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Full Length Research Paper

The evaluation mode of hotel housekeeping management

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The housekeeping department must satisfy the customers' requirements and provide the customers services at any time in 24 hours; therefore, it needs a large number of employees. The salary expenditure is really huge, along with the consumption of room material and supplies, and cleaning products. These are considered as a hotel's important expenditure based on cost calculation, thus, this department can affect the hotel's income and expenses directly. When the housekeeping quality is fixed, the faster is the housekeeping efficiency, the lower is the required personnel cost; hence, the housekeeping efficiency is one of the important indexes that influence the hotel's business performance. However, until now, there are no relevant studies that discuss the housekeeping efficiency measurement issue completely. For this reason, this study proposes a housekeeping efficiency index for hotel owners to evaluate their housekeeping efficiency objectively. Besides, we deduce the statistical properties of housekeeping efficiency index, and construct the evaluation mode of housekeeping efficiency; finally, a hotel in Central Taiwan is used as an example to explore its housekeeping efficiency.

Key words: Hotel housekeeping management, housekeeping efficiency index, cost.

INTRODUCTION

As time progresses, the development of transportation, and the growth on economy, people have more frequent business activities day by day; meanwhile, people desire to fully enjoy the leisure time and their vacation, and experience nature. Whatever objective they have, to choose a comfortable lodging environment at a hotel on the journey, and take a rest amply, or deem the hotel as a spot of resort, and experience the delight of lodging has become one of the very weighty key points of consideration on the itinerary of modern people's travel activities. For hotel operators, the hotel industry must follow the trend of the times, grasp the consumers' habits, characteristics, and temperaments at all times, elevate the service quality constantly, and develop unique commodity value or service mode in order to keep the superiority in the intense competition. The most important commodity of a hotel is the room; therefore, at the part of how to provide the tourists the fastest rooms with the highest quality to boost the customer satisfaction, the room attendants' proper preparation and careful handling has a decisive influence.

The housekeeping department is the department that is in charge of housekeeping exclusively in a hotel, and that can be the busiest and the most important core department. The hotel's main product is the room. To ensure the room's being clean, comfortable, and safe, and let the customers have a special and warm feeling of

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home away from home, the room attendants must maintain the professional and high-level service at any time, and cater to the customers' demands considerately to let the customers feel satisfied and then introduce the hotel to their relatives, friends, and personages in industrial and business circles. Imperceptibly, keeping good public praise has become the most direct and the most efficient propaganda free-of-charge, and more customers will come, being the greatest target of housekeeping. Besides the focal points described earlier on, the significance of the housekeeping department also includes the management cost of substantial manpower and material resources consumed on housekeeping management. The housekeeping department must satisfy the customers' requirements and provide the customers services at any time in 24 hours; therefore, it needs the three-shift workday system, and a large number of employees. The salary expenditure is really huge, along with the consumption of room material and supplies, and cleaning products, they are considered as the hotel's important expenditure based on cost calculation, thus, this department can affect the hotel's income and expenses directly. When the housekeeping quality is fixed, the faster is the housekeeping efficiency, the lower is the required personnel cost; hence, the housekeeping efficiency is one of the important indexes that influence the hotel's business performance. However, until now, there are no relevant articles that discuss the housekeeping efficiency question completely. For this reason, the research will imitate the process capability index, and propose a housekeeping efficiency index to offer hotel owners the way to evaluate their housekeeping efficiency objectively. Besides, the research will deduce the statistical properties of housekeeping efficiency index, and construct the evaluation mode of housekeeping efficiency; finally, it will take a hotel in Central Taiwan as an example to explore its housekeeping efficiency.

THE HOUSEKEEPING EFFICIENCY INDEX

The length of housekeeping time after a customer's usage is one of the important indexes of hotel management. The shorter is the time of cleaning and tidying, the better is the efficiency, and then, the hotel's operation cost will decrease, and the hotel's competitiveness will ascend. On the contrary, the longer is the time of cleaning and tidying, the worse is the efficiency, and then, the hotel's operation cost will increase, and the hotel's competitiveness will descend. Hence, the time of housekeeping is the shorter the better. However, there is less relevant literature to probe into how to measure the cleaning and tidying efficiency. From the angle of quality control, this belongs to smaller-the-best type, and there have been many researches of statistics and quality management investigating the process capability index of smaller-the-best type, like Kane (1986), Vännman (1995), Chen et al. (2001), Huang et al. (2002), Chen et al. (2006), and Chen et al. (2007), Therefore, the process capability index evaluating smaller-the-best type and proposed by Kane (1986) can be imitated to set the housekeeping time index (C_T) as follows:

$$C_T = \frac{UT_T - \mu_T}{3\sigma_T}$$ (Housekeeping time index)

UT_T : The upper limit of housekeeping time.
μ_T: The mean of housekeeping time.
σ_T: The standard deviation of housekeeping time.

Apparently, the smaller is μ_T value (namely the shorter is the average housekeeping time), the better is the hotel's business performance; or, the smaller is σ_T value, the smaller is the difference of housekeeping time, and at this time relatively, the index value is bigger. Hence, it's obvious that the index C_I can respond to the situation of housekeeping time reasonably. Because all parameters of cleaning and tidying are unknown, the evaluation value of the index can be obtained by samples. Meanwhile, because sampling has errors, it's not objective to judge whether the housekeeping time reaches an enterprise's demand with the index evaluation value merely. Therefore, the statistical test is one of the objective methods to evaluate the housekeeping time. The test hypothesis can be shown as follows:

H_0: $C_T \leqq C_0$

H_a: $C_T > C_0$

Because the expected value of the natural estimator $\tilde{C}_T$ of the index C_T is equal to $(b_n)^{-1} \times C_T$, so apparently, the index C_T is a biased estimator. This biased natural estimator can be shown as follows:

$$\tilde{C}_T = \left(\frac{USL - \overline{X}}{3S} \right)$$

$\overline{X} = (n)^{-1}(\sum_{l=1}^{n} X_i)$, and

$S = ((n-1)^{-1}\sum_{l=1}^{n}(X_i - \overline{X}_i)^2)^{1/2}$; they are the sample mean value and the standard deviation of the random sample $X_{i1}, \ldots, X_{in}$ respectively, and they are used to evaluate μ and σ. The constant b_n can be shown as follows:

$$b_n = \sqrt{\frac{2}{n-1}} \times \left(\frac{\Gamma[(n-1)/2]}{\Gamma[(n-2)/2]} \right) \quad n > 2。$$

It's obviously that as long as multiplying by b_n, you can get the unbiased estimator of C_T immediately as follows:

$$\hat{C}_T = (b_n) \times \left(\frac{USL-\overline{X}}{3S}\right)$$

THE STATISTICAL FEATURES OF C_T

In-fact, the unbiased estimator $\hat{C}_T$ of C_T only has the function that is of complete sufficient and statistic ($\overline{X}$, $S2$). Therefore, under the hypothesis of normal conditions, $\hat{C}_T$ is the minimum variance unbiased estimator (UMVUE) of C_T. Because the distribution of $(3\sqrt{n}/b_n)\ \hat{C}_T$ is the non-central t-distribution with the freedom of $(n-1)$; the non-central parameter is $\delta = 3\sqrt{n}\ C_T$ that can be taken as $t'_{n-1}(\delta)$.

In order to derive the variance and the probability density function of $\hat{C}_T$, first of all, some simple notes are introduced as follows:

$$Z = \frac{\sqrt{n}(USL-\overline{X})}{\sigma}$$ obey $N(3\sqrt{n}\ C_T, 1)$ distribution

$$K = \frac{(n-1)S^2}{\sigma^2}$$ obey χ^2_{n-1} distribution.

Actually $\hat{C}_T$ can be re-shown as follows:

$$\hat{C}_T = (b_n) \times \left(\frac{USL-\overline{X}}{3S}\right) = \left(\frac{b_n}{3}\right) \times \sqrt{\frac{n-1}{n}} \times (K)^{-1/2} \times (Z).$$

Under the hypothesis that the population is of normal distribution, because $\overline{X}$ and S^2 are mutual independent, therefore, to derive the probability density function of $\hat{C}_T$, first, we can assume:

$$E(\hat{C}_T)^2 = \left(\frac{b_n}{3}\right)^2 \times \left(\frac{n-1}{n}\right) \times E(K)^{-1} \times E(Z)^2. = \left(\frac{b_n}{3}\right)^2 \times \left(\frac{n-1}{n}\right) \times \left(\frac{\Gamma[(n-3)/2]}{2\Gamma[(n-1)/2]}\right) \times [9n(C_T)^2 + 1].$$

$$Var(\hat{C}_T)^2 = E(\hat{C}_T)^2 - E^2(\hat{C}_T) = \left(\frac{\Gamma[(n-1)/2]\Gamma[(n-3)/2]}{\Gamma^2[(n-2)/2]}\right)\{(1/9n) + (C_T)^2\} - (C_T)^2$$

For deriving probability density function of $\hat{C}_T$, we assume

$T = (3\sqrt{n}/b_n)\ \hat{C}_T = \frac{Z}{\sqrt{K/(n-1)}}$ obey $t'_{n-1}(\square)$ distribution at first.

We then assume $Y = \hat{C}_T = \frac{b_n}{3\sqrt{n}} \times T$

Because Y and T hold one-to-one mathematical relationship, thus

$$f_Y(y) = f_T(t)\left|\frac{d_T}{d_Y}\right|$$, Where $\left|\frac{d_T}{d_Y}\right| = \frac{3\sqrt{n}}{b_n}$ and

$$f_T(t) = \frac{2^{-(n/2)}}{\Gamma[(n1)/2]} \int_0^\infty x^{\left(\frac{n-2}{2}\right)} exp\{-0.5[x + (\frac{\sqrt{x}}{(n-1)}t - \delta)^2]\}dx\ ,\ t \in R_\circ \text{ then}$$

$$f_{\hat{C}_T}(y) = f_T\left(\frac{3\sqrt{n}}{b_n}y\right) \times \left(\frac{3\sqrt{n}}{b_n}\right) y \in R = f_{\hat{C}_T}(y) = f_T\left(\frac{3\sqrt{n}}{b_n}y\right) \times \left(\frac{3\sqrt{n}}{b_n}\right) y \in R = \left(\frac{b_n^{-1} \times \sqrt{n} \times 2^{-(n/2)}}{3 \times \Gamma[(n-1)/2]}\right) \int_0^\infty t^{\left(\frac{n-2}{2}\right)} exp\{-0.5[t + (\frac{\sqrt{nt}}{(n-1)b_n}\left(\frac{1}{3}\right)y - \delta)^2]\}dt,\ y \in R.$$

Hence, we can derive the probability density function and the variance of the minimum variance unbiased estimators (UMVUE) that are shown respectively as follows:

$$Var(\hat{C}_T) = \left(\frac{\Gamma[(n-1)/2]\Gamma[(n-3)/2]}{\Gamma^2[(n-2)/2]}\right)[(1/9n) + (C_T)^2]] - (C_T)^2_\circ$$

Table 1. The corresponding b_n value for each kind of n value.

n	b_n	n	b_n	n	b_n	n	b_n	n	b_n	n	b_n
5	0.798	40	0.981	75	0.990	110	0.993	145	0.995	180	0.996
10	0.914	45	0.983	80	0.990	115	0.993	150	0.995	185	0.996
15	0.945	50	0.985	85	0.991	120	0.994	155	0.995	190	0.996
20	0.960	55	0.986	90	0.992	125	0.994	160	0.995	195	0.996
25	0.968	60	0.987	95	0.992	130	0.994	165	0.995	200	0.996
30	0.974	65	0.988	100	0.992	135	0.994	170	0.996	205	0.996
35	0.978	70	0.989	105	0.993	140	0.995	175	0.996	210	0.996

$$f_{\hat{C}_{Tj}}(y) = \left(\frac{b_n^{-1}\times\sqrt{n}\times 2^{-(n/2)}}{3\times\Gamma[(n-1)/2]}\right)\int_0^{\infty} t^{\left(\frac{n-2}{2}\right)} exp\{-0.5[t + (\frac{\sqrt{nt}}{(n-1)b_n}\left(\frac{1}{3}\right)y-\delta)^2]\}dt ,$$

$x \in R$ (R is a real number). For the convenience of the calculation of the minimum variance unbiased estimator (UMVUE) $\hat{C}_T$, Table 1 has the corresponding b_n value for each kind of n value.

If the observation of the random sample is calculated, and value of the test statistics is obtained as $\hat{C}_T = v$, then we can calculate *p-value* shown as follows:

$$p\text{-}value = P\{\hat{C}_T \geq v \mid C_T = C_0\} = P\{(3\sqrt{n}/b_n)\hat{C}_T \geq (3\sqrt{n}/b_n)\, v \mid C_T = C_0\} = P\{t_{n-1}(\delta = 3\sqrt{n}\, C_0) \geq (3\sqrt{n}/b_n)\, v\}。$$

For the convenience of evaluating the index of housekeeping time, the research will provide a simple evaluation process that includes four steps as follows:

Step 1: To set the hotel's ideal housekeeping time index (C_0) and decide the sample number (n).

Step 2: To select the significance level α value.

Step 3: To calculate the sample mean value and the standard deviation according to the observation of the random sample, and calculate the test statistic value $\hat{C}_T = v$ based on the corresponding b_n value of sample sizes n (Table 1) we can get *p-value*.

Step 4: To judge whether the housekeeping time index achieves the hotel's ideal demand according to the following principles:

1. When *p-value* $\leq \alpha'$, we can judge that the housekeeping time index does not conform to the hotel's ideal demand.

2. When *p-value*> α', we can judge that the housekeeping time index conforms to the hotel's ideal demand.

THE ACTUAL EXAMPLE

The research case is a hotel of international tourist hotel level that is located at Central Taiwan. The hotel building has 24 stories with 220 rooms. Besides the rooms, there are the Chinese restaurant, the Western restaurant, the banquet hall, and the facilities of outdoor swimming pool in the air, sauna, and gym, etc. At the part of housekeeping, the research case hotel has a nine-step standard operation process, which is: cleaning away the garbage of the room, making up bed, making the bed, washing the bathroom, cleaning away the garbage, spraying the detergent, scrubbing, replenishing the bathroom amenities and articles, and wiping the furniture. The case hotel's housekeeping work process is as follows:

The research aimed at a hotel in Central Taiwan to make investigation in accordance with the four steps of evaluating the index of housekeeping time proposed earlier. We found that the research case hotel's ideal housekeeping time index (C_0) was 1.0; we selected 0.05 as the significance level α value, compiled statistics, got the hotel's housekeeping time index to be 0.752($\hat{C}_T$ =0.752), and the obtained *p-value* = 0.0406 ≤ 0.05, so, I judged this housekeeping time index did not conform to the research case hotel's ideal demand; Therefore, it needed to be improved.

After the improvement strategy and the support program were executed for a period of time, the research aimed at the research case hotel's ideal to do the investigation again. We found that the housekeeping time index after improvement was 1.003($\hat{C}_T$ =1.003), and the obtained *p-value* = 0.4794 > 0.05, so we judged the housekeeping time index after improvement has conformed to the research case hotel's ideal demand. In the future, we will collect the hotel's ideal housekeeping time indexes periodically to do the control.

Conclusion

The hotel industry must follow the trend of the times, grasp the consumers' habits, characteristics, and

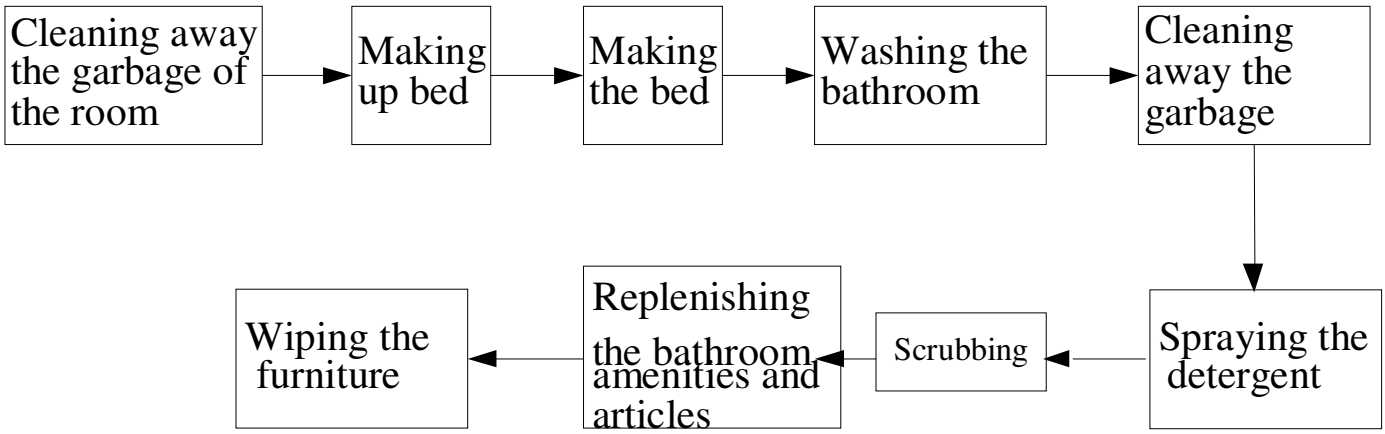

Figure 1. The housekeeping work process diagram.

temperaments at all times, elevate the service quality constantly, and develop unique commodity value or service mode in order to keep the superiority in the intense competition. The most important commodity of a hotel is the room; therefore, at the part of how to provide the tourists the fastest rooms with the highest quality to boost the customer satisfaction, the room attendants' proper preparation and careful handling has a decisive influence.

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