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ORIGINAL ARTICLE

Projection of the occurrence of work accidents based on unsafe act and work units☆

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Abstract
Objective: To estimate the trends and prediction of work accidents during period 2009–2022.
Methods: The study design was a time series design. The population in this study is all data on work accidents at the company during period 2009–2015.
Results: For work accident data in 2009–2015 dominated by occupational accidents in unsafe positions with a percentage of 0.59–0.16%. After projecting future events for the next 7 years the highest occupational accidents turn into working on rotating objects with a percentage of 0.30–0.57%. Work accident data for work unit variables found that there were 76 cases of work accidents that occurred in 2009–2015. In the work unit, the maintenance department is the department with the highest accident with 40 cases in 2009–2015 (0.70–0.46%). After being analyzed, the prediction results for occupational accidents in 2016–2022 are still held by the maintenance department with a value of 38 cases (0.34–0.28%).
Conclusions: The trends and prediction for the next 7 years, there are an increase in work accidents based on unsafe act variable and a decrease for variable works unit.

Introduction

The implementation of the occupational safety and health (OSH) management system in the industry should show a better development every year, including in the cement industry. There are many factors that affect the implementation of the OSH management system in the industry, some are inhibiting and some are supportive. A research conducted PT Semen Tonasa concluded that there is a relationship between age, knowledge, years of service and K3

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Table 1 Time series analysis of work accidents based on unsafe acts in 2009–2015.

Years	Number of accident (Y)				X	XY				X^2
	Using tools	Work fast	Work on rotating objects	Unsafe position		Using tools	Work fast	Work on rotating objects	Unsafe position	
2009	4	6	3	10	−3	−12	−18	−9	−30	9
2010	0	4	1	4	−2	0	−8	−2	−8	4
2011	0	5	0	0	−1	0	−5	0	0	1
2012	2	0	3	3	0	0	0	0	0	0
2013	3	7	0	3	1	3	7	0	3	1
2014	0	2	0	3	2	0	4	0	6	4
2015	1	3	4	5	3	3	9	36	15	9
n	10	27	11	28		−6	−11	25	−14	28

Source: Secondary Data, 2009–2015.

training with perceptions of the implementation of the occupational safety and health management system at PT Semen Tonasa.[1] The application of the OSH management system has the aim of preventing occupational accidents and occupational diseases, as well as increasing work productivity. A part of work accident investigation activities is the identification of work accidents.[2] Work accident investigation is a specific workplace inspection activity, which is carried out after a work accident that causes suffering to humans.[3] A lot of workers lose their lives and suffer to serious injuries because of workplace accidents. Work accidents also caused huge financial losses for the company.[4] Therefore, we need to know and identify the causes of accidents in the workplace.

Accidents in workplace especially in industrial sector is increasing. Occupational accidents in developing countries more prevalent more than in developed countries.[5] Indonesia as developing country is one of the countries that has not achieved the Zero Accident target to reduce the prevalence of workplace accidents. PT Semen Tonasa is the largest cement producer in Eastern Indonesia. To see the rate of increase in workplace accidents, this company need a forecasting or projection method, so that the number of workplace accidents can be predicted. Statistical and epidemiological approaches have been used for projections of workplace accidents. Forecasting or projections allow extrapolation from existing information about circumstances and developments to predict future events.[6,7] So by using quantitative forecasting, the prevalence of workplace accidents can be predicted in the future. This study was aimed to find out trends and projections of work accidents from 2009 to 2022 at PT Semen Tonasa.

Methods

A quantitative analysis with a time-series study was used in this study along with secondary data. The population in this study is all the work accident data in PT Semen Tonasa from 2009 to 2015, no sampling was conducted in this study. It means that all data from PT Semen Tonasa from 2009 to 2015 serves as the unit of analysis. The data in this study obtained from documents that the company in a form of work accident report and work accident investigation report. To know the work accident trend and projection, data analysis was performed using the SPSS program and Microsoft Excel.

Result

Analysis of work accident trend and projection based on unsafe act in 2009–2022

The trend of work accidents that occur based on unsafe acts from 2009 to 2015 mostly occurs on attitudes/actions that take unsafe positions. The highest accident based on the rate occurred in 2009 of 0.59%, where the attitude/actions of the worker took an unsafe position. The lowest accident occurred in the attitudes/actions of workers who neglected the use of tools (working without using procedures) in 2010–2014, in 2014 the trend of work accidents decreased by 0% of all dangerous attitudes/actions committed by workers.

From work accident data sources based on the unsafe act from 2009 to 2015, there were 10 cases of actions caused by the use of tools, there were 27 cases of actions caused by working with speed, there were 11 cases of actions caused by working on rotating objects, and there were 28 cases of actions caused by insecure positions can be seen in Table 1.

To find the values of a and b are $a = 11/7 = 1.57$ and $b = 25/28 = 0.9$. The linear equation is $Y = 1.57 + (0.9)X$. Using these equations, we can predict accidents on rotating objects in 2016 as example $Y = 1.57 + (0.9)$ (for 2016 the value of X is 4). The prediction result shows that from 76 accidents in 2009 to 2015 will going to happen 85 accidents in 2016–2022. Based on the description above we can see the trend of unsafe act there's an increase and decreasing accident every year starting from 2009 to 2022. Accident by using tools in previous 7 years was 10–14 accidents in next 7 years, work fast from 27 to 10 accidents, work on rotating objects from 11 to 55 accidents, and unsafe position from 28 to 6 accidents.

Decreases of these unsafe act occur in all actions but there is a slight change in which in the previous 7 years namely 2009–2015 work accidents often occur caused due to insecure position. In the next 2016–2022 due to

Table 2 Work accident prediction based on unsafe act seven years later.

Years	Unsafe act				Years	Unsafe act			
	Using tools	Work fast	Work on rotating objects	Unsafe position		Using tools	Work fast	Work on rotating objects	Unsafe position
2009	0.23%	0.35%	0.18%	0.59%	2016	0.17%	0.11%	0.30%	0.11%
2010	0%	0.23%	0.06%	0.23%	2017	0.17%	0.11%	0.34%	0.11%
2011	0%	0.34%	0%	0%	2018	0.11%	0.11%	0.40%	0.05%
2012	0.14%	0%	0.20%	0.20%	2019	0.11%	0.11%	0.46%	0.05%
2013	0.20%	0.47%	0%	0.20%	2020	0.11%	0.05%	0.51%	0%
2014	0%	0.11%	0%	0.16%	2021	0.05%	0.05%	0.57%	0%
2015	0.05%	0.17%	0.22%	0.30%	2022	0.05%	0%	0.57%	0%

Source: Primary Data, 2016.

workers working on rotating objects (cleaning, regulating, lubricating, etc.) work accident is estimated to increase continuously around 0.5–0.10%, this change is caused by due to power errors relevant work, where the worker works carelessly or does not want to know. The comparison in percentage can be seen in the Table 2.

Analysis of work accident trend and projection based on work units in 2009–2022

The trend of work accidents that occur based on work units from 2009 to 2015 mostly occurs in the Maintenance Department. The highest accident occurred in 2009 by 0.70% in the Maintenance Department, the lowest accident occurred in 2011 there were no accidents in the same place. In 2014, the trend of work accidents decreased in all work units by 0.11% and 0.16%.

Data on work accidents were obtained based on work units from 2009 to 2015 while the total number of work accidents that occurred was 76 cases, with details of which were 36 cases in the production department and there were 40 cases in the maintenance department. The work accidents trend in 2016–2022 can be predicted through the least square method with time series analysis can be seen in Table 3.

To find the values of a and b are $a = 36/7 = 5.14$ and $b = -24/28 = -0.9$. The linear line equation is: $Y = 5.14 + (-0.9)X$. Using this equation, we can predict the accident in the production department in 2016 as example $Y = 5.14 + (-0.9)$ (for 2016 the value of X is 4), so that: $Y = 5.14 + (-3.6) = 1$ means that work accidents in the production department in 2016 are estimated at 1 accident. The prediction result shows that in previous 7 years accident in production department was 36 accidents to 9 accident only in next 7 years and accident in maintenance department was 40 accidents to 38 accidents in 2016–2022.

Based on the description above, we can see that the work unit trend has decreased every year starting from 2009 to 2022, the decrease in work units occurred in all work units, from 2015 to 2016 there was a decrease of about 0.07%, then from 2016 to 2018 remained stable 0.22% and another decline from 2018 to 2022 of 0.05%, from this work unit the accident is still dominated by the maintenance department because the maintenance department covers all plant areas and work areas. The comparison in percentage can be seen in Table 4.

Discussion

Based on the unsafe act, the prediction trend of work accident rates in 2009–2015 is dominated by insecure positions of 0.59–0.30% while in the prediction of 7 years to come there will be a decline in 2016–2022 ranging from 0.17% to reach zero accident, then the trend of accidents using tools in 2009–2015 was 0.23–0.05% while the predictions for 2016–2022 occurred a slight increase of about 0.12% from 0.05% reaching 0, 17% then decreased again from 0.17% to 0.05%, then the trend for workplace accidents with rotating objects in 2009–2015 occurred 0.18% and increased in 2015 by 0.22% while for prediction 7 the coming year 2016–2022 is an increase from 0.22% to 0.30% and continues to increase until the year 2022 by 0.57% and this shifts the position of insecurity which previously occurred most frequently in 2009–2015.

These changes often occur due to the mistakes of the workers concerned, where the workers work carelessly or do not want to know. The direct cause of an accident is an unsafe act and unsafe conditions. The knowledge a person has is a very important factor in interpreting the stimulus we obtain. Workers with good knowledge and attitudes can prevent work accidents both on themselves and others.[8] If coworkers make mistakes can be reprimanded so that workers who have an unfavorable attitude at work can realize and not repeat mistakes. The company should provide insight to workers so that they can increase their knowledge about OSH and for workers who have good OSH knowledge. Like, training for workers and providing counseling about the dangers of accidents in the project, so that they can improve their knowledge so that when they work they already know what they should and should not do.[9]

Based on work units, the prediction trend of work accident rates in 2009–2015 was dominated by the maintenance department of 0.70–0.46%, in 2011 there was a decline of up to 0% and there was another increase in 2013 of 0.56% and 2015 there was a decrease of 0.46%, whereas in the predicted 7 years to come 2016–2022 there was a decrease in the maintenance department ranging from 0.34% to 0.30%, then the accident trend in the production department in

Table 3 Time series analysis of work accidents based on work units 2009–2015.

Years	Number of accident (Y)		*X*	*XY*		X^2
	Production department	Maintenance department		Production department	Maintenance department	
2009	11	12	−3	−33	−36	9
2010	5	4	−2	−10	−8	4
2011	5	0	−1	−5	0	1
2012	3	5	0	0	0	0
2013	5	8	1	5	8	1
2014	2	3	2	4	12	4
2015	5	8	3	15	24	9
n	36	40		−24	0	28

Source: Secondary Data, 2009–2015.

Table 4 Work accident prediction based on work units seven years later.

Years	Work units		Years	Work units	
	Production department	Maintenance department		Production department	Maintenance department
2009	0.64%	0.70%	2016	0.11%	0.34%
2010	0.30%	0.23%	2017	0.11%	0.34%
2011	0.34%	0%	2018	0.11%	0.34%
2012	0.20%	0.34%	2019	0.11%	0.30%
2013	0.34%	0.54%	2020	0.05%	0.30%
2014	0.11%	0.16%	2021	0%	0.30%
2015	0.30%	0.46%	2022	0%	0.30%

Source: Primary Data, 2016.

2009 was 0.64% down to 2015 amounted to 0.30% and for 2016–2022 predictions there was a drastic decrease of about 0.19% from 0.30% to 0.11% until 2019 then another decline from 0.11% until it reaches zero accident.

This happens because the working conditions are very high in the maintenance department compared to other departments which make the workers in this unit feel burdened when there are so many tools to repair. Most of this cement industry had machine and other technology and an ongoing maintenance activities.[10] Such as repairing heavy equipment used to transport limestone and repairing factory components when shut down kilns or repairs regularly so that workers are no longer able to withstand workloads and cause work accidents. But in the future, there will be a decrease in accident rates in each of these departments is expected to have developed technology so that workers in all departments no longer work too hard especially in the maintenance section just enough to control. Other than that, the influence of training and experience of the technician in maintenance department will help to upgrade their work performance, minimize maintenance job rework and reduce overtime.[11]

Conclusion

Trend and prediction of dangerous/unsafe act from 2009 to 2015 is 76 cases going up to 85 cases and dominated by unsafe position accident with 28 cases (0.59–0.16%) in 2009–2015 but change after the prediction analysis into working on rotation project with 55 (0.30–0.57%) cases in 2016–2022. For work units variable there is a decrease from 76 cases in 2009–2015 and going down to 47 cases in 2016–2022. However, the work unit that still dominates work accidents is the maintenance department with cases from 2009 to 2015 previously totaling 40 cases by percentage 0.70–0.46% to 38 cases by percentage 0.34–0.38% in 2016–2022 after prediction analysis.

Conflict of interest

The authors declare no conflict of interest.

References

1. Almani H, Wahyu A, Rahim MR. Persepsi Karyawan Terhadap Penerapan Sistem Manajemen Keselamatan Dan Kesehatan Kerja di PT Semen Tonasa. Media Kesehat Masy Indones. 2014;10:43–50.
2. Darwis AM, Wira A, Latief L, Kesehatan B, Masyarakat FK, Hasanuddin U. Events of work accidents in the printing industry Makassar City. JKKM. 2020;3:155–63.
3. Tarwaka. Keselamatan dan Kesehatan Kerja: Manajemen Implementasi K3 di Tempat Kerja. Surakarta: Harapan Press; 2014.
4. Nai'em F, Darwis AM, Noviponiharwani, Amin F. Analysis of work accident cost on occupational safety and health risk handling at construction project of Hasanuddin University the Faculty of Engineering. Enferm Clin. 2020;30:312–6, http://dx.doi.org/10.1016/j.enfcli.2020.06.070.

5. Nezamodini ZS, Ahmadabadi S, Mosavianasl Z. Application of job safety analysis and inspecting the changes in identification of hazards in a cement industry in Fars province in 2017. Biomed Public Heal. 2018;2:20–6.
6. Hardiningsih AY. Kajian Model EPidemi SIR Deterministik dan Stokastik pada Waktu Diskrit. J Chem Inf Model. 2019;53:1689–99, http://dx.doi.org/10.1017/CBO9781107415324.004.
7. Thamrin Y, Pisaniello D, Guerin C, Rothmore P. The emerging workforce of international university student workers: injury experience in an Australian university. Int J Environ Res Public Health. 2018;15:456, http://dx.doi.org/10.3390/ijerph15030456.
8. Pratama AK. Hubungan Karakteristik Pekerja dengan Unsafe Action Pada Tenaga Kerja Bongkar Muat di PT, Terminal Petikemas Surabaya. Indones J Occup Saf Heal. 2015;4.
9. Panjaitan SSU, Silalahi MI. Pengaruh Unsafe Action Terhadap Kecelakaan Kerja pada Pekerja Konstruksi di PT. DAP Perumahan Citra Land Bagya City Kota Medan. J Prima Mediak Sains. 2019;1.
10. Sah DP, Chaudhary S, Shakya R, Mishra AK. Occupational accidents in cement industries of Nepal. J Adv Res Altern Energy, Environ Ecol. 2019;6:22–8.
11. Ighravwe DE, Oke SA, Adebiyi KA. A reliability-based maintenance technicians' workloads optimisation model with stochastic consideration. J Ind Eng Int. 2016;12:171–83, http://dx.doi.org/10.1007/s40092-015-0134-6.