ISSN: 2513-2520

Quantitative Evaluation of Wayfinding at Bandaranaike International Airport for Departure Passengers

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1. Introduction

Wayfinding is one of the most important factors to be considered for overall passenger satisfaction in an airport terminal. Martel and Senevirathne (1990) found way finding information to be the most important service quality attribute for circulation. Furthermore, research related to overall service quality by Adikariwattage (2015) and Correia, Wirasinghe, and de Barros (2008) underscore the importance of circulation signage as one of the most important attributes at airport terminals. Larger and more complex the facility is more consideration need to be given for providing facilities for wayfinding. Most airport operators follow the practice of qualitatively evaluating wayfinding level of service, which is highly subjective to user profile and limited in use for planning and design purposes.

Purpose of this research is to apply the visibility index (VI) method, as a quantitative technique to evaluate wayfinding level of service for departing passengers at Bandaranaike International Airport (BIA), Sri Lanka. A set of level of service grades are derived for evaluating wayfinding level of service at BIA using the method proposed by Dada (1997). Calculated VI values are used in an importance performance analysis in order to identify strengths and weakness in the current wayfinding facilities at BIA.

2. Introduction to Visibility Index (VI)

Visibility index (VI) was introduced by Braaksma and Cook (1980) as a quantitative methodology to evaluate the way finding level of service of airport passenger terminals. The original version of VI was later modified to account for additional features related wayfinding (Dada, 1997; Tosic and Babic, 1984). Methodology proposed by Tosic and Babic (1984) was used to calculate VI in this study. Previous research has successfully applied (VI) for evaluating way finding level of service at airports in countries such as Hong Kong and Canada.

3. Methodology

In the calculation of the VI, the terminal is considered as a network with nodes representing locations of facilities and arcs representing sight lines between nodes. In the modification by Tosic and Babic (1984) terminal facilities are classified into primary and secondary facilities. Primary facilities are those air passengers must use, such as check-in counters and boarding gate, while secondary facilities are utilized depending on the needs of individuals, such as duty-free shops and restaurants. A weight, w_j, was assigned to each facility to account for the differential usage of such facilities. Thus, the modified VI is given by:

$$VI = \frac{\sum_{i,j}^{N} c_{i,j} w_j}{\sum_{i,j}^{N} r_{i,j} w_j} \quad (1)$$

Where, c_{ij} = 1- if node i is visible from node j and $r_{ij} \neq 0$, 0 - otherwise

r_{ij} = 1- if connection between node i and node j is relevant, 0 – otherwise

$0<w_j<1$, importance score of facility j

VI = overall visibility index for departure lounge

N = number of nodes in the passenger terminal

$VI_i = \frac{\sum_j c_{i,j} w_j}{\sum_j r_{i,j} w_j}$ Where, VI_i = visibility index for node I from other nodes

As can be seen in equation 1, VI is obtained by weighing the connectivity indicator (c_{ij}) and relevancy indicator (r_{ij}) with the assigned relative importance to each facility (node). Therefore, VI is a ratio between the weighted sum of the existing visible connections (c_{ij}) and the visible connections that should exist and relevant (r_{ij}).

Determining the relative weights can be done using two methods such as usage rate and perceived importance rating (Lam *et al,* 2003). Due to better reliability in the method, perceived importance level was used in this study. Respondents were asked to rate their perceived importance on a ten-point (0-10) Likert scale (0-"Extremely unimportant"; 10-"Extremely important").Thus, the weight for a secondary facility can be calculated as:

$$w_i = \frac{\sum_{j=1}^{10} w_j f_{ij}}{\sum_{j=1}^{10} f_{ij} \times 10} \quad (2)$$

Where, w_j - score (weight) of the important level j of the facility (0-10)

f_{ij} - corresponding frequency of the importance level j of facility i

4. Data Collection

Data necessary for the above analysis was collected at the Bandaranaike International Airport, Sri Lanka (BIA). BIA is one of two international airports connecting Sri Lanka with the rest of the world. The survey included two parts. Data related to visibility (c_{ij}) and relevancy (r_{ij}) was collected using observation. A questionnaire survey was carried out to collect data on user perceived importance of facilities. A total of 200 air passengers were invited to complete the questionnaire. Five primary and 43 secondary facilities were included in the final questionnaire, where the secondary facilities were classified into five major groups: Curb-side, Lobby Area, Check-in Hall, Common Lounge and Pier Area.

5. Data Analysis and results

Interviews of 123 air passengers were conducted in the restricted area of BIA. Majority of them were departing passengers. There were 53% male and 47% female respondents. About 8% of respondents were business travellers, 70% were leisure travellers and the remaining 22% traveling for other purposes.

5.1. Relative Importance of terminal facilities

Primary activities are given a ranking of 1 as they are compulsory activities. Secondary activities were ranked based on user perceived importance. Equation 2 was used to calculate the relative importance weights. Considering different areas within the departure concourse following results were obtained. Trolleys (0.85) are the most important in Curb side. Information counter (0.84) and flight information (0.83) display are 2nd and 3rd respectively. Info desk and elevator (0.75) are the most important ones in the lobby area. Money exchange outlets (0.71) and Banks (0.70) are 2nd and 3rd respectively. Baggage wrapping and passenger services (0.71) are the most important ones in Check-in hall. Toilet / Washroom (0.83) is the most important one in Common lounge, followed by Duty free, Non-duty-free shops and Escalator (0.79). Considering about the Pier area, Toilet / Washroom (0.77) is the most important facility. Drinking fountain and airline lounges are equally are equally placed at second place.

5.2. Calculation of VI and determining level of service grades

The VI for the departures level obtained using Equation (1) is 0.602. Methodology used by Lam et al. (2003) was used to calculate the level of service grades for BIA. According to this method, levels of service grades are defined based on the spread of the VI values for individual facilities. Using the mean of VI values as the anchor, LOS grades are defined by adding and subtracting proportions of standard deviations. Mean of VIs obtained for BIA is 0.653, Standard deviation of VI = 0.26. Thus, level of service grades can be obtained as follows: LOS A: VI > mean VI +

standard deviations (SD): well above average; LOS B: mean VI+SD > VI > mean VI+1/2 SD: above average; LOS C: mean VI+1/2 SD > VI >mean VI-1/2 SD: average; LOS D: mean VI-1/2 SD > VI > mean VI-SD: below average; LOS E: VI < mean VI-SD: well below average.

The overall VI for BIA's departures level is 0.602 and can be classified as LOS C per the LOS grades obtained using the above method. It implies visibility is somewhat impaired. The possibility of wayfinding problems exists and some disorientation is expected. Passengers are likely to ask for directions, and a fair number of directional signs are needed. According to the questionnaire survey, around 72% of the departing passengers had wayfinding difficulties (Slightly difficult - 58%, Very difficult - 14%). Whereas 25% indicated moderate level of way finding, Rest (3%) had no difficulties. This finding can be considered consistent with a LOS C conditions given above.

5.3. Importance performance analysis

Importance performance analysis can be used to categorize facilities based on VI and perceived importance. The weights of the facilities and their corresponding VI were plotted into a two-dimensional grid, and the grid was divided into four quadrants. VI equals 0.523 was set to be the crosshair point of the vertical axis. This is the lower bound of Los C. Weight equals 0.70 indicated that the facility was important to the passengers, thus it was set to be the crosshair point of the horizontal axis. (Figure 1)

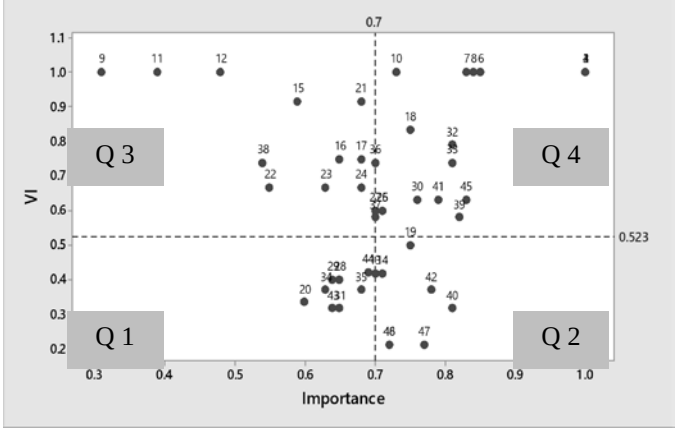

Figure 7: Matching between weights and visibility indices of facilities

Based on the combination of VI and relative importance, quadrant-4 represents high VI and highly important facilities. Thus, the organization must to try to maintain the already good level of service provided. Quadrant-2 represents facilities with high importance and low VI. Organization must give highest priority for improving

level of service of these facilities. Quandrant-3 represents facilities with low importance and high VI. Organization may maintain the good orientation level of service, however at times of resource limitations these can be assigned a less priority. Seven facilities are included in Quadrant 2. They are highlighted as in need of wayfinding improvements because they are important facilities with VI below service standard C. These facilities included the Money Exchange outlets, Banks (Lobby), washrooms and drinking fountains in Common lounge (Transit area) and Check-in area, Airline lounges, Elevators, Medical Centre, and ATMs etc. Thus, the airport authority need to give high priority in improving wayfinding for the above facilities.

6. Conclusion and Recommendations

VI and related level of service grades were defined for the departure concourse of the BIA main passenger terminal. Calculation of the level of service grades indicated the current wayfinding at BIA is at LOS-C. However, it must be noted that the above method of calculating level of service grades is influenced by the same VI values used calculate the overall VI. Also, it was assumed that the VI for individual facilities are normally distributed. Thus, it does not give a true gauging of the overall VI with respect to a set of independent benchmarks. This could be improved by determining the LOS grades using similar VI values calculated for a set of different airport terminals. The importance performance analysis using the VI and relative importance weights revealed critical facilities needing urgent attention for service quality improvement as well as areas having good wayfinding facilities. Therefore, VI and proposed LOS standards can be used as criteria for design and improvement of airport terminal layouts and wayfinding aids.

7. References

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Keywords: *passenger orientation; wayfinding; visibility index; level-of-service*