

Analysis Of Determining Offshore Worker Schedules in The Onwj Working Area During the Covid-19 Pandemic

Tegar Jaya Saka Buana¹, Adithya Sudiarno²

¹Master's Student of Sekolah Interdisiplin Manajemen Teknologi ITS

² Industrial and System Engineering Department of ITS

Institut Teknologi Sepuluh November

Surabaya, Indonesia

tegarsaka29@gmail.com, adithya.sudiarno@gmail.com

Abstract

PT. PHE ONWJ as one of the national oil and gas mining corporate has changed the work cycle for offshore workers from 12:12 (12 working days and 12 days off) to 21:21 during the COVID-19 pandemic era. The enactment of the extended days to the point of surpassing 21 working days due to the workers who are unable to work, increasing the workload for offshore workers. To identify the state of physical health of the workers, blood pressure measurements are taken every week for the on-duty workers. The record of the blood pressure performed by on-site doctors showed that the average worker with a 21-days on duty and an extended day is still in the normal range, which is below 120mmHg/80mmHg. The NASA TLX test was performed to identify the level of the workload of offshore workers. Out of the 142 respondents in the PHE ONWJ offshore working area, 51% of workers have experienced an extended day. The results of the NASA TLX questionnaire show that offshore workers at 21:21 have an average WWL of 80.68 (high) and workers with an extended day of 84.79 (very high). Therefore, an analysis is needed to determine the optimal work cycle during the COVID-19 pandemic. Analysis of work cycle alternatives using the AHP - Expertise Judgment method with 4 criteria: mental workload, operational-accommodation costs, health protocol, and operational protocols in the field with 4 alternatives such as 12:12, 14:14, 18:18, and 21:21 by 7 experts. The results acquired that the 12:12 cycle became an alternative with a dominant weight of 0.394 or 39.4% and the 14:14 cycle becomes the second alternative with a weight of 0.24 or 24%.

Keywords

COVID-19, Extended Day, NASA TLX, WWL, AHP-Expertise Judgment

1. Introduction

Corona Virus Disease – 19 or COVID – 19 is a dangerous type of virus that is aerosol and has the potential for transmission through the air. COVID-19 quickly spread to every part of the world in a short period. Due to this condition, WHO declared COVID – 19 as a pandemic in 2020. The pandemic has brought unprecedented changes in our daily lives including the work cycle of an employee. PT. PHE ONWJ is one of the oil and gas exploration and production companies in Indonesia that is experiencing a change in the work cycle for offshore workers. The normal work cycle before the pandemic era was 12:12 (12 working days with 12 days off), but during a pandemic, the work cycle changed to 21:21 with several health protocols that must be followed by all the workers.

The phenomenon that occurs in the field, workers are allowed to work more than 21 days or extended days if they have to replace their co-workers who are unable to carry out their duties due to tested positive for COVID-19. This condition was resulting the respective workers who work more than 21 days would have a long and unbalanced work cycle. In addition, a study conducted on offshore workers in several locations in the North Sea, United Kingdom, as mentioned in the book *Offshore working time about performance, health, and safety*, University of Oxford (Parkes, 2010) stated that based on workers perspective, 3 weeks of work (21 working days and 21 days off) is very unprofitable when it compared to 2 weeks (14 working days – 14 days off) of work. In the North Sea, offshore rig workers stated further “Three weeks is too long to be far from home”. Other references with the topic of Time-of-day and days-on-shift predict increased fatigue over two-week offshore dayshifts. Applied Ergonomics (Riethmeister et al., 2019) suggests that pre and post-shift fatigue accumulates in various ways over a two-week offshore period. This study discovered that the accumulation of post-shift fatigue scores was closely related to the following days in the next shift and experiencing chronic sleep deprivation. In addition, it was also stated that extending the offshore period (in this

study more than 14 days or two weeks of work shift period), may result in an increased risk of fatigue of the workers. Based on data collected in the field, more than 50% of workers have experienced an extended day and assume that the duration of work is too long, causing fatigue and workload in the field. When compared with several studies that have been conducted about the duration of the offshore work cycle, the average company applies a 14-working day cycle with 14 days off.

This study aims to determine and compare the health factor and mental workload of offshore workers with 21 days working days and workers with 21 days and extended day working days as one of the considerations to set the optimal work cycle alternative in PHJ ONWJ during the pandemic COVID-19. This study is expected to provide a work cycle alternative for offshore workers. This alternative can be a consideration for the stakeholder to make decisions about the work cycle for offshore workers during the COVID-19 pandemic.

2. Literature Review

2.1 Workload

According to Meshkati in Astianto (2014) in Asti (2017) (Hamad et al., 2020) workload can be defined as a difference between capacity or workers' ability with the demand of work that workers must be faced. Considering that human work is about mental and physical, therefore everyone has a different level of work loading. A high level of work loading followed by using excessive energy and overstressed is possible for the workers, on the contrary, a low level of work loading is likely to cause the workers to get bored easily or be under-stressed. Therefore, it is necessary to discuss the optimum level of work loading. Therefore, it is necessary to strive for the optimum level of loading intensity that exists between the two extreme limits, and of course, it must be different from one individual to another. According to Moekijat (2004) in *Analisa Beban Kerja dan Konflik Terhadap Kepuasan Kerja Karyawan* (Mauraksa et al., 2019) workload is the volume of work results or records of work results that can show the volume produced by a number of employees in a certain department. The amount of work that must be completed by a group or person in a certain time or workload can be seen from an objective and subjective perspective.

2.2 Relation Between Blood Pressure and Work Shift System

Blood pressure is the pressure exerted on the walls of the artery. Blood pressure is usually described as the ratio of systolic pressure to diastolic pressure. Blood pressure is the amount of strength the heart needs when it pushes blood against the artery walls as the heart pumps blood around the body. Blood pressure consists of systolic blood pressure and diastolic blood pressure. Systolic blood pressure is the highest pressure because the left ventricle pumps blood into the arteries, while diastolic blood pressure is the lowest pressure when the heart is at rest. Normal blood pressure is when the systolic blood pressure is less than 120 mmHg, and the diastolic blood pressure is less than 80 mmHg. Systolic blood pressure is always higher than diastolic blood pressure Based on The Joint National Committee VII (JNC-VII) in the book *Analisa Beban Kerja dan Konflik Terhadap Kepuasan Kerja Karyawan* (Dhani Redhono Harioputro, dr., Sp.PD, KPTI, et al., 2018) blood pressure is classified into 4 with indicators of systolic pressure and diastolic pressure as shown in the following Table 1:

Table 1. Blood Pressure Categories Based on The Joint National Committee VII (JNC – VII)

Blood Pressure Classification	Systolic Pressure (mmHg)	Diastolic Pressure (mmHg)
Normal	<120 or	<80
Pre-Hypertension	120 – 139 or	80 – 89
Hypertension Stage 1 (moderate)	140 – 159 or	90 – 99
Hypertension Stage 2 (severe)	>160 or	>100

2.3 NASA TLX (National Aeronautics and Space Administration Task Load Index)

NASA TLX is a subjective method which often used to measure workload mental in various industries. NASA TLX was developed by Sandra G. Hart from NASA-Ames Research Center and Lowell E. Staveland from San Jose State University in 1981(Hart & Staveland, 1988). This method used a questionnaire that was constructed based on demands

for a subjective measurement that was easier and more sensitive to workload. NASA TLX consists of 6 elements that will be measured in every individual involved in the test. The six elements are mental demand, physical demands, temporal demand, performance, effort, and frustration. Each element has a range score from low scale to high scale. The result of NASA TLX will be in WWL (Weighted Workload) with several classifications of workload mental scale. (Table 2)

Table 2. The Scale of Workload (Diniaty & Mulyadi, 2016)

Categories	Scale
Very Low	0 – 20
Low	21 – 40
Moderate	41 – 60
High	61 - 80
Very High	81 - 100

2.4 AHP – Expertise Judgement

This study used the AHP method as multi-criteria decision-making in proposing alternative decisions for the on-duty rotation schedule of offshore workers. Ciptomulyono (2001) explained that the AHP approach was developed from the measurement theory related to quantitative/non-quantitative (tangible/intangible) decision criteria in a decision model containing conflictual resolution. Therefore, the principle of this approach seeks to accommodate the decision maker's cognitive aspects, experience, and subjective knowledge as the basic data that determine the decision-making process. The approach using expert judgment does not emphasize the number of samples taken, but rather emphasizes the capability of the respondents in answering questions related to the issues (Gay and Diehl in Jaya et al., 2018). AHP is used to compare the notions or judgments of stakeholders about problems that need to be decided

(Yandri, 2018). So, from the results of the expert survey, the matrix will be processed and assessed in a combined matrix with a hierarchy of indicators or factors.

3. Methods

This study performed several data testing and method. Secondary data such as blood pressure records from one of the offshore PHES ONWJ is used to observe the status of physical health of the workers. To measure workload mental, this study used NASA TLX, which was distributed to all the PHE ONWJ workers. Workload mental data will be used as one of the criteria for AHP – Expertise Judgement to determine the alternative cycle offshore during the COVID-19 pandemic. AHP – Expertise Judgement used 4x4 metrics with the criteria emphasize in workload, accommodation, and transportation fee, health protocol, field operations and work cycle alternative 12:12, 14:14, 18:18, and 21:21.

4. Data Collection

142 respondents participated in the NASA TLX test with the characteristic 69 workers have never performed working with an extended day and 73 workers have performed extended day in their work. Out of the 73 workers who have had an extended day, the majority have done 7 days of extended days. So, the total duration of work in offshore for the respective workers is 28 days with 14 days off.

5. Results and Discussion

5.1. Recapitulation of Blood Pressure Records

The data of blood pressure systolic and diastolic blood pressure tests were collected in Mike – Mike Flow Station as one of the ONWJ offshore locations.

Table 3. Statistic of Offshore Workers Mike - Mike F/S Based on Blood Pressure Categories (Group A, January – April 2022)

Categories	Range of blood pressure systolic/diastolic (mmHg)	Personnel
Normal	120/80	13
	110/70	11
Pre-Hypertension	125/80	2
	130/80	1
	130/90	1
Hypertension stage 1	140/90	1
Total		29

Table 4. Statistic of Offshore Workers with Extended Day Mike/Mike F/S based on Blood Pressure Categories (January – April 2022)

Categories	Range of blood pressure systolic/diastolic (mmHg)	Personnel
Normal	120/80	9
	110/70	8
	100/60	2
Pre-Hypertension	130/80	2
Total		21

The data above showed that all Group A offshore workers at Mike – Mike F/S PHE ONWJ have an average normal blood pressure range which is in the range of 100 mmHg – 120 mmHg for systolic and 60 mmHg – 90 mmHg diastolic for the duration of work 21 days to 29 working days in the field. Nevertheless, statistically, there are at least 1 to 2 personnel classified as Pre-Hypertension or showing an increase in blood pressure during health monitoring. However, apart from physical activity or exposure due to the risk of work in the field, the increase in blood pressure can also be affected by the age of the worker. (Table 3 & 4)

5.2. NASA TLX

In the NASA TLX test, respondents completed the questionnaires to rate 6 workload indicators (0 – 100) and the number of trends in workload indicators based on pairwise comparisons. Furthermore, the rating score of each indicator for each respondent will be calculated and summed to obtain the WWL (weighted workload).

For example, respondent 1:

Score per indicator (Mental Needs) = 4 x 40 = 160

Score per indicator (Physical Needs) = 4 x 90 = 360

Score per indicator (Time Requirement) = 2 x 90 = 180

Score per indicator (Performance) = 1 x 90 = 90

Score per indicator (Level of Effort) = 0 x 90 = 0

Score per indicator (Level of Frustration) = 4 x 100 = 400

the WWL score is:

$WWL = 160 + 360 + 180 + 90 + 0 + 400 = 1.190$

Average WWL = $1190 / 15 = 79.33$ high mental workload classification

Based on the data and the calculations, the recapitulation and the comparison of mental workload for offshore workers with 21 days and offshore workers with 21 days and extended days will be specified in the table below.

Table 5. Comparison Between WWL Offshore Workers without Extended day and Offshore Workers with Extended Days

Worker Classification	Total Indicator Score (all respondents)						WWL	Average Score
	Mental Demands	Physical Demands	Temporal Demands	Performance	Efforts	Frustration		
21: 21	18.540	14.000	18.400	11.870	8.030	11.160	82.000	80,67
Extended day	22.770	17.970	17.190	12.570	8.380	13.970	92.850	84,79

Table 5 demonstrates the WWL score for workers with 21:21 who were exposed to a high mental workload and the workers with extended days reported having a very high mental workload than 21:21 workers. In conclusion, working on an offshore platform with more than 21 days of work is considered to have a very high workload in terms of mental needs, time requirements, physical needs, performance, effort, and frustration.

5.3 AHP – Expertise Judgement

In the AHP – Expertise Judgment test, 7 expertises participated in the assessment of weighing and comparing each criterion. From each weight given by the experts, a combined matrix will be calculated and the determination of the value of the consistency ratio (CR) must be less than 10% to obtain optimal results (saaty, 1990). Table 6 below will specify the result of the combined matrix calculation for the 4 criteria

Tabel 6. Combined Matrix Criteria

GOAL	Workload	A&T Fee	Health Protocol	Ops	VE	VP	VA	VB	Q max :
Workload	1,000	2,241	0,718	1,952	1,331	0,309	1,243	4,017	4,0333
A&T fee	0,446	1,000	0,359	1,000	0,633	0,147	0,591	4,021	CI : 0,0111
Health Protocol	1,392	2,784	1,000	1,669	1,595	0,371	1,499	4,046	
Ops	0,512	1,000	0,599	1,000	0,744	0,173	0,701	4,050	
					4,303			16,133	CR : 0,0124

Based on Table 6 above, the eigenvector (VP) value for the mental workload is 0.309, accommodation and transportation costs are 0.147, health protocol is 0.371, and field operations are 0.173. The health protocol factor became the dominant criterion with a weight of 0.371 or 37.1% and mental workload became the second dominant factor. The CR value was obtained from the consistency index ratio and the random index (RI) value. The RI value is obtained from the clause of the Oak Ridge laboratory which required the 4x4 matrix size to be 0.09. The CR value is 0.0124 which is smaller than 0.1, thus the weight or eigenvector value of the criterion matrix can be assumed to be consistent and valid.

For alternative comparisons, the same calculation method is used for each criterion. For workload criteria with a work cycle of 12:12, 14:14, 18:18 and 21:21 the eigenvector is determined. So does the calculation of the other 3 criteria to obtain the eigenvector value of the alternative combined matrix against the criteria.

Table 7. Eigenvector Combined Matrix Alternative Against the Criteria

Alternative	Alternative related to the Mental Workload	Alternative related to A&T fee	Alternative related to health Protocol	Alternative related to the Operational
12:12	0,437	0,322	0,387	0,395
14:14	0,250	0,236	0,244	0,219
18:18	0,172	0,232	0,182	0,189

21:21	0,140	0,209	0,187	0,198
-------	-------	-------	-------	-------

From the weight values of the criteria and alternatives as shown in Tables 6 and 7, the vertical AHP calculation is then performed by multiplying the eigenvector weight of each alternative by the weight of the respective criteria.

Table 8. AHP Vertical Calculation Determination of Offshore Work Cycle PHE ONWJ

Alternative	Alternative related to Workload	Alternative related to A&T fee	Alternative related to health Protocol	Alternative related to the Operational	Criteria Value	Alternative Value
12:12	0,437	0,322	0,387	0,395	0,309	0,394
14:14	0,250	0,236	0,244	0,219	0,147	0,240
18:18	0,172	0,232	0,182	0,189	0,371	0,188
21:21	0,140	0,209	0,187	0,198	0,173	0,178
					1,000	1,000

Example of Calculation: Alternative 12:12

$$\text{Alternative weight} = (0.437 \times 0.039) + (0.322 \times 0.147) + (0.387 \times 0.371) + (0.395 \times 0.173) = 0.394$$

From the results of the vertical AHP calculation, the 12:12 alternative has a weighted value of 0.394 or equivalent to 39.4%. For 14:14 alternative with a weight of 0.24 or equivalent to 24%, and for alternative 18:18 – 21:21 become 2 alternatives with the lowest weights, which are 18.8% and 17.8%. To conclude using the AHP - Expertise Judgment method for determining the work cycle for PHE ONWJ offshore workers during the COVID-19 pandemic, the 12:12 cycle is the sum of on-duty and off duty durations with the highest weight of 0.394 or 39.4%. However, if an alternative number of work cycles is needed as a consideration for the company, then based on the AHP test, 14:14 cycles with a weight of 0.24 or 24% can be an option.(Table 8 & Figure 1)

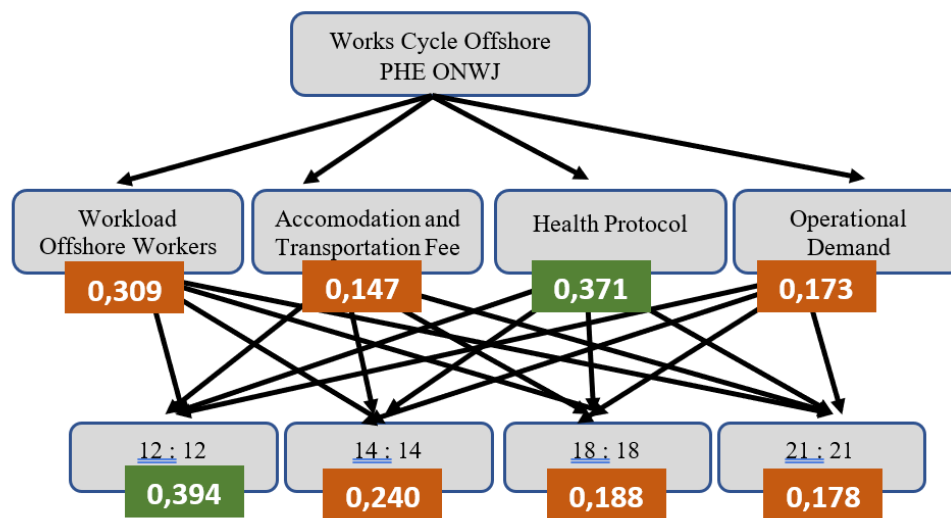


Figure 1. Conclusion of Alternative Weight Results of Offshore Work Cycle PHE ONWJ

6. Conclusion

This study discovers that the average offshore worker's blood is still classified as normal which is below 120mmHg/80mmHg for both workers whether they have 21 days working days or more than that. Therefore, the physical health of workers can still be stated to be good and fit to work. However, monitoring the physical health of workers every week is still required by regulation. For the level of workload for offshore workers based on the results

of the NASA TLX test, it was discovered that workers with a 21:21 cycle had an average WWL in the high category of 80.67, and the average worker who had experienced an extended day with an average WWL of 84.79 or categorized as a very high category.

For the analysis of alternative offshore work cycles using the AHP – Expertise Judgment method with 4 criteria and 4 alternatives, this study discovered that the health protocol is the main criterion with the highest weight value of 37.1% and followed by workload with a weight of 30.9%. As for the alternative weights based on the existing criteria, the 12:12 cycle becomes the main alternative to be re-applied as a work cycle with a weight of 39.4% and followed by a cycle of 14:14 with a weight of 24% as a second alternative. Management should discuss further about taking a significant step and efforts to change the offshore work cycle in the PHE ONWJ during pandemic to make the workers feel safe and most likely will reduce the workload in the field and will increase the safety and avoid accidents due to the exhaustion of the workers.

References

- Dhani Redhono Harioputro, dr., Sp.PD, KPTI, F., Yuliana Heri Suselo, dr., Ms., Betty Suryawati, dr., M., Sugiarto, dr., Sp.PD, F., R. Aj. Sri Wulandari, dr., Ms., Atik Maftuhah, D., & Dr. Ida Nurwati, dr., Mk. BUKU MANUAL KETERAMPILAN KLINIK TOPIK BASIC PHYSICAL EXAMINATION : PEMERIKSAAN TANDA VITAL. In *Kementrian Riset, Teknologi, dan pendidikan tinggi Universitas Sebelas Maret Fakultas Kedokteran* (Issue 0271). (2018).
- Diniaty, D., & Mulyadi, Z. Analisis Beban Kerja Fisik Dan Mental Karyawan Lantai Produksi Dipt Pesona Laut Kuning. *Jurnal Sains, Teknologi, Dan Industri*, 13(2), 203–210. (2016). <http://ejournal.uin-suska.ac.id/index.php/sitekin/article/view/1735>
- Hamad, A., Agung, S., & Firdaus, M. A. Pengaruh Beban Kerja Dan Stres Kerja Terhadap Prestasi Kerja Karyawan. *Manager : Jurnal Ilmu Manajemen*, 3(3), 352. (2020).<https://doi.org/10.32832/manager.v3i3.3867>
- Hart, S. G., & Staveland, L. E. Development of NASA-TLX. *Human Mental Workload. Advances in Psychology*, 52, 139–183. (1988).
- Mauraksa, A., Danial, R. D. M., & Norisanti, N. Analisis Beban Kerja dan Konflik terhadap Kepuasan Kerja Karyawan. *BUDGETING : Journal of Business, Management and Accounting*, 1(1), 21–27. (2019). <https://doi.org/10.31539/budgeting.v1i1.779>
- Parkes, K. R. *Offshore working time in relation to performance , health and safety - A review of current practice and evidence*. 1–70. (2010).
- Riethmeister, V., Matthews, R. W., Dawson, D., de Boer, M. R., Brouwer, S., & Bültmann, U. Time-of-day and days-on-shift predict increased fatigue over two-week offshore day-shifts. *Applied Ergonomics*, 78(February), 157–163. (2019). <https://doi.org/10.1016/j.apergo.2019.02.010>
- Saaty, T. L. How to make a decision: The analytic hierarchy process. *European Journal of Operational Research*, 48(1), 9–26. (1990). [https://doi.org/10.1016/0377-2217\(90\)90057-I](https://doi.org/10.1016/0377-2217(90)90057-I)
- Yandri, P. Pengambilan Keputusan Dengan Pendekatan Analytical Hierarchy Process (AHP) Studi Kasus pada Pengembangan Kawasan Situ Pulo, Bekasi. *Liquidity*, 2(1), 87–99. (2018). <https://doi.org/10.32546/lq.v2i1.135>

Biography

Tegar Jaya Saka Buana is an employee at oil and gas company in Jakarta, Indonesia who is also a student of the master's program at *Sekolah Interdisiplin Manajemen Teknologi (SIMT)*, Sepuluh Nopember Institute of Technology, Indonesia. In 2020, The Electro Industry of Engineering alumnus of the *Politeknik Elektronika Negeri Surabaya* began pursuing her master's degree in Industrial Management. His experience working in Operations and Production Oil and Gas that interested him in human safety management further.

Adithya Sudiarno is a doctor and lecturer in Industrial and System Engineering Department and Master's program at *Sekolah Interdisiplin Manajemen Teknologi (SIMT)*, Sepuluh Nopember Institute of Technology, Indonesia. Dr. Adithya's research is about HSE (Health Safety Engineering), workload assessment, human factors-ergonomics, innovation management, and risk management. Nowadays, he holds an Intermediate Professional Engineer degree (IPM) and an ASEAN professional engineer degree (ASEAN Eng)