

Analysis of airport ground accessibility in India by explicating the case of CSI Airport, Mumbai

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Abstract- As air transport serves a time sensitive market, the surface access to airports should be efficient and the airport-linked requirements be persistently updated. In the Indian context, there is an absence of dedicated transportation services to airports except for the city of New Delhi, where it has taken the first step by integration of dedicated airport express line with existing transportation system. Consequently, there is a need to emphasize on linking of dedicated transportation services in other Indian cities as a sustainable solution. Mumbai being the fourth most populated city in the world too lacks a dedicated transportation service to the airport, which is the second busiest airport in India and amongst the renowned in the world (Department of Economic and Social Affairs (UN), 2009). Therefore, the main objective of the study is to assess the need for emerging seamless ground accessibility to Indian airports by explicating the case of Mumbai. An interview survey was conducted to understand the trip characteristics of air passengers, their expectations and perceptions for making the mode choice. The results and conclusions were used in estimating cost and time savings per person per hour for the city of Bangalore, so that the same practice can be used for other Indian cities too.

Index Terms- time, cost, ground access mode choice, modes of transportation, dedicated transportation services

I. INTRODUCTION

The total travel time (TT) required for an air trip i.e. from door to door comprises of non-travel time, on-airport time, in-flight time and again the non-travel time. Non – travel time (NTT) signifies the time required to reach the airport and it is flexible due to various conditions. On-airport time comprises the time required by an air passenger to complete the required formalities. In-flight time (IFT) is the actual travel time. Amongst the three, on – airport time and IFT both are non-flexible. This study only deals with the NTT and the departing passengers. Figure no.1states the timeline of an air trip.

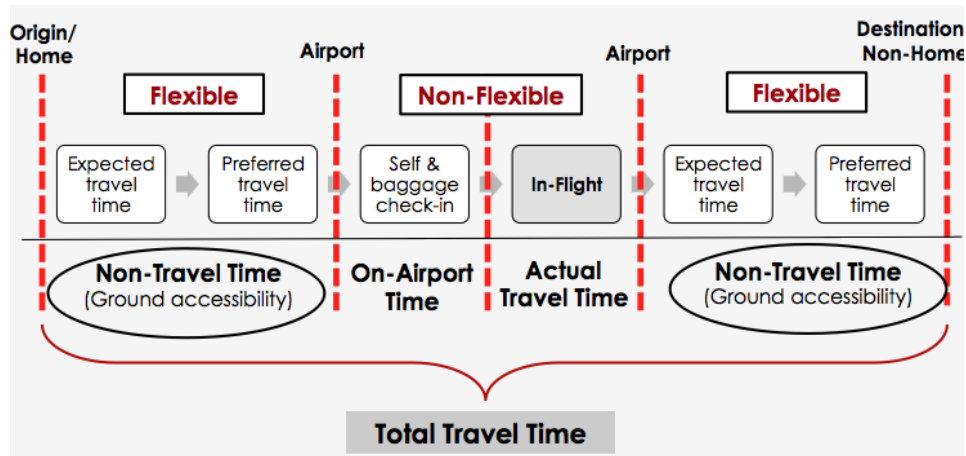


Figure 1: Timeline of an air trip

In India, it is observed that for small distance journeys the NTT is more than IFT. It is supported with the example of Mumbai to Ahmedabad as shown in table no.1. The approximate distance between these cities is 550kms (Google Maps, 2013) and the modes of transportation used for comparison are bus, rail and air in terms of cost and time elements(irctc.com, 2013), (makemytrip.com, 2013), (redbus.in, 2013).

Table 1: Time and cost elements for Mumbai to Ahmedabad

Mode of Transportation	Travel Time (hours)	Non-Travel Time (hours)	% of Travel Time	% of Non-Travel Time	Travel Cost (Rs.)
Air	1	5	20%	80%	4000 (Economy)
Rail	6 - 7	2.5	70 - 75%	25 - 30%	805 (Chair car)
Bus	10 - 12	1.0	90 - 92%	8 - 10%	1200 (A.C.)

The above example clarifies that NTT of air journey comprises of 80% of the TT, which is the highest as compared to road and rail travel. It is also clear that the cost of air travel is maximum amongst the three. Therefore, the primary objective of the study is to suggest solutions to reduce the NTT in context of air travel. Further, the case of Mumbai will be explicated for assessing the need of dedicated transportation services to airports in various cities of India. A primary survey was carried out, wherein about 200 samples were collected from various metro and non- metro cities of India to create an understanding about the opinions, expectations, perceptions and willingness of people towards a dedicated mode of transportation system to airport and strategies like the baggage handling strategy.

II. LITERATURE REVIEW

Transit Cooperative Research Program (TCRP) report 62 elucidates the various trip characteristics of markets segments – resident business (res-bus), resident non – business (res-non bus), non – resident business (non -res bus) and non – resident & non – business (non-res non-bus) (Transportation Research Board- National Research Council, 2000). Assuming those explanations as hypothetical scenarios a matrix is formed as shown in figure no.2 which is in turn used to develop a questionnaire for primary survey.

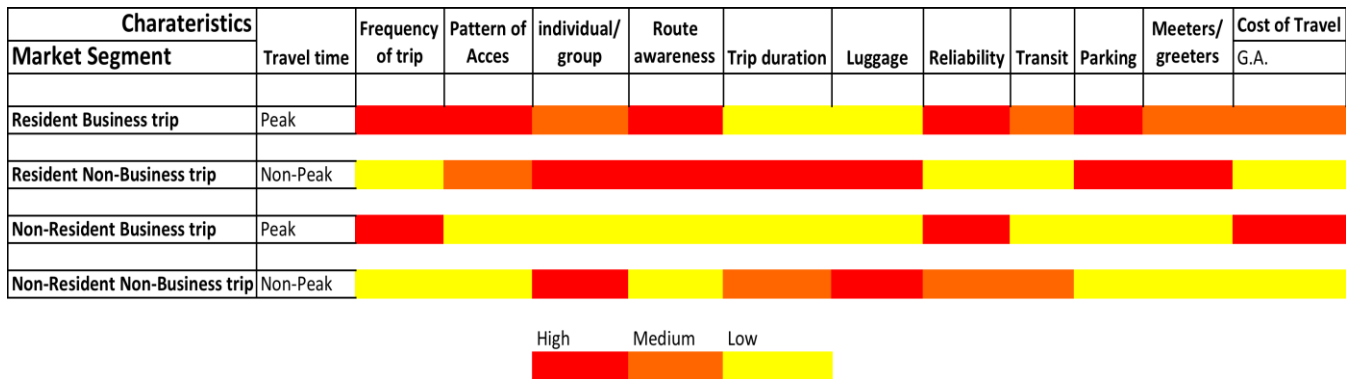


Figure 2: Characteristics of air passenger market segments (hypothetical scenarios)

The characteristics are rated in terms of high (red), medium (orange) and low (yellow) to justify the performances or behavior of different market segments. For example, the travelling frequency of business segment is generally very high compared to non-business segment. Likewise, the other characteristics are also descriptive. TAM Mei Ling(Hong Kong Polytechnic University, 2011) explained the graphical representation of time elements, which are witnessed while reaching the airport. Where, it can be believed that while departing from the origin,in addition to the expected travel time for reaching the airport, a safety margin (buffer time) is ideally kept in case of delays so that a person can reach arrive at the airport in the preferred time. Thus,it can be concluded that there are three main factors responsible for an air passenger to make mode choice selections for reaching airport – time, cost and distance. The cost required to reach the airport may comprise fuel costs in case of own vehicles, ticketing costs in case of public transport, charges of taxis/ cabs, parking charges, luggage charges, waiting charges, curbside charges, etc. TCRP report 62 provides the relation of level of service versus cost of travel, showing that as the level of service goes on increasing with the increase in cost(Transportation Research Board- National Research Council, 2000). Distances affecting the mode choice selection can be the distance between origin and airport, distance between origin and transit station, terminal/ baggage-claim area and transit station, terminal and parking area, etc. The time factor has been explained before.

A detailed study of some airports with highest public transportation (PT) mode share was made, such as Oslo airport, Norway (PT-64%), Hong Kong International airport (PT-63%), Narita airport, Tokyo (PT-59%), and Heathrow airport, London (PT-40%) (Transportation Research Board of the National Academics, 2008). The mainreason for these airports to have high shares of PT is through integration of dedicated modes of transportation services in the existing transportation system. Some of the services also

provide unique seating arrangement systems in the train as per needs of air travelers, providing comfort. Some of the operators do sell the rail tickets along with the air ticket booking. Hong Kong airport offered world's first off-airport check-in system inclusive of boarding pass. Narita airport, Tokyo alone has 4 dedicated modes of transportation to reach the airport from various parts of the city. It also offers 3-class seating where seats are reserved a day in advance. Heathrow airport in London also offers similar full off-airport check-in service. Such noteworthy strategies have made these airports renowned amongst the others. The amount spent on the strategies is excessive but they equally deliver effective, viable and sustainable solutions (Transportation Research Board of the National Academics, 2008). These were some of the significant features for making those airports renowned in the world. There is a need for application of similar strategies at Indian airports as a result of sustainable and efficient solutions.

III. ANALYSIS

A. Data Collection

As mentioned, 200 samples through Primary Survey were collected over a period of 5 days through online surveys. The samples were collected from metro cities of India like Mumbai, New Delhi, Bangalore, Ahmedabad, Hyderabad, Chennai, Kolkata, etc. and non-metro cities like Guwahati, Berhampur, Bhubaneswar, Chandigarh, etc. Opinions were gathered from people opting for air travel since practical knowledge is the key factor to answer the questions mentioned in the survey form. The Survey forms were sent to air travellers both from metro and non-metro cities to gain the knowledge about the facilities and other details related to the ground accessibility prevailing in their respective cities to access the airport, as it was practically not possible to visit most of the cities personally. The collected data was divided into two parts. The first part was according to the air passenger market segments and second, according to the cities with public transportation and without public transportation services.

Part 1 - Findings (according to air passenger market segments)

Out of 200 samples, 30 % of the samples belonged to the res – bus market segment, 44.5% of res – non bus, 6% of non res – bus and the remaining 19.5% of non res – non bus segment. The frequency of trip for business travelers was less than 6 months. Their party size observed was not more than two persons and the amount of luggage they carried was less than 7kgs. People resident of the city showed maximum reliability on the mode of transportation selected to reach the airport. 81% of the samples were willing to use public transportation system if available in their city. About 73% of the samples gave preference for off – site baggage check-in. The cost of travel in reaching the airport was between Rs.500 to Rs.900. About 60% of the samples faced traffic congestion, 15 to 20% of the samples had problems like baggage – handling and arranging vehicle for reaching airport and rest faced parking, queuing and connectivity problems.

Part 2 - Findings (according to metro and non – metro cities)

Out of 200 samples 83% samples were collected from metro cities and 17% from non – metro cities. Around 53% samples from the metro cities were domestic travelers. They need more than 1hour 40mins to reach the airport due to traffic congestions, parking issues, connectivity, etc. and the cost required to reach the airport was more than Rs.600 per trip. Maximum samples showed 75% reliability on the mode of transportation selected by them. 83% preferred using public transport system if available and 71% for baggage – handling strategy. About 77% of the samples selected the mode of transportation based on comfort and convenience while 23% preferred low cost and less time.

Conclusion

It is well defined that there is no dedicated transportation services in most of the Indian cities for reaching airport. People are willing to travel by PT if available in their city. Since there is absence of PT they have to spend huge amounts on Para – transit and private automobiles. Maximum people showed their willingness to use baggage-handling strategies. So, this study addresses the airport operators to take a step forward towards seamless ground accessibility to Indian airports.

B. Explicating case of Mumbai

Mumbai city is located in the western part of India.. Mumbai city is a linear city spread in three directions – the Southern part, the central part and the western part. The BMC (The Municipal Corporation of Greater Mumbai) limits the city of Mumbai till Borivali in the western part, Mulund in the central part and CST or the Colaba area in the southern part. So, accordingly Borivali, Mulund and CST stations have been assumed as the maximum distances from where the air travelers approach the CSI Airport, Mumbai. About 30% of the total traffic coming to the Chhatrapati Shivaji International (CSI) Airport, Mumbai has been found to be from the western part of the city, 30% from the central part and the remaining 40% from the southern part (Mumbai International Airport Pvt. Ltd. - GVK, 2012) as shown in figure no.4.

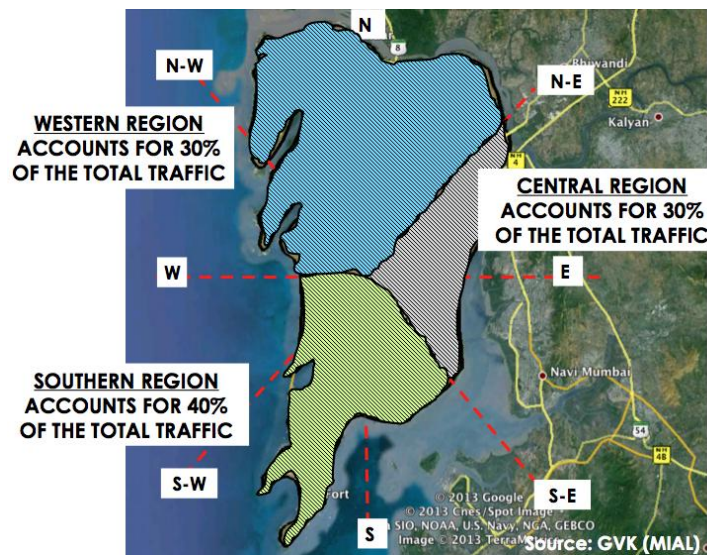


Figure 3: Map of Mumbai city(Google Maps, 2013)

About 30% of the samples gathered through primary survey belonged to the city of Mumbai. The details collected are analyzed in this section. Table no.2 indicates the minimum time and cost required to reach the CSI Airport, Mumbai by the available modes of transportation in the city also explains the frequency and operating hours in a day of the different modes of transportation. For example, the local bus service(BEST buses) take more than 2hours to reach the airport though the cost of travel is as low as Rs.20. However, it would also be very difficult for the air passengers to carry their luggage in the bus due to absence of storage space. Likewise the time taken by other modes of transportation are shown in Table no. 2.

Table 2: Time and cost factors for reaching CSI airport, Mumbai (through primary survey)

Mode	Part	Min. Time (hrs)	Min. Cost (Rs.)	Frequency (mins)	Operating hours
Local Rail	Southern	1:30	15	5	20
	Western	1:00	12	12	20
	Central	1:15	12	7	20
BEST Bus	Southern	2:15	20	15	16
	Western	1:00	12	12	20
	Central	2:30	25	15	16
Regional Bus (S.T.)	Southern	2:15	25	60	24
	Western	2:00	20	60	24
	Central	2:30	20	60	24
A.C. Bus	Southern	2:15	100	45	14
	Western	2:00	20	60	24
	Central	2:30	75	45	14
Taxi	Southern	2:15	450	15	24
	Western	2:00	20	60	24
	Central	2:00	350	15	24
On-demand Taxi (Meru)	Southern	2:15	600	-	24
	Western	2:00	500	-	24
	Central	2:00	500	-	24
Auto-Rickshaw	Southern	Available from halfway (2:30)	300	15	20

	Western	2:00	500	-	24
	Central	2:00	200	15	20
Pvt. A.	Southern	1.30	170 (+ Parking chrg)	-	-
	Western	2:00	500	-	24
	Central	1:30	150 (+ Parking chrg)	-	-

From the above table it is clear that all the existing transportation modes create problems for the passengers reaching CSI Airport. Local rail although having the lowest of cost and time do not offer convenience and comfort. There is a one-step gap between the rail platforms and the rail coaches which do not allow the passengers to carry their luggage comfortably. The local trains lack storage space and mostly remain crowded almost throughout the day. Though buses offer less cost but the time taken by them is very high and they too lack storage space. Auto-rickshaws are not a good option for families and passengers with lots of baggage. So, the only convenient and comfortable options left are private automobiles and taxi/ cabs. But passengers opting for private automobiles have to bear fuel costs, parking charges and many more. While, the meters of taxi/ cabs go on increasing rapidly due to traffic conditions of the city. The conclusions drawn in terms of time elements for the city are shown in figure no.5.

Conclusions drawn from table no.2 for time elements

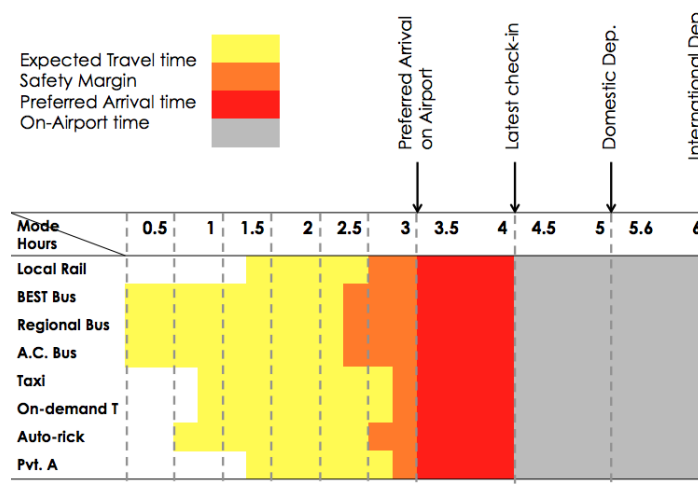


Figure 4: Conclusions drawn from table no.2

Time spent in queuing outside parking area of CSI Airport

Air passengers arriving at the CSI Airport do spend maximum of their time in queuing outside the parking areas. So, to analyse the exact no. of queuing 3-cases are shown in table no.3. Case-I with processing time/ veh as 30secs/veh, case-II with 20secs/veh and case-III with 15secs/veh. With arrival rate as 1254 veh/hour and 5 no. of servers the time spent by air passengers arriving at the Mumbai airport is found out. (Mumbai International Airport Pvt. Ltd. - GVK, 2012)

Table 3: Queuing formed outside parking area of CSI airport, Mumbai

Case – I		Case – II		Case – III	
Processing Time/ veh	30	secs/veh	20	secs/veh	15
Total No. of Servers	5	nos	5	Nos	5
Traffic/ server	250.8	veh/hr	250.8	veh/hr	250.8
Processing Time/ veh	30	secs/veh	20	secs/veh	15
Veh. Processed/ hr	120	veh	180	Veh	240
Shortfall/ Excess	130.8	veh	70.8	Veh	10.8
Veh Queue Size	Shortfall in no. of veh x 5.5m		Shortfall in no. of veh x 5.5m		Shortfall in no. of veh x 5.5m
Veh Queue Size	719.4	m/ hr	389.4	m/ hr	59.4
Que/ server	143.88	m	77.88	M	11.88
Queue	26	veh	14	Veh	2

As per case-I, with processing time as 30secs/veh there will be a queue of 26vehicles outside the parking area, case-II with 20secs/veh a queue of 14veh and case-III with 15secs/ veh a queue of 2vehicles. Therefore, air passengers reaching CSI airport in their own vehicles will have to spend time in queuing outside the parking area, where there is a probability of missing there flights.

Parking charges at Mumbai airport for the year 2012. (GVK, 2012)

A cost per car parking charges analysis was also done to find out the cost spend by air passengers at CSI Airport as shown in table no.4. To give an example of a person going on a business trip for a day and reaching the airport with his own car will have to spend about Rs.1000 for a day. Therefore, it is clear that the parking charges too are very high.

Table 4: Parking charges at CSI airport, Mumbai

Duration	Mumbai	
	Domestic (in Rs.)	International (in Rs.)
Upto 30mins	90	100
Upto 2hours	150	160
Each subsequent hour after that	90	100
For 24hours	1000	1000

Conclusion

The modes of transportation available in the city are not 100% reliable. From figure no.5, it can be noticed that the air passengers opting for public transportation prefer the local bus (BEST) or regional bus for reaching CSI Airport, Mumbai. However, they would require more than 3hours (refer figure no.5) from any part of the city due to the bus routes, traffic conditions and the stops taken by them. At the same time passengers face difficulty in handling luggage using the local BEST and the regional buses. There is no directness of vehicle system such as a dedicated bus service, shuttle buses or a BRTS system. An air passenger choosing local railway for reaching the CSI Airport would require more than 2hours (refer figure no.5) from any part of the city since he/ she will have to face queues for ticketing, waiting for the railway, etc and also face difficulty with the luggage. The metro-rail is under planning and construction phase in some parts of the city. There is an absence of a dedicated metro-rail connection for the airport. This is where the planners could have looked into it, since the number of passengers arriving at the airport would be 3541 domestic peak hour passengers and 3917 international peak hour passenger by the year 2026 (Mumbai International Airport Pvt. Ltd. - GVK, 2012). With such a high ridership planning of a dedicated transportation service could have been a sustainable solution, considering the percentage of traffic arriving at the CSI airport from 3-parts of the city as explained before. Passengers concerned with luxury generally opt private automobiles or taxicabs where they spend huge amounts of money on petrol/ diesel, luggage charges, waiting charges, parking charges (refer table no.2) and also face long queues outside the parking areas(refer table no.3). Therefore, it can be concluded that since the conditions in theMumbai city have become stagnant and the solutions, which are being proposed for the city, are not sustainable.

Airports in other Indian cities too are facing the same issues and challenges as Mumbai, regarding the ground accessibility from different parts of the city toairport. Cities like Bangalore, Hyderabad, Chennai, Ahmedabad, etc. which are some of the fastest growing cities and have turned into major international hubs for business and tourism purposes have started laying a lot of emphasis to redevelop and expand the existing airports in their respective cities but no major planning is being done in order to improve the ground accessibility to the airports. The case of Bangalore International Airport is evaluated to elaborate the outcomes of strategies if applied.

C. Application to Bangalore

The city of Bangalore is a radial city. The location of Bangalore International Airport from the center of the city is approximately 35kms (Google Maps, 2013).The airport handled about 12.6million passengers in the year 2011 (Bangalore International Airport pvt. ltd., 2012). Airport shuttle bus services are provided by BMTC, which is a dedicated mode of transportation for reaching the airport. It connects various parts of the city to airport. A High – speed rail is under planning where the work has taken a pause due some reasons. It would be integrated with Metro-rail system. Table no.5 estimates the savings in time and cost by per person, if dedicated PT services are planned for reaching the airport and can be used for the cost – benefit analysis by the airport operator. The data regarding the passengers reaching the airport was not available otherwise the analysis would have been in more depth.

Table 5: Time and cost saving elements for Bangalore (Bangalore International Airport pvt. Ltd., 2012) & (PayScale, 2013):

Mode of Transportation	Approx Speed (kmph)	Time req. to reach the airport from city center	Time taken by shuttle bus	Time saved (hours)	Average salary (per hour)	Cost saving/ hour/ person
High-Speed rail (HSR)	150	15 mins	120 mins	105 mins X 2 = 3:30hrs	Rs.84	Rs.294
Metro-rail	80	30 mins	120 mins	90 mins x 2 = 3:00 hours	Rs.84	Rs.252
Mono-rail	50	45 mins	120 mins	75 mins X 2 = 2:30 hours	Rs.84	Rs.210

If any of the dedicated modes of transportations like a HSR or metro-rail or may be even a mono-rail are planned in the city of Bangalore there would be a considerable savings in terms of cost and time as analyzed in table no.5. It would also be a sustainable and efficient solution if planned through proper channels, in spite of just widening the roads and curbside areas outside the airports.

IV. SUMMARY

The existing modes of transportation to reach airports in Indian cities are not sustainable. There is a need for emphasis on dedicated public transportation services. International airports provide greater infrastructure facilities for a smaller demand as compared to Indian airports. Strategies laid at international airports can be used for development of efficient ground accessibility for Indian airports.

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