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Mental Workload Assessment in a Taiwanese Hotel Chain

Yang Wu
Department of Food and Beverage Management, Far-East University, No. 49, Zhonghua Road, Xinshi Districts, Tainan City 74448, Taiwan, Republic of China

Abstract: Workload assessment is one of the most serious concerns for a manager, since a long-term heavy workload may affect employees' physical and mental health, performance and productivity, as well as turnover. Because reception clerks are the first contract points for customers in a hotel, their service quality generates the first impression of the company. To be aware of the workloads of hotel reception clerks, this study applies a workload assessment model to find out the relative workload levels of them, in which subjective subscales are introduced. Based on the data analysis, six reception clerks are classified as have relatively heavy workloads among the twenty-six samples. In addition, this study identifies the factors that the decision maker can focus on in order to effectively reduce the workloads of heavy workload clerks. The advantage of this study is that it provides a practical framework for managers to be more aware of the work situations of employees and thus they can more effectively improve the workload levels of staff and ensure that they provide high quality services, as well as reduce staff turnover.

Key words: Mental workload, hotel industry, reception clerk, critical factor

INTRODUCTION

Assessing workload is a management important issue, as it can ensure that the well-being and performance of employees both remain at high levels. A long-term heavy workload can affect an employee's physical or mental health, performance and productivity. Iverson and Pullman (2000) stated that heavy workloads have a negative impact on turnover and it may result in a state of stress and give rise to strain, accidents or illness. Hospital studies have shown that the added responsibilities and job stress associated with higher workloads can increase nursing staff turnover (Helmer and McKnight, 1989; Jolma, 1990; Lee *et al*., 2003). Davidson *et al*. (2006) argued that high employee turnover leads to higher labor costs and lower service quality, which can hurt the performance and growth of a company.

Human resources are one of the major resources of the hotel industry, since hospitality jobs require frequent customer contact and this has been shown to be stressful for hospitality workers and thus increase turnover intention. In addition, the behavior that these employees display will positively impact service quality (Morrison, 1996). Consequently, Firth *et al*. (2004) suggested that managers should actively monitor the employees with heavy workloads in order to reduce turnover.

Although, the concept of workload is used often in human factors research, there is still no adequate definition (Veltman and Gaillard, 1996). For instance, Wickens (1992) defined workload as the relationship between resource supply and task demand and mental workload is commonly defined as the ratio between task demand and the capacity of an employee (Kantowitz, 1988). The techniques for measuring mental workload can be divided into three categories: Performance-based measures, physiological measures and subjective ratings. However, in a complex task environment, performance measures often cannot accurately indicate workload. Physiological measures attempt to derive the impact of the workload from factors such as heart-rate, respiration rate and blood pressure, although these may be influenced by other factors. In subjective techniques, individuals are asked to assess their workloads using rating scales and this approach is generally accepted by potential subjects, since rating scales are easy to complete. Although, physiological measures of workload are believed by some to be more accurate than the subjective ones (Vidulich and Wickens, 1986), the latter are widely applied to workload assessment (Chang and Chen, 2006; Mayes *et al*., 2001; Miyake, 2001; Miyake *et al*., 2009).

Subjective measures have been applied to evaluate two types of workloads. The first type focuses on assessing workload for a specified task after the task has been completed (Matthews *et al*., 2003; Pickup *et al*., 2005; Stedmon *et al*., 2007). Its purpose is to improve operating characteristics and to decrease the workload for an operator, as appropriate. The other type of workload assessment is to find out the relative workloads within a

group of employees in the same environment (Chang and Chen, 2006) and it is the approach that the current study uses.

Because reception clerks are the first contract points for customers in a hotel, their service quality generates the first impression of the company. This study applies a workload assessment model to find out the relative workload levels of hotel reception clerks, in which subjective subscales are introduced. To identify the key factor (referred to as the critical factor) for the relatively heavy workload of reception clerks, this study applies the dual analysis for the workload assessment model. Moreover, this study incorporates the workload and performance levels into the work situation analysis of individual reception clerks and thus enables managers to be more aware of the actual work conditions of staff, which can lead to better Human Resource Management (HRM) decision making.

MATERIALS AND METHODS

Employees typically claim their workloads are heavy and most firmly believe that there are no fair and equitable measures to evaluate how heavy a workload they are carrying. In order to improve the weaknesses of the traditional workload measurement method, Chang and Chen (2006) extended the Data Envelopment Analysis (DEA) methodology in overall workload assessment. The major characteristic of the model is that the set of weights represents the most favorable weights of factors for each employee in calculating their workload scores. Hence, employees cannot refute the objectivity of the approach, even though their weighted overall workload score may indicate that, contrary to their subjective impression, they do not have a heavy workload.

Workload assessment model: In workload assessment, subjective measurement is a widely applied technique, since rating scales are generally accepted by potential subjects and easy to complete. For subjective measurement, individuals consider their own perceived work loads and then rate various workload factors using a given scale. When individuals rate questions, their perceived loading contains their capacity, which is an input of the individual. In other words, the rated value of each question represents a ratio of subscale to capacity. Therefore, Chang and Chen (2006) treat all factors as outputs and proposed a workload assessment model shown as follows:

$$\begin{aligned} &\text{Max } \theta_l = \sum_{i=1}^{n} u_i y_{il} \\ &\text{Subject to} \sum_{i=1}^{n} u_i y_{ik} \le 1, \forall k = 1,2,\ldots,L, \\ &u_i > 0, \forall i = 1,2,\ldots,n \end{aligned} \tag{1}$$

where, n is the number of assessment subscales, y_{ik} is the value of the ith subscale of the kth employee, L is the number of employees and u_i gives the weights associated with the ith subscale of employee l. Running model (1) for each employee, the set of weights associated with the values of the subscales gives the maximum workload score of each member of staff. Based on a comparison of the maximum overall workload score of each employee, their relative workloads are obtained. If the workload score is equal to one, then the employee is classified as having a heavy workload, and if not, as a non-heavy one.

Identification of the critical factors: For workload reduction of the relatively heavy workload of employees, it is important to identify the critical factor. In model (1), the objective is to maximize the value of:

$$\sum_{i=1}^{s} u_i y_{ij}$$

Therefore, the larger value of u_i, the greater the contribution of factor i to the workload score. If employee j has a workload score of one, they will be classified as having a heavy workload and the jth constraint of model (1) will be equal to one, i.e.:

$$\sum_{i=1}^{s} u_i y_{ij} = 1$$

We decompose this normalizing equation into s components, $u_1y_{1j} \le \alpha_1$, $u_2y_{2j} \le \alpha_2$, …, $u_sy_{sj} \le \alpha_s$ and join them into model (1), as follows:

$$\text{Max } h_j = \sum_{i=1}^{s} u_i y_{ij} \tag{2a}$$

$$\text{s.t. } u_i y_{ij} \le \alpha_i,\ i = 1, 2, \ldots, s \tag{2b}$$

$$\sum_{i=1}^{s} u_i y_{ik} \le 1,\ k = 1,2,\ldots,n,\ k \ne j \tag{2c}$$

$$u_i \ge \varepsilon > 0,\ i = 1,2,\ldots,s \tag{2d}$$

where, $\alpha_i = u_i * y_{ij}$ and:

$$\sum_{i=1}^{s}\alpha_i=1$$

u^*_i is the optimal weight of factor i obtained from model (1). Therefore, the dual of model (2) is shown as model (3):

$$\text{Min} \sum_{i=1}^{s}\alpha_i\theta_i+\sum_{\substack{k=1\\k\neq j}}^{n}\lambda_k-\varepsilon\sum_{i=1}^{s}S_i^+ \quad (3a)$$

$$\text{s.t. } \theta_i y_{ij}-\sum_{\substack{k=1\\k\neq j}}^{n}\lambda_k y_{ik}-S_i^+=y_{ij},\ i=1,2,...,s \quad (3b)$$

$$\theta_i, S_i^+\geq 0, k=1,2,...,n, k\neq j, i=1,2,...,s \quad (3c)$$

where, θ_i, λ_i and S^+_i are dual variables. α_i can be interpreted as the workload contribution of factor i of employee j. Based on the DEA framework, if the workload score of employee j is equal to one, then the dual variables corresponding to the constraints of (2c) will be equal to zero, i.e., $\lambda_k = 0$, k = 1, 2,..., n, k ≠ j and $S^+_i = 0$, i = 1, 2,..., s, at an optimum. Under this circumstance, the items in (3a) are only:

$$\sum_{i=1}^{s}\alpha_i\theta_i$$

retained. Because the objective values in model (2) and model (3) will be the same at an optimum, i.e.:

$$\sum_{i=1}^{s}u_i^* y_{ij}=\sum_{i=1}^{s}\alpha_i\theta^*_i=1$$

hence, $\theta_i^* = 1$, i = 1, 2,..., s. Because all θ_i^*s are equal, the values of (3a) w ill be the same for any equivalent changed value of α_i. In other words, if the decision maker reduces one unit of y_{ij}, then the reduction in workload score will be the greatest compared to reducing one unit of other factors, since $\Delta\alpha_i = u_p\Delta y_{Pj}$ where, $u_p = \max\{u_i\}$. Therefore, to effectively reduce the workload score of employee j, the improvement efforts should thus focus on factor p.

A case study: Reception clerks are the first contract points for customers in a hotel and thus the service quality of a hotel depends heavily on the effectiveness with which front-line clerks deal with customers and clients. Therefore, this study focuses on the workload assessment of reception clerks in a hotel chain.

Background: Tourist hotels in Taiwan can be divided into two categories: international and ordinary and there were 70 and 37 of these, respectively, as of June, 2012. Howard Hotel Chain is the largest scale in Taiwan, its service performance has won various national awards and it is one of the best regarded tourism brands in the country.

Assessment factors: To investigate the workload levels of the reception clerks in Howard hotels, the NASA Task Load Index (NASA-TLX), a widely used technique for subjective workload assessment, is utilized. NASA-TLX is a multidimensional approach that measures workload with a weighted workload score and the subscales of NASA-TLX are always applied to evaluate workload (Batmaz and Ozturk, 2008; Matthews *et al*., 2003; Mayes *et al*., 2001; Miyake, 2001; Sato *et al*., 1999). The inclusion of the six subscales was based on extensive research and psychometric analyses by Hart and her associates in a variety of contexts, including laboratory experiments and simulated flight experiments (Hart, 1986; Hart and Staveland, 1988). In this study, we use the subscales of the NASA-TLX as the workload assessment factors in model (1) and subjects subjectively rated their workloads based on five factors, using a rating scale from 0-100. The five factors are mental demands (Y1), physical demands (Y2), temporal demands (Y3), effort (Y5) and frustration level (Y6). The performance level (Y4) is obtained from the routine performance appraisal of the hotel and the scale is from 0-100.

In rating the workload factors, each reception clerk considered their own perceived workload and then responded to each question. For example, one question for the frustration level factor is: How insecure, discouraged, irritated, stressed and annoyed versus secure, gratified, content, relaxed and complacent do you feel in your job? When individuals rate this question, their perceived loading contains their capacity. The perceived workload is thus an index of an individual on a specific factor. In this analysis, the six assessment subscales are treated as outputs in model (1) and a large value of an output is considered to be heavier workload than a smaller one. The data on the six subscales from the twenty-six reception clerks is presented in Table 1.

The data and results: In this study, the LINGO software was used to run model (1) and the results, showing the workload scores and factor weights of the individual clerks, are presented in Table 2. The workload scores indicate that reception clerks 2, 3, 11, 12, 13 and 17 have a relatively heavy workload among the twenty-six clerks examined in this study, since their scores are all equal to one. In contrast, the other clerks are considered to have relatively non-heavy workloads, as their scores are all less than this.

Critical factors: The workload scores indicate that reception clerks 2, 3, 11, 12, 13 and 17 have a relatively heavy workload. Based on the weight columns in Table 2, the factor that leads to a heavy workload for clerks 2, 3, 11 and 12 is the performance subscale, that for clerk 13 is the temporal demands and that for clerk 17 is the effort. Therefore, the decision maker should focus on the critical factors to effectively reduce the workloads of heavy workload clerks. Notably, if an individual clerk shows that they have larger weights in multiple factors compared to others, even after reducing the load of the critical factor, their workload score may not be reduced, since they still have a relatively heavy workload. In such case, the task of workload improvement must continue.

Table 1: The results for the individual reception clerks

Clerk No.	Mental demands (Y1)	Physical demands (Y2)	Temporal demands (Y3)	Performance (Y4)	Effort (Y5)	Frustration level (Y6)
1	76	76	78	73	80	78
2	81	87	86	81	85	80
3	87	80	80	90	85	70
4	70	70	90	82	70	50
5	82	78	88	85	80	50
6	85	80	85	80	80	65
7	88	80	85	85	85	80
8	72	65	70	72	75	60
9	85	70	86	80	83	50
10	60	60	70	88	60	60
11	95	70	90	90	95	65
12	90	85	90	85	95	85
13	80	90	95	70	80	88
14	82	75	83	85	77	50
15	60	80	70	80	87	80
16	70	80	80	80	50	70
17	95	90	95	65	95	90
18	77	81	79	78	85	65
19	87	90	87	59	82	76
20	79	87	83	81	84	27
21	74	77	81	74	76	25
22	79	78	82	81	78	32
23	75	79	83	75	79	30
24	88	87	86	56	81	82
25	83	78	81	77	78	54
26	77	79	82	81	80	26

Location analysis: Because the five workload assessment factors were rated by the reception clerks themselves and the performance factor was obtained from the performance appraisal of the hotel, the workload score and the performance level of each reception clerk are statistically independent. Figure 1 shows a scatter diagram of the workload scores and the performance levels of clerks, with the X-axis as the former and the Y-axis as the latter. Based on the location analysis, four findings are obtained.

First, clerk 8 has the lowest workload and their performance level is relatively low compared to most of the others. A low workload can make an clerk feel there is a lack of any challenge in their work and thus contribute to low job satisfaction. In this situation, they may not feel valued or that their worth is unrecognized. Because such an clerk has a greater unfilled workload capacity, additional tasks can be assigned and incentives can be developed that more completely engage them in their work. HRM practices in this context should thus be

Table 2: The workload scores and the weights obtained by Model 1

		Weights					
Clerk No.	Overall workload score	Mental demands	Physical demands	Temporal demands	Performance	Effort	Frustration level
1	0.904	0.0001	0.0001	0.0001	0.0023	0.0001	0.0090
2	1.000	0.0001	0.0080	0.0001	0.0033	0.0001	0.0001
3	1.000	0.0001	0.0001	0.0001	0.0105	0.0001	0.0004
4	0.976	0.0001	0.0001	0.0085	0.0022	0.0001	0.0001
5	0.974	0.0001	0.0022	0.0021	0.0070	0.0001	0.0001
6	0.941	0.0006	0.0008	0.0074	0.0022	0.0001	0.0001
7	0.984	0.0013	0.0001	0.0001	0.0079	0.0001	0.0022
8	0.818	0.0001	0.0022	0.0001	0.0069	0.0021	0.0001
9	0.940	0.0001	0.0001	0.0085	0.0022	0.0001	0.0001
10	0.968	0.0001	0.0001	0.0001	0.0107	0.0001	0.0001
11	1.000	0.0001	0.0001	0.0001	0.0107	0.0001	0.0001
12	1.000	0.0001	0.0001	0.0009	0.0084	0.0001	0.0020
13	1.000	0.0001	0.0008	0.0076	0.0026	0.0001	0.0001
14	0.957	0.0001	0.0022	0.0021	0.0070	0.0001	0.0001
15	0.937	0.0001	0.0001	0.0001	0.0086	0.0001	0.0027
16	0.934	0.0001	0.0053	0.0001	0.0061	0.0001	0.0001
17	1.000	0.0001	0.0001	0.0001	0.0001	0.0101	0.0001
18	0.940	0.0001	0.0085	0.0001	0.0022	0.0006	0.0001
19	0.995	0.0001	0.0106	0.0001	0.0001	0.0001	0.0001
20	0.994	0.0001	0.0080	0.0001	0.0033	0.0001	0.0001
21	0.890	0.0001	0.0080	0.0001	0.0027	0.0001	0.0001
22	0.932	0.0001	0.0022	0.0021	0.0070	0.0001	0.0001
23	0.911	0.0001	0.0080	0.0007	0.0027	0.0001	0.0001
24	0.963	0.0001	0.0106	0.0001	0.0001	0.0001	0.0001
25	0.914	0.0062	0.0027	0.0001	0.0023	0.0001	0.0001
26	0.935	0.0001	0.0053	0.0001	0.0061	0.0001	0.0001

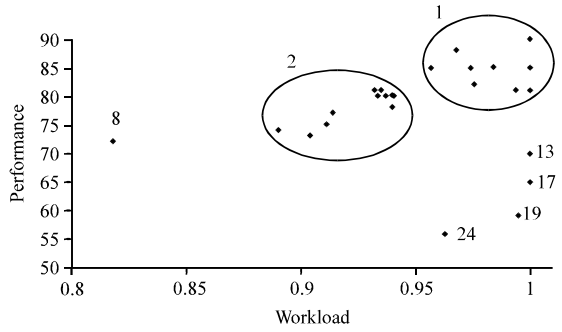

Fig. 1: Workload and performance scores of clerks

focused on improving clerk motivation to perform more tasks, while maintaining a high achievement level.

Second, clerks 13, 17, 19 and 24 have relatively heavy workloads, although their performance levels are almost the lowest ones. This situation indicates either that they do not have the abilities needed to do their tasks, or that their tasks are not suitable to their abilities. If this is the case, then managers can intensify their training programs and/or assign senior employees as instructors. If the characteristics of tasks are not suitable for a particular clerk, the manager can consider reassigning them to a new department where there is a more suitable job, thereby boosting their performance. Because there are four clerks who are poor performers with high workloads, the hotel should invest heavily in employee training programs in order to improve their abilities, which should in turn improve clerk performance. Likewise, by adopting such an approach, managers will perform better at identifying the type of person and related qualities required for particular parts of the hotel business. At the same time, managers should further examine clerk workloads to determine if there is a need to recruit more staff to reduce workloads and improve individual performance.

Third, most of the reception clerks, such as cluster 1, have both high workload and performance levels and are thus important human resources in this hotel. In this environment, HRM practices may revolve around extra rewards and recognition, as well as greater autonomy, employment security and opportunities for promotion, in order to retain the high performers and boost organizational performance. When staff has high employment security, receive feedback about their performance and have high autonomy in their work, they may experience feelings of satisfaction and hence have the intrinsic motivation to keep performing well. Nonetheless, managers should still pay attention to heavy workloads in such situations, for without a proper balance, they may create strain, accidents and/or illness. Finally, many of the reception clerks, such as cluster 2, have middling workload and performance levels. These represent untapped potential in this hotel and their abilities need to be developed. Additional tasks can be assigned and incentives can be created that more completely engage them in their work, since they have significant unfilled workload capacities. For these clerks, HRM practices should focus on improving motivation to perform more tasks while maintaining a high level of achievement.

However, it should be noted that most of the reception clerks belong to the excellent category (clusters 1 and 2) and this may be the reason why Howard has won various national awards and has become one of the most respected tourism brands in Taiwan. For the heavy workload individuals in this category, namely employees 2, 3, 11 and 12, managers should pay more attention to balancing their workloads by reassigning tasks. However, for the relatively non-heavy workload reception clerks, the management can offer training programs in a fixed time period to elicit more customer-oriented behavior.

Six months after the original survey, clerk 8 was promoted to the director of a team with seven members and clerks 13, 17 and 19 had left the hotel. It should be noted that two of the six heavy workload clerks left their jobs voluntarily, implying that a heavy workload may influence turnover in this hotel. This phenomenon is response to the studies of the scholars (Helmer and McKnight, 1989; Iverson and Pullman, 2000; Jolma, 1990; Lee *et al*., 2003) discussed in section 1. For the other clerks, the manager indicated that their performance had improved slightly after their workloads had been balanced and that the atmosphere in the work environment had improved significantly.

CONCLUSIONS

The importance of service quality to competitiveness has been established in a broad business context. It is generally accepted that service quality is an antecedent to customer satisfaction and that customer satisfaction is an antecedent to customer loyalty. Perceived service quality derives from the individual service encounters that occur between the customer and service provider, during which the customer evaluates the service offered and develops satisfaction or dissatisfaction. A hotel with better performance and a higher level of service quality can work to continuously obtain and maintain competitive advantages in the service sector. In other words, when employees have demonstrated excellent service behavior, the customer perceptions of service quality will increase. Because a hotel's HRM practices can create an

environment that elicits more customer-oriented behavior from reception clerks, it is important for managers to adopt appropriate ones. However, before doing so, managers should be aware of the work situation of each clerk, since the different workloads of individuals may influence the success of implementing these HRM practices.

This study applies a workload assessment model to uncover the relative workloads in a hotel, in which the NASA-TLX subscales are introduced. In addition, we identify the critical factor that the decision maker can focus on to effectively reduce the workloads of heavy workload employees. The advantage of this study is that it provides a practical framework for managers to be more aware of the work situations of employees and thus they can more effectively the improve workload levels of staff and ensure that they provide high quality services, as well as reduce staff turnover. To this end, this article offers a work situation analysis by plotting a scatter diagram of the workload and performance levels of the employees. Although one cannot classify individuals only according to workload and performance levels, this analysis can raise the awareness of managers with regard to the specific work situations of employees and thus aid in their decisions about which HRM practices to adopt.

Because there are three categories of techniques for measuring mental workload, it is worth identifying the critical factors for each category, so that managers can effectively reduce the workloads of heavy workload employees. Consequently, in future work, researchers can apply other techniques or assessment factors (such as the subjective workload assessment factor) to the measurement of workloads and identify the critical factors that arise from this to better determine the priorities for reducing employee workload.

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