

Occupational Health and Safety Management System in Wastewater Treatment Plant Workers'

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Abstract

Based on its type, this research is explanatory research which aims to analyze occupational health and safety and its impact on the occupational health and safety management system (OHSMS). There are 103 workers' used as samples. The partial least squares (PLS-SEM) analysis with SmartPLS 3.0 software can be informs that occupational health can be improve OHSMS, because workers feel their health is guaranteed by the health insurance provided by the company. Respondents' assessment of indicators of equipment condition is seen as meeting the standard and can be used in work with the support of the senses possessed by workers, besides that the staying power shown by workers is in the high category so that it supports the implementation of work. The better the implementation of work safety at the site, the better the implementation of OHSMS. The management of Losari Wastewater Treatment Plant (WWTP) is fully committed to the protection of assets and work environment and workers. Protection for workers is intended so that workers carry out their duties safely. The work equipment used in work is in good condition, so as to guarantee security and safety at work so as not to cause work accidents and work productivity is maintained.

Keywords: Health, safety, wastewater management system

INTRODUCTION

The Republic of Indonesia law Number 24 of 2011 places the Social Security Administering Body as the center for administering social security programs to replace a number of social security institutions in Indonesia, such as health insurance insurance institutions and workers' social security. This change has an impact on the orientation of the services provided, for employment it is carried out through BPJS Ketenagakerjaan

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and for health it is carried out through BPJS Kesehatan. In practice, this institution is responsible to the President. Referring to the data, it is shown that if the number of work accidents that have occurred in Indonesia is recorded, for 2021 there will be 234,270 work accident cases, this number has increased compared to 2020 which amounted to 221,740 work accident cases or an increase = 5.65% and the majority occurred at locations work (field/project) in the morning until noon (06.00 - 12.00). (Hartati, 2015; <https://dataindonesia, 2022>).

Currently one of the major projects under construction in Makassar City is the Losari Wastewater Treatment Plant (IPAL), which was built by the Ministry of Public Works and Public Housing (PUPR) through the Metropolitan Sanitation Management Investment Project (MSMIP) Program. The Losari WWTP project development aims to maintain the quality of groundwater and raw water, create a clean and healthy environment, as well as a means of education to increase public awareness of the issue of environmental pollution in Makassar City. Wastewater originating from household waste in the form of liquid waste from household water discharge (bathing, washing and toilets) is channeled to the WWTP through the installation of a water pipe network that is directly connected to houses in 5 (five) sub-districts (Tamalate, Mamajang, Mariso, Makassar, and Ujung Pandang District).

The technology used to process household waste is the Moving Bed Biofilm Reactor (MBBR). This technology uses polyethylene biofilm which is very effective in reducing the oxygen content of water decomposing bacteria (Biological Oxygen Demand), nitrifying and removing nitrogen so that the resulting effluent can meet quality standards as stipulated in the Regulation of the Minister of Environment Number P. 68/MenLHK/Sekjen /Kum.1/8/2016 regarding domestic wastewater quality standards. The construction of a Wastewater Management Installation in Makassar City will begin on 25 November 2020 and is planned for 12 February 2023, using $\pm$ 615 workers, 78% of whom are field workers, the rest are administrative staff. During the implementation of this project, there were work accidents that occurred. From the start until mid-2022 there have been 490 cases of work accidents and 20% of them suffered minor injuries, 12.5% were seriously injured and 6% experienced physical disabilities and $\pm$ 3% of them ended in death. This figure shows that work accidents are still relatively low. However, the factors underlying work accidents are an interesting issue to analyze so that the practice of occupational safety and health management in the completion of work in the field can be improved in a better direction (minimizing accidents and focusing on worker safety).



Occupational safety and occupational health is an effort to guarantee and maintain the health and physical and spiritual integrity of the workforce towards a just and prosperous society (Mangkunegara, 2009: 123). Occupational safety and health is one of the maintenance programs whose application is mandatory for companies. The implementation of work safety and occupational health programs for employees is very important because it aims to create a safety system and work unit by involving elements of management, workforce, working conditions and environment that are integrated in order to reduce accidents. Health and work safety issues are not solely the responsibility of the government, but the responsibility of all parties, namely employers, workers and the community. Occupational safety and occupational health is the most important thing for the company, because the impact of occupational accidents and diseases not only harms workers, but also harms the company. Occupational safety is the protection of workers from injuries caused by work-related accidents (Mondy, 2008: 360). In another section, Mathias & Jakson (2007: 245) explain occupational health as a condition that refers to the physical, mental and emotional stability of workers in general.

The occupational safety and health management system is part of the overall management system for organizational structure, planning, responsibility, execution, execution, achievement, evaluation and maintenance of occupational safety and health policies in order to control risks related to work activities to achieve occupational safety and health (Pangkey et al., 2012). The effectiveness of occupational safety and health management is expected to create working conditions that are safe, guaranteed safety, reduce the rate of work accidents so as to create work efficiency in terms of manpower, time, costs and can improve the quality and productivity of workers.

Occupational safety and health management at the Losari WWTP carried out by several companies (PT. Waskita Karya, PT. Karaga, and PT. Adhi Karya) under the command of the Ministry of Public Works and Public Housing (Directorate General Cipta Karya) has been implemented and implemented as a form of protection of worker safety and health. The effectiveness of occupational safety and health management shows that the company guarantees the safety and health of every worker. Having a sense of security and calm at work will increase worker productivity. The effectiveness of occupational safety and health management can also form a safe, comfortable and adequate work environment, support work implementation, create a pleasant work atmosphere, and enable all workers to work more efficiently (Tanti Winarti, 2017). Occupational safety and health management in the Losari WWTP project consists of 4 (four) aspects, namely planning (*plan*), execution, evaluation and actions. The implementation of occupational

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safety and health management focuses on planning and implementing occupational safety and health, while evaluation and action on occupational safety and health has not been fully carried out, there is still a lack of awareness and compliance of workers, so it is very important to eliminate the causes of differences so that they do not recur or occur again. Corrective actions and changes are needed in the integrated management system through corrective actions on the environment and work safety.

The implementation of the tasks of the workers has consequences in the process of setting weekly, monthly, quarterly, semi-annually and annually work targets and in accordance with established standards. Occupational safety and health is the provision of protection to employees that is oriented towards the condition of workers

LITERATURE REVIEW

Occupational safety

Occupational Safety is safety in carrying out work related to machinery, aircraft, tools / work equipment, materials, processes, foundations, work environment, products and procedures for carrying out work on installation, transportation, storage, processing, construction, agriculture, mining , limited space, and others. Law of the Republic of Indonesia Number 1 of 1970 explains that every worker has the right to protection for their safety when doing work for welfare and increasing national production and physically and psychologically while in the work environment. Occupational safety and health aspects directly affect employee work effectiveness and affect production efficiency, thereby affecting the level of achievement of workers (Pertwi et al., 2016).productivity. Occupational safety is protection given to workers from injuries caused by work-related accidents (Mondy, 2008:82).

Occupational safety is a major part of health science and its practice which aims to ensure that workers or the working community obtain the highest degree of health both physically, mentally and socially with preventive and curative efforts against diseases/health problems caused by work and environmental factors as well as disease. public (Suma'mur, 2006:6). Occupational safety is safety related to machines, aircraft, work tools, materials and their processing, the foundation of the workplace and the environment and the ways of doing work. There are 3 (three) constructs used in analyzing work safety, namely; workplace environment, machines (equipment) and safety guarantees (Suma'mur, 2006:13).

Occupational health

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The concept of occupational health today is changing more and more, not just health in the industrial sector but also leading to health efforts for all people in doing their work (health of all at work). This issue is not only about the relationship between the effects of the work environment and health, but also the relationship between the health status of workers and their ability to carry out the tasks they have to do. The goal of occupational health is to prevent health problems from occurring rather than treating them (Harrington, 2005:81; Suma'mur, 2006:6). Occupational health can also be interpreted as a condition that refers to physical, mental and emotional stability in general. A healthy individual is an individual who is free from illness, injury and emotional mental problems that can interfere with work activities. Occupational health is an effort to guarantee and maintain the health and physical and spiritual integrity of workers, especially humans, towards a just and prosperous society. The constructs used in occupational health include; Sensory condition, Stamina, Emotions and health insurance program (Mangkunegara, 2009:123). In another section, Mathias & Jakson (2007: 245) explains that occupational health is a condition that refers to the physical, mental and emotional stability of workers in general.

Occupational health and safety management system (OHSMS)

The area of work safety in the world of engineering includes human involvement, both workers, clients and company owners. Elements responsible for safety and health in the work environment are contractors, managers, field supervisors, workers and subcontractors, as well as safety professionals (Goetsch, 2003). OHSMS literally consists of three syllables, namely safety, health, and work. Safety in English is called safety which means a state of being free from harm and near harm (Geotsch, 2003: 10). Health according to the Law of the Republic of Indonesia Number 36 of 2009 explains that occupational health is a state of health, both physically, mentally, spiritually and socially that allows everyone to live productively socially and economically. work in English is called work or occupation which means activity or effort to achieve goals (income and others) (Geotsch, 2003:12). Occupational safety is safety related to machines, aircraft, work tools, materials and processing, the foundation of the workplace and its environment and ways of doing work (Suma'mur, 2006:17).

The Republic of Indonesia law Number. 1 of 1970 in explaining that work safety has a scope related to machinery, the basis of the workplace and the work environment, as well as how to prevent accidents and work-related illnesses, providing protection for production sources so as to increase efficiency and productivity. Occupational safety is a

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specialization of health sciences and its practices that aim to ensure that workers or the working community obtain the highest degree of health both physically, mentally and socially with preventive and curative efforts against diseases/health problems caused by work and environmental factors as well as common diseases (Suma'mur, 2006:13).

The measurement of occupational safety and health management adopts the measurement used by Ichsan et al., (2022), which consists of 15 items as well as indicators, namely: (1) the company is responsible for work accidents, (2) the company takes steps in dealing with cases of illness due to work completion, (3) reports of violations of occupational safety and health (K3) are in accordance with the standard operating procedure (SOP) (4) the implementation of occupational safety and health (K3) is in accordance with the standard operating procedure (SOP), (5) the completion of the work program has been carried out in a professional and sustainable manner, (6) the completion of the work program has been effective and efficient according to targets and expectations, (7) training on occupational safety and health has been carried out routinely, (8) the completion of control measures the risk has been taken (for example, workers do not use personal protective equipment (PPE) or hazards in the workplace), (9) measuring environmental impact measures and monitoring are carried out routinely and periodically, (10) measurement and monitoring of environmental impact aspects are appropriate, (11) employees know and understand how to use personal protective equipment (PPE), (12) available personal protective equipment (PPE) is still suitable for use, (13) occupational safety and health tools are available and sufficient, (14) available occupational safety and health tools are in accordance with national standards , and (15) workers feel satisfied with the implementation of occupational safety and health (K3) in the company

METHODS

Occupational safety and health is the most important thing for the company, because the impact of occupational accidents and diseases is not only detrimental to workers, but also detrimental to the company. The type of research used based on research objectives is explanatory research, namely to determine the effect of the variables being analyzed. This study aims to explain the effect of two or more symptoms or variables, namely the effect of the independent variable (occupational safety and health) on the dependent variable (occupational safety and health management). This research uses a quantitative approach through *explanatory survey* is a research method that aims to determine the characteristics and explain the relationship between the

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variables studied using a number of samples (Cooper & Schindler, 2008). The collection of data used in this study is *cross section*, namely the collection of research data conducted at a certain time period. The unit of analysis in this study was 103 (one hundred and three) workers at the Losari Wastewater Treatment Plant (WWTP) project in Makassar City. Hypothesis testing with the support of partial least squares structural equation modeling (PLS-SEM) with SmartPLS 3.0 software

RESULT

Outer Model

The value of convergent validity can be seen based on the value of the factor loading or outer loading on the latent variable with its indicators. The outer loading value is good if the loading factor is > 0.7 and the average variance extracted (AVE) value is > 0.5 .

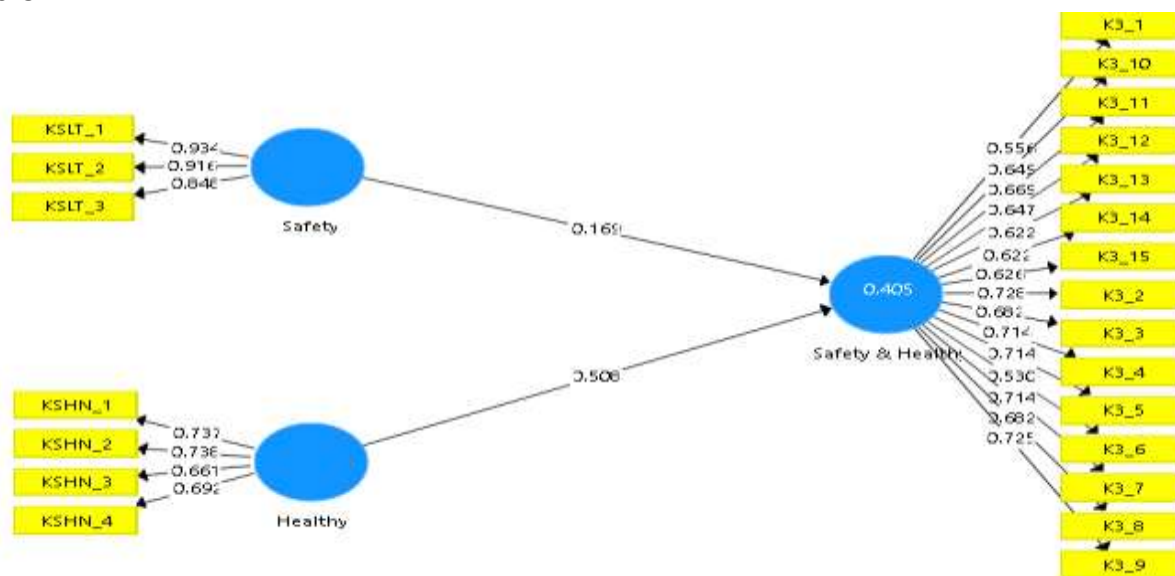


Figure 1: First Model

Figure 1. shows if there are still several indicators on the three variables, healthy, safety and OHSMS which show a loading factor value < 0.7 so that it must be removed from the model to obtain the desired results, so the test is carried out by removing the loading factor value whose value is < 0.7 then the data is processed again and for this it can be shown in the following figure:

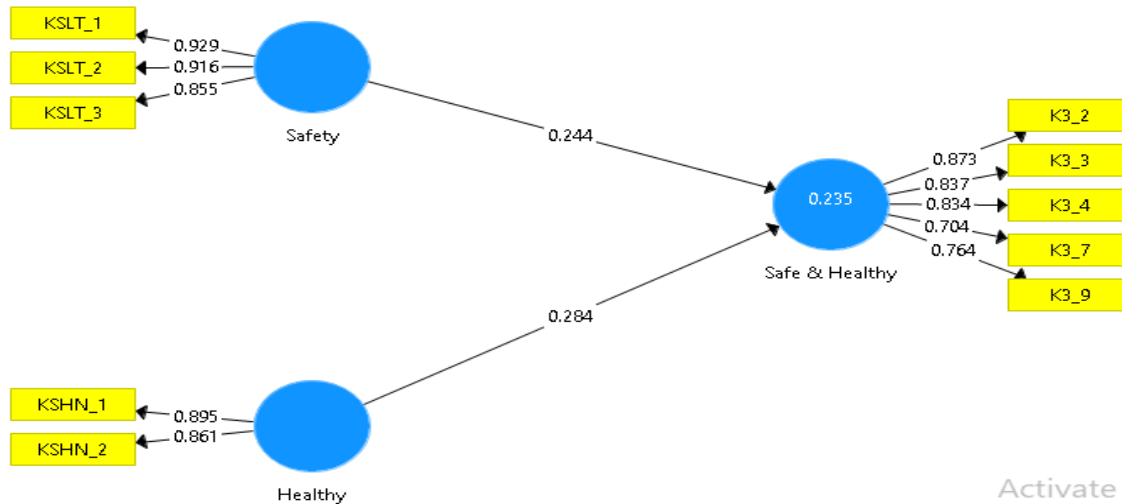


Figure 2: Final Model

The following are the results of outer loading and the AVE value referring to the final model, due to some constructs being considered not fulfilling (loading factor < 0.7). In the occupational safety and health management construct there are 10 indicators that have a loading factor value < 0.7 ; namely the company is responsible for work accidents (K3_1); violation reports on OHSMS are in accordance with the standard operating procedure (K3_3); the completion of the work program has been effective and efficient according to targets and expectations (K3_6); completion of risk control measures that have been carried out (such as employees not using personal protective equipment or hazards in the workplace) (K3_8); measurement and monitoring of environmental impact aspects are appropriate (K3_10); workers know and understand how to use personal protective equipment (K3_11); available personal protective equipment is still suitable for use (K3_12); the equipment used in OHSMS is available and sufficient (K3_13); equipment used in OHSMS according to national standards (K3_14); workers show a feeling of satisfaction with the implementation of OHSMS (K3_15).

Then in the occupational health construct there are 2 (two) indicators that have a loading factor value < 0.7 ; that is; emotions (KSHN_3) and the health insurance program (KSHN_4). Meanwhile for the work safety construct as measured by 3 (three) indicators, the whole meets $= > 0.7$. The results of the loading factor test that were fulfilled (> 0.7) can be shown in the following table:

Table 1. Final Model of Outer Loadings and AVE

Construct	Healthy	Safe & Healthy	Safety	AVE
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K3_2		0.873		0.648
K3_3		0.837		
K3_4		0.834		
K3_7		0.704		
K3_9		0.764		
KSHN_1	0.895			0.771
KSHN_2	0.861			
KSLT_1			0.929	0.812
KSLT_2			0.916	
KSLT_3			0.855	

Table 1. shows the average variance extracted from the OHSMS variable = 0.595, Healthyat work = 0.771 and Safety at work = 0.811. The three results have met the requirements that have been set, so that each variable has good composite reliability values alias construct variables used declared reliable.

Outer Model

R-squared value used to measure the degree of freedom variation by independent effect on whether the dependent have a substantive effect or not. The requirement is an R^2 value = 0.75 (means strong), $R^2 = 0.5$ (moderate), and 0.25 (weak), for it can be shown the results in the following table:

Table 2. R-square

Full model	R-square	R Square Adjusted	P Values
Safe & Healthy	0.271	0.256	0.000

Inner Model

The following is the inner model or structural model testing which can be explained that the goodness of fit test of the PLS (Partial Least Square) model can be seen from the values of the Standardized root Mean square Residual Model (SRMR). The PLS (Partial Least Square) model is declared to have fulfilled the goodness of fit model criteria if the SRMR value is <0.10 and the model is declared perfect fit if the SRMR value is <0.08

Tabel 3. Goodness of fit



GOF	Estimated Model
Saturated Model	0.048
Estimated Model	0.048

The goodness of fit results showed that the Standardized root mean square residual (SRMR) value of the PLS (Partial Least Square) model was 0.048. Because the model's SRMR value is <0.08 , this research model can be stated to be appropriate and feasible to use to test the hypothesis.

Hypothesis Testing

Hypothesis testing in this study shows that there are 2 (two) hypotheses being tested, the basic test uses a t-Statistics value > 1.96 (can be stated as proven/accepted) otherwise if the t-statistics value must be > 1.96 (then the hypothesis is declared rejected) . For that it can be shown as follows:

Table 4. Hypothesis

Causality	Original Sample (O)	T Statistics (O/STDEV)	P Values
Healthy -> Safe & Healthy	0.306	2.671	0.008
Safety -> Safe & Healthy	0.262	2.003	0.046

Healthy at work effect on occupational health and safety management system

The better the implementation of occupational health at the location (project), the better the implementation of OHSMS. This statement can be shown in the results of the partial least squares analysis with a t-statistics value $= 2,671 > 1.96$ as well as evidenced by a probability value $= 0.046 < 0.05$, that the application of occupational health at the site (project) has a significant positive effect on OHSMS. The problem of work accidents that often occurs today affects many high-rise building construction project workers or often referred to as high-rise buildings whose construction is mostly carried out in several big cities, such as the metropolis in Jakarta and other big cities in Indonesia. As there are many high-rise building construction projects, the higher the potential for work accidents,



the highest risk of work accidents is the construction of high-rise building projects, so it is necessary to concentrate on managing OHSMS (Djatkiko, 2016; Maria et al., 2017).

Personal protective equipment is protective equipment in minimizing the risk of work accidents that must be obeyed by employees to protect themselves from work accidents. According to some workers, personal protective equipment consists of various types of equipment that are considered comfortable and suitable for use. Workers understand how to use personal protective equipment. Some employees find the use of personal protective equipment inconvenient and time-consuming, and consider it unimportant. These conditions indicate that there is complete personal protective equipment and this situation indicates that the availability and adequacy of personal protective equipment is not the only factor affecting the implementation of OHSMS. There is a series of proper OHSMS management, such as training and implementation supervision, so that OHSMS is implemented properly and can support the productive workforce of employees. Thus, an effective OHSMS is needed to be able to increase employee productivity.

This study shows that occupational health has a significant positive effect on OHSMS. This study confirms that occupational health can be OHSMS, because workers feel their health is guaranteed by the health insurance provided by the company. The results of this study indicate that occupational health services are categorized in a very good category. Respondents' assessment of indicators of equipment condition is seen as meeting standards and can be used in work with the support of the senses possessed by workers, besides that the stamina shown by workers is in the high category so that it supports the implementation of work. This condition shows that the company pays full attention to the work tools and stamina of workers. In practice, the company does not provide special clinical facilities as a form of health service, but the company organizes partnerships with doctors and hospitals so that if something happens that can harm workers, then these conditions can be anticipated immediately. This was confirmed by the respondents that they did not experience any symptoms or respiratory problems due to their work in the open nature, besides that the workers received (provided) sufficient nutritious food to support their stamina at work.

The Republic of Indonesia Law Number 36 of 2009 related to health explains that health is a prosperous condition of body, soul and social that allows everyone to live productively both socially and economically which aims to implement healthy workforce strength, productivity, stable balance between work ability, workload and working environment conditions and protected from occupational diseases and work environment.



Occupational health according to Suma'mur has a medical nature and its purpose is the workforce (workers) which can be concluded that the health of the workforce is an integral part of productivity. Companies are required to regulate occupational health programs to maintain the health status of the workforce to maintain labor productivity. Efforts made by the company in creating occupational health include preventing physical health and mental disorders of workers while working. Treatment of diseases caused both at work and as a result of life in the worker's environment. Maintaining the health of workers to increase their productivity and prevent the consequences of bad work that can cause illness for workers.

Safety at work effect on occupational health and safety management system

The better the implementation of work safety at the site (project), the better the implementation of OHSMS. This statement can be shown in the results of the partial least squares analysis with valuest-statistics = $2.003 > 1.96$ is also proven by the probability value = $0.008 < 0.05$, that the implementation of safetywork on location (project) has a significant positive effect on OHSMS. The company in its implementation guarantees work safety. Losari WWTP management fully committed to the protection of employees, assets and work environment and workers, this is inseparable from the company's reputation and applicable laws and regulations which are demonstrated through a process of continuous improvement, implementation of measurable project work plans so as to ensure the safety, health and welfare of the personnel involved in all project activities. Protect assets and equipment to ensure the economic viability of the project. The company has been trying to improve the work safety of personnel with strong support from those in control of company decisions, so that the company continues to develop and continues to improve its quality management system, competence and skills of workers so that they can compete, so that they can make a high contribution to projects.

Preventive steps have also been taken in the project such as increasing the effectiveness of work safety in a planned, measurable, structured and integrated manner as well as preventing work accidents by involving: management, workforce/workers and trade unions (Noviandini et al., 2017). Zero accident is a condition which indicates that there has been no accident at work and resulted in the worker being temporarily unable to work for 2×24 hours (two days) which has an impact on process cessation and/or damage to equipment without loss of life where loss of work time is not beyond the next shift in a certain period of time and the number of hours worked by a certain person (Korneilis & Gunawan, 2018). Personal factors have a role in determining social



interaction in shaping individual behavior. Personal factors are one of the causes or factors that underlie accidents and come from humans or the workers themselves (Dwipayana, 2018).

The several personal factors that affect OHSMS, namely workload and fatigue at work because they have an impact on unsafe actions. Protection of work security experienced by workers both physically and mentally in the work environment. Protection for workers is intended so that workers carry out their duties safely. Findings in the field show evidence that the work equipment used in work is in good condition, so as to guarantee security and safety at work so as not to cause work accidents and work productivity is maintained. Work safety that is carried out properly can provide a safe and calm atmosphere at work. Procurement of equipment intended for prevention of help and protection becomes a determinant of work safety which then has an impact on reducing the incidence of accidents which are a source of illness, disability and death so that unnecessary costs can be minimized.

DISCUSSION

Occupational health has a significant positive effect on OHSMS. This study confirms that occupational health can be an occupational health and safety management system, because workers feel their health is guaranteed by the health insurance provided by the company. The results of this study indicate that occupational health services are categorized in a very good category. Respondents' assessment of indicators of equipment condition is seen as meeting standards and can be used in work with the support of the senses possessed by workers, besides that the stamina shown by workers is in the high category so that it supports the implementation of work. This condition shows that the company pays full attention to the work tools and stamina of workers. The better the implementation of work safety at the site (project), the better the implementation of OHSMS. The management of Losari WWTP is fully committed to the protection of employees, assets and work environment and workers, this is inseparable from the company's reputation and applicable laws and regulations which are demonstrated through a process of continuous improvement, implementation of measurable project work plans so as to ensure safety, health and the well-being of personnel involved in all activities throughout the project. Protect assets and equipment to ensure the economic viability of the project. The company has been trying to improve the work safety of personnel with strong support from those in control of company decisions, so that the company continues to develop and continues to improve the quality management system,

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competence and skills of workers so that they can compete, so that they can make a high contribution to the completion of a project.

Protection of work security experienced by workers both physically and mentally in the work environment. Protection for workers is intended so that workers carry out their duties safely. Findings in the field show evidence that the work equipment used in work is in good condition, so as to guarantee security and safety at work so as not to cause work accidents and work productivity is maintained. Work safety that is carried out properly can provide a safe and calm atmosphere at work. Procurement of equipment intended for prevention of help and protection becomes a determinant of work safety which then has an impact on reducing the incidence of accidents which are a source of illness, disability and death so that unnecessary costs can be minimized.

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