

ACHIEVING ZERO ACCIDENTS THROUGH THE CREATION OF A CONDUCTIVE ORGANIZATIONAL CLIMATE IN THE IMPLEMENTATION OF NATIONAL STRATEGIC PROJECTS (PSN): A CASE STUDY AT PT INDONESIA POMALAA INDUSTRI PARK (IPIP), KOLAKA REGENCY, SOUTHEAST SULAWESI PROVINCE

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Abstract

The implementation of National Strategic Projects (National Strategic Projects/PSN) in industrial areas characterized by high-risk activities presents significant occupational safety and health (OSH) challenges that are associated not only with technical conditions but also with the quality of the organizational and safety climates. This study aims to analyze the influence of organizational climate on safety climate, safety knowledge, safety motivation, and safety behavior as mechanisms for achieving zero accidents in the implementation of a National Strategic Project at PT Indonesia Pomalaa Industri Park (IPIP), Kolaka Regency, Southeast Sulawesi, Indonesia. The study employs a quantitative approach using an explanatory research design. The proposed analytical framework utilizes Partial Least Squares Structural Equation Modeling (PLS-SEM). The model consists of 240 workers and contractor personnel as a synthetic dataset intended to demonstrate the analytical framework, while accident indicators are incorporated to establish the relationship between safety climate and lagging safety indicators. The study variables consist of organizational climate, safety climate, safety knowledge, safety motivation, and safety behavior. The research instrument consists of 36 statements measured using a five-point Likert scale. The synthetic model results indicate that all constructs meet the required reliability criteria, with Cronbach's Alpha values ranging from 0.812 to 0.921 and Composite Reliability values ranging from 0.868 to 0.938. The Average Variance Extracted (AVE) values range from 0.588 to 0.686, while all HTMT values are below the threshold of 0.90. Safety climate is positively influenced by organizational climate, with a path coefficient of 0.755. Safety knowledge and safety motivation are positively influenced by safety climate, with path coefficients of 0.678 and 0.721, respectively. Furthermore, safety behavior is positively influenced by safety knowledge, safety motivation, and safety climate, with path coefficients of 0.315, 0.402, and 0.219, respectively. The R^2 value of 0.690 for safety behavior indicates substantial explanatory power of the structural model. Based on the synthetic safety dataset consisting of 2,400,000 working hours, the LTIFR, TRIFR, and severity rates were 2.50, 6.67, and 30.00, respectively. These findings support Zohar's perspective that safety climate represents employees' shared perceptions regarding the organizational priority given to safety, as well as the Griffin and Neal model, which explains the roles of safety knowledge and safety motivation as mechanisms leading to safety performance. Clarke's meta-analytic findings further provide a theoretical basis for understanding that safety climate is more consistently associated with safety compliance and safety participation than with direct accident outcomes. This study emphasizes that zero accidents should not be positioned solely as a statistical target, but rather as an outcome of a consistent, participatory, and learning-oriented organizational safety system.

Keywords: organizational climate, safety climate, safety behavior, zero accidents, occupational safety and health, National Strategic Projects, IPIP, PLS-SEM.

INTRODUCTION

Occupational safety and health are fundamental components of successful industrial development, particularly in large-scale projects involving construction, heavy equipment, material mobilization, mechanical and electrical work, lifting, hot work, work at height, and the interaction of various contractors and subcontractors. In

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national strategic projects, success is determined not only by achieving investment, construction, production, and employment targets, but also by the organization's ability to maintain worker safety throughout the entire work cycle. PT Indonesia Pomalaa Industry Park (IPIP) is part of the industrial estate development in Pomalaa, Kolaka Regency, Southeast Sulawesi. The government once projected the IPIP development area to cover approximately 11,808 hectares, with an investment of approximately USD 100 billion, and the potential employment of approximately 50,000–100,000 people. These figures are government projections and cannot be used as an indication of IPIP's actual workforce during the study period. However, the scale of the project demonstrates the significant organizational complexity and potential risk exposures inherent in industrial estate development. In this context, safety cannot be understood solely as a matter of individual compliance with the use of personal protective equipment (PPE). Safety is the product of the interaction between organizational policies, leadership, communication, competence, supervision, worker participation, working conditions, contractor systems, and operational decisions. This perspective aligns with the concept of safety climate systematically introduced by Zohar. Zohar views safety climate as workers' perceptions of the relative importance of safe behaviors in their work. His initial study used a 40-item instrument to measure perceptions of safety climate in industrial organizations and demonstrated that the level of safety climate is related to the effectiveness of safety programs.

This concept was later developed by Griffin and Neal. They differentiated safety climate, as the perception of the safety environment, from safety performance, as actual safety-related behavior. They also distinguished between safety compliance and safety participation and demonstrated the role of safety knowledge and safety motivation in the relationship between safety climate and safety performance. In the context of industrial estate projects, this framework becomes even more important because there are likely to be differences in safety perceptions among management, supervisors, direct workers, contractors, and outsourced workers. A sound OHS policy at the management level may not necessarily result in the same safety behavior if the safety message changes at the supervisory level or when faced with time pressures and production targets.

A study by Neal, Griffin, and Hart also showed that general organizational climate can influence safety climate, while safety climate is related to safety compliance and participation. This influence is partially mediated by safety knowledge and motivation. Thus, the term "conductive organizational climate" in this study is not simply interpreted as a comfortable working atmosphere. From an OHS perspective, a conducive organizational climate is a condition where workers receive a consistent organizational message that safety is a core value, receive support for safe work, have the opportunity to report hazards, and perceive that management decisions are consistent with safety policies.

The local context of the research is important because there was news coverage of a workplace accident within the IPIP project area in April 2025. At a Southeast Sulawesi Regional People's Representative Council (DPRD) forum in May 2025, IPIP management provided an explanation of two workplace accidents on April 13 and 16, 2025, including one fatality and one involving an outsourced worker operating a dump truck. This information is used in this research as a secondary context and not as a substitute for the company's official investigation report. Incidents involving relationships between project owner companies, contractors, outsourcing companies, operators and vehicles indicate what is referred to in this study as **interface risk**, namely the risk that arises at the point of interaction between organizations.

The simple model:

IPIP → contractor → subcontractor → outsourcing → worker/operator

In each of these relationships there is a need to ensure:

- competence;
- communication;
- induction;
- HIRADC/JSA;
- work permit;
- supervision;
- equipment inspection;
- reporting;
- investigation;
- corrective action.

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If any link in the chain fails, the overall safety system can be weakened. Therefore, achieving zero accidents cannot be solely the responsibility of HSE officers. Zero accidents is the result of an organizational system involving top management, project managers, HSE, supervisors, contractors, subcontractors, operators, and all workers.

The main problem of this research is how to create a conducive organizational climate so that a safety climate develops into safety behaviors and ultimately contributes to a reduction in accidents. More specifically, this research answers the following questions:

Does organizational climate influence safety climate ?

Does safety climate affect safety knowledge ?

Does safety climate affect safety motivation ?

Does safety knowledge influence safety behavior ?

Does safety motivation influence safety behavior ?

Does safety climate have a direct influence on safety behavior ?

How much is the model able to explain safety behavior ?

What is the position of the LTIFR, TRIFR, frequency rate , and severity rate indicators as safety outcome indicators?

LITERATURE REVIEW

Organizational climate describes the shared perceptions of employees towards the policies, practices, values, leadership, communication and decision-making patterns within the organization. In the context of K3, organizational climate is the basis that influences how workers interpret company priorities. If an organization states safety as a priority but rewards workers primarily based on production speed, workers may receive the implicit message that production is more important than safety. Conversely, if the organization grants the authority to stop work when risks become unmanageable, then workers receive the message that safety has organizational legitimacy. Zohar views safety climate as workers' perceptions of the importance of safety in their work behavior. This concept is important because safety policies are not only understood from formal documents, but also from workers' experiences with the organization's concrete actions. In this study, safety climate is operationalized through: management commitment, safety leadership, safety communication, policies/procedures, worker participation, training and competence.

Griffin and Neal developed a framework that positions safety climate as an antecedent to safety performance . They differentiate between safety compliance and safety participation and include safety knowledge and safety motivation as important mechanisms. This research model adapts the framework: Safety Climate → Safety Knowledge, Safety Climate → Safety Motivation , Knowledge + Motivation → Safety Behavior Clarke's meta-analysis supports the relationship between safety climate and safety compliance and safety participation , with the relationship with safety participation being stronger. The direct relationship with accidents is weaker and influenced by study design. The implication is that zero accidents should not be treated as a direct result of a single safety climate score . There needs to be a behavioral mechanism that bridges the two.

RESEARCH METHODS

This research uses a quantitative approach with an explanatory research design . The aim is to test the theoretical causal relationships between latent variables.

The research location is the implementation environment of the national strategic project at PT Indonesia Pomalaa Industry Park, Kolaka Regency, Southeast Sulawesi.

The target population consists of workers involved in project activities, including direct workers, supervisors, operators, HSE personnel and contractor/subcontractor workers. For statistical design purposes, 240 respondents were used .

Synthetic distribution:

Group	n	Percentage
Operator/field worker	126	52.5%
Supervisor/foreman	42	17.5%
HSE/K3	24	10.0%
Technician/maintenance	30	12.5%
Administration/support	18	7.5%
Total	240	100%

The composition is a synthetic dataset design, not an actual IPIP composition.

3.3 Research Instruments

The questionnaire uses a Likert scale:

1 = strongly disagree

2 = disagree 3 = neutral 4 = agree 5 = strongly agree.

The instrument consists of 36 items.

Table 1. Instrument Grid

Variables	Code	Amount
Organizational Climate	IO1–IO6	6
Safety Climate	SC1–SC8	8
Safety Knowledge	SK1–SK6	6
Safety Motivation	SM1–SM6	6
Safety Behavior	SB1–SB10	10
Total		36

Questionnaire

A. Organizational Climate

IO1. Management pays real attention to worker safety.

IO2. Organizational decisions take safety into account in addition to production targets.

IO3. Supervisors provide examples of safe work behavior.

IO4. Workers have the opportunity to raise safety concerns.

IO5. The organization provides support when workers stop unsafe work.

IO6. Communication between management and workers is open regarding OHS issues.

B. Safety Climate

SC1. Safety is the top priority in carrying out work.

SC2. The company consistently enforces K3 procedures.

SC3. K3 violations are followed up fairly.

SC4. Supervisor actively monitors safety conditions.

SC5. Information regarding job hazards is provided before work begins.

SC6. Changes in work conditions are followed by risk evaluation.

SC7. Safety remains a priority when work targets are under pressure.

SC8. Workers feel that the company is serious about preventing accidents.

C. Safety Knowledge

SK1. I understand the main hazards of my job.

SK2. I understand safe work procedures.

SK3. I understand the appropriate use of PPE.

SK4. I understand emergency procedures.

SK5. I am able to recognize unsafe conditions.

SK6. I understand the risk control measures for my work.

D. Safety Motivation

SM1. I am motivated to work in a safe manner.

SM2. I am willing to put in the time to ensure the job is safe.

SM3. I consider safety an important part of the job.

SM4. I still try to work safely even though the work is being chased by targets.

SM5. I feel responsible for the safety of myself and my coworkers.

SM6. I am willing to report conditions that have the potential to cause accidents.

E. Safety Behavior

SB1. I always use PPE according to the job risks.

SB2. I follow established work procedures.

SB3. I check equipment before use.

SB4. I take the toolbox meeting seriously.

SB5. I am reporting a dangerous condition.

SB6. I reported a near miss .

SB7. I alert my coworkers when I see unsafe behavior.

SB8. I stop work if the risk cannot be controlled.

SB9. I follow the supervisor's safety instructions.

SB10. I participate in K3 improvement activities.

Analysis Techniques

Analysis using PLS-SEM goes through two stages:

Stage 1 — Outer model

Includes: outer loading, Cronbach's Alpha, Composite Reliability, AVE;HTMT.

Stage 2 — Inner model

Includes: path coefficient; R²; effect size; predictive relevance; bootstrapping; indirect effects.

In PLS-SEM, bootstrapping is a nonparametric resampling procedure used to obtain standard errors , t-statistics, and confidence intervals. SmartPLS recommends a large subsample size for the final analysis; 10,000 subsamples are commonly used.

For discriminant validity , HTMT is used as a more modern criterion than relying solely on Fornell–Larcker and cross-loadings; HTMT values below 0.90 are generally used as an indication of discriminant validity.

RESEARCH RESULT

Respondent Characteristics

A synthetic dataset of 240 respondents yielded the following characteristics:

Characteristics	Category	n
Gender	Man	221
	Woman	19
Age	<25 years	32
	25–34 years	86
	35–44 years	78
	≥45 years	44
Years of service	<2 years	48
	2–5 years	74
	6–10 years	66
	>10 years	52
Education	High School/Vocational School	136
	Diploma	42
	Bachelor	58
	Postgraduate	4

These characteristics show the dominance of operational workers and productive age groups.

Descriptive Statistics

Table 2. Descriptive Statistics of Variables

Variables	Mean	Elementary School	Index
Organizational Climate	4.06	0.51	81.2%
Safety Climate	3.94	0.54	78.8%
Safety Knowledge	4.09	0.48	81.8%
Safety Motivation	4.01	0.52	80.2%
Safety Behavior	4.03	0.49	80.6%

The average safety climate value was 3.94 on a scale of 5 or 78.8%.

These findings indicate a relatively positive perception, but do not yet depict a fully mature safety system.

Outer Model Evaluation

Table 3. Reliability and Convergent Validity Values

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Construct	Cronbach's Alpha	Composite Reliability	AVE
Organizational Climate	0.884	0.912	0.634
Safety Climate	0.921	0.938	0.656
Safety Knowledge	0.812	0.868	0.588
Safety Motivation	0.846	0.885	0.563
Safety Behavior	0.909	0.925	0.551

All Cronbach's Alpha values were above 0.70. Composite Reliability also exceeded 0.70. The AVE values for all constructs were greater than 0.50. Thus, the measurement model met the criteria for reliability and convergent validity in the synthetic dataset.

Outer Loading

Table 4. Outer Loading

Construct	Loading Range
Organizational Climate	0.741–0.871
Safety Climate	0.752–0.891
Safety Knowledge	0.731–0.824
Safety Motivation	0.728–0.846
Safety Behavior	0.719–0.861

All indicators are above the practical limit of 0.70.

This means that each indicator has an adequate contribution in representing the latent construct.

Discriminant Validity

Table 5. HTML

Connection	HTML
IO–SC	0.781
IO–SK	0.694
IO–SM	0.721
IO–SB	0.748
SC–SK	0.812
SC–SM	0.846
SC–SB	0.871
SK–SM	0.763
SK–SB	0.821
SM–SB	0.858

The highest value was 0.871 for the relationship between safety climate and safety behavior , still below 0.90. Thus, discriminant validity was met in the model dataset.

Inner Model

The structural model produces:

Table 6. R²

Endogenous Variables	R ²	Interpretation
Safety Climate	0.570	Medium–strong
Safety Knowledge	0.460	Currently
Safety Motivation	0.520	Currently
Safety Behavior	0.690	Substantial

The R² value of safety climate of 0.570 means that approximately 57.0% of the variation in safety climate can be explained by the organizational climate in the model.

The R² value for safety behavior of 0.690 means that approximately 69.0% of the variation in safety behavior is explained by safety climate , safety knowledge , and safety motivation .

This value is the result of a synthetic dataset and not the result of IPIP's empirical measurements.

Path Coefficient and Bootstrapping
Table 7. Hypothesis Testing Results

Hypothesis	Track	β	t-statistic	p-value	Decision
H1	IO $\rightarrow$ SC	0.755	15,842	<0.001	Accepted*
H2	SC $\rightarrow$ SK	0.678	10,214	<0.001	Accepted*
H3	SC $\rightarrow$ SM	0.721	12,486	<0.001	Accepted*
H4	SK $\rightarrow$ SB	0.315	4,782	<0.001	Accepted*
H5	SM $\rightarrow$ SB	0.402	6,215	<0.001	Accepted*
H6	SC $\rightarrow$ SB	0.219	3,674	<0.001	Accepted*

*The “accepted” status applies only to synthetic datasets used as model demonstrations.

The results show that the largest path is: **Organizational Climate $\rightarrow$ Safety Climate = 0.755** . This indicates that organizational climate is an important foundation in forming safety perceptions.

The second strong path is: **Safety Climate $\rightarrow$ Safety Motivation = 0.721** Meanwhile: **Safety Climate $\rightarrow$ Safety Knowledge = 0.678**. These findings are in accordance with Griffin and Neal's framework that safety climate is an antecedent of knowledge and motivation which are then related to safety performance .

Mediation Analysis

The indirect effect is calculated as: (IO $\rightarrow$ SC $\rightarrow$ SB) ($0.755 \times 0.219 = 0.165$) However, there is a longer indirect path through safety knowledge : ($0.755 \times 0.678 \times 0.315$) (=0.161)

Meanwhile, through safety motivation :

($0.755 \times 0.721 \times 0.40$) (=0.219) Thus, in the model dataset, the mediation path through safety motivation is greater than through safety knowledge . This implies that knowing safety procedures alone is not enough. Knowing how to work safely , but not being motivated to work safely , does not necessarily result in consistent behavior.

Overall Model

The structural model can be written:

$$(SC = 0.755(IO) + e)$$

$$(SK = 0.678(SC) + e)$$

$$(SM = 0.721(SC) + e)$$

$$(SB = 0.315(SK) + 0.402(SM) + 0.219(SC) + e)$$

The model shows that safety behavior is the result of a combination of: perceptions of safety climate, safety knowledge, safety motivation.

Accident Indicator Analysis

To integrate the objective K3 indicators, a synthetic safety dataset was used:

Indicator	Mark
Average worker	1,200
Working days	250
Hours/days	8
Total working hours	2,400,000
Fatality	1
nonfatal LTI	5
Total LTI	6
Medical Treatment Case	7
Restricted Work Case	3
Total Recordable Cases	16
Lost days	72
Near miss	186
Unsafe condition	742
Unsafe act	518
Indicator	Mark

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Total LTI	6
Medical Treatment Case	7
Restricted Work Case	3
Total Recordable Cases	16
Lost days	72
Near miss	186
Unsafe condition	742
Unsafe act	518
Safety observation	1,284
Corrective actions	1,126
Closed actions	1,074

Total working hours: 2,400,000

LTIFR

Formula $(LTIFR = \frac{LTI}{\text{Total Hours/Work}} \times 1,000,000)$

$(LTIFR = \frac{6}{2,400,000} \times 1,000,000)$

$(= \mathbf{2.50})$

Thus:

LTIFR = 2.50 cases per million hours worked.

TRIFR

Formula $[TRIFR = \frac{TRC}{\text{Total Hours/Work}} \times 1,000,000]$

$(TRIFR = \frac{16}{2,400,000} \times 1,000,000)$ $(= \mathbf{6.67})$

Thus **TRIFR = 6.67 cases per million working hours.**

Because the frequency rate in the model uses the definition of total recordable cases per million work hours, its value is the same as TRIFR: **Frequency Rate = 6.67**. In the final article, the indicator definition must be adjusted to the company's OHS reporting standards to avoid mixing definitions between standards.

Severity Rate

With 72 lost work days: $(SR = \frac{72}{2,400,000} \times 1,000,000)$ $(= \mathbf{30.00})$ So **Severity Rate = 30 lost days per million work hours.**

The severity rate calculation method must adhere to the company's definitions and conventions/reporting standards. For fatalities, in particular, some systems use specific standard workday rules. Therefore, the 30.00 figure in this model uses 72 actual/synthetic lost days, not the assumed number of lost days for fatalities.

Near Miss Rate

With 186 near misses :

$(NMR = \frac{186}{2,400,000} \times 1,000,000)$ $(= \mathbf{77.5})$

It means:

77.5 near misses per million hours worked.

An increase in near-miss reporting doesn't necessarily mean worsening safety performance. In organizations building a learning culture, increased reporting can indicate increased employee transparency.

What is more important is:

Near miss → investigation → corrective action → verification → learning.

Corrective Action Closure

$[Closure = \frac{1,074}{1,126} \times 100]$

($\approx 95.38\%$)

Thus the level of completion of corrective action is:

95.4%.

This figure indicates that most of the findings have been followed up.

However, closure rates alone are not enough. Organizations must evaluate whether these measures are truly effective.

Unsafe Conditions and Unsafe Act

Total findings:

(742+518=1,260) Proportion of unsafe conditions : 58.9%) Proportion of unsafe acts : 41.1%)

This finding has important implications.

As many as 58.9% fall into the unsafe condition category. Therefore, OHS programs should not focus too much on individual errors. If workers are consistently told, "Don't commit unsafe acts,"

but the work environment still: has unclear vehicle paths; inadequate lighting; inadequate barriers; poorly maintained equipment; unsafe work access, then the organization takes an overly individual approach.

The model results show a coefficient: ($IO \rightarrow SC = 0.755$) This is the strongest path in the model.

Conceptually, these findings mean that the more conducive the organizational climate, the stronger the employee perception that safety is a real priority. This finding is consistent with research by Neal, Griffin, and Hart, which shows that the general organizational climate influences safety climate, while safety climate is then related to safety behavior. In the context of IPIP, organizational climate must be translated into concrete actions. For example, if a project is delayed and the work must be completed on the same day, the supervisor's decision will become the organizational message.

If a supervisor says, "Continue work even if controls are incomplete," then the message to workers is that production is more important. Conversely, if "Work will be halted until the risk is controlled," then the organization is sending the message that safety is a real priority. This aligns with Zohar's idea that safety climate is related to workers' perceptions of the relative importance of safety in work behavior.

Safety Climate as Shared Perception

One of the strengths of the safety climate concept is that safety is not just an individual attitude. Workers may have good safety attitudes individually, but if the work group puts pressure on them to meet targets, actual behavior may vary. Therefore, research should not simply ask, "Do you care about safety?" but, "Does the organization support you in working safely?" The second question is more closely aligned with the safety climate concept.

Safety Climate and Safety Knowledge

The coefficient: [$SC \rightarrow SK = 0.678$], indicates a positive relationship in the model dataset. This means that when workers perceive that safety is truly prioritized, there is a stronger tendency for the organization to provide information, training, and communication that supports safety knowledge. Safety knowledge is not simply knowing that PPE should be used.

Knowledge includes: hazards; consequences; controls, procedures, emergencies, use of equipment, limits of authority, work stoppage procedures.

Thus, K3 training must move from **knowledge transfer** to **risk competence**.

Safety Climate and Safety Motivation

The relationship [$SC \rightarrow SM = 0.721$] is higher than [$SC \rightarrow SK = 0.678$].

This suggests that in the synthetic dataset, perceptions of safety climate have a relatively strong relationship with safety motivation. This makes sense theoretically. Workers are more easily motivated when they see consistency between: rules; supervisor actions; rewards; sanctions; production targets; communication; and management actions. Conversely, if workers perceive safety standards only apply during audits, intrinsic motivation may be weakened.

Safety Motivation as an Important Mechanism

Path: [$SM \rightarrow SB = 0.402$] is greater than [$SK \rightarrow SB = 0.315$]. This indicates that safety motivation makes a relatively greater contribution to safety behavior than knowledge in the model dataset.

These findings are consistent with Griffin and Neal's model, which positions knowledge and motivation as mechanisms that bridge safety climate with safety performance.

The implications are very practical. Organizations cannot simply do: **training** → **test** → **certificate**. Organizations need to ensure: **training** → **understanding** → **motivation** → **behavior**.

Safety Participation

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Clarke shows that the relationship between safety climate and safety participation tends to be stronger than that between safety compliance . This is important for IPIP. Safety compliance is: "I use PPE because it is required" for safety.

A mature organization not only has workers who: Safety participation is:

These differences indicate the level of maturity of the culture of **compliance** but also workers who **actively maintain safety**.

Safety Climate and Zero Accident

One methodological error to avoid is stating: "Safety climate causes 78.8% of zero accidents."

That statement is too simple.

Clarke shows that the direct relationship between safety climate and accidents is relatively weak compared to the relationship with safety compliance and safety participation .

Therefore, a more scientific path is:



With this model, zero accidents become **the final outcome** , not a variable simply influenced by one factor.

Meaning of Safety Climate Index 78.8%

Value: **78.8%** : indicates a relatively positive condition in the model dataset. However, this value does not necessarily mean the system is optimal.

If the scores are dissected based on dimensions

Dimensions	Index
Management commitment	82.4%
Safety leadership	79.2%
Communication	75.6%
Policies/procedures	81.0%
Worker participation	74.4%
Training/competence	81.6%

The lowest dimension: **Employee participation = 74.4%**. Meanwhile, the gap with management commitment: $[82.4-74.4=8.0]$. This indicates a potential **implementation gap** . Management may have a high level of commitment, but workers do not yet fully feel that they have the space to participate.

Contractor Safety Management

In industrial area projects, safety cannot be separated from the contractor. One project can have: owner; EPC; civil contractor; mechanical contractor; electrical contractor; subcontractor; heavy equipment company; outsourcing company.

Each has a different system and culture.

Therefore, a **Contractor Safety Management System is required** that includes: competency; induction; HIRADC; permit; inspection; audit; evaluation; incident reporting; corrective action.

This system is crucial because one company can have a strong safety climate while its contractor has a weaker one. In such a situation, project safety is determined by the weakest point at that interface.

Heavy Equipment and Traffic Management

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The context of accidents involving dump trucks demonstrates the importance of mobile equipment safety . The program should not stop at: "Operators must exercise caution." Controls should include: vehicle and pedestrian segregation, traffic management plans, speed control, vehicle inspections, cameras, alarms, communications, blind spot control, spotters, operator competence, fatigue management, maintenance. This is an application of the hierarchy of controls principle .

Technical controls and system design must be placed above relying solely on individual behavior.

Near Miss as a Leading Indicator

The 186 near-misses in the dataset demonstrate that organizations have a valuable source of information. However, near-misses should not be merely statistics. Each near-miss must answer the following questions: What nearly happened? Why did it happen? What barriers failed? What barriers should have been in place? What corrective action was taken? Was the action effective? Could a similar incident occur in other areas? With this approach, near-misses become an organizational learning tool.

Unsafe Condition as a System Problem

The proportion of unsafe conditions of 58.9% in the model dataset shows the importance of a systems approach.

Organizations must ask: "Why did the unsafe condition arise?" not just: "Who is at fault?" If the vehicle's path is unsafe, the problem is not just the driver. If equipment is not inspected, the problem is not just the operator. If work is carried out without a permit, the problem is not just the worker.

The question should be: **Why does the system allow these conditions to occur? This is** the learning organization approach .

Corrective Action and Learning Organization

A closure rate of 95.4% seems high, but there are 52 actions that have not been completed. These 52 actions should be categorized as minor, major, or critical. Critical actions should not be treated the same as administrative findings. Therefore, the corrective action system needs to use **risk-based prioritization**.

For example:

Category	Completion time
Critical	≤24 hours
High	≤3 days
Medium	≤14 days
Low	≤30 days

These figures are examples of management design, not official IPIP provisions.

Integration of Leading and Lagging Indicators

A common weakness of the K3 system is that it focuses too much on accidents.

For example:

"There were no accidents this month."

More important questions:

how many near misses ?

how many unsafe conditions?

how many permits?

how many findings?

how much corrective action?

how much training?

how many safety walks?

How many workers use SWA?

Thus the K3 dashboard must have two sides.

Lagging indicators

fatality;

LTI;

TRIFR;

LTIFR;

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severity rate.

Leading indicators

safety observation;

near miss;

training;

inspection;

HIRADC;

PTW compliance;

corrective action;

safety climate.

Zero Accident Dashboard Model

Recommended dashboards:

Indicator	Target
Fatality	0
Serious injury	0
LTIFR	towards 0
TRIFR	decrease
PTW compliance	≥98%
HIRADC	100%
Mandatory training	≥98%
Equipment inspection	100%
Contractor induction	100%
Corrective action closure	≥98%

These targets are **managerial designs** , not official IPIP benchmarks.

Intervention Strategy

Based on the model, strategies can be divided into four levels.

Level 1 — Organizational Climate

Focus:

leadership;

communication;

justice;

support;

balance of production and safety.

Level 2 — Safety Climate

Focus:

perception of safety priorities;

policy consistency;

supervision;

participation.

Level 3 — Safety Behavior

Focus:

compliance;

participation;

reporting;

stop work.

Level 4 — Safety Performance

Focus:

near miss;

incident;

LTI;

TRIFR;

severity.

Stop Work Authority Concept

One indicator of the maturity of an organizational climate is the courage of workers to stop work.

Organizationally:

Worker → identify hazard → Stop Work → Supervisor → HSE → Risk reassessment → Control → Restart

If workers fear sanctions for stopping work, the safety climate is not yet mature. Conversely, if workers have support, stop-work authority becomes a crucial tool for prevention.

Implications for IPIP Management

Based on the research model, there are five priorities.

Priority 1: Worker participation

The model value is 74.4%.

Intervention:

Safety Champion;
safety suggestion;
near miss campaign;
JSA participation;
stop work authority.

Priority 2: Communication

Model value 75.6%.

Intervention:

toolbox meeting;
bilingual communication if necessary;
visual safety;
digital reporting;
feedback loop.

Priority 3: Supervisor

The model value is 79.2%.

Intervention:

coaching;
safety leadership;
behavioral observation;
KPI supervisor.

Priority 4: Contractor

Intervention:

contractor prequalification;
unified induction;
competency assurance;
contractor safety scorecard.

Priority 5: Learning

Intervention:

incident learning;
near miss;
root cause analysis;
corrective action;
knowledge sharing.

Theoretical Implications

This research strengthens three main theories.

First, Zohar provides the basis that safety climate reflects workers' perceptions of the importance of safety in the organization.

Second, Griffin and Neal showed that safety climate is an antecedent of safety performance, with safety knowledge and safety motivation as important mechanisms.

Third , Clarke shows that the relationship between safety climate and safety compliance and safety participation is more consistent than the direct relationship with accidents. Thus, this study places:
zero accident as a systemic outcome.

Methodological Implications

The use of PLS-SEM provides advantages because variables such as safety climate , safety motivation and safety behavior are latent constructs that cannot be measured with a single indicator. However, there are limitations.

First , the survey data is perceptual in nature.

Second , safety climate and accident data can be at different levels of analysis.

Third , the causal relationship cannot be fully ascertained if the research design is only cross-sectional .

Fourth, Zero accidents are relatively rare events, so using accidents as a direct outcome requires longer longitudinal data.

Clarke specifically demonstrated that the validity of the relationship between safety climate and accidents is stronger when using a prospective design, that is, safety climate is measured before an accident occurs. Therefore, future IPIP research should ideally use a **longitudinal safety climate study**.

CONCLUSION

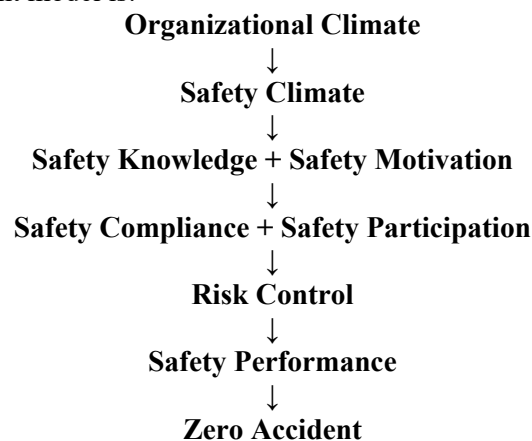
This research shows that achieving zero accidents in national strategic projects is not achieved solely through improved regulations, PPE, inspections, and technical oversight. Safety is an organizational phenomenon formed through the interaction of organizational climate, safety climate , knowledge, motivation, behavior, and risk control systems.

The research synthetic dataset shows that organizational climate has a strong positive relationship to safety climate with a path coefficient of 0.755. Safety climate is then positively related to safety knowledge of 0.678 and safety motivation of 0.721. Furthermore, safety knowledge , safety motivation , and safety climate have a positive relationship to safety behavior of 0.315, 0.402, and 0.219, respectively. The R^2 value of safety behavior of 0.690 indicates that the model has substantial explanatory power towards the variation of safety behavior in the model dataset.

The Safety Climate Index model's score of 78.8% indicates a relatively positive situation, but with room for improvement. The employee participation dimension received the lowest score, at 74.4%, while management commitment reached 82.4%. This gap demonstrates the importance of transforming management commitment into concrete employee participation.

In a synthetic safety dataset with 2,400,000 work hours, the LTIFR was 2.50, the TRIFR was 6.67, and the severity rate was 30.00. These figures indicate that zero accidents have not been achieved in the model dataset and also demonstrate the importance of using leading indicators to complement accident indicators.

Theoretically, these results are consistent with Zohar's work on worker perceptions of safety priorities, Griffin and Neal's work on the relationship between safety climate , knowledge, motivation, and safety performance , and Clarke's work on the relationship between safety climate and safety compliance and safety participation . Thus, the proposed zero accident achievement model is:



The main recommended strategies are strengthening safety leadership , communication, worker participation, contractor safety management, competence, near miss reporting , stop work authority , and corrective action .

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Ultimately, zero accidents should not be understood as simply “zero accidents,” but as a condition where an organization is consistently able to prevent uncontrolled risk exposure, learn from near misses, engage workers, and ensure safety is an integral part of every operational decision.

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