Analyzing Relationship between Safety Climate and Safety Leadership in a Phosphoric Acid Industry

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ABSTRACT

Introduction: Safety-based leadership style has a positive relationship with the workplace safety climate in a company. Transactional leadership has a direct positive relationship with work safety participation and has an indirect relationship with work safety climate. In a phosphoric acid industry especially in 2019, the achievement of sulfuric acid production decreased from 2019 to 2020. The gap range was caused by leadership factors. This study has an objective to analyze the overview of safety climate based on safety leadership in the phosphoric acid industry. **Methods:** This research used a cross-sectional quantitative survey. The respondents comprised of 44 personnel. The independent factors in this investigation were the dimensions of leadership style and the dependent variable in this study wasthe condition of the work safety climate in each work group in the creation unit. The analysis used NOSACQ-50 radar plot analysis. **Results:** Of all perceptions of consideration leadership style, eitherin the high, very high, or enough categories, the dimension of work safety justice had the lowest score. The highest dimension of work safety climate was in the dimension of management safety priority and ability, especially in the perception of a high and very high initiating structure leadership style. **Conclusion:** A very high perception of the consideration leadership style had a work safety climate that had a higher score when compared to the high and sufficient perception. The highest dimension of work safety climate was in the dimensions of management safety priority and ability, especially in the perception of a high and very high initiating structure leadership style.

Keywords: radar plot, phosphoric acid industry, safety climate, safety leadership style

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INTRODUCTION

The implementation of occupational safety programs is important because, according to the International Labor Organization (ILO), in non-fatal work accidents, there are 374 million work accidents every year. This is equivalent to more than one million people who experience work accidents every day, so workers lose approximately four days of working time (International Labour Organization, 2020). In terms of productivity, the number of workdays lost due to workplace accidents in Canada exceeds the number of workdays lost due to labor demonstrations (Asia Pacific Foundation of Canada, 2021).

According to data of the Global Wellness Institute (2020), losses caused by work accidents amounted to 250 billion dollars and 550 billion dollars in the case of workers with disabilities. Globally, the economic cost of occupational diseases and accidents is estimated to be between 1.8%-6.0% of GDP in various countries, or at least $3 trillion worldwide. In Indonesia, regarding the number of work-related accidents and claims granted by BPJS Employment Annual Report 2017, the payment for the Work Accident Insurance Program guarantee was Rp. 971,953 millions or 101.94% of the target of Rp. 953,422 millions. The work accident insurance fee was paid to 123,040 total work accident cases in Indonesia. The increase in payment for the JKK program guarantee in 2017 was 16.71% compared to its realization in 2016.

Meanwhile, in 2018, the cost incurred by the Employment Insurance and Social Security System in overcoming work accidents in 2018 was Rp1,226 billion with a total of 173,415 work accidents (Employment Insurance and Social Security System, 2018).

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The implementation of occupational safety programs is important because, according to the International Labor Organization (ILO), around 600,000 lives can be saved annually if companies implement occupational safety systems and programs. In fact, global estimates in 2017 found 2.78 million fatal accidents and illnesses and 7,600 work-related deaths every day worldwide (Tompa *et al*., 2019).

Indonesia, as a member country of the ILO, has implemented the Decent Work Agenda through the Strategic Plan of the Ministry of Manpower in companies. This commitment is reinforced by the inclusion of occupational health and safety aspects in the Ministry of Manpower's 2016-2021 Medium-Term Development Plan as stipulated in the Ministry of Manpower Regulation Number 27 of 2016 concerning the 2016-2021 Ministry of Manpower's Medium-Term Development Plan. In that document, health and safety aspects are proclaimed in the main targets, namely creating a safe and healthy workplace by increasing and improving K3 regulations, improving OHS programs, and improving OHS services in companies to be one of the strategies and directions of government policies in accordance with the Medium-Term Development Plan 2015-2020 (Ministry of Manpower Indonesia, 2018).

Regarding this issue, safety-based leadership style is known to have a positive relationship with the workplace safety climate in the company. Reviewing further, according to Becher (2016) transactional leadership had a direct positive relationship to work safety participation and had an indirect relationship to work safety climate. After reviewing previous research on leadership style and work safety climate, research on the relationship between leadership style and work safety climate needs to be carried out in order to identify factors influencing the incidence of work accidents in the company.

In this phosphoric acid industry, the majority of workers are men, and they work eight hours a day. The core issues faced by this industry are there are still plenty of unsafe actions and unsafe conditions that can lead to any near misses and accidents in the workplace. This phosphoric acid industry has implemented several occupational health and safety programs such as training and education to every supervisor in every plant. However, the contents that are given to the workers, especially supervisors, are technical topics with a few managerial topics that are related to safety leadership and safety climate.

The production of sulfuric acid was 545,906 MTPY, phosphoric acid was 116,111 MTPY, and purified gypsum was 426,361 MTPY, especially in 2019. In 2020, the performance data for the production of sulfuric acid was 591,695 MTPY, the capacity of phosphoric acid production was 113,798 MTPY and purified gypsum production capacity was 481,811 MTPY. Based on the annual achievement target data or the production capacity of the factory each year, when compared to the production achievement in 2019 and 2020, there was a fairly large gap between the production target and the production achievement, especially at the phosphoric acid plant. The gap range is caused by several influencing factors, starting from weather factors and wind direction, leadership factors, management, to the work safety climate at the phosphoric acid plant. In order to improve the gap between production target and actual performance, this research focuses on improving the plant's work safety climate and reducing work accidents. Therefore, this study has an objective to analyze the overview of safety climate based on safety leadership in this phosphoric acid industry.

METHODS

This research investigation utilized an exploration of configuration utilizing a cross-sectional quantitative examination technique. This examination has also passed the ethical assessment with the ethical clearance number 240/HRECC.FODM/V/2021. This examination focused on discovering the overview of safety climate dimensions based on safety leadership style dimensions. The number of respondents in this study was 44 laborers at the phosphoric corrosive plant of the phosphoric acid industry. The respondents comprised of 32 administrators, 8 foremen, and 4 directors who took part in this research on May 2021. The independent factors in this investigation were the components of leadership style as indicated by The Ohio State Studies (Leader-Behavior Description Questionnaire) which comprised of consideration (the pioneer's relationship with his members) and the initiating structure (the job of the innovator in accomplishing the objectives). Besides, the dependent variable in this study was the condition of the work safety climate in each work group in the creation unit.

The primary data were obtained from a survey, which was rounded out autonomously by the

laborers. This aimed to decide the administration style as indicated by the Ohio State Studies utilizing a Leader Behavior Description Questionnaire that also determined the authority style impression of each specialist. Every leadership style was determined by including the scores acquired for every style. Every style was classified into fair, high, and very high. The classifications utilized the standard deviation and mean of each measurement (Russell, Stogdill and Coons, 2015).

Moreover, the instrument regarding the assessment of work safety climate was analysed based on the Nordic Occupational Safety Climate Questionnaire (NOSACQ-50) that was developed by The National Research Center for the Working Environment. Each dimension of work safety climate was calculated by adding up the scores obtained in each dimension. This was done to determine the level of work safety climate in each dimension (Kines *et al*., 2011). Finally, an analysis of the relationship between each leadership dimension and the dimensions of work safety climate was carried out. Furthermore, the sequence of data analysis was carried out with a normality test which was then tested using the NOSAQC-50 radar plot test.

RESULTS

The descriptive analysis was utilized to depict the authority styles and the wellbeing of work environment in the phosphoric corrosive plant of the phosphoric acid industry. The depiction is illustrated in Table 1 below. Table 1 portrays the recurrence of every initiative style and every security environment measurement.

The Distribution of Leadership Style

The attributes of the safety leadership style are depicted in several sub-areas. The leadership styles that are portrayed include the consideration and initiating structure, as displayed in Table 1.

Based on Table 1, it can be seen that the leadership style seen from the consideration measurement for the most part showed an extremely high relationship, accounting for 47.7%, while the remaining 25% felt that the leadership style was adequate and 27.3% felt that the leadership style was in the high category. Meanwhile, in the initiating

Table 1. The Distribution of Leadership Style Dimensions in the Phosphoric Acid Plant on May 2021

Variable	Frequency	Percent
Consideration		
Fair	11	25.0%
High	12	27.3%
Very High	21	47.7%
Initiating Structure		
Fair	8	18.2%
High	21	47.7%
Very High	15	34.1%

Table 2. Distribution of Work Safety Climate Dimensions in the Phosphoric Acid Plant on May 2021

Variable	Frequency	Percentage
Management Safety Priority and Ability		
Low	3	6.8%
Fairly Low	1	2.3%
Fairly Good	15	34.1%
Good	25	56.8%
Worker Safety Commitment		
Low	1	2.3%
Fairly Low	9	20.5%
Fairly Good	19	43.2%
Good	15	34.0%
Peer Safety Communication, Learning, and Innovation		
Low	6	13.6%
Fairly Low	2	4.6%
Fairly Good	18	40.9%
Good	18	40.9%
Management Safety Justice		
Low	1	2.3%
Fairly Low	7	15.9%
Fairly Good	16	36.5%
Good	20	45.3%
Workers' Trust in The Efficacy of Safety Systems		
Low	1	2.3%
Fairly Low	6	13.6%
Fairly Good	15	34.1%
Good	22	50.0%
Workers' Safety Priority and –Unacceptable Risks		
Low	8	18.2%
Fairly Low	16	36.4%
Fairly Good	18	40.9%
Good	2	4.5%
Workers' Safety Empowerment		
Low	2	4.5%
Fairly Low	7	15.9%
Fairly Good	16	36.4%
Good	19	43.2%

structure measurement the leadership style was mostly in the high category, shown by a high level of 47.7%, 34.1% was in the very high category and the least was in the fair category with only 18.2%.

The Distribution of Work Safety Climate

The characteristics of work safety climate include the management safety priority and ability; worker safety commitment; peer safety communication, learning, and innovation; management safety justice; workers' trust in the efficacy of safety systems; workers' safety priority and risk non – acceptance; and workers' safety empowerment, as shown in Table 2.

Table 2 shows that dominantly the work management safety priority and ability was good with a percentage of 56.8%, and the lowest rate was in the fairly low category with a percentage of only 2.3%. Work safety climate, especially in the dimension of worker safety commitment showed that the highest rate was fairly in the good category with a percentage of 43.2%, and the lowest rate was in the low category with a percentage of only 2.3%. In addition, the work safety climate in the dimension of peer safety communication, learning, and innovation was mostly in the fairly good and good categories, sharing a similar percentage of 40.9%, and the lowest rate was in the fairly low category with a percentage of only 4.6%.

Moreover, regarding the safety justice dimension, the highest rate was in the good category with a percentage of 45.5%, and the lowest rate was in the bad category with a percentage of only 2.3%. Meanwhile, in the dimension of workers' trust in the efficacy of safety systems the highest rate was in the good category with a percentage of 50%, and the lowest rate was in the bad category with a percentage of only 2.3%. Moreover, the work safety climate on the dimension of workers' safety priority and unacceptable risks showed that the highest rate was in the fairly good category with a percentage of 40.9%, and the lowest rate was in the good category with a percentage of only 4.5%. Lastly, the dimension of workers' safety empowerment showed that the highest rate was in the good category with a percentage of 43.2%, and the lowest rate was in the low category with a percentage of only 4.5%.

The Overview of Work Safety Climate Using a Radar Plot

Through the radar plot (Figure 1), it can be seen that each dimension of the work safety climate was categorized as fairly good to good. Companies can improve and maintain a work safety climate, especially on dimensions that achieved a score above 3.30, specifically on the dimensions with the highest score, which is the dimension of management safety priority and ability in the workplace. Meanwhile, the dimension of work safety climate still had a fairly good score, in the dimensions of management safety justice; worker safety commitment; peer safety communication, learning and innovation; management safety justice; workers' safety priority and unacceptable risks; workers' trust in the efficacy of safety systems; and workers' safety empowerment. Thus, these dimensions need to be improved so that it can be aligned with the other dimensions so as to achieve good work safety climate in all dimensions.

The Differences of Work Safety Climate Dimensions in the Consideration Leadership Style Using a Radar Plot

The radar plot (Figure 2) and the tables 3 show that a very high perception of the consideration leadership style had a work safety climate that had a higher score when compared to the high and sufficient perception. Although the score for each dimension of work safety climate did not have a significant difference between very high, high, and enough leadership styles, some improvement certainly needs to be done, especially in the

Table 3. The Differences of Work Safety Climate Dimensions in the Consideration Leadership Style in the Phosphoric Acid Industry, May 2021

Work Safety Climate	Consideration		
	Enough	High	Very High
Management Safety Priority and Ability	3.246	3.278	3.288
Worker Safety Commitment	3.107	3.126	3.128
Peer Safety Communication, Learning, and Innovation	3.1214	3.122	3.132
Management Safety Justice	3.103	3.112	3.115
Workers' Trust in the Efficacy of Safety Systems	3.118	3.144	3.157
Workers' Safety Priority and –Unacceptable Risks	3.195	3.202	3.203
Workers' Safety Empowerment	3.213	3.216	3.230

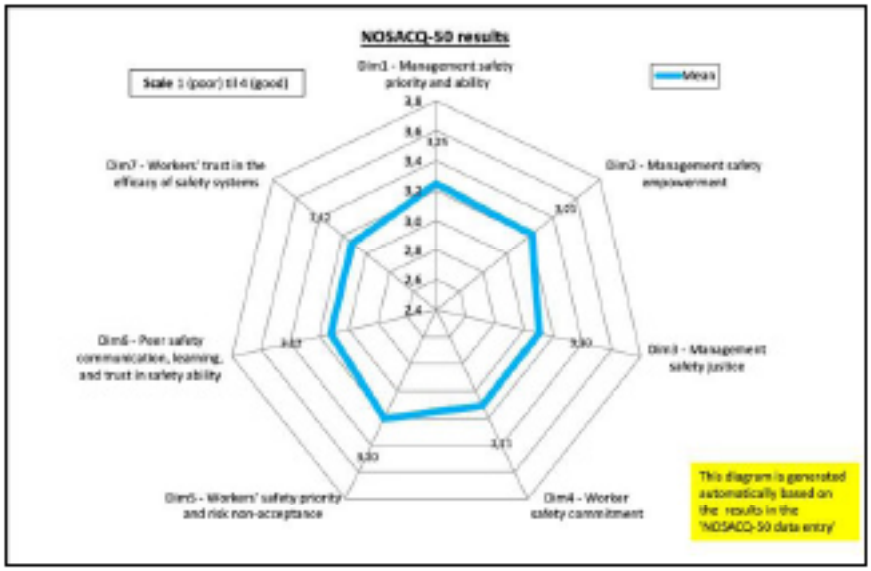

Figure 1. Safety Climate using a Radar Plot in the Phosphoric Acid Industry, May 2021

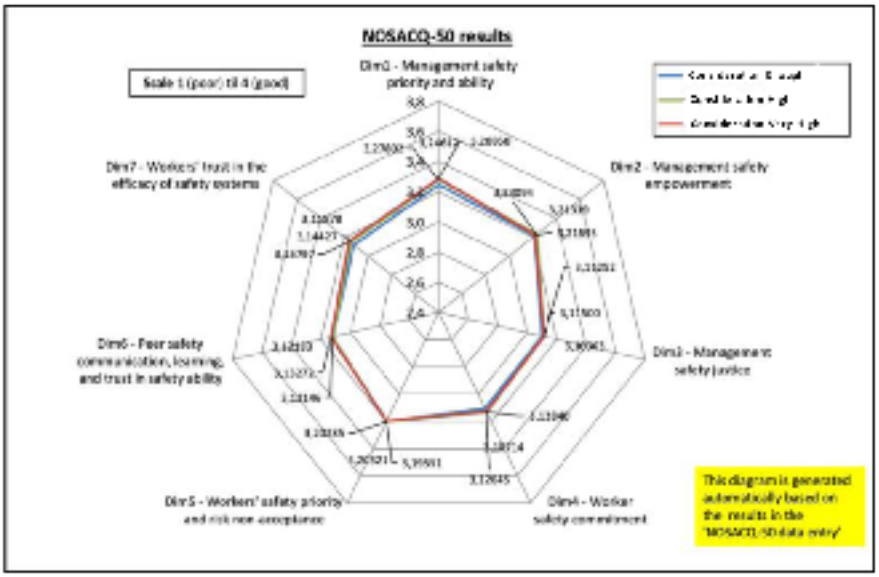

Figure 2. The Differences of Work Safety Climate Dimensions in the Consideration Leadership Style in the Phosphoric Acid Industry, May 2021

dimension of management safety justice. This is because in this dimension either in the perception categories of enough, high, and very high, the score was the lowest. Thus, it is necessary to take action to improve this dimension.

The Differences of Work Safety Climate Dimensions in the Initiating Structure Leadership Style Using a Radar Plot

The radar plot shows (Fugure 3) that the perception of the initiating structure leadership style was sufficient to describe a bad work safety climate. Meanwhile, the perception of the initiating structure leadership style was mostly in the high and very high categories, describing good work safety climate in each dimension.

The highest dimension of work safety climate was in the dimension of management safety priority and ability, specifically in the perception of a high and very high initiating structure leadership style. Meanwhile, the initiating structure leadership style with the highest score in the enough category was in the dimension of workers' safety empowerment.

However, although the dimension of the initiating structure leadership style was mostly in the high and very high categories, there were still

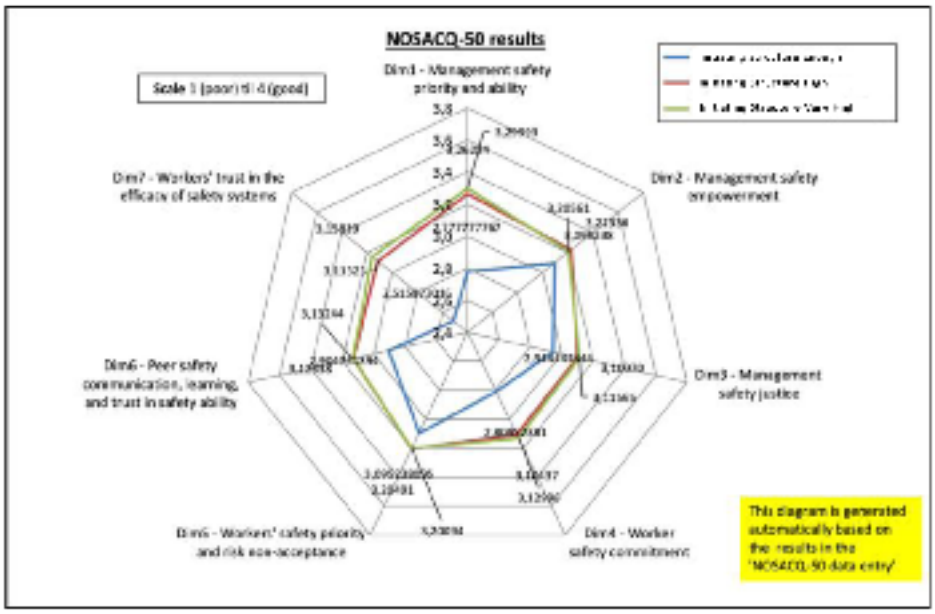

Figure 3. The Differences of Work Safety Climate Dimension in the Initiating Structure Leadership Style in the Phosphoric Acid Industry, May 2021

Table 4. The Differences of Work Safety Climate Dimensions in the Initiating Structure Leadership Style in the Phosphoric Acid Industry, May 2021

Work Safety Climate	Initiating Structure		
	Enough	High	Very High
Management Safety Priority and Ability	2.777	3.262	3.299
Worker Safety Commitment	2.809	3.104	3.109
Peer Safety Communication, Learning, and Innovation	2.905	3.126	3.132
Management Safety Justice	2.944	3.100	3.115
Workers' Trust in the Efficacy of Safety Systems	2.515	3.113	3.158
Workers' Safety Priority and –Unacceptable Risks	3.095	3.200	3.204
Workers' Safety Empowerment	3.095	3.205	3.223

dimensions that need some improvement, namely the dimension of management safety justice and worker safety commitment. In the dimension of management safety justice, intervention can be carried out in the form of management and leaders ensuring to provide work safety and equal safety treatment and not discriminating between one worker and another.

DISCUSSION

The Distribution of Leadership Style

Most of the leadership styles from the consideration dimension (the leader's relationship with his members) were in the very high category. The leadership style from the initiating structure dimension (the role of the leader in achieving the goals) was mostly in the high category. Considerations contributing in the high level can indicate that the leaders perform good interpersonal skills on workers (Rahayu, Musadieq and Prasetya, 2017). Moreover, the very high level of consideration also will affect the performance of safety climate (Zhu *et al*., 2018). Meanwhile, the high level of initiating structure also indicates that the leaders give good understanding on work rule and safety. The initiating structure dimension can also contribute to safety climate among workers (Shen *et al*., 2017).

The Distribution of Work Safety Climate

According to the data that were been obtained in this research, there were several dimensions of work safety climate that had varying categories (Silvia, Ihsan and Rizky, 2020). The dimensions of the occupational safety climate, which tend to have good categories, were the management safety

priority and ability; peer safety communication, learning, and innovation; management safety justice; workers' trust in the efficacy of safety systems; workers' safety priority and unacceptable risks; and workers' safety empowerment. However, the work safety climate still ranks fairly well in terms of the dimensions of occupational safety obligations. The dimension of the priority dimension will have a good level if the company itself has the regulations on safety climate (Syahrial, 2017). The dimension of peer safety communication, learning, and innovation can also has a good level when the company has programs to boost the worker performance through training (Oah, Na and Moon, 2018).

The Overview of Work Safety Climate Using a Radar Plot

According to Cooper (2016), the intervention that can be done to develop work safety climate on the dimension of management safety priority and ability in the workplace is to redevelop the role of management in paying attention to the work safety climate. This should be done not only by the management, such as in the production unit, but also by the overall management to top management where all of them must prioritize the work safety climate in the workplace, especially in the phosphoric acid plant. In addition, in an effort to provide improvement and development on these dimensions, it is also necessary to have a direct and periodic leadership role (Silvia, Ihsan and Rizky, 2020).

Furthermore, improving the work safety climate on the dimension of management safety justice, workers' safety priority and unacceptable risks, and worker safety commitment can be done by implementing several methods recommended by Brooks (2017), namely by providing leadership training to leaders at the bottom level, especially to the four leaders who are responsible for each work group in the phosphoric acid plant. It is hoped that this leadership training will be able to provide leaders with the ability to provide a fair working safety climate for each of their members and increase member commitment so that workers can prioritize their safety in every work process they do, especially during the production process (Jafari *et al*., 2017). Leaders must also improve their relationships with members and must clearly provide information related to work safety goals to each of their members so that the three dimensions of the work safety climate can improve (Handayani, Musadieq and Prasetya, 2015).

In addition, on the dimensions of peer safety communication, learning, and innovation; workers' safety empowerment; and workers' trust in the efficacy of safety systems can be done by providing training in the form of occupational health and safety communication. This training is not only given to individual leaders but can also be given to all members (Khasanah and Kholil, 2019). Training can also be done by g training to leaders, and it is hoped that each leader can later provide and distribute occupational health and safety knowledge to each of his members without exception (Rahayu, Musadieq and Prasetya, 2017). In addition, the implementation of a hearing program can be carried out to provide input and gather innovations related to appropriate work safety programs for workers, especially in the phosphoric acid plant. Thus, the existence of this program can increase the dimensions of the work safety climate in the dimensions of the dimensions of learning, work safety communication, and innovation; Empowerment of work safety; And confidence in work safety capabilities (Lu *et al*., 2019).

The Differences of Work Safety Climate Dimension in the Consideration Leadership Style Using a Radar Plot

The scores for each element of work safety climate did not have a huge difference between very high, high, and enough leadership styles, and there surely should be some improvement, particularly in the dimension of management safety justice. This is because regardless of whether the impression of authority style was in the high, very high, and enough categories, the components of work safety justice had the lowest score. Subsequently, it is important to take action to improve this dimension.

Interventions that can be done to increase the level of this dimension to be in a good category are management and leaders should provide work safety and equal safety treatment and not discriminate between one worker and another (Becher, 2016). This can be done starting from the earliest work safety programs such as providing safety induction, formulating hazard identification, doing risk assessment, and determining control (HIRADC), formulating Job Safety Analysis (JSA), reporting and investigation. It is better to conduct all work safety programs by involving all workers, so that

workers feel they have all aspects of work safety when they work (Tappura, 2020).

Furthermore, at all levels of the considerationleadership style, there were dimensions of work safety climate that need to be improved, namely the dimensions of learning, work safety communication, and innovation (Fargnoli and Lombardi, 2020). This can be done by providing safety representative training, namely providing training related to occupational safety and health starting from work safety communication, socialization of work safety procedures, emergency response, fire prevention and control, housekeeping, behavior based safety, and so on.

Furthermore, in relation to management safety justice, the provision of the training can be given equally to all workers. Training can be carried out periodically and alternately and what needs to be considered is that training is carried out repeatedly, so that the work safety climate can be attached to all workers.

Furthermore, this dimension can also be improved by management providing consistent feedback related to work safety aspects, conducting and improving work safety communication, and taking corrective actions in order to follow up on incidents related to work safety (Cooper, 2016).

The training carried out is not only training related to work safety, but can also leadership style training, especially the consideration leadership style. This is sought to hone the interpersonal skills of leaders, especially in dealing with the work safety climate in their work groups. In addition, by conducting this leadership training, of course, it can increase the perception of the consideration leadership style. In addition to conducting training, innovation can also be carried out by conducting periodic assessments of perceptions of leadership style and work safety climate. This assessment is carried out as a form of surveillance of the perceived state of leadership style and work safety climate in the workplace. Thus, if a work safety program is formulated, the program can be targeted and effectively improve the work safety climate for workers (Bazzoli *et al*., 2020).

The Differences of Work Safety Climate Dimension on the Initiating Structure Leadership Style Using a Radar Plot

According to Cooper (2016), work safety justice can be done by minimizing the behavior of blaming someone involved in a work accident and taking action as fairly as possible, especially related to work safety violations. In addition, PT. X can consistently disseminate work accident investigation procedures as well as good and correct near miss and work accident reporting so that no workers feel they are being treated unfairly. In addition, the validity of the reports provided can be easily identified and maintain the confidentiality of the reporter. This intervention can be applied to support workers to be more active in reporting potentially hazardous events, so that they can be quickly and accurately corrected.

In addition to making improvements to the dimension of the work safety climate, especially the dimension of management safety justice, it is necessary to increase the dimension of worker safety commitment. In this dimension, efforts can be made by increasing support and interaction with groups of workers related to the work safety climate (Kines *et al*., 2011).

In addition, efforts to increase the dimension of worker safety commitment can be made by conducting personal risk tools or conducting a pre-start risk assessment to increase worker safety awareness before starting work (Eskandari *et al*., 2017). This activity is carried out by assessing possible hazards and formulating possible prevention and countermeasures to be carried out. This industry has implemented a HIRADC and JSA analysis before each work is carried out, so this effort can be one of the initial efforts in increasing the dimension of worker safety commitments. Furthermore, the HIRADC and JSA analysis efforts are expected not only to fulfill work procedures, but also to be thoroughly understood by workers who will carry out the work. In addition, the provision of safety induction that is more specific to workers who work in each job can be done as an effort to increase the dimension of worker safety commitment. Safety induction that is specific to the worker's job must be easily understood by workers and actually carried out by workers when doing work in the field.

Monitoring and supervision provided by the leader of the work group also needs to be carried out periodically to ensure the commitment to safety of workers. Monitoring can be done by assessing the perception of the workers' work safety climate (Oah, Na and Moon, 2018). Thus, appropriate treatment can be given by leaders to improve the work safety climate in the workplace. Furthermore, training, especially leadership training, can also be given to each group leader so that the leader can provide a

clear picture to workers regarding the safety goals to be achieved along with the mission to achieve them.

CONCLUSION

All dimensions of the workplace safety climate were rated from fairly good to good. Most of the leadership styles of the consideration dimension (the relationship of the leader with his members) were in the very high category. Meanwhile, the leadership style of the initiating structure dimension (the manager's role in achieving the goals) was mostly in the high category. A very high perception of the consideration leadership style had a work safety climate that has had a higher score when compared to the high and sufficient perception. The higher the level of leadership style, the higher the level of work safety climate in this phosphoric industry.

The research results can be beneficial for the industry, especially any phosphoric acid industries as a reference in early detection of safety climate levels in the workplace. Therefore, the near misses that will lead to injuries can be prevented and regulated by monitoring the safety leadership style and safety climate.

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