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Mitigation of Noise Influence to Improve Technician Performance in Technical Squadron 045 Roesmin Nurjadin Air Force Base

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A B S T R A C T

This study investigates the impact of noise on technician performance at Engineering Squadron 045 Roesmin Nurjadin Air Force Base and proposes effective mitigation strategies. Using a quantitative survey method supported by field observations and grounded in ergonomics theory, the research found that noise levels in key work areas exceeded recommended limits, resulting in decreased concentration, increased stress, and reduced work quality. To address these issues, the study recommends the use of personal protective equipment (PPE), improvements in workspace design, and adjustments to work schedules. These measures are expected to enhance both technician productivity and well-being, while promoting a safer and more conducive work environment.

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INTRODUCTION

Noise is one aspect of the work environment that has a significant impact on the performance, health, and safety of workers. In the context of the military environment, especially in the 045 Engineering Squadron of the Roesmin Nurjadin Air Force Base (Lanud Rsn), noise is an inevitability that cannot be avoided. The sources of noise in this environment are very diverse, ranging from aircraft engines, technical equipment, to various other operational activities. Technicians assigned to the 045 Engineering Squadron play a very vital role in the aircraft maintenance and repair process, so their performance greatly determines the overall smoothness of operations. The impact of excessive noise is very serious. High noise can trigger various health problems such as hearing loss, stress, and sleep disturbances. In addition, noise can also disrupt concentration, which directly affects the performance of technicians. Decreased concentration not only reduces productivity but also has the potential to compromise flight safety and reduce operational effectiveness. In situations where precision and speed are critical, these distractions can be fatal. Therefore, it is very important to proactively identify and address these sources of noise in the work environment.

Effective mitigation measures must be implemented immediately to improve the performance and well-being of the Technicians. This study, which examines the impact of noise and its mitigation strategies in the 045 Engineering Squadron, has great significance. Not only does it provide guidance for better management of the work environment, it also offers valuable contributions to the literature on human resource management and occupational health in the military context. The approach taken in this study involved quantitative surveys and field observations. Through the survey, data were collected from the technicians to get a clear picture of how noise affects them. Direct observation in the field allows researchers to understand the real conditions and evaluate the effectiveness of various existing mitigation measures. Thus, this study is not only theoretical but also practical and applicable.

The noise generated during the Running Engine of Hawk 109/209 and F-16 C/D fighter aircraft has various significant impacts on technicians working in the 045 Engineering Squadron. Based on the results of interviews with respondents, it is known that the noise directly disrupts their concentration while working. This causes a decrease in the quality of communication between colleagues, which in turn affects overall productivity. In addition, many technicians complain of often feeling tired or tired quickly due to continuous exposure to noise. Other effects include the emergence of prolonged headaches and increased levels of stress and anxiety. This noise also affects the quality of sleep of technicians, which is often disturbed, causing further health problems. No less important, hearing loss is one of the problems often experienced by technicians, with some of them reporting frequent ringing in the ears (tinnitus). Based on data from the dr. Sukirman Hospital, Lanud Rsn, the number of patients who underwent health checks with Ear, Nose and Throat (ENT) specialists included 5 people in 2021, 16 people in 2022 and 7 people in 2023, this shows a fluctuation in the number of technicians affected by noise who have had

their complaints checked. This phenomenon shows that the noise produced by fighter jets not only has an impact on physical health, but also on the mental well-being of technicians, which in turn can affect the overall operational performance of the 045 Engineering Squadron.

LITERATURE REVIEW

Noise as a work environment factor has been the subject of various studies in recent decades. These studies underline the negative impact of noise on worker health and performance. One of the previous studies that discusses noise is a study entitled Analysis of noise levels caused by airport activities and management efforts, a case study at Kualanamu International Airport, North Sumatra by Rachmi Layina Chimayati in 2017 stated that noise is quite problematic for the surrounding environment that directly receives the impact, namely workers. Some supporting theories for this study include the following:

Theory Noise

According to Tannady (2017:3) Noise is sound Which not wanted Because No in accordance with context room and time, so that it can cause disturbances to human comfort and health. Noise can disturb and damage human hearing. Noise is an unwanted sound. This noise is produced by a vibrating source, where the vibrations affect the surrounding air molecules, causing the molecules to vibrate as well. These vibrations then create waves of mechanical energy that propagate through the air medium in a longitudinal pattern. The impact of noise, like discomfort, disturbance communication, and decline performance Work, become problem health Which significant. Noise not only affects physiological components, such as brain structure and hearing organs, but is also influenced by psychological factors, where the sound is considered an unwanted stimulus.

Theory Level Noise

According to Wignjosoebroto (2003:4) explains that noise is an unwanted sound that disturbs human comfort. The effects of this noise are not only physical such as damage to the hearing aid, but also psychological, such as impaired concentration, anxiety, and stress. The importance of noise control in the work environment and daily life become highlight main in reduce impact negative effects of this noise. Noise measurement and management are important for maintaining individual health and well-being.

Table 1. Categorization level noise according to Wignjosoebroto (2003:4)

No	Condition Voice	Decibel (dB)
1	Deafening/Very tall	100- 120
2	Very Hustle and bustle Busy/High	80- 99
3	Strong/Medium Tall	60- 79
4	Calm/Not Tall	10- 59
5	Very calm/very No Tall	0- 9

Theory Impact noise

According to Smith (2017), noise can cause impaired concentration, decreased productivity, and increased stress levels. Basner et al. (2014) added that noise exposure Which prolonged can cause disturbance sleep and increase the risk of cardiovascular disease. In the context of the industry military, Berglund et a. (1996) show that noise from military equipment and machinery has a significant impact on personnel well-being. The study found that noise not only affects hearing, but also affects the psychological condition of personnel, including increased stress and mental fatigue. This is in line with the findings from McBride (2004), Which identify that Noise on military bases can reduce operational effectiveness and workplace safety.

Theory

Developed by Grandjean (1980) emphasizes the importance of designing a work environment that can improve worker efficiency and well-being. This theory is relevant in the context of noise mitigation, because a well-designed work environment can reduce exposure noise and increase technician performance. Besides That, theory This Also emphasize importance tool personal protective equipment (PPE) and appropriate work arrangements to minimize the impact of noise. According to Warisno, B. (2008) in the Basics of Ergonomics of Work System Design, prolonged noise in the work environment can affect worker performance and health as well as efficiency at work.

Theory Noise Mitigation

Noise mitigation is an effort to reduce or eliminate noise. impact negative noise to worker. According to Harris (1991). Noise mitigation can be done through three main approaches, namely the Engineering, Administrative, and Personal Approaches. This can be explained as follows:

Approach Technique

This approach involves modifications to the noise source, track transmission noise, And recipient noise. Harris (1991) identified several engineering strategies, such as noise reduction. voice, closing machine, and material absorber voice which can be used to reduce noise in the workplace. Research by Beranek (1993) shows that the use of material Which absorb voice in wall and ceilings can reduce noise levels significantly.

Approach Administrative

This approach includes work time arrangements and rotation. worker for minimize exposure noise. According to Suter (1992), good work schedule arrangements can reduce the time workers are exposed to high noise, thereby reducing the risk of hearing loss and stress. In addition, training and education about the dangers of noise and how to protect yourself are also important parts of this approach.

Approach Personal

This approach involves the use of PPE, such as earplugs and earmuffs, designed to protect workers' hearing. According to research by Rabinowitz (2000), use PPE Which appropriate can reduce noise impact to worker until 20-30 dB. According to Mr. Sukardi, K. (2003) important for control noise in work environment to maintain worker health and improve performance, Implementation of preventive measures, such as the use of Personal protective equipment (PPE) and work environment arrangements are essential to reduce the negative impacts of noise. However, the effectiveness of PPE is highly dependent on the suitability and compliance of workers.

Implications Mitigation Noise

Noise mitigation focuses not only on reducing noise levels, but also on improving worker performance and well-being. Research by Szalma and Hancock (2011) shows that a quieter work environment can improve cognitive performance, reduce errors, and increase productivity. Besides That, study by Melamed et al. (1992) found that noise reduction can reduce stress levels and increase job satisfaction. In the military environment, noise mitigation has broader implications, including improving operational safety and mission effectiveness. Research by Patterson et al. (2010) shows that controlled noise can improve communication and coordination between team members, which is critical in operations.

METHODOLOGY

This study uses a quantitative descriptive research design with approach survey and observation field. Design This chosen to get a comprehensive picture of the noise levels in the working environment of Engineering Squadron 045 and its impact on the performance and health of technicians.

Procedure Data collection

Data collection was conducted in two stages. First, noise measurements were conducted in various work areas in the Engineering squadron for one week. Measurements were made using a sound level device. meters that is 4 in 1 Multi Function Environment Meter CEM DT-8820 as well as done on O'clock Work peak for get data that maximum. Second, questionnaire shared to technician Which has been selected as sample. Filling questionnaire done in a way anonymous to ensure the honesty of respondents.

Figure 1. Sound level meters 4 in 1 Multi Function Environment Meter CEM DT-8820

Population And Sample

The population in this study were all technicians working at the 045 Engineering Squadron of the Roesmin Nurjadin Air Force Base. Samples were taken using the purposive sampling method, taking into account technicians who have at least one year of work experience. The number of samples taken was 30 technicians, which were considered representative to describe conditions in the field.

Instrument Study

According to Isni, N., & Rahayu, T. (2016) noise has an impact to level stress worker in environment industry, which is relevant to the relationship between noise and stress. The instruments used in this study included a questionnaire designed to measure technicians' perceptions of noise and its impact on performance and health. they. Questionnaire This consists of from question covered with scale Likert 5 points, start from "No Once, seldom, sometimes, often, very often", question This designed so appearance for get results Which expected from the Research by asking for input and direction from the Supervisor. The questionnaire data for the Technicians are as follows:

Table 2. Question Questionnaire to for Technicians

NO	QUESTION				
	Part I: Demographics Respondents				
1	How many long You has Work in environment RSN Air Base?				
	Part II: Impact Noise to Performance				
2	Whether You feel noise moment *Running Engine* aircraft combat bother and potential danger when you work?				
	a. Very often	b. Often	c. Sometimes	d. Rarely	e. Never
3	Whether You feel noise moment *Running Engine* aircraft combat bother concentration?				
	a. Very often	b. Often	c. Sometimes	d. Rarely	e. Never
	Part III: Impact Noise to Health				
4	Whether You feel noise increase stress at work?				
	a. Very often	b. Often	c. Sometimes	d. Rarely	e. Never
5	Whether You feel noise impact negative on sleep quality?				
	a. Very often	b. Often	c. Sometimes	d. Rarely	e. Never

Furthermore, data about degrees noise existing and using a sound level meter, including the following:

Table 3. Condition Existing Noise from Aircraft Hawk109/209 (Source: Hawk Technical Order PK 101B-44109-1A. 1998. Chap 5-00. Page 6)

NO	ROUND MACHINE	RPM	RADIUS	NOISE	INFORMATION
1	Round Idle	56 %	0 – 3 m	105 – 95 dB	
2	Round Maximum	104 %	0 – 3 m	130 – 110 dB	

The noise level of the F-16 C/D aircraft varies depending on on situation operational and distance measurement. During the implementation of the aircraft engine ground run during maintenance at the 045 Engineering Squadron, Rpm 75% used a sound level meter, namely the 4 in 1 Multi Function Environment Meter CEM DT-8820. That is as big as 100 - 130 dB on Radius 0 until 5 meters.

Analysis Data

The data obtained were analyzed comprehensively using descriptive statistical techniques to provide a clear picture of the level and distribution of noise in various work areas. Analysis This involving calculation average and standard deviation for describe pattern noise Which There is. Besides That, data from the questionnaire were analyzed to understand the technicians' perceptions regarding noise. And the impact to performance as well as health them. Through correlation analysis, the relationship between noise levels and technician performance and health is also evaluated, so that work areas that require further noise mitigation measures can be identified. This study not only helps in understanding the impact of noise on technicians, but also provides a strong basis for decision making in reducing noise risks in the work environment, improving technician welfare, and optimizing operational performance. This analysis is an important step in efforts to improve the quality of a safer and more comfortable work environment.

Validity and Reliability

Test validity Which done to questionnaire aiming to ensure that the questionnaire actually measures what it is supposed to measure. Validity indicates the extent to which an instrument the succeed catch draft or variable Which become the focus of research. There are several types of validity tests, including validity Contents (content validity), validity construct (construct validity), and criterion-related validity. This test is important to ensure that the results of the questionnaire are accurate and relevant to the research objectives. The validity test on the questionnaire conducted at the 045 Engineering Squadron can be said to be accurate because the validity content can reveal the perceptions

of Technicians using the purposive sampling method, which is considered representative to describe field conditions regarding noise and its impact on performance and health.

Reliability testing is a statistical procedure used to assess the consistency and stability of the results obtained from a measurement instrument, such as a questionnaire or test. This test helps ensure that instrument the produce results Which same or similar when used in condition Which The same in time different. High reliability indicates that the instrument is reliable and not influenced by undesirable factors. Common methods for testing reliability include internal consistency tests. (like Cronbach's Alpha) And test repeat (test-retest). On reliability test questionnaire Which implemented in Squadron Technique 045 can already be categorized as reliable because it has the same test results at different test times.

With this method, research is expected to provide an overview Which accurate about level noise in Squadron Technique 045 and its impact on technician performance and health, so that effective mitigation strategies can be proposed.

RESEARCH RESULT AND DISCUSSION

Measurement Level Noise

Measurement level noise done in various area Work at the 045 Engineering Squadron of the Roesmin Nurjadin Air Force Base for one week by Technicians who have the qualifications of Hawk 109/209 and F-16 C/D aircraft Engine Inspectors who know the noise level and understand the operation of the Sound Level Meter. The data obtained shows that the noise level varies depending on the location and type of activity taking place. The highest noise level was recorded in the maintenance area during the aircraft engine Groundrun, for the Hawk 109/209 aircraft with average reach 120 dB on RPM 104%, whereas on the plane F-16 CD with average reach 115 dB on RPM 75%, which exceed threshold limit Which recommended by The World Health Organization (WHO), with an average of around 60 dB. However, in area Which close together Organization/WHO) in document "Occupational noise: assessing the burden of disease from work-related hearing impairment at national and local levels." This document is published by WHO on year 2004, And own number ISBN reference 9241591927 that is as big as 85 dB For exposure Work during 8 hours per day. In the administration area and technicians' break room, the noise level is relatively lower with hangars, shelters and runways, the noise level reaches 80-90 dB during working hours. peak operations. These data indicate that technicians in Engineering Squadron 045 are exposed to high levels of noise, especially in their primary work areas.

Perception Technician to Noise

A questionnaire distributed to 30 technicians in the 045 Engineering Squadron revealed their perceptions of noise and its impact on their performance and health. The results of the questionnaire analysis showed that the majority of technicians (77%) considered noise in their workplace to be disturbing and potentially dangerous. As many as 63% technician report experienced impaired

concentration due to noise, while 73% stated that noise increased their stress levels.

Besides That, 60% technician confess that noise impact negatively on their sleep quality, which indirectly affects their performance at work. Only 15% of technicians felt that noise had no significant impact on their sleep quality. health and performance they. Data This show that noise is a serious problem that affects the welfare and performance of technicians in the 045 Engineering Squadron. Data Chart and Answers to the questionnaire questions to the Technicians are as follows:

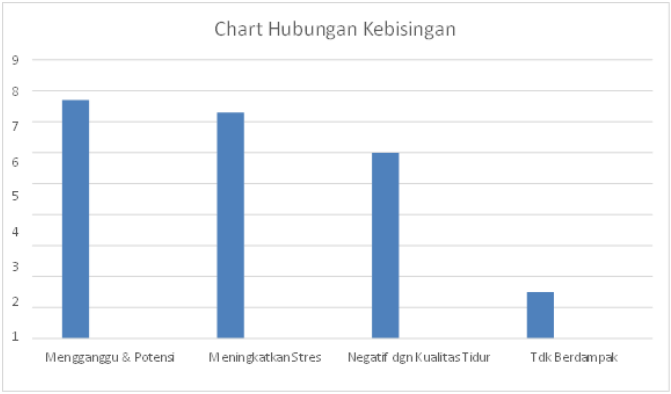

Figure 2. Noise Relationship Chart with Negative Effects of Noise for Technicians

Table 4. Answer question Questionnaire from for Technicians.

NO		CODE TECHNICIAN NAME	AGE (YEARS)	ANSWER QUESTION				
				1	**2**	**3**	**4**	**5**
		Aircraft Hawk 109/209						
1	1	A	57	34	B	B	B	B
2	2	B	51	28	B	B	B	B
3	3	C	45	22	B	B	B	B
4	4	D	39	16	B	B	B	B
5	5	E	49	26	B	B	B	B
6	6	F	47	24	B	B	B	B
7	7	G	49	26	B	B	B	B
8	8	H	40	17	B	B	B	B
9	9	I	49	26	B	B	B	B
10	10	J	49	26	B	B	B	B
11	11	K	46	23	B	B	B	B
12	12	L	47	24	B	B	B	B
13	13	M	32	9	C	C	D	D
14	14	N	41	18	B	B	B	B
15	15	O	41	18	B	B	B	C
		Aircraft F-16 CD						
16	1	P	26	3	C	C	D	D

17	2	Q	42	19	B	B	B	B
18	3	R	37	14	B	C	C	D
19	4	S	37	14	B	C	B	D
20	5	T	42	19	B	B	B	B
21	6	U	42	19	B	B	B	B
22	7	V	39	16	B	C	B	D
23	8	W	39	16	B	C	B	D
24	9	X	48	25	B	B	B	B
25	10	Y	29	6	C	C	D	D
26	11	Z	40	17	B	B	B	B
27	12	A1	27	4	C	C	D	E
28	13	A2	29	6	C	C	D	D
29	14	A3	29	6	C	C	D	D
30	15	A4	29	6	C	C	D	D

Analysis Correlation Noise and Performance

Analysis correlation done for know connection between levels noise with performance and health technician. Results analysis shows a significant negative correlation between noise level and technician performance. This means that the higher the noise level, the lower the technician's performance. Noise also has a significant positive correlation with stress levels and sleep disturbances according to Tambunan, M. (2015). These data show that noise No only influence performance direct technician, but also affects other factors that contribute to performance, such as stress levels and sleep quality. This underscores the importance of noise mitigation to improve technician performance and well-being.

Implementation Step Noise Mitigation

Based on the research results, several noise mitigation measures have been proposed and tested for their effectiveness. These measures include:

1. Use Tool Protector Self (PPE)
   Technicians are advised to use earplugs or earmuffs when working in areas with high noise levels to protect their hearing and improve work comfort. During a one-month trial of the use of personal protective equipment (PPE), the results showed that 80% of technicians felt more comfortable and experienced reduced concentration disorders when working in noisy environments. In addition, technicians report that use PPE help they work more focus and productive, so that increase overall performance in place Work. Implementation This very It is recommended to maintain health and work efficiency.
2. Repair Design Room Work.
   Modifications were made to the workspace design to reduce sound reflection, such as installing sound-absorbing materials on the walls and ceilings. Measurement results after the modifications showed an average noise level reduction of 10 dB in the aircraft engine maintenance area.
3. Arrangement Timetable Work.

To reduce noise exposure when running aircraft engines, technician work can be rescheduled by arranging more frequent rest breaks and rotations. Work in a way effective. Based on analysis data noise, area with level noise highest must given priority in setting schedule. Technicians working in the area can be given more frequent breaks, such as every 1 hour, and rotated to lower noise exposure tasks. This rotation ensures that no technician is exposed to high noise levels continuously, reducing long-term health risks. Technicians reported decreased stress and fatigue levels after implementing this re-scheduling.

4. Training And Education
   Training on noise hazards and personal protection was conducted to raise technicians' awareness. As a result, 90% of technicians now better understand the importance of using personal protective equipment (PPE) and strategies to reduce noise exposure, such as designating safer areas and using noise-reducing equipment. This training is effective in improving workplace safety.
5. Evaluation Effectiveness Step Mitigation
   Evaluation was conducted to assess the effectiveness of the mitigation measures that had been implemented. Technician performance data before and after the implementation of the mitigation measures were analyzed. The results showed a significant increase in performance after the implementation of the mitigation measures, with an average increase in productivity of 15% and a decrease in work errors of 20%.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

This study was conducted with the aim of identifying and overcoming the influence of noise on the performance of technicians at the 045 Engineering Squadron of the Roesmin Nurjadin Air Force Base. Based on the measurement of noise levels in various work areas and analysis of technician perceptions, it was found that noise in environment Work squadron This Enough tall and negatively impact the performance and health of technicians.

1. Level Noise the High
   Noise measurements showed that noise levels in key work areas, such as aircraft engine maintenance areas, averaged 95 dB, exceeding the WHO-recommended safe limit. Other areas such as hangars and runways also recorded high noise levels, while administrative areas and break rooms had lower noise levels.
2. Impact Noise to Performance and Health
   The questionnaire analysis revealed that the majority of technicians felt disturbed by noise, which caused impaired concentration, increased stress, and decreased sleep quality. This has an impact direct on decline performance technician, with significant negative correlation between noise level and technician performance.
3. Effectiveness Step Mitigation
   Implementation of noise mitigation measures such as the use of PPE, improved workspace design, work schedule arrangements, and technician training have proven effective. These measures have been successful lower

the level noise, reduce impact negative noise, and improve technician performance and well-being.

4. Use Tool Protector Self (PPE)
   The use of PPE such as earplugs and earmuffs should be promoted more intensively, accompanied by training on how to use them correctly. Comfortable and standard PPE should be provided to all technicians working in areas with high noise levels.
5. Repair Design Room Work Repair design room Work For reduce noise, such as installing sound-absorbing materials on walls and ceilings, needs to be done. In addition, there needs to be a rearrangement of the equipment layout to minimize sound transmission to the technician's work area.
6. Arrangement Timetable Work
   Rescheduling that provides adequate rest periods and job rotation to reduce noise exposure is essential. This will help reduce technician stress and fatigue, thereby improving their performance.
7. Training and Education Sustainable
   Training on noise hazards and how to mitigate them should be conducted periodically. This education is important to increase technician awareness of the importance of protecting themselves from noise.

Recommendation

This research opens up opportunities for further research on mitigation noise in environment Work military other. Some recommendations for further research include:

1. Studies Term Long
   Long-term research on the impact of noise and the effectiveness of mitigation measures on technicians' health and performance is needed. This is important to understand the long-term impacts of noise and ensure the sustainability of mitigation efforts.
2. Development Technology Mitigation Noise
   The development and application of new technologies for noise mitigation, such as active noise control systems and more effective sound-absorbing materials, need further research
3. Analysis Economy
   Analysis economy from implementation step mitigation Noise reduction in Technicians has shown significant benefits, particularly in terms of health cost savings. By reducing noise exposure, the risk of associated health problems can be reduced, resulting in reduced medical costs and insurance claims. It also has the potential to increase productivity and job satisfaction, providing additional financial benefits to the Unit. Cooperation between the Units (Air Squadron and Engineering Squadron) operating the Hawk 109/209 Fighter Aircraft is required. And F-16 CD with Hospital dr Sukirman Air Force Base RSN to schedule periodic Technician health checks, especially regarding hearing problems.

ADVANCED RESEARCH

Further research is needed to develop real-time noise monitoring systems integrated with predictive analytics and sensor-based smart PPE to track noise exposure and technicians' physiological responses. Studies should also explore the long-term effects of noise on cognition and neurological health, as well as assess the effectiveness and economic efficiency of noise mitigation strategies in military work environments.

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