Critical Success Factors to Improve Safety Culture on Construction Project in Indonesia

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Abstract. Safety in the construction industry is still a major concern in some countries around the world.
This is due to the far higher levels of occupational accidents in the construction industry than other
industries. This study aims to (i) identify factors that affect safety, (ii) determine critical success factor
implementation of safety and (iii) the performance improvement at work done to achieve salvation. This
study uses Factor Analysis and Analytical Hierarchy Process. From this research, the 5 Critical Success
Factors are the leadership of (30.69%), Behavioural Safety (22.49%), Safety Planning (22.26%),
Individual Capability (17.52%), and the Report and Evaluation (7.04%). The result is based on the
critical success factors of the obtained improvement to the implementation of safety culture.

Keyword : Critical Success Factors, Safety Culture, Construction Project

1. Introduction
Safety is a very important element in the successful execution of a job. Safety in the construction industry is still a major concern in some countries in the world. This is because the levels of occupational accidents in the construction industry is still statistically far higher than other industries [1]
The efforts to prevent from accident is by working effectively to improve policies or regulations regarding occupational safety management system in the construction industry. At the project level, work accidents cause delays in the completion of projects due to lost working hours. Moreover, the other impact, which is no less important, is lowering the quality of human life [2].
Based on the description above, the researchers formulated several problems as follows (1) What factors influence the success of safety on construction projects in Indonesia? (2) Which part of the Critical Success Factors largely influences safety culture? and (3) How is it to improve the safety program as forming a safety culture based on the success factors of the safety performance?
The objectives of this research are (1) To identify the success factors of safety work on construction projects, (2) to determine the Critical Success Factors that mostly influence safety culture in the construction project and (3) to provide an improved method of implementation of the safety program as a shaper of safety culture work based on the success factors of safety performance

2. Theoretical Study
Critical success of a construction project is an important problem for most governments, users and communities [3]. The Project will be considered successful when the project is completed on time, the budget does not swell, good quality and without workplace accidents [4]. [5] state that the CSF is required for the success of any program in a way that the purpose of the
organizations might not compatible with current conditions, so their programs will fail catastrophically. [2] propose a complete list of critical success factors that can affect the successful implementation of safety programs. The following figure illustrates several Critical Success Factors of safety culture development according to the experts who conducted research and based on the rules

![Critical Success Factors Development of Safety Culture](image)

| Table 1. Critical Success Factors Development of Safety Culture |
|---------------------------------------------------------------|
| **No.** | **Dimension** | **Description** | **Source** |
|---|---|---|---|
| 1 | Clear goals | Clear and reasonable safety goals should be established to provide a clear direction for staffs to work toward, and to serve as the target against which overall safety performance can be measured. | [6] |
| 2 | Authority and responsibility | The proper authorities and responsibilities are assigned to workers to handle safety incidents and to take appropriate action. | [6] |
| 3 | Teamwork | All levels of staff in the company must be engaged in the safety programs; improving safety should be seen as a collective effort which requires cooperation from everyone involved. | [6] |
| 4 | Program evaluation | Safety programs should be periodically evaluated to determine its success in meeting set out goals and objectives. | [6] |
| 5 | Sufficient resource allocation | Sufficient resources (eg. staff, time, money, information, facilities, equipment, machinery) to carry out daily activities to achieve both short-term and long-term. | [6] |
| 6 | Leadership | Leaders are personally involved in ensuring that the organization’s safety management system is developed and is implemented. Leadership and management commitment to safety is recognized as a fundamental component of the organization’s safety culture. | [7] |
| 7 | Safety Meeting | To improve safety performance at the project, formal safety meeting must be held regularly to review the safety records. | [8] |
| 8 | Communication | When the lines of communications between management and workforce are open, workers can bring reports of unsafe working practices and hazardous environments. | [9] [6] |
| 9 | Efficient Enforcement System | Efficient enforcement scheme should be developed and should be implemented to ensure that workers follow the safety rules and regulation. | [9] |
| 10 | Suitable Supervision | Supervisors are capable of allocating work that matches worker’s skill, identifying hazard conditions and making the environment safe by communicating with workers and by listening to them and be sure all workers follow the safety rules and find solution for the occurring safety problem. | [9] |
| 11 | Conflict resolved quickly by project participants | Safety being overlooked in the context of heavy workload and other priorities, taking shortcut to save effort and time. | [10] |
Conflicts will aggravate the situation if they are not resolved quickly.

|   |   |
|---|---|
| 12 | Risk preference  |
|   | The more willingness to take a risk, the stronger risk tolerance an individual may have |
| 13 | Decision motivation  |
|   | With the motivation of specific decisions, the decision is a significant directivity, which resulted in the fact that the activity of the decision will be moving towards the expected direction and purpose |
| 14 | Noise  |
|   | Loud noise from operation of machines may make workers feel fidget, then, unreasonable assessment of self-risk tolerance may happen |
| 15 | Peer behaviors  |
|   | The effect of peer behaviour refers to workers would do as same as what their peer workers do. If other workers complete work earlier by taking risks, it will enhance individuals’ risk tolerance to take the same risks |
| 16 | Participation of employees  |
|   | Successful safety programs largely depend on employee involvement as workers tend to support the activities that they themselves help to create. Workers should be given the opportunities to provide input into the design and implementation of safety programs such as being a member of the safety committee, reporting hazards and unsafe practices to supervisors, identifying training needs, investigating accidents, etc. |
| 17 | Positive group norms  |
|   | Group norms are the accepted attitudes about various things amongst a group of people. In practice, members of a group conform to certain attitudes simply to avoid sanctions. If positive attitudes towards safety can be built and embedded within a group, safety can then be managed successfully. This is the basis of good safety culture. |
| 18 | Safety knowledge  |
|   | The more safety knowledge the workers have, the more clear about the seriousness of risk taking in construction project, then the lower risk tolerance may happen |
| 19 | Physical health  |
|   | This factor influences the pressure workers can endure, the working quality, and the corresponding ability to confront risks. |
| 20 | Emotion  |
|   | It means whether workers are happy or not, sometimes working with anger or sadness may result in irrational of risk decision making. |
| 21 | Equipment and Maintenance  |
|   | Regular maintenance of equipment to ensure that they are always in safe working condition. |
| 22 | Personal Attitude  |
|   | Better safety attitudes mean better perception of the work atmosphere that leads to better safety performance. |
|   | Professional knowledge                      | It refers to the degree of professional knowledge which will affect workers directly while dealing with professional project issues and will result different risk tolerance. | [18] |
|---|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 24 | Sensitivity to potential risks              | It refers to the ability that workers can make quick response and judgment to potential risks by analyzing relevant information. Being more sensitive means the workers emphasize more on safety issues, thus they have lower willingness to take risks. | [17] |
| 25 | Safety Plan Presentation                    | K3 plan is presented at the meeting of the preparation for the construction work to be approved and be signed.                                                                                                                                  | [16] |
| 26 | Safety plan is part of a contract           | Safety plan that was approved become an integral part of the contract documents of the construction work and a reference implementation on the construction.                                                                                                                                 | [16] |
| 27 | Construction K3 policy in the form of Joint Operation | In the case of construction work carried out in the form of Joint Operation, the Joint Operation leader should establish the safety Construction policies that apply to all company in Joint Operation.                                            | [16] [21] |
| 28 | Suitability implementation of the Safety Plan | If there is a discrepancy in the implementation of the Safety Plan and / or alteration and / or occupation add / subtract, then safety plan must be reviewed and be approved.                                                                                     | [16] |
| 29 | Documentation of the results of the application of Safety Plan | Documentation of the results of the implementation of Safety Plans are made and are reported regularly (daily, weekly, monthly and quarterly), which become part of the report on the implementation of work. | [16] |
| 30 | Accident report                             | In case of work accident, the contractor shall make a report of workplace accidents.                                                                                                                                                                            | [16] |
| 31 | Performance improvements                    | The Company shall implement performance improvements based on the results of performance evaluation conducted quarterly safety plan, in order to ensure the suitability and effectiveness of the application.                                                   | [16] |

### 3. Methodology

In answering the formulated problems, there were several stages of research used by the authors. Those stages were intended to this study can be done effectively and efficiently and to produce relevant outputs. The stages of the research that were to be carried out research variables were used in the questionnaire respondents of this study as follows.
This research method was based on the literature study, depth interviews and survey respondents. Data analysis method used factor analysis for grouping CSF and Analytical Hierarchy Process to determine the ranking.

**Table 2. Research variables**

| No | Variables                                      | No  | Variables                                      |
|----|-----------------------------------------------|-----|-----------------------------------------------|
| 1  | Clear goals                                   | 17  | Positive group norms                          |
| 2  | Authority and responsibility                  | 18  | Safety knowledge                              |
| 3  | Teamwork                                      | 19  | Physical health                               |
| 4  | Program evaluation                            | 20  | Emotion                                       |
| 5  | Sufficient resource allocation                | 21  | Equipment and Maintenance                     |
| 6  | Leadership                                    | 22  | Personal Attitude                             |
| 7  | Safety Meeting                                | 23  | Professional knowledge                        |
| 8  | Communication                                 | 24  | Sensitivity to potential risks                |
| 9  | Efficient Enforcement System                  | 25  | Safety Plan Presentation                      |
| 10 | Suitable Supervision                          | 26  | Safety plan is part of a contract             |
| 11 | Conflict resolved quickly by project participants | 27  | Construction–K3 policy in the form of Joint Operation |
| 12 | Risk preference                               | 28  | Suitability implementation of the Safety Plan |
| 13 | Decision motivation                           | 29  | Documentation of the results of the application of Safety Plan |
| 14 | Noise                                         | 30  | Accident report                               |
| 15 | Peer behaviours                               | 31  | Performance improvements                      |
| 16 | Participation of employees                    |     |                                               |

*Figure 1. Research Methodology*
4. Result

Factor Analysis calculation served to reduce the factors into new factor by combining several factors into one new factor. With this method the factor analysis results were obtained in the form of five factors gained from forming factors (Table 3) as follows (1) Report and evaluation, (2) Safety behavior, (3) Safety planning, (4) individual ability, (5) Leadership

| No. | Reports and Evaluation Companies | Behavioural Safety | Safety planning | Individual Ability | Leadership                  |
|-----|--------------------------------|-------------------|----------------|-------------------|-----------------------------|
| 1   | Program evaluation             | Communication     | 2 Clear goals  | 3 Risk preference | Authority and responsibility |
|     |                                | Noise             |                |                   | Teamwork                    |
| 2   | Sufficient resource allocation | Noise             | 2 Clear goals  | 3 Risk preference | Decision motivation         |
| 3   | Efficient Enforcement System   | Peer behaviours   |                |                   | Sensitivity to potential risks |
| 4   | Safe Supervision               | Participation of employees | Construction-K3 policy in the form of Joint Operation | | Leadership |
|     |                                |                   |                |                   | Conflict resolved quickly by project participants |
| 5   | Equipment and Maintenance      | Positive group norms | Documentation of the results of the application of Safety Plan | | |
| 6   | Suitability implementation of the Safety Plan | Safety knowledge | | | |
| 7   | The accident report            | Physical health   | | | |
| 8   | Performance improvements       | Emotion           | | | |
| 9   | Safety Meeting                 | Personal attitude | | | |
| 10  |                                | Professional knowledge | | | |

After conducting the factor analysis to determine the Critical Success Factors for development of the implementation of new safety work on the construction project, a ranking of the Critical Success Factors was completed by comparing each - each of these factors. Rating assessment aimed to determine how important these factors in the development of safety culture on the project construction purposes in Indonesia. The ranking was done by using Analytical Hierarchy Process (AHP).
After getting the data from each expert then did recapitulation and took the value - average of all ratings of experts in order to obtain results as in the following table:

Table 4. Results Analytical Hierarchy Process

| Critical Success Factors | Reports and evaluations | Safety behavior | Safety planning | Individual ability | Leadership |
|--------------------------|-------------------------|-----------------|-----------------|--------------------|------------|
| Reports and evaluations  | 1,000                   | 0,301           | 0,306           | 1,890              | 1,872      |
| Safety behavior          | 6,200                   | 1,000           | 4,250           | 3,250              | 1,269      |
| Safety planning          | 6,400                   | 1,092           | 1,000           | 4,840              | 3,051      |
| the ability of           | 4,225                   | 3,456           | 1,279           | 1,000              | 1,672      |
| the individual Leadership| 5,225                   | 5,440           | 3,458           | 5,229              | 1,000      |

Based on the AHP calculation of the obtained percentage of weight each factor, as follows (1) Leadership = 30.688%, (2) Safety behavior = 22.492%, (3) Safety Planning = 22.258%, (4) Individual Ability = 17.525%, and (5) Report and Evaluation = 7.038%.

5. Discussion

Based on the questionnaire that has been given to respondents to the safety factor of 31, the data was processed using factor analysis (using SPSS Program) which aimed to reduce the factors into five new factors. Each - each new factor that also had a new description is explained in the following table.

Table 5. Description of Critical Success Factors

| No. | Critical Success Factors | Description | Literature |
|-----|--------------------------|-------------|------------|
| 1   | Leadership               | Top Management must have the commitment and concern on making and improving workplace safety programs involving all workers and employees (such as policy making as well as rewards and punishments consistently) | [2] state that management plays a very important role in the safety program that is efficient and effective. |
| 2   | Behavioral safety        | Behavior and awareness of every employee about the importance of workplace safety can improve the implementation of safety so that each employee is expected to behave positively including in maintaining safety (such as workers always wear PPE and part of the signs and rules) | [2] state that management plays a very important role in the safety program that is efficient and effective. |
| 3   | safety planning          | The company must have a good plan that includes goals, costs and | According to [22] that the safety program can achieve the desired results |
policies in the implementation of safety on every work unit when the safety objectives have been clear.

4 the ability of the individual Workers should be able to have a rapid response to the risks that may arise and can take immediate decisions that can prevent accidents [17] argues that the ability of workers can make a rapid response and assessment of potential risks by analyzing relevant information.

5 Reports and Evaluation Companies must have a report that is standard / have on the implementation of safety standards in full. The report will be evaluated periodically to allow for increased performance. According [2] safety programs should be periodically evaluated to determine their success in meeting the goals and objectives set.

Based on these findings, it is necessary for Critical Success Factors strategy to be implemented either as shown in Table 6 as follows.

| No. | CSF (Results of Factor Analysis and AHP) | Findings On The Ground | Improvement Policy | The responsible stakeholders |
|-----|------------------------------------------|------------------------|--------------------|-----------------------------|
| 1   | Leadership                               | Lack of commitment from top management to the importance of safety | [2] state that management plays a very important role in the safety program that is efficient and effective. The need for a strong commitment from the top management of companies to be able to continue to conduct the evaluation and improvement of the implementation of work safety regulations. | Top Company Management |
| 2   | Safety behavior                          | The low awareness of the workers on the implementation of safety as there are still many violations of rules / signs and lack of awareness of the use of PPE | Successful implementation of the program of work safety can be achieved if the positive attitude of employees towards safety is amplified [2]. The need for appropriate policies that include rewards and punishment so that the implementation of work safety can be done well and can be understood by all employees and workers. | All employees and workers, safety supervisors |
| 3   | Safety planning                          | The presence of good   | According [23] In good evaluation of safety planning, it is necessary | Top Management |

Table 6. Safety Culture Improvement Implementation CSF
planning on safety such as budget planning implementation K3 safety has not been allocated properly and lack of planning of the safety program and implementation of managerial leadership, policies that are in accordance with the regulations set by the government. Variety of approaches in occupational safety and health, among others, will be outlined the importance of proper planning. The need for careful planning of the budget allocation on safety and the need for such a program concerning safety training.

4 Individual ability

Workers had less sensitivity to the risk for accidents that caused low anticipation. According [23] in building a safety culture it is necessary to have good behaviour in developing individual abilities. Training can help employees make better decisions and improve the ability in their field of work. The need for training to know what to do in case of accidents. Top Management, Safety Manager and employees as well as workers.

5 Reports and Evaluation

The low reports of accidents occurred so an evaluation of the risk of accident did not achieve the maximum. Therefore, the anticipation of occupational accidents was still low. According [2] safety programs should be periodically evaluated to determine their success in meeting the goals and objectives set. It needs to be monitored for any accidents to work and be evaluated regularly and continuously to improve the implementation of work safety. Top Management, Safety Manager, Safety Supervisor.

6. Conclusion

The conclusions and results of this research to the development of safety on the construction project are:

1. There are 31 safety factors derived from the literature and the previous research. Those factors become a variable factor questionnaire to respondents who had experience in the field.

2. In the implementation of the safety culture in construction projects, there are 5 Critical Success Factors that must be considered and must be implemented to achieve a good safety. The fifth factor weighs role on the implementation of safety i.e. Leadership Factor = 30.69%, Behavioural Safety Factor = 22.49%, Safety Planning Factor = 22.26%, Individual Capability Factor = 17.52%, and Factor Report and evaluation = 7.04%. 
3. Critical Success Factors Based on the necessary steps - steps to increase safety culture that involve all levels of the company both from top management to project workers step namely:
   a. The need for a strong commitment from the top management of companies to be able to continue to conduct the evaluation and improvement of the implementation of work safety regulations.
   b. The need for appropriate policies that include rewards and punishments so that the implementation of work safety can be done well and can be understood by all employees and workers.
   c. The need for careful planning of the budget allocation on safety and the need for such a concerning safety-training program.
   d. Need for training / training to know what to do in case of accident.
   e. Need to be monitored for any accidents to work and to be evaluated regularly and continuously to improve the implementation of work safety.

To increase safety, it is expected to achieve the implementation the 5 Critical Success Factors.

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