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# Factors Evaluation of The Road Infrastructure Project Performance through HSE Management System at PT SKIM Indonesia

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***Abstract:***
*Construction Phenomenon in 2017-2019 shows the ownership of the company's Occupational Safety and Health Management System (SSHMS) certificate has increased close to 70% but the work accident rate has also increased approach 40%. Security, Safety, Health and Sustainability (SSHS) and SSHMS Standards are mandatory for Construction Services Companies based on the mandate of Law No. 02 of 2017 about Construction Services and Government Regulation No. 50 of 2012 about the Implementation of SSHMS. It is necessary to further evaluate the integrated implementation factors between the SSHS and SSHMS Standards and their relation to the understanding level of employees and workers towards them. The research was conducted on twenty-two road infrastructure projects from state-owned enterprise IstakaKarya Inc. Data was collected based on interviews, questionnaires, and supporting documents. Used five independent variables X (SSHS and SSHMS), one dependent variable Y (infrastructure project performance on environmental issues), and one intervening variable Z (employee and workers understanding). Statistical analysis uses Structural Equation Modeling (SEM) - Analysis of the Moment of Structural (AMOS). The result shows a significant relationship between several variables X to Z and Y especially variables Z to Y.*

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## I. Introduction

The construction sector takes an important role in the development of a nation. In 2019 in the 1st quarter, this sector became the fourth largest contributor to Indonesia's GDP (Gross Domestic Product) at 10.37% (growing 5.69%) (Kristianus and Pangastuti, 2019). The amount of labor growth in the construction sector is also quite significant at around 5-7% per year, especially in the last 5 years. Besides, the construction sector in Indonesia has grown rapidly in the last five years (Wirahadikusumah et al., 2019). In 2014-2019, many achievements have been achieved in terms of road infrastructure development in Indonesia, mainly in the context of realizing connectivity between regions in Indonesia.

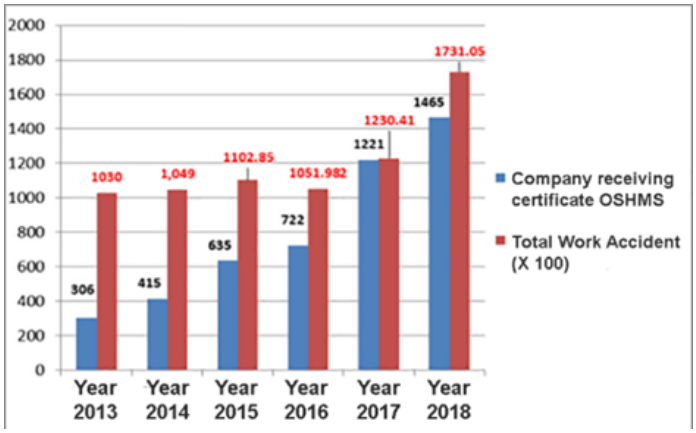


**Figure 1.** Graphic Comparison Number of SSHMS Recipient Companies and Number of Work Accidents (2013 - 2018)

Government Regulation No. 50 of 2012 explicitly requires all Construction Service Companies to implement SSHMS as an Integration System between OHS Management and Company Management. OHS regulation in the construction sector, in general, is currently regulated through Law No. 02 of 2017 concerning Construction Services, in which the contents mandate "the implementation of construction services based on security and safety" and "realizing public safety and comfort of the built environment." With consideration of work safety, the Government through Law No. 02 of 2017 again requires Service Providers to meet SSHS Standards. The effective determination of these two systems, the SSHS and SSHMS systems, will begin in mid-2017. The construction world in Indonesia is growing with the number of construction companies in Indonesia. Including the establishment and development of state-owned enterprise (SOE) construction companies in Indonesia, which one of them is PT SKIM &IstakaKarya Inc. with operational areas covering all regions of Indonesia.

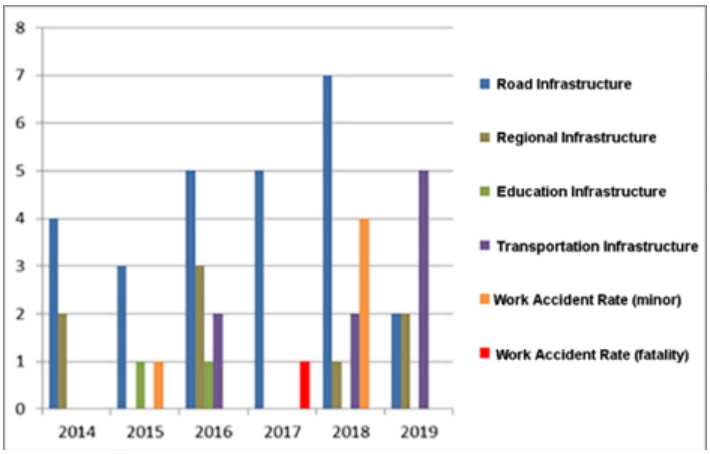


**Figure 2.** Types and Number of Infrastructure Projects IstakaKarya Inc. and Work Accident Rates in 2014-2019

## II. Methods

This research is intended to evaluate the factors related to the performance of road infrastructure projects in the integrated implementation of SSHS and SSHMS standards (Case Study in PT SKIM and IstakaKarya Inc.). The flow of evaluation that will be applied, which refers to Law No. 2 of 2017 and Government Regulation of the Republic of Indonesia No. 50 of 2012 concerning the Implementation of SSHMS comparative study was carried out on patients of Department of general Medicine at Dr. Ram Manohar Lohia Combined Hospital, Vibhuti Khand, Gomti Nagar, Lucknow, Uttar Pradesh from November 2014 to November 2015. A total 300 adult subjects (both male and females) of aged ≥ 18, years were for in this study.

The research uses a quantitative approach, with explanatory research design. While the research method used in this research is a survey, using a questionnaire for the collection of data. Then the data from the questionnaire results will be analyzed using Structural Equation Modeling (SEM) tools. Secondary data was also obtained from IstakaKarya Inc.: SSHS and SSHMS Planning Reports, SSHS and SSHMS Implementation Reports (12 SSHMS Elements, 44 SSHMS Sub Elements, 166 SSHMS Elements), tasks, duration estimation, resource estimation, work drawings, and demolition documentation. From secondary data at this stage, data on infrastructure projects that are implementing OHS implementation can be obtained and interviews and questionnaires can be distributed to the project's workforce.

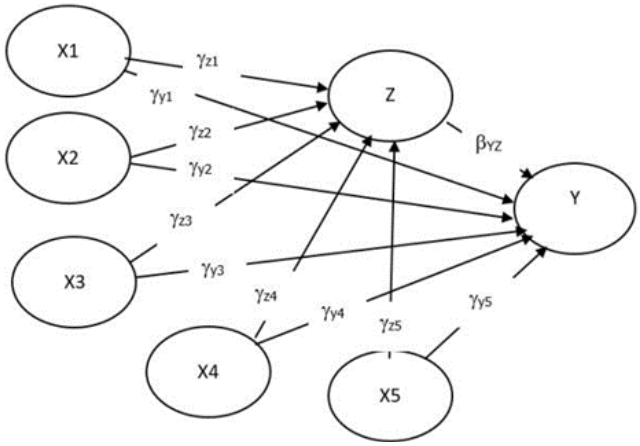


**Figure 3.** Research Structural Equation Model Approach

In this research, five Exogenous Variables are used (X1), (X2), (X3), (X4) and (X5), where each of the variables is:

1) X1 = Determination and Planning of OHS Policy
2) X2 = Implementation of OHS Plan
3) X3 = Monitoring and Evaluation of OHS Performance
4) X4 = Safety and Health of Construction Work
5) X5 = Construction Sustainability
6) Endogenous Variable is (Y), i.e. Project Performance on Indicators of Environmental Issues
7) Intervening / Intermediate Variable (Z) is the Level of Employee and Worker Understanding of SSHS and SSHMS.

This research is divided into stages as described inThe SEM model, which has become a solution for estimation calculations, must be tested on three basic assumptions: (a) multicollinearity, (b) normality and (c) outliers. Then the GOF must be evaluated. GOF suitability index: Chi-square (or π2), prob (π2), GFI, AGFI, RMSEA, NFI, TLI, Cmin / df, ECVI, and many others. But this one is considered enough. If all this has passed the passing grade, then we will narrate the results of the analysis. In the narrative, we must also compare with other research (empirical research) that we use as a reference, thus our research position in filling the research gap does exist.

Structural Equation Model:

a) Exogenous structural equation (X) → intervening (Z):
   Z = ɣ z1 X1 + ɣ z2 X2 + ɣ z3 X3 + ɣ z4 X4 + ɣ z5 X5
b) Exogenous structural equation (X) → endogenous (Y):
   Y = ɣ y1 X1 + ɣ y2 X2 + ɣ y3 X3 + ɣ y4 X4 + ɣ y5 X5
c) Exogenous structural equation (X) → intervening (Z) → ... endogenous (Y):
   Y = ɣ y1 X1 + ɣ y2 X2 + ɣ y3 X3 + ɣ y4 X4 + ɣ y5 X5 + βyzZ

Each coefficient in the structural equation has 2 subscripts.

a) For the coefficient that connects each exogenous variable to an intervening variable (Z) called ɣzi, where the initial subscript is the destination variable (Z), the next subscript is the origin variable, namely: 1, 2, ... or 5.
b) For the coefficient that connects each exogenous variable to an endogenous variable (Y) called ɣyi, where the initial subscript is the destination variable (Y), the next subscript is the origin variable, namely: 1, 2, … or 5.
c) For the coefficient that links the intervening variable to an endogenous variable (Y) called βyz, where the initial subscript is the destination variable (Y), the next subscript is the origin variable, namely: Z.

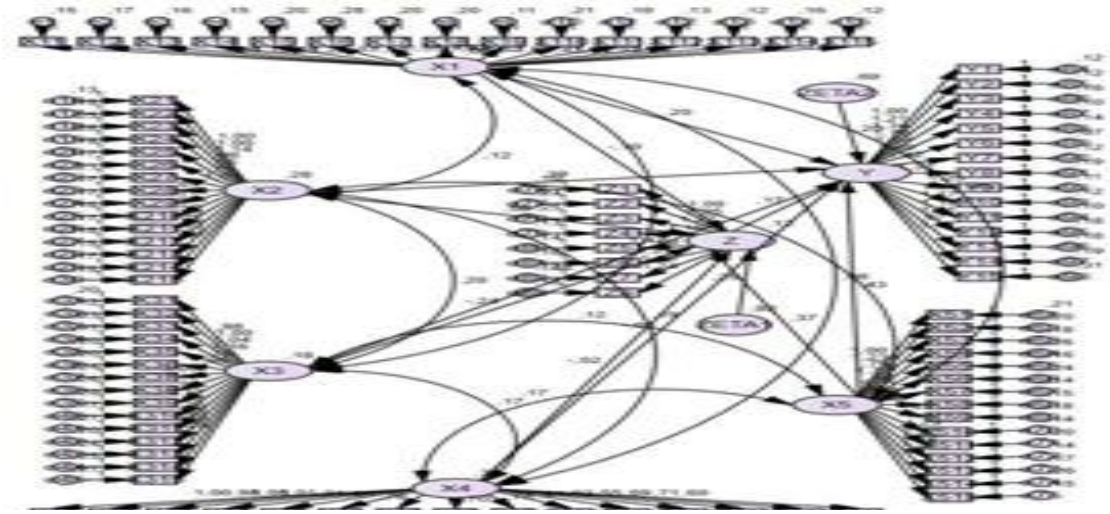


**Figure 4.** Variable Relationship Model and Indicator Variables One-Stage Approach or Hybrid Model)

**Statistical analysis**

SEM is a path model by involving latent variables. Latent variables are variables that cannot be measured directly. The indicators developed were written down in a questionnaire and distributed to the research unit (selected personnel in IstakaKarya Inc. (Persero)) to obtain a response. To facilitate the selection of answers, the answer column will be given an interval score, which is a Likert Scale (1-5).

The SEM approach is two-fold:

(a) one stage approach or hybrid model, and

(b) two stages approach.

Both yield the same parameter estimates. One stage approach is used if the SEM model involves measurement indicators that are not too large. All latent indicators and variables can be covered in a path diagram in a single combination. If it involves tiered indicators (2nd order or more); then usually a two-stage approach is used. This research is categorized as 3rd order, because the indicators will reflect 12 elements, and the 12 elements reflect the five principles of SSHMS. Thus, the approach that will become the reference is the two stages approach.

## III. Result

Related to the existence of these 5-extreme data, In-depth Interview has been carried out to be able to try to correct the perception of the correspondent. If the extreme data cannot be corrected, the perception will be excluded from the data tabulation, but if it can be corrected, the perception will still be entered into the data tabulation. Tabulate the total data using SPSS statistical tools ver.22.

**One Stage Approach or Hybrid Model Analysis**

In the initial analysis phase, testing will be carried out for all indicator variables using SEM AMOS. Ver. 22 with a one stage approach or hybrid model method.
From the test results above, the structural equation based on the estimation results of the model as follows:

From the test results above, the structural equation based on the estimation results of the model as follows:

a) exogenous structural equation (X) → intervening (Z):
   Z = -0.104 X1 + 0.577 X2 - 0.241 X3 + 0.023 X4 + 0.371 X5
b) exogenous structural equation (X) → endogenous (Y):
   Y = 0.195 X1 + 0.386 X2 - 0.158 X3 - 0.046 X4 + 0.431 X5
c) Exogenous structural equation (X) → intervening (Z) → endogenous (Y):
   Y = 0.195 X1 + 0.386 X2 - 0.158 X3 - 0.046 X4 + 0.431 X5 + 0.166 Z

A condition where several things indicate an imperfect indication of the variable relationship model and variable indicators using SEM AMOS. Ver. 22 one stage approach or hybrid model as mentioned above, cannot be used as a conclusion because of SEM AMOS. Ver. 22 one stage approach or hybrid models sometimes experience an output distortion if the model involves a large number of indicator variable relationships. For more certain, it must be carried out modeling and tiered statistical

**Analysis using SEM AMOS. Ver. 22 two stages approach.**

There are three variable indicator tests at this stage, namely:

**1) Normality Test**

**Table 1:** Output Normality Test

| Variable | min | max | skew | c.r. | kurtosis | c.r. |
|---|---|---|---|---|---|---|
| X5 | -3,184 | 1,629 | ,078 | ,349 | -,216 | -,482 |
| X4 | -2,817 | 1,436 | -,193 | -,861 | -,581 | -1,299 |
| X3 | -2,744 | 1,483 | -,127 | -,567 | -,504 | -1,128 |
| X2 | -3,770 | 1,287 | -,291 | -1,300 | ,127 | ,284 |
| X1 | -2,638 | 1,218 | -,207 | -,926 | -1,010 | -2,258 |
| Z | -2,387 | 1,190 | -,144 | -,642 | -1,125 | -2,516 |
| Y | -2,433 | 1,398 | ,214 | ,956 | -1,025 | -2,292 |
| Multivariate | | | | | 16,233 | 7,921 |

Judging from the value of CR skewness and CR kurtosis on each indicator (98 indicators), it appears that several indicators have fulfilled the normality assumption, this is indicated by the value of several indicators that CR skewness and CR kurtosis are in the range ≤ +1.96 or ≥ -1.96. The complete output data is a normality test using SEM AMOS. Ver. 22 with the two stages approach method.

**2) Outlier Test**

**Table 2:** Outlier Test Output

| Observation number | Mahalanobis d-squared | p1 | p2 |
|---|---|---|---|
| 20 | 35,666 | ,000 | ,001 |
| 11 | 25,917 | ,001 | ,002 |
| 70 | 23,277 | ,002 | ,001 |
| 86 | 22,078 | ,002 | ,000 |
| 15 | 19,679 | ,006 | ,001 |

Based on the list of Mahalanobis distances in each observation, it appears that the 20th observation (35,666) is the observation with the farthest distance from the centroid, then compared with the chi-square value ($\chi$20.05,119 = 145,461). Because the maximum value of the Mahalanobis distance is smaller than the chi-square value, there is no indication of extreme data. The complete output data of the outlier test uses SEM AMOS. Ver. 22 with the two stages approach method.

**3) Model Conformity Test**

**Table 3:** Model Conformity Test Output

| Model | RMR | GFI | AGFI | PGFI |
|---|---|---|---|---|
| Default model | ,000 | 1,000 | | |
| Saturated model | ,000 | 1,000 | | |
| Independence model | ,568 | ,276 | ,035 | ,207 |

From the GFI value (1,000) is greater than the good fit criteria that is ≥ 0.9; indicates that this model in terms of its suitability index is in a good category**.**

**4) Model Significance Test**

**Table 4:** Model Significance Output

| | Estimate | S.E | C.R | P | Status |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Z < ---X1 | ,023 | ,122 | ,192 | ,848 | **Not significant** |
| Z < ---X2 | ,558 | ,138 | 4,040 | *** | **Significant** |
| Z < ---X3 | -,069 | ,141 | -,492 | ,623 | **Not significant** |
| Z < ---X4 | -,027 | ,098 | -,280 | ,780 | **Not Significant** |
| Z < ---X5 | ,315 | ,098 | 3,230 | ,001 | **Significant** |
| Z < ---ZETA1 | ,375 | | | | |
| Y< ---X1 | ,180 | ,086 | 2,080 | ,037 | **Significant** |
| Y < ---X2 | ,358 | ,105 | 3,417 | *** | **Significant** |
| Y < ---X3 | -,016 | ,100 | -,158 | ,874 | **Not Significant** |
| Y < ---X4 | -,040 | ,070 | -,574 | ,566 | **Not Significant** |
| Y < ---X5 | ,348 | ,072 | 4,808 | *** | **Significant** |
| Y < --- ZETA 1 | ,195 | ,065 | 2,986 | ,003 | **Significant** |
| Y < --- ZETA 2 | ,300 | | | | |

From the table above, a significant status is obtained if the value of P ≤ 0.05, the value α = 0.05 illustrates the maximum data of 5% experiencing a deviation from the normal distribution. Significant status is obtained when the value of P α α (Sham, 2014). The value *** indicates that the significance value is very small close to 0 so that it can be interpreted as data experiencing a very small deviation from the normal distribution. Model significance test results can be translated as follows:

a) Variable X2, which is the Implementation of OHS Plan, influences SIGNIFIKAN approaching 100% to Variable Z, namely the Level of Understanding of Employees and Workers towards SSHS and SSHMS.
b) Variable X5, Sustainability of Construction has a SIGNIFICANT effect of 99.9% on Variable Z, namely the Level of Employee and Worker Understanding of SSHS and SSHMS.
c) Variable X1, which is the Determination and Planning of OHS Policy, has a SIGNIFICANT effect of 96.3% on Variable Y, namely Project Performance (Environmental Issues).
d) Variable X2, which is the Implementation of OHS Plan, influences SIGNIFIKAN approaching 100% to Variable Y, namely Project Performance (Environmental Issues).
e) Variable X5, namely Construction Sustainability Construction has a Significant effect approaching 100% to Variable Y, namely Project Performance (Environmental Issues).
f) Variable Z, which is the Level of Employee and Worker Understanding of SSHS and SSHMS, has a significant effect of 99.7% on Variable Y, namely Project Performance (Environmental Issues).

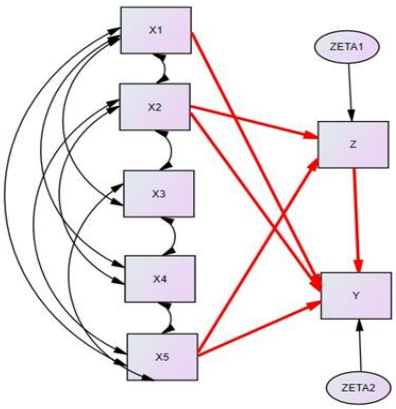


**Figure 10.**The Significance Model of Variable Relationships and Variable Indicators

## IV. Discussion

For IstakaKarya Inc., to increase the socialization and promotion of SSHMS and SSHS to all employees and workers within the state-owned IstakaKarya Inc. (Persero) is especially related to the principle factors for the Establishment and Planning of OHS Policies, Monitoring and Evaluation of OHS Performance and the principles of Construction Safety and Health because these two factors are principles in the application of SSHMS and SSHS. In its implementation, it can be supported by awarding rewards directly to individuals or teamwork for good performance of OHS implementation, rewards can be in the form of financial rewards and responsibility rewards (Azeez et al., 2019).

To General Construction Service Performers, even though SSHMS (2012) is a longer system compared to SSHS standard (2017), it does not mean that SSHMS is no more important than SSHS because both standards and systems are currently required to be implemented side by side, so It is expected that construction service operators are always able to improve the understanding of all employees and workers related to SSHS and SSHMS, In the previous research, it was also emphasized that one of the causes of work accidents was the failure of workers to identify the hazards and the employee's ignorance of potential hazards (Pereira et al., 2017).

Further researchers, to develop research on the integration of SSHS and SSHMS implementation concerning construction performance on cost, quality, time and human resources indicators, using wider population data by involving several other Construction SOEs.

By developing a set of key indicators by following a systematic process consisting of conceptualization, operationalization, indicator making, and validation and revision. The pressure-state-practice (PSP) model provides an overall framework for developing key indicators (Guo, 2016).

The proposed multidimensional safety performance model can be supported by structural equation modeling (SEM) analysis. Besides, 16 latent dimensions to relative weights and recommendations for construction safety professionals are provided to improve construction safety performance (Gunduz et al., 2016).

## V. C**onclusion**

After analyzing and testing statistics through the significance test of the SEM-AMOS model, it is found that there are a relationship and influence of variables X1, X2, X3, X4, and X5. Both directly to the Y variable and through the intervening variable.

1. A significant relationship is identified between the implementation of SSHMS and SSHS integration on the Performance of Road Infrastructure Projects, especially on Indicators of Environmental Issues through variable X1, namely the Establishment and Planning of OHS Policy, variable X2, namely the Implementation of OHS Plan, and variable X5, namely Sustainability of Construction. Conclusion of this study reinforces previous research which states that an integrated or systematic approach in practice needs to be done to predict how the allocation of resources and the safety policy of a construction project can affect safety performance. This has proven to be able to assist companies in developing proactive strategies designed to improve safety performance (Pereira et al., 2018). Conclusions of this study corroborates previous research which states that the five influential factors of the management process identified by hierarchical descriptions based on OHSAS 18001 affect management performance in different ways (Li et al., 2016). Conclusion of this study also adds information to previous research which states that the weak factors for implementing OHS are OHS training, safety in contract documents, routine OHS meetings, and employee involvement (Choudhry and Zahoor, 2016).
2. From the results of the test of the significance of the model through SEM-AMOS, the indicator variable X2 can be evaluated, namely the Implementation of the OHS Plan and X5 variable, namely Construction Sustainability, which significantly influences the Z intervening variable, namely the Level of Understanding of Employees and Workers towards SSHS and SSHMS.
3. Analyzing the results of the test of the significance of the model through SEM-AMOS, obtained a significant effect between the Z variable, namely the Level of Understanding of Employees and Workers Against SSHS and SSHMS against the Y variable, namely Project Performance (Environmental Issues).Conclusion This study corroborates previous research which states that a good understanding of work safety will affect the achievement of safety conditions at worksites (Hasanzadeh, 2019). Conclusions This study also corroborates previous research which states that the important role of safety competencies or understanding in safety behavior, as well as the need for safety management methods to improve worker safety behavior and safety conditions at work (Li and Meng Fan, 2018). Conclusion This study also corroborates previous research which states that having the correct number of safety personnel with the necessary educational and professional qualifications can help reduce the incidence rate of construction companies. Also, an adequate staff of safety personnel with the necessary educational and professional qualifications can improve safety management in construction (Awolusi and Marks, 2016).

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