The Relationship of Workload and Shift Systems with Operator Fatigue Levels at PT XYZ

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ABSTRACT
Work fatigue is a common problem in the manufacturing industry, especially in jobs with high physical activity and shift work systems. This study aims to determine the relationship between workload and work shifts on the level of operator fatigue at PT XYZ, a casting component manufacturing company that operates 24 hours with three shift systems. The study used an analytical observational method with a cross-sectional approach to 30 operators selected through total sampling techniques in the period October–November 2025. Data was obtained through questionnaires and analyzed using Spearman Rank and Chi-Square tests. The results show that most operators have workloads and fatigue levels in the medium to severe category. Statistical analysis showed a significant relationship between workload and fatigue level (p = 0.001; r = 0.610) as well as a significant relationship between work shifts and fatigue level (p = 0.018). Thus, it can be concluded that workload and shift work systems affect the level of operator fatigue so that better work management and shift management are needed to reduce the risk of work fatigue.

Keywords **:** *Workload; Shift Work; Work Fatigue; Operator; Casting.*

ABSTRAK
Kelelahan kerja merupakan masalah umum di industri manufaktur, terutama pada pekerjaan dengan aktivitas fisik tinggi dan sistem kerja shift. Studi ini bertujuan untuk mengetahui hubungan antara beban kerja dan shift kerja terhadap tingkat kelelahan operator di PT XYZ, perusahaan manufaktur komponen pengecoran yang beroperasi 24 jam dengan sistem tiga shift. Studi ini menggunakan metode observasi analitis dengan pendekatan cross-sectional terhadap 30 operator yang dipilih melalui teknik pengambilan sampel total pada periode Oktober–November 2025. Data diperoleh melalui kuesioner dan dianalisis menggunakan uji Spearman Rank dan Chi-Square. Hasil penelitian menunjukkan bahwa sebagian besar operator memiliki beban kerja dan tingkat kelelahan dalam kategori sedang hingga berat. Analisis statistik menunjukkan hubungan yang signifikan antara beban kerja dan tingkat kelelahan (p = 0,001; r = 0,610) serta hubungan yang signifikan antara shift kerja dan tingkat kelelahan (p = 0,018). Dengan demikian, dapat disimpulkan bahwa beban kerja dan sistem kerja shift mempengaruhi tingkat kelelahan operator sehingga diperlukan manajemen kerja dan manajemen shift yang lebih baik untuk mengurangi risiko kelelahan kerja.

Kata kunci : *Beban kerja; Kerja shift; Kelelahan kerja; Operator; Pengecoran.*

INTRODUCTION

Fatigue felt during work activities is a crucial problem in the industrial world, especially in jobs that have high physical demands and repetitive activities. Fatigue can have implications for decreased productivity, reduced concentration, and an increased risk of work accidents when the fatigue is not properly controlled. In the manufacturing industry, the main factors that often affect the level of fatigue are high workloads and the implementation of shift work systems

PT XYZ is a casting component manufacturing company that operates for 24 hours so that it implements a three-shift work system. Operators in the production department face physical activities such as machine operation, mold lifting, production process monitoring, and other repetitive work. Based on the initial data of the study, it was noted that the majority of operators have workloads in the medium to heavy category. In addition, the level of fatigue is also dominated by the medium and severe categories, indicating the potential for a considerable physical and mental burden on workers.

The shift work system is also an important factor because workers, especially on night shifts, have to adjust the biological rhythm of the body and sleep patterns. Preliminary data shows that shift workers tend to

experience more fatigue than morning and afternoon shifts. Related conditions corroborate work-related allegations that can affect the physical condition and level of alertness of operators.

Analytical observational design is a method applied to this study using a cross-sectional approach. The research took place in the range of October - November 2025. Examples amounted to 30 operators which were then determined through the application of total sampling techniques. Data were obtained through questionnaire distribution and then analyzed through the use of the Spearman Rank test and the Chi-Square test to see the relationship between variables

This study aims to determine the relationship between workload and work shifts and the level of fatigue that occurs in PT XYZ operators. It is hoped that the findings of the analysis can be a reference for consideration for companies in improving workload management, shift scheduling, and work fatigue prevention strategies.

RESEARCH METHODS

Observational analytics became the method applied to this study through the use of *cross-sectional* designs. This research took place in the range of October - November 2025 which is located in the work area of PT XYZ. All operators from related companies became the population for this study, namely 44 people and then sample tests were carried out through the total sample technique. The use of research instruments in the form of questionnaires that contain a number of respondent characteristic data including name, age, last level of education, and working period. Furthermore, a questionnaire was also used to measure the level of fatigue at work, including workload and work shift patterns. Furthermore, the data obtained will be analyzed using *the Spearman Rank* test and *the Chi-Square* test in analyzing univariate and bivariate on related data. The following is a flowchart of *Observational analytical research methodology*:

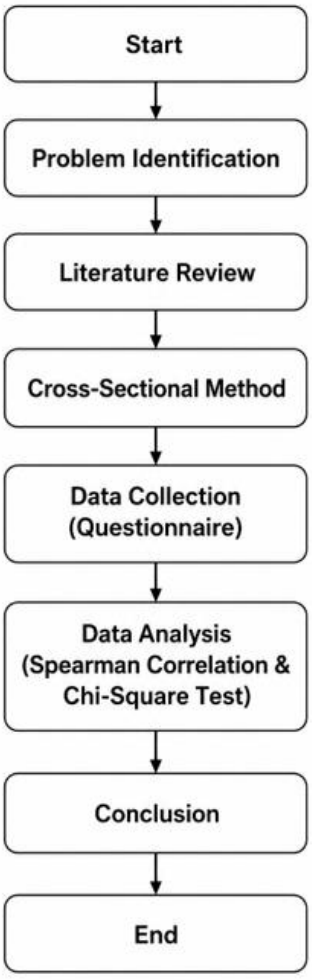

Figure 1. Research Flow

RESULTS AND DISCUSSION

Respondent Characteristics

The survey was aimed at collecting primary data obtained with respondents' characteristics including age, last education, and length of work. The number of respondents was 30 PT XYZ operators. All respondent characteristics are presented in the form of a table.

Referring to the presentation of the related table, it was recorded that some of the respondents were classified as 26-40 years old, namely 16 people (53.3%), while 14 people (46.7%) were over 41 years old. As for the last level of education, the majority of respondents were high school/vocational school graduates, namely 20 people (66.7%), then 7 (23.3%) Bachelor graduates, and 3 people (10.0%) were Diploma graduates. In general, it can be concluded that most of the workforce is highly educated.

Meanwhile, for the working period, all respondents (100%) by referring to the data obtained were recorded for more than three years in the company which shows that the workers have a long enough professional experience at PT XYZ.

Table 1. Distribution of Respondents by Age, Last Education, and Length of Service

Respondent Characteristics	N	%
1. Age		
26-40 years old	18 people	(60%)
>40 years old	12 people	(40%)
2. Education		
SMK/SMA	30 people	(100%)
3. Working period		
>30 years old	30 people	(100%)
Total	30	(100%)

Univariate Analysis

Table 2. Distribution of respondents by work fatigue category

Work Fatigue	N	%
Mild Fatigue	4 orang	(13,3%)
Moderate Fatigue	16 orang	(53,3%)
Severe Fatigue	10 orang	(33,3%)
Total	30 orang	(100%)

The level of work fatigue is seen from the scores filled in by respondents on the fatigue questionnaire. The results showed that most workers experienced moderate level fatigue, namely 16 people (53.3%). Then there were 10 people (33.3%) who experienced severe fatigue, and 4 people (13.3%) were in the category of mild fatigue.

Table 3. Distribution of Respondents By workload category

Work Fatigue	N	%
Light workload	2 orang	(6,7%)
Medium workload	17 orang	(56,7%)
Heavy workload	11 orang	(36,7%)
Total	30 orang	(100%)

The findings of the study show that the majority of operators are in the category of workload at a medium level, namely 17 people (56.7%). In addition, there were 11 people (36.7%) who felt that the workload was heavy, and only 2 people (6.7%) were in the light category. These findings illustrate that most workers face fairly high job demands, especially on physical activity and daily production loads. This high workload also has the potential to affect the level of fatigue experienced by operators.

Table 4. Distribution of Respondents Based on Work Shift category

Work shifts	N	%
Morning	10 orang	(33,3%)
Afternoon	10 orang	(33,3%)
Night	10 orang	(33,3%)
Total	30 orang	(100%)

Work shifts at PT XYZ operators are divided equally, 10 people (33.3%) each in the morning, noon, and night shifts. This even division shows a three-shift rotation system. However, night shift workers are still at higher risk of experiencing higher fatigue due to changes in sleep patterns.

The Relationship of Workload to Work Fatigue

Table 5. The Relationship of Workload and Work Fatigue in PT XYZ Operators (n = 30)

Workload	Mild Fatigue	Moderate Fatigue	Severe Fatigue	Total
Lightweight	2	0	0	2
Medium	2	13	2	17
Weight	0	3	8	11
Total	4	16	10	30

The Spearman correlation test results indicate a significant relationship between workload and operator fatigue. This is demonstrated by a significance value of $p = 0.001$ ($p < 0.05$), thus the hypothesis stating a relationship between the two variables is accepted. Furthermore, the Spearman correlation coefficient value of $r = 0.610$ indicates a positive relationship with a relatively strong correlation strength. This positive relationship indicates that the higher the workload experienced by operators, the higher the level of work fatigue.

Based on the data distribution, workers with high workloads tend to experience severe levels of fatigue, while workers with moderate workloads generally experience moderate levels of fatigue. This finding indicates a tendency for fatigue to increase as the workload increases. This is understandable considering that activities in the casting department require high physical abilities, sustained concentration, and speed in completing production processes. This combination of demands results in greater energy expenditure, increasing the risk of work fatigue in operators.

The Relationship between Work Shift and Work Fatigue

Table 6. The Relationship of Work Shift with PT XYZ Operator Fatigue Level (n = 30)

	Light	Shift	Medium	Total Weight
Morning	2	7	1	10
Afternoon	1	6	3	10
Night	1	3	6	10
Total	**4**	**16**	**10**	**30**

The results of the Chi-Square test indicate a significant relationship between shift-based work systems and worker burnout levels. This is indicated by a significance value of $p = 0.018$ ($p < 0.05$), thus the hypothesis stating a relationship between the two variables is accepted. This finding indicates that work shift allocation is significantly related to worker burnout levels.

Referring to the findings of the Chi-Square test, it shows a significant relationship between work shifts and operator fatigue levels, as evidenced by the value $p = 0.018$. The findings of related figures indicate that the shift work system affects the level of worker fatigue.

From the table, it can be seen that night shift workers experience the most severe fatigue (6 people). This happens because working at night causes sleep pattern disruption and a decrease in body condition. In contrast to morning shift workers who tend to have low levels of severe fatigue.

The findings of this study are in line with other studies that state that night shifts are more at risk of causing fatigue due to changes in biological rhythms. The findings of the study show that a number of factors that affect the level of fatigue that occurs in PT XYZ operators are derived from the characteristics of physical work and the rotating work system implemented by the company. Referring to univariate data, the majority of respondents had work beans classified as medium to large and showed fatigue levels that tended to be in the medium and severe categories. This condition is in accordance with the context of work in the casting section which requires physical endurance, movement repetition, and work speed to meet daily production targets.

The relationship analysis using the Spearman Rank test showed a meaningful correlation that took place between work fatigue and workload, where the number 0.001 was recorded as the p value and 0.610 as

the correlation coefficient r. The correlation value indicates a positive relationship with a strong enough force, so operators with a larger workload indicate a higher level of fatigue. These findings are consistent with the ergonomic understanding that increased demands on physical work—such as lifting, prolonged standing, and machine monitoring—can accelerate muscle fatigue and decreased concentration. In this study, the trend was evident in the distribution of data, where the majority of workers with heavy workloads were in the category of severe burnout.

In addition to the workload factor, the shift system has also been shown to be related to operator fatigue, as shown by the results of the Chi-Square test where the number 0.018 is recorded as the p-value of the test. Operators who worked during the night shift were recorded as the group with the highest levels of severe fatigue. This can be explained by changes in circadian rhythms, decreased sleep quality, and high mental fatigue due to working when the body's alert level is at a low point. These findings are in line with the findings of a number of empirical studies that have found that night shift workers tend to experience sleep disturbances and decreased stamina that contribute to increased fatigue.

Overall, this study confirms that workload and work shifts are two factors that affect operator fatigue at PT XYZ. The combination of intense physical activity and a work schedule that is not in line with the biological rhythm of the body leads to a high level of fatigue found. These findings show the need for more proportional workload management, shift pattern adjustments, and efforts to prevent fatigue through rest management and body recovery for workers.

CONCLUSION

This study shows that workload and work shifts have a significant relationship with the level of fatigue in PT XYZ operators. Workload was shown to have an effect on fatigue with a value of $p = 0.001$ and a correlation of $r = 0.610$, indicating that the heavier the workload the operator received, the higher the level of fatigue experienced. Work shifts also showed a meaningful association with fatigue ($p = 0.018$), where operators working night shifts had higher levels of fatigue than morning and afternoon shifts. In general, work conditions in casting sections that demand repetitive physical activity and take place in a three-shift work system contribute to a high level of fatigue in workers. These findings confirm that workload management and shift schedule realignment are essential to reduce fatigue and improve operator safety and productivity.

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