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# Work Load Identification of Hotel's Shift Scheduling in Yogyakarta Indonesia

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**Abstract.** Services in hotel industry require workers to have direct interactions with the customers. Some hotel departments operate for 24 hours and apply shift work system for its workers. Shift schedule applied to the workers should consider the work load on top of fulfilling the workforce requirements. The objective of this research is to identify the work load of shift scheduling for hotels in Yogyakarta, Indonesia, i.e. physical and psychosocial work load. The shift schedules observed are collected from 20 hotels in Yogyakarta. The object of this research is hotel shift workers in front office, housekeeping, and security departments. Physical work load is measured using heart beat converted into scale of Rating Perceive Exertion (RPE). And psychosocial work load is measured using Copenhagen Psychosocial Questionnaire (COPSOQ). The result shows that there is no direct influence of shift scheduling to its physical and psychosocial work load. However, in developing work-load based shift scheduling model in the next research, we have to consider the physical and psychosocial work load by giving more consideration to shift allocation parameter and also work-stretch and off-day pattern parameter. Both parameters will contribute to shift schedule flexibility for achieving worker's working-life balance.

**Keywords:** worker shift schedule, work load, hotel industry

## 1. INTRODUCTION

Services offered by hotel industry involve human resources and most departments in hotel operate for 24 hours to serve their customers. As consequence, most departments in hotel apply shift scheduling to manage its workers. Work arrangement in shift scheduling will directly effect to the workforce performance (Chiang *et al.*, 2010; Puttonen *et al*, 2010; Lee *et al.*, 2011). And further effect to its organization itself (Ivankovic & Jerman, 2010) because workforce scheduling has a significant effect on operational cost saving in hotel industry (Ernst *et al.*, 2004; Li *et al.*, 2012).

Workforce performance is influence by physical and psychosocial factor (Green & Taylor, 2008). Physical work load measurement approach could be done by measuring energy expenditure due to physical activities based on oxygen consumption or heart rate (Pulat, 1992). Psychosocial workload measurement approach is based on the way individuals interact with the demand of their job and their environment (Green & Taylor, 2008). Unge *et al*. (2007), Kausto *et al*. (2011), and Shan (2012) have examine the evidence for physical and psychosocial workload at work without considering the worker scheduling. Physical work load have been considered in shift scheduling using many factor, i.e. off day and break arrangement (Thompson, 1996), minimum worker requirement in each shift (Louly, 2012; Labidi *et al*, 2014), work day and off day arrangement (Topaloglu & Selim, 2010; Eradipa *et al*, 2014), work element standard time (Eradipa *et al*, 2014). Many researches in shift scheduling development have considered worker's preference as psychosocial work load (Lim & Mobasher, 2011; Rigi, 2011; Eradipa et al., 2014; Labidi *et al*, 2014). Worker's preference is one of the inputs in developing shift allocation arrangement among workers, besides the management policies. Workers' overall job satisfactions are influence by their schedule flexibility satisfaction to accommodate their individual and social requirement (Lee *et al*., 2011). So that shift scheduling is a complex problem because it has to meet workforce requirement which also considering worker's personal needs. Shift arrangement assigned to the workers should accommodate the work-life balance.

This work is part of research in developing work load based shift scheduling model. The objective of this work is

to identify work load of shift scheduling, i.e. physical and psychosocial work load, for hotel's workers in Yogyakarta Indonesia. This work will investigate workers' work load resulting from shift schedule applied. The result of this work will be one of the inputs considering in developing shift scheduling for next work.

## 2. RESEARCH METHODOLOGY

Hotel shift workers' work load data used in this work is the work load data in Dewi *et al*. (2014). The work load considered is physical and psychosocial work load. Physical work load measurement is based on rating of perceived exertion (RPE) Borg's Scale. The subjects' heart rate, i.e. hotel's shift worker, was measured before and after they performed their task. Psychosocial work load assessment instrument used is Copenhagen Psychosocial Questionnaire (COPSOQ). The COPSOQ has been developed and validated by Kristensen and Borg of the Danish National Institute for Occupational Health in Copenhagen (Pejtersen *et al.*, 2010). The data are collected from 20 hotels in Yogyakarta Indonesia, which consist of 3 groups, i.e. shift worker in front office department, shift worker in housekeeping department, and shift worker in security department. For each hotel, worker's work load is assessed in morning shift (M) and evening or night shift (E/N).

Shift scheduling parameter data are collected by using questionnaires based on shift scheduling parameters in Purnama & Yuniartha (2014). The shift scheduling parameters are:

1. Schedule period (A)
2. Number and type of shift in 24 hours (B)
3. Shift allocation (C)
4. Work-stretch and off-day pattern (D)
5. Shift allocation policy for female workforce (E)
6. Distinctive shift allocation (F)
7. Distinctive work-stretch (G)

The analysis is performed for each department to group the hotels based on the shift scheduling parameters. For the first step, the hotels will be grouped based on shift scheduling parameters. Then the work load of resulting group will be analyzed. The grouping process applies non-hierarchical clustering method, i.e. Basic Sequential Algorithmic Scheme (Holm, 1979). The steps in Basic Sequential Algorithmic (BSAS) for each department are:

1. Determine the comparison matrix for each scheduling parameter
2. Determine the proximity matrix
3. Determine the group of hotel

## 3. RESULT AND DISCUSSION

The shift scheduling parameters data collected from the 20 hotels observed are grouped to investigate the applied shift scheduling. The shift scheduling parameters data are coded using numeric codes as input for grouping the hotels using BSAS. Table 1 to Table 3 show the shift scheduling parameters collected for each department, respectively. The parameter of schedule period, symbolized with A in the column title, consists of a week (1), 2 weeks (2), 4 weeks (3), or a month (4). Number and type of shift are symbolized by letter B in column title, consists of 1 shift (1), 2 shifts (2), 3 continuous shifts (3), 3 overlapping shifts (4), 4 overlapping shifts (5), and 5 overlapping shifts (6). Continuous shift type is for shift that the starting time of a shift coincides with the end time of previous shift. Overlapping shift type is for condition that starting time of a shift is a few hours before the end of the previous shift. It means there are a few hours that coincide between 2 consecutive shifts. Three shifts application may in form of continuous or overlapping, but for more than 3 shifts application, it absolutely is in form of overlapping type.

Table 1: Group of Shift Scheduling Parameters for Front Office Department

| Hotel Number | Shift Scheduling Parameter | | | | | | | Group |
|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | |
| 3 | 1 | 3 | 0 | 4 | 0 | 0 | 1 | 1 |
| 7 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 2 |
| 11 | 3 | 3 | 14 | 0 | 2 | 1 | 0 | 3 |
| 9 | 4 | 1 | 11 | 7 | 0 | 0 | 1 | 4 |
| 16 | 4 | 3 | 0 | 0 | 1 | 1 | 0 | 5 |
| 18 | 4 | 3 | 0 | 0 | 2 | 0 | 0 | 6 |
| 14 | 4 | 3 | 0 | 0 | 2 | 0 | 0 | 6 |
| 17 | 4 | 3 | 0 | 0 | 2 | 1 | 0 | 7 |
| 15 | 4 | 3 | 0 | 0 | 2 | 1 | 0 | 7 |
| 6 | 4 | 3 | 0 | 3 | 2 | 1 | 0 | 8 |
| 19 | 4 | 3 | 5 | 3 | 0 | 0 | 0 | 9 |
| 12 | 4 | 3 | 6 | 3 | 2 | 0 | 0 | 10 |
| 13 | 4 | 3 | 6 | 3 | 2 | 1 | 0 | 11 |
| 8 | 4 | 3 | 6 | 3 | 2 | 1 | 0 | 11 |
| 10 | 4 | 3 | 6 | 3 | 2 | 1 | 1 | 12 |
| 5 | 4 | 3 | 8 | 4 | 2 | 0 | 0 | 13 |
| 2 | 4 | 4 | 8 | 4 | 2 | 1 | 0 | 14 |
| 20 | 4 | 5 | 0 | 0 | 2 | 0 | 0 | 15 |
| 1 | 4 | 5 | 0 | 4 | 2 | 0 | 0 | 16 |
| 4 | 4 | 5 | 0 | 4 | 2 | 0 | 1 | 17 |

Shift allocation parameter, symbolized with C, consists of 15 types. The code number start with 0 for no pattern shift allocation then the next code number is combination of cyclic or non-cyclic shift allocation and cyclic period (2 day, 6 days, 7 days, 18 days, 2 weeks, 4

weeks, and 1 month), with the consecutive code number start from 1 to 14. Parameter of work-stretch and off-day pattern is symbolized with D in column title, it show the work-day and off-day pattern. It consists of 8 types start with code number 0 for no pattern and consecutively for 1-1, 5-1, 6-1, 7-1, 4-2, 13-1, and 30-1. Shift allocation policy for female workforce is denoted by letter E, code number 0 means there are no female worker, 1 shows that female worker assigned for morning shift only, and 2 for female worker assigned in morning and evening shift. Distinctive shift allocation parameter, symbolized with F, shows that for specific worker, usually assigned in specific shift, different with other workers. For supervisor who is assigned in specific shift are given code numbers of 1, 2 for senior worker, 3 for casual worker, 4 for others position, and 0 for no specific shift allocation. This code number is also applied for distinctive work-stretch in column title G.

Table 2: Group of Shift Scheduling Parameters for Housekeeping Department

| Hotel Number | Shift Scheduling Parameter | | | | | | Group |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | |
| 3 | 1 | 5 | 0 | 4 | 0 | 1 | 1 |
| 7 | 2 | 2 | 0 | 0 | 1 | 0 | 2 |
| 11 | 3 | 3 | 0 | 0 | 0 | 1 | 3 |
| 1A | 4 | 1 | 0 | 0 | 0 | 0 | 4 |
| 10A | 4 | 1 | 9 | 4 | 0 | 0 | 5 |
| 9 | 4 | 1 | 11 | 7 | 0 | 0 | 6 |
| 16 | 4 | 2 | 0 | 0 | 0 | 0 | 7 |
| 20A | 4 | 2 | 0 | 5 | 0 | 1 | 8 |
| 5 | 4 | 2 | 6 | 3 | 0 | 0 | 9 |
| 6 | 4 | 3 | 0 | 0 | 0 | 0 | 10 |
| 20B | 4 | 3 | 0 | 0 | 0 | 0 | 10 |
| 18 | 4 | 3 | 0 | 0 | 0 | 0 | 10 |
| 1B | 4 | 3 | 5 | 3 | 0 | 0 | 11 |
| 19 | 4 | 3 | 5 | 3 | 0 | 0 | 11 |
| 10B | 4 | 3 | 6 | 3 | 0 | 0 | 12 |
| 15 | 4 | 3 | 6 | 3 | 0 | 0 | 12 |
| 14 | 4 | 3 | 6 | 3 | 2 | 0 | 13 |
| 17 | 4 | 4 | 0 | 3 | 0 | 1 | 14 |
| 10C | 4 | 4 | 6 | 3 | 0 | 0 | 15 |
| 2 | 4 | 4 | 8 | 4 | 0 | 0 | 16 |
| 8 | 4 | 5 | 0 | 3 | 0 | 1 | 17 |
| 12 | 4 | 5 | 5 | 6 | 0 | 0 | 18 |
| 13 | 4 | 5 | 10 | 3 | 0 | 0 | 19 |
| 4 | 4 | 6 | 0 | 3 | 2 | 0 | 20 |

There are 3 hotels that divide the housekeeping department into sub-department. The sub-departments are rooms and public areas for hotel with 2 sub-departments. While for hotel with 3 sub-departments, the sub-departments are rooms, indoor, and outdoor public areas. The resulting group shows in the last column, and the code number shows group number. For 20 data collected, the front office departments have 17 groups, housekeeping departments have 20 groups, and security departments have 15 groups.

Table 3: Group of Shift Scheduling Parameters for Security Department

| Hotel Number | Shift Scheduling Parameter | | | | | | Group |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | F | G | |
| 3 | 1 | 3 | 0 | 4 | 0 | 0 | 1 |
| 11 | 3 | 2 | 3 | 2 | 0 | 0 | 2 |
| 9 | 4 | 1 | 11 | 7 | 0 | 0 | 3 |
| 6 | 4 | 2 | 0 | 6 | 0 | 0 | 4 |
| 16 | 4 | 3 | 0 | 0 | 1 | 0 | 5 |
| 17 | 4 | 3 | 0 | 3 | 1 | 0 | 6 |
| 7 | 4 | 3 | 0 | 4 | 0 | 0 | 7 |
| 4 | 4 | 3 | 0 | 4 | 0 | 0 | 7 |
| 2 | 4 | 3 | 0 | 4 | 0 | 0 | 7 |
| 20 | 4 | 3 | 0 | 4 | 1 | 0 | 8 |
| 5 | 4 | 3 | 5 | 3 | 0 | 0 | 9 |
| 8 | 4 | 3 | 5 | 3 | 0 | 0 | 9 |
| 13 | 4 | 3 | 5 | 3 | 0 | 0 | 9 |
| 1 | 4 | 3 | 5 | 3 | 1 | 1 | 10 |
| 14 | 4 | 3 | 6 | 3 | 0 | 0 | 11 |
| 19 | 4 | 3 | 6 | 3 | 0 | 0 | 11 |
| 18 | 4 | 3 | 8 | 4 | 0 | 0 | 12 |
| 15 | 4 | 5 | 0 | 0 | 0 | 0 | 13 |
| 12 | 4 | 5 | 5 | 3 | 0 | 0 | 14 |
| 10 | 4 | 5 | 6 | 3 | 1 | 1 | 15 |

The grouping process use BSAS algorithm start by determining the comparison matrix for each shift scheduling parameter. Each element of comparison matrix will be equal to "1" if 2 compared hotels have the same code value of shift scheduling parameter, and "0" for different code value. The next step is determining proximity matrix, i.e. average value of comparison matrix for each hotel. The group determining step is based on threshold value that can be determined by trial and error. Two hotels with proximity matrix difference less than the threshold could be grouped in the same group, otherwise make a new group. The last column in Table 1 to 3 show the resulting group.

The next step is identifying the work load of each hotels group for each department. The rating interpretation scale of physical work load and COPSOQ scale of psychosocial work load from the data in Dewi *et al*. (2014) is in Table 4 to 6. Physical work load was assessed based on rating of perceived exertion (RPE) Borg's Scale using

the maximum heart rate data. Physical work load in Table 4 to 6 are in RPE scale, with the highest value is 10.8. It's mean that all physical work loads of observed hotel's shift workers is in light level. The upper limit of light level in RPE scale is 11. This condition shows that the physical work load is not influenced by the shift scheduling pattern applied to the workers. It's because its jobs characteristic are not requires excessive physical power. Even though the jobs in housekeeping department need more physical power compare to front office and security department, mostly workers in housekeeping department have been equipped with equipment to simplify their tasks. Besides, most of observed hotels apply rotation shift allocation, means that workers will assigned in different shift. The rotation shift allocation will give positive effect on worker's performance (Muecke, 2005). The physical work load is balanced by rotation shift allocation.

Table 4: Work Load of Front Office Department

| Hotel Number | Hotel Group | Physical Work Load | | Psychosocial Work Load | |
|---|---|---|---|---|---|
| | | M | E/N | M | E/N |
| 3 | 1 | 7.6 | 6.9 | 65.91 | 66.89 |
| 7 | 2 | 7.3 | 8.7 | 77.84 | 65.91 |
| 11 | 3 | 8.2 | 8.5 | 77.84 | 67.05 |
| 9 | 4 | 8.5 | 9.6 | 64.77 | 63.64 |
| 16 | 5 | 10.0 | 6.6 | 76.70 | 70.45 |
| 18 | 6 | 7.1 | 7.0 | 71.59 | 79.55 |
| 14 | 6 | 8.8 | 7.8 | 67.61 | 76.14 |
| 17 | 7 | 8.3 | 8.2 | 67.05 | 71.02 |
| 15 | 7 | 7.9 | 7.5 | 64.20 | 65.34 |
| 6 | 8 | 7.9 | 7.6 | 64.20 | 72.73 |
| 19 | 9 | 8.6 | 8.4 | 60.23 | 68.18 |
| 12 | 10 | 7.1 | 7.4 | 69.89 | 77.27 |
| 13 | 11 | 7.9 | 8.7 | 69.32 | 67.61 |
| 8 | 11 | 8.0 | 7.8 | 71.02 | 75.57 |
| 10 | 12 | 8.9 | 8.2 | 68.75 | 67.61 |
| 5 | 13 | 6.8 | 7.7 | 60.23 | 64.77 |
| 2 | 14 | 7.8 | 9.9 | 64.20 | 69.32 |
| 20 | 15 | 7.7 | 8.8 | 69.89 | 73.86 |
| 1 | 16 | 7.9 | 8.5 | 64.20 | 73.30 |
| 4 | 17 | 8.7 | 7.2 | 81.82 | 62.50 |

But difference condition shows by the psychosocial work load. Most observed hotels are in light level (> 60) and some of them are in moderate level of psychosocial work load according COPSOQ scale (>40 – 60). This result also shows that there is no direct interaction between shift scheduling pattern and its psychosocial work load. Because for hotels in the same group could have different level of psychosocial work load. However, for hotels with psychosocial work load in moderate level may indicate workers dissatisfaction. COPSOQ scale shows worker's subjective perception of 2 aspects, i.e. worker's individual interaction with the demand of their job and work environment. Workers dissatisfaction could be affected by the flexibility of their appplied shift schedule to accomodate their individual and social requirement, as discuss in Lee *et al*. (2011). Worker dissatisfaction factor could lead to negative effect on worker performance. So that the shift scheduling assigned to the workers have to accomodate workers' working-life balance.

Table 5: Work Load of Housekeeping Department

| Hotel Number | Hotel Group | Physical Work Load | | Psychosocial Work Load | |
|---|---|---|---|---|---|
| | | M | E/N | M | E/N |
| 3 | 1 | 6.3 | 8.7 | 67.05 | 73.86 |
| 7 | 2 | 6.3 | 8.7 | 67.05 | 73.86 |
| 11 | 3 | 9.5 | 7.7 | 67.05 | 60.23 |
| 1A | 4 | 8.5 | 9.2 | 65.91 | 63.64 |
| 10A | 5 | 7.7 | 9.6 | 63.07 | 48.86 |
| 9 | 6 | 8.8 | 8.9 | 71.59 | 68.18 |
| 16 | 7 | 8.7 | 7.8 | 77.84 | 58.52 |
| 20A | 8 | 8.0 | 8.8 | 65.91 | 67.05 |
| 5 | 9 | 8.1 | 9.2 | 72.16 | 68.75 |
| 6 | 10 | 8.2 | 9.1 | 58.52 | 72.16 |
| 20B | 10 | 10.8 | 6.9 | 71.02 | 68.75 |
| 18 | 10 | 10.8 | 6.9 | 71.02 | 68.75 |
| 1B | 11 | 10.8 | 6.9 | 71.02 | 68.75 |
| 19 | 11 | 8.8 | 8.9 | 73.86 | 68.18 |
| 10B | 12 | 8.1 | 7.4 | 68.18 | 67.05 |
| 15 | 12 | 9.9 | 8.2 | 58.52 | 72.16 |
| 14 | 13 | 8.2 | 7.8 | 71.02 | 71.02 |
| 17 | 14 | 9.0 | 8.6 | 61.93 | 68.75 |
| 10C | 15 | 7.6 | 7.8 | 71.59 | 65.34 |
| 2 | 16 | 6.9 | 7.3 | 75.00 | 65.91 |
| 8 | 17 | 9.5 | 9.2 | 66.48 | 70.45 |
| 12 | 18 | 8.4 | 8.4 | 53.41 | 56.82 |
| 13 | 19 | 8.8 | 9.3 | 75.57 | 78.98 |
| 4 | 20 | 8.8 | 9.3 | 75.57 | 78.98 |

Furthermore, as discussed in Purnama & Yuniartha (2014), shift pattern assignment to the workers may also cause long-term negative effect to worker's health because bad shift allocation, i.e. insomnia, excessive sleepiness, excessive fatigue, and shift work disorder (Eldevik *et al*., 2013; Di Milia *et al*. 2013), high cardiovascular risk (Esquirol *et al*., 2011; Pimenta *et al*., 2013; Haus & Smolensky, 2013), obesity (Antunes *et al*., 2010; Chen *et al*., 2010; Haus & Smolensky, 2013), and cancer (Haus & Smolensky, 2013). More over Postnova *et al*. (2014) have

developed a physiologically based mathematical model of sleep-wake cycles to examine the effects of shift rotation interval (RI) (i.e., the number of days spent on each shift) on sleepiness and circadian dynamics on forward rotating 3-shift schedules. The model becomes shift response maps that can aid in development of shift schedule.

Therefore, for next research in developing shift scheduling considering worker's work load, even the shift scheduling parameters have no direct influence to the physical and psychosocial work load, we have to give more consideration to shift allocation parameter and also work-stretch and off-day pattern parameter. Because both of parameters will determine the working-life pattern applied to the workers. These shift scheduling parameters will determine the flexibility of shift scheduling assigned to the workers. We could balance the physical work load between workers by applying rotation shift allocation. And we could consider the psychosocial work load by accommodating the worker's individual and social requirement.

Table 6: Work Load of Security Department

| Hotel Number | Hotel Group | Physical Work Load | | Psychosocial Work Load | |
|---|---|---|---|---|---|
| | | M | E/N | M | E/N |
| 3 | 1 | 6.1 | 10.3 | 71.02 | 55.11 |
| 11 | 2 | 10.7 | 8.9 | 74.43 | 72.10 |
| 9 | 3 | 8.9 | 7.5 | 64.20 | 75.00 |
| 6 | 4 | 8.6 | 8.8 | 47.16 | 65.34 |
| 16 | 5 | 8.8 | 8.6 | 69.32 | 64.77 |
| 17 | 6 | 9.5 | 8.5 | 60.80 | 67.61 |
| 7 | 7 | 8.9 | 7.0 | 69.89 | 63.64 |
| 4 | 7 | 8.8 | 8.1 | 70.45 | 69.89 |
| 2 | 7 | 8.6 | 7.7 | 67.61 | 64.20 |
| 20 | 8 | 8.2 | 8.4 | 69.30 | 68.18 |
| 5 | 9 | 8.6 | 8.0 | 63.07 | 75.57 |
| 8 | 9 | 7.3 | 6.4 | 74.43 | 78.98 |
| 13 | 9 | 8.4 | 8.6 | 74.43 | 68.18 |
| 1 | 10 | 7.1 | 7.3 | 68.75 | 65.34 |
| 14 | 11 | 8.7 | 9.0 | 57.39 | 60.23 |
| 19 | 11 | 6.6 | 6.6 | 63.07 | 60.23 |
| 18 | 12 | 8.9 | 8.4 | 77.84 | 75.57 |
| 15 | 13 | 9.1 | 9.6 | 60.80 | 58.52 |
| 12 | 14 | 10.0 | 9.7 | 78.41 | 73.30 |
| 10 | 15 | 9.0 | 9.1 | 84.09 | 77.27 |

## 4. CONCLUSION

The objective of this research is to identify the work load of shift scheduling, i.e. physical and psychosocial work load. Data from 20 hotels observed are grouped based on its shift scheduling parameters. Different group of shift scheduling results in the similar level of physical work load, it means that there is no direct influence of shift scheduling to its physical work load. And it's conformable with Dewi *et al.* (2014) that work load level, for both physical and psychosocial work load, in different shifts and hotels, are not significant different. The same condition shows by the psychosocial work load, there is no direct influence of shift scheduling parameters to its psychosocial work load. Hotels with different shift scheduling parameters may result in the same level of psychosocial work load and hotels with the same shift scheduling parameters may result in different level of psychosocial work load. However, in developing work-load based shift scheduling model in the next research, we have to consider the physical and psychosocial work load by giving more consideration to shift schedule flexibility in order to accommodate worker's working-life balance. The shift schedule flexibility could be determined by shift allocation parameter and also work-stretch and off-day pattern parameter.

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