



## DISCOVERING THE INFLUENCING FACTORS OF SAFETY CULTURE IN THE STAE-OWNED ENTERPRISE IN THAILAND

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### ABSTRACT

This study aimed to study the current safety climate and determine the relationship between safety climate and influencing factors in one of the largest Hydro Power Plant in Thailand. **Method:** This cross-sectional research recruited 336 employees to complete the Safety Climate questionnaires, recommended by the UK's Health and Safety Executive (HSE), to measure 9 dimensions of organizational safety climate. **Results:** The results revealed that average score of Personal Priorities and Need for Safety were highest (accounted for 7.96 out of 10), whereas the average score of the Safety Rules and Procedures was lowest (accounted for 5.62). **Conclusion:** The results illustrated that the influencing factors were 1) the job and condition of employment were significantly influencing 7 dimensions at 0.05 level of confidence ( $p$ -value  $<0.05$ ) (2) the factor of age was significantly influencing 3 dimensions at 0.05 level of confidence ( $p$ -value  $<0.05$ ). **Limitation:** This research was carried out in limited period of time and therefore, follow-up study should be carried out, particularly when any change introduced to the organizational contexts or any intervention applied to existing safety management system, in order to maintain and improve organizational safety culture.

**Keywords:** Safety Climate, Safety Culture.

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### BACKGROUND

In Thailand, many and private and state-owned enterprises are implementing different safety management systems according to their missions and strategies. The state-owned Hydro Power Plant has been implementing the so-called Quality Safety Health Environmental Energy and Information Security (QSHEEnIS), an Integrated management system approach, since 2012 and the management believe this approach will cultivate safety culture in the organization. Since the system has never been evaluated so it's their curiosity to prove whether such culture exist.

### OBJECTIVES

This study aims to draw the picture of safety climate in this state-own organization and determine factors that influencing such climate, whether there are any relationship between gender,

age, employment duration, job position, condition of employment, and individual factor may contribute to the safety climate of the plant.

### THE STUDIES OF SAFETY CULTURE

Safety culture was presented by the International Nuclear Safety Advisory Group (INSAG), International Atomic Energy Agency (IAEA) in 1986. INSAG had generated a report for developing safety concepts after the accident in a Nuclear Power Plant in Chernobyl, Ukraine (1,3).

The most widely accepted and used Safety culture definition references from Advisory Committee on Safety Nuclear Installations (ACSNI). ACSNI (4) defined the safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies and patterns of behavior that determine the

commitment to, and the style and proficiency of, an organization's health and safety management. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventive measures.

Dov Zohar (5) is the first person that defined the word "Safety climate". Zohar had studied from 20 factories employees in Israel in 1980 and defined the safety climate as a concept of ideas exchange among employees about working environment.

There are many studies and defined definition of safety culture and safety climate as following;

De Cock et al. (6) attempt to distinguish organizational climate from culture. Organizational are characterized by a coherence of numerous processes. Organizational climate, then, is the perception of this coherence by all the members. On the other hand, organizational culture is a form of significant behavior and value that has a deep implicit.

Van Hoewijk et al. (7) describes organization climate consists of the relationship of environment, tradition, and various opinions. But organization culture, there are researchers define many different definitions and they are still not have the conclusion of its.

Schein (8) conceives of organization climate is determined by attitudes, beliefs, and values. But organization climate is just displayed the superficial aspects of organizational culture, which is expressed in the depths of subconscious.

Denison (9) defined the safety culture is measures in the term of qualitative methods, but Safety climate is measures in the term of quantitative methods since the measurement techniques: for example; questionnaire, cannot describe the significant and implicit meaning of the safety culture.

Mearns et al. (10) stated that safety climate refers to an appearance and

safety attitude of employees at that time. Questionnaire is the most proper tool using to research the safety climate. Also, safety climate conveys the meaning of safety culture in the period of time as well.

Flin (11) proposed that the concept of culture is difficult to change and more complex than climate.

Glennon (12,13) operationalizes safety climate is a concept of employees who realize about their organization nature can affects to behavior expression in order to reduce or eliminate hazards, which is important in organizational climate.

Brown and Holmes (14) noted safety climate is a unique of perceptions or beliefs from an individual and/or groups.

Cooper and Philips (15) defined that safety climate is an exchange of safety workplace ideas and beliefs among employees.

Coyle et al. (16) proposed the safety climate is a measurement of attitudes and perceptions of occupational health and safety.

Cabrera et al. (17) stated that safety climate is an exchange of employees' ideas about working environment and safety policies within an organization.

Williamson et al. (18) subsequent definitions of safety climate as a conclusion of safety ethics in an organization or workplace that reflect to safety beliefs and predicts an employee behavioral approach to a safety workplace.

Dov Zohar (19) defined safety climate is an exchange of perceptions about respect and attend for activities, follow the procedures, and comply with safety policies.

The Health and Safety Executive (HSE) (20) divided the development of organization safety culture into 5 groups. This model will eliminate the weaknesses then improve them to the higher level

### **Level 1: Emerging**

Knowledge about safety is only in an academic. The corporation considers that organization safety is not a result to a business risk. The safety department is seemed to be the only one division has to deal with safety issues. Many accidents appear in this level but no accident prevention due to lack of safety awareness.

### **Level 2: Managing**

The accident rate is in a middle level but there are very likely to be a serious accident. Safety is found as the major risks and accidents that happened will be protected. Safety will along with rules and engineering control. Executives will aware of accidents that happened from unsafe behaviors of operational staffs. The safety indicators for this level use metrics based on lagging indicators. For example, when employee got serious accident and have to take days off, senior executive will involve this situation by acting in the negative way like punishment.

### **Level 3: Involving**

The level 3 has the low accident rate because the organization encourages employees to be involved in an occupational health and safety. Executives recognize the factors and causes of accident. Executives and operators have a good relationship. Most importantly, employees recognize their occupational health and safety responsibilities. This level has a good safety performance and effective data storage.

### **Level 4: Cooperating**

Employees are encouraged to realize in an occupational health and safety in term of morality and economics. Both of executives and employees have an awareness of causes and factors of the accident and find the ways to resolve them. Employees have responsibilities and duties in an occupational health and safety. The important thing of this level is the employees' value. The organization controls the accidents by using proactive measurement and has a

good safety performance as well as effective data storage. There is an accident monitoring and healthcare program.

### **Level 5: Continually improving**

Accident prevention is a corporate value that covers to accident from internal and external an organization. Even low serious accident, corporation is still not satisfied. The corporation is unconvinced that there would be accidents. They have tools and systems for control in the safety and find the best way to develop the risk control methods. All employees in the organization exchange their significant opinions about health and safety in workplace and acknowledge the importance of preventing accidental outside the workplace. Corporation knows the importance and invests to advocate employees about occupational health within family.

## **METHOD AND DATA**

### **Study design**

This state-owned enterprise responsible for electric power generation and transmission for the whole country of Thailand, power generation facilities consists of 3 thermal power plants, 6 combined cycle power plants, 24 hydropower plants, 8 renewable energy plants, and four diesel power plants.

This cross-sectional study conducted in one of the largest Hydro Power Plant in order to examine the safety climate in and search for factors that influence employees to demonstrate the current safety climate in this Hydro Power Plant. By using the calculated average scores from a questionnaire-based tool on the formula calculating dimension scores in Safety Climate Measurement User Guide and Toolkit developed by the Health and Safety Executive (HSE) (21,22).

### **Population and Sample**

1. **Population:** Employees who working in the Hydro Power Plant.
2. **Samples:** A number of employees were selected to displayed employees working in a Hydro Power Plant

3. **Sample Size:** A number of employees were selected to be samples of employees working in a Hydro Power Plant choose by purposive sampling in Top management employees level 11-12 were 4 persons and choose by simple random sampling were 300 volunteers who work in the Hydro power plant. All participants was reviewed and approved by Ethical Review Committee for Human Research, Faculty of Public Health, Mahidol University (COA. No. MUPH 2017-023).

The selection of sampling is simple random sampling by using the sampling calculation (24) as following.

$$n = \frac{Nz^2\sigma_x^2}{NE^2 + z^2\sigma_x^2}$$

n = Number of sample size

N = Number of population

z = From table of two-tailed is 1.96

$\sigma_x^2$  = Variance by reference the related research (36) that is 0.59

E = Error the researcher specific as 5% or 0.05 (Power = 95%)

Substitute values in the formula

$$n = \frac{663(1.96)^2(0.59)^2}{663(0.05)^2 + (1.96)^2(0.59)^2}$$

n = 296 Samples

## Research Tool

This study uses a questionnaire from the Safety Climate Measurement User Guide and Toolkit (23) include the HSE Health and Safety Climate Survey Tool (CST) (33) which has been ranked the best safety climate tool in a review of safety climate/culture tools (22). The tool states that it encourages employee involvement in health and safety by seeking the views of employee on how they are involved in some of the key aspects of health and safety culture and climate in their organization. The tool also involves employees in seeking improvements based on the information which emerges and tool provides companies with information about aspects of their existing health and safety climate. The CST can also be used to assess change of the safety climate over time. The tool comprises a 71-item computer based self-assessment

questionnaire using a standard five point rating scale. The questionnaire statements are organized into 10 factors: Organizational commitment and communication, Line management commitment, Supervisor's role, Personal role, Workmates influence, Competence, Risk taking behavior and some contributory influences, Some obstacles to safe behavior, Permit-to-work systems and Reporting of accidents and near misses.

The questionnaire was divided into 2 parts.

**Part 1:** Personal data on gender, age, duration of employment, job position, employment nature, department and section.

**Part 2:** Safety Climate

Questionnaire-based tool developed by the Health and Safety Executive (HSE) were consisted 43 questions which divided 4 parts, 9 dimensions and using the 5 levels Likert scale such as:

Level 1 Strongly disagree

Level 2 Disagree

Level 3 Uncertain

Level 4 Agree

Level 5 Strongly agree

The 43 questions were divided 4 parts and subdivided 9 dimensions namely:

### 1. Organisational Context

a. Management Commitment

consisted of 7 questions.

b. Communication consisted of 5 questions.

c. Priority of Safety consisted of 4 questions.

d. Safety Rules and Procedures consisted of 3 questions.

### 2. Social Environment

a. Supportive Environment

consisted of 6 questions.

b. Involvement consisted of 3 questions.

### 3. Individual Appreciation

a. Personal Priorities and Need for Safety consisted of 5 questions.

b. Personal Appreciation of Risk consisted of 4 questions

### 4. Work Environment

a. Physical Work Environment

consisted of 6 questions  
The research tool was assessed from two qualified specialists and the researcher selected 30 from 336 samples to test a questionnaire-based tool for confirm that tool had no confuse in negative and positive questions.

### Data Gathering

The methods of data collection are as follows:

1. Obtained a Human Ethics research certificate before gather the data.
2. The researcher has to make an appointment with all participants about the date, time, and location by coordinating with their supervisors to describe the purposes and processes for collecting information.
3. The researcher writes a report to the participants' supervisor by specify the questionnaires distribution date and return date. The researcher got returned questionnaires from every department when the return date is due.
4. The supervisor of participants let the participants to do the questionnaires for 15-30 minutes.
5. Collect data in questionnaires that contain 43 questions. There are 5 levels of Likert scale:
  - Level 1 Strongly disagree
  - Level 2 Disagree
  - Level 3 Uncertain
  - Level 4 Agree
  - Level 5 Strongly agree
6. Processing the data by using Statistical Package for Social Science (SPSS) windows version 18 and calculating the score of questionnaire by formula calculating dimension scores in Safety Climate Measurement User Guide and Toolkit

The method of calculating the score of questionnaire are;  
There are 2 types of questions

- 1) Positive questions, from score 1-5 (Survey score)

- 2) Negative questions, calculate the score by reverse the scoring (6-Survey score) = Actual score

- 3) Dimensions in the questionnaire have different numbers of items and, therefore, scores need to be standardized before plot and compare these dimensions. Converting the scores to a 1 to 10 scale can be achieved by dividing the actual score by the total score and then multiplying by 10. Scores are calculated from the questionnaire items, follow the formula calculating dimension scores in Safety Climate Measurement User Guide and Toolkit for each of the nine dimensions. Then interpreted the dimension score to be a radar plots

7. Use data to identify the relationship of safety climate with genders, ages, duration of employment, job positions, and employment nature.
8. Describe data from the statistic to the characteristics that relate to safety climate of employees in the Hydro Power Plant.

### Data Analysis

1. Descriptive statistics study the general information distribution in terms of percentage, mean, and standard deviation of personal characteristics
2. Descriptive about safety climate scores by using mean, standard deviation, maximum value, and minimum value for all variables used.
3. Inference statistics use the Pearson's Correlation ANOVA and Stepwise Multiple regressions in order to find the relationship between factors and safety climate

All statistical analyses were performed by using Statistical Package for Social Science (SPSS) window version 18.

**General Characteristics of the Sample Group**

The research distributed 400 copies of Safety Climate questionnaire to the sample group and the results were returned 336 copies or 84%. The sample group was male rather than female. There were 223 males, which accounted 66.37%. There were 93 people or 27.68% with ages between 51 and 60 years, 92 people or 28.38% with ages between 21 and 30 years. There were 155 people or 46.13% had employment duration more than 10 years and 110 people or 32.74% had employment duration 1 - 5 years. Most of them were Contract labor. There were 191 Contract labor or 56.85% and 100 general employees (level 3-7) or 29.76%. The employment nature were Contract labor 191 people or 56.85% and general employees 138 people or 41.07% as showed on the table 4.1

**Table 1:** Frequency and Percentage of general characteristics

Personal data	Number (Persons) (n = 336)	Percent
<b>Gender</b>		
Male	223	66.37
Female	113	33.63
<b>Age</b>		
18 - 20 years	7	2.08
21 - 30 years	92	27.38
31 - 40 years	73	21.73
41 - 50 years	71	21.13
51 - 60 years	93	27.68
<b>Employment duration</b>		
Less than 1 year	12	3.57
1-5 years	110	32.74
6-10 years	59	17.56
More than 10 years	155	46.13
<b>Job position</b>		
Top management level 11-12	2	0.60
Management level 8-10	36	10.71
General employees level 3-7	100	29.76
Special contract labor (4 years contract)	7	2.08
Contract labor	191	56.85
<b>Employment nature</b>		
Full-time employee	138	41.07
Special contract labor	7	2.08
Contract labor	191	56.85

**RESULTS**

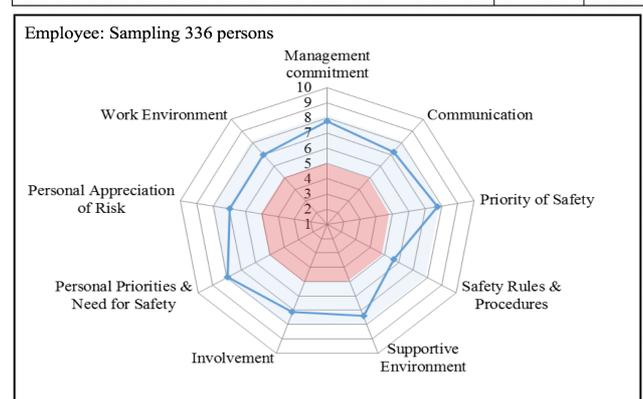
**Safety Climate Score**

The sample group displayed the safety climate scores using an average score

obtained from the Calculating dimension scores in Safety Climate Measurement User Guide and Toolkit of the Health and Safety Executive (23). The safety climate of Personal Priorities and Need for Safety had the highest score at 7.96 points, then 7.80 points were the score of Management Commitment, and the Safety Rules and Procedures had the lowest score at 5.62 points (see table 2). When we plotted safety climate scores in nine dimensions into the Radar plot, we would perceive the current state of the organization's safety climate. The score which is in the range of 1.00-5.00 points means the safety climate needs to be improve, 5.01-8.00 points means good in criteria, and 8.01-10.00 points means very good in criteria (see figure 1).

**Table 2:** Safety Climate Scores

Safety Climate	Scores	SD
Personal Priorities and Need for Safety	7.96	0.67
Management Commitment	7.80	0.81
Priority of Safety	7.78	0.69
Supportive Environment	7.39	0.82
Communication	7.22	0.81
Involvement	7.14	0.89
Personal Appreciation of Risk	6.98	1.08
Work Environment	6.97	1.02
Safety Rules and Procedures	5.62	1.94



**Figure 1:** Safety Climate Display in Radar Plot.

After the sampling demonstrated the safety climate scores separated by department, the score in the dimension of Management Commitment, Administration Department (ADM) had the highest score, which accounted 7.92 points. For the dimension of Communication found the Facility Department (FAC) had the highest score,

which accounted 7.39 points. For the dimension of Priority of Safety, ADM had the highest score, which accounted 7.88 points. For the Safety Rules and Procedures dimension, FAC had the highest score, which accounted 5.97 points. For the dimension of Supportive Environment, Maintenance Department (MTN) had the highest score, which accounted 7.63 points. For the Involvement, ADM had the highest score, which accounted 7.31 points. For the Personal Priorities and Need for Safety, FAC had the highest score, which accounted 7.99 points. For the Personal Appreciation of Risk, FAC had the highest score, which accounted 7.08 points. And the Work Environment, FAC had the highest score, which accounted 7.13 points (see table 3). When plotted the scores of all nine dimensions into the Radar plot, we would perceive the current safety climate of the each department (see figure 2-6).

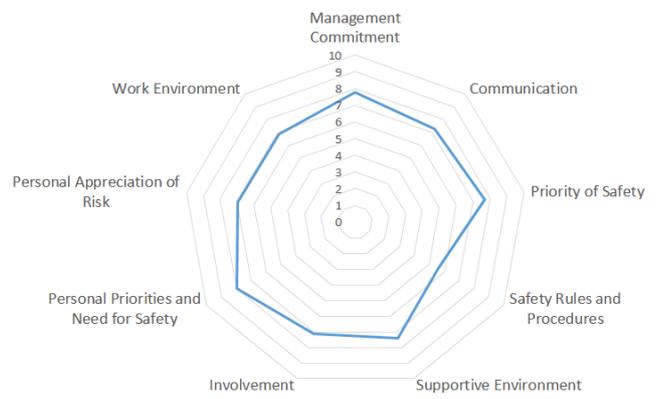
**Table 3:** Safety Climate Score Divided By Department

Safety Climate	Overall	CTR	OPR	MTN	FAC	ADM
Sample size	336	61	30	37	156	52
Management Commitment	7.80	7.84	7.79	7.58	7.79	7.92
Communication	7.22	6.94	7.25	7.14	7.39	7.06
Priority of Safety	7.78	7.77	7.67	7.61	7.80	7.88
Safety Rules and Procedures	5.62	5.50	5.60	5.12	5.97	5.08
Supportive Environment	7.39	7.57	7.39	7.63	7.42	6.95
Involvement	7.14	7.13	7.11	7.17	7.10	7.31
Personal Priorities and Need for Safety	7.96	7.97	7.96	7.90	7.99	7.88
Personal Appreciation of Risk	6.98	6.93	6.98	6.59	7.08	7.03
Work Environment	6.97	6.81	6.90	6.78	7.13	6.85

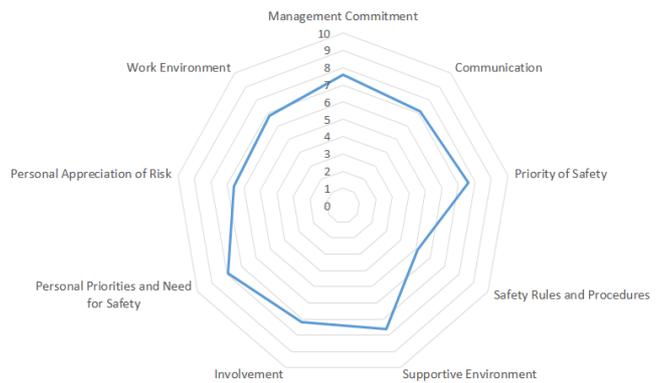
Overall: all Department  
 CTR: Central Department  
 OPR: Operation Department  
 MTN: Maintenance Department  
 FAC: Facility Department  
 ADM: Administration Department



**Figure 2** Radar Plot shows the Safety Climate scores of Central Department (CTR)



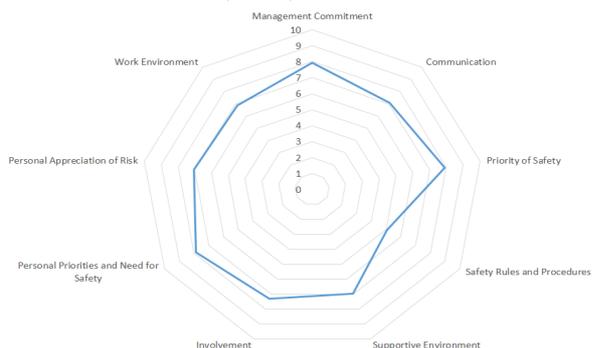
**Figure 3:** Radar Plot shows the Safety Climate scores of Operation Department (OPR).



**Figure 4:** Radar Plot showed the Safety Climate scores of Maintenance Department (MTN).



**Figure 5:** Radar Plot showed the Safety Climate scores of Facility Department (FAC).



**Figure 6** Radar Plot shows the Safety Climate scores of Administration Department (ADM)

According to the Radar plot of the each department, there were similar in the Safety Climate but difference in the scores of each dimension. The dimension that has the most different of score out of nine dimensions is Safety Rules and Procedures, which had the score of each dimension less than 6 points.

**Correlation among factors in the study**

Based on the results of the Safety Climate questionnaires, Pearson’s Correlation Coefficient was used to analyze the internal correlation among gender, age, employment duration, job position, and employment nature. The analysis result encountered that the job position and employment nature are independent variable and very similar.

Using the Correlation technique analyzes the correlation in all independent variables must not be the multicollinearity. If the Pearson’s Correlation Coefficient (r) is higher than 0.8, there is the multicollinearity. And also, if the tolerance of independent variable is very low, a value closer to 0, there is the multicollinearity. According to the table 4.4, the job position of Special contract labor (X14) and the employment nature of special contract labor (X22) had the Pearson’s Correlation Coefficient (r) equal to 1.000, which likened the same variable. In order to minimize redundant problems in the analysis, researcher should to use only the factor of job position in this model.

**Table 4:** Correlation among factors

	X11	X12	X13	X14	x21	x22
X11 Pearson Correlation Sig. (2-tailed)	1					
X12 Pearson Correlation Sig. (2-tailed)	-.027 .624	1				
X13 Pearson Correlation Sig. (2-tailed)	-.050 .357	-.225** .000	1			
X14 Pearson Correlation Sig. (2-tailed)	-.011 .837	-.051 .356	-.095 .082	1		
X15 Pearson Correlation Sig. (2-tailed)	-.089 .104	-.398** .000	-.747** .000	-.167** .002		
x21 Pearson Correlation Sig. (2-tailed)	.093 .090	.415** .000	.780** .000	-.122* .026	1	
x22 Pearson Correlation Sig. (2-tailed)	-.011 .837	-.051 .356	-.095 .082	1.000** .000	-.122* .026	1
x23 Pearson Correlation Sig. (2-tailed)	-.089 .104	-.398** .000	-.747** .000	-.167** .002	-.958** .000	-.167** .002

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

X11 stand for the job position of Top Management Level 11-12

X12 stand for the job position of Management Level 8-10

X13 stand for the job position of General employees Level 3-7

X14 stand for the job position of Special contract labor (4 years contract)

X15 stand for the employment nature of Contract labor

x21 stand for the employment nature of Full-time employee

x22 stand for the employment nature of Special contract labor

x23 stand for the employment nature of Contract labor

**CORRELATION AMONG FACTORS AND SAFETY CLIMATE BY USING THE ANALYSIS OF PERSON'S CORRELATION COEFFICIENT**

Analysis determines the correlation of gender, age, employment duration, job position, and employment nature with safety climate nine dimensions under the Pearson's Correlation Coefficient. The analysis results indicated as below.

Management Commitment has no correlation with gender, age, employment duration, job position, and employment nature according to the Pearson's Correlation Coefficient (r)

Communication has correlation with job position of management level 8-10 (X12) in accordance with the Pearson's Correlation Coefficient (r) equal to -0.188 3 Priority of Safety has no correlation with gender, age, employment duration, job position, and employment nature according to the Pearson's Correlation Coefficient (r)

Safety Rules and Procedures has correlation with gender and entire job position (X11, X12, X13, X14) in accordance with the Pearson's Correlation Coefficient (r) equal to 0.151, -0.131, -0.243, -0.141, and -0.129, respectively.

Supportive Environment has correlation with age 41 - 50 years (age\_4) and job position of management level 8-10 (X12), Special contract labor (X14) in accordance with the Pearson's Correlation Coefficient (r) equal to 0.160, -0.108 and -0.163 respectively.

Involvement has correlation with age 31 - 40 years (age\_3) and job position of management level 8-10 (X12), considering the Pearson's Correlation Coefficient (r) equal to 0.113 and -0.114, respectively.

Priorities and Need for Safety has correlation with job position of management level 8-10 (X12) according to the Pearson's Correlation Coefficient (r) equal to -0.110

Personal Appreciation of Risk has correlation with gender and job position

of top management level 11-12 (X11), management level 8-10 (X12), general employees (level 3-7) (X13), considering the Pearson's Correlation Coefficient (r) equal to -0.111, -0.142, -0.194, and -0.128, respectively.

Work Environment has correlation with job position of top management level 11-12 (X11), management level 8-10 (X12), general employees level 3-7 (X13), considering the Pearson's Correlation Coefficient (r) equal to -0.149, -0.231, and -0.123, respectively.

Interpretation of the correlation among the factors of this study and the safety climate, if the results represent that the factor of job position correlates with the safety climate, the employment nature will also correlate with the safety climate as well. Because the both factors are the same according to 3 Correlation among factors in the study.

The information of Pearson's Correlation Coefficient represent on table 5.

Male stand for a gender that bearing an X and Y chromosome pair in the cell nucleus

Age\_1 stand for Age 18 - 20 years

Age\_2 stand for Age 21 - 30 years

Age\_3 stand for Age 31 - 40 years

Age\_4 stand for Age 41 - 50 years

Time\_1 stand for Employment duration Less than 1 year

Time\_2 stand for Employment duration 1-5 years

Time\_3 stand for Employment duration 6-10 years

X11 stand for the job position of Top management level 11-12

X12 stand for the job position of Management level 8-10

X13 stand for the job position of General employees level 3-7

X14 stand for the job position of Special contract labor (4 years contract)

**Table 5:** Correlation among factors and safety climate nine dimensions

	male	age 1	age 2	age 3	age 4	time 1	time 2	time 3	X11	X12	X13	X14
Management Commitment	Pearson Correlation Sig. (2-tailed)	.059 .282	-.051 .352	.087 .113	-.025 .654	-.076 .162	.061 .263	.002 .973	.019 .722	-.035 .518	-.078 .153	.029 .592
Communication	Pearson Correlation Sig. (2-tailed)	.069 .208	-.096 .079	-.022 .683	.104 .057	-.028 .609	-.044 .425	.049 .372	-.059 .280	-.188** .001	-.027 .619	-.034 .533
Priority of Safety	Pearson Correlation Sig. (2-tailed)	.078 .152	-.018 .745	.041 .453	.021 .704	-.031 .577	.034 .530	.067 .220	-.003 .958	-.069 .207	-.076 .163	.063 .249
Safety Rules and Procedures	Pearson Correlation Sig. (2-tailed)	.007 .896	-.003 .952	.084 .125	.029 .596	-.051 .356	.091 .094	.085 .122	-.131* .016	-.243** .000	-.141** .010	-.129* .018
Supportive Environment	Pearson Correlation Sig. (2-tailed)	-.053 .332	-.045 .408	-.065 .233	.160** .003	.005 .922	-.015 .779	-.025 .653	.057 .296	-.108* .049	-.029 .590	-.163** .003
Involvement	Pearson Correlation Sig. (2-tailed)	-.047 .390	-.079 .149	.113* .038	.045 .406	-.007 .900	.007 .901	.056 .310	.046 .403	-.114* .037	-.076 .167	.094 .085
Personal Priorities and Need for Safety	Pearson Correlation Sig. (2-tailed)	.072 .186	-.032 .564	.022 .689	.074 .177	-.045 .409	.035 .525	-.028 .606	.075 .170	-.110* .043	.000 .999	.010 .860
Personal Appreciation of Risk	Pearson Correlation Sig. (2-tailed)	.022 .693	-.095 .083	.079 .150	.093 .090	-.086 .117	.029 .595	.027 .623	-.142** .009	-.194** .000	-.128* .019	-.065 .235
Work Environment	Pearson Correlation Sig. (2-tailed)	.018 .571	-.004 .943	.051 .355	.074 .173	-.005 .929	.082 .132	.092 .091	-.149** .006	-.231** .000	-.123* .024	-.077 .158

\*\* . Correlation is significant at the 0.01 level (2-tailed).  
\* . Correlation is significant at the 0.05 level (2-tailed).

**CORRELATIONS AMONG FACTORS AND SAFETY CLIMATE BY MULTIPLE REGRESSION ANALYSIS**

In this study, based on the correlations of factors such as gender, age, employment duration, job position, and employment nature with safety climate in all 9 dimensions. Multiple regression analysis is used to analyze independent variables that are influential or correlated with dependent variables statistically significant.

Management Commitment from table 6 shows that independent variables included gender, age, employment duration, job positions and employment nature were less correlated with dependent variable. The correlation coefficient ( $R^2 = 0.029$ ) was only 2.9% and was not statistically significant (p-value = 0.655)

**Table 6:** Multiple Regression Analysis (Management Commitment)

Model	Management Commitment				
	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error of the Estimate	F	p-value
1	0.029	-0.007	0.81095	0.795	0.655

Communication from table 7 found that job position and age were statistical significant negative correlation with Communication (p-value < 0.05).

Score of Communication in management level 8-10 has the lowest score compared to other positions. Employee age 21-30 years have the lowest scores. The attendance is 31-40 years, compared to the other period. By considering form unstandardized coefficients (B), see table 7.

**Table 7:** Multiple Regression Analysis (Communication)

Variable	Communication			
	R <sup>2</sup>	F	B	p-value
Model	0.068	8.025		0.000
(Constant)			7.433	0.000**
Management level 8-10			-0.649	0.000**
Age 21-30 yrs.			-0.342	0.001**
Age 31-40 yrs.			-0.241	0.034*

\*\*p-value < 0.01 \*p-value < 0.05

Priority of Safety from table 8 shows that independent variables such as gender, age, employment duration, job position and employment nature were less correlated with dependent variable. The correlation coefficient ( $R^2 = 0.029$ ) was only 2.9% and was not statistically significant (p-value = 0.655)

**Table 8:** Multiple Regression Analysis (Priority of Safety)

Model	Priority of Safety				
	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error of the Estimate	F	p-value
1	0.029	-0.007	0.68882	0.795	0.655

Safety Rules and Procedures as stated in table 9, the job position is negatively correlated with Safety Rules and Procedures. Significantly, the p-value < 0.01. As recognized in unstandardized coefficients (B) from table 4.9, Top management level 11-12, special contract labor, the management level 8-10 and general employees level 3-7 have the lowest average scores respectively, compared to the reference position of contract labor.

**Table 9:** Multiple Regression Analysis (Safety Rules and Procedures)

Variable	Safety Rules and Procedures			
	R <sup>2</sup>	F	B	p-value
Model	0.150	14.618		0.000
(Constant)			6.192	0.000**
Top Management level 11-12			-3.859	0.003**
Special contract labor			-2.287	0.001**
Management level 8-10			-1.933	0.000**
Employee level 3-7			-0.992	0.000**

\*\*p-value < 0.01

Supportive Environment from table 10, there is a positive correlation between age of employees and Supportive Environment dimension. Significantly at 0.01 level of confidence (p-value < 0.01). Job position was statistical significant negative correlation with Supportive Environment, the p-value < 0.05. Interpretation of unstandardized coefficients (B) in table 4.10, job position, special contract labor and management level 8-10 positions have the lowest scores in rank compared to other

positions. Employees with 41-50 years old have the highest scores compared to other periods.

**Table 10:** Multiple Regression Analysis (Supportive Environment)

Variable	Supportive Environment			
	R <sup>2</sup>	F	B	p-value
Model	0.061	7.241		0.000
(Constant)			7.383	0.000**
Age 41-50 yrs.			0.295	0.006**
Special contract labor			-0.906	0.003**
Management level 8-10			-0.301	0.034*
**p-value < 0.01		*p-value < 0.05		

Involvement from table 11 found that the job position was negatively correlated with Involvement. Significantly at 0.05 level of confidence (p-value = 0.037). Interpretation of unstandardized coefficients (B) in table 11. Score on Involvement of management level 8-10 had the lowest score compared to other positions.

**Table 11:** Multiple Regression Analysis (Involvement)

Variable	Involvement			
	R <sup>2</sup>	F	B	p-value
Model	0.013	4.387		0.037
(Constant)			7.178	0.000*
Management level 8-10			-0.326	0.037*
*p-value < 0.05				

Personal Priorities and Need for Safety as stated in table 12 found that the job position are negatively correlated with the Personal Priorities and Need for Safety. Significantly at 0.05 level of confidence (p-value = 0.043). Interpretation of unstandardized coefficients (B), score on Personal Priorities and Need for Safety of the management level 8-10 had the lowest mean score compared to other positions.

**Table 12:** Multiple Regression Analysis (Personal Priorities and Need for Safety)

Variable	Personal Priorities and Need for Safety			
	R <sup>2</sup>	F	B	p-value
Model	0.012	4.112		0.043
(Constant)			7.981	0.000*
Management level 8-10			-0.237	0.043*
*p-value < 0.05				

Personal Appreciation of Risk as stated in table 13 found that the job position are negatively correlated with the Personal Appreciation of Risk. Significantly, the p-value < 0.05 and age of employees are negatively correlated with the Personal Appreciation of Risk and significantly, the p-value < 0.01. Interpretation of unstandardized coefficients (B) results in an Personal Appreciation of Risk score for the top management level 11-12, management level 8-10, Special contract labor, employee level 3-7 have lowest respectively, compared to the reference position of contract labor, and the 21-30 years old have the lowest scores, compared to other periods.

**Table 13:** Multiple Regression Analysis (Personal Appreciation of Risk)

Variable	Personal Appreciation of Risk			
	R <sup>2</sup>	F	B	p-value
Model	0.121	9.097		0.000
(Constant)			7.340	0.000**
Top Management level 11-12			-2.340	0.001**
Management level 8-10			-0.965	0.000**
Special contract labor			-0.840	0.035*
Employee level 3-7			-0.438	0.001**
Age 21-30 yrs.			-0.339	0.009**
**p-value < 0.01 *p-value < 0.05				

Work Environment dimension as stated in table 14, the job position is negatively correlated with Work Environment. Significantly at 0.05 level of confidence (p-value < 0.05). Interpretation of unstandardized coefficients (B) in table 4.14 showed top management level 11-12, management

level 8-10, Special contract labor and employee level 3-7 have minimum score respectively when compared to reference position as contract labor.

**Table 14:** Multiple Regression Analysis (Work Environment)

Variable	Work Environment			
	R <sup>2</sup>	F	B	p-value
Model	0.126	11.959		0.000
(Constant)			7.241	0.000**
Top Management level 11-12			-2.241	0.001**
Management level 8-10			-0.954	0.000**
Special contract labor			-0.812	0.029*
Employee level 3-7			-0.464	0.000**
**p-value < 0.01		*p-value < 0.05		

The correlation among the five factors and the nine safety climate dimensions can be summarized as follows:

**Table 15:** Correlation Among Safety Climate and Factors

Factors	Gender	Age	Employment duration	Job position	Employment nature
Management commitment	x	x	x	x	x
Communication	x	✓	x	✓	✓
Priority of Safety	x	x	x	x	x
Safety Rules & Procedures	x	x	x	✓	✓
Supportive Environment	x	✓	x	✓	✓
Involvement	x	x	x	✓	✓
Personal Priorities & Need for Safety	x	x	x	✓	✓
Personal Appreciation of Risk	x	✓	x	✓	✓
Work Environment	x	x	x	✓	✓

x Means No correlation    ✓ Means Correlation

Job position and employment nature were significantly associated with seven safety climate dimensions namely Communication, Safety Rules and Procedures, Supportive Environment, Involvement, Personal Priorities and Need for Safety, Personal Appreciation of Risk and Work Environment whereas age was significantly associated with three safety climate dimensions such as Communication, Supportive Environment and Personal Appreciation of Risk but factors of gender and duration of employment were not significantly associated with all 9 dimensions.

**DISCUSSION OF STUDY RESULTS**

**Safety Climate Scores**

The scores derived from the safety climate measures can be plotted to provide a graphical representation of each dimension and overall picture of current state of the organization.

The results revealed that safety climate of the target Hydro Power Plant was good, all nine dimensions score in the range of 5.01-8.00 points. Safety Rules and Procedures had the lowest score at 5.62 points. When considered from radar plot Safety Rules and Procedures dimension nearly five points, which indicate may be poor from Safety Climate Measurement User Guide and Toolkit. From the results, this organization could decide on an action plan based on safety climate assessment. The value of the safety climate assessment can only be fully realized if it is used as part of ongoing organizational communications. It is important to communicate the results of the safety climate assessment in a variety of ways including written reports, team briefings and individual feedback, not only to decision makers, but also to those who took part. The degree of success in improving the safety climate will depend on using data to develop action plans for continuous improvement (27). There are two primary reasons for this:

The people who shared their views and contributed to reply the questionnaire will expect there to be some actions or changes based on their efforts and activities; and the data is likely to uncover areas for improvement that have to be resolved in order that a lasting improvement in safety can be achieved.

Therefore, it can be said that the organization should realize to develop safety action plans. Though safety climate assessment showed the results in low, moderate or good for continuous improvement on safety.

**Safety Climate Scores divided by Department**

The safety climate of all five departments were good, similar to the safety climate of organization. Same as

the result of the lowest score in all department was Safety Rules and Procedures.

The safety climate scores in Facility Department (FAC) showed the highest score in five of nine safety climate dimensions when compared with other department namely Communication, Safety Rules and Procedures, Personal Priorities and Need for Safety, Personal Appreciation of Risk and Work Environment. In this department have many kinds of work such as construction, carpenter, electrical maintenance, plumbing, dam inspection, garbage man, gardener etc., which had many work instructions and procedures. Hence, it can be said that employees and labors had known their responsibility on safety and shared their view in positive result in safety climate.

Administration Department (ADM) had the highest score in three dimensions that is Management Commitment, Priority of Safety and Involvement. On the other hand, ADM had the lowest score in three dimensions such as Safety Rules and Procedures, Supportive Environment and Personal Priorities and Need for Safety. ADM work on accountant, purchase, human resource, health care and administration and services. All of section in this department work related with document.

Operation Department (OPR) was the only one department that found moderate score in the order of ranking. No result in the highest and the lowest.

Central Department (CTR) found the lowest score in Communication. Other eight dimensions showed the score in range 5.01-8.00 points.

Maintenance Department (MTN) showed the highest score in Supportive Environment. In contrast, found the lowest in four dimensions namely Management Commitment, Priority of Safety, Personal Appreciation of Risk and Work Environment.

All of department's radar plot showed the different score from each

department, but score is nearly. This result similar to Yi Gao et al. (23) studied, which indicated that all four occupational groups were significantly different from each other in terms of participants' perceptions of safety attitudes of other occupational groups. The order of ranking of score from the highest to the lowest was FAC, OPR, CTR, ADM and then MTN.

### **Correlations among gender, age, employment duration, job position, employment nature and safety climate**

Job position and employment nature were significantly associated with seven safety climate dimensions namely Communication, Safety Rules and Procedures, Supportive Environment, Involvement, Personal Priorities and Need for Safety, Personal Appreciation of Risk and Work Environment. The results showed negatively correlated in all job position and employment nature, significantly at 0.05 level of confidence (p-value < 0.05). And management level 8-10 showed negative value of unstandardized coefficients (B) in all safety climate dimensions, so the management level 8-10 was the most important factor in organization to express the safety climate. The management level 8-10 is the level between top management and general employees, who deploy safety policy from top management to general employees and enforce rules and procedures to subordinates. Safety drivers must rely on these level group.

Age was significantly associated with three safety climate dimensions such as Communication, Supportive Environment and Personal Appreciation of Risk. The significant group was age between 21-30 years that has negatively correlated in Communication and Personal Appreciation of Risk. Thus the organization should be emphasized about safety and improve the safety program for new employees. To instill a safety awareness for young employees. On the other hand, employees between 41-50 years old has positively correlated with Supportive Environment. Therefore, organization should provide employees between the ages of 41-50

years as role models and study how to motivate other age of employees to be positive relationship with Supportive Environment.

Gender and employment duration were not correlated with all nine dimensions of safety climate. This results different from Yi Gao et al. (23) studied, which indicated that staff with longer employment histories held less positive perceptions about safety climate. The results of this research maybe indicating that control variables are good for safety performance. Therefore, there is no statistical significance.

### RESEARCH LIMITATION

Collected data in contract labor group, on action plan the supervisor of participants distributed the questionnaires and let the participants to do the questionnaires and returned to supervisor. After that, the researcher will got return questionnaires from every department when the return date is due. But in fact, the researcher must went to every area where the contract labor working and received the questionnaires from group of the participants. Because the supervisors in each department had competition in quality award and must went to present the project in other Hydro Power Plant in period of research. Contract labor had many area of works such as office area, mess hall, room service area, golf course, garden in all area around the Hydro Power Plant etc. Therefore, the data collection was delayed.

### RECOMMENDATIONS

Propulsion of safety in the organization requires employees in the management level 8-10 who has a very strongly associated to the safety climate in all seven safety climate dimensions.

Firstly, the organization should review the safety rules and procedure because of this dimension showed the lowest score in nine of safety climate dimensions.

According to the safety climate results,

the organization should develop an association safety plan and implement. Once the safety plan is performed, the organization should re-examine the safety climate and compare the performance for continuous improvement.

### RECOMMENDATIONS FOR FUTURE STUDY

The next study should include factors that might be associated to the safety climate such as marital status, safety training program, and experience from previous employers.

The next study should divide occupation such as engineers, accountants, lawyers, nurses, etc. to find out whether there are any relationships between occupations and safety climate.

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