Connectivity of Bandaranaike International Airport (BIA) as an Aviation Hub of the Future: The Way Forward

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Introduction

Sri Lanka's national policies envisage developing the island into an aviation hub in the South Asian region.The key feature of a hub airport is to have a coordinated set of arrival and departure flightsfrom different airports (spokes). By consolidating these traffic flows the hub and spoke system gives a wider choice of transfer options to passengers allowing accessibility across different origins and destinations improving the connectivity offered. Airlines also benefit through the said hub and spoke system as origins and destinations that cannot be connected through a direct flight are facilitated in this manner. Measuring the connectivity offered at BIA as a potential hub airport is vital in the process of assessing the government plans for the development ofthe country's airports.

According to Reynolds-Feighen(2001) cited in Burghouwt and Wit (2005), spatialconcentration(geographical concentration of an airlines' network around a hub/hubs) and temporal configuration arethe two main features of a hub and spoke network in terms of the connectivity it provides.Temporal configuration, the focus of this study, deals with hub time table coordination where a synchronised, daily bank set of flightsisoperated through the hubs. This is measured usingboth quantity and quality of connections offered by airlines operating at the hub (Veldhuis, 1997; Burghouwt and Wit, 2005 and Li, et al., 2012). Temporal co-ordination also refers to a wave system structure organised at the hub for arrival and departure flights. In an "ideal wave" structure, the arrival wave would be followed by a transfer period and a corresponding departure wave of flights (Danesi, 2006).

Objectives

The objective of this study was to assess the temporal configuration of Bandaranaike International Airport (BIA) with the aim of evaluating (a) how it has utilised the available runway capacities (in terms of slots offered) and also (b) schedule coordination between the operating airlines to increase connectivity.

This paper has two objectives :

1. Identification of the wave system structure at BIA – to assess whether there is a coordinated set of arrival wavesand corresponding departure waves
2. Analysis of the level of connectivity offered at BIA – to assess the indirect connectivity offered via BIA through these wave system structures as against direct connections

Methodology

A wave system structure should have a number of continuous flight waves and hub repeat cycles(Danesi, 2006). Methodology followed by Danesi (2006) to assess airline hub waves has been adapted to suitairports by counting the number of departures and arrivals in each hour of the day. Plotting the count against time on a bar chart, arrival and departure waves are identified. Then observations are made to identify whether this cycle repeats in the same manner and throughout the seven days of the week.

The connectivity of the wave system structurehas been identified mainly using methods by Li, et al.(2012). Quantity of connectivity is measured by the number of viable connections falling into the viable connection threshold (VCT), defined as a connection which satisfies both the minimum connecting time (MCT)of 45 minutes (Doganis and Dennis, 1997) and the maximum acceptable connecting time (MACT)of 180 minutes,for a flight after arriving at the hub airport (considering the standards used by the national carrier as well aslandside and airside infrastructure limitations at BIA).Sum of all these connections within the VCT was identified as the quantity of viable connections (QVC). QVC indicate the number of all possible connections resulting from *BIA Flight Schedule*; the larger the QVC,themore connecting opportunities the BIA provides. The connections established between low cost carriers and full service carriers were eliminated as low cost carriers do not have code share agreements, nor do they provide interlining facilities.

Quality can be defined as the attractiveness of the indirect connections provided, which aremeasured using *time* and *routing factor* as the two variables. Time variable is

determined by taking the ratio of non-stop flight to perceived travel times of the indirect connection.Perceived travel time includes actual flying time of two connecting segments plus the transfer time after applying a penalty factor (Li, et al., 2012).The penalty factor is introducedin order to take into account disutility experienced by passengers when transferring against flying direct. The model also encompasses a routing factor (RF) calculated by dividing the indirect distance by direct distance of two connecting flight segments and values (1, 0 and 0.5) were assigned for a resulting de-routing factor (DRF) as follows:

$$RF = 1, \quad DRF \leq 1.2$$
$$RF = 0, \quad 1.5 < DRF$$
$$RF = 0.5, \quad 1.2 < DRF \leq 1.5$$

Connections which satisfy the quality and quantity of connection were determined as per the above explained methodology within a week in the month of July. By summing the product of Quantity of Viable Connections (QVC) and Quality of Connectivity Index (QCI) the Hub Connectivity Indicator (HCI) was calculated after excluding the connections with a QCI closer or equal to "0'. One unit of HCI is equal to one indirect connection.

Results

Though the observations above (Figure 1) do not reveal a structure of an ideal wave system, the BIA,inclusive of all airline operations,seems to have on average four waves which repeat approximatelyonall days of the weekfrom 0400–0900hrs, 1000-1400hrs and 1500–2100hrsand 2200-0200hrs.This wave system structure is particularly influenced by theactivities of thehub carrier, Sri Lankan Airlines (ALK/UL), which operates four flight waves aligned to the above mentionedtimes. Operations appear peaking during early morning and late night with the contribution of other airlines as well; but, during the midday, only the ALK flights provide a significant contribution to create a wave.

Total 894 arrivals and departures are handled at BIA per week, while BIA's single runway with the current capacity constraints can only handle twenty five (25) flights in any given hour. The full capacity of BIA is only utilised during 0500-0600, 0800-0900 and 1900-2000hours. The above said total arrivals and departures make 1961 (QVC) indirect connections falling within the VCT, resulting in a Hub Connectivity Indicator (HCI) of 750.7. Only 38% of QVC indirect connections turn out to be quality connections to passengers at BIA. Sri Lankan airlines as the hub carrier accounts for 86% of the above said (HCI) at BIA by making 1703 of the total connections. The quality of these connections only accounts for an index of 265.9 as a major portion of

the connections that fall within the VCT are found closer to the higher threshold limit and only 36% are found closer to the nearer threshold limit. For example, with regard to the Kuwait- Male connection via BIA, the perceived transfer time between flight arrival and departure accounts for 140 minutes, thusfalls closer to the upper boundof the VCT.

Figure 1: Weekly Hub Wave System at BIA

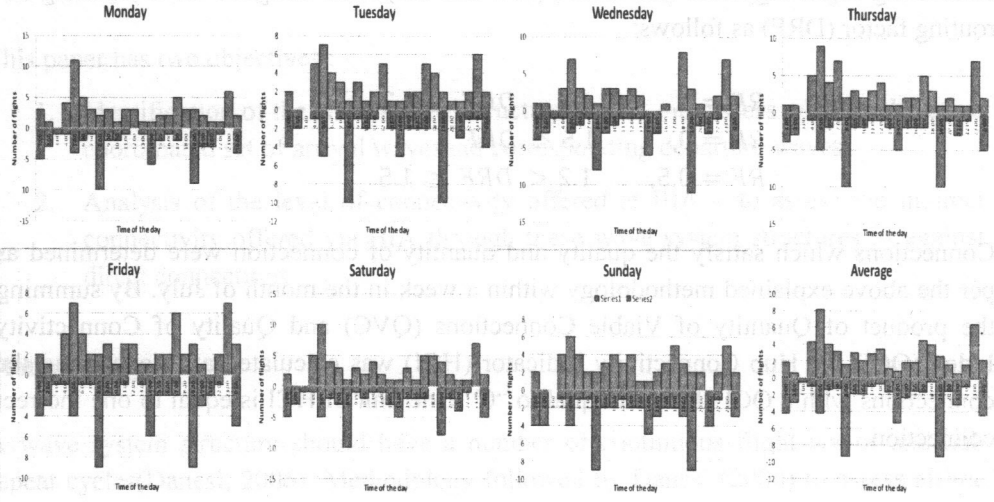

Table 1: Comparison on Quantity of Viable Connections (QVC) and Hub Connectivity Indicator (HCI)

Quantity of Viable Connections and Hub Connectivity Indicator (HCI)	All Airlines	ALK
Total arrivals and Departures	894	471
Quantity of Viable Connection (QVC) - indirect Connections made by all airlines within Viable Connection Threshold (VCT)	1961	1703
Quality of the indirect connections	305.2	265.9
Hub Connectivity Indicator(HCI) of the Quantity of Viable Connection (QVC)	750.7	640.4

Source: (Li, et al., 2012)

Conclusion and Policy recommendations

SriLankan Airlines is the hub carreer which provides a major portion of the connections formed.However, an overwhelming majority of their connections are not within the specified VCT, and even the connections provided by the airline that fall within the VCT are closer to the upper margin of the threshold than to the lower margin. This

indicates that their quality of connectivity is inadequate, and that the ALK needs to substantially improve its connectivity by taking into consideration the other arrival and departure flights within the threshold of 45–180 minutes to provide a better connectivity through BIA.

Given the policy directions and recommendations to encourgae transfering via BIA and establish its position as a hub, it is imperative to take into consideration factors such as limitations at the BIA on the airside and landside handling, eventhough more flights can be accomodated on the runway with the present infrastructure. The quality of connections provided may be hindered by the negative records on punctuality at BIA by the handling agent (on average 75%). Hence, the standard VCT of 45, which is much below the current levels, may not be practical within such a context.

Aviation policy should direct the operators to optimise the current capacity at BIA with coordinated schedule planning in slot allocation to airlines. The national carreir has a significant role to play in coordinating with other airlines and planning its schedules to improve the quality of the indirect connections provided.

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