence of unsafe behaviors. Leadership and governance mechanisms ensure accountability, resource allocation, and reinforcement of life-preserving behaviors, while training and competency programs equip personnel with the skills and understanding necessary to respond effectively to complex operational risks. Integration of digital platforms, real-time monitoring, and knowledge management systems further enhances the organization's capacity to learn, adapt, and respond dynamically to emerging threats. Collectively, these mechanisms transform safety from a reactive compliance obligation into a strategic organizational capability that drives performance, resilience, and sustainable improvement.

The model contributes significantly to continuous improvement, organizational resilience, and safety culture. By linking structured learning processes to measurable safety outcomes, it provides a roadmap for fostering a proactive, learning-oriented environment in which knowledge is systematically captured, disseminated, and applied. The framework encourages the institutionalization of life-preserving behaviors, reinforces psychological safety, and promotes cross-functional collaboration, thereby enhancing both team performance and organizational adaptability. Moreover, it establishes a foundation for empirical validation, benchmarking, and longitudinal research, providing evidence-informed guidance for managers, safety professionals, and policymakers seeking to strengthen safety culture, optimize operational practices, and achieve sustained improvements in high-risk project environments.

In conclusion, the organizational learning-based conceptual maturity model offers a robust, evidence-informed approach for integrating learning with safety performance, advancing continuous improvement, resilience, and safety culture within PBOs. Its structured, staged framework provides actionable guidance for organizations to systematically enhance safety outcomes, institutionalize knowledge, and cultivate resilient, life-preserving practices that persist across projects and operational contexts.

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