

The Analysis of Employee Workload through Subjective Workload Assessment Technique (SWAT) and Swedish Occupational Fatigue Inventory (SOFI) Methods

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Abstract

This study aims to determine the workload level that employees have in the Marketing Department and improvement department at PT. XYZ. Measurements were carried out using the SWAT (Subjective Workload Assessment Technique) and SOFI (Swedish Occupational Fatigue Inventory) methods by recognizing the level of employee workload, because the large amount of heavy workload will have an impact on work stress. Therefore, it is important to concern the related aspects so that the employees can produce an optimal output. The Repair Department employees have the highest workload value, that is in the fourth activity, namely checking vehicles which has a value of 70%. Based on the results of data processing in ten respondents of Marketing Department employees, it can be concluded that the Mental workload in the medium category is 100%. Meanwhile, the highest dimension with an average value of 3.97, namely Lack of Energy. Then, Physical Activity (Physical Exertion) with a total average of 2.66. Lack of Motivation with a total average of 1.78, Physical Discomfort with an average total of 1.53. Based on calculations on employees of the Repair Department, the SWAT percentage of 70% is included in the category of Repair is Necessary.

Keywords: Employee Workload; SWAT; Sofi methods

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1. Introduction

In the industrial world, workload is one of the things that need to be considered because it determines how a business improves, stops, or declines (Abadi & Riyanto, 2021; Aliyyah et al., 2021). Human resources are one of the most important factors in an organization or business to achieve its goals because they are one of the determining factors for the success or failure of a company (Fahmi, 2020). Besides being one of the factors that determine the success of an organization or business, human resources are also beings with certain thoughts, feelings, needs, and expectations (Murawski, 2021; Trihapsari, Mujahidah, & Humairoh, 2021). This situation makes them as one of the success factors of an efficient organization and performance improvement, where the organization or company must be able to create conditions where employees can develop and improve their skills and abilities optimally (Akkermans, Van Oppen, Wynstra, & Voss, 2019; Alefari, Almani, & Saloni, 2020).

Human resources are one of the determining factors for the success or failure of a company in achieving its goals. Besides human resources become one that greatly determines the success of an organization or company, they also become who have certain thoughts, feelings, needs, and expectations. This situation makes human resources as one of the determining elements of an organization success that improve efficiency and performance to achieve these aspects. Then, the organization or company must be able to create conditions that encourage and enable (Smol, Adam, & Preisner, 2020).

Workload is a workspace experienced by employees related to situational factors consisting of physical and psychological environmental factors (Qiu, Ming, Sallak, & Lu, 2021). It is an individual external factor that creates pressure because of too heavy a workload. The workload that is too heavy or too light affects work efficiency. Too light workload means too many staff. These benefits result in organizations, they will pay more employees for the same productivity, resulting in cost efficiencies. On the other hand, when there is an employee shortage or when there is a lot

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of work and few employees, it can cause physical and mental fatigue among employees. Finally, the workers become unproductive because they are too tired. Measuring mental stress is one of the factors needed by companies to determine employee workload. Because employees or workers are an important factor that affects the quality of the company (Ardana, 2012).

Specifically, workload can be divided into two, namely physical workload and mental workload. Physical workload tends to lead to the load an employee receives in a job related to his physiological conditions, such as noise, vibration (vibration), and hygiene. Mental workload tends to lead to the load that an employee receives in a job related to his psychological condition, such as available task completion deadline, type of work activity, as well as individual factors of motivation level, expertise, and fatigue (Ardana, 2012; Yeh, Chang, Feng, sclerosis, & Yang, 2020).

PT. XYZ was established as a trading company. Its company has six business lines: Repair, Financial Services, Heavy Equipment, Mining & Energy, Agribusiness, Information Technology, Infrastructure, and Logistics. The company is supported by its subsidiaries engaged in the assembly and distribution of cars, motorcycles and related parts, heavy equipment sales and rentals, mining and related services, plantation development, financial services, as well as infrastructure and information technology.

The large workload owned by the employees of PT. XYZ will also have the impact on the body health itself to the loss of work motivation. If the workload is too light, it can result in boredom in employees. Meanwhile, if the employee's ability is low, it can have an impact on completing the tasks so that the time needed is longer and increases the workload of his work. Based on the results of an initial survey conducted by researchers on several employees of PT. XYZ who often complain about the heavy and exhausting workload they receive at work, yet there is little motivation to complete their works. The results of interviews conducted with several employees in the Repair Department contained several indicators of excessive workload, among others, lack of employees which caused *bottleneck* work resulted in employees need to work extra or overworked to complete on time. As a result, the employees often experience *burnout*, such as squatting or bending for too long, then lack of appreciation for good performance by company, and also many employees complain because the duration of completing assignment is too short which causes the works cannot completed on time.

The Subjective Workload Assessment Technique (SWAT) method was developed by the Aerospace Medical Laboratory of Wright-Patterson Air Force Base, Ohio, USA. Harry G. Armstrong. SWAT is designed to answer the question of how to measure workload in a real-world environment. Besides, the Subjective Workload Assessment (SWAT) technique is a procedure in which scales copied from people/individuals are assigned to many important tasks that affect mindset and are related to the performance/fulfillment of various tasks (Pratiwi, Pawennari, & Afiah, 2022; Pudiasuti, 2020; Rahmah & Suryadi, 2022). This method was developed by Reid and Nygren through basic scaling methods. SWAT differs from other subjective measures because it is carefully developed and rooted in formal measurement theory, specifically shared measurement theory (Pratiwi et al., 2022; Rahmah & Suryadi, 2022; Riza Fauzy & Sudiarno, 2019). Data collection according to the SWAT analysis method was carried out with mental pressure combination cards in the form of specially prepared sheets of 27 sheets.

The SOFI method is a method developed by Ashbeng in 1998, which has five question indicators (multidimensional) (Navikas et al., 2021; Pawlowska, Tenne, Ghosh, Makowski, & Lapkiewicz, 2022). These five dimensions of SOFI are lack of energy, physical discomfort, lack of motivation, physical exertion, and sleepiness. In order to find out the workload level that employees have in the Marketing Department and improvement department at PT. XYZ, then measurements were carried out using the SWAT (Subjective Workload Assessment Technique) and SOFI (Swedish Occupational Fatigue Inventory) methods by recognizing the level of employee workload, because the large amount of heavy workload will have an impact on work stress (An, Wang, Liang, & Liu, 2017). Therefore, it is important to concern the related aspects so that the employees can produce an optimal output.

2. Methods

This type of research is quantitative (Sugiyono, 2019). This research was conducted at PT. XYZ which is located Surabaya City, East Java, Indonesia. Data sources were from primary data and secondary data. Primary data came from the Subjective Workload Assessment Technique (SWAT) questionnaire and the Swedish Occupational Fatigue Inventory (SOFI) questionnaire which had been tested for validity and reliability. Secondary data involved scientific articles, books, etc. which are used as research sources. In this study, the author used the Slovin formula for sampling in this study. The population in this study amounted to twenty employees, which were divided into two departments, namely ten employees in the Repair Department and ten employees in the Marketing Department.

3. Result and Discussions

Sequencing on SWAT cards was carried out to test the validity and additive model of the data and determine the re-scale value. The scale shows the interval scale for each combination based on Time, Effort, and Stress. The creation of final scaling criteria in this SWAT method is based on the Kendall coefficient. The value is above 0.75 which indicates the index of agreement in the arrangement of cards between objects is relatively equal and homogeneous. If reviewed more carefully, the use of group scale is much better. The value of the Kendall coefficient is less than 0.75, so a separate final scale is needed based on the prototype.

Table 1. Kendall's Correlation Test Results

Subject	Sig.	Decision
Distribution X1, X2, X3, ..., X10	0.565	Data Valid

Source: Data Processing (2022)

Based on measuring mental workload through the SWAT method, at the scale development stage is obtained the value of Kendall's coefficient of Concordance (W) = 0.565 and the correlation results show that respondents tended to the aspect of Time effort (T). Sequence of filling out a questionnaire 27 SWAT cards that has been carried out where there are three pairs of comparison dimensions used in SWAT, namely Time load (T), Mental effort load (E), and Psychological pressure load (S). The result of this questionnaire is in the form of a resonant assessment of the three dimensions, which is felt to be the most burdensome in carrying out its work.

The data obtained is then inputted into SWAT software using DOSBox 0.74 as an emulator. The first stage is to calculate the value of the Kendall Coefficient. The manufacturing criteria of these three scales (GSS, PSS, and ISS) are determined from Kendall's Coefficient of Concordance. If the value of the coefficient is > 0.75 , then it can be said that the index of agreement in the preparation of cards among respondents is relatively equal and homogeneous. Thus, a group scale is used. Conversely, if the value of the coefficient is < 0.75 , then the scaling solution used is an individual scaling solution or prototype. The sequencing data of 27 SWAT cards for employees of the Repair Department was processed using the SWAT program to determine the value of the Kendall's coefficient (w) and determine the effect of T, E, and S dimensions on determining workload values and creating scales for the Event Scoring stage.

The following table of prototype data processing carried out using Dosbox 0.74 software with SWAT program or can be seen in Table 2 as follows:

Table 2. Prototype Employee of Repair Department

Respondents	TEST	TSE	ETS	EST	SET	STE	SUGGESTED PROTOTYPE
1	0.68	0.74	0.06	-0.09	0.09	0.29	T
2	0.74	0.77	0.19	-0.08	0.01	0.22	T
3	0.77	0.76	0.22	0.03	0.01	0.19	T
4	0.77	0.80	0.23	0.08	0.18	0.36	T
5	0.63	0.66	0.10	-0.05	0.03	0.21	T
6	0.70	0.75	0.13	-0.01	0.15	0.34	T
7	0.73	0.71	0.25	0.07	0.00	0.16	T
8	0.82	0.85	0.28	0.13	0.19	0.38	T
9.	0.75	0.82	0.13	0.00	0.21	0.41	T
10	0.78	0.82	0.16	0.02	0.08	0.29	T

Source: Data Processing (2022)

Table 2 shows the result of processing Prototype data to determine the dimensions that respondents subjectively consider

to be the dominant dimension in determining the value of workload. The output of the SWAT software also obtained the importance value of the workload dimension of Time Load = 73.16%, Effort Load = 19.43 %, and Stress Load = 7.40 %

The results show that the contribution of dimensions that affect the highest workload value is Time dimension which is 73.16%, the value for the Effort dimension is 19.43%, and the value for the Stress dimension is 7.40%. The most influential dimension according to Repair Department employees is Time. It states that the indicators, such as the amount of time pressure experienced in performing their duties are the most influential factor on the value of employee workload.

The results of the data are tested for validity by software with Kendall's Coefficient of Concordance test to produce the Kendall coefficient (Ramadan, Hapsari, Pramesti, & Ikhlas, 2019; Sugiyono, 2017). The result obtained is 0.565 which based the value of the Kendall coefficient from the processed data < 0.75. So, it can be said that the agreement index in the preparation of cards among respondents is not homogeneous and is processed based on an individual scale. The resulting scale cannot represent group workloads, so in order to determine the workload measurement scale, the most suitable method is through an Individual Scaling Solution (ISS). Table 3 shows Individual Scaling Solution on employees of Repair Departments based on Dosbox output,

Table 3. Individual Scaling Solution (ISS) of Employee Repair Department

No.	Workload Dimensions		
	Time	Effort	Stress
1	73.28%	20.77%	5.95%
2	72.47%	20.71%	6.82%
3	81.86%	6.96%	11.18%
4	62.40%	16.98%	20.62%
5	73.81%	23.78%	2.41%
6	67.63%	23.02%	9.34%
7	74.11%	9.70%	16.19%
8	74.92%	13.61%	11.47%
9	67.88%	15.25%	16.87%
10	77.88%	18.05%	4.07%
Average	72.62%	16.88%	10.5%

Source: Data Processing (2022)

Event scoring was carried out to assess the state of each driver at the time of carrying out work. In addition, event scoring is used as a correction process between the workload of each respondent's state.

Table 4. All Categories of Respondent Expenses

Source: Data Processing (2022)

No	Mahfud		Iwan		Eko		Udin		Wawan	
	Scale	Category	Scale	Category	Scale	Category	Scale	Category	Scale	Category
1	54.3	Medium	23.7	Low	51.2	Medium	42.6	Medium	23.7	Low
2	96.9	High	19.4	Low	7.4	Low	100	High	22.5	Low
3	42.6	Medium	19.4	Low	46.9	Medium	42.6	Medium	92.6	High
4	46.9	Medium	92.6	High	42.6	Medium	88.3	High	46.9	Medium
5	50	Medium	4.3	Low	34.9	Low	34.9	Low	50	Medium
6	26.8	Medium	23.7	Low	23.7	Low	19.4	Low	23.7	Low
Average	52.91	Medium	30.51	Low	34.45	Low	54.63	Medium	43.23	Medium

No	Nurkholis		Ahmad		Rizki		Andrean		Tri	
	Scale	Category	Scale	Category	Scale	Category	Scale	Category	Scale	Category
1	92.6	High	19.4	Low	46.9	Medium	23.7	Low	50	Medium
2	27.5	Low	51.2	Medium	19.4	Low	54.3	Medium	0	Low
3	50	Medium	26.8	Low	77.5	High	22.5	Low	23.7	Low
4	100	High	95.7	High	77.5	High	95.7	High	92.6	High
5	73.2	High	23.7	Low	23.7	Low	34.9	Low	96.9	High
6	54.3	Medium	50	Medium	54.3	Medium	19.4	Low	50	Medium
Average²	66.26	High	44.46	Medium	49.88	Medium	41.75	Medium	52.2	Medium

According to the workload research data on employees of the Repair Department for the first respondent to the tenth respondent, when viewed from work activities, there is one respondent who has a high workload based on the average workload. As for respondents with a moderate workload as many as seven people. As for respondents with a low workload of two people. For the highest workload according to activity, Udin respondent with a value of 100 on workplace cleaning activities, for Nurkholis respondents with a value of 100 on vehicle checking activities, for the highest workload according to the average, there is Nurkholis with a high load category with an average value of 66.26.

Mental workload measurements were performed using the Swedish Occupational Fatigue Inventory (SOFI) method. The data needed to process data is the average of each dimension, and the total average. There are five dimensions, including lack of energy, physical activity, physical discomfort, lack of motivation, and drowsiness. A recapitulation of the Swedish Occupational Fatigue Inventory (SOFI) questionnaire results in the Marketing Department can be seen in Appendix (x).

Based on the results of questionnaires by workers in the Marketing Department at PT. Astra International Tbk., it was obtained the average of each dimension according to the Swedish Occupational Fatigue Inventory (SOFI) method is as follows:

Table 5. Average SOFI Dimensions of Marketing Department

Dimension	Average
Lack of Energy	2.42
Physical Activity	2.1
Physical Discomfort	1.12
Lack of Motivation	2.34
Drowsiness	3.2
Average Total	2.236

Source: Data Processing (2022)

According to the Table 5 and based on the SOFI questionnaire, it is known that work fatigue is found in the Marketing Department at PT. Astra International Tbk. The dimension with the highest average total is drowsiness with a value of 3.2. Then, the next highest dimension is the dimension of Lack of Energy with a value of 2.42. Then, the next dimension is Lack of Motivation with a value of 2.34. Next, the dimension of Physical Activity (Physical exertion) with a value of 2.1. Moreover, the dimension with the smallest average is the dimension of Physical Discomfort which has an average value of 1.12.

Based on the SOFI questionnaire of ten employees in the Marketing Department, the results of the fatigue level are obtained with the low category of 0%, the medium category of 100% with the number of ten workers, and the high category of 0%. Thus, it can be concluded that the level of burnout of production workers based on the SOFI questionnaire falls into the medium category. Based on the results of the SOFI dimension, it can be known that the dimension with the highest total average is Drowsiness with a value of 3.2. Then, the next highest dimension is the dimension of Lack of Energy with a value of 2.42. Then, the next dimension is Lack of Motivation with a value of 2.34. Then, the dimension of Physical Activity (Physical exertion) with a value of 2.1. And for the dimension that has the smallest average is the dimension of Physical Discomfort which has an average value of 1.12.

Sequencing on SWAT cards was carried out to test the validity and additive model of the data and determine the re-scale value. The scale shows the interval scale for each combination based on Time, Effort, and Stress. The creation of final scaling criteria in this SWAT method is based on the Kendall coefficient. The value is above 0.75 which indicates the index of agreement in the arrangement of cards between objects is relatively equal and homogeneous. If reviewed

more carefully, the use of group scale is much better. The value of the Kendall coefficient is less than 0.75. So, a separate final scale is needed based on the prototype.

Table 6. Kendall Correlation Test Results

Subject	Sig.	Decision
Distribution X1, X2, X3, ... , X10	0.8565	Data Valid

Source: Data Processing (2022)

Based on the measurement of mental workload with the SWAT method, the scale development stage obtained the value of Kendall's coefficient of Concordance (W) = 0.8565 and the correlation results show that respondents tend to the Time effort (T) aspect.

Based on the results of data processing to measure the mental workload using the SWAT method, in the first stage, namely Scale Development. The value of Kendall's Coefficient of Concordance (W) in employees of the Repair Department is 0.8565. The value of Kendall's Coefficient of Concordance (W) is less than 0.75. This means that the results obtained from ten research respondents are heterogeneous so that they cannot represent the overall workload of employees in the Repair Department of PT. Astra International Tbk. So that the scaling solution that can be used is individual scale (ISS) or prototype scale (PSS) (Graduation & Rahmat Rizalmi, 2020). The making of individual scales is based on approximate relative important values as in research by Ananda and Setiawan in 2021.

In the table above, it can be seen the results of the prototype on the Repair Department employees to determine the dimensions that respondents subjectively think are the dominant dimensions in determining the value of workload. It aims to find out the dimensions that according to subjective respondents as the dominant dimension in determining the quality of workload. In groups, the dimension contribution that affects the highest workload value is the Time dimension which is 72.62%, then for the Effort dimension value is 16.88%, and the value for the Stress dimension is 10.5%. So, according to respondents, the most influential dimension in determining workload is the Time dimension of 72.62%.

Based on the Table of Individual Scaling Solution Results Table, results from the SWAT method for Repair Department employees, the Kendall coefficient value obtained is 0.671 or less than 0.75. The resulting scale cannot represent group workloads, the Individual Scaling Solution is the most suitable method in determining workload measurement scales. Based on the data above, the value of Effort dimension is 16.88%, then for Time is 72.62%, and for Stress is 10.5%. Then, the most influential is Time Load with an average load value of 72.62%. This suggests that employees of the Repair Department significantly feel the burden of time more dominantly in influencing their work.

Table 7. All Categories of Respondent Expenses

TYPES OF ACTIVITIES	WORKLOAD						TOTAL	
	LOW		MEDIUM		HIGH			
	N	%	N	%	N	%	N	%
Waiting for Customer Arrival	4	40%	5	50%	1	10%	10	100%
Cleaning the Workplace	6	60%	2	20%	2	20%	10	100%
Communication to Customers	4	40%	4	40%	2	20%	10	100%
Checking the Vehicle	0	0%	3	30%	7	70%	10	100%
Repair Customer's Car	6	60%	2	20%	2	20%	10	100%
Take a Test Drive	6	60%	4	40%	0	0%	10	100%

Source: Data Processing (2022)

Based on Table 7, the first activity, namely waiting for the arrival of the customer, has a low workload of 40%, medium 50%, and high 10%. In the second activity, cleaning the workplace, has a low workload of 60%, medium 20%, and high 20%. In the third activity, communication with customers, has a low workload of 40%, medium 40%, and high 20%. The fourth activity, checking the vehicle, has a low workload of 0%, medium 30%, and high 70%. The fifth activity, repairing the vehicle, has a low workload of 60%, medium 20%, and high 20%. Last, in the sixth activity, doing a test drive, has a low workload of 60%, medium 40%, and a high of 0%. For activities that have the highest high workload value, the fourth activity, namely checking vehicles, has a value of 70% or a total of 7 people.

For the calculation of mental workload based on the SOFI questionnaire in the Marketing Department, with a total of ten employees in the Marketing Department, that the mental workload results are obtained with a low category of 0%, a medium category of 100%, and a high category of 0%. Thus, it can be concluded that the mental workload of production workers based on the SOFI questionnaire falls into the medium category. The dimension with the highest average total is Drowsiness with a value of 3.2. Then, the next highest dimension is the dimension of Lack of Energy

with a value of 2.42. Then, the next dimension is Lack of Motivation with a value of 2.34. Then, the dimension of Physical Activity (Physical exertion) with a value of 2.1. Last, for the dimension that has the smallest average is the dimension of Physical Discomfort (Physical discomfort) which has an average value of 1.12.

4. Conclusions

The Repair Department employees have the highest workload value, that is in the fourth activity, namely checking vehicles which has a value of 70%. Based on the results of data processing in ten respondents of Marketing Department employees, it can be concluded that the Mental workload in the medium category is 100%. Meanwhile, the highest dimension with an average value of 3.97, namely Lack of Energy. Then, Physical Activity (Physical Exertion) with a total average of 2.66. Lack of Motivation with a total average of 1.78, Physical Discomfort with an average total of 1.53. Based on calculations on employees of the Repair Department, the SWAT percentage of 70% is included in the category of Repair is Necessary. This means that there needs to be an additional pusher device with the aim of making it easier to check the vehicle. Besides, need to add a maximum time policy both in waiting for the customer's arrival, waiting for the customer to complete the initial administration, and repairing the vehicle. Based on the highest total average of the SOFI questionnaire, namely the dimension of Drowsiness with a value of 3.2. It is necessary to determine the rest time through the calculation of energy consumption needed during the work time converted into the need for rest time in all work divisions ($R_t = 0$), which means that the rest hours given for 60 minutes are enough.

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