Structural Equation Model (SEM) relationship between location and building height and Work Breakdown Structure toward safety costs at rental apartement project

Z Mahmudah* and Y Latief
Department of Civil Engineering, Faculty of Engineering, Universitas Indonesia, Kampus Baru UI Depok, Jawa Barat 16424, Indonesia

*zufamhmdh@gmail.com

Abstract. Occupational Health and Safety at the construction is still hampered from the budget side and mindset that OHS is an additional cost. As a result, decisions related to OHS may not be based on ethical considerations and basic rights to a safe workplace, but in the economic field. This study focuses on analyzing the relationship of building location, height of building and work breakdown structure to OHS costs and further reviewing the factors in these variables that are the dominant effect on OHS costs. The purpose of this study is to analyze the factors in each variable that has a dominant effect on occupational health and safety cost and analyze the relationship between location variable, height of building and WBS to the health and safety cost model in at flat construction projects using Structural Equation Model - Partial Least Square (SEM-PLS).

1. Introduction
Safety in the construction industry, as well as in the infrastructure sector has always been a major problem. The global construction and infrastructure industry exposes workers to the different occupational hazards that often result in fatal accidents. These hazards vary according to work activities, safety culture, production pressure, and worker training. The hazard profile also differs depending on the construction phase. Therefore, the construction industry is a heterogeneous risk exposure area due to many factors involved in the construction process [1].

The construction industry is one of the industrial sectors that has a high risk of work accidents. Some of the main causes of work accidents in construction projects are due to the unique construction project, different work locations, open and weather-influenced, limited implementation time, dynamic and demanding high physical endurance, and many who use untrained labor [2]. K3 construction is still hampered from the budget side as well as the mindset that K3 is an additional cost. As a result, decisions related to OSH may not be based on ethical considerations and basic rights to a safe workplace, but in the economic field [3]. Based on the above findings, this study focuses on analyzing the relationship of building location, building height and work breakdown structure to OHS costs and further reviewing the factors in these variables that are the dominant influence on OHS costs [4]. The higher the percentage of work accident prevention applications, the lower the work accident rate will be. The combination of appropriate prevention application is more important than the number of prevention application carried out [5].
2. Literature Review

2.1. OHS cost for rusunawa project
Based on the Regulation of the Minister of Public Works and Public Housing Number: 28 / PRT / M / 2016 concerning Guidelines for the Analysis of Work Unit Price for Public Works, OHS costs consist of OHS costs, OHS costs specifically and OHS AHSP. Unit price analysis (AHSP) is the calculation of the cost of labor, materials and equipment to get the unit price or one particular type of work [6].

Based on the PUPR Minister Circular No. 66 of 2015, concerning the Implementation Costs of the Occupational Safety and Health Management System (SMK3) in the Construction of Public Works, the details of the implementation of the Construction SMK3 [7] are as follows:

- RK3K preparation
- K3 Information and Promotion
- Work Protective Equipment
- Personal Protective Equipment
- Insurance and permits
- K3 personnel
- Health facility facilities
- Signs
- Others Related to OHS Risk Management

2.2. Project location
The construction industry has unique characteristics, namely different work sites, open, weather-influenced, limited implementation time, dynamic, demanding high physical endurance and using a lot of untrained labor, involving a large workforce and the construction industry has the many dangers and risks in each type of work. These hazards include falling, falling on objects, being shocked, and fire. With the characteristics and scope as above the construction industry is one that contributes to the causes of workplace accidents [8].

2.3. The height of the project
Buildings classified according to height include (Government Regulation No 36 of 2005 Concerning Implementing Law No. 28 of 2002) [9]: high-rise buildings; the number of floors of the building is more than 8 floors medium-rise buildings; number of floors of buildings 5 to 8 floors low-rise buildings; the number of building floors up to 4 floors

2.4. Work breakdown structure
According to PMBOK 5th edition, the definition of WBS is a description or decomposition of the hierarchy of the total scope of work that must be done by the project team to complete the project objectives. WBS manages and defines the total scope of the project, and states the job specifications in the agreed project scope statement [10].

According to Mackay in the planning stage WBS has 15 functions for the management process [11] namely:

- Defines the scope of the project
- Develop a detailed list of tasks
- Identifying stakeholders
- Estimating project time requirements
- Identify and evaluate potential risks to the project
- Evaluate project resource requirements
- Prepare contingency plans
- Identify the interrelationship / interdependence relationships on each WBS element
- Identify project critical paths
- Monitor the resources needed by the project
- Play a role in the process of project control when changes occur
- Serving as a tool to study the project phase
- Acting as a reporting tool on the status of the project

2.5. Theory of relationship between project location and OHS costs

The results of the estimation of multiple linear regression regarding the variable influence of the role of the management of conditions and work environment as well as the awareness and quality of workers on the performance of construction projects [12] are shown in Table 1.

| No | Independent Variable                              | Coefficient |
|----|---------------------------------------------------|--------------|
| 1  | Intersep                                          | 1.713        |
| 2  | Management role                                  | 0.140        |
| 3  | Working conditions and environment               | 0.331        |
| 4  | Workers’ awareness and quality                  | 0.104        |
| 5  | Determination (R2)                               | 0.530        |
| 6  | Multiple correlation coefficient                 | 0.281        |

In the criteria table the work safety system factors above show that the conditions and work environment variables have the highest coefficients.

2.6. Theory of relationship between building height and OHS costs

According to John Ridley at work at heights a lot of risk of work accidents caused [13]. To prevent workers from falling from a building height is by:

- Using the platform or work platform.
- When workers can fall from a height of 2 m or more, guard rails must be given at least 910 mm (36 inches) from the floor, intermediate rails to ensure vertical gaps do not exceed 470 mm (18 inches), and 150 mm (6 inches) toe boards.
- Rigging or safety net if working at height.
- Must use a ladder that is well maintained, on a hard and flat foundation, if a length of 3 m or more must be treaded or tied at the top, having a length of at least 1 m above the platform used, if the total height is more than 9 m must equipped with an intermediate platform, legs must be placed 1 unit from the wall for each increment of 4 units.

2.7. Theories of relationship between WBS and OHS costs

Each risk in each activity will be determined control measures to prevent or reduce the possibility of the risks that exist. According to Adityanto, risk control can be carried out [14] as follows:

2.7.1. Pressing probability by:

- Conduct Safety induction once a week (sample activities: Before starting all activities on the project, workers are gathered first to be reminded of the importance of using PPE in work).
- Carry out OSH patrols on each employee routinely to supervise workers and notify workers if there is a threat that is threatening while they are working (example of activity: When lifting material if it passes a worker below, the worker is told to step aside first).
- Install warning signs so that workers always work carefully (example activity: At the time of excavation the ground is given a warning sign "beware of digging pits").
2.7.2. Reducing the consequences by:
- Always use personal protective equipment (PPE) at work (for example: at work at height it is required to use full body harness).
- Make innovations in tools and work methods that make workers feel safe and comfortable (example: in a column casting work, a work floor is made in column formwork).

2.7.3. Avoid (avoid) risk. By replacing tools that are no longer suitable for use (for example: in formwork work, wood that has become porous is replaced).

2.7.4. Risk transfer by every worker has been protected by Jamsostek.

3. Research methodology

3.1. Literature review
In this part to identify variables Y is OHS cost have 11 indicators. Variables X are Location have 10 indicators, project height have 3 indicator and WBS have 6 indicators.

3.2. Creating survey questionnaire
After review literature for 4 variables, all of indicators for questionnaire. Then after being compiled into 29 question with the answer likert scale. Likert scale is used to measure the opinion of respondents regarding the extent of the causes and impacts of each variable using a scale of 1 to 5. Scale 5 has the highest impacts and scale 1 has the lowest impacts.

3.3. Distribution of the questionnaire
This research strategy will be carried out by means of a quantitative survey, a survey carried out by taking a sample from one population using a questionnaire for primary data collection tool. This research survey was conducted on several correspondents who had been determined in advance. The sampling method used is non probability sampling with a purposive sampling procedure. With nonprobability sampling, members of the population do not have the same chosen opportunity to be sampled and the purposive sampling procedure of sampling techniques is quite often used because this method uses criteria that have been selected by researchers in selecting samples. From all questionnaires distributed to all professional in project team with experiences more than 3 years. This research sample used 208 samples and need more samples.

3.4. Analysis SEM-PLS
After collected survey questionnaire, data analysis will be process using program SmartPLS.

4. Results and discussions
The data in this study consisted of primary data obtained directly from the source, primary data collection was carried out through a questionnaire survey, the questionnaire contained several conditions to obtain the research sample as expected, namely construction project professionals with a minimum of 5 year experiences in Indonesia. Data collected from 208 respondents.

| Table 2. SEM PLS outer loading result. | T Statistics |
|--------------------------------------|-------------|
| High density → Project location      | 9.819       |
| Medium density → Project location    | 13.794      |
| Low density → Project location       | 7.346       |
| Open location → Project location     | 5.089       |
| Narrow location → Project location   | 10.476      |
| Land stability → Project location    | 6.638       |
Table 2. Cont.

| Variable | T Statistics |
|----------|--------------|
| Contamination around the land → Project location | 6.509 |
| Traffic system and limitations → Project location | 10.671 |
| Thuggery and vandalism → Project location | 6.170 |
| Noise around the land area → Project location | 9.288 |
| Low (1-4 Floors) → Building height | 20.921 |
| Medium (5-8 floor) → Building height | 51.23 |
| Height (>8 floor) → Building height | 9.769 |
| Rusunawa work packages → WBS | 18.804 |
| Job package description → WBS | 20.568 |
| Person in charge → WBS | 18.419 |
| Reference document → WBS | 17.853 |
| Resource needed → WBS | 24.916 |

In the path coefficient table 2, to see the significance of the influence between variables it is necessary to look at the t-value (T statistic) which has a value > 1.96 [15]. For example, High density areas affecting Project location has a value of 9.819 > 1.96 so it can be said that high density on project locations has a significant effect.

Table 3. R square results.

| Variable          | Original Sample (O) | T Statistics (|O/STDEV|) |
|-------------------|---------------------|-------------------|
| OHS Special Cost  | 0.279               | 4.390             |
| OHS General Cost  | 0.214               | 3.938             |
| Building Height   | 0.210               | 3.524             |
| WBS               | 0.212               | 3.547             |

Based on table 3, the R-square value of OHS General Costs is 0.214 and OHS Special Costs are 0.279, which means the constructability variability of OHS General Costs can be explained by the Project Height and work breakdown structure of 21.4%, while OHS Special Costs are 27.9%.

Table 4. SEM PLS path coefficient result.

| Variable | Original Sample (O) | T Statistics (|O/STDEV|) |
|----------|---------------------|-------------------|
| Project Height -> Special OHS Cost | 0.213 | 2.196 |
| Project Height -> General OHS Costs | 0.238 | 3.131 |
| Project Location -> Special OHS Costs | 0.155 | 2.270 |
| Project Location -> General OHS Costs | 0.152 | 2.130 |
| Project Location -> Project Height | 0.438 | 7.263 |
| Project Location -> WBS | 0.357 | 4.988 |
| WBS -> General OHS Costs | 0.280 | 3.610 |
| WBS -> Special OHS Costs | 0.190 | 2.769 |
In the path coefficient table, to see the significance of the influence between variables it is necessary to look at the t-value (T statistic) which has a value > 1.96. For example, Number 1, project height influences OHS special costs or project heights have a value of 2.196 > 1.96, so it can be said that project heights to OHS special costs have a significant effect.

5. Conclusion
The conclusions of this research are:
- this study presented the analysis, findings and discussion with variables at the project location, project height and work breakdown structure. If seen from the results of the R-Square, it can be seen that OHS general cost variable can be explained by indicators of project height and work breakdown structure of 21.4%, while OHS special costs are 27.9%.
- From the value of the significance of the indicators it can be seen that the dominant influence OHS costs.
- Based on the results of Smartpls 3.0 with the Bootstrapping (Path Coefficient) method of 9 relationships between variables, which fulfill the significance (T Statistic > 1.96) of 8 (seven) relationships between variables that are significant and affect each other.

Acknowledgement
The author would like to thank the financial support provided by the University of Indonesia through PUTI Proceedings of the Fiscal Year 2020 with the contract number: NKB-1184 / UN2.RST / HKP.05.00 / 2020 managed by the Directorate of Research and Community Engagement (DRPM) Universitas Indonesia.

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