

Building a Safety Culture in the Construction Sector: A model to assess the safety maturity of a company

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Abstract

High numbers of work accidents prove that work safety can no longer be denied. There must be a system to manage safety, especially in the construction sector, which has the highest contribution of work accidents in Indonesia. The system to manage safety is usually called Safety, Health, and Environment system (SHE system). However, the success of SHE systems is affected by the safety maturity level of the company. In fact, the number of work accidents is still increasing even though SHE systems have been applied in those companies. This research was conducted to develop a safety maturity model in order to improve safety and project performances. This research will draw a portrait of the existing safety maturity level of Indonesian construction companies. After knowing the existing level and the indicators that have not been fulfilled, a model for improving the existing safety maturity level was developed. The variables of the research are: safety policy, safety institution, safety cultures, safety maturity level, safety performance and project performance. This research was conducted through Delphi and questionnaire survey methods. The results of this research are the improvement of a safety maturity model and the suggestion of improvement actions to increase safety maturity level.

Keywords

Work accidents, SHE, safety maturity level, safety performance.

1. Introduction

1.1 Background

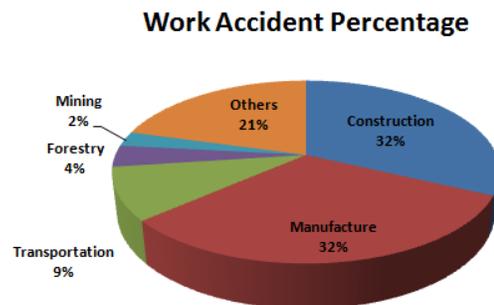


Figure 1. Number of accidents percentage

Lately, construction sector has been the largest contributor for number of accidents in Indonesia. It contributes for 32% for number of accidents based on the survey conducted by National Journal (2009). This fact shows that safety in construction sector has not been well-maintained by the contractors. While the contractors have knowledge about safety, health and environment system, but still cannot reduce the accidents.

The maturity of each contractor also defines the success of safety, health and environment system application. Hopkins (2005) said that safety culture has being attention because safety, health and environment system will be success if the contractors have a good safety maturity level. Safety, health and environment system is a well-planned action to prevent accident or work illness (Siswowardojo, 2003). The trend line also proves that safety can no longer be denied. When safety, health and environment system has been applied, the number of accidents is supposed to be decreasing, but not happening in fact. Ek et al. (2007) said that the success of safety, health and environment system is based on the existence of enterprise safety culture. The safety maturity level of national private contractors is not at a good level to make the safety, health and environment system success.

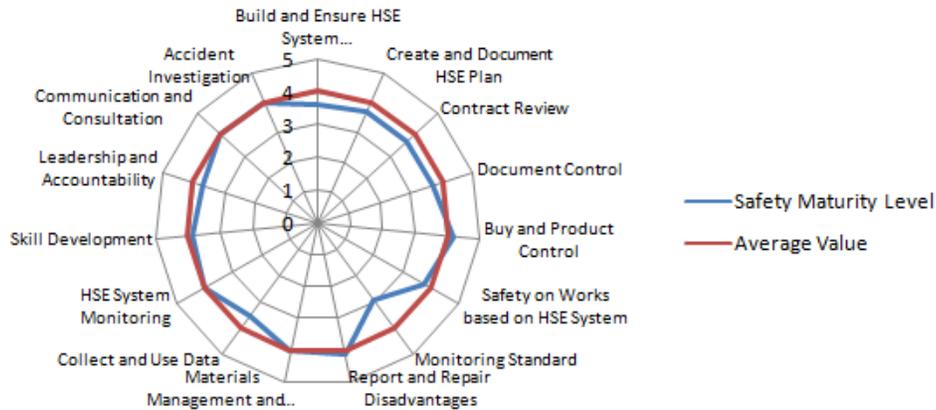


Figure 2. Safety maturity level of national private contractor spectrum

As we can see from the spider web diagram above, there are some indicators below the average of good enterprises standard. While the red line represents the standard average, the green line represents the existing condition of national private contractors. The more company grows mature, the more they fulfill all of the indicators above the average point. This data triggers this research, to develop a model so the enterprises can improve their safety maturity level one step ahead of their existing level.

1.2 Research Objectives

1. Identify safety maturity level condition of construction sector in Indonesia.
2. Identify the relation between safety culture and safety maturity level affected by policy and institution to improve safety performance and project performance.
3. Develop a model to improve safety maturity level of construction enterprises.

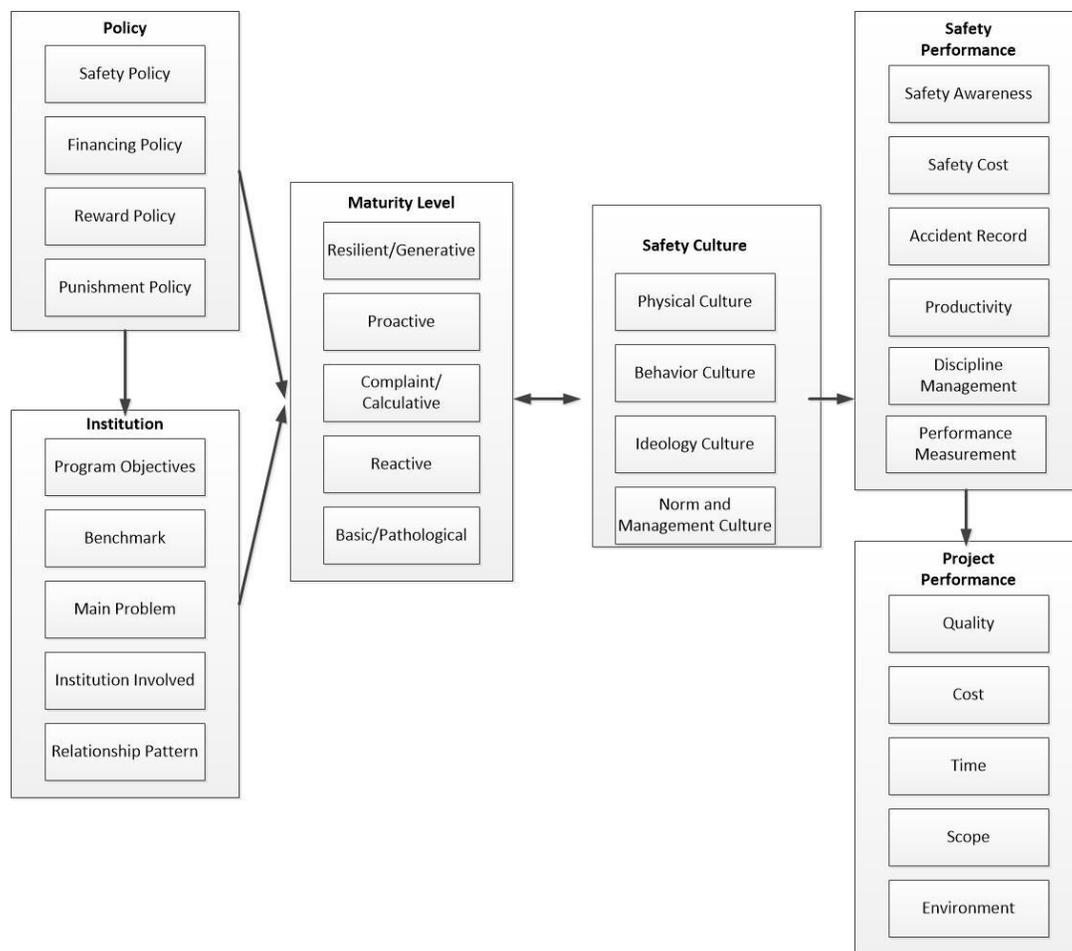


Figure 3. Research Operational Model

Figure 3 shows the operational model of this experiment. The arrow shows the relationship between variables. Policy gives impact to institution. Then the institution will affect the safety maturity level. The safety maturity level and safety culture will affect each other. Then when safety culture is formed, it will give impact to safety performance that will affect project performance.

2. Theoretical Review

The novelty of this research is looking for the relationship between all aspects, from policy, institution, safety culture, safety maturity level, safety performance, and project performance.

Safety, Health and Environment Management System. HSE System is part of system management including organizational structure, planning, responsibility, executing procedure, process, and resources needed to develop, to apply, to achieve, to review, and to maintain safety policy and work illness in terms of risk control that is related to work activity for creating a safe, efficient productive environment (PP No. 50/2012).

There are twelve elements as the requirement for HSE system:

1. Apply commitment
2. HSE documentation
3. Control and review contract
4. Control document
5. Control Product
6. Work safety based on HSE
7. Monitoring standard
8. Report and fix action
9. Material management and mobility

10. Collect and use data
11. Check HSE system
12. Develop skill

Safety Maturity Level. The attention and commitment level of enterprises for safety factors. Based on UK Coal Journey, there are five level and fifteen indicators for each level.

Table 1. Safety Maturity Level

MATURITY LEVEL		
Level 1	Vulnerable (Basic)	<ul style="list-style-type: none"> • Existing system does not work well • No risk identification process, risk assessment and control • No contract review procedures • No document control procedure • No PPE (Personal Protective Equipment) • No safety performance monitoring on department level • No explanation about safety from the manager • Ignore near miss • No procedure to keep and move the materials • No data documentation • No audit • No safety training for the labor • Manager does not pay attention to the safety • Bad HSE communication • Bad and shallow accident investigation
MATURITY LEVEL		
Level 2	Reactive	<ul style="list-style-type: none"> • System will work after an accident happen • Risk identification, risk assessment, risk control work reactively • Start making review contract procedure • Start paying attention to document controlling procedure • PPE is applied to reduce impact • Department safety performance is traced and incident level is settled by department. Incident level is a bonus system for manager • Manager explain about safety periodically • Start to pay attention for near miss • Start to make keeping and moving materials procedure • There is a procedure to document the data • There will be audit if there is a problem • Labor gets basic safety training • Obedience level is low • Forming HSE communication • Accident investigation focuses on human error.
Level 3	Compliant (Planned)	<ul style="list-style-type: none"> • System focuses on decreasing the number of accidents • Risk identification, risk assessment, and risk control work based on the system • The procedure consider risk identification, risk assessment and risk control on design and modification process • Document controlling procedure does not work well • PPE works depend on risks • Management include safety system performance and

MATURITY LEVEL		
		<p>result is part of periodic report and used as evaluation result</p> <ul style="list-style-type: none"> • Manager has program to visit site until the project is done • There is discussion to control near miss • There is planning for keeping and moving materials • Safety staff has documented and applied identification, collecting, maintaining procedure • Audit planning • Staff receives safety training, include how to be a safety leader • There is labor engagement towards HSE implementation • HSE communication getting better • Accident investigation with limited analysis
Level 4	Proactive	<ul style="list-style-type: none"> • System focuses on planning, executing and evaluating • Risk identification, risk assessment, risk control work proactively • Risk identification and risk assessment is being done by a skillful staff • HSE document has status identification, authority, and modification date • Safety procedures for all activities are well-planned, include PPE • Safety leadership include in yearly assessment, include measureable targets • There is a comprehensive program to decide how to do a safety visit, evaluate and make sure they are competent • Controlling potential risks • There is a procedure to ensure materials keeping and mobility • The latest HSE datas are collected and analyzed • Integrated audit • Staff receive safety leadership training based on skill and development • Engagement of HSE implementation from all levels • Open HSE communication • Accident investigation by identifying accident causes
Level 5	Resilient	<ul style="list-style-type: none"> • System is a part of daily activities and HSE is a need • Integration of risk identification, risk assessment, and risk control to all systems • Procedure, risk identification, and risk assessment are well managed • There is a system to create, and to accept HSE document changes • Integrated HSE system • Safety leadership management is the main element to evaluate their performance, and part of enterprises safety assessment. Targets are defined and settled • There is a comprehensive program to evaluate manager visit and feedback from staff • Risk elimination before accident happen • There is a system to identify and give label for certain

MATURITY LEVEL		
		chemical substances <ul style="list-style-type: none"> • HSE data is part of integrated HSE system • Evaluation/external audit for repairing system and system effectiveness system that is implemented • Staff receives safety leadership training periodically and the development depends on individual needs • Leaders have strong safety leadership • Work safety is always a main topic in every meeting • Work accident investigation to identify all accident factors

Safety Performance. Safety performance is a measurable implementation result of HSE system.

Project Performance. Work performance is the result of project management that is being done. The performance is good when it can achieve its objectives (Carr, 1998).

3. Research Methodology

The research methodology is the method that is used to conduct the research in terms of achieving the research objectives. The initial step is by doing an expert validation for the questionnaire contents. The contents are from UK Coal Journey. The next process is by conducting a pilot survey to picture the real respondents. The process continues to questionnaire survey. The survey respondents are 188 safety experts such as safety manager, safety officer, etc. The respondents are those safety workers on site, not at the head offices. After all data are collected, the radar charts are made to show the existing condition.

4. Research Results and Discussions

The research uses 15 indicators to measure safety maturity level. These 15 indicators are based on UK Coal Journey. 15 indicators are different for each level to show the characteristic of basic, reactive, complaint, proactive, and resilient level. The radar charts are made to show the existing condition of Indonesian construction enterprises. Three indicators with highest score are chosen as the most indicators that needed to be developed. The first radar chart is the basic level. At the basic level, there is no indicator that reach score 4. The three highest score are:

1. No PPE (Personal Protective Equipment)
2. Bad HSE communication
3. No safety performance monitoring on department level

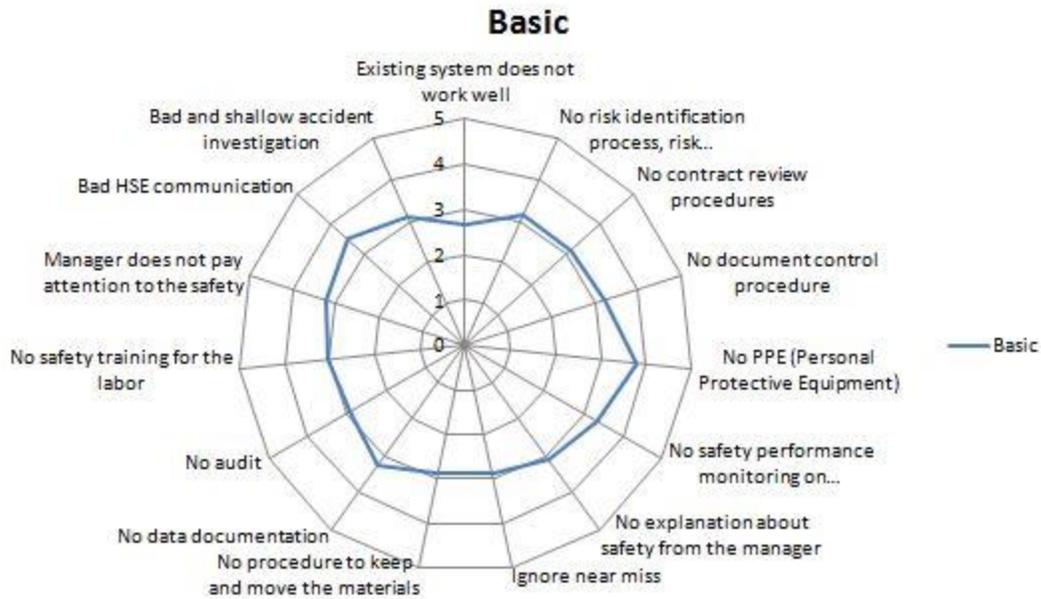


Figure 4. Basic Level Radar Chart

To improve those three indicators, there are some suggestions to increase the score. The first indicator can be improved by revising the PPE program. Standard approaches include adding new policies, increasing monitoring measures and sometimes resorting to progressive discipline for workers with multiple PPE-related safety violations. The enterprises can also provide human factors training. Human factors training can improve PPE compliance by giving employees a better awareness of how injuries can occur, motivate them to wear their PPE and remember it at critical times to ensure that your PPE and safety policies don't go to waste. One of the most effective ways to improve a safety culture and prevent injuries is to optimized safety-related communication throughout an organization (Williams, 2003). To make a better communication, the enterprises should make it into a discussion. Through a comprehensive discussion, the enterprises will get corrective feedbacks. Solving problems together also can improve the communication skills (Angelica, 2007). There are five ways to do a safety performance monitoring:

1. Safety audits and informal inspections
2. Safety surveys
3. Safety occurrence reporting
4. Investigation of safety occurrences
5. Safety studies

To improve the safety performance monitoring, the safety indicators have to be defined. There must be a systematic collation and evaluation of results from all safety monitoring activities. The evolution of the indicators should be analyzed and the application of corrective action process has to be done.

The next radar chart shows reactive level, which is the second lowest safety maturity level. The three indicators with the highest score from reactive level are:

1. Start paying attention to document controlling procedure
2. Start to pay attention for near miss
3. Forming HSE communication

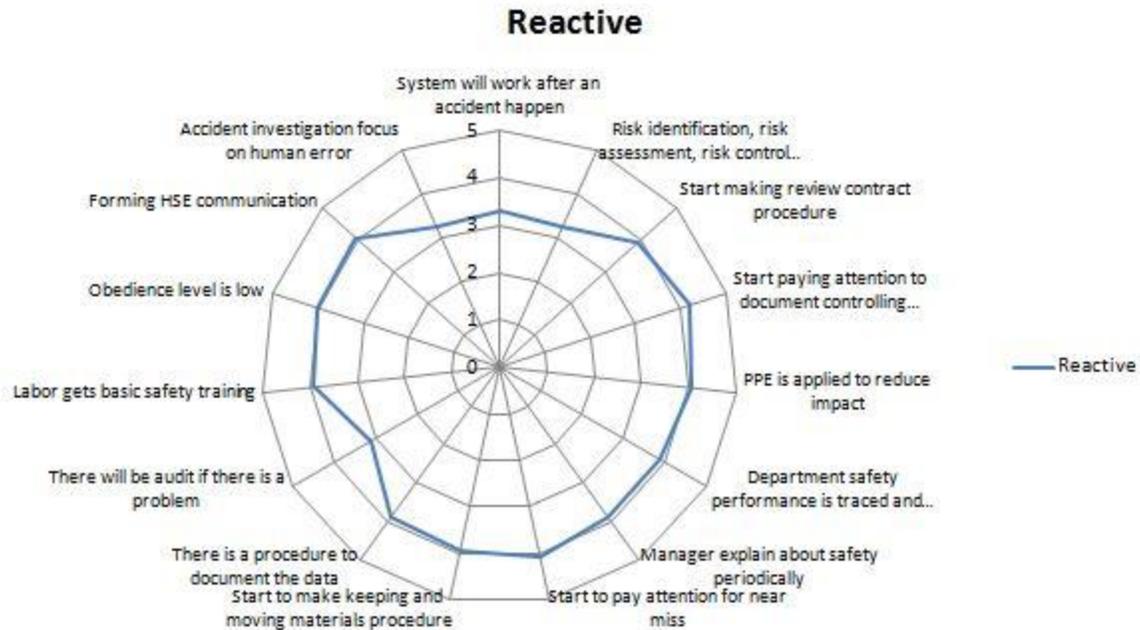


Figure 5. Reactive Level Radar Chart

To improve document control procedure, the maintaining and controlling distribution procedure of documents has to be included to the document control procedure. The document controlling procedure must be implemented to define the controls needed to; approve, review, update, identify changes, identify revision status and provide access. Based on wise.businessware.com, there are four steps to improve near miss reporting:

1. Define and communicate to all employees the expectation of near miss reporting
2. Train the employees about the procedure to do a proper near miss reporting
3. Monitor the information collected so troublesome areas can be tracked and corrected
4. Make an incentive program. Reward the employees for reporting hazards and taking an active role in creating a safer workplace

The third level is compliant. In this level, the three indicators with the highest score are:

1. Safety staff has documented and applied identification, collecting, maintaining procedure
2. Manager has program to visit the site until the project is done
3. Management include safety system performance and result is part of periodic report and used as evaluation result



Figure 6. Complaint Level Radar Chart

The site manager or even project manager has to plan a routine site visit. The manager also has to do proper preparation for a site visit. The manager should deliver the project charter and also problem statement so there will be a clear understanding of what the project is intended to deliver. There must be an observation to see potential issues evolved over time.

The following level is proactive level. In this level, the enterprises have the initiative to develop HSE system. The three indicators are:

1. Controlling potential risks
2. There is a procedure to ensure materials keeping and mobility
3. The latest HSE data are collected and analyzed

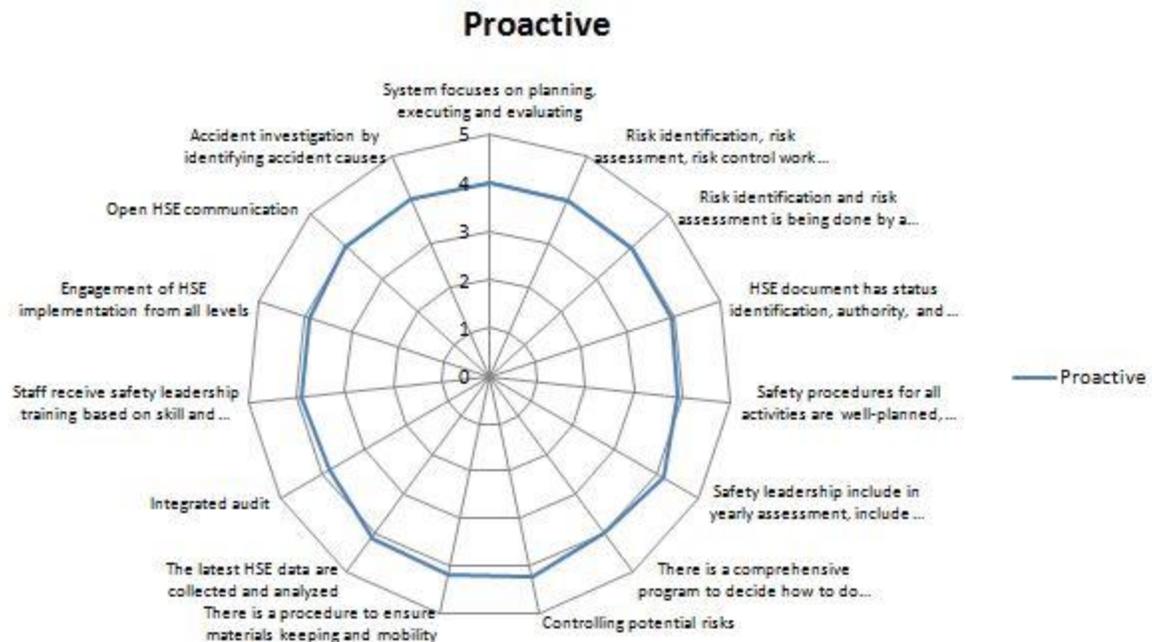


Figure 7. Proactive Level Radar Chart

The enterprises need to do risk identification, risk assessment, and risk control in terms on controlling potential risks. The first thing to do is to identify all potential risks that may occur in project. The identification should be comprehensive and detail. After the identification, the risks are assessed and ranked. The last thing is to define the controlling action to prevent the risks or to reduce the impact of the risks.

The highest safety maturity level is resilient level. In this level, HSE is supposed to be a daily needs. The three indicators with the highest score are:

1. Work safety is always a main topic in every meeting
2. Integration of risk identification, risk assessment, and risk control to all systems
3. Evaluation/external audit for repairing system and system effectiveness system that is implemented



Figure 8. Resilient Level Radar Chart

Resilient level is the top performance from a safety maturity level. At this level, safety is really a matter for the enterprises and has become a daily needs. Safety awareness is at its highest concern for all employees. All enterprises are aiming to reach this level, so a safe workplace will be created.

5. Conclusion

In conclusion, every construction enterprise is at its own safety maturity level. The sequences of the level start from basic, reactive, compliant, proactive, until resilient level. The survey has shown to us the three indicators for each level that can be improve so they can level up the enterprises safety maturity level. The suggestion methods are given above to improve from the existing level to the higher level. By improving enterprises safety maturity level, it will create better safety cultures. When great safety cultures are settled, it will give a great safety performance. A great safety performance will eliminate work accidents, work illnesses and will save a lot of project time and project cost. By eliminating those risks is also ensuring the quality of the result. Last but not least, a good safety performance will affect the project performance. So in simple words, by improving safety maturity level will deliver a good project performance.

References

- Bizmanualz, Document Control, How to Improve It, Available: https://www.bizmanualz.com/increase-productivity/improve-document-control.html?utm_referrer=https://www.google.co.id/, December 15, 2017.
- Foster, P., Hault, S., The Safety Journey: Using a Safety Maturity Model for Safety Planning and Assurance in UK Coal Mining Industry, pp. 61, 65, 67 & 68, 2013.
- Goncalves, A. P., Silveira, J. C., & Oliveira, M. M., Safety Culture Maturity in Petrochemical Companies in Brazil- The view of the Employees, pp. 3, 2012.
- Pramudya, A., Structural Equation Model (SEM) Relationship between Policy and Safety Maturity Level on Safety Performance and Project Performance in Construction Services Company, pp.4, 2017.

- Safe Start, 3 Ways to Improve PPE Use Among Employees, Available: <https://www.safestart.com/news/3-ways-improve-ppe-use-among-employees>, December 15, 2017.
- Safety Performance Monitoring and Measurement, Available: https://www.skybrary.aero/index.php/Safety_Performance_Monitoring_and_Measurement, December 15, 2017.
- Vecchio-Sadus, A. M., Enhancing Safety Culture Through Effective Communication, pp. 4 & 8, 2017.
- Vongvitayapirom, B., Sachakamol, P., & Kropsu-Vehkaper, H., Lessons Learned from Applying Safety Culture Maturity Model in Thailand, pp. 10&15, 2013.
- Wise Businessware, How to Improve Near Miss Reporting, Available: <http://blog.wisebusinessware.com/safetyinsiderblog/how-to-improve-near-miss-reporting>, December 2017.
- Zhang, L., and Gao, Y., Safety Culture Model and Influencing Factors Analysis in Construction Enterprises of China, pp. 3302, 2012.

Biographies

Johan Santoso is a magister student of Civil Engineering Construction Management Program at Faculty of Engineering, Universitas Indonesia. He holds a Bachelor of Civil Engineering Degree in 2017 at Faculty of Engineering, Universitas Indonesia. He took a fast track program, which integrating between bachelor degree program and magister degree program. He is conducting a research about safety because of his concern about the numbers of work accidents in Indonesia, especially in construction sector.

Yusuf Latief is a Professor at the Faculty of Engineering, Universitas Indonesia. He teaches for Undergraduate, Graduate and Doctoral Programs. He earned his Bachelor, Master, and Doctoral degrees in Civil Engineering at Universitas Indonesia. In 2011, he has promoted as Professor of Civil Engineering at Universitas Indonesia. His inauguration speech presented National Construction Cluster Competitiveness as a solution to overcome the low competitiveness in the national construction industry sector. He actively writes articles in national and international journals with specifications in the areas of Project Management and Construction.

Rossy Army Machfudiyanto is a PhD student in Civil Engineering Universitas Indonesia has author, in 2016. One is titled Improvement Policies Based on Dimension of Safety Culture in Construction Projects, Conference ICES ITB, Bandung. The other is titled Identification of Safety Culture Dimensions based on the Implementation of OSH Management System in Construction Company, Conference SCESCM UGM, Bali.