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Integration of Rail and Air Transport; Approach to Adjusting the Effects of the Airport on The City Airport on Surrounding Urban Areas (Case Study: Mehrabad International Airport)

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Abstract

Airports that once were located out of the city because of the community needs, have gradually created challenges with the physical growth of the city and being surrounded by the urban areas. Inner-city airport on the one hand leads to environmental, social and other issues for residents of the surrounding areas and on the other hand, the airport is in the bottleneck for developmentin line with the increasing growth of cargo and passengers. Organizing inner-city airport issues in its affecting area requires limitation on the functioning of the airport. By reducing the airport performance, air travel demand should be offset through other modes of transport that in addition to responding to passenger demand, improve issues related to the surrounding urban areas. Development of high-speed rail network on an inter-city scale is one of the alternatives for air transport need. The study aimed to investigate the relation between rail and air transportation in Mehrabad inner-city airport to meet air transportation demand and adjusting its negative effects on the surrounding urban areas. Pursuing research objective is based on an approach to study concepts and experiences through the comparative analytical method. The results show that developing high-speed rail transport is an appropriate alternative to air transportation at distances less than 800 km. Finally, by studying and detecting Mehrabad issues in its affected urban area, requirements and the way of developing the rail network in relation to Mehrabad airport are described.

Keyword: *Integration of Air and Rail Transportation, High Speed Rail (HSR), Inner-city Mehrabad Airports, Surrounding Urban Area*

Introduction

Airports are located outside the cities based on society's needs in terms of passenger and cargo demand in long distances, but gradually and followed by growing urbanization, the horizontal and scattered development of cities and airport attractions, built areas of the cities have reached around the airports and in some cases, airport has been integrated in the urban development and is seen as an inner-city phenomenon. The proximity of residential development with airports leads to environmental problems especially noise pollution in these areas. On the other hand, the airport technological development is constrained in accordance with the conditions and needs of the community. One of the methods for organizing issues arising from the performance of inner-city airports in the surrounding urban areas, is limiting the activities of air transportation in them. By reducing the airport performance, air travel demand should be offset through other modes of transport which are comparable with air transportation in terms of time, cost of travel, comfort and safety. Development of inner-city rail transport (High-Speed Rail or HSR) in relation to air transportation is a significant approach to compensate for this demand. Mehrabad airport and its surrounding urban areas located on the southwest of Tehran as a case study was objected by some city managers, stakeholders, environmentalists and residents to be closed because of creating multiple problems for neighboring communities. Tehran Urban Management and airport authority following these objections, took some limitations such as transferring wide-body flights to Imam Khomeini airport, reducing annual flights of Mehrabad and imposing limitations on flying hours to organize the airport [1]., Considering that current policies in Mehrabad have not been effective in organizing the issues in the surrounding urban areas, Mehrabad airport performance limitations on a larger scale seems necessary to solve its problems. So the most important aim of this study is to investigate the relation between rail and air transport to respond to air transport demands in inner-city airports and organizing and adjusting the negative consequences of airport on the surrounding urban areas. Following this objective, the most important question is that, by reducing the airport performance, the development of high-speed rail lines

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related to inner-city Mehrabad airport how can reduce undesirable side effects of the airport operation in addition to compensating for air travel demands. After the introduction and problem statement, the first part of this paper deals with methodology. The second part reviews the literature. The theoretical context of research is examined in the form of theoretical concepts and universal experiences of HSR in connection with airport and air transportation. Case studiy is presented in Section threeAnd The fourth part analyze the results. At the end, the appropriate approach for organizing Mehrabad airport and adjusting its issues in the affected area and conclusion of the research are explained.

1. Literature Review

1.1 Rail and Air Transportation Relation

In the past two decades and since the inception of high-speed train (HST) in Europe in 1981, several studies have been done on the relation between air and rail transportation that some of them are mentioned in Table 1. Background of studies in the field of high-speed rail (HSR) and air transportation shows that most research has considered the competition between airports and railways and often they have been tried to show the preferred mode of traveling on different routes with comparative development. Also a small number of studies have examined the limited and full cooperation between rail and air transportation. The dominant purpose of the studies is the link between rail and airport to reduce the congestion and environmental pollution at airports. While the inner-city airports and its integration with high-speed rail are not mentioned. So this study first reviews the concepts of railway and airport link, not competition between these two modes. Then evaluated the integration between inner-city airport and railway transportation as an approach to reduce side effects caused by aircraft operations at the affected area.

2. Methodology

The process of answering the research question is based on reviewing concepts and experiences and analytical–comparative method. The study first refers to the issues of inner-city airports in affected urban areas and their functional limitations. Then, the concepts and views on the relation between air and rail will be discussed. Then the HSR development experiences as an alternative mode to compensate for air travel demand will be studied and reviewed. This will be achieved using library studies and earlier papers and research. By studying the concepts and experiences, results and a clear framework will be obtained on how HSR and air transportation will communicate. After that, by reviewing and detecting issues related to Mehrabad inner-city airport in its affected area, the development of high-speed rail transportation in connection with Mehrabad airport is analyzed. Finally, the requirements, and how to develop the rail network to reduce Mehrabad airport problems on the surrounding urban areas are described.

3. Theoretical Concepts

3.1. Inner-City Airports and Its Challenges in The Surrounding Urban Areas

Twentieth century has begun with more than a billion people, 10% of which were urban people, and has ended with more than 6 billion people, 50% of which live in urban areas. From the sociological perspective, urbanization in the twentieth century is a global process that increasingly draws not only the industrial world but also the Third World to itself. An issue that should not be overlooked in this process is the patterns of physical development and growth or city forms [2]. In recent decades, cities have grown unplanned and urban areas have risen several times to their original size in a short time. This phenomenon is known as city horizontal spread or scattering pattern and causes many problems in the developing and developed cities [3]. One possible outcome of horizontal scattering of cities is isolating large-scale applications within the cities. Some traditional airports that are located at 15-30 km from the main city have gradually changed into the unwanted neighbors of residential developments [1]. In this paper, this type of airports is called "inner-city airports" (Figure 1). Restricting the airport in the heart of the city caused the appearance of opposition and challenges between local planning (urban areas around the airport) and the airport planning. On the one hand, inner-city airports need to expand their infrastructures and capacity to compete with other centers and meet the growing passenger and freight demands, On the other hand, increasing airport capacity and its flight traffic, increases the environmental impact, especially the noise pollution, and Leads to the protest of residents in surrounding areas and environmental stakeholders. So the challenges of the performance of inner-city airport on the surrounding local communities, prevent the future development of airport infrastructure in accordance with freight and passenger demand. Table 2 shows some of the most important challenges of inner-city airports. According to the disturbance caused by inner-city airport function to surrounding local communities, some airports took measures to limit airport activities, provide land use compatibility programs and noise management. The purpose of the reduction of airport activity is achieving a rational management between the airport functioning and surrounding communities. Also

- It should be reasonable in terms of airport functioning;
- It should be performed carefully based on local needs and community expectations;
- It should be based on the information that logically emphasize the need for the implementation of these limits, and
- Limitations should not be improper and it should not interfere with the airport business function [4].

There are different types of operational restrictions at airports. Appropriate strategies for these types of limitations include cancellation of the flight operations of noisy aircrafts, using quieter aircrafts, and changing the flight schedule and rescheduling it. Removing all flights in the night hours is not very reasonable and is not commercially affordable, so its implementation is optional and changeable. In fact, prohibition of all night flights on the one hand, causes the society and the people less affected by noise pollution and its side effects, but on the other hand, unnecessary elimination of the low-noise, non-polluting flights follows undesirable commercial and economic consequences [4]. For organizing issues arising from the inner-city airport on the affected area, it is necessary to reduce activity of the airport. But, as noted above, if this restriction is unreasonable, it is not economically viable. This study shows that taking proper alternative mode to reduceflights at the inner-city airport, in addition to reducing the negative consequences of the airport on surrounding area, also the demand for air travel at certain distances can be compensated.

3.1. Integration or Abstraction of rail and air Transportation

According to Stubbs and Jegede (1998) the main form of transport for overseas journeys, prior to the advent of road and air transport, was a combination of rail and sea. While road and rail transport, like maritime and air transportation, have generally been in competition with each other, this competition cannot be considered for interactions between railways and sea or road and air. rail and sea, have been Two essential complementary modes for each other [5]. A new form of intermodal complementarily is the link between railway and airport. The development of railways links to airports, can be compared with the development of railways links to ports. According to continued growth of the airline industry and airports and the sufficient demand to support rail services at airports, the number of rail connections to airports expected to increase. The main logic for rail connections to airports is the need for passengers to start (or end) their air travel to (or from) the airport [6]. Interactions between HSR and air transportation may take place in the form of competition and cooperation. Both types can result in substitution of operations between the two modes, driven by their commercial viability, market strength of both modes and different institutional and environmental constraints. Modal substitution may improve the internal efficiency of each particular system (substitution through competition) and in the broadest sense, may reduce, the systems' cumulative burdens/emissions on the environment (substitution through complementarity) [7]. Yet closer co-operation could increase the role of the railways in air transport to the benefit of both industries, while competition between the industries could be counterproductive, not only to the industries but also for passengers and society [6]. The two alternative co-operative relations are discussed in the following section in more detail.

3.2.1. Simple Co-operation between the Rail and Air Transport Industries

The advantage of the railway as a means to access the airport is mainly twofold. Firstly, it is a reliable and high capacity form of airport access that is immune to the problems of road congestion. Secondly, it contributes to a reduction in air pollution around airports, when substituting for car commutes to the airport. Both advantages have prompted the development of rail links to airports. In addition, the airport also benefits from the perceived higher status image of rail access, certainly in Europe, and from the reduced need for parking which leaves more space for higher-earning commercial development. This is the minimum level of integration that currently exists at many airports. In the case of simple co-operation, the benefits are mainly to the users of the rail services, with some additional revenues coming to the rail service operator. The extent to which such co-operation leads to the replacement of the car as an access mode determines the benefits of reduced congestion on roads leading to the airport and reduced air pollution around the airport [6].

3.2.2. Full Co-operation between the Rail and Air Transport Industries

When railway services to/from airports become important to the airlines, a different form of co-operation between the industries is fostered, which is one form of integration between the rail and air transport services. In this case, the railway is an integrated part of air transport and the differences between the airlines and the railways almost disappear, as they both provide a complete transport service [6]. From the users' point of view, they are complementary if the combination instead of a single transport mode is preferred for travelling between two cities. From the transport operators' point of view, HSR is a complement to Air Transportation if it replaces short-haul 'feeder' flights connecting into and out of long-haul flights by using 'feeder' trains according to a compatible (balanced) timetable. Generally, three types of complementary and commercially viable networks Due to the Hub & Spoke system used in many airports exist:

• HSR may partially replace air transportation in collecting and distributing passenger flows between a hub airport and particular spokes. [One example is Frankfurt Main airport (Germany), where many short-haul domestic air transportation services have been replaced by equivalent HSR services.]

• HSR may completely substitute Air Transportation by providing 'feeder' services between a hub and spokes while Air Transportation exclusively connects hub airports to each other. [One example that still has take place is the connection between Paris (France) and

Rome (Italy) by Air Transportation services, which would be 'fed' by HSR instead of short-haul Air Transportation services]

• Air transportation may connect hub airports with spokes while HSR provides exclusive surface connections between hub airports themselves. [One example is an HSR line connecting Paris CDG airport (France) and Lyon Satolas airport (France), which is partially 'fed' by air passengers]

Several conditions should be fulfilled before setting up the above networks:

- The airports should be connected to the HSR network.
- The timetables of HSR and Air transportation should be coordinated.
- Through ticketing including convenient checking and transferring of passengers and their baggage between the two modes should be provided [7].

3.3.International Experiences on The Development of Rail-Air

The first HSR line entered operation in 1981 when the French railways launched the HSR service on the line Paris–Lyon. One of the main reasons for beginning HSR in France was the oil crisis in 1973. At that time, it was expected that electrically powered HSR would reduce dependability of the transport sector on crude oil and thus reduce overall fuel consumption by replacing aviation on particular markets [8].

3.3.1. Integration of rail and air lines

The first steps towards integration were probably made in Switzerland, where well developed passenger check-in facilities at main rail stations exist. Later this provided the basis for integration between Finnair and the Swiss Federal Railway, SBB. Finnair added four new destinations to its scheduled network - Bern, Basel, Lausanne and Luzern - by integrating its flights from Helsinki to Zurich with SBB's railway services to these cities from Zurich Airport. In this case, rail services did not replace aircraft services, certainly not Finnair's aircraft services, but served to complement them [6]. Lufthansa (LH) offers HST services from Frankfurt Airport to Stuttgart and Cologne city centers as an integral part of its route network. On these routes, HST services substitute for LH's aircraft services. The integration of LH's flights with services of the German rail company, Deutsche Bahn (DB), is completed. Air France (AF) signed an agreement with the French National Railways (SNCF) and launched 'TGV Air' services, where SNCF serves Paris CDG Airport from a dozen relatively close destinations as part of AF's route network. On the Paris CDG-Lyon route, SNCF also code-shares its TGV HST service with United Airlines and on the Paris CDG -Brussels route AF has substituted all its flights with HST services [6].

3.3.2. Experiences of competition between rail and air transport industries

On the Paris-Lyon and Madrid-Seville routes, four years after the introduction of HST services the aircraft modal share on the routes decreased by 24% and 27% respectively. On the London-Paris and London-Brussels routes, the new HST train services captured nearly two-thirds of the combined air-rail traffic to Paris, and nearly half to Brussels [9]. HSR passenges may come from both modal substitution (passengers taken from other modes) and induced traffic (new trips made). Although assessing induced traffic is notoriously difficult, surveys made in the aftermath of HSR launches in both Asia and Europe suggest that induced traffic ranges from 6% to 37% of HSR ridership [10]. When substitution leads to competition among modes, it can increase the services of each mode. So competition between air-rail lines in inner-city airports cannot be useful because it will bring greater environmental consequences. Different intervals are proposed as threshold in which HSR can be a good alternative for the plane. According to Givoni and Banister (2007), the travel distances up to 800 km is apparently the most appropriate threshold. At distances greater than this threshold, HSR loses its advantage in providing travel times compared to air transport [6].

4. Environmental Benefits of Substituting Air to HSR Mode

Table 4 shows a comparison of the environmental damage caused by a flight and an HSR journey between London and Paris with respect to local air pollution and climate change impacts. The advantage of the HSR over the aircraft is clear, especially considering both the local air pollution and climate change impacts. HSR's environmental performance can be even better than that reported in Table 4 depending on the extent to which renewable energy is used to generate the electricity that is required to power the HSR. In France, where electricity is mainly from nuclear energy, the environmental impact of HSR is lower, notwithstanding concerns on nuclear waste and risks [10].

5. Mehrabad as the subject

Mehrabad airport was built next to a small village called Mehrabad at a good distance from Tehran with the construction of airstrips between 1940 and 1942. The growth of passengers and freight in Mehrabad airport in the last ten years shows that the role of this airport in air travel, international and political exchanges and cooperation becomes more and more prominent. Despite the transfer of international flights from Mehrabad to Imam Khomeini International Airport, in the current situation, that the airport is responsible for transportation of domestic and hajj air travel, the number of passengers exceeds the capacity of the airport and in the near future will impose far more problems to the airport. Mehrabad international airport is currently used for military and civil flights. Its total land area

which is located on the South of Tehran's Azadi Square, under the Tehran - Karaj special road and in northern Tehran - Karaj old road is about 1346 hectares. Mehrabad Airport is located in District 9 of Tehran Municipality and regions 2, 5, 10, 17, 18 and 21 are in its adjacency [11]. Mehrabad Airport, the country's most important airport in terms of annual performance (due to airport activity indicators such as the number of takeoffs and landings, number of passenger transfer number, air freight transport and domestic airport which has flights to them and vice versa), ranked first in the country [11].

6. Analysis of Results

Airport activities are harmful and dangerous for the surrounding land use and the health of residents and workers in it. In contrast, surrounding land use and activities also can be dangerous for airport activities especially flights. With the growth of air transport, and dispersion of Tehran, Mehrabad airpost created a wide range of problems for its surrounding area in the past few decades. Some of the most important problems of Mehrabad airport are:

6.1. Environmental Problems

Generally environmental problems of Mehrabad airport include air pollution and noise pollution caused by the activities of this center. The bearable noise range for people who live in urban areas is 35-55 dB. Based on another report, district 9 of Tehran municipality is divided into three areas based on noise pollution assessment:

1) Very dangerous and dangerous areas (75 - 85 dB): Mehrabad airport and parts of Terminals
2) Crucial areas (60 - 75 dB): Southern part of Mehrabad airport
3) Areas that exceed standard limit (45 - 60 dB): other neighborhoods of municipal district 9 [12].

In accordance with this category and figure 3, it can relatively be stated that the whole areas in district 9 are in grave danger of noise pollution. This has made the region as the most polluted area in Tehran metropolis.

6.2. Social- Economical problems

Among the issues of Mehrabad in the surrounding urban areas the social problems such as diseases, sleep disorders and economic issues including unemployment of local people, low economic value of land and housing around Mehrabad airport can be mentioned. Figure 4 shows that the the arrangement of Mehrabad and the reduction of flights were not significant. It can be said that the current approach to arrangement and restriction of activities at Mehrabad airport had no significant effect on the surrounding urban areas for reduction of problems. The proposed approach for the arrangement of airport, reduction of flights and Compensation for reduced trips is provided in the following section.

6.3. Explaining the rail and air integration in Mehrabad airport

Now the only connection between air and rail transport in Mehrabad, is the direct access via the line 4 of urban subway network to the airport terminals. The network is very convenient for transporting workers and passengers and can account for a considerable share of air travelers. It can also reduce the pollution and congestion of vehicles going to the airport. However, it shows the limited role and cooperation of railways in providing services to air transport in Mehrabad airport. Increasing role of rail transportation based on HSR development related to Mehrabad airport, can provide direct services to many cities at specific intervals (approximately 800 km). Also integration of railways and airlines in Mehrabad airport can be used to meet the environmental and economic objectives at the regional and national levels and reduce the impact of Mehrabad on the environment. Integration of air and rail transport in Mehrabad airport is subject to agreement between the airport officials, operators of airlines, Islamic Republic of Iran Railway Company and operators of railway lines. Considering the high-speed train with a speed of about 250 km per hour with high frequency in addition to reducing adverse environmental effects of airports travel times will be comparable to air travel. Suggested routes for the integration of rail and air transport in the research include high-traffic routes from Mehrabad output which have regular rail lines and are located at an approximate distance of 800 kilometers or less. The proposed routes are presented in the table 6. By integrating rail and air transport in Mehrabad Airport in Tehran, in the above routes, about 23 percent of the airport performance is reduced and will be provided by high-speed rail. This reduction in performance in Mehrabad, will reduces nuisance caused by aircraft operations on the surrounding urban areas and at a large scale, will bring decentralization and regional development. The connection of Mehrabad and rail lines can be happened by connecting Tehran railway to Mehrabad airport in the form of a separate major line. HSR stations can directly provide services from Mehrabad airport. So, the transfer of passengers between modes will be faster. Replacing the HSR with aircraft on the above routes will reduce the use of runway and lead to reduced environmental impact on a local and macro scale.

7.Suggestions

rail and air transport integration in Mehrabad faces challenges that can be investigated in other studies. These challenges are discussed as the following topics:

23 percent of Mehrabad activities in terms of the passengers' choice, will be transferred to rail mode (if any), or to other modes such as road transport? Transferring 23% of Mehrabad activities to rail transport requires full cooperation between air and rail transport authorities in the country. Also, Tehran is the

destination of many flights from different cities of Iran; therefore, omitting some of Mehrabad flights will actually lead to the closure of other Iranian airports. The option of landing in Imam Khomeini airport or in farther towns should be discussed for economicization. The replacement of air to rail travel lead to imposed demand on rail service. As mentioned in the world experiences, surveys after launching HSR in Asia and Europe showed that induced traffic is placed in the range of 6% to 37% of HSR travelers that is unavoidable to determine the number and capacity of HSR at different distances. Also launching HSR follows the spatial creep that can be studied at the regional and national development scale.

Table 1. Background of studies on rail and air transportation (Source: classification of author)

Writers	Research title	Objectives	Results
Stubbs and Jegede (1998)	"Integrating rail and air lines in Great Britain"	Reducing the increasing congestion on the roads around the airport based on switching from road to rail transport to access the airport	Integration of rail and air transportation, especially in large airports has a high potential to switch from road to rail mode to access to the airport and provides an environmentally sustainable form of transport for a large number of travelers that this will be feasible only with very careful planning and collaboration between the rail and airport authorities.
Janic (2003)	"HSR multivariable evaluation, Maglev[1], high-speed trains and air transportation in Europe "	studying rail and air mode based on operational, socio-economic and environmental indicators using weighting indicator (15 sub-indices), and selecting appropriate alternative transportation	HSR is the alternative preferred mode according to the examined indicators.
Givoni and Banister (2007)	"The role of rail transportation in the future of air transportation"	Clarifying the role of railways in the future of air transportation with regard to environmental problems caused by air transportation	With the development of high-speed train (HST) and the environmental problems caused by air transportation, railways can play a greater role in co-operating with airlines in providing integrated transport services for medium-range travel (up to 800 kilometers). Comparing the passenger market share for high-speed rail and air transport on London-Paris line showed that the HST has a larger share of the passenger market to itself. This is because of the travel cost and time, comfort and safety and the progressive development of high-speed rail lines.
Mirzakhani , (2014)	" The role of rail transport in the future of air transportation."	Drawing new geometry of Iran with regard to the benefits of rail transportation at a space-time scale based on rail and air transportation competition	Two opposite and important developmental consequences will be possible after improving access at the national level: First intensifying the focus of the urban scale to the regional scale which in this case the rail lines will attract all the benefits and investment to itself and will change into the country's main corridor so the rest of country would be deprived of the development and progress. Second, establishing the spatial balance at a land scale, which in this case the rail lines provide the economic and development conditions for all parts of the country.

1. Maglev trains or maglev is a kind of trains that are floating in the air at a short distance from the rails and without much resistance from the environment can move at very high speeds. This trains use the electromagnetic force for their movement and theoretically Maglevs can reach speeds comparable to the speed of jet aircraft (500 to 580 kilometers per hour).

Figure 1. Congonhas-São Paulo inner-city airport in the Brazil, [15]

Table 2. Typology of problems of inner-city airport surrounding areas(Source: Khalili, Kheyroddin and kamali, 2016: 12)

Dimensions	Challenges
Environmental	- Contributing to poor air quality and exacerbating chronic diseases (asthma, etc.) - Emissions of carbon and greenhouse gases (at local and global scale) - Deterioration of surrounding communities - Noise pollution and the high cost of coping with it
Economic	- Relatively few jobs for locals - Reduced property values in the surrounding area - Occupying valuable land in the heart of cities
Social	- Segregation and lack of integrity of surrounding areas due to reduced accesses - Social insecurity due to plane crash - Social costs, diseases and sleep disorders
Physical-Spatial	- Limits on urban development and the development of residential neighborhoods - Land use problems and incompatibility of surrounding land uses - Increased traffic congestion on access routes to airports, - Reduced access of surrounding communities by establishing rigid boundaries and segregation of some local communities - Focusing on communication routes on access to the airport and not on local residents access
Management	- Limitation of airport expansion - Restrictions on passenger and cargo capacity increase - Lack of economies of some inner city airports due to limitations of development

Table 3. Share of different modes (in %) before and after introducing high-speed trains
a: total traffic increased 37% b: total traffic increased 35%. Source: (Mirzakhani, 2014)

	Paris-Lyon line, TGV-470 km			**Madrid - Seville Line, AVE - 540 km**		
	Before 1981	After 1984	Changes	Before 1991	After 1994	Changes
Airplane	31	7	24	40	13	27
Train	40	72	32	16	51	35
Car and bus	29	21	8	44	36	8
Total	100	100	37[a]	100	100	35[b]

Table 4. The Environmental Damage from Aircraft and HSR Journeys on the London-Paris Route (Euro/seat).
(Source: Dobruszkes and Givoni, 2013: 177)

Type of trip	Local air pollution (LAP)	Climate change (CC)	LAP + CC
Aircraft	0.82	2.03	2.85
HSR	0.52	0.29	0.81

Figure 2. Location of Mehrabad in the city and region 9 of Tehran

Table 5. Comparison of Mehrabad airport with the whole country in 2011

Airport performance	Mehrabad	Whole country	Percent
Takeoff and landing (aircraft)	108553	352344	30.81
Sending and receiving passengers (people)	13569573	42572885	31.87
Sending and accepting load (kg)	112464937	432549672	26

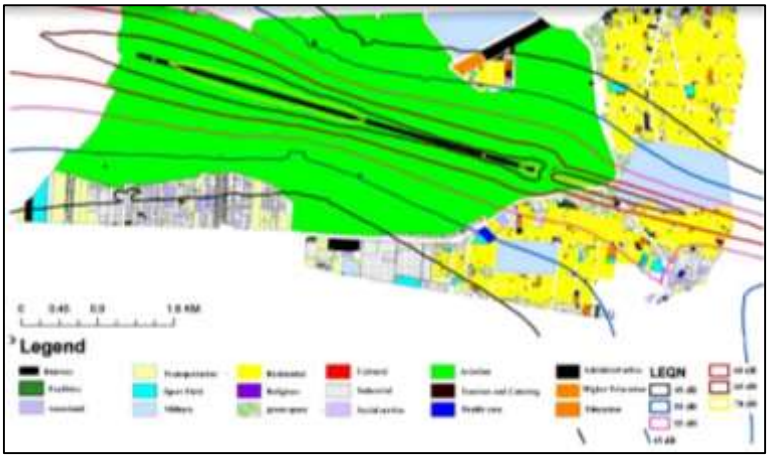

Figure 3. Stable noise balance curve for day and night (DNL) in Mehrabad airport, (Source: 11)

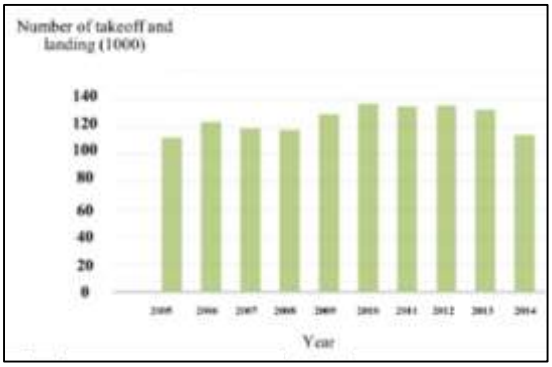

Figure 4. Trend of changes in the number of takeoff and landing at Mehrabad International Airport (2005-2014) , (Source: Authors by using Statistical Yearbook of Iran's civil aviation agency, 2015)

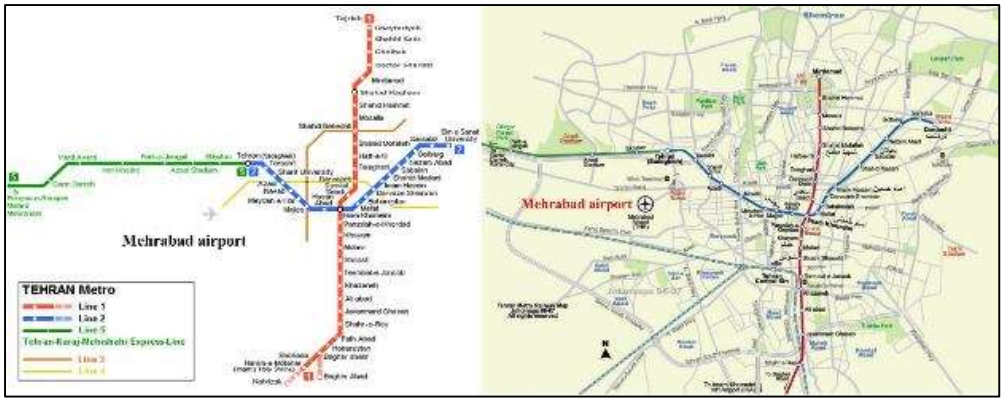

Figure 5. Map of location of Mehrabad airport station in railways of Tehran and Suburbs- Subway, (Source: Tehran Metro Map & Schedule)

Table 6. The reduced trips in Mehrabad (Source: Authors by using Statistical Yearbook of Iran's civil aviation agency, 2015)

Destination	Ground distance (approximate)	Number of flights to Mehrabad	Percent to all flights in Mehrabad
Ahvaz	820	5555	9.7
Tabriz	630	3175	5.5
Esfahan	450	1946	3.4
Yazd	620	1429	2.5
Gorgan	420	919	1.6
Sari	280	289	0.05
	Total airport yield decreased in percent		22.75

8.Conclusions

This study reviews the air and rail integration in Mehrabad airport by explaining the concepts and records of HSR development in connection with air transportation. Given that Mehrabad activity in the western part of Tehran has created several problems for the residents of the surrounding areas and residents of these areas are experiencing low quality of life, urban management and airport authorities have been organizing the airport problems by reducing the activity of Mehrabad Airport. However, the current approach is not responsive to the issues. This study showed that for solving problems in the long run, significant reduction in flights and replacing some routes especially at distances less than 800 km with high-speed rail lines, in addition to compensating for the demand for air travel, the problems caused by the operation of inner-city airports such as Mehrabad in their area of influence can be adjusted. HSR and airport integration requires cooperation of airlines, airport authorities, Islamic Republic of Iran Railway Company and train operators. Considering that the Metro Station of Mehrabad Airport is a line from the main line of Tehran Metro, the cooperation between the railway and the airport should be considered together with a line connecting these two harbors. So that access from the airport to the railways and vice versa take place in a short time. Or high-speed rail service should be directly provided from Mehrabad airport. On the routes where the replacement of railroad and aircraft service takes place, the travel time should be comparable to the flight time.

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