Occupational Health and Safety Effects on Productivity in a Garment Factory Using Structural Equation Modeling

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Abstract. An industry goal is to create a product to make a profit. Development of human resources is one important thing for a company to consider. Companies have an opportunity to increase work productivity by the rules of OHS (Occupational Health and Safety). This study aimed to: (1) Partially determine the influence of work safety on employee productivity. (2) Partially determine the influence of health on employee productivity. (3) Simultaneously determine the influence of health and safety on employee productivity simultaneously. (4) Determine that variables that have a major influence on employee productivity. A questionnaire was used to collect data from 200 respondents. Results of SEM showed that safety did not have an effect on productivity (p=0.467). However, occupational health effected productivity (p=0.002). Thus, health has a significant influence on work productivity.

1. Introduction

The Company is a form of association or organization that guides the goal to create a product or serve customers for profit. The purpose of an industry is to create a desired product for gain. Industrial activities are used to process or transform raw materials into new products, or change the goods from low value into high value goods [1]. The number of work accidents in Indonesia is still high, and through the end of 2015, there were as many as 105,182 work accidents. Meanwhile, in the case of serious accidents that resulted in deaths as many as 2,375 cases were recorded [2]. Accidents are directly proportional to the growth of new companies in Indonesia. The number of small companies in Indonesia is 141,894 or 83.70%, medium scale industries comprise 14,970 or 8.83%, and the number of large scale industries is 12,660 or 7.47%; Indonesian industry totals include 169,524 companies. Concomitant with increasing the number of new companies will be a need for more employees. However, if the number of accidents still high, this will certainly affect the development of the company.

Occupational Health and Safety is a program system designed for employees or companies in regards to preventive action of accidents and diseases caused by working relations in the work environment by identifying factors that potentially cause accidents and diseases [3].

There are several similar studies with different methods and variables on occupational safety and health as well structural equation modeling, such as the effect of occupational safety and health to improve employee productivity [3]. Moreover, the Occupational Health and Safety Management System formulates
safety and health management systems for manufacturing plants in South India [4]. An empirical analysis of the effectiveness of occupational health and safety management systems in SMEs has been conducted [5]. [6] completed research on leadership and employees' perceived safety behaviors in a nuclear power plant with a structural equation model. [7] discussed the effect of an integrated management system on safety and productivity indices in a case study of Iranian cement industries. Furthermore, application of interpretive structural modeling and structural equation modeling to analyze factors contributing to sustainable manufacturing in the Indian automotive component sector was completed by [8]. [9] also discussed the use of structural equation modeling to improve the health sector. Differences in this research include the subjects, variables, indicators, methods and the companies where the research was conducted. From some of these differences are expected to explain to the three variables well.

2. Method
The data analysis was adapted in regards to the research design and variables. The hypothesized causal model generated was tested with structural equation modeling (SEM) in AMOS. Structural Equation Modeling is a multivariate statistical technique that combines factor analysis and correlation analysis [10]. This statistical approach aims to analyze relationships among variables in a model, between indicators and a construct, or between constructs. The object of this research was PT Mataram Tunggal Garment, an apparel exports company located in the Yogyakarta province, Indonesia. The subjects were 200 employees at PT Mataram Tunggal Garment.

3. Sample Determination
According to [11], a sample is part of the total number in the population. The probability sampling technique used in this research provides equal opportunity for each element of the population to be chosen. Simple random sampling was included because usually SEM requires large sample sizes. [12] suggested that to test a model using SEM, between 100-200 subjects are needed; alternatively, based on the number of parameters, multiplying by five, up to ten, may be needed, depending upon the all latent variables. Once survey in 72 SEM research, got median of sample size are 198. For that reason, 200 subjects are usually accepted as representative samples using SEM; in this study female employees in each division served as the respondents.

4. Variable
Variables used in this study included safety (X1) and health (X2) as independent variables. Employee productivity (Y) was the dependent variable.

5. Questionnaire Design
Questionnaires included a number of written questions used to obtain information from respondents in terms of personal reports, or things that are known [13]. A Likert scale was used for the response options. The following areas were assessed:
1) Work Safety
Safety could be explained as employee safety or the hardships caused by the working environment. Safety was measured using the Safety Climate Questionnaire (SCQ) made by Glendon and Litherland, 2001 cited in the study [14]
2) Occupational health
Occupational health refers to employees who do not have physical disorders, and/or pain caused by the working environment. According [15] occupational health is "a business and circumstances that
allow a person to maintain his health in the workplace"

3) Productivity
Productivity is a scale to measure employees performance, and whether they could complete the target or not. Productivity is a set of economic resources to produce something as a comparison between the sacrifice (inputs) and production (output) [16].

Based on the operationalization of variables, the questionnaire was formulated in six parts:
1) Respondent characteristics (gender, age, education, marital status, length of employment, employment status, the amount of income and number of dependents).
2) Safety Work
3) Occupational health
4) Productivity

6. Statistical Analysis
Each statistical technique used in this research had a specific designation. Several tests were used including the following:

Normality Test
To test whether the data had a normal distribution the non-parametric statistical test of Kolmogorov-Smirnov (K-S) was used [17]. If the result of Kolmogorov-Smirnov was greater than 5%, it was concluded that the data had a normal distribution [17]. Normality tests are purposed to verify that residuals have a normal distribution [17][18].

Validity Test
Validity tests were used to measure the validity of the questionnaires. A questionnaire is considered valid if the questions in the questionnaire reveal something that will be measured by the questionnaire [19]. A validity test was done to prove significance of the data attained.

Reliability Test
A reliability test was used to measure indicators of questionnaires from variables or constructs. A questionnaire is considered reliable if someone answers the statements consistent over time [19]. To find a reliable measuring instrument, Cronbach’s Alpha was used.

Confirmatory Factor Analysis Test
Confirmatory Factor Analysis is a multivariate analysis method that can be used to confirm that the model corresponds to the hypothesis. The rotation used in confirmatory factor analysis is determined by: (1) Kaiser-Meyer-Olkin (KMO test), (2) Anti-image correlation test, (3) Total variance explained test, (4) Cumunality, (5) Component matrix, and (6) Component Transformation Matrix [20]

Determination coefficient test
Determination coefficient test ($R^2$) was essentially used to determine the extent to which a measure model could explain variations in the dependent variable [21]. A value close to the mean of the independent variables provides almost all the information needed to predict the dependent variable variations.

7. Result
The respondents criteria were shown below:
1) The 200 participants were all female (100%).
2) Approximately 49% or 98 people were < 25 years old; 31.5% or 63 people were between 26 –
35 years old; 16.5% or 33 people were aged between 36 – 45 years; and 3% or 6 people were aged > 45 years.

3) Education: Senior in High School accounted for 73.5% of 147 people; Junior in High School amounted to 52 people or 26%; and one person completed only Elementary School, 0.5%.

4) Marital status: those married included 117 people or 58.5%. Single people accounted for 75 people or 37.5%, and the widowed status included 8 people or 4%.

5) Years of Service: < 3 years accounted for 91 people or 45.5%; between 3 – 7 years included 53 people or 26.5%; between 8-12 years included 27 people or 13.5%, and >12 years accounted for 29 people or 14.5%.

6) Job status: Permanent Employees were 113 people or 56.5%, while the rest were Temporary Employees, 87 people or 43.5%.

7) Amount of Income: < Rp.1,300,000 included 193 people or 96.5%; between Rp.1,400,000 - Rp.1,600,000 included 5 people or 2.5%, and two people (or 1%) had incomes between Rp.1,700,000 - Rp.2,000,000.

8) Burdensome: between 2 – 4 people included 86 respondents or 43%; burden of < 2 people included 39 respondents or 19.5%, and more than 4 people accounted for 6 respondents or 3%. Those with no burden included 69 people or 34.5%.

Instruments used in this research included various software packages, such as Excel 2007, SPSS (Statistical Product and Service Solution) 11, and AMOS 21. Raw data were obtained and then processed to check for normality, validity, reliability, confirmatory analysis, and determination coefficient tests in SPSS 11.

1) Normality test results showed that the Kolmogorov-Smirnov Test was 0.660 with a probability of 0.777 > 0.05. Thus, the data have normal distribution.

2) Validity test results showed that correlation coefficients in all questions for work safety, occupational health, and productivity had values greater than the r table = 0.1396. Based on that result, all instrument were considered valid and could be analyzed in the next steps.

3) Reliability test results showed that work safety, occupational health, and productivity variables had a Cronbach's Alpha coefficient greater than 0.6, so all variables were declared reliable.

4) Kaiser-Meyer-Olkin and Bartlett's Test, based on factor analysis, resulted in a KMOMSA (Kaiser-Meyer-Olkin measure of sampling adequacy) value of 0.858 > 0.05 with a probability < 0.05, suggesting that all measurement subvariables were worthy.

5) Anti-image correlation test. Results showed that all variables had a correlation anti-image > 0.5, which means all measurement sub-variables could be component factors with a critical success factor for questionnaire sampling.

6) Total variance explained test. Results showed that from 71 measurement variables, 18 factors were formed, which was determined by initial eigenvalues that were ≥ 1.

7) Communalities formed 71 factors. Results showed that greatest role was subvariable P1 which was 0.797 or 79%, and the lowest was H3 0.600 or 60%.

8) Component matrix. This was formed of several factors: 1-4, 1-3 and 1-10. The component value of a factor could be defined as the correlation between a factor that was formed with the component. The correlation between a factor of 1 to S1 and S1 2 with a factor of each component factor of 0.411 and 0.271, and the value of the correlation of the highest on the first factor is the correlation between a factor of 1 to H5 with a value of 0.803.

9) Component transformation matrix is the correlation between factors formed with components. For example, the correlation between a factor of 1 to S1 and S1 2 with a factor of each component factor of 0.722 and 0.504, and the correlation value is highest at 1 factor.
is the correlation between a factor of 1 to H8 with a value of 0.856. Apparently from the results, the data could not be rotated because after processing all three times her into a convergent, so that further data on what their interpretation of the first analysis

10) The determination coefficient was essentially a measure of how much variance in the dependent variable(s) that a model could explain [19]. This research only used two independent variables, so the R squared value was 0.301 or 30.1%. It can be concluded that work safety and occupational health accounted for 30.1% of productivity; the rest was affected by other variables.

SEM is a multivariate statistical technique that combines factor analysis and correlation, and aims to verify the relationship between variables in a model, indicators and constructs, or the relationship in each construct(s) [22].

Reffering on the structural model and measurement model in the framework that can be formulated as Figure 1.

![AMOS Model 1 (Model Standardized Coefficients)](image)

**Figure 1.** AMOS Model 1 (Model Standardized Coefficients)

| Goodness of fit | Cut – off Value | Model Result | Information |
|----------------|-----------------|--------------|-------------|
| X² – Chi Square | Expect for low score | 171.078 | less |
| Probability    | ≥ 0.05          | 0.000        | less |
| Cmin/DF        | ≤ 2.0           | 2.312        | less |
| GFI            | ≥ 0.90          | 0.892        | less |
| RMSEA          | ≤ 0.08          | 0.081        | less |
| AGFI           | ≥ 0.90          | 0.847        | less |
| TLI            | ≥ 0.90          | 0.915        | good |
| CFI            | ≥ 0.90          | 0.931        | good |

Source: Output Amos 21

From the result above (Table 1), there are five points that have low values in model 1, while the others are acceptable. Based on the SEM stages to improve model fit, it is necessary to interpret and
modify such models that are out of range. The purpose of modification is to examine whether the chi-square value can be decreased; a lower chi-square value means that model is a better fit to the data. Chi-square and significance is essential, so it was necessary to modify the model; examination of the modification indices was conducted.

There are three versions proposed by AMOS, covariance, variance and regression weights. The best option is based on theoretical justification, because the program is only used to confirm that the empirical model is appropriate with the theoretical model. Examination of the covariance suggested correlating e1 and e2, and e13 and E14 in order to decrease the chi-square for each 23.127 and 11.883. Theoretical support suggested e1, e2, e13, e14 were error indicators. Each indicator formed the same construct for work safety and productivity.

Indicators in a construct must have a strong correlation in order to form a final construct. By correlating errors that have a high impact on chi-square, the output in Figure 2 was obtained. Below is the AMOS result after modification to determine the effects of work safety, occupational health, and productivity.

![Figure 2. AMOS Model 2 (Model Standardized Coefficients)](image)

**Table 2. Measurement Model – Goodness of fit (After Modification)**

| Goodness of fit | Cut – off Value | Results Model | Information |
|-----------------|-----------------|---------------|-------------|
| X² – Chi Square | Expected Has Low Score | 132.646 | Less |
| Probability ≥ 0.05 | 0.000 | Good |
| Cmin/DF ≤ 2 | 1.834 | Good |
| GFI ≥ 0.90 | 0.917 | Good |
| RMSEA ≤ 0.08 | 0.065 | Good |
| AGFI ≥ 0.90 | 0.879 | Less |
| TLI ≥ 0.90 | 0.946 | Good |
| CFI >0.90 | 0.957 | Good |

Source: Output Amos 21

[23] stated that if the parameters are not able to explain a suitable model, it can be measured by another fit model. Result of the suitability model analysis indicated that the path model was not satisfactory. Another test uses Cmin / DF, GFI, RMSEA, TLI and CFI to indicate a good model. Path models in this research already met the Goodness of fit assumptions [23].

Testing the hypothesis with the results obtained in the SEM analysis are shown in Table 3 below:
Table 3. Estimation Results SEM

| Connection Between Variable | Estimation | P     |
|----------------------------|------------|-------|
| Productivity <- Safety_Work | 0.106      | 0.467 |
| Productivity <- Sanity_Work | 0.298      | 0.002 |

1) Hypothesis 1 was used to determine the path coefficient weight of work safety on productivity; the obtained value was 0.106 (p=0.467), suggesting an insignificant relationship. Hypothesis 1 was not supported.

2) Hypothesis 2 was to determine the weight of work safety on productivity; the obtained value was 0.298 (p=0.002), suggesting a significant relationship. Hypothesis 2 was supported.

3) Hypothesis 3, that relationship between variables is significant, because of the value of work safety is 0.002 and coefficient is 0.298. Both variables are simultaneously has the value but once is not qualified.

4) Hypothesis 4 was used to determine the impact of work safety on productivity; a value of 0.298 (p=0.002) was obtained, and the productivity regression coefficient weight was 0.106. This means that work safety has the most influence on productivity.

8. Conclusion

Based on the results of the study, a number of conclusions can be stated, namely:

1) Workplace safety has no significant effect on work productivity; the test results of the path analysis (SEM) suggested that the values obtained (safety lines on productivity=0.106, p=0.467) exceeded the standard cutoff value.

2) Occupational health significantly influences productivity of labor based on the results of the path analysis (SEM; the standardized regression coefficient of occupational health on work productivity was 0.298, p=0.002, which met the standard cut off value).

3) Simultaneously, both safety and occupational health affect productivity, but because one of the two variables did not meet the standards, this relationship was declared insignificant.

4) Healthy work proved to be the most dominant influence on the productivity of employees because it met the standard of the cut off value (p=0.002).

References

[1] Utomo, A. P. 2015. Regresi Robust Untuk Memodelkan Pendapatan Usaha Industri Makanan Non Makloon Berskala Mikro Dan Kecil Di Jawa Barat Tahun 2013. Jurnal Matematika, Sains, Dan Teknologi. 15(2). 63-74

[2] BPJS. 2016. Jumlah Kecelakaan Kerja di Indonesia Masih Tinggi. (online): http://www.bpjketenagakerjaan.go.id/berita/5769/Jumlah-kecelakaan-kerja-di-Indonesiamasih-tinggi.html. Accesses online: 29 July 2017

[3] Kusuma, A. N. 2017. Pengaruh Keselamatan Dan Kesehatan Kerja (K3) Terhadap Produktivitas Kerja Karyawan Bagian Sistem Distribusi PDAM Surya Sembada Surabaya. Jurnal Ilmu Manajemen Jim. 5(1)

[4] Abdul Zubar, H., Visagavel, K., Deepak Raja, V., & Mohan, A. 2014. Occupational Health and Safety Management in Manufacturing Industries. Journal of Scientific & Industrial Research, 73(June), 381–386. Retrieved from http://nopr.niscair.res.in/handle/123456789/28878

[5] Arocena, P., & Nunez, I. 2010. An empirical analysis of the effectiveness of occupa-tional health and safety management systems in SMEs. International Small Business Journal. 28(4). 398–419.
Martínez-Córcoles, M., Gracia, F., Tomás, I., & Peiró, J. M. 2011. Leadership and employees’ perceived safety behaviours in a nuclear power plant: A structural equation model. Safety Science. 49(8–9), 1118–1129. https://doi.org/10.1016/j.ssci.2011.03.002

Hamidi, N., Omidvari, M., & Meftahi, M. 2012. The effect of integrated management system on safety and productivity indices: Case study; Iranian cement industries. Safety Science. 50(5). 1180–1189. https://doi.org/10.1016/j.ssci.2012.01.004

Thirupathi, R. M., & Vinodh, S. 2016. Application of interpretive structural modelling and structural equation modelling for analysis of sustainable manufacturing factors in Indian automotive component sector. International Journal of Production Research. 7543(January). 1–22. https://doi.org/10.1080/00207543.2015.1126372

Ratnam, K. A., Dominic, P. D. D., & Ramayah, T. 2014. A Structural Equation Modeling Approach for the Adoption of Cloud Computing to Enhance the Malaysian Healthcare Sector. Journal of Medical Systems. 38(8). 82. https://doi.org/10.1007/s10916-014-0082-5

Hooper, D., Coughlan, J., & Mullen, M. R. 2008. Structural equation modelling: Guidelines for determining model fit. Electronic Journal of Business Research Methods. 6(1). 53–60.

Levy, P. S. and Lemeshow, S., 2013. Sampling of populations: methods and applications. John Wiley & Sons.

Iacobucci, D. 2010. Structural equations modeling: Fit Indices, sample size, and advanced topics. Journal of Consumer Psychology. 20(1). 90–98. https://doi.org/10.1016/j.jcps.2009.09.003

Oppenheim, A. N. 2000. Questionnaire design, interviewing and attitude measurement. (New edn). London. (New edn). London. https://doi.org/10.1016/0149-7189(94)90021-3

Wills, A. R., Biggs, H. C. and Watson, B. 2005. Analysis of a safety climate measure for occupational vehicle drivers and implications for safer workplaces. The Australian Journal of Rehabilitation Counselling, 11(1), pp.8-21.

Robson, L. S., Stephenson, C. M., Schulte, P. a, Amick, B. C. I., Irvin, E. L., Eggerth, D. E., Grubb, P. L. 2012. A systematic review of the effectiveness of occup-pational health and safety training. Scandinavian Journal of Work, Environment & Health, 38(3). 193–208. https://doi.org/10.5271/sjweh.3259

Rogers, M. 1998. The Definition and Measurement of Productivity. Melbourne Institute, (9), 27. https://doi.org/10.2307/145776

Corder, G. W., & Foreman, D. I. 2011. Nonparametric Statistics for Non-Statisticians: A Step-by-Step Approach. Nonparametric Statistics for Non-Statisticians: A Step-by-Step Approach. https://doi.org/10.1002/97811181165881

Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2012). Probability and Statistics for Engineers and Scientists. Power (Vol. 3rd). https://doi.org/10.1017/CBO9781107415324.004

I. Ghozali, Aplikasi Analisis Multivariate dengan Program IBM SPSS19. Semarang : Badan Penerbit Universitas Diponegoro. 2011

Statistics Solutions. 2016. Confirmatory Factor Analysis. Handbook of Structure Equation Modeling2. https://doi.org/10.4135/97814266288.n69

Hooper, D., Coughlan, J., & Mullen, M. R. 2008. Structural equation modelling: Guidelines for determining model fit. Electronic Journal of Business Research Methods. 6(1). 53–60.

Kline, R. B. 2011. Principles and practice of structural equation modeling. Structural Equation Modeling (Vol. 156). https://doi.org/10.1038/156278a0

Ho, R. 2014. Handbook of Univariate and Multivariate Data Analysis with IBM SPSS. CRC Press.