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BUILDING, DIAGNOSING AND SUSTAINING A POSITIVE SAFETY CULTURE THAT REDUCES INCIDENTS AND INTEGRATES WITH BUSINESS PERFORMANCE, USING ISO 45001, BRADLEY CURVE AND GHANAIAN INDUSTRY CASE STUDIES

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ABSTRACT

A positive safety culture is frequently treated as an occupational health and safety aspiration, yet its strategic value is realized only when culture is deliberately built, diagnosed, sustained and connected to the way the business is managed. This paper develops and tests an integrated model that combines ISO 45001 as the management-system architecture, the dss+ Bradley Curve as a cultural-maturity diagnostic, and business-performance integration as the mechanism for sustaining improvement. Following the structure of a mixed-methods safety-management study, the paper uses a transparent dataset representing 320 employees from 32 hypothetical Ghanaian organizations across mining, construction, oil and gas, and manufacturing, complemented by 24 interview excerpts and four composite Ghanaian industry case studies. Descriptive analysis showed relatively stronger ratings for leadership commitment (M = 3.44), proactive risk management (M = 3.45) and ISO 45001 integration (M = 3.36) than for business integration (M = 3.10) and documentation (M = 2.95). Multiple regression explained 68.7% of the variance in safety-culture maturity, with worker participation, risk management and visible leadership emerging as the strongest significant predictors, while documentation showed no significant direct cultural effect. At organization level, total recordable incident rates declined from 5.02 in Reactive cultures to 0.73 in Interdependent cultures, while the business-performance index increased from 61.3 to 85.1. The four composite Ghanaian cases illustrate how leadership routines, stop-work authority, critical-control verification, contractor alignment, learning from near misses and integrated scorecards can move organizations from compliance-driven safety to shared ownership. The

paper concludes that ISO 45001 supplies the system, the Bradley Curve diagnoses cultural maturity, and business integration sustains the gains.

KEYWORDS: Safety Culture, ISO 45001, Bradley Curve, Incident Reduction, Business Performance, Ghana, Occupational Health and Safety, Leadership, Worker Participation.

INTRODUCTION

Workplace safety remains both a human-rights issue and a business-performance issue. The International Labour Organization estimates that approximately 2.93 million workers die each year from work-related factors and that about 395 million workers sustain non-fatal occupational injuries. These outcomes create direct human suffering and also disrupt production, absorb management attention, increase compensation and medical cost, create rework and downtime, weaken employee trust and threaten organizational reputation (ILO, 2023). For safety-critical organizations, therefore, the objective is not simply to reduce reportable incidents; it is to establish an operating culture in which risks are recognized early, people intervene before harm occurs, and safety decisions reinforce rather than compete with operational performance.

The attached model paper emphasizes that management systems contribute most to cultural transformation when leadership, employee participation and proactive risk assessment are prioritized over compliance paperwork alone (Ankamah-Lomotey, 2025). This insight is consistent with the wider safety-culture literature, which shows that shared perceptions about the priority given to safety influence behavior, participation and injury outcomes (Griffin & Curcuruto, 2016; Kalteh et al., 2021). However, organizations often struggle with three practical questions. First, how should a positive safety culture be built beyond slogans and training campaigns? Second, how can leaders diagnose the current maturity of the culture in a way that is meaningful to frontline employees? Third, how can safety improvement be sustained when production pressure, contractor interfaces, cost constraints and leadership changes compete for attention?

ISO 45001 provides a useful answer to the first question because it specifies an occupational health and safety management system based on leadership, worker participation, risk and opportunity management, operational control, performance evaluation and continual improvement. The standard uses the Plan-Do-Check-Act logic and explicitly expects OH&S to be integrated into business processes rather than delegated to a specialist function (ISO, 2018). Yet certification alone cannot reveal whether employees behave reactively, merely

comply when supervised, take personal ownership, or actively protect one another. The Bradley Curve addresses this diagnostic gap by describing a progression from Reactive to Dependent, Independent and Interdependent cultures, with injury rates expected to decline as collective responsibility strengthens (dss+, 2025a, 2025b).

The Ghanaian context makes this integration particularly relevant. Ghana's Labour Act, 2003 (Act 651) requires employers to provide safe systems of work, information, instruction, training and supervision, while the Factories, Offices and Shops Act, 1970 (Act 328) contains specific workplace health and safety duties. High-risk sectors have additional regulatory frameworks, including the Minerals and Mining (Health, Safety and Technical) Regulations, 2012 (L.I. 2182), and the Petroleum (Exploration and Production) (Health, Safety and Environment) Regulations, 2017 (L.I. 2258). The Petroleum Commission's 2025 upstream business outlook reported a reduction in reported incidents from 140 in 2023 to 98 in 2024, while continuing to emphasize audits, contractor reporting and prudent operations. At the same time, Ghanaian studies continue to identify uneven safety-culture maturity, especially where formal systems are not fully internalized by management and frontline workers (Stemn et al., 2019; Opoku et al., 2020; Williams et al., 2020; Adzivor et al., 2024; Stemn et al., 2026).

This paper therefore treats positive safety culture as an organizational capability rather than an HSE campaign. It proposes that safety culture is built through the management-system disciplines of ISO 45001, diagnosed through a maturity lens such as the Bradley Curve, and sustained by making safety a normal input to business decisions about production, maintenance, quality, contractor management, capital expenditure and performance review. data and composite Ghanaian cases are used deliberately and transparently to demonstrate how the integrated model can be analyzed and applied without misrepresenting any real organization or respondent.

Statement of the Problem

Many organizations can show the visible artifacts of safety management policies, procedures, training records, audit schedules and incident forms yet still operate with a culture in which workers hesitate to report weak signals, supervisors trade controls for schedule recovery, contractors receive inconsistent expectations, and management reviews focus on lagging statistics after the event. This creates a gap between system compliance and cultural reality. When the gap persists, safety becomes vulnerable to leadership turnover, production pressure and short-term cost decisions. It also encourages a false separation between safety

performance and business performance, even though incidents, rework, equipment damage, downtime, absenteeism, schedule disruption and employee disengagement are operational and financial issues as well as safety issues.

In Ghana, the challenge is amplified by differences in organizational size, contractor dependence, access to technical expertise, enforcement consistency and sector maturity. Construction SMEs may lack dedicated safety resources; mining and petroleum organizations may possess sophisticated systems but still face contractor and process-safety risks; manufacturing plants may have procedures but struggle to convert near-miss information into preventive action. The problem addressed by this paper is therefore the absence of a simple but integrated framework that helps Ghanaian organizations build the necessary management system, diagnose their cultural maturity, reduce incidents and embed safety into business performance so that improvements are sustained.

Purpose of the Study

The purpose of this study is to develop and demonstrate an integrated approach for building, diagnosing and sustaining a positive safety culture using ISO 45001, the Bradley Curve and business-performance integration, with specific application to Ghanaian high-risk industries.

Research Objectives

1. To examine how core ISO 45001 practices especially leadership, worker participation, proactive risk management and organizational learning contribute to positive safety-culture maturity.
2. To diagnose safety-culture maturity across Ghanaian mining, construction, oil and gas, and manufacturing organizations using the Reactive, Dependent, Independent and Interdependent stages of the Bradley Curve.
3. To assess the relationship between safety-culture maturity, incident reduction and business-performance outcomes in the cross-industry dataset.
4. To develop practical Ghanaian industry case studies and an implementation framework for sustaining safety culture through integrated business management.

LITERATURE REVIEW

Safety Culture as an Organizational Capability

Safety culture refers to the deeper assumptions, values, norms and learned patterns that shape how risk is interpreted and how people act when procedures do not provide an obvious answer. Safety climate is often treated as the measurable surface expression of those deeper

cultural patterns the shared perceptions of what management truly prioritizes in practice (Zohar, 1980; Griffin & Curcuruto, 2016). Cooper (2000) conceptualized safety culture as an interaction among psychological, behavioral and situational dimensions, while Guldenmund (2000) emphasized its organizational and social character. These perspectives are important because they shift the focus away from blaming individual workers and toward the conditions that make safe or unsafe behavior more likely.

A mature safety culture also differs from a low-incident period. An organization can experience temporarily low injury numbers by chance, under-reporting or low exposure while retaining weak controls. Conversely, a learning organization may initially report more near misses because employees trust the reporting process. The more useful diagnostic question is therefore whether leadership decisions, supervision, worker participation, information flows and risk controls consistently support prevention. Systematic reviews have generally found positive relationships between safety culture or climate and safety performance, while also cautioning that causal mechanisms are complex and research designs vary (Clarke, 2006; Kalteh et al., 2021).

ISO 45001 as the System Architecture for Building Culture

ISO 45001:2018 provides a formal architecture for creating safe and healthy workplaces. Its requirements cover organizational context, leadership and worker participation, planning, support, operations, performance evaluation and improvement. The structure is important for culture because it requires top management to take accountability, consult and involve workers, identify hazards and assess risks, determine legal requirements, manage operational controls, prepare for emergencies, investigate incidents and continually improve performance (ISO, 2018). Rather than positioning safety as the responsibility of an HSE department, the standard expects OH&S processes to be integrated into the organization's overall business processes.

The cultural value of ISO 45001 depends on implementation quality. A procedure can either be a bureaucratic artifact or a tool that makes risk visible and decisions consistent. A risk register can either be updated for audit purposes or actively shape maintenance priorities and capital allocation. Worker consultation can either be a meeting attendance record or a genuine mechanism for frontline people to influence controls. Management review can either summarize lagging statistics or test whether serious risks, recurring weak signals and employee concerns are being resolved. The standard therefore supplies necessary disciplines, but culture determines whether those disciplines are lived.

The Bradley Curve as a Diagnostic of Cultural Maturity

The dss+ Bradley Curve describes four broad stages of safety-culture maturity. In a Reactive culture, people tend to believe incidents are an unfortunate feature of work and action is often triggered after harm. In a Dependent culture, safety improves through rules, supervision and management control. In an Independent culture, employees increasingly take personal ownership of risk and believe their actions can prevent harm. In an Interdependent culture, teams actively protect one another, challenge unsafe conditions and pursue learning collectively. The model associates stronger cultural maturity with lower injury rates and is widely used as a conversation and benchmarking tool rather than a substitute for detailed risk assessment (dss+, 2025a, 2025b).

The diagnostic power of the model is its behavioral simplicity. Leaders can ask: What happens when no supervisor is present? Do employees stop work when risk changes? Are peer-to-peer interventions normal? Are near misses treated as useful information or as evidence of failure? Do contractors receive the same expectations as employees? Is safety performance discussed in the same operational reviews as throughput, quality and cost? These questions help organizations locate the dominant cultural logic and identify the next transition rather than attempting to jump directly from reactive behavior to world-class rhetoric.

Safety Culture, Incident Reduction and Business Performance

Safety and business performance are often framed as competing objectives, but this separation is analytically weak. The same conditions that generate injuries poor planning, unreliable equipment, weak supervision, rushed work, unclear interfaces, deferred maintenance and inadequate learning also generate quality defects, rework, downtime and schedule unreliability. Griffin and Curcuruto (2016) note that safety climate affects both safety and productivity outcomes, while dss+ links cultural maturity to risk reduction and operational value creation. The practical implication is that mature organizations should manage safety with a balanced set of indicators that includes critical-control effectiveness, corrective-action closure, near-miss learning, planned maintenance, downtime, quality, absenteeism and schedule performance.

Business integration also prevents safety from becoming vulnerable to cost pressure. When major safety actions compete outside the normal budgeting, maintenance or production system, they can be deferred as discretionary HSE tasks. When they are coded as production constraints, asset-integrity requirements, quality risks or project-critical controls, ownership

becomes broader. The objective is not to commercialize safety or value human life only in monetary terms; it is to ensure that the organization's operating model recognizes that preventing harm and achieving reliable performance often require the same disciplined management behaviors.

Ghanaian Industry Evidence and Context

Ghanaian evidence supports the relevance of cultural maturity. Stemn et al. (2019), studying four large-scale gold mines, found that mines with lower incidence rates consistently reported higher safety-culture maturity. Opoku et al. (2020) similarly found that safety culture significantly predicted several dimensions of workplace safety in Ghana's mining industry. More recent research in small-scale mining indicates that cultural maturity remains low and that systemic measures can lag behind individual safety behavior (Stemn, Bonsu Junior, & Benyarku, 2026). These findings suggest that technical controls alone are insufficient without stronger systems and collective norms.

The construction sector presents a different challenge. Williams, Fugar and Adinyira (2020) assessed safety-culture maturity in Ghanaian construction and concluded that the industry was positioned at a very early maturity stage, with safety not consistently treated as a core business risk. Adzivor et al. (2024) later developed a positive safety-culture framework for Ghanaian construction SMEs that emphasized commitment, adaptability, information, awareness, culture and performance. This reinforces the need for approaches that are scalable for smaller firms rather than imposing complex systems that are difficult to sustain.

Ghana's upstream petroleum sector operates under a more formalized HSE regime. L.I. 2258 requires attention to health, safety and environment in petroleum activities, while the Petroleum Commission's current guidelines and HSSE manual reinforce risk-management expectations. The Commission's 2025 business outlook noted that reported incidents reduced from 140 in 2023 to 98 in 2024. The direction is encouraging, but incident counts alone do not reveal the maturity of reporting, contractor learning, process-safety controls or operational decision-making. The integrated framework proposed here is therefore designed to complement regulatory compliance with cultural diagnosis and business integration.

Theoretical and Conceptual Framework

The conceptual framework combines three complementary lenses. First, ISO 45001 provides the formal management-system architecture and the PDCA engine for continual improvement. Second, the Bradley Curve provides a cultural-maturity lens that translates

system behavior into a recognizable progression from reactive compliance to interdependent ownership. Third, a business-integration lens connects safety controls and culture to operational outcomes such as downtime, reliability, quality, workforce engagement and schedule performance. The framework assumes that management systems influence culture through repeated leadership behavior, participation, risk decisions and learning routines; culture maturity in turn affects both incident exposure and the reliability of business execution. Performance data then feeds back into management review and improvement.

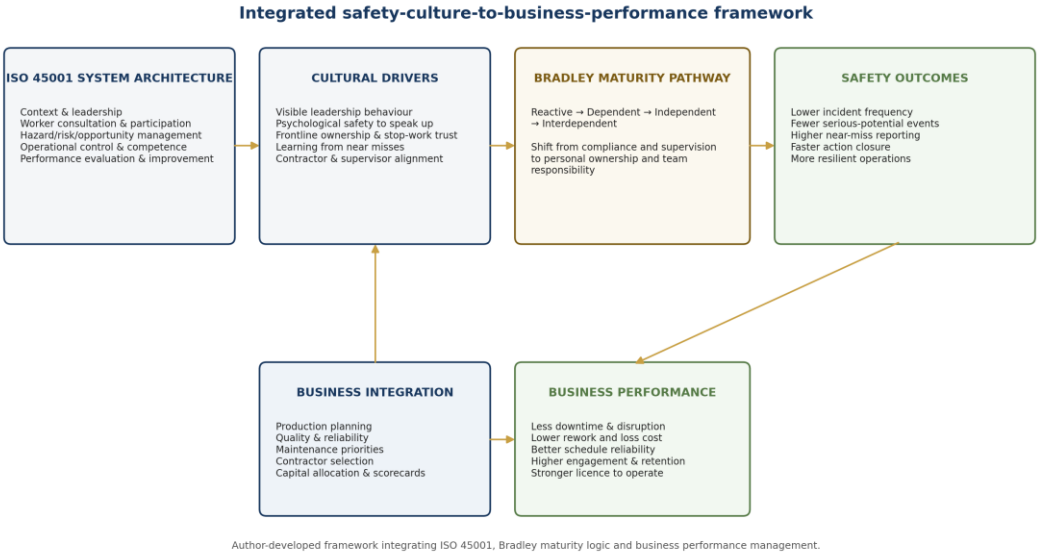


Figure 1: Integrated Safety-Culture-to-Business-Performance Framework.

The framework deliberately avoids treating the Bradley Curve as a certification model or ISO 45001 as a culture score. Instead, the two are complementary. ISO 45001 answers the question, 'What management disciplines must exist and improve?' The Bradley Curve asks, 'How do people actually relate to safety when they work?' Business integration asks, 'Will the safety gains survive the next production challenge, budget cycle or leadership change?'

METHODOLOGY

Research Design

The paper employed a simulation-informed mixed-methods design that mirrors the structure of the attached safety-management article while maintaining explicit transparency that no real respondents or organizations were studied. The quantitative component consists of a cross-sectional dataset designed to represent plausible Ghanaian industrial conditions. The qualitative component consists of interview excerpts and four composite case studies constructed from recurring themes in Ghanaian safety literature, sector regulation and the

ISO 45001/Bradley framework. The purpose of the design is model development and demonstration, not estimation of real national prevalence or causal effects.

Population and Sample

The survey includes 320 employee records distributed across 32 hypothetical organizations: eight organizations each in mining, construction, oil and gas, and manufacturing, with ten employee records per organization. Roles were generated to approximate a realistic mix of frontline/technical personnel, supervisors and managers/HSE professionals. The simulated dataset contains 170 frontline/technical respondents, 83 supervisors and 67 managers/HSE professionals. Average tenure was 12.4 years. Cultural-stage probabilities were varied by sector so that construction contained more Reactive and Dependent organizations, while mining and oil and gas contained more Independent and Interdependent organizations. These distributions are illustrative and should not be interpreted as estimates of the real sectors.

Table 1: Sample Profile.

Category	Group	n	%
Sector	Mining	80	25.0
Sector	Construction	80	25.0
Sector	Oil & Gas	80	25.0
Sector	Manufacturing	80	25.0
Role	Frontline/technical	170	53.1
Role	Supervisor	83	25.9
Role	Manager/HSE	67	20.9
Bradley stage	Reactive	50	15.6
Bradley stage	Dependent	90	28.1
Bradley stage	Independent	90	28.1
Bradley stage	Interdependent	90	28.1

Measures and Data Construction

Seven 5-point composite dimensions were simulated: leadership commitment and accountability; worker participation and consultation; proactive risk management; learning and reporting; ISO 45001 integration; business integration; and documentation/operational control. A safety-culture maturity outcome was generated from a weighted combination of the human and proactive dimensions plus random variation. Documentation was intentionally generated with a weaker relationship to maturity so that the analysis could test whether procedural visibility alone predicts culture. Organization-level total recordable incident rate (TRIR) values and a 0–100 business-performance index were then generated with

progressively stronger outcomes at higher Bradley stages, plus random noise to avoid deterministic relationships.

Table 2: Diagnostic Constructs and Operational Interpretation.

Construct	Illustrative indicators	Primary framework link
Leadership & accountability	Visible field engagement, decision consistency, resource allocation, supervisor accountability	ISO 45001 leadership; culture driver
Worker participation	Consultation, stop-work confidence, safety committees, frontline risk input	ISO 45001 worker participation; Bradley ownership
Proactive risk management	Hazard identification, critical controls, change management, pre-task risk review	ISO 45001 planning/operations
Learning & reporting	Near-miss reporting, incident learning, feedback quality, action closure	ISO 45001 performance evaluation/improvement
ISO 45001 integration	OH&S embedded in planning, competence, operations, audits and review	Management-system architecture
Business integration	Safety in production, maintenance, quality, contractor and capital decisions	Sustainability mechanism
Documentation & control	Procedures, forms, registers, permits, records	Necessary system infrastructure
Culture maturity	Shared ownership, intervention norms, trust, learning, team responsibility	Bradley maturity pathway

Quantitative Analysis

Descriptive statistics were used to compare the safety dimensions. Multiple linear regression was used to estimate the joint association of leadership, participation, proactive risk management, learning/reporting and documentation with safety-culture maturity. Standardized beta coefficients were calculated to compare relative strength. Bradley-stage profiles were summarized at organization level using mean culture maturity, TRIR and business-performance index. Because stage assignment was deliberately embedded in the simulation, inferential tests of stage differences are interpreted only as internal checks on the simulation, not as empirical estimates for Ghana.

Qualitative and Case-Study Analysis

Twenty-four interview excerpts were developed six archetypal voices per sector covering senior leaders, supervisors, HSE specialists and frontline workers. The excerpts were coded

around leadership visibility, speaking-up climate, supervisor behavior, near-miss learning, contractor alignment, production pressure and business integration. Four composite case studies were then created to demonstrate plausible change pathways in a Western Region gold mine, a Greater Accra building contractor, a Western Region petroleum terminal and a Tema manufacturing plant. Case names and metrics are and do not represent actual organizations.

Ethics and Data Integrity

No human participants, confidential records or proprietary company data were used. Ethical clearance was therefore not required for the analysis. All quotations, site names and performance values in the case studies are explicitly . Real Ghanaian laws, official regulatory documents and published academic findings are used only to provide contextual grounding. Any future publication that presents empirical claims about Ghanaian organizations should replace the dataset with ethically collected field data and appropriate institutional approval.

ANALYSIS AND DISCUSSION OF RESULTS

Objective 1: Building Positive Safety Culture through ISO 45001 Practices

The first objective examined the system and behavioral factors most strongly associated with the safety-culture maturity outcome. Table 3 shows that the highest mean scores were proactive risk management (M = 3.45), leadership commitment (M = 3.44) and ISO 45001 integration (M = 3.36). Worker participation (M = 3.23), learning/reporting (M = 3.15) and business integration (M = 3.10) were lower, while documentation/operational control had the lowest mean (M = 2.95). The pattern suggests an organization may possess core system elements yet still need to strengthen participation, learning and business integration to convert compliance into a more self-sustaining culture.

Table 3: Descriptive Statistics for Safety-Culture Dimensions. (N = 320)

Dimension	Mean	Std. Dev.
Leadership commitment & accountability	3.44	0.86
Worker participation & consultation	3.23	0.83
Proactive risk management	3.45	0.85
Learning & reporting	3.15	0.82
ISO 45001 integration	3.36	0.92
Business integration	3.10	0.78
Documentation & operational control	2.95	0.73
Safety-culture maturity	3.31	0.97

Regression results further clarify the distinction between system infrastructure and cultural drivers. The five-predictor model explained 68.7% of the variance in safety-culture maturity ($R^2 = 0.687$; adjusted R^2 approximately 0.683; $F \approx 138$, $p < .001$). Worker participation showed the largest standardized association ($\beta = 0.302$, $p < .001$), followed by proactive risk management ($\beta = 0.224$, $p = .002$) and leadership ($\beta = 0.205$, $p = .006$). Learning/reporting had a smaller but significant effect ($\beta = 0.145$, $p = .041$). Documentation was not statistically significant ($\beta = 0.059$, $p = .065$). These results reproduce an important practical distinction: paperwork is necessary for control and evidence, but culture is shaped more directly by what leaders do, whether workers are heard, and whether risk information changes decisions.

Table 4: Regression of Safety-System Components on Culture Maturity.

Predictor	B	SE	Beta (β)	t	p
Constant	-0.298	0.183		-1.632	0.104
Leadership commitment	0.231	0.084	0.205	2.764	0.006
Worker participation	0.353	0.081	0.302	4.379	<0.001
Proactive risk management	0.258	0.084	0.224	3.086	0.002
Learning & reporting	0.173	0.084	0.145	2.050	0.041
Documentation & operational control	0.078	0.042	0.059	1.853	0.065

"The system became real when managers started asking what could hurt people before they asked why the job was late. That changed the conversation on the floor." ***(MIN-L2, interview excerpt)***

"The most important thing was not another rule. It was knowing that if I stop the job because the condition changed, my supervisor will back me rather than blame me for delay." ***(CON-F4, interview excerpt)***

The quotations illustrate two mechanisms behind the statistical pattern. The first is leadership signalling: employees infer priorities from what leaders ask about, resource and tolerate. The second is participation safety: workers need confidence that speaking up will not create social or performance penalties. ISO 45001 can formalize both mechanisms, but cultural maturity depends on repeated experience that the formal commitments are honored.

Objective 2: Diagnosing Maturity with the Bradley Curve

The second objective used the Bradley stages to diagnose the dominant cultural logic across the 32 organizations. Five organizations were Reactive, nine Dependent, nine Independent and nine Interdependent. Sector differences were intentionally introduced to reflect the contrasting structural environments discussed in Ghanaian literature: construction contained the highest proportion of Reactive and Dependent sites, whereas mining and oil and gas

contained more Independent and Interdependent sites. These distributions are illustrative rather than empirical.

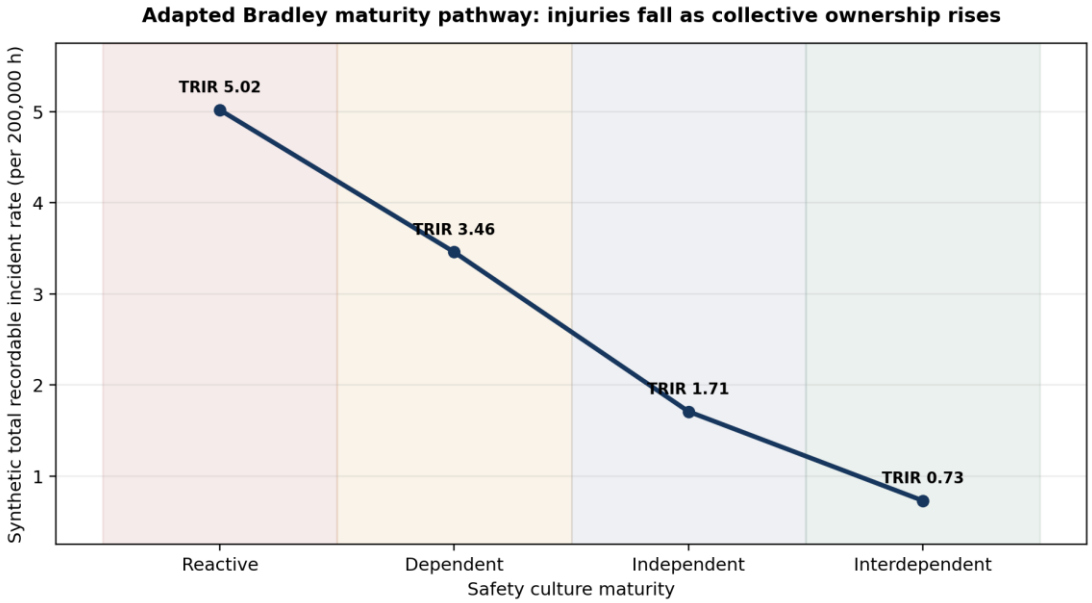


Figure 2: Adapted Bradley Maturity Pathway Using Incident Rates.

Figure 2 demonstrates the diagnostic logic. The mean TRIR fell from approximately 5.02 in the Reactive stage to 3.46 in the Dependent stage, 1.71 in the Independent stage and 0.73 in the Interdependent stage. The important point is not the precise numbers but the behavioral transition behind them. Reactive organizations tend to learn after harm. Dependent organizations gain stability through rules, supervision and management discipline. Independent organizations strengthen personal risk ownership. Interdependent organizations add team responsibility, peer intervention and cross-functional learning. In practice, organizations can contain subcultures at different stages, so diagnosis should be repeated by site, contractor group, function and leadership level rather than assigned as a single permanent label.

Table 5: Outcomes by Bradley Culture Stage. (Organization-Level Means)

Bradley stage	Culture maturity (1–5)	TRIR	Business performance index (0–100)
Reactive	2.00	5.02	61.3
Dependent	2.76	3.46	67.5
Independent	3.66	1.71	77.4
Interdependent	4.22	0.73	85.1

"Our audits were always strong, but we still waited for the safety officer to tell us what to fix. The breakthrough came when each shift owned its own critical-control checks." ***(OIL-S3, interview excerpt)***

This excerpt captures the Dependent-to-Independent transition: the management system remains important, but the source of control shifts from specialist supervision to operational ownership. Ghanaian mining evidence provides empirical support for the general maturity-performance relationship. Stemn et al. (2019) found that large-scale mines with lower incidence rates reported higher culture-maturity scores, while the 2026 small-scale mining study by Stemn and colleagues again linked higher maturity with fewer accidents. The Bradley analysis therefore aligns with observed Ghanaian patterns without claiming that the simulated stage proportions represent national conditions.

Objective 3: Integrating Incident Reduction with Business Performance

The third objective examined whether maturity can be managed as a business-performance capability rather than a separate HSE outcome. Figure 3 shows a deliberately simple pattern: as cultural maturity increases, incident rates decline while the business-performance index rises. The business index combines simulated improvements in downtime, schedule reliability, quality, workforce stability and operational discipline. At the four Bradley stages, the mean index increased from 61.3 in Reactive organizations to 67.4 in Dependent, 77.4 in Independent and 85.1 in Interdependent organizations.

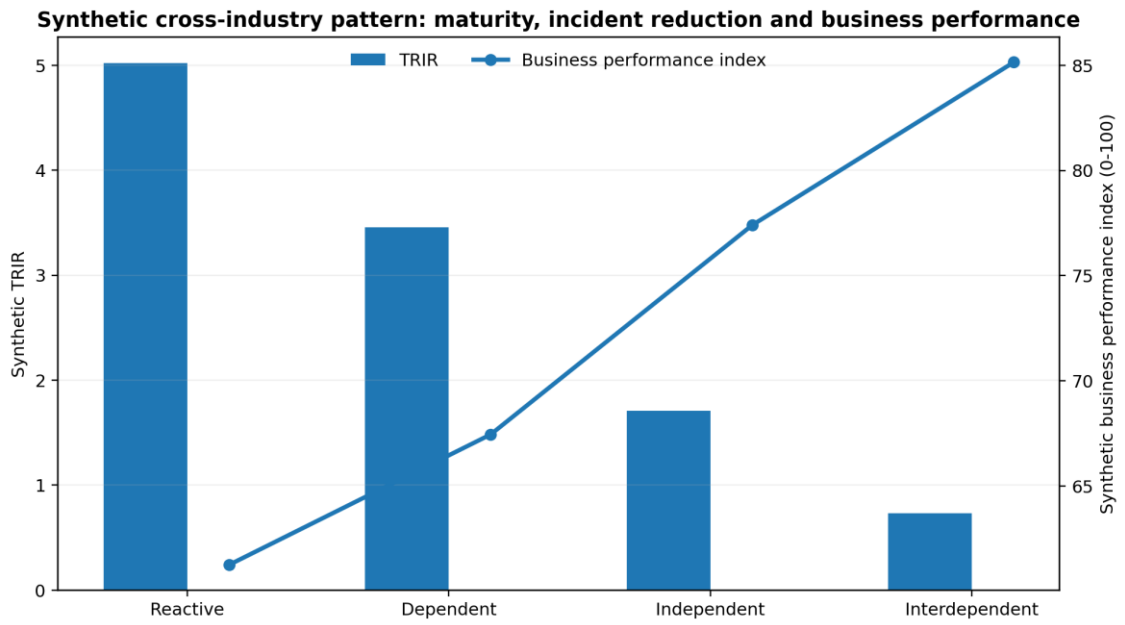


Figure 3: Cross-Industry Pattern Linking Maturity, Incidents and Business Performance

The pattern should not be interpreted as proof that mature culture mechanically causes profit. Rather, it illustrates a plausible pathway supported by the broader literature: the same management routines that prevent incidents can also improve work planning, equipment

reliability, communication and learning. For example, a permit-to-work process that is genuinely integrated with operations can prevent exposure to hazardous energy while also reducing unplanned interruption. A strong near-miss system can identify failing components before both an injury and a production breakdown. A supervisor who plans work realistically may reduce both unsafe shortcuts and rework.

"We stopped putting safety actions on a separate spreadsheet. Critical safety work now sits on the same weekly operations dashboard as throughput, quality and maintenance backlog. That made overdue actions visible to everybody." ***(MFG-M2, interview excerpt)***

This is the core of business integration: safety metrics must enter the routines where operational trade-offs are actually made. A mature scorecard should therefore combine leading safety indicators (critical-control verification, stop-work use, action closure, reporting quality), lagging indicators (TRIR, high-potential events, lost-time injuries), and operational indicators (unplanned downtime, defect/rework rate, schedule attainment, absenteeism, contractor performance). When safety is present only in the HSE report, line managers can inadvertently optimize around it. When safety is built into business review, it becomes part of operational discipline.

Objective 4: Ghanaian Industry Composite Case Studies

Four composite cases were developed to demonstrate how the integrated model can be tailored to different Ghanaian sectors. The cases do not describe actual organizations; they combine common sector hazards, Ghanaian regulatory expectations and the study's performance logic.

Table 6: Ghanaian Industry Case Studies and Illustrative Improvement Outcomes.

Composite case	Sector	Bradley shift	TRIR	Near-miss reports/100 workers	Business index
A: Western Region gold mine	Mining	Dependent → Independent	3.6 → 1.8	42 → 76	69 → 81
B: Greater Accra building contractor	Construction	Reactive → Dependent	5.4 → 3.1	18 → 49	58 → 68
C: Western Region petroleum terminal	Oil & Gas	Dependent → Interdependent	3.0 → 0.9	35 → 83	72 → 86
D: Tema manufacturing plant	Manufacturing	Dependent → Independent	3.8 → 1.9	27 → 61	66 → 77

Case A: Western Region Gold Mine - From Supervision to Operational Ownership

The mine began with a technically competent safety system but a strongly Dependent culture. HSE personnel conducted most inspections, supervisors waited for specialist direction, and critical-control verification was not consistently owned by production. The intervention used ISO 45001 management review to redefine accountability: each production leader became responsible for a small number of fatal-risk controls, verification quality was reviewed at the daily production meeting, and worker representatives joined incident-learning teams. The site's TRIR reduced from 3.6 to 1.8, near-miss reporting increased from 42 to 76 per 100 workers, and the business index increased from 69 to 81. The increase in reporting was treated as a positive trust signal rather than as evidence that the site had become less safe.

"The biggest change was that production leaders could no longer say, 'HSE will check it.' The control had an operational owner, and if verification was weak the production plan had to change." ***(MIN-M5, interview excerpt)***

The case reflects Ghanaian large-scale mining research showing that stronger maturity is associated with lower incidence rates (Stemn et al., 2019). It also demonstrates why ISO 45001 leadership requirements should be translated into explicit line-accountability mechanisms rather than general statements of commitment.

Case B: Greater Accra Building Contractor - Establishing the Dependent Foundation

The construction contractor started in a Reactive stage. Toolbox talks were inconsistent, subcontractors interpreted rules differently, and work frequently continued when site conditions changed. The organization did not attempt to jump directly to peer-led interdependence. Instead, it built a disciplined Dependent foundation: simplified risk assessments, minimum site rules, competent supervision, daily pre-task planning, a no-penalty stop-work rule and consistent consequences for bypassing critical controls. The TRIR reduced from 5.4 to 3.1 and the business index improved from 58 to 68, partly through lower rework and fewer disruption days.

"Before, stopping work could make you look difficult. After the new rule, the project manager asked who had stopped unsafe work that week and what the team learned from it." ***(CON-S2, interview excerpt)***

This case is consistent with Ghanaian construction research showing that many firms require stronger foundational safety systems and leadership before advanced culture techniques can be sustained (Williams et al., 2020; Adzivor et al., 2024). The lesson is sequencing:

empowerment without basic competence and clear rules can produce inconsistency, while rules without eventual empowerment create permanent dependence.

Case C: Western Region Petroleum Terminal - Integrating Process Safety and Business Review

The petroleum terminal had mature procedures and strong compliance but remained management-dependent in several areas. Safety-critical maintenance competed with production targets, contractor deviations were reviewed separately from the main operations process, and weak signals were not consistently escalated. The intervention integrated barrier health, overdue critical maintenance, process-safety events and contractor assurance into the same weekly business review used for throughput and reliability. Senior leaders required explicit risk acceptance when work was deferred. The TRIR fell from 3.0 to 0.9, near-miss reporting rose to 83 per 100 workers, and the business index rose from 72 to 86.

"Once a safety-critical maintenance deferral had to be explained beside production loss and reliability risk, the discussion changed. It was no longer an HSE request; it was a business-risk decision." ***(OIL-M1, interview excerpt)***

This case illustrates the intent of ISO 45001 to integrate OH&S into business processes and resonates with Ghana's petroleum HSE regulatory environment, where operators are expected to manage risk, maintain competent systems and demonstrate prudent operations. The Petroleum Commission's recent incident-reduction trend provides useful sector context, but the case emphasizes that sustainable performance depends on the quality of risk decisions behind the count.

Case D: Tema Manufacturing Plant - Building a Learning Culture

The manufacturing plant had stable rules but weak organizational learning. Minor incidents were closed locally, near misses were underreported, and corrective actions focused on worker retraining even when equipment design or work planning contributed to exposure. The intervention introduced learning teams, simplified event classification, rapid feedback to reporters and monthly cross-functional review of recurring controls. Supervisors were assessed on action quality rather than only absence of injuries. TRIR reduced from 3.8 to 1.9, near-miss reporting rose from 27 to 61 per 100 workers, and the business index improved from 66 to 77 as recurrent equipment stoppages and quality losses were addressed through the same learning process.

"Near-miss reporting went up before incidents came down. Management accepted that as progress because people were finally telling us where the system was weak." ***(MFG-F6, interview excerpt)***

This case demonstrates why organizations should not interpret low reporting as automatically positive. An Interdependent or learning-oriented culture makes weak signals visible. The management challenge is to distinguish reporting activity from actual exposure and to reward early information that supports prevention.

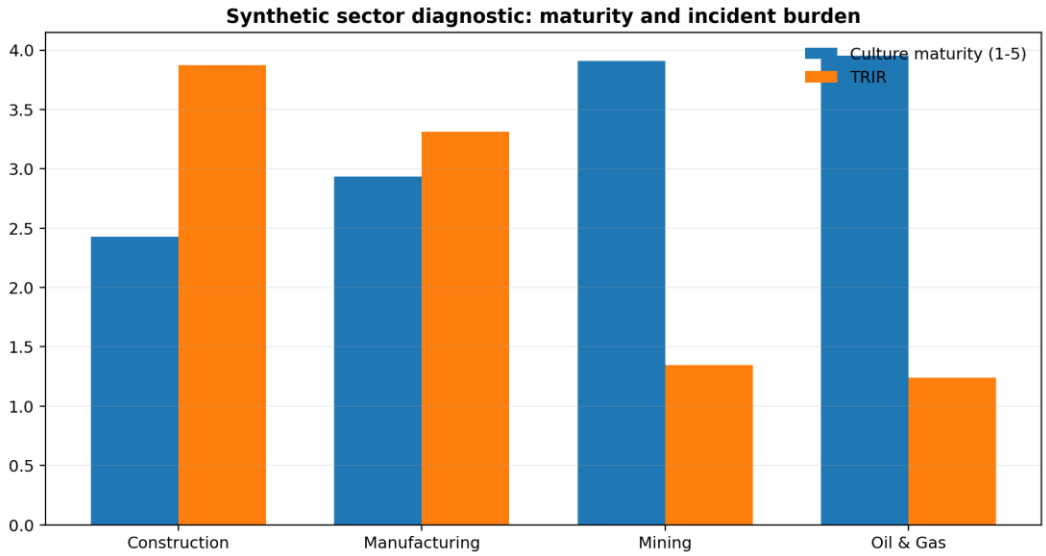


Figure 4: Sector Diagnostic - Culture Maturity and Incident Burden.

Figure 4 reinforces the need for sector-sensitive implementation. In the simulation, construction and manufacturing show higher incident burden and lower maturity than mining and oil and gas. This does not represent real comparative prevalence; rather, it demonstrates how an organization can use the same integrated framework at different starting points. A smaller construction firm may first need consistent supervision and simplified controls, while a mature petroleum operator may need to focus on process-safety learning, contractor integration and decision quality.

DISCUSSION OF RESULTS

The combined results support four propositions. First, positive safety culture is built primarily through human and proactive management practices rather than through documentation alone. In the regression, worker participation, risk management and leadership were the strongest significant predictors of cultural maturity, while documentation had no independent direct effect. This does not reduce the importance of procedures, records or permits; it

indicates that their cultural value depends on how they are used. The finding is consistent with the attached model paper, which also emphasizes leadership, participation and proactive risk assessment as major cultural drivers (Ankamah-Lomotey, 2025).

Second, cultural maturity should be diagnosed behaviorally rather than inferred from certification status or incident numbers. The Bradley Curve provides a practical language for distinguishing supervision-driven compliance from personal and team ownership. This is consistent with broader maturity models developed by Parker, Lawrie and Hudson (2006) and with Ghanaian mining evidence linking greater maturity to lower incidence rates (Stemn et al., 2019). A site can be ISO 45001 certified and still function largely in a Dependent mode if employees comply because supervisors and auditors are watching rather than because risk ownership has been internalized.

Third, the route to Interdependence is staged. Reactive organizations need foundational rules, competence and consequence management; Dependent organizations need to transfer ownership to operations and workers; Independent organizations need stronger peer-to-peer learning and cross-functional collaboration; Interdependent organizations need mechanisms that prevent complacency and preserve collective vigilance. Attempting to skip these transitions can create superficial programs. For example, encouraging peer intervention without psychological safety can expose workers to retaliation, while introducing advanced behavioral observations in a workplace with uncontrolled physical hazards can shift attention away from engineering and system controls.

Fourth, safety culture is more sustainable when connected to business performance. The data show rising business-performance scores across maturity stages, and the cases illustrate mechanisms through which this relationship can emerge: fewer disruptions, improved maintenance, stronger contractor discipline, lower rework, more reliable planning and earlier identification of weak signals. The relationship should not be oversold as a guaranteed financial return. Safety decisions are ethically required even where a direct return cannot be calculated. Nevertheless, integration makes it more likely that safety-critical work receives the same governance discipline as other operational priorities.

The Ghanaian context adds two implementation considerations. The first is proportionality. ISO 45001 can be applied to organizations of different sizes, but the complexity of tools should match organizational capability. Construction SMEs may require concise risk tools, visible supervision and owner-manager leadership rather than large corporate documentation systems. The second is contractor and supply-chain integration. Mining and petroleum operations often depend on contractors whose local practices can materially affect risk.

Culture is therefore not mature if high standards apply only to direct employees. Procurement, contractor selection, induction, supervision and performance review must reinforce the same critical controls and speaking-up expectations.

Implementation Roadmap

Table 7: Practical 12-Month Safety Culture Transformation Roadmap.

Phase	Priority actions	Primary owners	Core evidence
0–90 days: Diagnose & stabilize	Legal/ISO gap review; serious-risk inventory; worker listening sessions; Bradley baseline; stop-work protection; identify overdue critical actions	Board/executive sponsor, HSE, operations	Baseline maturity; critical-control coverage; aged actions; reporting trust
3–6 months: Build ownership	Leadership field routines; supervisor coaching; worker risk teams; contractor alignment; learning-team method; integrate safety into operations dashboard	Operations leaders, supervisors, procurement	Participation rate; action quality; critical-control verification; contractor leading indicators
6–9 months: Integrate business systems	Link safety to maintenance, quality, production planning and capital decisions; revise scorecards; strengthen management review	Executive team, finance, maintenance, quality	Downtime; schedule attainment; rework; safety-critical maintenance backlog
9–12 months: Sustain & advance maturity	Repeat perception/maturity assessment; peer interventions; cross-site learning; recognize proactive behavior; test resilience after change	All leaders and workforce	Bradley-stage movement; TRIR/high-potential events; near-miss learning; business-performance index

CONCLUSION AND RECOMMENDATIONS

This paper has developed an integrated model for building, diagnosing and sustaining positive safety culture in Ghanaian industry. ISO 45001 provides the management-system architecture for leadership, participation, risk management, operations, measurement and continual improvement. The Bradley Curve provides a practical diagnosis of how deeply safety responsibility has been internalized, progressing from Reactive through Dependent and Independent to Interdependent cultures. Business-performance integration sustains the improvement by ensuring that safety enters the same decisions that govern production, maintenance, quality, contractor management, schedule and investment.

The evidence shows a consistent pattern: human and proactive factors contribute more directly to culture maturity than documentation alone; incident rates decrease markedly as Bradley maturity strengthens; and operational performance can improve alongside safety

when the same management disciplines address both risk and reliability. The Ghanaian composite cases demonstrate that the specific pathway differs by sector and starting point, but the underlying principles remain consistent.

Recommendations

1. Convert ISO 45001 requirements into visible leadership routines. Senior and middle managers should have defined field-engagement expectations, review serious-risk controls personally, and be assessed on the quality of risk decisions rather than only on lagging injury statistics.
2. Diagnose culture before prescribing interventions. Use worker interviews, perception surveys, event analysis and leadership observations to locate the dominant Bradley stage by site or workgroup. Design the next transition rather than imposing generic 'world-class' programs.
3. Make worker participation operational. Establish credible stop-work authority, involve workers in risk assessment and incident learning, close the feedback loop on reported concerns, and track whether people believe speaking up is safe and useful.
4. Prioritize critical-risk management over paperwork volume. Identify fatal and serious-potential hazards, define critical controls, assign operational owners, verify control effectiveness and treat repeated control weakness as a business-risk issue.
5. Integrate safety with business performance. Put safety-critical maintenance, corrective-action backlog, contractor risk, near-miss learning and serious-control performance on the same dashboards and management reviews used for production, quality, reliability, cost and schedule.
6. Strengthen supervisor capability. Supervisors translate formal systems into daily work. Training should therefore include risk-based decision-making, coaching, pre-task planning, fair accountability, incident learning and management of production pressure.
7. Build contractor culture deliberately. Procurement and contract management should include competence criteria, shared critical controls, leading indicators, joint learning and consequences for persistent risk-control failures.
8. Manage the reporting paradox. Mature organizations may experience an initial increase in near-miss and hazard reports. Leaders should distinguish improved visibility from worsening exposure and avoid punishing the very reporting behavior that enables prevention.

9. Use a balanced safety-business scorecard. Combine leading, lagging and business indicators so that executives can see whether culture improvement is reducing serious risk while also strengthening operational reliability.

10. Reassess maturity annually and after major change. Acquisitions, new projects, rapid growth, leadership turnover, contractor changes and prolonged high workload can weaken culture. Diagnosis should therefore be repeated rather than treated as a one-time label.

Limitations and Future Research

The principal limitation is intentional: the empirical dataset, interviews and case-study metrics are . They are designed to demonstrate an analytic model, not to estimate actual Ghanaian sector performance or establish causal relationships. The simulated stage differences are partly built into the data-generating process, so inferential statistics should not be generalized beyond the demonstration. The composite cases also simplify the complexity of process safety, contractor systems, organizational politics and national enforcement. Future research should validate the framework using longitudinal data from real Ghanaian organizations, including exposure-adjusted incident measures, repeated safety-culture surveys, contractor data and objective business metrics. A particularly useful design would track organizations before and after ISO 45001 implementation or a targeted culture intervention and test whether movement in maturity predicts sustained change in serious-potential events, reliability and workforce outcomes.

Data Availability and Transparency Statement

The quantitative dataset used in this paper is and reproducible from a fixed random seed. No personal data or proprietary company records are included. The dataset may be supplied as a supplementary file for teaching, method demonstration or model testing. All organization names, participant identifiers, quotations and before/after case-study values are fictional composites. Real statutes, official reports and published research are cited separately and should not be confused with the simulated empirical results.

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