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Role of Safety Culture in Improving Occupational Health and Safety Performance in Steel Production

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Abstract: *The steel production industry is one of the most safety-critical manufacturing sectors because workers are routinely exposed to high temperatures, molten metal, heavy machinery, hazardous chemicals, dust, noise, vibration, confined spaces, electrical systems, lifting operations, and demanding production schedules. In such an environment, occupational health and safety performance cannot depend only on written rules, personal protective equipment, or engineering controls; it also requires a strong organizational safety culture.*

Safety culture represents the shared values, attitudes, beliefs, leadership practices, communication patterns, and behavioral expectations through which safety is prioritized in everyday work. This research paper examines the role of safety culture in improving occupational health and safety (OHS) performance in steel production. The paper adopts a conceptual and analytical research approach based on published literature and occupational safety frameworks. Particular attention is given to management commitment, employee participation, safety training, communication, reporting of near misses, supervisory leadership, risk awareness, compliance with procedures, and continuous improvement. Previous research in steel and manufacturing environments indicates that safety culture and safety climate can influence safe work behavior and accident outcomes.

Keywords: Safety Culture, Occupational Health and Safety, Steel Production, Safety Performance, Safety Climate, Employee Participation, Workplace Accidents, Risk Management

I. INTRODUCTION

Occupational health and safety is a fundamental component of sustainable industrial development. The steel industry is particularly important from an OHS perspective because steel production involves complex production processes and potentially severe hazards. Activities such as raw-material handling, coke production, sintering, iron making, steel making, casting, rolling, maintenance, transportation, and material handling expose workers to multiple physical, chemical, mechanical, ergonomic, and environmental risks. Consequently, preventing accidents and occupational illnesses requires more than technical safety measures. It requires an organizational environment in which safe behavior is consistently encouraged, supported, monitored, and rewarded.

The International Labour Organization recognized a safe and healthy working environment as a fundamental principle and right at work in 2022 and emphasizes the development of preventive safety and health cultures. The ILO also identifies safety culture, risk management, worker participation, and integration of OHS with business operations as important elements of effective occupational safety management.

Safety culture refers broadly to the shared organizational values and practices concerning safety. It influences how managers and employees perceive hazards, how seriously safety procedures are followed, whether workers report unsafe conditions, and whether production pressures are allowed to override safety requirements. In a strong safety culture, safety is regarded as an integral part of production rather than as a separate administrative responsibility.

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This is particularly relevant in steel production because production targets, maintenance requirements, equipment availability, and operational continuity can sometimes create pressure for workers to take shortcuts. Research conducted in the steel industry has shown that production pressures, safety hazards, and organizational and social factors can influence safe or unsafe work behavior. Therefore, developing a strong safety culture is essential for converting formal safety policies into actual safe practices.

II. CONCEPT OF SAFETY CULTURE

Safety culture can be understood as the collective way in which an organization thinks and acts about occupational safety. It includes management attitudes, employee perceptions, safety-related values, organizational policies, communication systems, training, supervision, reporting mechanisms, and behavioral expectations.

Safety culture should be distinguished from safety climate. Safety climate generally refers to workers' perceptions of how safety is currently prioritized within their organization, whereas safety culture is a broader concept involving deeply embedded organizational values, norms, and practices. Safety-climate measurements can nevertheless provide useful indicators of organizational safety conditions. Reviews of manufacturing research have identified management commitment, training, procedures, and worker attitudes as recurring components of safety climate.

In steel production, safety culture becomes visible through practical activities such as:

1. Compliance with standard operating procedures;
2. Use of personal protective equipment;
3. Participation in safety meetings;
4. Reporting of hazards and near misses;
5. Effective permit-to-work systems;
6. Lockout/tagout practices;
7. Emergency preparedness;
8. Supervisor safety behavior;
9. Participation in safety inspections;
10. Maintenance of safety-critical equipment; and
11. Willingness to stop unsafe work.

Thus, safety culture is not merely a written safety policy. It is reflected in what employees and managers actually do during routine and non-routine operations.

IV. OCCUPATIONAL HAZARDS IN STEEL PRODUCTION

Steel manufacturing contains a combination of high-energy processes and hazardous materials. The major occupational hazards are summarized below.

Table 1. Major Occupational Hazards in Steel Production

Hazard Category	Examples in Steel Production	Possible Consequences
Thermal hazards	Molten metal, furnaces, hot surfaces	Burns, heat stress, serious injuries
Mechanical hazards	Rolling mills, conveyors, cranes, moving machinery	Crushing, amputation, fractures
Chemical hazards	Gases, fumes, solvents, process chemicals	Poisoning, respiratory illness
Dust and fumes	Metal fumes, silica-containing dust, coke dust	Respiratory disorders
Noise	Rolling mills, compressors, heavy machinery	Hearing loss, fatigue
Electrical hazards	High-voltage equipment, electrical maintenance	Electric shock, burns, fatalities
Ergonomic hazards	Manual handling, repetitive work, awkward postures	Musculoskeletal disorders
Fire/explosion	Combustible gases, fuels and process materials	Burns, fatalities, property damage
Confined spaces	Tanks, vessels, pits and enclosed process areas	Asphyxiation, toxic exposure
Vehicle hazards	Forklifts, trucks, rail transport	Collision and struck-by injuries
Falls	Platforms, ladders, elevated work areas	Fractures, severe injuries

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Psychosocial hazards	Shift work, workload, production pressure	Fatigue, stress, reduced attention

These hazards demonstrate why safety performance in steel production must be approached systematically rather than through isolated interventions.

V. ROLE OF MANAGEMENT COMMITMENT

Management commitment is one of the most important dimensions of safety culture. Workers are more likely to treat safety seriously when organizational leaders consistently demonstrate that safety has priority over short-term production pressures.

Management commitment can be demonstrated through:

1. adequate allocation of safety resources;
2. regular workplace safety inspections;
3. participation in safety meetings;
4. prompt correction of identified hazards;
5. investment in safe equipment and technology;
6. enforcement of safety procedures;
7. transparent accident investigation;
8. recognition of safe behavior; and
9. allowing employees to stop dangerous work.

Research reviewing manufacturing safety-climate studies identifies management commitment and associated training and procedures among the most frequently examined safety dimensions.

Management commitment becomes especially important when safety conflicts with production targets. If supervisors communicate that output is more important than safety, employees may gradually develop unsafe norms. Conversely, when management consistently refuses to compromise safety requirements, workers receive a clear message that safety is a core organizational value.

VI. EMPLOYEE PARTICIPATION AND SAFETY CULTURE

A strong safety culture requires active participation from workers. Employees working directly with equipment and processes often have practical knowledge of hazards that may not be visible to senior management. Therefore, organizations should establish mechanisms through which employees can communicate safety concerns.

Employee participation may include:

1. safety committees;
2. toolbox meetings;
3. hazard identification exercises;
4. near-miss reporting;
5. safety suggestion systems;
6. workplace inspections;
7. incident investigations;
8. risk assessments; and
9. participation in safety training.

Worker participation also creates ownership of safety responsibilities. Instead of perceiving safety as something imposed by management, employees begin to view themselves as active contributors to workplace safety.

The ILO emphasizes cooperation and social dialogue as important elements in strengthening occupational safety and health systems.

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VII. SAFETY TRAINING AND AWARENESS

Training is another important mechanism through which safety culture influences OHS performance. Steel workers need both general and task-specific training because hazards vary substantially across departments.

Training should cover:

1. hazard identification;
2. safe operating procedures;
3. emergency response;
4. PPE selection and use;
5. machine guarding;
6. electrical safety;
7. fire safety;
8. chemical handling;
9. confined-space entry;
10. working at height;
11. lifting and crane operations;
12. lockout/tagout;
13. first aid; and
14. reporting of unsafe conditions.

Training should not be restricted to new employees. Refresher training should be conducted periodically and whenever processes, equipment, procedures, or hazards change.

Research examining incident patterns in an Indian steel plant specifically highlighted the importance of safety awareness and training, particularly for newly recruited and temporary workers who may be unfamiliar with the work environment.

VIII. SAFETY COMMUNICATION AND REPORTING

Effective communication is essential for maintaining a positive safety culture. Workers should be able to report hazards, unsafe behavior, equipment problems, and near misses without fear of punishment.

A strong reporting culture provides information about potential accidents before they result in serious harm. Therefore, organizations should establish:

1. confidential reporting mechanisms;
2. digital incident-reporting systems;
3. near-miss registers;
4. daily safety briefings;
5. toolbox talks;
6. safety alerts;
7. emergency communication procedures; and
8. feedback mechanisms.

Reporting should lead to corrective action. If employees repeatedly report hazards without seeing any response, their confidence in the safety system may decline.

IX. SUPERVISORY LEADERSHIP

Supervisors have a direct influence on employee behavior because they translate organizational policies into daily operational practices. A supervisor who consistently follows safety procedures provides a behavioral model for employees.

Effective safety supervision involves:

1. monitoring compliance;

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2. correcting unsafe practices;
3. encouraging questions;
4. communicating hazards;
5. conducting pre-job briefings;
6. checking PPE;
7. supporting stop-work authority; and
8. recognizing positive safety behavior.

Supervisory behavior is particularly important in steel plants where employees may encounter rapidly changing operational conditions. Research on safety climate has identified the supervisor's safety role as an important dimension associated with safety performance.

X. SAFETY CULTURE AND SAFE WORK BEHAVIOUR

Safety culture influences how workers interpret and respond to workplace hazards. A positive culture encourages workers to follow procedures even when supervisors are not directly observing them.

The relationship can be conceptualized as:

Safety Culture → Safety Awareness → Safe Work Behaviour → Reduced Exposure → Improved OHS Performance

However, the relationship is not automatic. Safe behavior also depends on equipment design, workload, work organization, competency, environmental conditions, and production pressures. Research in the steel industry supports a sociotechnical perspective in which technical and social factors jointly influence safe behavior.

XI. SAFETY CULTURE AND ACCIDENT PREVENTION

Accident prevention is one of the primary outcomes associated with effective safety culture. A positive culture promotes proactive hazard identification rather than relying only on accident investigation after an event occurs.

Table 2. Relationship Between Safety-Culture Components and OHS Outcomes

Safety-Culture Component	Expected Organizational Practice	Potential OHS Outcome
Management commitment	Visible leadership and resource allocation	Stronger safety compliance
Employee participation	Safety committees and reporting	Better hazard identification
Safety training	Regular competency development	Reduced unsafe behavior
Safety communication	Toolbox talks and safety alerts	Improved hazard awareness
Supervisor leadership	Active monitoring and coaching	Better procedural compliance
Near-miss reporting	Early identification of precursors	Preventive intervention
Safety procedures	Standardized operating practices	Reduced process deviations
Risk assessment	Systematic hazard evaluation	Better risk control
PPE management	Correct selection and use	Reduced exposure
Incident investigation	Root-cause analysis	Prevention of recurrence
Recognition systems	Rewarding safe practices	Positive safety motivation
Stop-work authority	Empowerment to interrupt unsafe work	Prevention of serious incidents

XII. RELATIONSHIP BETWEEN SAFETY CULTURE AND SAFETY PERFORMANCE

Occupational safety performance should not be measured solely by accident frequency. A comprehensive system should combine lagging indicators and leading indicators.

Table 3. Indicators for Measuring OHS Performance

Indicator Type	Indicator	Measurement Purpose
Lagging	Lost-time injury frequency	Measures injury occurrence
Lagging	Total recordable injuries	Measures recorded injury burden

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Lagging	Lost workdays	Measures severity/impact
Lagging	Occupational illness cases	Measures health outcomes
Lagging	Fatality rate	Measures catastrophic outcomes
Leading	Safety training completion	Measures competency development
Leading	Near-miss reports	Measures proactive reporting
Leading	Safety inspections	Measures preventive activity
Leading	Corrective-action closure	Measures response effectiveness
Leading	Safety observations	Measures behavior and hazard recognition
Leading	Risk assessments completed	Measures proactive risk management
Leading	Employee safety participation	Measures involvement
Leading	Safety-climate scores	Measures workforce perceptions

Manufacturing safety research recommends connecting safety-climate measurements with actual safety-performance data rather than relying exclusively on questionnaire scores.

XIII. SUGGESTED RESEARCH METHODOLOGY

For an empirical study, an explanatory cross-sectional research design can be adopted to examine the relationship between safety culture and OHS performance in steel production organizations.

A questionnaire can be administered to workers, supervisors, engineers, and safety personnel. A five-point Likert scale can be used, ranging from 1 = strongly disagree to 5 = strongly agree.

Table 4. Suggested Research Methodology

Component	**Proposed Approach**
Research design	Descriptive and explanatory
Study sector	Steel production
Target population	Workers, supervisors, engineers and safety personnel
Sampling	Stratified/random sampling
Primary tool	Structured questionnaire
Scale	Five-point Likert scale
Safety-culture dimensions	Management commitment, training, communication, participation, supervision, reporting
OHS-performance dimensions	Safety compliance, accident prevention, near-miss management, injury reduction
Secondary data	Accident records, inspection reports, safety audits
Reliability	Cronbach's alpha
Descriptive analysis	Mean, SD, frequency and percentage
Inferential analysis	Correlation, t-test/ANOVA
Relationship analysis	Multiple regression
Advanced analysis	SEM/PLS-SEM where appropriate
Significance level	0.05

A mixed approach using employee perceptions alongside objective safety records would provide stronger evidence than relying only on questionnaire responses. This is consistent with recommendations in the safety-climate literature to validate perceptual measures against actual safety-performance indicators.

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XIV. DISCUSSION

The literature indicates that safety culture should be understood as an organizational system rather than simply an employee-attitude problem. In steel production, unsafe outcomes can emerge from interactions among equipment, procedures, production pressure, supervision, worker competence, organizational communication, and management decisions. The steel-industry sociotechnical research demonstrates that safety hazards, safety culture, and production pressures can jointly influence employee safety behavior.

Evidence from the Taiwanese steel industry is also relevant because safety-climate scores were significantly associated with occupational accident rates, suggesting that employee perceptions of safety conditions can provide useful information about actual safety outcomes.

Similarly, research on safety-related incidents in an Indian steel plant identified practical opportunities for strengthening safety awareness and training, particularly among newer and temporary employees. These findings reinforce the importance of treating workers as participants in the safety system rather than merely as recipients of safety instructions.

The role of management is especially significant. If senior managers establish ambitious production targets without providing adequate resources for safety, employees may perceive an implicit conflict between production and safety. A mature safety culture instead integrates safety into production planning, maintenance, quality management, and operational decision-making.

XV. CHALLENGES IN DEVELOPING SAFETY CULTURE IN STEEL PRODUCTION

Several challenges may prevent organizations from developing a strong safety culture:

1. **Production pressure:** Employees may prioritize production targets over safety.
2. **Contract and temporary workforce:** Temporary workers may have limited familiarity with organizational procedures.
3. **Communication gaps:** Shift work and multilingual workforces can create communication challenges.
4. **Under-reporting:** Workers may hesitate to report near misses because of fear of blame.
5. **Inadequate supervision:** Weak supervisory monitoring can allow unsafe practices to become normalized.
6. **Training limitations:** One-time training may not produce sustained behavioral change.
7. **Paper-based compliance:** Organizations may focus on documentation rather than actual risk control.
8. **Weak corrective action:** Repeated hazards may remain unresolved.
9. **Normalization of deviance:** Repeated exposure to unsafe conditions without incidents can create false confidence.
10. **Lack of worker involvement:** Employees may not be sufficiently involved in hazard identification and risk assessment.

XVI. STRATEGIES FOR STRENGTHENING SAFETY CULTURE

Steel organizations can improve safety culture through an integrated approach.

Table 5. Safety-Culture Improvement Strategies

Strategy	Implementation
Visible leadership	Managers conduct regular safety walks
Worker participation	Establish active safety committees
Training	Conduct regular task-specific and refresher training
Near-miss reporting	Introduce simple non-punitive reporting
Safety audits	Conduct regular behavioral and system audits
Risk management	Update risk assessments after process changes
Supervisor development	Train supervisors in safety leadership
Safety communication	Use toolbox talks and multilingual safety materials

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Recognition	Recognize teams demonstrating positive safety practices
Corrective actions	Track hazards until closure
Digitalization	Use digital incident and inspection systems
Stop-work authority	Empower workers to stop unsafe operations
Performance management	Include leading safety indicators in management reviews

XVI. CONCLUSION

Safety culture plays a critical role in improving occupational health and safety performance in steel production. The complexity and severity of hazards within steel manufacturing mean that technical safeguards alone cannot provide sufficient protection. A sustainable safety system requires management commitment, employee participation, effective supervision, continuous training, transparent communication, proactive hazard identification, near-miss reporting, and consistent enforcement of safe work procedures.

The literature shows that safety culture and safety climate are meaningfully connected with safety behavior and accident outcomes. Research in the steel industry indicates that social, technical, organizational, and production-related factors can influence safe behavior, while evidence from Taiwan demonstrates a significant association between safety-climate scores and occupational accident rates.

Therefore, steel organizations should move from a reactive approach—where safety management begins after an accident—to a proactive approach based on prevention, participation, learning, and continuous improvement. Safety should be incorporated into production planning rather than treated as a competing objective. Management should measure not only injuries and accidents but also leading indicators such as safety observations, training effectiveness, near-miss reporting, hazard-correction rates, employee participation, and safety-climate perceptions.

Ultimately, a strong safety culture creates an organizational environment in which employees understand hazards, managers demonstrate commitment, supervisors reinforce safe behavior, and workers feel empowered to report and control risks. Such a culture can contribute to safer workplaces, improved occupational health, stronger employee engagement, reduced operational disruption, and more sustainable steel production.

REFERENCES

1. Brown, K. A., Willis, P. B., & Prussia, G. E. (2000). Predicting safe employee behavior in the steel industry: Development and test of a sociotechnical model. *Journal of Operations Management, 18*(4), 445–465.
2. International Labour Organization. (2022). *A safe and healthy working environment is a fundamental principle and right at work*. International Labour Organization.
3. International Labour Organization. (2022). *Social dialogue for safe workplaces*. International Labour Organization.
4. International Labour Organization. (2024). *Occupational safety and health*. International Labour Organization.
5. Singh, V., & Verma, A. (2020). A review, simple meta-analysis and future directions of safety climate research in manufacturing organizations. *International Journal of Occupational Safety and Ergonomics, 26*(4), 678–704.
6. Schwatka, N. V., Hecker, S., & Goldenhar, L. M. (2016). Defining and measuring safety climate: A review of the construction industry literature. *Annals of Occupational Hygiene, 60*(5), 537–550.
7. Teoh, K. R. H., et al. (2018). Practical application of safety climate: A case study in the Taiwanese steel industry. *International Journal of Industrial Ergonomics, 67*, 67–72.