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A STUDY ON THE IMPLEMENTATION OF PRE-CONSTRUCTION HEALTH AND SAFETY PLANNING IN THE CONSTRUCTION PROJECTS IN UNIVERSITAS NEGERI SEMARANG IN 2018

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Abstract— The construction sector in Indonesia is still having a high number of fatal accidents nationwide approximately 32% of all accidents and lately tends to increase. Reducing the number of accidents required a comprehensive understanding of how and why the event occurred. From the management process, one of the ways to reduce the number of accidents is by conducting safety planning during pre-construction phase. In construction projects, costs, and building structures have been planned since the pre-construction phase. However, the safety aspects are generally planned at the stage of construction by contractors. According to recommendations from several experts [2] ; [14]; [11]; and [18], construction safety planning should be carried out as early as possible (called pre-construction safety planning), as well as structural planning and costs. Furthermore, to be able to find out whether a pre-construction safety plan has been sufficient or not, an assessment tool is needed. The assessment tool must meet the requirements, which are valid, reliable and easy to use. Pre – construction safety planning assessment model used in this study was Maturity Index of Pre-construction Safety Planning (MISAP) by [9]. This model has adequate numbers of validity and reliability. However, it still requires further verification in its usage. Therefore, this study was proposed to verify the MISAP to construction projects in Universitas Negeri Semarang (UNNES). The results of this study are expected to calculate the validity and reliability of the instrument (MISAP). In addition, it could assess the quality of the project safety planning at UNNES.

The validity and reliability of the instrument (MISAP) and the project safety-planning index for the construction projects at UNNES could be obtained. If the index is low, it can provide input or suggestions to improve pre – construction safety planning. Therefore, the potential for accidents is smaller and it is expected that that construction accidents do not occur. Other benefits are to increase in Indonesia's image in the international forum in terms of safety planning. The results of this study showed that: (a) The maturity of the pre-construction safety planning of projects in 2018 in UNNES was categorized as under developed, (b) The content validity of the previous research instruments still required improvement from new regulations, (c) the reliability of previous research instruments can categorized as sufficient.

Keywords— implementation; planning; safety; pre-construction; UNNES project;

I. INTRODUCTION

The construction project is a complex and unique project involving various parties such as the owner, a consultant, a contractor and a sub-contractor, supplier, and government who have an interest in the results. The construction parties based on their skills consist of construction experts, mid-level staff and labor, the last two parties mostly have inadequate competencies. Project locations are mostly in the open area, which are very directly affected by nature such as heat, rain, day and night, wind, floods and the like which means it is difficult to be fully controlled. In terms of time, many projects must be completed in a limited duration so that it requires extra-strict management.

The construction sector still has poor performance in terms of occupational health and safety (OHS). The occupational Health and Safety in Indonesia occupy the fifth position, or the worst in Asean (Bali Post, 13/05/2004). The position until the end of 2008 did not change much by referring to [1]. [1] states that the number of occupational accidents in Indonesia is the 52nd position out of 53 countries surveyed with accident rates in the construction sector. Therefore, accident prevention construction requires serious attention to decrease the number of accidents in Indonesia and improve Indonesia's image in terms of occupational health and safety.

A good construction safety requires a safety plan that has been prepared before the construction phase, which is often called pre-construction safety planning. In Indonesia, this pre-construction safety planning is not yet common. A number of frequent accidents are allegedly due to the absence of pre - construction safety planning. The recommendation from [2], [14], [11], and [18] is to conduct construction safety planning as early as possible. Furthermore, the safety plan must be conducted during the construction / operation stage [12]. In its implementation, the construction safety must also be controlled so that the pre – construction safety planned is really carried out.

In 2008, the Ministry of Public Works issued the Ministry Regulation No. 09 / PER / M / 2008 which regulates that a safety plan must be made by participants in the auction of a construction project. At present, the regulation has started to be implemented. The regulation was then refined with the Ministry Regulation No. 05 / PRT / M / 2014. Through the regulation, the government has indeed required the Occupational Safety Plan Contract (RK3K) since the pre-construction stage. However, its implementation requires more monitoring. As in Article 4 paragraph 3, the implementation of construction safety is conducted during pre-construction phase includes conceptual design, feasibility studies, surveys, investigations, DED, and the selection of service providers (ISC). The regulations have been ready.

The problems in this study were formulated as follows: How to assess the readiness of the pre-construction safety plan? Has construction safety plan been implemented properly? Current assessment issues play an important role in every activity. To assess the pre-construction safety planning maturity, there must be an instrument / model of assessment. The valuation model must meet the requirements: valid and reliable. At overseas, CDM (Construction Design Management) and Process Protocol are implemented to assess to maturity of the preconstruction safety planning. In Indonesia, [7] has developed a pre-construction safety planning maturity assessment model. This model was refined several times and has been validated on construction projects in the Central Java. The model was named Maturity Index of Pre-construction Safety Planning (MISAP). In this study, review of MISAP was conducted to investigate its validity and reliability and whether the indicators were still relevant to the current situation. Then the instrument was implemented for medium-rise construction projects (one to four floors).

The problems of this study were: (1) How is the content validity of the preconstruction safety planning maturity assessment instrument? (reviewing key factors and variables) (2) How is the reliability of the preconstruction safety planning maturity assessment instrument? (3) What is the maturity level of pre-construction safety planning for projects at Universitas Negeri Semarang in 2018?

II. PLANNING, PLANNING MATURITY, AND ASSESSMENT

One effort to ensure the implementation of occupational health and safety is a good / mature pre-construction safety plan. Furthermore, assessing the pre - construction safety plan requires a good assessment instrument. According to [13], a good assessment tool is valid, reliable, and practical. In this modern age, systematic assessment is required [16]. A quality management system based on a continuous improvement process involves assessment-analysis-improvement [19]. [10] argues that decision making must be based on facts / data and not based on opinion, while data can be obtained from assessments. Assessment is a systematic and sustainable method of collecting and analysing information from various sources about a program and assessing program results [17]. Assessment is performed to find out the level of performance or achievements of the subjects assessed. With the results of the assessment, it will be able to know which ones are good / mature and which ones have not. Ward (1980) states that an assessment process must be accountable for its validity and reliability. Validity is an ability of a test instrument that can measure what is meant to measure, and reliability is the regularity of assessment in measuring what will be measured. The validity of the assessment instrument consists of face validity, content validity, construct validity, concurrent validity, and predictive validity [15].

Maturity, according to the dictionary (dictionary.reference.com), is development of a full, perfect condition, and mature consideration to bring a plan, status or quality which has developed. According to [5], maturity plans are plans that have been carefully considered. In this study, maturity was interpreted as a statement of the perfection of a pre – construction safety plan. Index is a numerical or mathematical symbol that describes the level or position of a variable. A variable is a phenomenon or phenomenon under study. Index means the degree of strength of a variable, which starts from a basic level constructed in a way that the it is easy to understand and compare. The index is used for various variables, such as salaries and prices, ultra violet levels of sunlight, intelligence index, growth index, and so on. Indexes can be arranged in a variety of ways, ranging from 0 to 10 and starting from 0 to 100. The index used in this study started from 0% to 100% because it is easy to use and in line with the scores of other similar assessments. Therefore, the relationship and comparison can be analyzed.

Previous studies in Indonesia on the model of pre-construction safety planning maturity assessment instruments were carried out by [7] (2009, 2011, and 2013) and has produced the pre-construction safety planning maturity assessment instrument which were named MISAP. This model has been validated by involving 74 construction projects and the results are: (a) the model has content validity, with the involvement of academics and practitioners through three phases of Delphi method, (b). this model has construct validity analyzed by PLS, 27 items out of 40 item were valid, (c) the model has fulfilled the reliability requirements of the instrument with the reliability of 0.856 (for owner factors), 0.867 (for consultant factors), 0.892 (for the contractor factor), and 0.891 (for the stakeholder factor), (d) the assessment was performed manually or by using computer.

In this study, the MISAP model was reviewed and then used to assess the level of maturity of pre-construction planning on projects at UNNES in 2018. The results of the research were used to improve the management of projects in the UNNES to comply with safety requirements. With the issue of Public Work Ministry Regulation No.05 / PRT / M / 2014, it is necessary to update the MISAP indicators according to the new regulation.

III. METHOD OF THE STUDY

This study was an applied research because the focus was on practical needs. This study applied an existing assessment instrument and adjusted it to the enactment of government regulations (in this case Public Work Ministry Regulation PU no. 05 / PRT / M / 2014). In its implementation, this study employed a mixed approach. According to [3], mixed approach is a research approach that uses both quantitative and qualitative methods. The study took place on the construction projects in Universitas Negeri Semarang in the 2018 fiscal year. All projects were used as a sample (total sampling) considering its small amount. The procedures of the study consisted of 5 stages: (1) information-gathering phase, (2) the stage of developing the instrument (3) the stage of collecting data through observation and documentation (4) data analysis stage (5) the stage of preparation of the research results.

The variable in this study was the maturity of pre- construction safety planning. This variable was a mono variable which can then be grouped into these following key factors that played a role in pre-construction safety planning:

1) The role of owner (OW) which includes various variables from the Owner. . These aspects are coded: OW1, OW2 , OW3, and etc.
2) The role of the consultant (KS) which includes various variables from the consultant. These aspects are coded: KS 1, KS 2 , KS 3 , and etc.

3) The role of the contractor (KN) which includes various variables from the contractor. These aspects are coded: KN1, KN2 , KN3 , and etc.
4) The role of stakeholders (ST) which includes various variables from Stakeholder both physical and non-physical. These aspects are given code: ST 1, ST 2, ST 3 , and etc.

Data collection employed documentation, observation, and the Delphi method. Documentation was used to revealed the background of the project / samples and review regulation relevant to the topic of research. Observation was used to assess the maturity of the pre-construction safety planning at the projects in UNNES. The Delphi method was a method that revealed subjective considerations about the possibility of occurrences of future events on the basis of related events (Dunn, 1981). It involved a structured process for gathering and filtering knowledge from a group of experts for the help of a series of question lists with controlled feedback [21]. This technique was used to ask experts to discuss systematically a complex problem with a series of questionnaires sent by post or by computer system to a select group of experts. Generally, the number of stages is between two and seven and the number of participants are between two and fifteen people (Yueng, 2009). In this study, two Delphi methods were used with four participants, all participants were doctors in the field of Construction Management who were relevant to the topic of this study.

Quantitative data analysis used mathematical analysis and statistical analysis. The formula to calculate the maturity of the pre-construction planning of projects at UNNES in 2018 was called MISAP. MISAP was an index calculation method generated from [9].

$$\text{MISAP} = 0{,}9 \sum_{n=1}^{6} OWi + 0{,}6875 \sum_{n=1}^{8} KSi + 0{,}7 \sum_{n=1}^{9} KNi + 0{,}7 \sum_{n=1}^{4} STi$$

The pre-construction safety planning maturity criteria (MISAP) are as follows:
0% < MISAP <20% is undeveloped,
20% <MISAP <40% is under developed,
40% <MISAP <60% is less developed,
60% <MISAP <80% is developed, and
80% <MISAP <100% is really developed.

The mathematical calculation formula above can be made into forms that can be used manually, can also be created using EXCEL program so that it can be operated with a computer.

IV. THE RESULTS OF THE STUDY

A. Text Font of Entire Document

The study was conducted from May to September in 2018. The study was conducted at the projects in UNNES in 2018. The scope of the study was limited to the pre-construction project stage (upstream), that was the stage between of conception and auction (procurement), as well as in projects with the conventional delivery patterns: DBB (design-bid- built). The names of the projects on this study are shown in Table 1.

TABLE I - Lists of Projects in Universitas Negeri Semarang in 2018

No.	The project name	Contract value (Rp)	Service Provider	Information
1.a.	3rd Phase of Library Building Construction at Unnes	Rp. 25,324,016,000 Procurement Document No: 1.4.6/UN37.7.11/TU/2018 June 4, 2008	PT Sumber Alam Sejahtera	The next project is called PSTa
1.b	3rd Phase of Construction Management of Library Building at Unnes	Rp. 587,537,500 Procurement Document No. 1.9.4/UN37.7.1.6/TU/2018,April 9, 2018	PT Bina Karya	The next project is called PSTb
2	2nd Phase of the Badminton Building Renovation at Pegandan Campus of Universitas Negeri Semarang	Rp. 1,409,500,000 Procurement Document No: 1.27.4/UN37.7.11/TU/2018,17,April 2018	CV Insan Mandiri	The new project is then called PGD
3	Construction of roof of futsal building, Universitas Negeri Semarang	Rp. 6,731,840,000 Procurement Document No. 1.5.6/UN37.7.11/TU/2018 June 5, 2018	PT Harmony International Technology	The next project is called PIK

The results of the observation on the occupational health and safety at the construction projects at UNNES in 2018 can be summarized as follows. In the PST project, this project was a continuation project from the previous year. The parts of the building which was being constructed were not the structures but was located at a certain height. From observing procurement documents No. 1.4.6 / UN37.7.11 / TU / 2018 dated June 4th, 2008, there is a clause on Occupational Health and Safety Construction. However, it still did not comply with Ministry of Public Work Regulation number 05 / PRT / M / 2014 regarding OHS construction, preparation of hazard identification in DED, the inclusion of potential hazards and assessment criteria to fulfil OHS construction requirements. In addition, the owner in selecting consultants and contractors have not included the performance of OHS in construction. There was no schedule for the owner to review and monitor the implementation of OHS in the construction site. Furthermore, a perimeter fence has been built around the construction site. However, it appears that the obligation to use Personal Protection Equipment (PPE) has not been obeyed by workers. Horizontal and vertical net were absent. Safety briefing and patrol were not performed. OHS planning by consultants and contractors were not performed due to the project owner's lack of control. In the PGD project, this project was also a follow-up project from last year. The parts of the building that were being constructed are not structures. Based on the procurement document No. 1.27.4 / UN37.7.11 / TU / 17th of April 2018, there is a clause about Construction OHS. However, it is not in line with the Ministry of Public Work Regulation number 05 / PRT / M / 2014 concerning construction OHS staffs, preparation of hazard identification in DED, the inclusion of potential hazards and assessment criteria to fulfil OHS construction requirements. In addition, the owner in selecting consultants and contractors have not included the performance of OHS in construction. There was no schedule for the owner to review and monitor the implementation of OHS in the construction site. Furthermore, a perimeter fence has been built around the construction site. However, it appears that the obligation to use Personal Protection Equipment (PPE) has not been obeyed by workers. This building only has one floor, but because it is building for physical exercise and meeting, the potential danger can be included in the two-storey building.

The PIK Project is a continuation of the previous year project. The part of the building that was being constructed was the making / connecting of columns and the construction of the roof. It was a structural work and was located at a certain height. Based on the procurement document No. 1.5.6 / UN37.7.11 / TU / 2018 dated June 5th, 2018, there is a clause about Construction OHS. However, it is not in line with the Ministry of Public Work Regulation number 05 / PRT / M / 2014 concerning construction OHS staffs, preparation of hazard identification in DED, the inclusion of potential hazards and assessment criteria to fulfil OHS construction requirements. The results of assessment recapitulation of the development of the pre- construction safety planning on projects in UNNES in 2018 can be illustrated in figure 1.

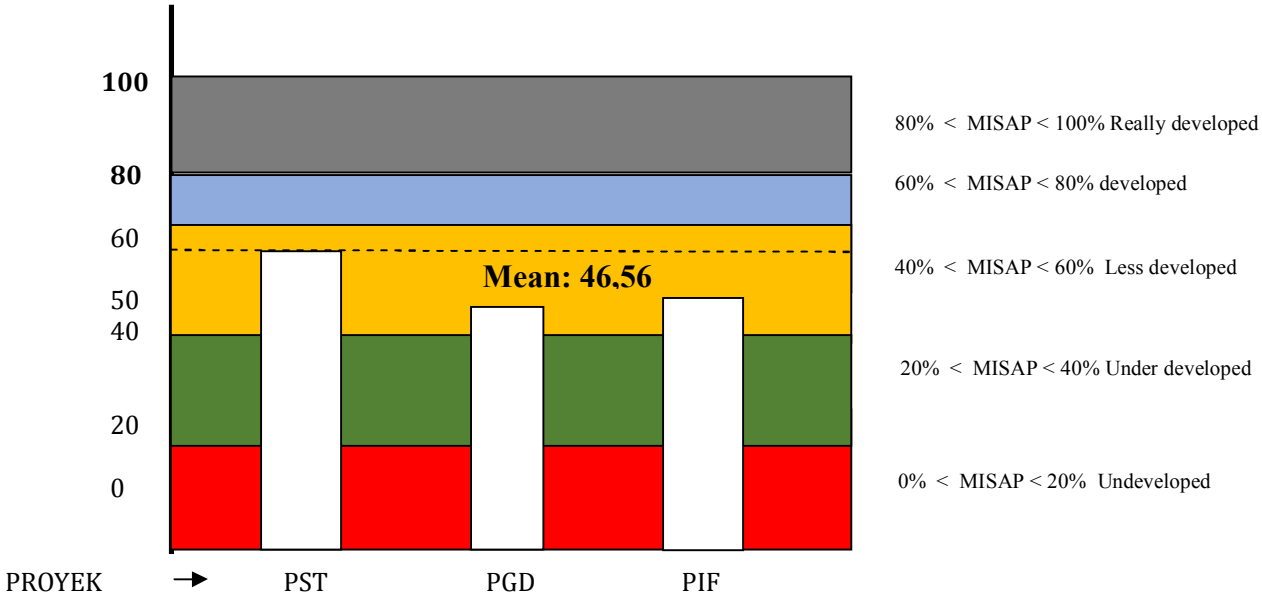

Fig. 1 Maturity pre- construction safety planning at UNNES projects in 2018

The results showed these following: MISAP for PST = 55,425; MISAP for PGD = 41,625; and MISAP for PIK = 42,745 with mean = 46,56. All of them are in the underdeveloped category.

In addition, the owner in selecting consultants and contractors have not included the performance of OHS in construction. There was no schedule for the owner to review and monitor the implementation of OHS in the construction site. Furthermore, a perimeter fence has been built around the construction site. However, it appears that the obligation to use Personal Protection Equipment (PPE) has not been obeyed by workers. This shows that OHS planning by consultants and contractors were not performed due to the project owner's lack of control.

V. THE REVIEW OF THE PREVIOUS INSTRUMENT BASED ON THE DEVELOPMENT OF REGULATION

The instrument used in this study was the Maturity Index of Safety Planning (MISAP) by [9]. Some quality components of the instrument are: a. Content validity: based on the review of Minister of Public Works Regulation number 05 / PRT / M / 2014 and a circular letter from the Minister of Public Works number 66 / SE / M / 2015 dated December 3, 2015, then the content validity of the instruments need to be evaluated again. To summarize the additional points of regulation, the Delphi method was carried out by giving a questionnaire to the participants in the first round. Based on the responses on the first round, the answers were summarized and then sent back to the participants for the second round. The results of the second round were expected to have points agreed upon by all participants. Some variables that need to be added to improve the previous instrument, from the results of the Delphi method are: (1) the necessity of calculating OHS costs on project cost proposal included in general costs (Circular of Public Work Ministry No. 66 / SE / M / 2015). And (2) Occupational Safety Plan Contract preparation and presentation by contractors (Ministry Regulation No. 05 / / PRT / M / 2014).

b. Construct validity. The number of projects was three, construct validity calculation is not sufficient. Therefore, the validity used in this study was from the previous study such as: Owner Role Validity = 0.599; Validity of the Consultant Role = 0.723; Contractor Role Validity = 0.763; Validity of Stakeholder Roles = 0.576. The calculation was performed using SEM-PLS program (Structural Equation Model - Partial Least Square). The basis for decision-making validity tests was that the correlation value was greater than 0.70. However, on the research and the development design, the scale of loading factors from 0.50 - 0.60 is still acceptable [20]. Because all validity scores above 0.50, the instruments were categorized as valid.

c. Reliability. The composite Reliability and Cronbach Alpha of instrument on the previous study were as follows: the role owner reliability = 0.846; reliability of the consultant role = 0.835; contractor role reliability = 0.891; stakeholder role reliability = 0.891. According to [20], a construct is categorized as reliable if the value of composite reliability and cronbach alpha is above 0.70. Because all reliability scores above 0.70, the instrument was categorized as reliable.

VI. DISCUSSION

The following is a discussion of the results of the study. a. The maturity of the pre-construction safety planning for UNNES projects in 2018 on average is categorized as under - developed categories (score 46.56). This shows that improvement is required on the safety planning at the pre- construction stage, both for the Owner, Consultants, Contractors and Stakeholders. The Owners, Consultants, and Contractors need to learn the newly issued regulations to be implemented immediately. These regulations include Public Work Ministry Regulation No. 05 / / PRT / M / 2014) and Circular Letter of Public Work Ministry Regulation No. 66 / SE / M / 2015. The role of the Owner and Consultant still seems minimal. The owner can make a decision to improve construction safety from the conception stage. Fink (1997) argues that the owner can participate in controlling through the proposal submitted by contractors. Next, the architects and planning engineers can improve the construction safety in the design process. In the UK, although the Construction Design Management has been implemented for more than 10 years, until 2006 planners still lacked in utilizing their potential to eliminate and reduce risk in the workplace (www.hse.Gov.uk downloaded 20/09/2006). In USA, there is less motivation from professional designers to adopt safe design concepts because they assume that safety is included as the job of contractor according to Behm (2005). Behm (2005) also states that the effect of planning on construction safety is lost if planning are not carried out until the construction phase takes place.

b. The validity of the assessment instrument: the following variables must be added on the content validity: the compulsory calculation of OHS costs on project cost proposal included in general costs (Circular of Public Work Ministry No. 66 / SE / M / 2015), and Occupational Safety Plan Contract Preparation & presentation by contractors (Ministry Regulation No. 05 / PRT / / M / 2014). In construct validity, the instrument of this study has sufficient numbers of construct validity which was above 0.50 (>0.50). With sufficient numbers of validity, this instrument can be used to measure what should be measured. c. Reliability of the instrument, the reliability of this assessment instrument has sufficient reliability value, which is above 0,70 (> 0.70). With sufficient reliability value, this instrument can be used consistently, meaning that it is used at various times and used by various people when tested on one object, the results are relatively similar.

d. Occupational health and safety at construction in general, pre – construction safety planning is an accident prevention efforts using the upstream approach. The prevention of accidents in construction projects in Indonesia are mostly conducted using the downstream approach. This phenomenon occurs in both developing countries and countries that have implemented construction safety. Construction Occupational Health and Safety in Indonesia is still a concern. The number of fatal accidents tends to increase annually as shown in Table 2

TABLE III - FATAL WORKPLACE ACCIDENTS IN INDONESIA

Year	2001	2003	2005	2011	2015	2016
Total cases	104,774	105,846	99,203	108,696	105,182	101,367
Fatality	1,768	1,748	2,045	31,195	2,375	2,382
Percentage of fatality to total case (p)	1.69%	1.65%	2.07%	2.87%	2.16%	2.35%

It implies that there is a need for socialization to all parties in construction safety regarding the importance of safe design and pre-construction safety planning. Ways of socialization are by submitting the results of this study to the various stakeholders, writing in professional journals and at seminars, and can also conduct training. It implies that there is a need for socialization to all parties in construction safety regarding the importance of safe design and pre-construction safety planning. Ways of socialization are by submitting the results of this study to the various stakeholders, writing in professional journals and at seminars, and can also organize training or workshops in collaboration with relevant agencies and institutions. The further effect that can be expected is the decline in the number of construction accidents in Indonesia and the increasing image of Indonesia in terms of work safety.

VII. CONCLUSION AND SUGGESTION

The conclusions of this study are:

a. Construction safety in Indonesia is still low and some efforts are needed to improve it.
b. Pre-construction safety planning for projects in UNNES in 2018 was categorized as underdeveloped
c. With the new regulation, the content validity of the pre-construction safety assessment instruments still needs to be refined. Improvements were made with the addition of the regulations listed in Ministry of Public Work Regulation number 05 / PRT / M / 2014 and Circular Letter of Ministry of Public Work No. No. 66 / SE / M / 2015.
d. The reliability of the pre-construction safety assessment instrument currently in use is still usable.

The following are the suggestions based on the results of the study:

a. Pre-construction safety planning for projects at UNNES in 2018 needs to be improved. Improvement can be performed by entering OHS clauses in the auction document. Consultants need to be more professional in making technical specifications by incorporating specific OHS aspects.
b. It is necessary to provide sufficient funds for the implementation of OHS construction in accordance with the mandate of Ministry of Public Work Regulation number 05 / PRT / M / 2014 and Circular Letter of Ministry of Public Work No. No.66 / SE / M / 2015.
c. It is recommended to carry out further validation of the pre-construction safety assessment instrument.
d. It is recommended that Unnes provides personnel who handle OHS construction problems in the UNNES environment, which will be able to help direct the realization of OHS regulations on UNNES projects, or even on some projects outside the UNNES

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