LOAD PROFILE OF WORKFORCE USING WESTINGHOUSE METHOD IN WAREHOUSE WORK SYSTEM

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ABSTRACT

Workers play a crucial role in a company, and their workload significantly influences productivity. This research was conducted in a manufacturing company, specifically in the Warehouse Department (storage section), due to indications of low productivity. The research objective was to analyze the workload profiles of workers in the storage section of the manufacturing company's warehouse. The analysis was conducted using the Westinghouse method, which considers skill, effort, condition, and consistency in analyzing work time. Cycle time to standard time was calculated considering rating factors and allowances. The research results revealed that the four workers in this section experienced workload levels of 68% for Worker 1, 28% for Worker 2, 57% for Worker 3, and 50% for Worker 4. Overall, the workers exhibited an underloaded workload profile. The highest underload was observed in Worker 2, indicating the lowest productivity among the four workers. Based on these findings, it is recommended to enrich the job tasks for workers in the warehouse or consider transferring them to other departments that require additional workforce to improve the current work system in the warehouse.

***Keywords**: load profile; warehouse; Westinghouse; workload; work system*

ABSTRAK

Pekerja memiliki fungsi yang penting di perusahaan dan kinerjanya mempengaruhi produktivitas. Penelitian ini dilakukan di perusahaan manufaktur pada bagian Gudang (seksi penyimpanan barang) yang terindikasi kurang produktif. Tujuan penelitian adalah untuk menganalisis profil pembebanan pada pekerja seksi penyimpanan barang di gudang perusahaan manufaktur. Analisis dilakukan menggunakan pendekatan metode Westinghouse dengan mempertimbangkan skill, sffort, condition dan consistency dalam analisis waktu kerja yang dilakukan. Waktu siklus hingga waktu standar dihitung dengan mempertimbangkan rating factor dan allowance. Hasil penelitian mengungkapkan bahwa empat orang pekerja pada seksi ini mengalami pembebanan kerja sebesar 68% pada pekerja 1, 28% untuk pekerja 2, 57% untuk pekerja 3, dan 50% untuk pekerja 4. *Keseluruhan pekerja menunjukkan profil pembebanan yang underload. Underload terbesar dialami pekerja 2 yang mengindikasikan produktivitas terendah diantara keempat pekerja. Berdasarkan pada temuan ini disarankan untuk memperkaya pekerjaan atau memindahkan ke bagian lain yang membutuhkan untuk memperbaiki sistem kerja saat ini di gudang.*

***Kata Kunci**: profil beban; gudang; Westinghouse; beban kerja; sistem kerja*

INTRODUCTION

Workers play a crucial role in a business, and their performance is expected to help the company achieve its goals. The company naturally expects its employees to work productively with well-managed workloads within the available working hours. According to Nwinyokpugi (2018), workload management is highly correlated with employee efficiency. Effective time management is crucial for workers to enhance work productivity (Lukodono & Ulfa, 2018).

This research was conducted in the storage section of the Warehouse Department in a manufacturing company. The storage section is responsible for storing various items in the company's

warehouse, including gearboxes, spare parts, and even office supplies. They also handle promotional items sent to customers, such as t-shirts and umbrellas. Currently, the workforce in the storage section consists of one supervisor, one foreman, and two operators. This study was conducted to understand the workload profiles of workers in the warehouse due to indications of low productivity in their work.

Several previous studies have been conducted on employee workload. For example, Sari et al. (2019) examined the workload of employees in the fertilizer industry. The research findings showed that five operators experienced overloads, leading to a recommendation for an additional workforce. Budaya & Muhsin (2018) investigated the workload in the Quality Control Department. Their findings revealed that nine individuals experienced workloads above 100%. Wahyuni et al. (2018) analyzed the workload in a welding workshop. The research results suggested the addition of one worker to reduce the workload and prevent overloading.

Workload is a critical area of study as it significantly impacts worker productivity. According to Shishira et al. (2017), understanding the characteristics of workload is key to making optimal decisions and improving system performance. Therefore, the purpose of this research is to analyze the workload of employees in the Warehouse Department to determine whether it is overloaded or underloaded. This analysis will enable management to review and make informed decisions regarding workload allocation.

METHODS

The methodology employed in this research begins with the identification of the types of activities performed by each worker in the Warehouse Department at all levels. Time measurements are then taken using a stopwatch in the four warehouse employees through work sampling. According to de la Riva et al. (2015), the duration of work sampling depends on the study's requirements and can range from hours to days to determine the percentage of time and intensity for each activity during working hours. Time measurements are taken for each activity performed. The time for each activity is multiplied by its frequency in a month, and it can be multiplied by the number of goods (according to the type of activity) to obtain the total time spent by each worker in a month on their tasks. The Westinghouse approach is employed in calculating the cycle time (Ws) of the workers by assigning a Rating Factor (RF). This Rating Factor includes considerations of skill, effort, condition, and consistency (Cevikcan et al., 2012). The normal time (Wn) is then calculated using the determined rating factor and cycle time. Allowances (allw) are set for each activity, followed by the calculation of the standard time (Wstd) based on the previous normal time and allowances. The workload percentage for each worker is then calculated by comparing it with the available time (W available).

RESULTS AND DISCUSSIONS

Identification of activities for each worker in the storage section of the Warehouse Department was conducted in detail, and time measurements were taken for each activity using a stopwatch. The measured time was then multiplied by the frequency of the activities. For example, for activity 1a, 'Receive and check the documents', the stopwatch recorded a time of 0.32 minutes, and it occurred six times in a month. Thus, the cycle time (Ws) for this activity is calculated as 0.32 minutes multiplied by six, resulting 1.92 minutes. Similarly, for activity 1b, 'Receive and check the conformity of the deposited goods', the stopwatch recorded a time of 0.63 minutes, and it occurred 6 times a month with a quantity of four. Therefore, the cycle time for this activity is calculated as 0.63 minutes multiplied by six and then by four, resulting in 15.12 minutes. However, some activities may only occur once a month. The overall cycle time for each job is presented in Table 1 for Worker 1 (operator level), Table 3 for Worker 2 (operator level), Table 4 for Worker 3 (foreman level), and Table 5 for Worker 4 (supervisor level). These tables display the calculated cycle times for each worker's activities.

Table 1. Working time measurement of worker 1

Job Code	Job Description	Minutes/month					
		W stopwatch	Ws	RF	Wn	Allw	Wstd
1	1. Receiving Service (ANP)						

Job Code	Job Description	Minutes/month					
		W stopwatch	Ws	RF	Wn	Allw	Wstd
1a	a. Receive and check the documents	0.32	1.89	0.16	2.19	0.21	2.65
1b	b. Receive and check the conformity of the deposited goods	0.63	15.12	0.16	17.54	0.21	21.22
1c	c. Provide deposited goods identity	0.19	1.13	0.16	1.32	0.21	1.59
1d	d. Request approval from section head and provide document sequence identity	0.38	2.27	0.16	2.63	0.21	3.18
1e	e. Record transactions on the computer and provide duplicate slips to the user	0.82	19.66	0.16	22.80	0.21	27.59
1	1. Receiving Service (Spare Part)						
1d	d. Request approval from section head and provide document sequence identity	0.47	0.47	0.16	0.55	0.21	0.66
1e	e. Record transactions on the computer and provide duplicate slips to the user	1.13	523.91	0.16	607.73	0.21	735.36
2	2. Receiving Service of office supplies (ATK)						
2a	a. Receive and check the documents	0.32	7.88	0.16	9.14	0.21	11.05
2b	b. Receive and check the conformity of ATK	0.63	31.50	0.16	36.54	0.21	44.21
2c	c. Ask for section head signature for handover	0.38	9.45	0.16	10.96	0.21	13.26
2d	d. Type transaction on the computer	0.82	40.95	0.16	47.50	0.21	57.48
3	3. Retrieval Service (ANP)						
3a	a. Receive and check the documents	0.32	5.67	0.16	6.58	0.21	7.96
3b	b. Search and retrieve deposited goods	1.13	81.65	0.16	94.71	0.21	114.60
3c	c. Request approval from section head and provide document sequence identity	0.38	6.80	0.16	7.89	0.21	9.55
3d	d. Record transactions on the computer and provide duplicate slips to the user	0.82	58.97	0.16	68.40	0.21	82.77
3	3. Retrieval Service (Spare Part)						
3c	c. Request approval from section head and provide document sequence identity	0.47	0.47	0.16	0.55	0.21	0.66
3d	d. Record transactions on the computer and provide duplicate slips to the user	1.13	74.84	0.16	86.82	0.21	105.05
4	4. Retrieval Service of office supplies (ATK)						
4a	a. Receive and check the documents	0.32	20.48	0.16	23.75	0.21	28.74
4b	b. Check availability and budget of ATK	0.32	81.90	0.16	95.00	0.21	114.95
4c	c. Search and retrieve ATK	1.13	294.84	0.16	342.01	0.21	413.84
4d	d. Record transactions on the computer and provide duplicate slips to the user	1.13	294.84	0.16	342.01	0.21	413.84
5	5. Storing (ATK)						
5a	a. Organize tidiness and security of deposited goods	0.63	31.50	0.16	36.54	0.21	44.21
5b	b. Find location and store the deposited goods	0.63	31.50	0.16	36.54	0.21	44.21
5c	c. Record location of deposited goods storage in the master stock data and transaction data	0.95	47.25	0.16	54.81	0.21	66.32
5	5. Storing (ANP)						
5a	a. Organize tidiness and security of deposited goods	0.95	22.68	0.16	26.31	0.21	31.83
5b	b. Find location and store the deposited goods	0.95	22.68	0.16	26.31	0.21	31.83
5c	c. Record location of deposited goods storage in the master stock data and transaction data	0.95	22.68	0.16	26.31	0.21	31.83

Job Code	Job Description	Minutes/month					
		W stopwatch	Ws	RF	Wn	Allw	Wstd
6	6. Stock-Taking/Stock Opname (ATK)						
6a	a. Summarize and copy master stock data	4.41	4.41	0.16	5.12	0.21	6.19
6b	b. Contact user	0.63	0.63	0.16	0.73	0.21	0.88
6c	c. Count and check the conformity of deposited goods	37.80	37.80	0.16	43.85	0.21	53.06
6d	d. Record physical counting of deposited goods	9.45	9.45	0.16	10.96	0.21	13.26
6e	e. Prepare physical counting of ATK report	6.30	6.30	0.16	7.31	0.21	8.84
6	6. Stock-Taking/Stock Opname (ANP)						
6a	a. Summarize and copy master stock data	4.41	4.41	0.16	5.12	0.21	6.19
6b	b. Contact user	0.63	0.63	0.16	0.73	0.21	0.88
6c	c. Count and check the conformity of deposited goods	37.80	37.80	0.16	43.85	0.21	53.06
6d	d. Record physical counting of deposited goods	9.45	9.45	0.16	10.96	0.21	13.26
6e	e. Prepare physical counting of deposited goods	6.30	6.30	0.16	7.31	0.21	8.84
6	6. Stock-Taking/Stock Opname (PLC)						
6a	a. Summarize and copy master stock data	4.41	4.41	0.16	5.12	0.21	6.19
6b	b. Contact user	0.63	0.63	0.16	0.73	0.21	0.88
6c	c. Count and check the conformity of deposited goods	37.80	37.80	0.16	43.85	0.21	53.06
6d	d. Record physical counting of deposited goods	9.45	9.45	0.16	10.96	0.21	13.26
6e	e. Prepare physical counting of deposited goods	6.30	6.30	0.16	7.31	0.21	8.84
7	7. Monthly Reporting (ALL)						
7a	a. Process master stock data and transaction data of deposited goods	240.00	240.00	0.16	278.40	0.21	336.86
8	8. Usage Reporting of A&P						
8a	a. Process transaction data of A&P issue	30.00	30.00	0.16	34.80	0.21	42.11
8b	b. Prepare usage report of A&P	15.00	15.00	0.16	17.40	0.21	21.05
9	9. Usage Reporting of ATK						
9a	a. Process transaction data of ATK issue	30.00	30.00	0.16	34.80	0.21	42.11
9b	b. Prepare usage report of ATK	15.00	15.00	0.16	17.40	0.21	21.05
10	10. Follow-up report of deposited goods						
10a	a. Process master stock data of deposited goods based on last issue	30.00	30.00	0.16	34.80	0.21	42.11
10b	b. Prepare follow-up report of deposited goods	15.00	15.00	0.16	17.40	0.21	21.05
10e	e. Record follow-up result of a master stock data	15.00	15.00	0.16	17.40	0.21	21.05
R5S	R5S. 5S						
Ia	a. Sort out unnecessary documents/goods	405.00	405.00	0.16	469.80	0.21	568.46
Ib	b. Organize the working area and put the goods/documents in the proper place	405.00	405.00	0.16	469.80	0.21	568.46
Ic	c. Clean the working area and goods/documents	405.00	405.00	0.16	469.80	0.21	568.46
Id	d. Check and/or maintain working equipment and vehicle	405.00	405.00	0.16	469.80	0.21	568.46
II	II. Other supporting activities		778.31	0.16	902.83	0.21	1092.43
					T O T A L		6620.85

According to Cevikcan et al. (2012), the Westinghouse method is also known as the LMS method, named after the creators: Lowry, Maynard, and Stagemerten, who developed it at Westinghouse and published it in 1972. The method analyses four factors: skill, effort, conditions, and consistency, each with six levels: poor, fair, average, good, excellent, and super skill. Each factor has two degrees: higher or lower. In this research, each worker was evaluated to determine their Rating Factor (Table 2). Allowance is a significant coefficient in calculating the standard time, which is intended to ensure that workers maintain their performance level at 100% throughout the working day (de la Riva et al., 2015).

Table 2. Westinghouse Rating Factor

Worker	Rating Factor			
Worker 1	Skill	Excellent	B2	0.08
	Effort	Good	C1	0.06
	Conditions	Good	C	0.02
	Consistency	Average	D	0.00
	Total			0.16
Worker 2	Skill	Good	C1	0.06
	Effort	Fair	E2	-0.08
	Conditions	Good	C	0.02
	Consistency	Fair	E	-0.02
	Total			-0.02
Worker 3	Skill	Excellent	B2	0.08
	Effort	Excellent	B2	0.08
	Conditions	Average	D	0.00
	Consistency	Good	C	0.01
	Total			0.17
Worker 4	Skill	Excellent	B2	0.08
	Effort	Excellent	B2	0.08
	Conditions	Good	C	0.02
	Consistency	Good	C	0.01
	Total			0.19

Based on Table 1, Worker 1 has a total standard work time per month of 6620.85 nimutes.

Table 3. Working time measurement of worker 2

Job Code	Job Description	Minutes/month					
		W stopwatch	Ws	RF	Wn	Allw	Wstd
1	1. Receiving Service (CAT)						
1a	a. Receive and check the documents	0.00	0.00	-0.02	0.00	0.21	0.00
1b	b. Receive and check the conformity of the deposited goods	0.00	0.00	-0.02	0.00	0.21	0.00
1c	c. Provide deposited goods identity	0.00	0.00	-0.02	0.00	0.21	0.00
1d	d. Request approval from section head and provide document sequence identity	0.00	0.00	-0.02	0.00	0.21	0.00
1e	e. Record transactions on the computer and provide duplicate slips to the user	0.00	0.00	-0.02	0.00	0.21	0.00
3	3. Retrieval Service (CAT)						
3a	a. Receive and check the documents	0.41	9.32	-0.02	9.13	0.21	11.05
3b	b. Search and retrieve deposited goods	1.46	100.60	-0.02	98.59	0.21	119.29
3c	d. Request approval from section head and provide document sequence identity	0.49	11.18	-0.02	10.95	0.21	13.25
3d	e. Record transactions on the computer and provide duplicate slips to the user	1.05	72.66	-0.02	71.20	0.21	86.16
5	5. Storing (CAT)						
5a	a. Organize tidiness and security of deposited	0.00	0.00	-0.02	0.00	0.21	0.00

Job Code	Job Description	Minutes/month					
		W stopwatch	Ws	RF	Wn	Allw	Wstd
	goods						
5b	b. Find location and store the deposited goods	0.00	0.00	-0.02	0.00	0.21	0.00
5c	c. Record location of deposited goods storage in the master stock data and transaction data	0.00	0.00	-0.02	0.00	0.21	0.00
6	6. Stock-Taking/Stock Opname (CAT)						
6a	a. Summarize and copy master stock data	5.67	5.67	-0.02	5.56	0.21	6.72
6b	b. Contact User	0.81	0.81	-0.02	0.79	0.21	0.96
6c	c. Count and check the conformity of deposited goods	48.60	48.60	-0.02	47.63	0.21	57.63
6d	d. Record physical counting of deposited goods	12.15	12.15	-0.02	11.91	0.21	14.41
6e	e. Prepare physical counting of deposited goods report	8.10	8.10	-0.02	7.94	0.21	9.60
R5S	R5S. 5S						
Ia	a. Sort out unnecessary documents/goods	405.00	405.00	-0.02	396.90	0.21	480.25
Ib	b. Organize the working area and put the goods/documents in the proper place	405.00	405.00	-0.02	396.90	0.21	480.25
Ic	c. Clean the working area and goods/documents	405.00	405.00	-0.02	396.90	0.21	480.25
Id	d. Check and/or maintain working equipment and vehicle	405.00	405.00	-0.02	396.90	0.21	480.25
II	II. Other supporting activities		105.00	-0.02	102.90	0.21	124.51
				T O T A L			2364.58

Based on Table 3, Worker 2 has a standard work time of 2364.58 minutes per month in performing his tasks.

Table 4. Working time measurement of worker 3

Job Code	Job Description	Minutes/month					
		W stopwatch	Ws	RF	Wn	Allw	Wstd
1	1. Receiving Service (Spare Part)						
1a	a. Receive and check the documents	0.28	3.92	0.17	4.59	0.27	5.82
1b	b. Receive and check the conformity of the deposited goods	1.12	47.04	0.17	55.04	0.27	69.90
1c	c. Provide deposited goods identity	0.28	11.76	0.17	13.76	0.27	17.47
3	3. Retrieval Service (Spare Part)						
3a	a. Receive and check the documents	0.28	9.24	0.17	10.81	0.27	13.73
3b	b. Search and retrieve deposited goods	2.24	147.84	0.17	172.97	0.27	219.68
5	5. Storing (Spare Part)						
5a	a. Organize tidiness and security of deposited goods	1.68	70.56	0.17	82.56	0.27	104.85
5b	b. Find location and store the deposited goods	1.68	70.56	0.17	82.56	0.27	104.85
5c	c. Record location of deposited goods storage in the master stock data and transaction data	0.84	35.28	0.17	41.28	0.27	52.42
6	6. Stock-Taking/Stock Opname (Spare Part)						
6a	a. Summarize and copy master stock data	3.92	3.92	0.17	4.59	0.27	5.82
6b	b. Contact User	0.56	0.56	0.17	0.66	0.27	0.83
6c	c. Count and check the conformity of deposited goods	134.40	134.40	0.17	157.25	0.27	199.70
6d	d. Record physical counting of deposited goods	8.40	8.40	0.17	9.83	0.27	12.48
6e	e. Prepare physical counting of deposited goods report	5.60	5.60	0.17	6.55	0.27	8.32
11	11. Monitoring operational of section	540.00	540.00	0.17	631.80	0.27	802.39
12	12. Monitoring data and document flow	240.00	240.00	0.17	280.80	0.27	356.62
R5S	R5S. 5S						

Ia	a. Sort out unnecessary documents/goods	540.00	540.00	0.17	631.80	0.27	802.39
Ib	b. Organize the working area and put the goods/documents in the proper place	540.00	540.00	0.17	631.80	0.27	802.39
Ic	c. Clean the working area and goods/documents	540.00	540.00	0.17	631.80	0.27	802.39
Id	d. Check and/or maintain working equipment and vehicle	540.00	540.00	0.17	631.80	0.27	802.39
II	II. Other supporting activities		253.64	0.17	296.76	0.27	376.89
				T O T A L			5561.31

Worker 3 has a total standard work time of 5561.31 minutes to perform his tasks for one month.

Table 5. Working time measurement of worker 4

Job Code	Job Description	Minutes/month					
		W stopwatch	Ws	RF	Wn	Allw	Wstd
7	7. Monthly Report						
7b	b. Process data to become visual data (Power BI)	20	20.00	0.19	23.80	0.13	26.89
8	8. Usage Report of A& P						
8c	c. Reporting usage of A&P	15	15.00	0.19	17.85	0.13	20.17
9	9. Usage Report of ATK						
9c	c. Reporting usage of ATK	15	15.00	0.19	17.85	0.13	20.17
10	10. Follow-up report of deposited goods						
10c	c. Reporting deposited goods follow-up	5	5.00	0.19	5.95	0.13	6.72
10d	d. Follow-up	10	10.00	0.19	11.90	0.13	13.45
11	11. Monitoring operational of section	60	60.00	0.19	71.40	0.13	80.68
12	12. Monitoring data and document flow	60	60.00	0.19	71.40	0.13	80.68
13	13. Coordination with related parties	540	540.00	0.19	642.60	0.13	726.14
R5S	R5S. 5S						
Ia	a. Sort out unnecessary documents/goods	405	405.00	0.19	481.95	0.13	544.60
Ib	b. Organize the working area and put the goods/documents in the proper place	405	405.00	0.19	481.95	0.13	544.60
Ic	c. Clean the working area and goods/documents	405	405.00	0.19	481.95	0.13	544.60
Id	d. Check and/or maintain working equipment and vehicle	405	405.00	0.19	481.95	0.13	544.60
II	II. Other supporting activities		1275.00	0.19	1517.25	0.13	1714.49
				T O T A L			4867.81

Worker 4 has a standard work time of 4867.87 minutes to perform his tasks for one month. The available working time measurement is shown in Table 6, which is 9774 minutes per month.

Table 6. Available time measurement

Working Time per month			Time Allowance	Available Time/ W available (Minutes/month)
Days	Hours	Minutes		
27	181	10860	0.9	9774

The available work time in one month consists of 27 working days, with a total of 181 hours or 10860 minutes. With an allowance of 0.9, the available work time amounts to 9774 minutes per month. This time represents the maximum workload (100%).

Table 7. Work load percentage

Worker	Total Working Time (Minutes)	Load %
Worker 1	6620.85	68%
Worker 2	2364.58	24%
Worker 3	5561.31	57%
Worker 4	4867.81	50%

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By comparing the total working time with the available time, the load percentage for each worker can be determined (Table 7). The results indicate that there is still a considerable amount of unproductive time for each worker in the storage section of the warehouse. Figure 1 illustrates the load profile of each warehouse worker.

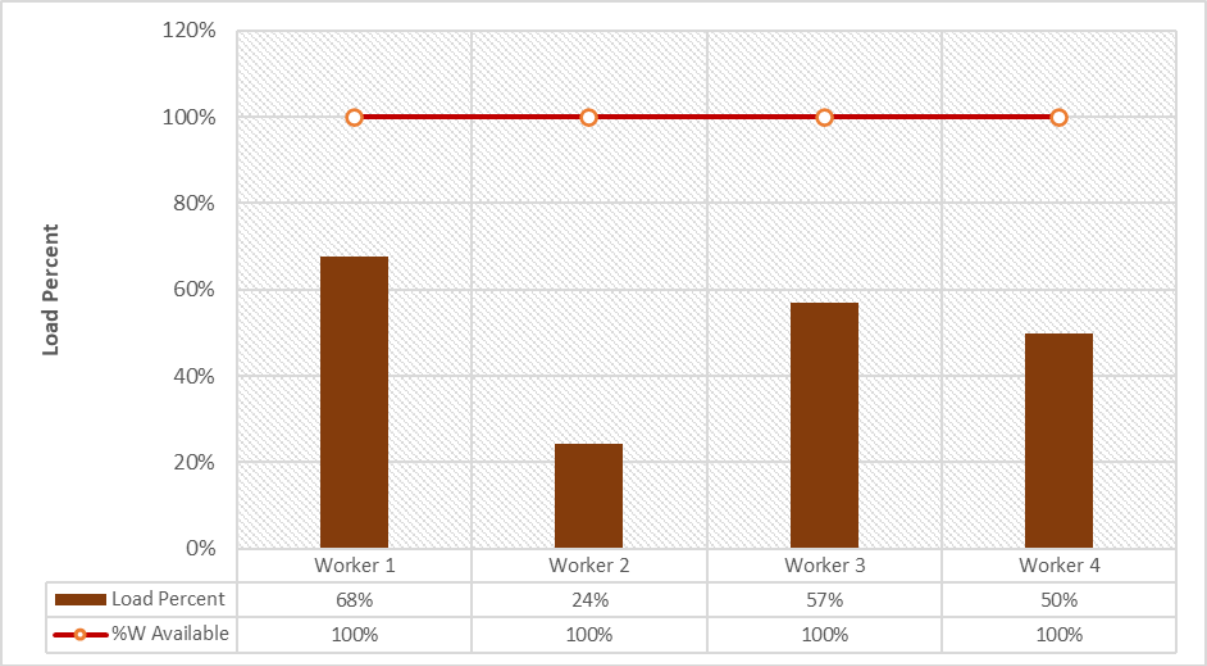

Figure 1. Load profile of warehouse workforce

Based on figure 1, current work system showed that all four workers in the storage section of manufacturing company's warehouse have an underloaded workload, including operators, foreman, and supervisor. Among the four workers, Worker 2 has the lowest workload (largest underload), resulting in low productivity. According to Hanjani and Singgih (2019), workload significantly affects worker productivity as the work environment and capacity align with productivity. The findings of this research indicate the presence of underutilized people, which is a form of waste in the work area. According to D'Antonio and Chiabert (2018), from the Lean perspective, the waste of underutilized people can be considered from the different side, such as an unbalanced distribution of tasks that involves more workforce than necessary and leads to wastage. Considering the obtained results, it is recommended that management address this issue and make policies to enrich employees' job tasks or consider transferring them to other sections that require additional workforce or are experiencing overload. This is necessary to improve the current work system in the warehouse.

CONCLUSIONS

Workers play a crucial role in any business. The research conducted in the storage section of the manufacturing company's warehouse involved calculating the workload of the four workers over in one month. All four workers have an underloaded workload. Worker 1 has a workload of 68%, Worker 2 has a workload of 26% (the lowest workload), Worker 3 has a workload of 57%, and Worker 4 has a workload of 50%. This underloaded condition indicates the occurrence of underutilized people, which is a form of waste in the workplace. Management is advised to consider enriching job tasks or transferring workers to other departments that require additional workforce.

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