

# Designing Safety Maturity Level Questionnaire of Construction Project

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**Keywords:** Human factor, safety in construction, Safety Maturity Level (SML), fuzzy method

**Abstract:** The high fatality in construction occurs due to the characteristics of construction projects involving equipment, permanent workers and subcontractors, construction work methods, and open fieldwork. The human factor is essential in construction. Workers have contributed as a cause of accidents due to unsafe actions they take. Knowing the level of maturity of safety in construction projects is important to prevent work accidents. Therefore, in this research, a safety questionnaire was designed in the field of construction so that it can be used to assess the safety maturity level of a construction project. The method used is a literature study and in-depth interviews with relevant parties in construction projects of apartments > 20 floors. The questionnaire was prepared considering three aspects, namely psychological, behavioral, and situational. While the factors considered are Information and Communication (IC), Commitment (CM), Organizational Learning (OL), Leadership (LI), and Competence (CP). The final results obtained are three types of questionnaires, namely the HSE Questionnaire with 40 questions, Staff/Management Questionnaire with 25 questions, and Foreman and Worker Questionnaire with 15 questions. Furthermore, this questionnaire is used to assess the construction project to determine in which level of safety maturity. Based on data collection and processing, shows that the safety maturity level of the construction project observed is calculative.

## 1 INTRODUCTION

Occupational accident data based on the Social Security Administrator (BPJS) Employment of Indonesia shows an increase from 2017 of 123,041 cases and in 2018 of 173,105 cases. Work accident cases consist of light, moderate, severe, and fatality categories. The high fatality cases occur in traffic accidents, manufacturing, and construction.

A construction project is a prone to occupational accidents due to its dangerous characteristics and unpredictable changes (Maryani, et al, 2015).

The high fatality in construction occurs due to the characteristics of construction projects involving equipment, permanent workers and subcontractors, construction work methods, and open fieldwork. The human factor is essential in construction. Workers have contributed as a cause of accidents due to unsafe actions they take.

Based on Haslam et al. (2005), more than 70% of occupational accidents in construction were due to unsafe actions and unsafe behavior of workers.

The safety culture maturity model was first introduced by the International Atomic Energy

Agency (IAEA) in 2002. According to the IAEA, there are three stages in the development of safety culture maturity that occurs in organizations. Each stage involves a different awareness and impact on human safety. This model is used by Hudson (2004) in developing new models. The model developed uses five levels in determining the stages of a safety culture maturity.

Knowing the level of maturity of safety in construction projects is important to prevent work accidents. Therefore, in this research, a safety questionnaire was designed in the field of construction so that it can be used to assess the safety maturity level of a construction project.

## 2 LITERATURE REVIEW

According to ASCNI in the journal Cooper (2000), safety culture is the interaction between humans (psychological aspects), work (behavioral aspects), and organization (situational aspects).

- a. The psychological aspect is also called climate safety and has the analogy of "how people

- feel." Psychological aspects can be measured through interviews and/or short questionnaires (Lefranc, 2012).
- b. The behavioral aspects have the analogy of "what people do." According to Lefranc, 2012, the measurement of behavioral aspects can be done by direct observation, while according to Boughaba (2014), it can also be done through questionnaires and/or interviews.
  - c. The situational aspect has the analogy of "what the organization has." Measurement of situational aspects through comparison of the application of company management systems and applicable regulations (Lefranc, 2012). While Filho et al. (2010) developed safety culture measurement methods based on situational aspects by taking into account the policies compiled by the company in making strategic plans and actions relating to the activities, awareness, and quality of the company's OHS.

The description of each stage in the development of safety culture, according to Hudson (2004), is as follows.

1. Pathological: pure accident mistakes from workers. The management system is only in compliance with regulations so that business remains legal and legally recognized.
2. Reactive: the company starts to take serious action in managing OHS, but only based on events that have occurred (curative), and there is no management to prevent accidents.
3. Calculative/Bureaucratic: the company has established an OHS management system and implemented OHS data collection. Awareness of OSH is only in the management sector or related to the OSH division, so there are significant differences in behavior patterns among workers associated with OSH.
4. Proactive: the OHS management system starts to involve workers in the improvisation of OHS management and begins to change the pure top-bottom management approach into two-way communication.
5. Generative: all levels of position actively participate. Safety is a culture and is part of the company's habits.

Choudhry et al. (2007) explain about construction project characteristics that project planning and execution are under limited time and budgetary pressure. This condition shows the differentiating construction project comparing other industries.

The concept of the maturity level of safety in construction is new. Machfudiyanto and Latief, 2017 formulated a conceptual framework for building a safety culture in construction in Indonesia. The results of this research are:

- a. Policy input with four latent variables, there are safety policy, safety cost policy, reward policy, and punishment policy.
- b. Institutional input with five latent variables, there are program objectives, benchmarks, major constraints, institutions involved, and patterns of roles and relationships.
- c. Construction safety occupational culture includes physical culture, behavioral culture, ideological culture, and culture of management norms.

### 3 RESEARCH METHODOLOGY

The method used is a literature study on the level of safety maturity in manufacturing and in-depth interviews with relevant parties in construction projects of apartments, offices, and malls > 20 floors. The questionnaire was prepared considering three aspects, namely psychological, behavioral, and situational. While the factors considered were determined based on literature review and in-depth interviews with OSH Manager. Table 1 shows the dimensions used.

Table 1 Dimensions that are used in the Construction Safety Maturity Level

Factors/ Dimension	Description
Information and Communication (IC)	Describe awareness, attention, and willingness to communicate information and problems related to OSH.
Commitment (CM)	Company support for aspects of health and safety, which includes planning, priorities, training, auditing, awards, investments, procedures, and team formation. Honesty with commitment is more meaningful than a written statement that says that occupational safety and health are important.
Organizational Learning (OL)	The learning process that focuses on aspects of practice, reporting, culture, and learning from mistakes and failures.
Leadership (LI)	Describe the leadership style of a supervisor or supervisor that can affect the OSH performance of

Factors/ Dimension	Description
	employees while working. Managers at all levels (including senior superiors) are very concerned about OSH aspects, which are proven in their consistency in the implementation and OSH behavior in the field.
Competence (CP)	The ability of each employee to manage and carry out work in the work area in accordance with the job description provided with due regard to work safety.

Then the questions and answers were drawn up, which described the five safety maturity levels. In contrast to the manufacturing industry, construction requires a grouping of workers based on their level of understanding of OSH. So that obtained the HSE category, staff, and foreman and workers. Pre questionnaires were distributed to them to get validation of questions that would be used in data collection.

After the questionnaire is arranged, then data is collected by filling out the questionnaire for each category of workers.

## 4 RESULT AND DISCUSSION

### 4.1 Construction Safety Maturity Level Questionnaire

The final results obtained are three types of questionnaires, namely the HSE Questionnaire with 40 questions, Staff/Management Questionnaire with 25 questions, and Foreman and Worker Questionnaire with 15 questions. Table 2 shows the detail of the question and categorize based on the type of worker.

Table 2 Construction Safety Culture Maturity Level

No	Question	HSE	STAFF	Foreman & Worker
1	Do you often talk about workplace safety with coworkers?	IC1	IC1	IC1
2	Does managing information about OSH affect the safe	IC2		

No	Question	HSE	STAFF	Foreman & Worker
	way of working?			
3	What do you usually do when facing near misses?	IC3	IC3	IC3
4	Does the project management (main contractor) ensure that workers know information about safety?	IC4	IC4	
5	Is there a discussion between workers and project management (main contractor) regarding OHS?	IC5	IC5	IC5
6	Has the OSH program been understood by all Department members?	IC6		
7	Does the project management (main contractor) prioritize handling OHS issues?	CM1		
8	Does training on OSH have an impact on workers' ability to work?	CM2		CM2
9	Do you get a penalty or a fine if you violate OSH rules?	CM3	CM3	CM3
10	How is compliance with the use of PPE in the work area?	CM4	CM4	CM4
11	Are there procedures for working	IC7		IC7

No	Question	HSE	STAFF	Foreman & Worker
	and using the equipment?			
12	How does the company manage worker health?	CM5	CM5	
13	Does the project management (main contractor) often have discussions about OSH knowledge and experience?	OL1		
14	Are activities to reduce hazards well planned?	OL2		
15	Does HSE / OSH provide analysis/recommendations based on accidents that occur?	OL3	OL3	
16	Does the project management (main contractor) motivate workers to report work errors openly?	OL4	OL4	
17	Does the employer assess workers in terms of OSH?	OL5	OL5	
18	Does the project management (main contractor) periodically follow up on the OSH document?	OL6		
19	Do your supervisors and coworkers respond well	LI1	LI1	

No	Question	HSE	STAFF	Foreman & Worker
	to your opinions during OSH discussions?			
20	Does project management (main contractor) pressure workers to implement work safety?	LI2		LI2
21	Has the worker helped with the operation of the OSH in your area?	LI3		LI3
22	Do superiors prioritize performance targets over safety?	LI4	LI4	
23	Does the HSE / OSH team prioritize an OSH guidance program that involves workers?	LI5		
24	Is the lack of ability of workers to be the cause of work accidents?	CP1		CP1
25	Are workers leading directions to reduce the impact of work accidents during emergencies?	CP2	CP2	
26	Are there workers who can make emergency response efforts according to procedures and control themselves from panic?	CP3	CP3	CP3

No	Question	HSE	STAFF	Foreman & Worker
27	Do you understand and apply OSH procedures in the work area?	CP4	CP4	
28	Does the project management (main contractor) provide details of tasks clearly about the main duties, responsibilities, and competencies?	CP5	CP5	
29	Do you get work safety training according to the type of work?	CP6	CP6	CP6
30	Is the project management (main contractor) committed to carrying out safety procedures adequately and correctly?	CM6	CM6	CM6
31	Does your supervisor always monitor (supervise) your safe workings?	CM7	CM7	
32	Has the project management (main contractor) planned the OSH routine and taken it seriously?	CM8		
33	Do you have the ability to learn from experience to prevent	CP7		

No	Question	HSE	STAFF	Foreman & Worker
	accidents from happening again?			
34	How do you get information about the OSH policy?	IC8	IC8	
35	Does the project management (main contractor) measure OSH performance?	OL7		
36	Do safety-related assessment indicators on your work affect performance?	OL8	OL8	
37	Does the project management (main contractor) carry out OHS risk control for guests, third parties, and subcontractors?	LI6	LI6	
38	Does the project management (main contractor) conduct strict handling of violations of smoking in the work area?	LI7	LI7	LI7
39	Does the project management (main contractor) involve you in formulating OHS policies?	LI8	LI8	
40	Does project management (main	LI9	LI9	LI9

No	Question	HSE	STAFF	Foreman & Worker
	contractor) motivate you to work safely?			

#### 4.2 Assessment result

The data processing of this questionnaire is using a fuzzy method. Furthermore, this questionnaire is used to assess the construction project to determine the level of maturity of its safety at the level of pathological, reactive, calculative, proactive, or generative.

In this study, questionnaire filling data was obtained by 21 HSE people and 26 staff with the results of the questionnaire showing a value of 4.08, namely in the proactive category. While filling the foreman and worker questionnaires got 117 people with a value of 3.56, namely the calculative category. Overall, the level of maturity for an apartment project that is the object of observation is calculative.

### 5 CONCLUSION

The conclusion that can be drawn from this research is that it is important to obtain guidance on assessing the level of safety maturity for construction projects. The aspects used in the assessment are psychological, behavioral, and situational aspects. While the factors/dimensions that are appropriate for construction are Information and Communication (IC), Commitment (CM), Organizational Learning (OL), Leadership (LI) and Competence (CP).

The questionnaire generated for HSE consisted of 40 questions, for staff 25 questions, as well as foremen and workers 15 questions. Data processing found that the construction project observed was at the calculative level.

For further research, data processing should be done on each of the observed factors. The purpose is to get an assessment of each factor and can then be used to develop recommendations for improving the level of safety maturity.

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