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Investigation on Sultan Abdul Halim Airport Capacity: Its Current Utilisation And Future Potential

Nurul Mazlina Mazlan[1], Azlin Abdul Rahim[2*]
[1,2] Malaysian Institute of Aviation Technology, Universiti Kuala Lumpur, Selangor, Malaysia.
[*]Corresponding author: azlin@unikl.edu.my

Abstract. The airport is a vital part of the aviation system. The rapid growth of passengers using the airport terminal may lead to the congestion and disruptions of the airport operational. This paper discuss the current passenger capacity of Sultan Abdul Halim Airport against the airport design capacity. The evaluation been made through the peak hour movement and passenger forecast. Observation was made at this airport, processes are then mapped for efficiency of passenger movement. Another investigation were to determine the factors that can affect potential status of Sultan Abdul Halim Airport and provide suggestions for future operational status for the airport. Methodology use for this research is by observation and capacity calculation using the Airport Development Reference Manual. The result shows all factors that contribute to the potential of Sultan Abdul Halim to become the next aviation hub in this region.

Keywords: sultan abdul halim airport capacity, current utilisation, future potential

A. Introduction

This research is to investigate the current capacity at Sultan Abdul Halim Airport by resolve of the passengers' peak hour movement and passengers' demand forecast. The increasing number of passengers at Sultan Abdul Halim Airport might cause congestion in the future. The main problem is Sultan Abdul Halim Airport ability to provide and maintain the services and facilities for passengers continuously. It is important to know whether the airport design capacity can cater the future traffic of passengers. Besides, it also important to know the current and required airport facilities in order to determine whether Sultan Abdul Halim Airport requires additional facilities and capacity expansions in the future.

B. Literature Review

Airport is either an intermediate or terminal point of an aircraft on the air portion of a trip. The facility must be designed to enable an aircraft to land and take off. In between these two operations, it might, if required, unload and load payload and crew, and be serviced. [1]

1.1 Airport Capacity

Airport capacity is the capability of the airport in handling or caters to the passenger in a certain period of time. The airport terminal capacity can be defined as an optimal nominal capacity that can be achieved if infrastructure development and synchronized for the ability to accept the passengers, cargo and aircraft that an airfield generates. [2] Three common categories of capacity considering the constraint elements are technical capacity, acceptable capacity and allowed capacity. Technical capacity is defined as the maximum number of aircraft or passengers that can be accommodated in a certain period of time when there is continuous demand. [2] It is affected by the physical constraints of the available infrastructure, for example, the maximum throughput figure of a runway or the maximum number of passengers dependent on the limited terminal space available.

Acceptable capacity is the maximum number of aircraft or passengers than can be accommodated in a certain period of time, taking into account a maximum allowable delay or

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waiting time per step in the airport process. [2] It is defined by the acceptable Level of Service (LoS). This applies to a departing passenger and flights, and also arriving ones: waiting times at the baggage claim area is another example of how service levels determine acceptable capacity. Allowed capacity is defined by regulations and legislation that balance economic importance against any nuisance that may be caused by local residents. [2]

The problem with current airport terminals is that the passenger is subject to delays and procedures that, together with increasing congestion of the airway system, have produced a marked deterioration in the overall level of service in air travel. [3]

1.2 Method Describing Airport Peak Hour

Peak-hour passenger movement instead of annual passenger movement is the basis for the design of the passenger terminal and its facilities. The most important role of the operational management of an airport is to maximize the use of existing facilities and minimize the problem of congestion. Norman J. Ashford has outlined below the three most important methodologies for determining design peak-hour passenger: The Standard Busy Rate (SBR), Busy Hour Rate (BHR) and Typical Peak-Hour Passenger (TPHP). [1]

- The Standard Busy Rate (SBR)

  The standard busy rate (SBR) measure or a variation of it is a design standard that has been used in the United Kingdom and elsewhere in Europe, especially by the former British Airport Authority (BAA). It is defined as the thirtieth highest hour of passenger flow or that rate of flow that is surpassed by only 29 hours of operation at higher flows. [1] Design of SBR ensures that facilities will not operate at or beyond the capacity for more than 30 hours per year in the design year, which is felt to the reasonable number of hours of overload. In practice the relationship of SBR to the actual observed annual peak volume as stated below:

  Absolute peak hour volume = 1.2 x Standard Busy Rate

- Busy Hour Rate (BHR)

  Busy hour rate (BHR) is the modification of SBR that also been used for some time in BHR or 5 percent busy hour. This is the hourly rate above which 5 percent of the traffic at the airport is handled. This measure introduced to overcome some of the problems involved with using SBR, where the implied level of congestion at the peak was not the same from the airport to airport.

- Typical Peak Hour Passengers (TPHP)

  The FAA uses a peak measure called typical peak hour passenger (TPHP) means that the peak hour of the average peak day of the month. It is seen that the peak is more pronounced with respect to annual flows at small airports. As airports grow larger, the peaks flatten and the troughs between peaks become less pronounced. For instance, airports which had more than 30 million passengers annually would have 3.5% TPHP whereas much smaller airports (which had less than 100,000 passengers) would have 20% TPHP.

- Busiest Timetable Hour (BTH)

  Busiest Timetable Hour is suitable for small airports with a limited database. BTH can be calculated using average load factors and existing or projected timetables. Error in forecasting, rescheduling and reequipping uncertainty of the airlines and variations in the average load factors are the subject of this method. [1]

- Peak Profile Hour

  It is straightforward to understand this method. First, the peak month is selected. For each hour, the average hourly volume is computed across the month using the actual length of the month. This gives an average hourly volume for an ‘average peak day’. [1]

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- Other Methods

  Most the airport authorities have used the thirtieth highest hour in West Germany. In France, Aeroports de Paris used 3 percent overload standard. Dutch airports use the sixth busiest hour, which is approximated by the average of the 20 highest hours. [1]

1.3 Airport Passenger Terminal

Airport terminals are buildings that contain various essential facilities. In the terminal building, as well as its airside and ground access interfaces, facilities may be nearing capacity and, in some cases, may have an exceeded their design limitations. The basic planning criteria in the development of passenger terminals concepts must be in easy orientation and simplicity, minimise walking distances, minimise level changes and airport must built-in to accommodate the future changes in the dynamic industry. [6]. Thus, the condition shows the importance of passenger handling facilities of the airport. However, inconveniences like long queues at security screening or long transfer routes may cause the passengers to leave the terminal with a bitter experience. In addition, an increase of security threat, delay of connecting flights and passenger missing their flights is the result from improperly handled passenger flow. [7]

Indicators are being used to measure every '*processor*' (category for every facility provided at the airport terminal). For 'Departure' section, there are *check-in*, *immigration*, *security*, and *holding lounge / hall*. As for the 'Arrival' section, there are *immigration arrival* area, *security*, and *holding lounge / hall* [8].

C. Methodology

To complete the research, the researcher uses two type of methodology for data collection which is primary data and secondary data. For the primary data, the researcher will conduct the observation at the Sultan Abdul Halim Airport terminal and interview the Operation Manager of Sultan Abdul Halim Airport. For secondary data, the researcher will get data from different resources such as books, journals, and electronic resources such as e-journal, internet, websites, and also online materials. The instrument used to determine capacity is through the calculation of terminal counters/processor by using secondary data. The formula to calculate capacity is based on the Airport Development Reference Manual (ADRM).

D. Results and Discussion

For the first objective, a traffic forecast has been prepared covering the period from 2007 until the Ultimate ppa from the Sultan Abdul Halim Airport Master Plan, 2008. Table 1 shows the forecast and actual numbers of passenger movements. From Table 1 below, it shows the actual passenger movements in 2018 has exceed the numbers forecast in 2056 in Sultan Abdul Halim Airport Master Plan.

Phase/Year		**2007 ppa**	**Current Phase 1 2016 ppa**	**Phase 2 2031 ppa**	**Phase 3 2056 ppa**	**Ultimate ppa**	**Actual Passenger Movement 2018**
Total		291,006	382,037	512,110	653,895	1,200,000	817,253

Table 1: Difference Forecast and Actual Passenger Movements [9] [10]

Figure 1 shows the actual passenger movements at Sultan Abdul Halim Airport from the year 2009 until 2018. The numbers are increasing steadily and shows there is an accumulative growth for the past years. The numbers of actual passenger movements are two times higher or 22% difference than the numbers forecast in Sultan Abdul Halim Airport Master Plan.
On the other hand, Table 2 summarizes the forecast scheduled annual aircraft movements and the actual numbers of aircraft movements in 2018. From this table, the actual passenger

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movement in 2018 have exceeded the forecast numbers in 2056. The actual aircraft movements have increase three times higher with 13% difference from the forecast numbers in 2056 as per Sultan Abdul Halim Airport Master Plan.

Phase/Year	Current 2007	Phase 1 2016	Phase 2 2031	Phase 3 2056	Ultimate	Actual Aircraft Movements 2018
Total Combined	2,668	3,489	4,665	5,927	10,909	9,544

Table 2: Difference Forecast and Actual Sultan Abdul Halim Airport Aircraft Movements [9] [10]

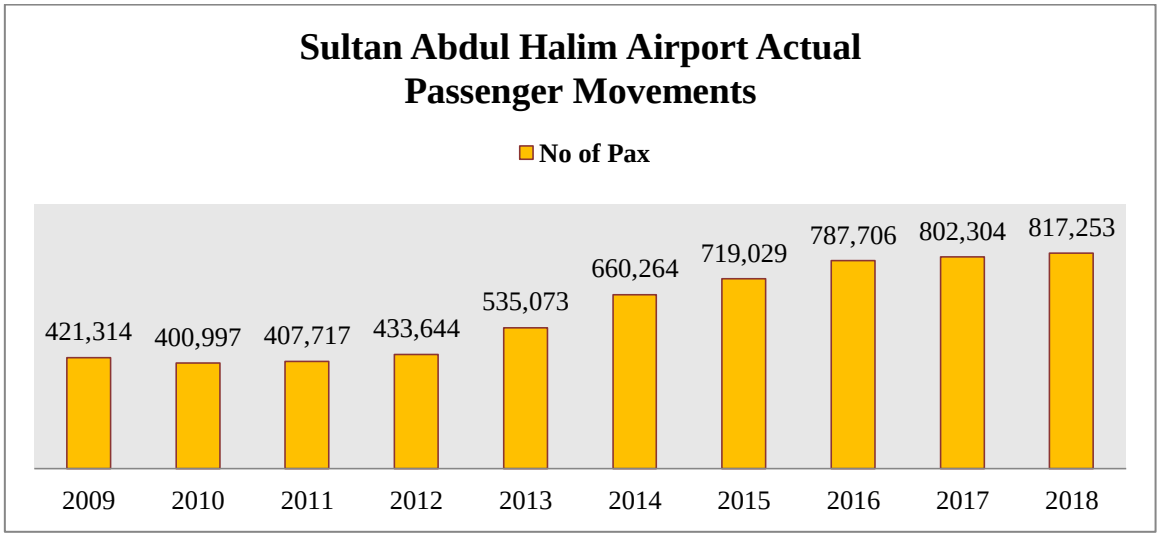

Figure 1: Sultan Abdul Halim Airport Actual Passenger Movements

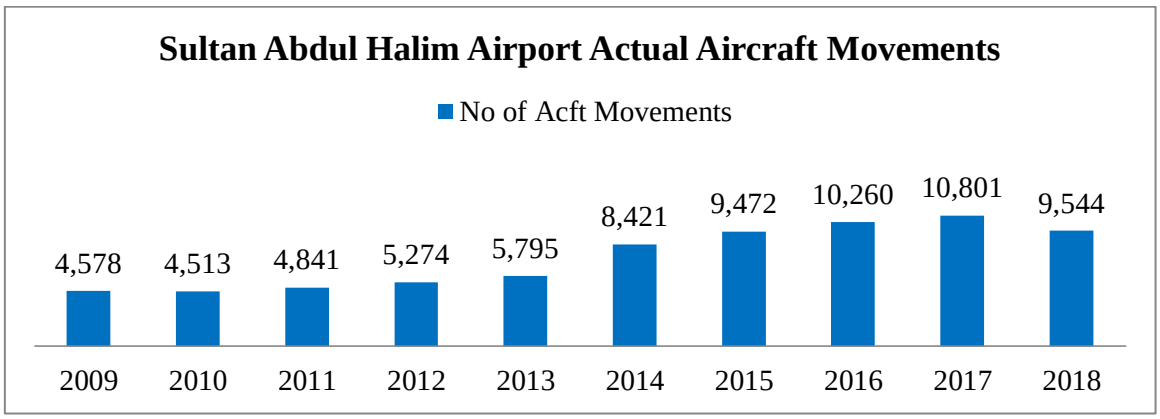

Figure 2: Sultan Abdul Halim Airport Actual Aircraft Movements [9]-[10]

Figure 2 shows the actual numbers of aircraft movements in Sultan Abdul Halim Airport. It shows there is an accumulative growth for the past years, even though the numbers in 2018 shows a decline in aircraft movements. The passenger peak hour movements are determined based on peak hour aircraft movements. From the forecast, it shows that the passenger peak hour movements remain fairly stable. Furthermore, when the same airline increases the number of operations this will result in additional peaks in other parts of the day. The current numbers of passenger peak hour are calculated by using method Peak Profile Hour.

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Phase/Year	Current 2007 Pax/hour	Phase 1 2016 Pax/hour	Phase 2 2031 Pax/hour	Phase 3 2056 Pax/hour	Ultimate Pax/hour	Actual *pph* 2018
Total Combined	306	314	317	320	590	556

Table 3: Difference of Forecast and Actual Passenger Peak Hour [9] [10]

For the second objective, there are several airlines which make an inbound and outbound flight to Sultan Abdul Halim Airport. The peak hour movements of aircraft are made based on the current year 2019. There are at least 102 schedule flight movements in a week for both departure and arrival, for domestic sector. Air Asia operates 34% of flight movements out of 100%. Firefly contributes 27% of flight movements in Sultan Abdul Halim Airport. Both Malindo and Malaysia Airlines contribute 21% and 18% respectively. The highest peak days for flight movements are in Monday, Friday, Saturday and Sunday. Subang Airport and Kuala Lumpur International Airport recorded the highest rate for domestic destination in a week which is 49 flight movements for both destinations, followed by new route which has been introduced which is Senai International Airport contribute only 4 flights in a week.

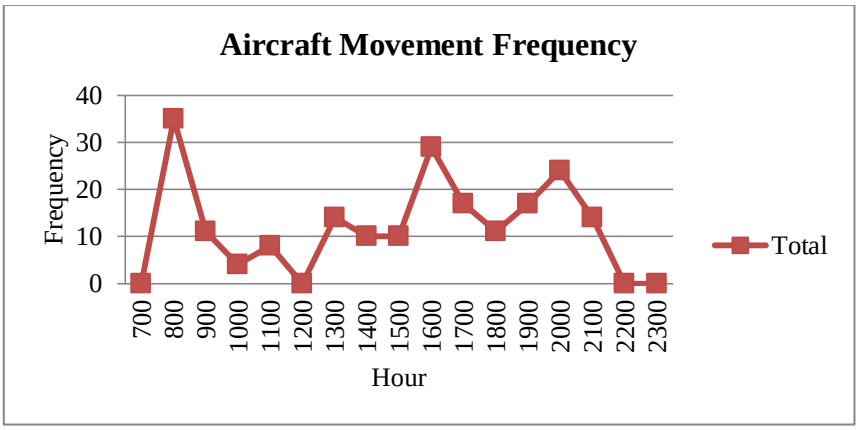

Figure 3: Aircraft Movements Frequency

From Figure 3, it has been breakdown by the hour from 0700 until 2300 for both depart and arrival flights. The highest numbers or peak hour for aircraft movements frequency in Sultan Abdul Halim Airport are in 0800, 1600 and 2000. During this time, there are at least 24 to 35 flights for both depart and arriving from Sultan Abdul Halim Airport per week. These are the busiest time at the airport. This is the most crucial time for check-in counter, airport security and baggage handling area. The airport staffs need to fully focus on these times to avoid any congestion in those areas. Every facility is needed to cater the increasing number of passengers and flights during this hour. Failure to provide required facilities can lead to terminal congestion, especially during peak hour.

Based on Sultan Abdul Halim Airport Master Plan 2008, the terminal equipment for phase 1 (2016) and the current terminal equipment (2019) shows that the current facilities are sufficient except for baggage make-up and customs. Based on the table, it shows that baggage make-up and customs facilities are still unsuccessful to follow the estimation provided in Sultan Abdul Halim Airport Master Plan.

Therefore, the first objective has been determined and it can conclude that the current passenger capacity has exceeded the forecast capacity in the Master Plan. The passenger and aircraft movements in Sultan Abdul Halim Airport are increasing every year, and the numbers can exceed the airport design capacity plus Sultan Abdul Halim Airport might not be able to handle all the capacity in the future.

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For the second objective, the current and required airport terminal facilities have been determined. For the customs and baggage make-up facilities, both are not following the forecast requirements in the Master Plan. These facilities might contribute to congestion in the peak hour process. For baggage make-up, there is a need to consider if the machine broke or jammed. This also could lead to check-in congestion and long queuing. All of these facilities need to come out with actions and the best way to avoid congestion and ensure the smooth process to cater to the amount of passenger.

E. Conclusion and Recommendation

From the research, it can be concluded that investigation on capacity utilization is important in order to know the level of ability of airport in handling passengers and providing comfortability to the passengers. Based on the study carried out on Sultan Abdul Halim Airport it shows that it will not capable in handling the capacity both of passenger and aircraft movements in the future. There are several problem identified throughout the research, for both objective.

In the first objective, it shows that the passenger capacity almost exceed the airport design capacity which can lead to major inconvenience. The recommended solution is to set difference between the flight times of airlines for one or two hour difference. This is to minimize the *pph* in peak times and it could longer the time before it reached the time to expand the terminal or bottlenecks area. For the second objective, aside from make sure the customs and baggage make up facilities keep up with the Master Plan, another recommendation is to install at least two baggage drop positions for web and self-service check-in passengers, this can reduce the queue in the check-in counter. Overall, improving quality control in terminal operations is important.

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