

Qualitative Assessment of Factors Contributing to Occupational Incidents in Large Construction Projects in India

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Abstract

The construction industry is characterized by dynamic work environments, changing site conditions, multiple contractors, complex work activities, heavy equipment, temporary structures, and significant interaction between workers and machinery. These characteristics make occupational safety management particularly challenging. In India, construction-worker health and safety research has examined safety management, safety climate, safety performance, behavior-based safety and occupational health issues, but systematic approaches to understanding the multiple and interconnected causes of incidents remain an important area for further investigation. ScienceDirect

This study proposes a qualitative investigation of factors contributing to occupational incidents in large construction projects in India. The research focuses on **human, organizational, supervisory, technical, environmental and project-related factors**. A qualitative methodology involving semi-structured interviews, focus-group discussions, site observations, document review and thematic analysis is proposed. Incident and near-miss records can be analyzed to identify recurring causal patterns. Previous construction-accident research indicates that worker actions, risk management, immediate supervision, equipment/material factors, local hazards, worker capabilities and project management can interact in the causal chain of incidents. ScienceDirect

The proposed study aims to move beyond identifying immediate unsafe acts and examine underlying organizational and management factors. The resulting framework can support improved hazard identification, risk assessment, safety culture, supervision, training, contractor management and incident-prevention strategies in large construction projects in India.

Keywords: Construction safety, occupational incidents, accident causation, qualitative research, construction projects, safety management, human factors, organizational factors, HIRA, India.

Introduction

Construction is one of the most complex industrial environments because work conditions change continuously as a project progresses. Workers may simultaneously perform activities involving excavation, scaffolding, lifting, electrical installation, concrete work, welding, work at height, material transportation and heavy equipment operation.

Large construction projects introduce additional complexity because they generally involve:

- Large and diverse workforces.
- Multiple contractors and subcontractors.
- Different levels of worker experience.
- Simultaneous work activities.
- Complex project schedules.

- Heavy machinery.
- Temporary structures.
- Changing environmental conditions.
- Multiple management levels.
- Communication challenges.

A systematic review of construction-worker health and safety research in India found that major research themes include safety management, safety climate, safety performance, musculoskeletal disorders and behavior-based safety. The review also identified opportunities for stronger theoretical foundations in Indian construction-safety research. ScienceDirect

Construction incidents should therefore not automatically be attributed to worker behavior alone. Research using the Construction Accident Causation framework found strong relationships among **worker actions, risk management and immediate supervision**, demonstrating that incident causation can involve multiple interconnected levels. ScienceDirect

This research consequently adopts a **systems-oriented qualitative approach** to examine why incidents occur and what organizational conditions may contribute to them.

Problem Statement

Traditional accident investigations sometimes focus heavily on the immediate unsafe act—for example:

“Worker was not wearing PPE.”

However, such a conclusion may not explain why the unsafe act occurred.

A deeper investigation may identify questions such as:

- Was appropriate PPE available?
- Was the worker trained?
- Was the task adequately planned?
- Was the worker under time pressure?
- Was supervision adequate?
- Were PPE requirements communicated?
- Did the supervisor observe the activity?
- Was the work procedure practical?
- Were contractors properly managed?
- Was there a conflict between productivity and safety?
- Had similar near misses occurred previously?

Research on construction accident causation emphasizes this type of interconnected relationship between worker actions, supervision and risk management. ScienceDirect

Objectives

The study has the following objectives:

1. To identify common occupational incidents occurring in large construction projects.
2. To identify immediate causes associated with construction incidents.

3. To investigate underlying human and organizational factors.
4. To examine the influence of safety management practices on incident occurrence.
5. To assess the role of supervision and communication in incident causation.

Literature Review

Construction safety in India

Indian construction-safety research has identified several important challenges, including communication problems, inadequate PPE use, insufficient training, psychological factors such as stress and burnout, weak safety culture and challenges in compliance. ScienceDirect

A study specifically examining safety performance in the Indian construction industry developed a framework of safety indicators and reported that management involvement in site operations and safety training were important aspects of safety performance. ScienceDirect

These findings suggest that construction safety is influenced by both **individual behavior and organizational systems**.

Human factors

Human factors may include:

- Knowledge.
- Skills.
- Experience.
- Risk perception.
- Fatigue.
- Motivation.
- Attention.
- Decision-making.
- Safety awareness.
- Stress.

However, human error should not automatically be considered the final cause of an incident.

For example:

Worker error

↓

Insufficient training

↓

Inadequate supervision

↓

Weak competency-management system

This provides a more useful explanation than simply recording “worker negligence.”

Organizational factors

Organizational factors may include:

- Safety policies.
- Management commitment.
- Safety culture.
- Resource allocation.
- Contractor management.
- Communication.
- Safety staffing.
- Training systems.
- Work planning.
- Production pressure.

A review of construction-safety research identified a broad range of factors influencing safety performance, reflecting the dynamic and temporary nature of construction work. ScienceDirect

Supervision

Supervisors are an important link between management policies and actual site activities.

Supervisors influence:

- Work planning.
- Hazard identification.
- Permit compliance.
- PPE use.
- Work sequencing.
- Communication.
- Immediate correction of unsafe conditions.

Research into construction accident causation found immediate supervision to be strongly connected with both worker actions and risk management. ScienceDirect

Safety culture

Safety culture represents the shared attitudes, beliefs and practices concerning safety within an organization.

Indicators may include:

- Management commitment.
- Open reporting.
- Worker involvement.
- Learning from incidents.
- Safety communication.
- Fair treatment.
- Visible safety leadership.

A strong safety culture should encourage workers to report hazards and near misses without fear of inappropriate retaliation.

Incident-Causation Framework

The study can classify factors into six major categories.

Individual factors

- Lack of experience.
- Insufficient knowledge.
- Fatigue.
- Stress.
- Risk perception.
- Unsafe behavior.

Task-related factors

- Complex work.
- Poor work planning.
- Inadequate procedures.
- Simultaneous activities.
- Inappropriate sequencing.

Supervisory factors

- Inadequate supervision.
- Poor communication.
- Failure to enforce procedures.
- Inadequate toolbox meetings.
- Insufficient field monitoring.

Organizational factors

- Weak safety culture.
- Production pressure.
- Inadequate resources.
- Poor contractor management.
- Inadequate training systems.

Technical factors

- Defective equipment.
- Inadequate guarding.
- Poor maintenance.
- Improper tools.
- Equipment incompatibility.

Environmental factors

- Heat.

- Rain.
- Wind.
- Dust.
- Noise.
- Poor lighting.
- Congested work areas.

Data Collection

Semi-structured interviews

Interview questions may include:

1. What are the most common safety incidents on this project?
2. What do you believe are the major causes?
3. What conditions typically exist before an incident occurs?
4. How effective is supervision?
5. Are workers adequately trained?
6. How are near misses reported?
7. What role does production pressure play?
8. How effectively are contractors managed?
9. What safety procedures are difficult to implement?
10. What changes could prevent similar incidents?

Site observations

The researcher can observe:

- PPE compliance.
- Housekeeping.
- Work-at-height practices.
- Lifting operations.
- Electrical work.
- Scaffolding.
- Excavation.
- Traffic management.
- Material storage.
- Worker-supervisor interaction.

Observation data can then be compared with interview responses.

Document review

Documents may include:

- Accident reports.
- Near-miss reports.
- Safety inspection records.
- Toolbox-talk records.
- Training records.
- Permit-to-work records.

- Risk assessments.
- Method statements.
- Audit reports.
- Corrective-action records.

Qualitative Data Analysis

The recommended analytical method is **thematic analysis**.

The process can involve:

Step 1: Familiarization

Read interview transcripts and observation notes repeatedly.

Step 2: Initial coding

Identify important statements.

Example:

“We had very little time to finish the work.”

Code:

Time pressure

Step 3: Categorization

Group similar codes:

- Time pressure.
- Workload.
- Overtime.

→ **Production/work-pressure factors**

Step 4: Theme development

Potential themes include:

- Safety-management weaknesses.
- Human factors.
- Supervision.
- Communication.
- Contractor management.
- Work pressure.
- Training and competency.
- Equipment and maintenance.

Step 5: Causal interpretation

Examine how the themes interact.

Major Factors to Investigate

Training and competency

Questions include:

- Are workers trained before assignment?
- Is training task-specific?
- Are competencies verified?
- Is refresher training provided?
- Are language barriers addressed?

Communication

Potential problems include:

- Language differences.
- Poor shift handover.
- Inadequate toolbox meetings.
- Poor communication between contractors.
- Incomplete permit information.

Communication has been identified as one of the safety challenges discussed in research on the Indian construction sector. ScienceDirect

Contractor management

Large projects frequently involve multiple contractors.

Potential issues include:

- Different safety standards.
- Inconsistent training.
- Poor coordination.
- Unclear responsibilities.
- Inadequate supervision.

Production pressure

Construction projects operate under schedule and cost constraints.

Potential consequences include:

- Shortcuts.
- Reduced inspection.
- Overtime.
- Fatigue.
- Inadequate planning.

Research on construction safety has also examined stress and its relationship with unsafe behavior, indicating that occupational stress can be relevant to construction safety analysis.

Safety Performance Indicators

The study can evaluate both leading and lagging indicators.

Leading indicators

- Safety training completion.
- Toolbox talks.
- Safety inspections.
- Hazard observations.
- Near-miss reporting.
- Corrective-action closure.
- Permit compliance.
- Equipment inspections.
- Safety audits.
- Worker participation.

Lagging indicators

- Lost-time injuries.
- Recordable injuries.
- Falls.
- Struck-by incidents.
- Equipment-related incidents.
- Electrical incidents.
- Property damage.
- Lost workdays.

Indian construction research has also developed frameworks for identifying and evaluating safety-performance indicators, demonstrating the potential for systematic measurement of construction safety performance. ScienceDirect

Recommendations

1. Strengthening task-specific safety training.
2. Improving competency assessment for high-risk activities.
3. Increasing field-level safety supervision.
4. Strengthening contractor safety management.
5. Improving communication between contractors and project management.
6. Integrating worker feedback into risk assessments.
7. Strengthening near-miss reporting and learning.
8. Investigating underlying causes rather than assigning blame solely to workers.
9. Improving management of work-related fatigue and excessive workload.
10. Regularly reviewing HIRA and method statements.
11. Strengthening safety inspections for temporary structures and equipment.
12. Monitoring leading safety indicators.
13. Sharing lessons learned across different project areas.
14. Establishing a systematic closure-and-verification process for corrective actions.

Research Limitations

Potential limitations include:

- Workers may be reluctant to discuss incidents openly.
- Incident records may be incomplete.
- Recall bias may affect interviews.
- Contractors may have different reporting practices.
- Findings from one project may not be directly generalizable to all Indian construction projects.
- Qualitative interpretation involves researcher judgment.

These limitations can be reduced through **triangulation**, using interviews, observations and documentary evidence together.

Conclusion

Occupational incidents in large construction projects are complex events influenced by interactions between workers, tasks, equipment, supervision, organizational systems and environmental conditions. Research on construction accident causation demonstrates that worker actions, risk management and immediate supervision can be strongly interconnected rather than independent causes.

In the Indian context, existing literature also highlights challenges involving communication, training, PPE use, safety culture, work practices and psychosocial factors. ScienceDirect

This paper proposes a qualitative methodology based on interviews, focus groups, site observations, incident records and document analysis. Thematic analysis combined with root-cause analysis can provide a more comprehensive understanding of why incidents occur.

The proposed approach shifts the focus from **“Who made the mistake?”** toward **“What conditions allowed the incident to occur?”** This systems-oriented perspective can help large construction organizations identify weaknesses in safety management, supervision, training, contractor coordination, risk assessment and organizational culture.

Ultimately, effective incident prevention requires not only correcting unsafe acts but also identifying and controlling the **underlying conditions and organizational factors** that allow unsafe situations to develop.

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