Opportunities for High-Speed Railways in Developing and Emerging Countries: A case study Egypt

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Von der Fakultät V - Verkehrs- und Maschinensysteme
der Technischen Universität Berlin
Zur Erlangung des akademischen Grades
Doktor der Ingenieurwissenschaften
- Dr.-Ing. -
genehmigte Dissertation

Promotionsausschuss:

Vorsitzender: Prof. Dr.-Ing. Jürgen Thorbeck
Berichter: Prof. Dr.-Ing. habil. Jürgen Siegmann
Berichter: Prof. Dr.-Ing. Mohamed Hafez Fahmy Aly

Tag der wissenschaftliche Aussprache: 06.09.2012

Berlin 2012

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A Thesis
Submitted to Faculty of Mechanical Engineering and Transport Systems-
TU Berlin

in Partial Fulfillment of the Requirement for
the Degree of Doctor of the Railways Engineering
Approved Dissertation

Promotion Committee:

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Referee: Prof. Dr. - Eng. Mohamed Hafez Fahmy Aly

Day of scientific debate: 06.09.2012

Berlin 2012

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This dissertation is dedicated to:

My parents and my family for their love,

My wife for her help and continuous support,

My son, Ahmed, for their sweet smiles that give me energy to work

In a world that is constantly changing, there is no one subject or set of subjects that will serve you for the foreseeable future, let alone for the rest of your life. The most important skill to acquire now is learning how to learn.

John Naisb

ACKNOWLEDGMENT

First and foremost, countless thanks go to the God

To my thesis director, Prof. Dr.-Ing. habil. Jürgen Siegmann, director of Department Track and Railway Operations, for his permanent guidance and support during the elaboration of this research. I learned a lot from him directly and indirectly. He has played an important role in directing my work wisely at critical moments as well as been a vital tool in its execution. Indeed, he has taught me how to learn, think, and search. It is only thanks to his strong encouragement, profound interest and extensive knowledge that this dissertation has been possible. At the moment of closing this work, I realize that it has been an immense privilege to benefit from his exemplar dedication to railway research and teaching, and I can only wish that it will continue in the years to come.

I am grateful to Prof. Dr.-Ing. Mohamed Hafez Fahmy ALy for his kindness in supporting my research and his real cooperation with me and also for his persistent questioning that strengthened of this thesis. I am grateful to Professor Peter Mnich for continuously providing constructive feedback to my research and insightful advice on my career development. I want to thank some colleagues from ILS; C. Weise, Dinh Truyen, and Dayoub for spurring me to expand my knowledge and for their help when I was getting settled and for all the talks we had

I would like to thank those people who contributed to making this work feasible through providing direct help, financing, sharing their knowledge and enthusiasm or simply through their friendship, support, patience and love. They were so many that I am faced with immense task and risk not mentioning someone that deserves at least as much recognition as those presented here. This work was executed in a new city, a new country and a new reality. I will always remember those first cold days of the year in Berlin and all the life, and further, the beauty of this excellent small city and the forests and fields around it. Special thanks go to my country Egypt that allowed me to get the chance of studying in Germany, and provided me the financial support, in the form of my scholarship.

I want to dedicate this thesis to my parents for their endless love and support, and their persistent confidence in my ability to complete this journey.

Finally, I want to express my deepest thank to my wife Abeer for her advice, tenderness, and above all for her real love. She always supported and pushed me, and besides, she left her home country to stay with me in Germany. She spent alone for long time while I was being in my work. She really contributed to my success because she never thought about herself. Eventually, I would like to mention my child (Ahmed), Mother and Father. They really add a special taste to my life, which supported me indirectly.

Mahmoud A. M. Ali

Berlin, August 2012

ABSTRACT

If the railway transport is to be important and succeed in the intermodal the commercial market of passenger services for long-distance, it must demonstrate its ability to compete with road and air transport. The main thing is to gain a bigger share of the volume of traffic in convenient travel times which, in turn, can be achieved only by operating at high speeds. In fact, the number of cases that have been achieving sustainable improvements in modal split for rail transport was introduced only when the private sector participate in the operation and construction of some lines. That introduced a completely new passenger rail and long-distance services, and through additional enhancements. As high-speed trains (HST) and quality requires the services of railway transport efficient vehicles and the development of infrastructure.

High-speed rail (HSR) lines are generally planned to serve corridors with high passenger demand on the existing traditional railroads lines (or high demand of passenger in corridors), which currently is not correctly served by available railway transport services. These corridors usually have large markets concentrated around major cities. In addition, passengers in the developed country are divided into those who can take an HSR train directly to their destination stations and those who cannot. The best route choices are assumed by minimizing the generalized cost of travel in the available alternatives. The relationship between demand-supply characteristics such as value of time, speed, train departure time, trip length and fares is explored to determine market limits by comparing different routing strategies for each type of passenger. Important parameters to increase the attractiveness of a high-speed system which are connect urban centre area with each other in a short journey time.

In the developing and emerging countries, government should support funding, where this funding is a key to the financing of new rail projects as transport projects are infrastructure projects that need huge investments for upgrading and maintenance. Investment in HSR is a government decision with major effects on the cost of rail transport; and therefore on the modal split in corridors where private operators compete for traffic and charge prices close to total producer costs (including infrastructure). The rationale for HSR investment is not different to any other public investment decision. They represent an important part of any state's assets. Given the fact that the investments needed for transport projects are huge and costly at the same time, funding of these projects has become one of the biggest challenges. A scarcity in funds has resulted in a situation where transport services always lack upgrading. There is an urgent need for drawing up funding methods that prop the amounts of money the government allocates in this respect. Applying international models in this regard is important.

The government in the developing and emerging countries are responsible for transport infrastructure. At the same time, services are offered by government bodies. Economic and business considerations are crucial for any of these actors when deciding whether to participate in such projects. The private sector is still unable to take part in the execution of infrastructure projects, like roads, railways, bridges, and airports. The present study examines whether, and under which conditions, long-distance passenger rail services can be operated economically with subsidies from government and participate private sector for operation or/and construction of some lines. If public funds should be allocated to this mode of transport if its net expected social benefit is higher than the existing alternative. To do so, should be encouraged the private sector to participation in the establishment of this project. To calculate the expected traffic volume in relation to the quality of available options offered by all modes of transport,

the study reproduces the principles of travellers' behavior and it can used analyzed using by comparing with the another projects in the developed countries such as Germany and France. Moreover, to determine the most important influencing factors, the various cost drivers are identified. As well as the effects of changes in social, legal, financial and political conditions for example as a consequence of rising energy prices or wide fluctuations in interest rates.

The results of the analysis is that, compared with competing transport modes, the strengths of rail transport is to be found in the medium to long-term direct links that are designed to improved traffic, at constant high-speed. If the average speed of 200-250km /h can be achieved in such ways, and the market shares of up to 50% is possible, and generate traffic just is not enough to cover all operating costs, are these fonts hence that will lead to improve the strength of rail transport or that the establishment of these projects is not a meaningful. But also to achieve the operating surplus which, in turn, can be applied to the initial investment. Although it seems that the infrastructure of the railway without any funding subsidies in general can not be achieved, the share of total expenses borne by state and local governments can be reduced substantially, and also what are the factors that help create a new HSR lines in developing and emerging countries.

Finally, this thesis discusses a new analytical model (using comparing between the projects) to estimate opportunities for HSR in developing and emerging countries, under which conditions the expected benefits from generated and deviated traffic, and other alleged external influences and indirect benefits justify the investment in HSR projects. It pays special attention to intermodal effects and pricing. The result shows that ticket price and train on-time performances, which are used as important factors affect on the passengers to use high speed rail. It can see also the results of this research through three cases: the Green field such as case study in Egypt and Iran, Yellow field such as Indian and Red field such as UAE, on the basis of strategies followed a similar path from the analysis previous project in the developed countries. These bases include to the important factors that help to create a new HSR line in developing and emerging country such as Egypt. Then, the results of the analysis of the previous project were applied to the case study in text form and diagrams of the suggested future vision for the case study.

KURZFASSUNG

Wenn der Schienenpersonenverkehr im Fernverkehrsmarkt im intermodalen und kommerziellen Markt für Langstrecken im Personentransport eine wichtige Stellung haben soll, muss der Verkehrsträger Bahn seine Konkurrenzfähigkeit gegenüber dem Individual- und Luftverkehr unter Beweis stellen. Ausschlaggebend für die Gewinnung hoher Anteile des Verkehrsaufkommens sind in erster Linie attraktive Reisezeiten, welche nur über hohe Betriebsgeschwindigkeiten realisiert werden können. Tatsächlich konnte erst durch die Einführung neuer einigen Linien im privaten Sektor in den Betrieb und den Bau eine Verbesserung im Modal Split für den Schienenverkehr erreicht werden. Neben zusätzlicher Weiterentwicklung ermöglichte dies ein völlig neues System im Dienstleistungsbereich des Personennah- und Fernverkehrs. Hochgeschwindigkeitszüge und qualitativ hochwertige Produkte des spurgeführten Verkehrs setzen leistungsfähige Fahrzeuge und die Entwicklung der Infrastruktur voraus.

Hochgeschwindigkeitslinien (HGV) wurden grundsätzlich für Korridore mit hoher Nachfrage im existierenden traditionellen Schienennetz entwickelt, die derzeit nicht ausreichend von den verfügbaren Bahnverkehrsdienstleistungen bedient werden. Diese Korridore decken in der Regel große Märkte in Form mehrerer Ballungsräume ab. Darüber hinaus werden die Passagiere in Industrie Länder in zwei Bereiche unterteilt: Personen die mit Hochgeschwindigkeitszügen direkt ihren Bestimmungsort erreichen und Personen, die diesen Service nicht nutzen können. Es wird angenommen, dass die beste Routenentscheidung in der Minimierung der allgemeinen Reisekosten bei der Betrachtung der verfügbaren Alternativen liegt. Das Verhältnis zwischen Angebot- und Nachfragemerkmalen und die Bedeutung von Zeit, Geschwindigkeit, Zugabfahrt, Reisedauer und Tarifen werden erforscht, um die Beschränkungen des Marktes festzustellen, indem verschiedene Routenstrategien für jeden Passagiertyp verglichen werden. Ein wesentlicher Parameter zur Steigerung der Attraktivität eines Hochgeschwindigkeitssystems, das zwei großen Wirtschafts- und Bevölkerungszentren miteinander verbinden soll, ist eine kurze Reisezeit.

In den Entwicklungs- und Schwellenländern, sollte die Regierung finanzielle Unterstützung, wo diese Förderung der Schlüssel für die Finanzierung neuer Eisenbahn- Projekte ist, da Verkehrsprojekte Infrastrukturprojekte sind, die enorme Investitionen benötigen. Die Investition in Hochgeschwindigkeitsnetze ist eine Entscheidung des Staates mit gravierenden Auswirkungen auf die Kosten des Bahnverkehrs und dementsprechend auf den Modal Split in Korridoren, wo private Anbieter um den Verkehr und die Angebotspreise, nahe den Gesamtproduktionskosten (inklusive Infrastruktur) konkurrieren. Die Begründung für Investitionen in Hochgeschwindigkeitszüge unterscheidet sich nicht von anderen Investitionsentscheidungen im öffentlichen Sektor. Sie ein wichtiger Bestandteil jedes Staatsvermögens. Angesichts der Tatsache, dass die Investitionen, die für Verkehrsprojekte benötigt werden, in gleicher Weise enorm, wie knapp sind, wird die Finanzierung dieser Projekte zu einer der größten Herausforderungen. Eine Verknappung der Mittel hat zu der Situation geführt, in der Verkehrsleistungen grundsätzlich einen Mangel an Modernisierung aufweisen. Es besteht ein dringender Bedarf für die Erstellung von Finanzierungsmethoden, die das verfügbare Budget der Regierung in dieser Hinsicht abstützen. Die Heranziehung international bewährter Modelle ist vor diesem Hintergrund von wesentlicher Bedeutung.

Die Regierung in den Entwicklungs- und Schwellenländern sind verantwortlich für die Verkehrsinfrastruktur. Gleichzeitig werden die Dienstleistungen von staatlichen

Stellen angeboten. Wirtschaftliche- und betriebswirtschaftliche Überlegungen sind für jeden dieser Akteure ausschlaggebend bei der Entscheidung, ob an solchen Projekten durchgeführt werden. Der private Sektor ist immer noch nicht an der Ausführung von Infrastrukturprojekten beteiligt, wie dem Bau von Straßen, Eisenbahnen, Brücken oder Flughäfen. Die vorliegende Studie untersucht, ob und unter welchen Bedingungen, Schienenpersonenfernverkehr mit Zuschüssen der Regierung wirtschaftlich betrieben und zu beteiligen privaten Sektor in den Betrieb und den Bau zu beteiligen werden kann. Öffentliche Gelder sollten in diesem Rahmen in Anspruch genommen werden, wenn der Nettogewinn im sozialen Bereich höher ist als seine existierende Alternative. Um dies zu tun, ist es wichtig, den Privatsektor bei der Durchführung des Projektes zu beteiligen. Zur Berechnung des zu erwartenden Verkehrsaufkommens in Bezug auf die Qualität der verfügbaren Optionen, die von allen Verkehrsträgern angeboten werden, beschäftigt sich die Studie mit den Grundsätzen des Verhaltens von Reisenden, und dient zudem als Vergleich mit anderen Projekten in entwickelten Ländern wie Deutschland und Frankreich. Darüber hinaus werden die wichtigsten Einflussfaktoren bestimmt, indem die verschiedenen Kostentreiber identifiziert werden. Ferner werden die Auswirkungen der Veränderungen im sozialen, rechtlichen, finanziellen und politischen Rahmen untersucht wie zum Beispiel die Folge der steigenden Energiepreise oder großen Schwankungen der Zinssätze.

Als Ergebnis im Vergleich mit konkurrierenden Transportmöglichkeiten zeigt sich, dass die Stärke der Bahn auf mittleren bis langen direkten Verbindungen mit durchgehend hohen Betriebsgeschwindigkeiten liegt, die zur Verbesserung des Verkehrsaufkommens entwickelt wurden. Wenn Durchschnittsgeschwindigkeiten auf solchen Strecken von 200 - 250 km/h realisiert werden und das generierte Aufkommen bei Marktanteilen von bis zu 50 % liegt und der induzierte Verkehr nicht nur hoch genug ist um sämtliche Betriebskosten zu decken. Sondern auch deutliche Betriebsüberschüsse erzielt, welche wiederum eine Mitfinanzierung der Investitionen ermögliche. Trotzdem erscheint eine komplette Finanzierung von Eisenbahn-infrastruktur ohne Staatshilfen im Regelfall zwar nicht möglich, die Beteiligung der öffentlichen Hand an den Kosten kann jedoch deutlich zurückgeführt werden, um letztendlich zu identifizieren, was die Faktoren sind, die eine Entwicklung von HGV-Linien in Entwicklungs- und Schwellenländern unterstützen.

Zusammenfassend analysiert diese Dissertation ein neues analytisches Modell (durch den Vergleich zwischen den Projekten), um die Möglichkeiten für die Entwicklung von HSR in Entwicklungs- und Schwellenländern einzuschätzen. Unter welchen Umständen die erwarteten Vorteile von generiertem und abweichendem Verkehr und anderen vermeintlichen externen Einflüssen und indirekten Vorteilen die Investition in HSR rechtfertigen können. Die Analyse legt besonderen Wert auf die intermodalen Effekte und die Preisgestaltung. Das Ergebnis zeigt, dass der Ticket-Preis und die Pünktlichkeit wichtige Einflussfaktoren für die Nutzung des Hochgesch-windigkeitsverkehrs (durch die Fahrgäste) sind. Die Ergebnisse dieser Forschung werden durch drei Fälle veranschaulicht: die Grüne Bereich wie die Fallstudie in Ägypten and Iran, die Gelbe Bereich wie zum Beispiel in Indien und die Rote Bereich wie zum Beispiel in UAE, auf der Grundlage von Strategien, die einen ähnlichen Weg aus der Analyse früherer Projekt in den entwickelten Ländern verfolgen. Diese Ausgangspunkte beinhalten die wichtigsten Faktoren, um eine neue HGV-Linie in Entwicklungs- und Schwellenländern wie Ägypten zu unterstützen. Anschließend an die Analyse wurden die Ergebnisse des vorangegangenen Projekts auf die Fallstudie in Textform und Diagrammen angewendet, um die vorgeschlagene Zukunftsvision für die Fallstudie zu erläutern.

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LIST OF ABBREVIATIONS

UAE	United Arab Emirate
D&E	Developing and Emerging countries
HST	High –Speed Trains
HSR	High –Speed Rail
HSS	High –Speed System
GDP	Gross Domestic Product
GNP	Gross National Product
NICs	Newly Industrializing Countries
EMC	Emerging Market Countries
U.N	United National
BEM	Big Emerging Market
OECD	Organization for Economic Cooperation and Development
IMF	International Monetary Fund
GNI	Gross National Income
LEDCs	Least Economically Developed Countries
THSRC	Taiwan High Speed Rail Corporation
FRA	Federal Railroad Administration
ENR	Egyptian National Railways
KTX	Korean Train Express
MoT	Ministry of Transport
EU	European Union
EGP	Egyptian Pound
EC	European Commission
UIC	International Union of Railways
SNCF	French National Railways
TSI	Technical Specifications for Interoperability
PPPs	Public Private Partnerships
BOT	Build Operate Transfer
LCC	Life Cycle Costs
ICE	InterCity Express
LAV	Liniea Alta Velocidad
JNR	Japanese National Railway
LE	Egyptian pound
BCA	Benefit-Cost analysis
PCSU	Privatization Coordination Support Unit
CAPMAS	Central Agency for Population Mobilization and Statistics
GARBLT	General Authority for Roads Bridges and Land Transport
JICA	Japan International Cooperation Agency
ECMT	European Conference of Ministers Transport
ITS	Institute for Transport Studies

EXECUTIVE SUMMARY

Railways had a great influence on societies as the other transport modes developing in the world. Railways change the concept of distance, spread culture and made travel generally available. Standard time was created and life styles were totally changed by railways. However, cars, which were made in the twentieth-century, had a big influence on the railway. The expansion of cars caused a decrease in the demand for travel by rail. Cars have some features over the train. They are convenient, with diverse designs and competitive prices. In 1960, oil prices were very low and the car was an adequate means of establishing rapid economic growth. Therefore, the use of cars increased quickly. This phenomenon was repeated all over the world.

Meanwhile, the transport system, which focused on the car, has changed gradually since 1980, because of road overcrowding, air pollution and high fuel prices. Transport policy has also changed from a supply policy to a demand policy which limits car use, and has in some cases adopted congestion pricing, and high road taxes. Therefore, railways are being revived and made a comeback after the economic stagnation of the 1980s, because many countries are seeking the environmentally-friendly, energy-saving, mass transport systems for economic and social reasons. This is phenomenon called the Rail Renaissance.

Now it is time to initiate concrete solutions to tackle the emissions contributing to climate change, therefore, will be presented the environment as a high priority issue to the policy-makers. Transportation is responsible for the majority of the carbon dioxide emissions in our society (developing and emerging countries) compare with the industry and electrical station, but few of us would be willing to give up the convenience of quick and easy travel from point A to point B in the name of reducing our emissions. So, how it can be maintained the current level of speed and convenience without burning copious amounts of fossil fuels? The answer: High-speed trains or planning this system.

Since the start high-speed train (HST) services have been demand in many countries and are planned in many more, these countries include developed and industrialized developed countries, but this system has not be applied in developing and emerging countries, and the train has once more become the dominant mode of transport on many routes. This research review summarizes the different elements of HST operation with the objective of characterizing HST operation and putting in context its impact in terms of what it is best designed for and what it can deliver. The review concludes that the HST is best designed to substitute conventional railway services on routes where much higher capacity is required and to reduce travel time, further improving the railway service, also against other modes, therefore leading to mode substitution. However, the high investment in HST infrastructure could not be justified based on its economic development benefits since these are not certain. Also, high-speed rail is significantly more costly than expanding existing air service, and marginally more expensive than auto travel. This research describes the high-speed rail is better positioned to serve shorter distance markets where it competes with auto travel than longer distance markets where it alternatives for air.

The high-speed trains will be attractive and lovely to ride in Europe when it powered by electricity. The beauty of operating transportation system on electricity is the flexibility available for its source. Can generate electricity from any number of carbon dioxide free sources, including hydro, wind, solar, and, yes, even nuclear.

The convenience of high-speed trains is something that cannot be overlooked, but now the HSR train service can be operate along on the conventional tracks, as is the case in the Europe countries such as Germany.

It also can not be establishing the new HSR lines on the conventional tracks. Thereby, this is not possible in the developing and emerging countries, because the most of trains run with diesel fuel and all the network of the railway track is old (such as Arab region[1]). This leads to that in the developing and emerging countries can not create high-speed trains on old tracks. Also can be said that all trains in these countries now are sluggish compared to their modern-day counterparts.

The aim of this research is to contribute to the economic analysis of the proposal new high speed rail investment projects in requiring public funds the developing and emerging countries. The economic evaluation of projects can help governments to obtain a clearer view of the expected net benefits of different lines of action, as it attempts to identify the projects which really deserve the sacrifice of other social needs competing for the same public funds. Taking into account the income of people in these counties, while the Income has a significant impact in this analysis, also will analyze the circumstances under which society may benefit from investing in high speed rail, and when it is sensible to delay the investment decision. The high speed rail network may be built gradually, adding new lines once the economic evaluation of projects shows a positive social profitability.

[1] Arabic railway networks used about 2250 diesel locomotive to draw trains on the lines (Non-electrified lines), and about 360 electric locomotives on electrified lines limited spreading.

1 INTRODUCTION

Transport is of increasing relevance to the growth of nations. It is a crucial decision of production and trade patterns and consequently also of economic integration. For some countries it may also contribute to the generation of income through the provision of transport services. Participation in world trade depends increasingly on the type, quality and costs of transport services. At the present time, intra-company trade and trade in intermediate products are growing faster than trade in finished goods. This trend is closely linked to improvements in transport and logistics services

The rapid growing world population put pressure on the transportation sector in both urban and rural communities. Moreover, the increase of population in the developing and emerging countries year after year leads many nations to adopt alternative public transportation policies to present better service to their citizens. Thus, transportation planners around the world are considering serious public policy changes related to existing mass transportation. Whether the travel is for short or long distance, the existing transportation sectors are in desperate need of upgrades, and consequently produce more traffic congestion, and contribute to increased pollution. Therefore, the pursuit of alternative transportation has come in the form of high-speed rail transit. This form of transport is not new to the transportation sector, but in the developing and emerging countries is a new transport system, but it has been met with opposition, primarily because the concerns over cost and the impact upon existing transportation sectors.

The increasing movement of people and products at the local, regional, national, and an international level has placed extreme demands on transportation systems, especially in the developing world. Highway, rail and air transportation system congestion are growing fast, and a transportation network developed to meet the needs of an age in which there was less travel and movement of materials, are not suitable to the needs of today. Because in most metropolitan regions, there is no space available to expand highway or rail and airport infrastructure, and there is strong environmental and political opposition when such expansion is proposed. One key to solving today’s transportation problems is to develop systems that meet markets served poorly by the existing transportation infrastructure.

Whereas, the important question is: How should plans for high-speed railways be viewed in the context of economic development? Even if high-speed railways in a developing country find a market of travelers willing and able to pay for the evident, personal benefits they derive from faster rail travel, this itself does not imply that there is developmental interest in this sector of the transport industry.

Indeed, if the question is considered in this light, it might be said that fast travel is luxury consumption. It is generally affordable only by those in developing countries who have by definition already raised themselves above the masses of the poor, who are rightly the focus of much of the world's development. But is this narrow view justified? In the view of financial development institutions such as the World Bank, it is not. And it is certainly not a view that is applied when congested conventional roads are replaced by high-speed, high-quality expressways, where the consumption benefits of savings from travel time by higher income, private car owners are routinely included in project appraisal methodologies. In the developing and emerging, are these countries need high-speed network, and is that inevitably will affect the overall performance of the transport system, operationally and financially and environmentally. That performance is important in economic development.

In summary, high speed rail does not offer a quick or simple solution to relieving congestion on our nation's highways and airways. High speed rail system is costly, take years to develop and build, and require essential up-front public investment as well as potentially long-term operating subsidies. Yet the potential benefits of high speed rail both to riders and non riders are many. Whether any of the nearly 70-90 current domestic high speed rail proposals (or any future domestic high speed rail proposal), may eventually be built will depends on the addressing the funding, public support, and other challenges facing these systems. Determining which, if any, proposed high speed rail system should be built will require decision makers to be better able to determine a project's economic viability meaning whether total social benefits offset or justify total social costs.

Consequently, the traffic congestion, air pollution, and accidents are serious problems in developing and emerging country especially in Egypt. Traffic management plans, emission controls and efficient of the pricing policies on road automobile are active instruments for reducing air pollution, accidents and congestion of road transport. However, they did not provide a complete solution. High speed of railways has many advantages for both the operator and society. A high speed rail system can have a number of operational and environmental benefits. In terms of operational aspects, it easy the use of high-speed, high-powered, high-acceleration and lower-noise traction motors in comparison with diesel engines. Therefore, where the presence of the railway, and where it is importance the rail in most of these countries. The answer, as in so many aspects of economy, it depends on the local conditions where the new line is to be built and the expected volume of demand. Choosing an investment option without comparing it with relevant alternatives is, at best, contrary to good economic practice. The primary function of high speed railways is to solve a transport problem, and their advantage over other feasible alternatives has to be demonstrated on a case by case basis.

2 PROBLEM AND OBJECTIVES

2.1 Problem

Many developed countries have adopted high-speed rail as a solution to accommodate growing transport demand such as Japan, France and Germany. In many cases the high-speed railway has proved to be a catalyst for economic development and has played a part in sustaining continuing economic growth. Meanwhile, the increase in travel demand could lead to overcrowded airports, delayed flights and congested roads, air pollution, and accidents are serious problems in developing and emerging country especially in Egypt.

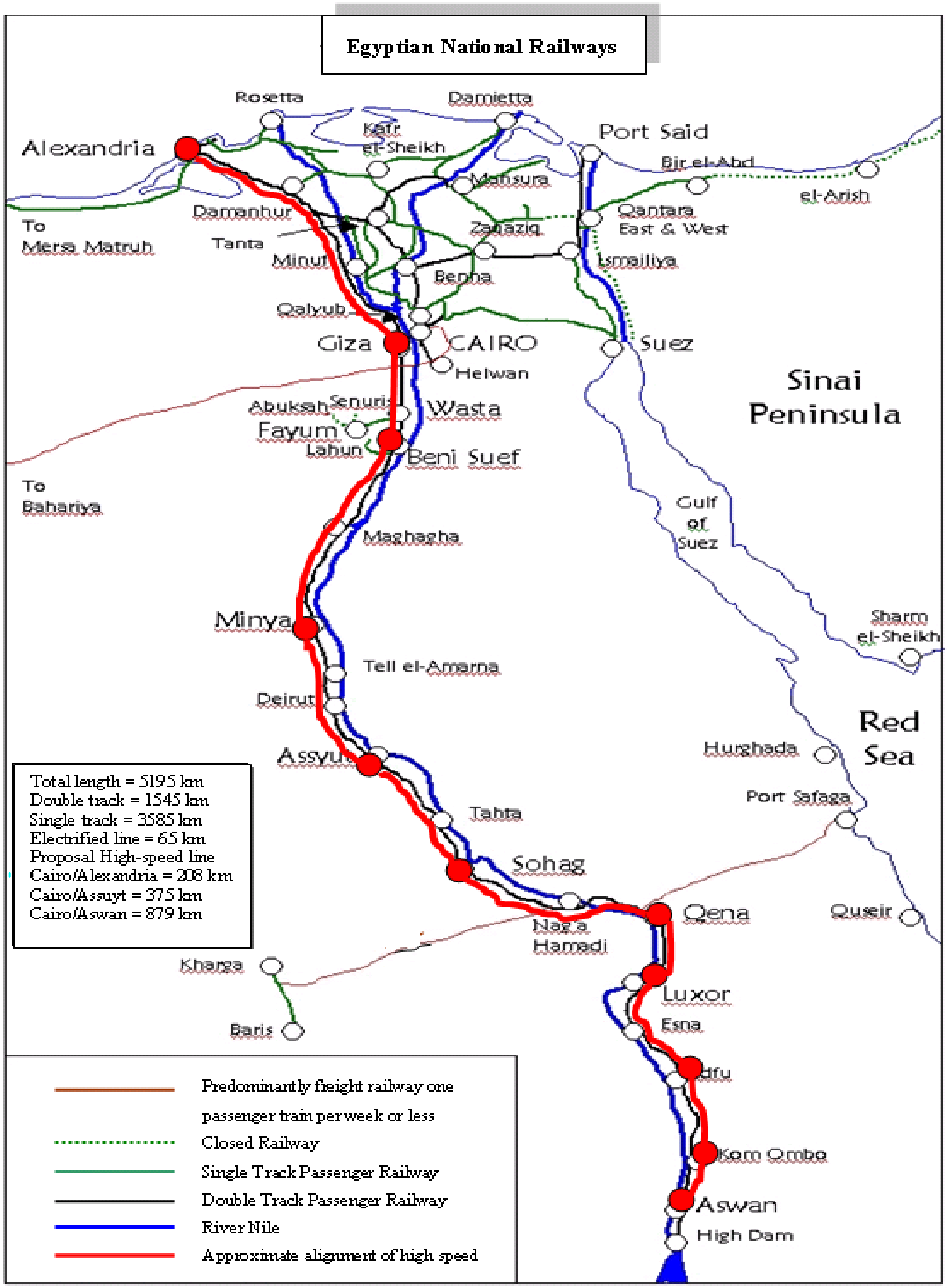


Figure 1: The ENR Network and the Proposal High-Speed Line.

The urge to fight these challenges is therefore pushing economies toward more efficient, and sustainable, solutions. Rail, and especially High Speed Rail (HSR), is an important means to reducing air pollution, accidents and congestion of road transport and to meeting these challenges and contributes to sustainable mobility development. In developing and emerging countries such as Egypt, the reduction in train speed is impediment to the progress of this country because this leads to the delayed arrival of passengers and cargo at the exact time. Therefore, not paying enough attention to rail transport and the lack of strategy of transportation affects the national economy of these countries because it is the connection between economic resources, production sites and markets. The time of the trip has a significant impact on the demand of transportation. This means that the length of the trip has a big role in the detection of transportation type. The demand for different types of transport depended not only on the time but also on several factors, including the importance of the arrival of the goods in the exact time and personal considerations of the traveler through the set up of time or provide the benefit of time. Especially with the increase in the speed of the type or means of transport, the transport pries will be increased.

The advantages of having higher speed by the air and car compared to that of the railways make a large demand for motor transport. However, the technical development has helped to increase the speed of trains reducing the difference in speed and the railway particular HSR offers tangible advantages over other transport modes such as air, conventional rail and the car for medium to long distance journeys. The comparisons between the railway and other types of transportation are limited in countries having small area. If the area of any country is small, this will limit the use of the domestic air transport. This mean the country with small area can use the road and rail transport more then air transport. The high speed is very important for the passenger transport from door to door because reducing the time of traveling, especially with the increase of man's desire to shorten the time of his travel as much as possible. Meanwhile, the HSR it brings together many of the features that can be desired while travelling such as speed, comfort, reliability, and safety. HSR's ability to compete with domestic air travel in terms of time and comfort has made a modal shift possible.

Therefore, in the developing and emerging countries such as Arab countries the design speed of the trains is 120 -160 km/h for passengers [1] and the design speed of the freight is 100 km/h, however. Moreover, the average operation speed for the passenger trains is between Ø = 100 - 130 km/h[2], in a few cases less than 100 km/h, and the average operation speed for freight trains is Ø = 80 km/h [2]. Also, the higher trains speed in comparison with that of the cars, this leads to the shorten journey times. From this point, came several questions such as what is the feasibility and opportunities for the creation of high-speed lines in emerging and developing countries, for example in Egypt (see Figure 1)[3], and what is the extent benefit from a comparison of high costs

[2] The design speed is various between the countries. For example, Egypt 140 km/h, Morocco 160 km/h, Algeria 120 km/h, Tunisia 140 km/h, Syria 120 km/h, Mauritania 100 km/h.[1] The average operation speed is less than design speed about 15% [2]

[3] Traffic congestion, accidents and air pollution are serious problems in Egypt. Introduce new of railways system has many advantages for both the operator and society. In addition, the demand on the travel increased in the future years as shown in the forecast in section 6.7, as well as the number of tourism also increased (the number of tourism in 2008 is 12,3 million tourism [4]). It is reported that with the introduction of railways capacity expansion projects, travel demand growth within the corridors will be greater than expected travel growth in the next years and this growth was probably not just influenced by the effects such as stable in income or population growth, the improvement of transportation properties (increase speed, travel time, travel cost, price, etc.). Thereby, it could be improve ENR network between Cairo/ Alexandria and Cairo- Luxor /Aswan, leads to accommodate these forecast of the demand, through a new system of railways. Figure 1 illustrates the existing rail line and the proposal HSR line in future to solve this problem in Egypt.

construction of these lines? **Traffic congestion, accidents and air pollution are serious problems in Egypt. Traffic management schemes, efficient pricing policies, and emission controls on road vehicles are effective instruments for reducing congestion and air pollution of road transport. However, they would not provide a complete solution.** Over all the world, Railroad is the most important and popular means of transportation for persons and freight [3] because the many people believe that it is safe, regular and fast transportation way. Increasing speed gives railroad an advantage in competition with other ways such as roadway. Thus, studying the predominant obstacles which obstruct increasing speed is very important. Therefore, there are several questions have to be are discussed in this research. Why this system of high speed rail do not exist in the developing and emerging countries and weather, the reason is due to the absence of sufficient experience of the railway systems, or due to the essential costs of this system as well as the lack of supply and demand on this type of passenger transportation as compared to other means of transport or the market of high speed rail in this countries is weak.

2.2 Objectives

This research presents an analytical study of the high speed railway transport system in development and emerging countries in order to determine its positive and negative points for the construction of the high-speed line in these countries. Also, this research will perform analytical study of the transport system of high-speed railway is in these developing and emerging countries. Moreover, the system of high-speed railway will be evaluated based on specific group of criteria in order to determine the direction of railway transport, the Government's strategy in this area and the vision in the development of this type of transport. These will help developing and emerging countries to meet the requirements for goods or passengers transportation, especially the transfer of passenger. Also, this research will determine the importance of the railway transport in comparison to that of other types of transport dependent on the viewpoint of citizens and the demand for high speed railway transportation. The implementation of the high speed rail line is in the developing and emerging countries depending on three factors. The first is the needed of establishing lines with high speed due to citizen high population and the geographical situation of specific region. The second factor is the ability of economic situation of these countries to implement such system. The last factors is the demand for this type and constriction cost. Consequently, the objective of this research is to provide policy suggestions for building of an efficient high-speed rail network that can both be profitable and solve practical problems that the contemporary transportation system faces.

The main objectives also in the study are to estimate the building of a new HSR system in developing and emerging countries, whereas these countries have high population density in rail transport corridors. Also the objectives of this study to estimate the total cost of providing intercity passenger transportation services by high-speed rail, and compare that with the current high speed rail in developed countries. The cost calculation is to include the cost of building, operating, and maintaining infrastructure, as well as carrier, user and social costs. From this calculation it can be calculated the pricing of ticket for the new HSR in developing and emerging countries. It can be applied these goals to the case study in Egypt as:

• To assess whether the installation of a ground based high-speed link between Cairo/ Alexandria, Cairo/Assuyt, and Cairo/Aswan via Luxor and may be reasonable in terms of micro economic, macro economic and spatial aspects on the one hand and
• If is the answer is positive, to give a statement which of both techniques should be preferred for realization.

In order to achieve the objectives it was necessary to assess the expected costs of line construction, vehicles, operations and maintenance as well as the expected revenues by the sale of tickets. This was requiring a prognosis on the volume of traffic on the one hand and a complete planning of operations including vehicle circulation on the other hand. The appropriate study design results from the mentioned aspects and is outlined in Figure 2. The work packages feedback and refining are reserved for further investigations

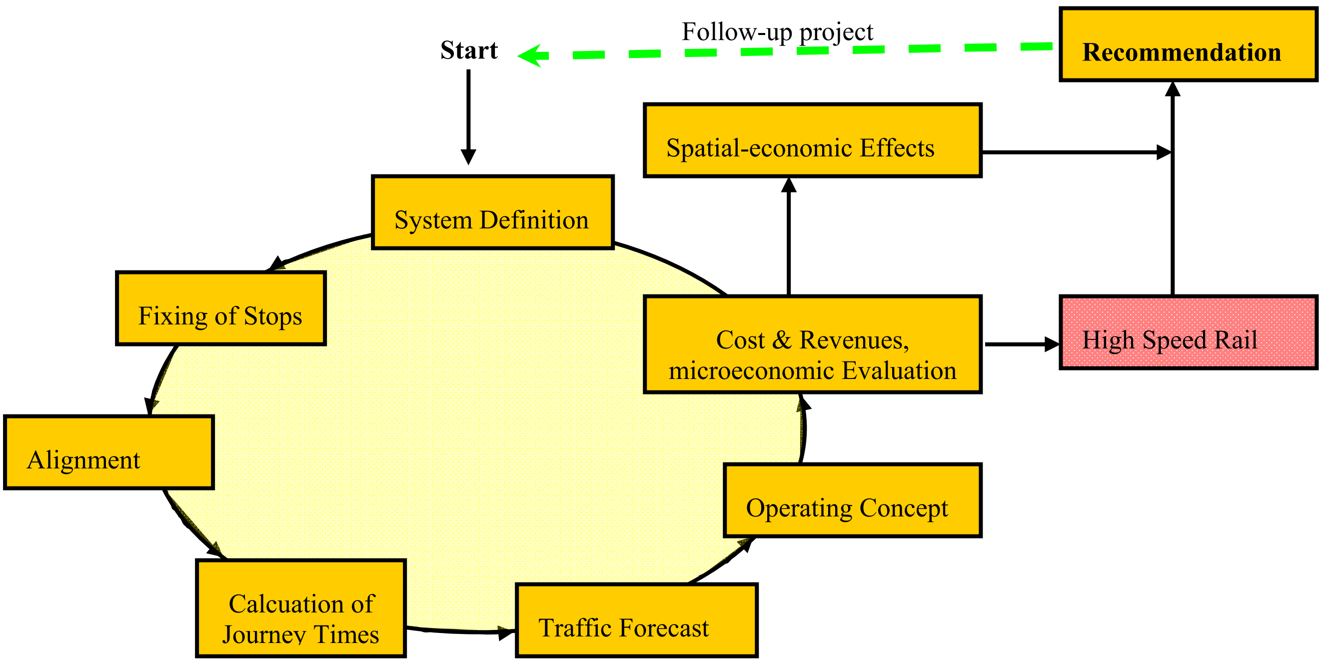


Figure 2: Design of these Study for the HSR

2.3 Structure of the Research

This research begins to explain the introduction of this study in chapter 1. Current Chapter (chapter 2) describes the problem of this research, objectives, and research methodology. Chapter 3 describes and explains the countries (the developing and emerging countries) classification. Chapter 4 describes the state of high speed railways today in the developed countries. It will include definition and a brief history of high-speed rail throughout the world; and a description of current high-speed rail planning in the world. Chapter 5 a clear review on the current state of railways in the emerging and developing countries (Egypt, Iran, United Arab Emirates (UAE), and India). Presented also, a description of current network and explain the reasons of decline of railways as a form of passenger transport. A screening model for High Speed Rail is elaborated in Chapter 5. This model includes indicators that would lead to the decision a new HSR network. It is aimed to be used by countries with similar characteristics to Egypt. Chapter 6 will discuss the possibility of developing and emerging countries to establish high-speed rail lines. Also in this chapter will discuss what are the requirements and factors that help to create this kind of modern technology, as well as estimate the methods of the forecast demand of the case study. Despite, estimate the methods of the calculation cost of the proposed HSR line in the case study. In addition will discussing the economic potential of these countries to establishment of these lines.

Chapter 7 will describes the economic evaluation of the new HSR project, and discuss the methods to estimate the benefits of high-speed rail. Benefit Cost analysis is a method that is used in order to valuation project and help in the decision making process of deploying it or not in this chapter. Also it will evaluate the environmental and economic benefit of high speed rail and what is the benefit from this technology. It will be discussed weather the high-speed trains will improve the national economic, the availability of energy and the impact on the environmental pollution. And also, will explain the factors affecting the economic viability of high speed rail lines include the level of expected costs, and public benefits (i.e., benefits to the nation as a whole from such things as reduced congestion. Chapter 8 describes the present and the future price of the high-speed in comparison to other means in the long run. Also will be determined the maintenance costs of permanent high-speed rail tracks in comparison to the high-speed rail lines and the other transportation dependent on all financial aspects. Chapter 9 presents the review and analyzes the conclusions of this thesis. It gives directions for further research as well.

2.4 Research Methodology

Research methodology: The research adopted four main axes to achieve the objectives of this study which are as follows: **First axis:** Research will be conducted in order to gather general information about Egypt and more specifically about its transportation sector. In particular, there will be an attempt to find and learn about Egypt transportation strategies and acknowledge to what extent HSR systems are included. A case methodology has been applied to analyze the phenomenon of population density and major cities formation and the economic development effects resulting from HSR deployment worldwide. The approach is largely qualitative and descriptive supported with quantitative analysis of existing empirical evidence and synthesis of the relevant literature.

An extensive literature review will be carried out regarding the methods of evaluating transportation investment. Once a decision is taken about the new transportation project, it will be supported with evidence that it will provide mostly positive impacts. There are many different methods of ex-ante evaluation and those will be presented in one of the chapters, based on the background information of the Egypt transport sector and, the review of evaluative methods of transportation investments.

On the basis of this research currently being conducted about proposal HSR in Egypt, the cases are based on studying situations in the countries that have experience with the functioning HSR system for a period of time that is enough to allow for the development effects of HSR to occur. At the first stage, empirical evidence was collected through the review of models already developed in the literature that estimate the factor and the impact of HSR on the location of the activities and the regional development in countries have already high speed lines; then the key indicators for measuring the economic effects for the transportation investments will be determinant. There will be an attempt to compare between the situation in the case study and the worldwide experience (Asian and Europeans countries). For instance, Egypt and Germany have almost the same population size and also Egypt like France, where France has always been a central government; this centralization is not only for political decision processes, but also for transportation route and etc. It would be of great interest to find similarities. Also, both have two or more cities that are the most populated and dominant in each country accordingly.

Second axis: cases of experiences in Germany, France, Spain, USA/Canada, China/Taiwan and Japan were studied before and after deployment of HSR. These country studies aimed to:

- Analysis and explain the basis of the strategy following a similar path to the analyzed project in the country, including the important factors that help to create a new HSR line in a developing country such as Egypt.
- Achieved the phenomenon of major cities formation as a result of HSR deployment, and determine the possibility and magnitude of associated development effects.
- Analyze in details the regional economic impacts of the HSR link on either, large or small cities, connected or not connected to the network.
- Based on the specific country context, lay out the lessons learned for Egypt, and this maybe suggestion of a method that can be used in Egypt.

This method could be adopted for the assessment evaluation of the project, which has an object to cover as many impacted aspect as possible, thereby feeding the next phase of the research. Consequently, the cases study will be structured around the following aspects:

- Status of the growth in GDP per capital in the next years and its effect on people movement.
- Status of intercity conventional railway network in a country pre-HSR deployment.
- Competing modal share and modes in a country's corridor of study before and post-HSR.
- Studies done in a country that raised issues of major cities and regional development prior to spread of HSR and proposals made to address them, if any.
- Actual outcomes post-HSR: the expected outcomes with respect to the construction of a new HSR line and regional development that occurred as a result of HSR or did not occur, and unexpected outcomes.
- Existing empirical evidences on how HSR affect the regional development and distribution of growth among large and small cities.

Third axis: methodology forecast: it will used as a basis for the traffic forecasts, the existing traffic flows in Egypt will be analysis and differentiated by means of transport, trip purpose and by origin and destination of trips. This is carried for the domestic between cities traffic within the case study. The forecasts will be designed to reflect the interaction between the different means of transport, such as train, private car, bus and air, resulting by external influencing factors such as growth in GDP in the next years, the development and growth of population and employment, car ownership, market regularities, user costs, transport policies and the extension of rail, road and plan infrastructure as well as new air and rail services. Particular focus was placed on modeling that can be use on the rail services. In addition to the traditional supply factors, for example travel time, transport cost, frequency of services and changes in public transport, factors specific to high-speed train service were considered, e.g. train-user costs based on speed and travel distance. Consequently, the case study findings and empirical evidence were analyzed and compared. So, it wills a screening model for HSR will be formed. It will be a model to be used for understanding whether it is worth applying a HSR network. The countries of Egypt, Iran, India and UAE will constitute the basis for the formation of this model. The model will include parameters that are vital and relevant with HSR.

According to forecasting HSR ridership the forecasting methods have recently been used to estimate ridership for high speed rail systems. The possibility of study of a system of high-speed rail lines for Egypt is described. Absent of a comprehensive local data and any travel forecasting models for the country, an incremental demand model and a gradual way mode selection as the modeling techniques to use for the study. In this forecasting method, a forecast is made of the total origin-destination travel for the forecast years for all the competing modes of transportation. This forecasting technique involves the use of a multinomial mode choice model to determine the share and the number of passenger trips in the future for modes. The steps taken to estimate base-year demand and market shares are described and the application of the models to forecasting demand. Thus, due to the very limited use, limited economic feasibility, of high-speed freight rail, this dissertation will confine itself to examining passenger HSR.

The ability to develop accurate forecasts for a high speed ground transport such as a HSR service in the region is restricted by a number of factors. The HSR service might be an extensive improvement of existing conventional rail service. The new rail service would offer passengers new travel times and fare choices. In addition, the enhanced rail service might offer improved levels of reliability, comfort and convenience. All these factors would have an effect on the passenger's choice of travel mode and would have to be incorporated into the ridership forecasts.

Fourth axis: methodology of cost calculation; in this section, will be explained the methodology of cost calculation of the new line in Egypt as were analysis in chapter 6. Therefore will be calculated the expected operating and maintenance costs of the new proposed HSR project. So, these can be estimated these costs based on the total annual volume of passenger forecast as follows:

- Estimate the total construction costs and the total annual construction costs of expected HSR system
- Estimate the total annual operating and maintenance costs of expected HSR system.
- Estimate the total annual cost per train-kilometers expected to be travelled on the HSR system.
- Estimate the share and comparison the ticket price between proposal HSR in Egypt and European countries.
- Estimate and comparison of HSR market share and railway speed between European countries and expected proposal HSR in Egypt.

Also will be calculated the cost of the new proposal project depended on the forecast patronage demand for a HSR corridor in 2015. This methodology depended on the traffic volume in the last years; therefore it will be used the linear regression models to estimated the forecast of passenger demand in the next years. Consequently, it can be calculated the change rate of the traffic volume for the forecast by this method.

3 COUNTRY CLASSIFICATION

The aim of this chapter is to consider knowing the classification of country in economic terms, and the income per capital gross domestic product (GDP). Because it can be benefit from this classification to determined the developing and emerging countries. Therefore, established any new ssystem of transportation such as HSR line depended on the economic force of the country and income per capital, and on the other hand depends on the people to use this system, also this depends on their incomes depended on the income per capital, and on the other hand depends on the individuals to use this system, as well as this depends on their income. The next section will present an overview of the high-speed network in the developed country. Then illustrate some of the network in developing and emerging country with the income per capital. In the last section shows the listed of emerging economies and the conclusions.

3.1 Developed Countries

Countries that have reached a level of economic achievement through an increase of production, per capita income and consumption, and utilization of natural and human resources.The average per capita income levels for the different groups of countries. However, the way that income is distributed within a country may have a significant impact on overall standards living. People living in a low-income countries with relatively good income well distributed may have a better quality of life overall than those living in a higher income country where much of the income goes to a small segment of the population, as most people have income levels below those available to people living in countries with lower average per capita incomes.

Individuals of different skills, orientation, histories and the status; these may have a significant impact on income distribution patterns. However, social and political relationships can also have an effect directly or indirectly to distribution of income [7]. It can be said, income patterns can be influenced by public policy, and including efforts to improve skills and productivity and to increase expand opportunities for a population. The view of many analysts would those steps have been taken in the direction to have a positive impact on development

Some systems have been creator to group countries according to their levels of per capita income. The United Nations Statistical Yearbook notes that there is no common agreement in the United Nations system concerning the terms developed and developing, when referring to the stage of development reached by any given country or area and its corresponding classification in one or the other grouping [8]. The yearbook divides the world into two groups. Countries in North America, Europe and the former U.S.S.R. (The Union of Soviet Socialist Republics), Japan, Australia and New Zealand are said to be developed. All others are developing.

Also world dividing into two large blocks, the above system tends to obscure the differences within each group and to emphasize the differences between them. In its annual global economic and social survey, the (U.N.) uses a somewhat different classification system. It separates the former Soviet Republics and the former communist countries of Eastern Europe into a third group called “economies in transition [9]. In effect, these countries are grouped together despite wide disparities among them on the basis of their history rather than their level of development.

The World Bank uses the same basic framework, though it pegs the threshold for each category lower than does the U.N.[4] Using the foreign exchange method of calculating income, the World Bank divides countries into four groups. Low-income countries are those with per-capita income levels below $995 (in 2009 U.S. dollars). Lower middle income countries have incomes between $996 and $3.955. Upper middle-income countries have income levels between $3,956 and $12,195, and high-income economies are defined by the World Bank as countries with a Gross National Income per capita of $12,196 or more [11]. According to the United Nations definition some high income countries may also be developing countries such as United Arab Emirates and Qatar where the income per capital is 46,857 and 68,872 respectively [4]. As well as countries with have per capita income levels above the latter amount. Thus, a high income country may be classified as either developing.

Advanced economies or the developed country are listed in Table 1 it can be observed that, in this table some of the developed country. It is noted that in this table will shows total railways network and the ratio of HSR line from the total railways in these country.

In addition, this country have a largest in terms of GDP per capital such as the United States, Japan, Germany, France, Italy, Switzerland, Spain the United Kingdom, and Canada constitute the subgroup of major advanced economies. Often, the developed countries are in the euro area (12 countries) and the newly industrialized Asian economies are also distinguished as subgroups, such as Japan. The result from this Table 1 is: It is noted that all country which includes the high speed rail line, it is found that income per capita is high. This shows that the economy of these countries is high, and the passenger transport is required to move people from one place to another, and requirements vary considerably between different places and between different social groups dramatically and rapidly. Where lead this to expansion the high speed line in these countries.

[4] The thresholds and ceilings for the U.N. categories would be higher they were expressed in U.S. dollars for 2000.

Table 1: High speed line in the developing country with operation speed 250 km/h

Country[5]	Area (km^2)	Population	Total length of railway network	High speed line [5]				% HSR from total length [6]	GDP per capital [4]
	thousands	million	km	In operation	Under construction	Planned	Total	%	US $
Belgium	31	10.4	5693	209	0	0	209	3.7 %	43,533
France	640	64.0	33,778	1896	210	2616	4722	5.6 %	42,747
Germany	357	82.3	33,706	1285	378	670	2333	3.8 %	40,785
Italy	301	58.1	16,959	923	0	395	1318	5.4 %	34,435
Netherland	42	16.7	2,886	120	0	0	120	4.15%	48,223
Spain	506	46.0	15.083	2056	1767	1702	5525	13.63%	31,946
Switzerland	41	7.6	3544	35	72	0	107	1.0%	67,560
United Kingdom	243	61.1	16,173	113	0	0	113	0.7%	35,334
Japan	378	127.1	20,036	2534	509	583	3626	12.65%	39.731
USA	9,629	307.2	226205	362	0	900	1262	0.2%	46.381

Source [4] [5] [6]

[5] Here in the country, there are also some country have HSR line under operation, but do not exist in this table. Because, will be taking some country have largest high speed rail network in the world, addition to the China and Taiwan [see Table 2].
[6] The percentage of high-speed line in operation case relation to the total length of network

3.2 Emerging Country (Transition Countries)

The term emerging markets is used by investment analysts to categorize countries that are in a transitional case between developing countries that are just beginning to industrialize and countries that are fully developed. Also can be defined the emerging markets is used to describe a nation's social or business activity in the process of rapid growth and industrialization. Currently, there are approximately 28 emerging markets in the world, with the economies of India and China considered being the largest[7].

Defining an emerging countries based on the size of its economy is of little help. For example China's economy, if computed in terms of Purchasing Price Parity is the world's second largest, yet it is not an advanced economy, Luxembourg, Norway, and Switzerland are smaller economies are correctly considered advanced because of their high per capita wealth and active involvement in the global economy, On the other hand, one is justified in classifying some highly populated countries with low gross domestic product per capita, such as India or China, as emerging market countries because their large size causes their economies to be globally active in terms of trade and investments. Hence, the classification of some large relatively poor countries as emerging market economies creates a wide GDP per capita gap between wealthier and poorer emerging market countries. For example, Taiwan and South Korea are much wealthier than China or India [12]. Furthermore, the level of international economic activity also varies considerably among emerging markets. Taiwan and South Korea are more active than Poland or the Czech Republic in the global economy. In fact, South Korean firms invest in Eastern Europe a way to expand their market and enhance profits, the superior size of the South Korean, where it plays a relatively active role in the global economy. Emerging markets are characterized by strong economic growth, resulting in an often marked rise in GDP and disposable income. As a result, people in emerging countries are often able to buy goods and services that they previously would not have been able to afford. And also there are many companies and factories that help the rapid growth in these countries; this provides international companies with the opportunity to tap large, new customer bases, potentially driving significant growth for a number of companies and industries. Though disposable incomes in emerging markets are rising, many of their citizens are still relatively poor. Luxury goods such as high-end automobiles and designer clothes are sure to benefit from the increased purchasing power of emerging economies,

In recent years, new terms have emerged to describe the largest developing countries such as BIRCs that stand for Brazil, India, Russia, and China. These countries do not share any common agenda, but some experts believe that they are enjoying an increasing role in the world economy and on political platform [13].

Over the next 50 years, the BRICs economies could become a much larger force in the world economy. Using the latest demographic projections and a model of capital accumulation and productivity growth, map out GDP growth, income per capital and currency movements in the BRICs economies until 2050. The term rapidly developing economies is now being used to denote emerging markets such as The United Arab Emirates, Chile, Kuwait and Malaysia that are undergoing rapid growth [14]. Other

[7] Emerging market that are on a continuum between advanced or underdeveloped economies, they possess viable financial, communication technological, and legal infrastructures, and are active participants in the global economy emerging markets have the potential to reach sustainable economic development. They also have open, or at least opening, political systems, the presence of a viable middle class, and a culture that accepts change and innovation.

emerging markets not associated with command economies will also present considerable market opportunities in the coming years. Asian markets such as India and Indonesia will provide increasing growth potential through the further liberalization of their economic structures.

By the year 2010, these two countries and China could become three of the world's six largest economies [15]. Similarly, the "Asian Tigers" of Singapore, Hong Kong, South Korea, and Taiwan are evolving from emerging markets into Newly Industrialized Countries (NICs) and will ultimately progress to fully developed nations of the First World. The Big Emerging Market (BEMs), the U.S. Department of Commerce recently designated certain countries the BEMs of the future. These BEMs are China, Indonesia, India, Mexico, Argentina, Brazil, Poland, and Turkey [16]. There is little doubt that these countries will provide excellent opportunities for export expansion. However, much of the economic development has already taken place, and the rate of expansion is beginning to slow. South Korea and Brazil, for example, are already fully industrialized countries.

In some cases, countries may be dropped from the list of NICs or emerging market countries for reasons not necessarily linked to their economic performance. This suggests that their level of development according to that system of categorization is less a function of their own condition and more a function of their relationship with foreign markets or other countries. For example, countries in Eastern Europe would likely no longer be considered developing countries or NICs if (like Spain and Portugal in the past) [17] they joined the European Union. Also, countries may find their status as successful emerging market economies may be reduced for reasons not entirely of their own making. These include recessions in the developed countries which cut their export markets or financial crises where events in one emerging market country have a contagion effect. In the latter situation, investors or lenders may reduce their exposure in emerging market countries generally, seemingly without much regard for the situation in particular countries.

Transition process is usually characterized by the changing and creating of institutions, particularly private enterprises; changes in the role of the state, thereby, the creation of fundamentally different governmental institutions and the promotion of private-owned enterprises, markets and independent financial institutions [19].

While, what is the reality of the rail transport sector in the emerging countries, in the following Table 2 will explain the situation of the railway in some of this country, including the length of high-speed rail line if found that. It cab be observed from this table that, there are some country have no railway network, but these country consider from the emerging country [14]. Therefore, railways in transition economies are undergoing profound reform programs, as an example in China, where in next years, the market of the high speed rail in China has almost one-third on the total high-speed rail in the world[8]. From the Table 2, it is noted that the relationship between population, railway network and income per capita. It cab be observed that, some of this country has income per capital is higher but it has not transport sector by railway network. Conversely, India and China have larger railway network, however, with the lowest income per capital.

[8] China has now about 4079 km HSR line in operation and 6154 km under construction. The total world HSR line in operation about 14604 km and 9799 km under construction [5] this mean that now China has almost about 1/3 HSR line in the world, this is in operation cases. In the next years China has also about 42% of total HSL in the world (this is in operation and under construction cases)

Table 2: Situation of the railway network in the some emerging country

Country	Area (km^2)	Population	Total length of rail network	High speed line [5]				% HSR from total length[9]	GDP per capital [4]
	thousands	**million**	km	Operation	U.Construction.	Planning	Total		US $
China	9,561	1,339	65,419	4079	6154	2901	13134	6.23 %	3678
Taiwan[10]	36.2	23	1509	345	0	0	345	22.9 %	17.040
South Korea	100	48.5	3378	412	0	0	412	12.2%	17.074
Turkey	784	76.8	8686	235	510	1679	2424	2.7 %	8.723
Brazil	8,547	198.7	29.817	0	0	511	511	-	8.220
India	3,287	1,166.1	63,273	0	0	495	495	-	1031
Argentina	2,780	40.9	25,023	0	0	250	250	-	7.726
Egypt	1,001	78.6	5.195	0	0	0	0	-	2450
UAE	83.6	4.98	-	-	-	-	-	-	46.857
Qatar	11.4	1.7	-	-	-	-	-	-	68.872

Source: Source [4] [5] [6]

The result from this analysis is the railway networks do not depended only on the income per capital, but depends on the market of the rail or who used the rail transport sector (supply and demand passengers, leisure user, business user and holiday user). Also population density, distribution and growth are three very important in determining country's passenger transport needs. In Table 2, it should be noted a densely populated country (India and China) obviously has a greater need for rail transport sector than one about of similar size which is sparsely populated (like Argentina). A scattered population such as in India may result in greater demand for long distance rail transport than a more concentrated population (like Egypt); and rapid population growth creates additional to transport sector, which in many cases is not satisfied

3.3 Developing Country

What is a developing country? How does one know whether a country is actually developing? How the progress countries are making in development can be measured ? There are many measures used which seek to identify and rank countries in expression of their levels of development. Most focus on income levels, due to the premise that countries are more developed when their annual levels of per capita income rise. Others examine social, structural and other criteria, due to the premise that these are also important attributes of development. In general, development is a multi-dimensional concept that encompasses economic, social and political criteria.

Countries the rank of countries in their levels of development according to various criteria, countries that rank high according to one measure may rank lower according to another. At the same time, it was commonly believed that lifting a country's average

9 The percentage of high-speed line in operation case relation to the total length of network

10 GDP per Capita - Taiwan Compared to Continent, The gross domestic product (GDP) per capita is the national output, divided by the population, expressed in U.S dollars per person, available at: http://www.globalpropertyguide.com/Asia/Taiwan/gdp-per-capita

per capita income level would lead to improvements in most other areas, however, the social conditions and general welfare of the people may not necessarily lead to the improvement when a country's average income level increases. The contact between levels of countries' per capita income and their levels of social development (measured by health and educational criteria) are not necessarily strong. Countries that have relatively high levels of per capita income may be the lowest rank in the social development and structural. By contrast, some poor countries rank with the advanced countries in their systems of governance and their levels of individual and economic freedom.

Countries in the process of change directed toward economic growth, that is, an increase in production, per capita consumption, and income. The process of economic growth involves better utilization of natural and human resources, which results in a change in the social, political, and economic structures

There are four criteria which are often used today to rank and assess countries levels of development. They are:

- Per capita income
- Economic and social structure
- Social conditions
- The diffuse level of economic and political freedom [17].

Developing country is a country that has low scales of public governments, industrialization, social programs, and human rights guarantees that are yet to develop to those met in the west. It is often a term used to describe a nation with a low level of material well being. Despite this definition, the levels of development may vary, with some developing countries having higher average standards of living.

To start it is important to recall that developing countries are in general countries which have not achieved a significant degree of industrialization relative to their populations, and which have, in most cases a medium to low standard of living. There is a strong correlation between low income and high population growth.

The terms used when discussing developing countries refer to the intent and to the constructs of those who used these terms. Other terms sometimes used are less developed countries, least economically developed countries (LEDCs), underdeveloped nations or Third World nations, and non-industrialized nations [18]. Conversely, the opposite end of the spectrum is termed developed countries, most economically developed countries, First World nations and "industrialized nations.

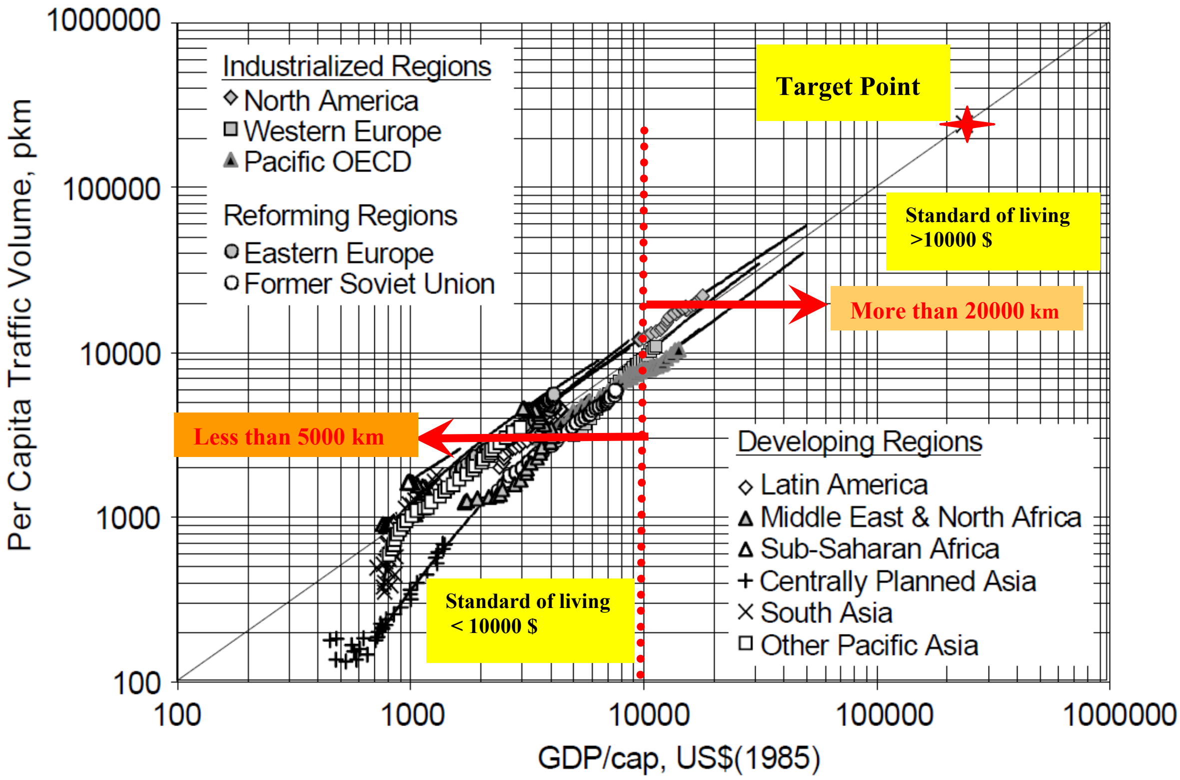
The United Nations (U.N) divided the developing countries into five categories [17]. The Least Developed Countries are 29 low-income countries with per capita (GNP) levels below $995 (in 2009 U.S. dollars) [11] and have major problems in terms of their economic diversification and social development. This group of countries is different from the least developed countries mentioned above. But the World Bank divides the low-income countries are those with per-capita income levels below $935 (in 2008 U.S. dollars). Developing countries, it still suffers from neglected infrastructure, rising inflation and food costs, and a large disparity of wealth between urban and rural residents. Though the debate over emerging market definitions does not generally happen on such a big stage, emerging market definitions that rely solely on broad economic indicators provide a useful high-level view of the market opportunity for technology companies and development industry.

3.4 GDP per capita and Relationship between Economic Growth and Transport Demand

Several retrospective studies show that the movement of people (and goods) is closely correlated with economic growth, giving rise to the idea of linkage between mobility and standard of living. According to this idea, it is impossible to separate raising standards of living from increasing mobility, both at macroeconomic level, that of nations, or microeconomic level, that of individual choices. By describing the basis for this coupling, it will highlight the key factors of transport demand, especially passenger demand for inter-urban mobility.

Coupling GDP per capita and transport demand; if economists point out that this link has been fixed in recent economic history, regardless the country in question, they merely underline the part played by the key factors of economic growth and speed, the supply of transport and its technological capabilities in particular area. It will be begun by recalling the proof another factor must immediately be added to the key factor of economic growth, which changes to the structure of transport supply.

Figure 3 explain the relationship between income and mobility. Whereas, there are two of the regions with highest income; Industrialized Regions [North America (NAM), Western Europe (WEU), pacific OECD nations (PAO)], and Reforming Region [Eastern Europe (EEU), former Soviet Union (FSU)], per-capita mobility and income have grown in essentially the same proportion, with target point . This pattern exists despite a wide variety of different regional and cultural settings. However, there are major differences in absolute mobility; some regional lie above the target point, while others below the central the target point (dashed line). For instance, at $10,000 per capita, per capita mobility in WEU was only 60% that of NAM [215], reflecting different infrastructures, population densities, cultures, and unit costs of transport.



Source: [215]

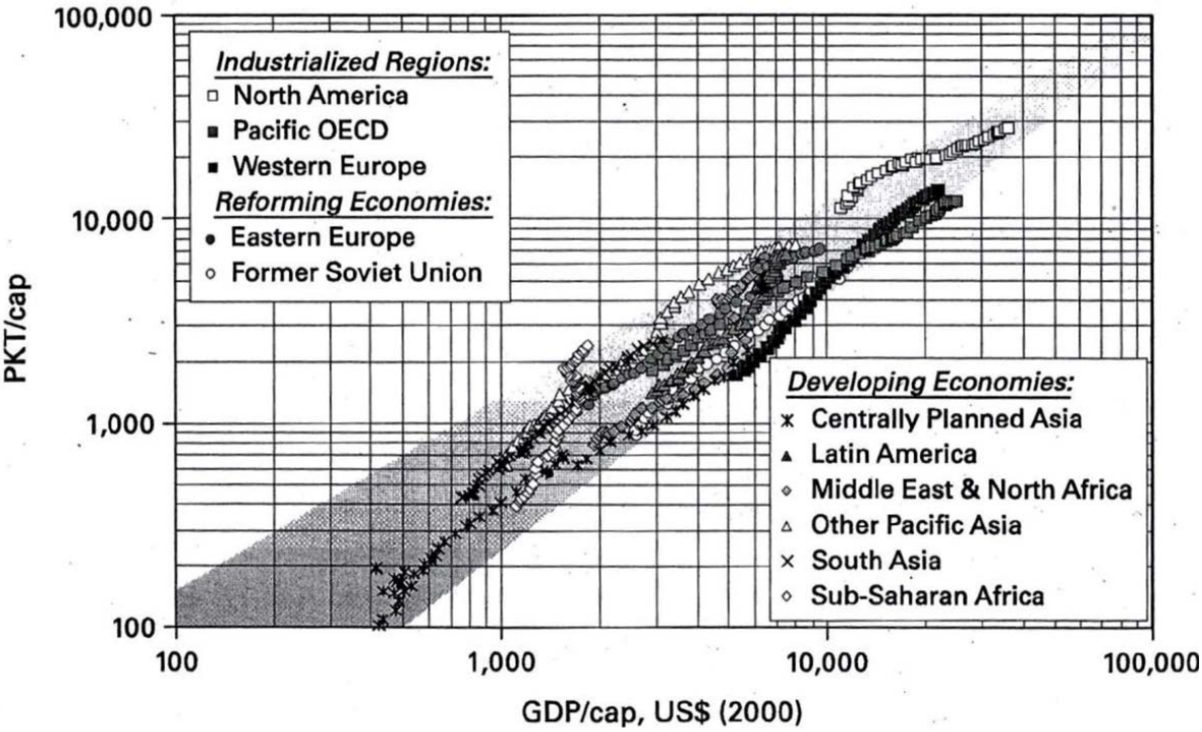
Figure 3: Total Mobility in Pkm per year [Data 1960-1990 Trends 1960-2050]

In the other hand, there are six lower income regions show more difference, which reflects many factors. One factor is that transfer of income statistics into common units is imperfect. A second factor is the replacement of motorized transport for other modes, notably non-motorized forms (walking, bicycles, and animal-drawn carts) and motorcycles. the curvature of the growth in mobility in Pacific Asia nations (PAS) will be interpret in Figure 3, for instance, as evidence of the replacement; such curvature is not evident in all low-income regions, perhaps because the extent of curvature also depends on the methods used for gathering and converting income data. A third factor, profound economic stagnation, applies particularly to Middle East and North Africa (MEA) and Sub-Saharan Africa (AFR). In these regions, economies contracted sharply in the 1980s despite the overall mobility continued to rise, temporarily. As a result, the data show a hysteresis between economic stagnation and demand for transport because earlier investments (the major share of transport costs) continue to promote mobility in the early stages of stagnation.

Figure 3 also shows the regional projections and the target point values for 1960, to 2050. Any of the regions close to the levels of income and mobility levels of the target point by the year 2050, which is consistent with its use as a concept rather than a strictly realistic statement about the future. The target point is sufficiently distant in the future that its specific location on the central trajectory does not matter much. Industrialized Regions, the region where the projected income growth will be highest by 2050, would reach the target point only a century later if income kept growing at the same rates.

In projections of the World Bank, the growth is strongest in developing countries, where population more than doubles during the period 1990 to 2050 and accounts for 85% of world population in 2050. These values are similar to the 1992 UN medium forecast [219; 248]. For example, passenger transport in industrialized regions will grow by a factor of three, and that there will be a nine-fold increase in developing regions between 1990 and 2050 [215]. The rapid growth has resulted in a multitude of problems including severe traffic congestion and pollution, and the situation is expected to worsen even further in the future.

According to the Schäfer and Victor (2000) created the direct link between economic growth and mobility in the Figure 3. Using GDP per inhabitant in constant 1985 dollars as an introduction device, they were able to construct a graph in which the first bisector gives a surprising equivalence between the level of GDP and total annual mobility per capita. As most countries are located close to the first bisector, or approach it over time (from 1960 to 1990), one could almost say "Tell me a country's GDP per capita and it will tell you the average distance travelled over a year: one kilometre per dollar of GDP per inhabitant". Consequently, the figure is constructed on a logarithmic scale; it may directly deduce a distance/GDP elasticity of 1. In other words, a given percentage of growth in GDP per capita is matched by an identical percentage of growth in the distance travelled over a year.



Source: [216]

Figure 4: Total Mobility in Pkm per year [Data 1950-2005 Trends 2005-2050]

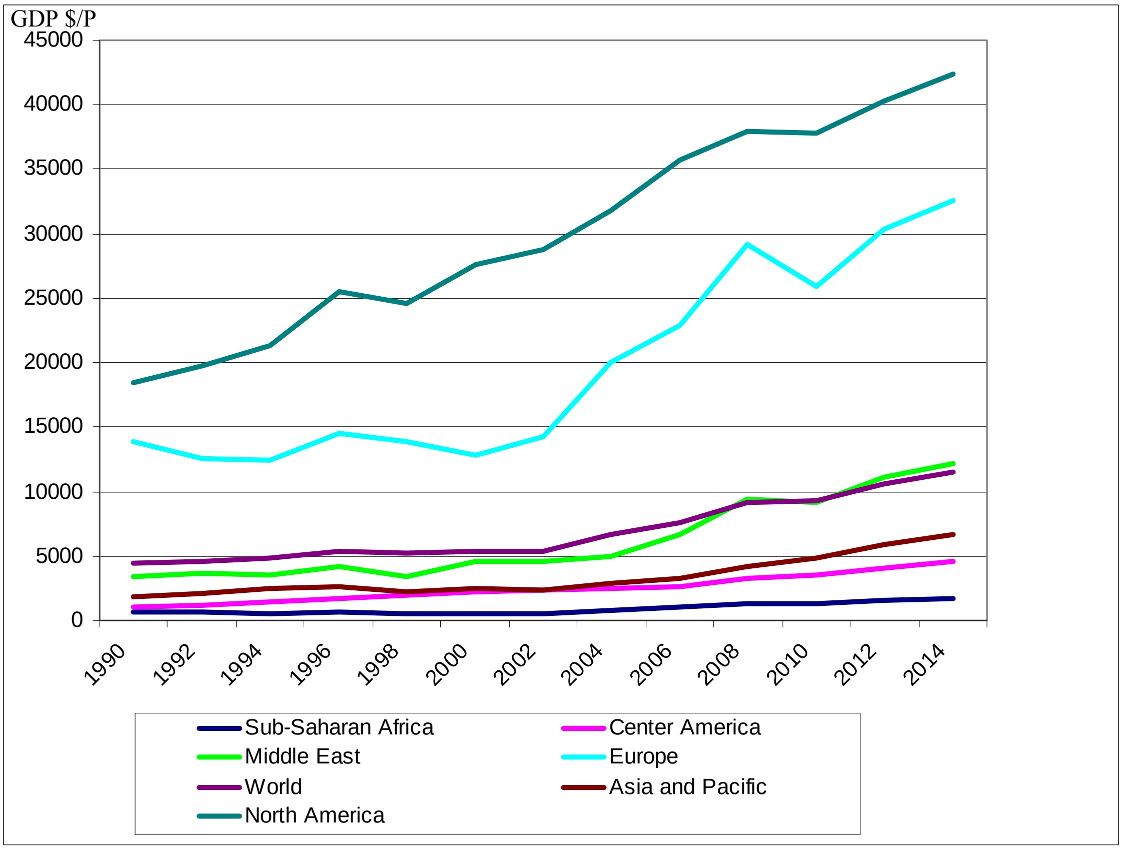
In addition, the data were updated in a recent study (Schäfer et al., 2009), this time including data on personal mobility until 2005, as shown in Figure 4 [216].
A comparison between Figure 3 and Figure 4 shows firstly that coupling is both real and longstanding. In this version, however, taking into account a calculation of purchasing power parities based on constant 2000 dollars, the first bisector effect is eroded. It becomes more difficult to deduce the level of annual mobility per capita from the level of GDP per inhabitant. for example, and accordant to data in Table 1, it will taking a standard of living more than of $10 000 GPD per capital on the x axis, levels of mobility vary widely, from 10 000 kilometres a year for industrialised countries in the Asia-Pacific zone to 20 000 kilometres a year for North America and Western Europe [Figure3a]. Thus, in developing regions, taking levels of living is less than $10000 GPD per capital [see Table 2], levels of mobility less than 13 000 kilometres annual for Middle East and North Africa and South Asia [Figure3]. That makes it more difficult in Figure 4 to establish a target point like the one in Figure 3.

Moreover, the all world regions are roughly following one path between per capita mobility and economic development; economic growth rates will determine future mobility levels. High growth rates of GDP per capita in primarily far in EU and North America countries will result in more balanced per capita mobility levels among the world regions. According to the U.N and the World Bank and based on a linear relation between per capita GDP and per capita mobility global per capita mobility [see Figure 3] will double by 2020 given an annual increase in GDP per capita of two percent. Despite in light of an increasing world population of 50 percent, world mobility will grow by a factor of three times [217; 218].

It can be also observed that, in light of a world population increasing by 50 percent by 2020, absolute motorized mobility will increase by a factor of three. Most of the projected growth will occur in developing countries, especially in the South Asia, Other

Pacific Asia, and Centrally Planned Asia & China regions, where high economic growth rates suggest significant mobility increases: based on an average annual growth rate in per capita GDP of 4 percent.

Consequently, over the last twenty years, political power and economic has been shifting towards emerging economies. A number of developing countries have become centres of strong growth, raising their shares of global income significantly, which has made them major players in regional and global affairs [see Figure 5]. Furthermore, flows of trade, aid and investment between emerging and developing countries have all intensified.



Source: [242]

Figure 5: World Economic Output over Years, 1990-2014 (2011 GDP per capital $)

It can be observed from Figure 5 that, the one reason developing countries are growing faster than developed countries is that they are younger, still at an early phase in their demographic transition. Where, global demographic shifts are inexorably changing the distribution of global economic activity. Thus, this leads to effective on the behavior of the transport mobility in these regions.

The necessity to keep on the mobility path requires the switch from slower transport mean to more flexible or faster transport systems, given a fixed travel time budget. Consequently, economic development can be considered as being the cause for changes in the model split too. However, the development of modal splits seems to be a substitution process over per capita GDP, i.e., from railways to buses to cars and planes in all regions of the world. It can observe that in Table 3 shows average passenger mobility in the major EU countries for all transport modes from year 2003 to 2008. This data account for the four major motorized transport modes; passenger cars, buses and coaches, railways and tram and metro and also high speed rail transport [247]. In

Belgian, Germany, Spain, the UK, Italy and France, domestic passenger traffic has been more or less flat since the early 2000s. In terms of passenger kilometres, personal transport demand in developing countries is much lower than in developed countries both in total and on a per capita basis. Currently in developing countries the account for just 26% of total passenger car kilometres; and on a per capita basis, total average passenger kilometres in developing countries are only 18% of per capita levels in developed countries [251]. In other words, all other conditions equal, an additional person in a developing country would increase personal transport demand by less than a fifth of what an additional person in a developed country would add to global personal transport demand. Thus, because population growth is concentrated in developing countries, the increment to global personal transport demand from population growth will be relatively small.

Table 3: Avarage Passenger Traffic in the major EU countries (in biliion Pkm the avarage between 2003-2008)

	Belgium	Germany	Spain	France	Italy	UK
Passenger Cars	109.55	861.15	335.54	729.11	724.8	678.5
Buses& Coaches	18.30	66.24	54.41	45.24	101.54	50.42
Tram& Metro	0.94	15.50	6.08	12.50	6.23	9.00
Railways	9.34	76.24	21.85	77.76	49.79	46.47
HSR Transport	0.98	20.8	2.87	44.93	8.42	0.834*
Total Passenger Mobility	139.11	1039.93	420.75	909.54	890.78	785.224

Source: [247]

* Notes; the high speed rail in the UK start in 2004

As a result the demand for speed is directly linked to the GDP and to the individual welfare and the demand for speed is far from saturation. So, the question, it will be needed a new faster modes? Or it will be needed to limit the high speed modes development in relation with population income? For the answer of this question, there is only very limited data on the performance of passenger transport available for inhabitants of developing countries and some of which have been found is not complete. Thus, it will be taken for example the EU countries to demented the relationship between the GDP and the mobility of transport assume that the average total passenger transport in years 2003 to 2008 traveler. Thus in the developing countries the figure of mobility of passenger is less than EU and North America, and this countries behaves like one in OECD, Middle East & North Africa and Sub-Saharan Africa countries from a certain per capita GDP on.

3.5 Summary

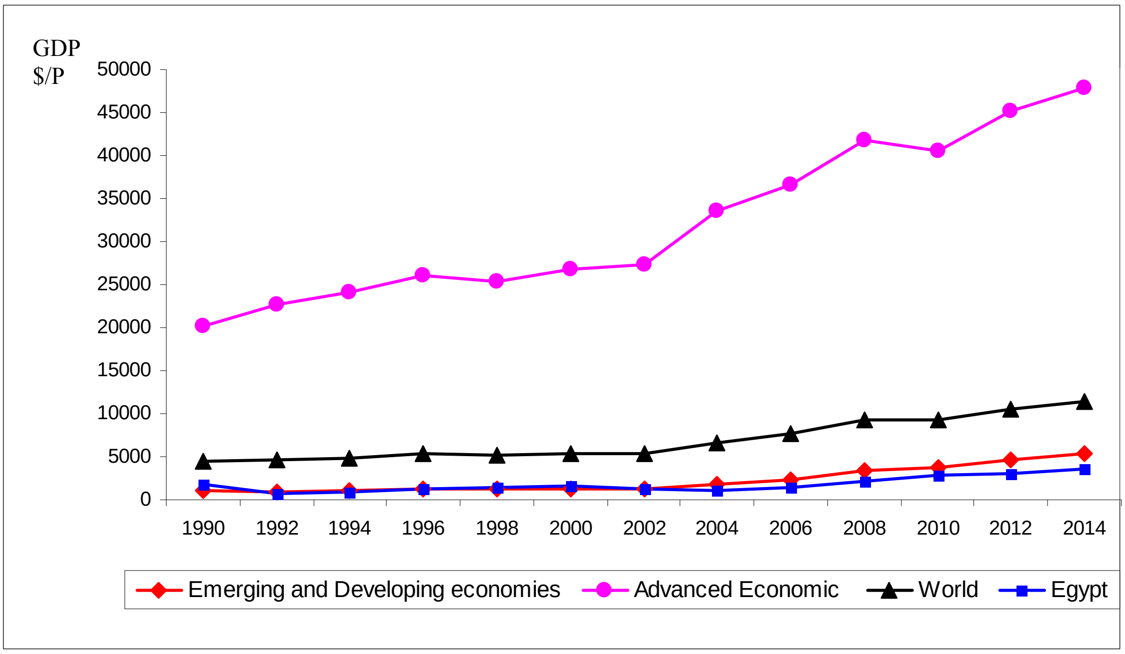
There is no clear definition of the country classification, where there are many divisions of developing and developed countries in the world. The developing country tend to be applies mainly to the poorer country of the world, principally those in Asia, Africa, and South America. Every country in the world is developing to some extent, although the rate of development varies significantly, some countries which may still be regarded as developing, have reached a much more advanced level of development than others. Some are in fact becoming poorer, population is increasing rapidly, but economic growth is slow or even negative, so that purchasing power is diminishing and achievable standards including those of transport sector.

In Figure 6 countries will be reviewed through process that will result in a classification of countries according to: Advanced or developed economic market, Emerging and developing Market and World region in term of GDP per capital. Also it can be division the countries according to the GDP per capita to:

- Developed markets, definition in investing are those countries that are by to be the most developed the. Overall there is high degree of consistency across these markets and therefore less risky (such as: Western Europe, Australia and New Zealand)
- Emerging markets are generally countries that are restructuring their economies and have less accessibility relative to developed markets. Whereas, demonstrate some level of openness and offer a wealth of opportunities in trade, technology transfers, and foreign direct investment. Thus these countries have large economic growth based on change in their economic philosophy (such as: East Asia, Center and Eastern Europe, Latin America, Middle East and North Africa).
- Developing markets or frontier, these types are much lower accessible to foreign investors, and also have lower market capitalization and liquidity than the other developed emerging markets (such as: Developing Asia, South Asia, some Middle East countries, and Sub-Saharan Africa). Consequently, many countries have small GDP but large populations and the larger sample allows a better understanding of the interaction between demographic trends and economic trends. It also means I can compute trends for geographic regions and local neighbourhoods, like South Asia.

In terms of the transport rail sector, there are a number of important differences between the operation of railway transport sector in developing, emerging and developed countries. Income levels are lower in developing countries, conversely than developed countries. This resulting in low car ownership and hence a strong demand for transport rail sector, also the supply of relatively cheap labour, low income also lead to problem of affordability of fares. Also it can be observed in some of the developing countries the poorer shortage of funds is a major problem, while political instability, poor enforcement of laws and regulations, and corruption may have a significant effect on the management of this country especially in the sector of rail transport. Addition to this, it can be noted that in this chapter it can be divided countries in this study depended on the income group. Accordant to the World Bank can be divided counties to: The groups in this classification are: low income, \$955 or less, lower middle income, \$956–3,945, upper middle income, \$3,946–12,195, high income, \$11,196 or more. Whereas the income per capita are the main factor that determines to use the transport mode in developing and emerging countries. **Furthermore, in this chapter has been reached to the first of the bases that are adopted upon in the construction**

of HSR rail lines such as income per capita. It can be observed that from [Table 1 and Table 2] all country that has high-speed railway line the income of people is higher than countries that do not have this system. Because the HSR system ticket may be higher than the convention rail and the bus, this due to the higher construction and operation cost. Moreover, it has be noted that, the countries under study in the term of income per capital are Egypt,[11] India, UAE and Iran, Turkey whereas, these country considered from developing and emerging country



Source: [242]

Figure 6: The Developed of the GDP per Capita in the World

The experiences of the previous countries help in appreciating indicators for the building of High Speed Rail. Parameters that show the need for application a HSR network that already exist. It can be observed that the time and money budgets are stable over space and time and can be used for projecting future levels of mobility and transport mode. The fixed travel money budget requires that mobility rises nearly in proportion with income. Covering greater distances within the same travel time requires that travelers shift to faster modes of transport. The choice of future transport modes is also constrained by path dependence because transport infrastructures change only slowly. In addition, the GDP of the country does not play a major role in the building of HSR. It is certain that a parameter that is vital, but the fact that the GDP is high does not mean that HSR will be built. If it was so, the Gulf countries are rich, but do not have HST .In other words, one of the richest countries in the world would already have HSR (something that is not the case)[12].

Higher speeds have profoundly changed standards of living and lifestyles, not always in a diabolical way. But it will be seen are probably right to suppose that there are limits to the quest for speed. However, that does not mean that personal mobility will level off in the years to come, especially where long-distance mobility is concerned. The

[11] However, despite high levels of economic growth over the past few years, living conditions for the average Egyptian remain poor.

[12] It can be observed that is very interesting to note that at the time these words are written, the President of the United States of America, Barack Obama, has advertise the allocation of $8 billion dollars to high-speed rail projects in 13 major corridors [Source: retrieved on January 28t 2010 from http://www.nytimes.com/2010/01/29/us/politics/29obama.html?hp]

accessibility gains offered by fast transport are such that demand for high-speed rail and air travel will remain strong. The extent of their relative growth will essentially depend on public policy, on the investment that public authorities are willing to finance or not, on the restrictions they might impose on the use of fossil fuels. Mitigation policies will have to be all the more proactive insofar as it will be stilled a long way from reaching saturation point.

Consequently, the rail transport, especially high-speed trains is costly. The fact that trains require heavy ground infrastructure, which is not the case with aircraft, is absence problem for the public finances (it will be returned for this point in the chapter 5 and 6). If higher speeds require substantial investment in infrastructure, where is the money to come from? And to what extent can the cost be passed on to users? Should public transport subsidies, which are the rule in urban areas, be extended to inter-urban travel? As it can be seen, it is not possible to consider the distance/GDP or speed/GDP elasticity without also looking at the question of the cost, for both users and the public purse.

Finally, as the result from the Table 3, the mobility of passenger depends on the GDP per capital. For the period up to 2030, major growth in income is expected in most regions of the world. In the developed world, GDP per capita is predicted to grow by 2-3% per year on average. For many developing countries annual growth rates of 4-5% have been predicted for this period (for example China has had an annual GDP growth rate of 8% in recent years). In this study will be focused on the construction a new HSR line in developing and emerging countries. Consequently, the adopted upon in the construction of HSR rail lines such as income per capita or GDP. It can be observed that from [Table 1 and Table 2 and Table 3] all country that has high-speed railway line the mobility and GDP per capital is higher than D & E countries. Because the HSR system ticket may be higher than the convention rail and the bus, this due to the higher construction and operation cost.

In the next chapter, will be presented and analysis the high speed rail project in the countries [Japan, Germany, France, Spain, and U.S.] including a comparison between them. This countries will be used a basis for the formation of a screening model for HSR, which will follow in the country under study (Egypt, India, Iran). Section 5.3.3 shows details about the important route which can be taken as for example of the application in the case study.

4 STUDY AND REVIEW OF HIGH-SPEED RAILWAYS IN THE DEVELOPED COUNTRIES

The chapter starts with discussing the definition of high speed rail from two standpoints: infrastructure and rolling stock. Then, the various technologies of high-speed rail around the world are presented. HSR systems in Japan and Europe (especially France and German) are discussed. Later, some characteristics of the HSR services, from the points of features and factors affecting high speed rail, will be discussed. This can help the implementations of a new HSR lines in some countries under study. In addition, will be analyzed the high speed rail project in this country [Japan, Germany, France, Spain, and U.S.] including a comparison between them.

4.1 Overview of High-Speed Railways

High-speed rail system is used in a number of countries. In other countries, it is in plan or either under construction. The high-speed train is a means of transportation of great capacity. It has some advantages, therefore, to compare the overall environmental performance of HSR with other competitive transport modes, all environmental impacts must be considered. These are, mainly: energy consumption and the combustion of fossil fuels; air pollutant emissions and noise; and environmental damage like land use and resource depletion. These impacts occur during the construction, operation and maintenance of HSR. It plays a great role in servicing the regional planning and economic and social development. So, high speed rail systems must be developed be able to achieve high financial benefit. Therefore, all beneficiaries, such as private sector, must be involved in operating these systems.

It can be observed that congestion on highways and airports becomes a serious problem as traffic grows. The loss on economy due to this problem has become a significant issue. HSR systems may reduce the level of congestion by diverting passengers to rail transportation. Therefore, HSR lines have a major commitment in time scheduling regarding its potential impact on national, regional and local activities. Because of this, the decisions to build a new high speed lines have to be coordinated by a number of administrative fields and levels to produce the optimum benefits. These fields include national, regional, local and environment administrations .

It has become accepted wisdom that transportation infrastructure is not only necessary for regional economic development, but can actually promote relatively faster rates of growth [22]. In this context, since its birth, high-speed rail system has been always regarded as one of the public infrastructure investments that could develop a regional economy and society. For example, most Japanese people agreed that the construction of Tokaido Slinkiness line was a great success from both operation and societal perspectives.

It is noted that the issue of regional equity became important in nations lives. HSR can help achieving this equity. HSR also looks effective as a boost to regional economic development. People look to HSR as a clear for their own economy. Thus, the construction of HSR becomes a high political issue for decision makers who are supported by regional residents.

High Speed Railways now is one of the most important technological breakthroughs in passenger transportation developed in the second half of the 20th century. At the beginning of 2010 there were about 14,600 km of new high speed lines in operation in various parts of the world. This number includes upgraded traditional tracks. It is expected for this network to reach 35,000 km length in the next 15 years [23]. Presently, there are two high-speed railways technologies exist in the world: steel-wheel-on-steel-rail systems and magnetic levitation (Maglev) systems. Finally, the high speed rail network is devoted to provide high speed services to passengers willing to pay for a lower travel time and a better service.

4.1.1 Definitions

There is no standard definition for HSR. There is no even a standard name; sometimes it is called high speed railway and other times it is called very high speed railway. As HSR involves many complex factors, its definition varies according to used criteria. The International Union of Railways (UIC) High Speed Rail Track Force wanted to reflect this diversity by considering HSR from all the standpoints: infrastructure, rolling stock and operating. There are many common characteristics in high-speed rail systems. Most of them are electrically driven via overhead lines but it is not necessarily a defining aspect as other forms of propulsion, such as diesel locomotives, may be used (such as British HST services). On the other hand, the use of continuous welded rails is a definitive aspect. These rails reduce track vibrations allow trains to pass at speed exceed 200 km/h. For many years, it was normally, in the rail industry, to consider high speed just as a technical concept which is only related to the maximum speed can be achieved by trains running on particular track segments. In all cases, high speed is a combination of all the elements that constitute the established system infrastructure. One of the HSR definitions depends on infrastructure comprises with three different types of lines:

- Separate lines built for speeds of 250 km/h (150 mph),
- Existing lines upgraded to speeds of 200 km/h (125 mph), or
- Upgraded lines whose speeds are constrained by circumstances such as topography or urban development. [24]

Many high speed rails are also compatible with the conventional network. The expression of high speed traffic is frequently used to express the movements of this type of trains on conventional lines with lower speeds than permitted on the new high speed infrastructure. There are some obstacles in this application: in very densely populated regions, the speed is restricted to 110 km/h in order to avoid noise and nuisance. And in case of special mountain tunnel or crossing long bridges, the speed is limited to 160 or 180 km/h for obvious reasons associated with capacity or safety [24]. Finally, in these countries where the performance of the conventional rail cannot exceed the speed of 160 km/h, it is considered as a first step towards a future genuinely high speed service.

Second of the HSR definitions is rail transport in which trains are electrically propelled at speeds exceeding. In high speeds railways, crossing is not allowed in any kind. Also, tracks must be fenced to prevent passing. High-speed trains also must have sophisticated, modern signaling and automated train control systems. High speed railways are very efficient in travelling for long destinations (100 to 500 miles apart).[13]

The network of HSR has been expanded slowly but steadily around the world. It can also be define HSR as a railway system operating daily at speeds of 200 km/h or greater. Table 4 illustrates the features of technical of HSR line and the impact of the

[13] The Federal Railroad Administration and US Department of Transportation definition the high-speed rail rather than a speed-based definition. It recognizes that total trip time (including access to and from stations), rather than speed per se, influences passengers' choices among transport options in a given market, and that travelers evaluate each mode not in isolation, but in relation to the performance of the other available choices.[25]

high speeds on the reduction of rail travel time. Where, the important differences regarding gradients and electric traction systems are observed. Therefore, both French and German railways study and intend to increase maximum running speed of HST up to 350 km/h 350 until 2010

Table 4: High Speed Rail Technologies Around the World

Country	Japan	France	Germany	Italy	Spain	Korea
Line	Tokyo – Osaka [515 km]	ParisLyons [427 km]	Hannover-Würzburg [327 km]	Roma-Florence [260km]	Madrid-Barcelona [522 km]	Seoul-Pusan [412 km]
Max. speed (Km/h)	260/300	300	250	250	300	350
Travel time	2h 30min	1h 50min	2h	1h 35min	2h 30min	1h 55min
Radius curvature $R_{\min}$ (m)	2500	4000	7000	3000	4000	7000
Max. longitudinal gradient (‰)	20	35	12.5	8	30	35
Distance of axes of two tracks (m)	4.2	4.2	4.5	4.2	N.A	5.0
Superelevation (mm)	200	180	150	160	N.A	N.A
Dedicated route[14]	3042 km	2106 km	1663 km	1318 km	3823 km	412 km

Source: [169]

4.1.2 High Speed Line Framework

1. High Speed Rail Line Option

There are two options to developing high speed rail service; the option chosen determines the level of high speed service that can be attained:

- Upgrading existing track, signaling systems, and equipment (e.g., tilting trains) to enable trains to travel somewhat faster over the existing rail network, or
- Building new rail lines enabling trains to travel at much higher speeds than are possible over the existing rail network, which is shared with freight rail.

The advantage of upgrading existing track is its lower cost; one estimate puts the average cost of such upgrades at around $7 million per mile (about $4.37 million/km in 2007) [26]. One limitation of that approach is that the existing network usually has many limitations dependence on the train speed curves, at grade road crossings with railway, including electrifying the route and replacing a bridge, etc. that limit the potential speed improvements

Conversely, building new rail lines makes much higher speeds possible up to 200 mph (320 km/h) or more. One limitation of that approach is the cost, which is estimated to average $35million per mile (about $21.9million/km in 2007) [26] or more in densely populated areas or difficult terrain.

The problem of a new HSR lines is the higher cost of construction in most countries. Indeed HST trains in the Japanese, French, Spanish and German all use a newly constructed track on the sections where high speed is achieved, which translates into

[14] Dedicated route here included both the HSR rail line in operation and HSR rail line under construction in all cases [Table 1; 2]

high construction costs. So far, the demand on many routes is not high enough to justify the cost of building new tracks that allow high-speed operation. This problem was resolved by the model *train tilting* of HST, but at the price of lower speeds. To allow higher speeds on conventional lines with tight curves, the train tilts as it passes through curves. The introduction of tilting trains, which lean inside on curves to enable higher speeds, this is a railway technology which was seen briefly here in the early 1980s and is now becoming standard technology for new high-speed and regional-type railway rolling stock throughout the world, with increasingly widespread use in Europe, Japan.

By simply *tilting the train* in tight radius curves (although by a sophisticated computerized mechanism), the discomfort passengers feel from the centrifugal force as the train goes at high speed through curves is solved. The bogies remain firmly attached to the rails while the body of the carriage tilts, and so compensates for centrifugal force [249]. This principle is adopted by many countries as a cheaper alternative to the TGV and Shinkansen models of HST. The Swedish X-2000 and the Italian Pendolino (ETR-450) are examples of HSTs running on conventional rail using the tilting mechanism, thus avoiding the price of expensive new tracks, but reaching maximum speed of only 210 kph (X-200) or 250 kph (ETR-450). Today, a tilting mechanism is also used on TGV trains, like the TGV Pendulaire, which can reach a maximum speed of 300 kph [5].

2. Components of a High Speed Rail System

High speed rail is correctly viewed as a system made up of several components, including the train, the track, and the signal and communications network. High speed rail can use either conventional steel wheel on steel rail technology, or magnetic levitation (in which superconducting magnets levitate a train above a guide rail), commonly referred to as maglev.

3. Track

To make high speed operation possible, rail track must be substantially flat and straight, with shallow curves and gentle changes in elevation. As train speeds increase, the risk of crashes at intersections where roads cross the rail line (at-grade crossings) increases, so safety dictates that higher speed tracks not have any at-grade crossings. This is the standard to which new high speed lines in other countries are usually built. The result is the rail equivalent of the Interstate Highway System, allowing trains to operate at high average speeds without risk from crossing traffic. Such lines are usually restricted to the use of high speed passenger trains, so that the trains do not conflict with slower passenger or freight trains. Also there are many features of high speed lines are as follows:

- Adoption of standard gauge (1435mm) by all systems currently operating;
- Use of either traditional ballasted track with sleepers or slab track where the rails are fastened to a continuous rigid concrete slab. Both types use standard flat bottom rail (typically 60 kg/m). A layer of resilience normally needs to be incorporated in slab track between the rails, base plates and concrete slab to reduce the transmission of vibration into the ground;
- Slab track is significantly more expensive to install but has lower ongoing maintenance costs. To date, slab track on high speed rail has generally been limited on high speed lines to some long viaduct and tunnel sections where maintenance access is more difficult and where there are unlikely to be ground movements or settlements (which are difficult to correct with slab track). A number of railway

systems, including Japan, Germany and Netherlands, have been developing and testing various designs of slab track on HSR for a number of years and some have long sections of earthworks supported track slab in use.

- Associated civil engineering support structures (e.g. bridges, embankments, etc.) are similar to those found on conventional railways, but the main differences being the greater width of formation (to accommodate tracks spaced further apart and with larger side clearances for aerodynamic reasons), and much larger tunnel cross sections to avoid problems with pressure shock waves (only one track per tunnel for the speed ≥300 km/h). In populated areas, earth bunds or fences are commonly used to mitigate the transmission noise of high speed operation;
- Station design follows standard railway practice, the main difference being the avoidance of platforms on lines used by trains travelling at high speed. This results in through stations where only some trains stop, having platforms located on loop lines. In additional, the noise protection and HSR line should be built separated without mix freight transport.

4. Rolling Stock

There are many types of trains depending on where trains are running and what they carry. The most useful and usual type of trains is electric trains. Other than this type of trains, you can find diesel trains and steam locomotives. But there are two main types of modern high-speed trains

1. Steel wheel on steel rail (SWSR) technologies with or with out tilting capability and also they are basically ordinary trains with powerful engines as exemplified by the TGV, ICE3, Adtranz Talgo 350 and other rolling stock products in the range 160 km/h to 350 km/h. The key trend in SWSR rolling stock technologies has been the integration of the fundamental characteristics of maximum speed, acceleration, braking, multiple power systems, onboard power, bogie suspension, and tilting capacity. Today, and in the future, manufacturers will supply rolling stock to suit the operator's specification that, in turn, will have been developed to respond to the particular geography, railway operating environment and commercial conditions in which it will operate, see also section 6.3.4.2.
2. Maglev trains are new and much less common. These trains form several prototype high-speed designs that have been built and tested over time. Various countries use any of these types of trains depending on the system preferred by their local transportation planners, or the feasibility of contracting between public and private entities involved in high-speed rail transit. A brief discussion of the two types of high-speed trains would help in providing the technological background of high-speed trains.

All high speed trains currently operation on high speed rail lines use electric traction, and most recent HST designs have commercial speed of around 300 km/h, trains are operated as fixed formation units with driving position at each end .Same trains can operate in multiple. Trains have also lower axle loads than for conventional locomotive hauled trains to reduce dynamic forces on the track at high speeds. The lower axle loads are achieved through either having power cars at each end of a limited number of trailer cars (e.g. German ICE), by combining power cars with powered bogies at the ends of the fixed set of intermediate trailer cars (e.g. some TGVs), or by distributing the powered axles throughout the train (Japanese Shinkansen technology), and also limited axle load about (11 to 17 tons for 300 km/h)

There are two concepts for the intermediate trailer cars, articulated on shared bogies (TGV practice) or conventional independent cars with two bogies (e.g. ICE). Train body widths vary significantly between different countries, with French single deck TGVs being around the same width as UK classic trains (about 2.85m wide), German ICE being similar to the wider European UIC load gauge (about 3m wide) and the Japanese Shinkansen employing cars up to 3.38 m wide. Although some railways operate a proportion of tilting trains on high speed lines all the design of all high speed lines is based on achieving the maximum operating speed without the need to use tilting train technology. The different needs and special characteristics of the different countries pursuing the development of HST operation led to the evolution of different models of HSTs. The Japanese Shinkansen, which was the first modern HST in operation, can be considered as the base model for HST. Subsequently, three other models have evolved. There are many types of HST in the world, but will take some type such as, titling trains, TGV, ICE, and AVE and so on.

4.2 High-Speed Rail Technology

4.2.1 High Speed Guided Surface Transport Technology

High speed guided surface transport systems divided fall into two general categories the first one is, based on conventional railway technology where trains run on a pair of steel rails using flanged wheels. Systems with operating speeds in excess of 250 km/h are in service in a number of European countries and Japan and are currently under construction in other European and far Eastern countries. The current maximum commercial operating speed is 300km/h. All systems with speeds above 250 km/h currently use electric traction. Second category adopting an alternative means of guidance and support, for speeds of 250 km/h and higher the only alternative systems currently under development/ available are magnetic levitation (MAGLEV) systems where vehicles are supported and guided by magnetic levitation from a specially constructed guide beam. The lack of direct contact between the vehicle and beam results in a reduction in friction and component wear compared with a conventional railway. Propulsion is achieved by means of electric linear motors incorporated into the guide-way and commercial inter-city operating speeds of up to 500 km/h [27] are claimed to be possible. The technology has been developed independently in Japan and Germany where test tracks have been operating successfully for a number of years.

4.2.2 Conventional High Speed Rail Technological

In order to, the firs system category can either be totally segregated or integrated with an existing rail network. Segregated systems allow freedom of choice in key parameters such as track gauge, vehicle size, train length and propulsion systems, but the cost new HSR is higher. For non-segregated systems, the specification of these and other technical features will be heavily influenced by those for the existing railway system due to the need to run on both new high speed and classic rail networks. The high speed rail systems in operation to date include both segregated and non-segregated solutions.

HSR system share the same basic engineering rules with conventional railways both are based on the fact that rails provide a very smooth and hard surface on which the wheels of the trains may roll with a minimum of friction and energy consumption they also have technical differences. For example, from an operational point of view, their signaling systems are completely different: whereas traffic on conventional tracks is still controlled by external (electronic) signals together with automated signaling systems, the communication between a running HSR train and the different blocks of tracks is usually fully in-cab integrated, which removes the need for drivers to see line side signals. Similarly, the electrification differ, since most new high speed lines require at least 25kv to achieve enough power, whereas conventional lines may operate at lower voltages. Additional technical dissimilarities exist regarding the characteristics of the rolling stock and the exploitation of services.

Different countries have developed high-speed railway systems in different ways. Such as Japan has developed an independent high-speed railway system by dependence standard gauge track instead of narrow gauge, high-speed trains (HST) run only on this new purpose built lines. In France, HST is allowed to run on the existing railway network. By the end of 1994, the length of commercial service HST on existing lines (3424 km) was more than that on new high-speed lines (2316 km). Several countries have developed tilting trains that operate on conventional lines.

In Figure 7 explain the relationship between the high-speed rail track and the traditional track, there are four different exploitation models types of this relationship and all these differences suggest that more than speed it is the relationship of HSR with existing conventional services and the way in which it is organized the use of infrastructure what plays a more relevant role in the economic definition of high speed services. Techik und System der Magnetschellbahn Transrapid

1. The exclusive exploitation model is characterized by a complete separation between high speed and conventional services, each one with its own infrastructure. This was the model taken by the Japanese Shinkansen.
2. A mixed high speed model high speed rails run either on specifically built new lines or on upgraded segments of conventional lines. This type also consists of network of high speed lines used exclusively by high speed trains but the trains can be also run on conventional lines. This corresponds to the French model, who's TGV.

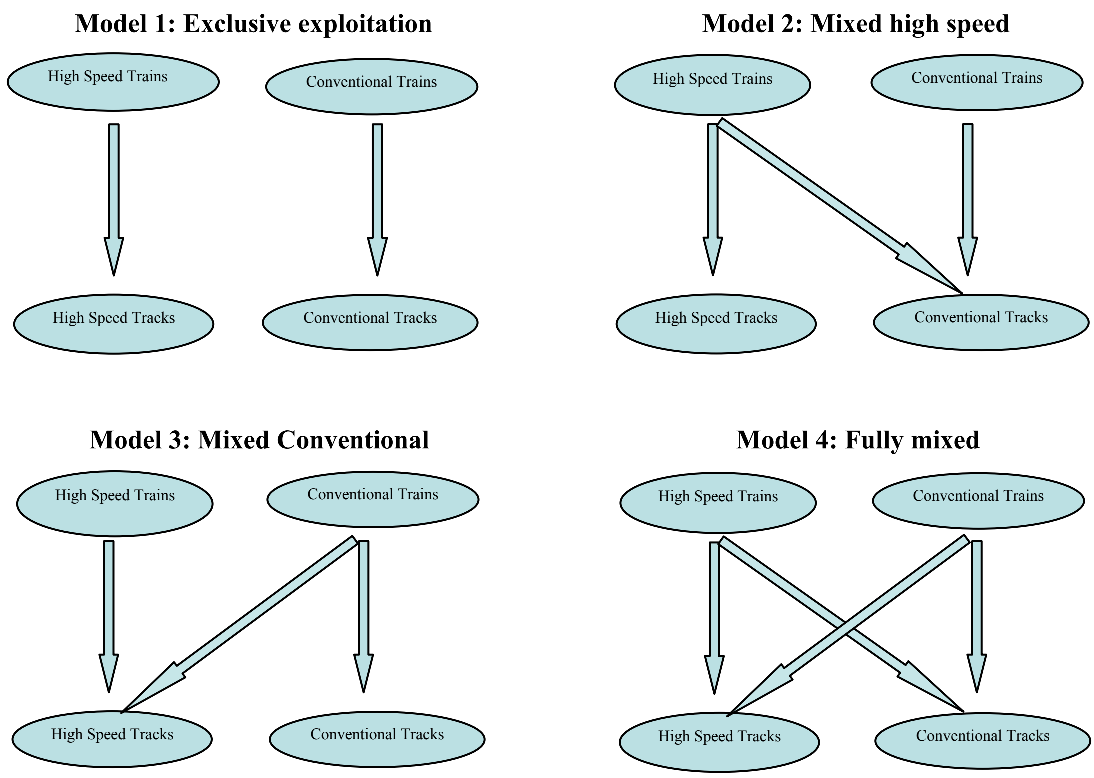


Figure 7: The Model relationship between HSR and conventional services

3. A mixed conventional system, used in Spain, in which AVE trains are run at high speeds on new, standard gauge lines [1435mm], while others [ALVIA] run on both

the new infrastructure and Spain's older, non standard gauge of [1668mm], using the Talgo gauge changing technology.

4. Finally, a fully mixed system (such as the German ICE trains, and Italy's Rome-Florence line), in which both high-speed and conventional trains, including freight trains in Germany, can utilize the infrastructure provided.

From this reasons, choosing the particular exploitation model is a decision affected by the comparison of the cost of building new infrastructure versus the costs of upgrading the conventional network, the definition of HSR immediately becomes not only a technical question but also an economic one, where there are three additional factors contribute to the definition of HSR in economic terms:

- The first one is the specificity of the rolling stock, whose technical characteristics must be adapted to the special features of high speed
- The second one is the public support enjoyed by most HSR undertakings, particularly in Europe where national governments have already compromised huge amounts of funds in the development of their high speed network during the next decades. At the supranational level [61].
- The third reason lies on the demand side for HSR services. Railways operators in many countries have widely acknowledged their high divisions as one of the key factor in the survival of their passenger rail services

4.2.3 Magnetic Levitation (MAGLEV) Systems

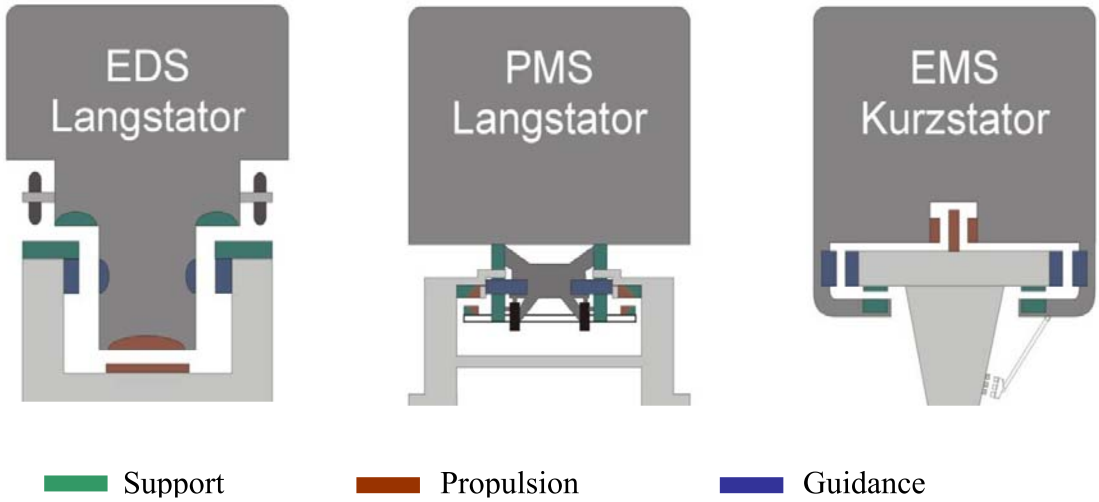
The second type of high-speed train is known as the magnetic levitation train (or Maglev train). If the tilting train model of HST is considered a downgrade from the Shinkansen and TGV models, mainly in terms of speed, the Maglev model of HST is an upgrade. Magnetic levitation technology was first tested in the 1970s, but it has never been in commercial operation on long-distance routes. The trains do not have wheels. They use huge magnets to lift the trains above the tracks. Because they do not actually touch the ground, these trains can travel faster than the traditional high-speed train's. While a conventional train drives forward by using friction between wheels and rails, but the Maglev train replace wheels by electromagnets and levitate on the guideway, producing propulsion force electromechanically without any. There are three types of levitation technologies:

(1) Electromagnetic suspension (EMS); Magnetic fields inside and outside the vehicle are less than EDS; proven, commercially available technology that can attain very high speeds (500 km/h); no wheels or secondary propulsion system needed. The separation between the vehicle and the guideway must be constantly monitored and corrected by computer systems to avoid collision due to the unstable nature of electromagnetic attraction; due to the system's inherent instability and the required constant corrections by outside systems, vibration issues may occur.

(2) Electrodynamics suspension (EDS); Onboard magnets and large margin between rail and train enable highest recorded train speeds (581 km/h) and heavy load capacity; has demonstrated successful operations using high-temperature superconductors in its onboard magnets, cooled with inexpensive liquid nitrogen. Strong magnetic fields onboard the train would make the train inaccessible to passengers with pacemakers or magnetic data storage media such as hard drives and credit cards, necessitating the use of magnetic shielding; limitations on guideway inductivity limit the maximum speed of the vehicle; vehicle must be wheeled for travel at low speeds.

(3) Hybrid electromagnetic suspension (PDS); Onboard magnets and large margin

between rail and train enable highest recorded train speeds (581 km/h) and heavy load capacity; has demonstrated (successful operations using high-temperature superconductors in its onboard magnets, cooled with inexpensive liquid nitrogen. Strong magnetic fields onboard the train would make the train inaccessible to passengers with pacemakers or magnetic data storage media such as hard drives and credit cards, necessitating the use of magnetic shielding; limitations on guideway inductivity limit the maximum speed of the vehicle; vehicle must be wheeled for travel at low speeds (as show in the Figure 8).



Source: [133]

Figure 8: The Type of Maglev Levitation

There are electromagnets attached to the moving railcar, but they are positioned facing the underside of the guideway's steel rails. Maglev trains do not have engines[15], and the railcar is interlocked with the guideway so there is no risk of derailment. This physical configuration also allows the railcar to accelerate and decelerate at ease, move at steep inclines and tight curves, and to produce very little wear and tear on the track itself (in contrast to conventional train wheels). Rather, magnetic fields created by the electrified coils in the guideway walls and the track come together to propel the train. The guideway is a magnetized coil running along the truck, and repels the large magnets on the train's undercarriage, thereby allowing the train to levitate above the guideway. Once the train is levitated, power is supplied to the coils within the guideway walls and creates a magnetic field that pulls and pushes the train along the guideway. In this way, Maglev trains essentially float on a cushion of air and, given the aerodynamic design of the train, helps eliminate friction to allow these trains to reach very high speeds.

The Maglev train has been the central focus of technological research and application on modern high-speed rail transit systems for many years. In particular, Maglev technology has received the most attention, particularly in North America, considering its attractive feature of greatly reducing its environmental impact on surrounding communities. Some nations utilizing Maglev technology include Germany and Japan. Japan has developed the High Speed Surface Transport (HSST), while Germany has developed the Transrapid system [28]. Most recently, Japan has been promoting a

[15] The Maglev train receives its propulsion force from a linear motor, which is different from a conventional rotary motor; it does not use the mechanical coupling for the rectilinear movement. Therefore, its structure is simple and robust as compared with the rotary motor.

newer version of the Maglev known as the superconducting Maglev technology. This technology is aimed at producer faster trains with the convenience of greater comfort and functional efficiency. The problem about maglev trains is that they are expensive to make. Although they are much faster, maglev trains will probably not replace the traditional high-speed trains until they become cheaper to build.

4.3 Features of a high speed railway

With any new form of transportation technology, there are features, advanced and disadvantages to its implementation on a mass scale. Generally, there are many steps will be taken, when we speak about the features of high speed rail, these steps depended on the planning and alignment element for HSR. The most of important features of the HSR are:

- Level crossings are the most common reason for accidents on railways, where road vehicles break down or get stuck on the railway and the train crashes through them.
- All high speed lines are fenced off. Indeed in all railway lines are fenced off anyway, however high speed lines are fenced off for obvious reasons, to eliminate the risk of any animal or people wandering onto the railway line.
- Foundations for high speed lines are much deeper than conventional railways. Usually a layer of concrete and asphalt is put down (like a road) and then the ballast is put on top. This is to try and stop movements in the ground from affecting the alignment of the railway.
- The wide spacing between the lines is important because when two trains pass each other the speed difference can be as much as more then 300km/h . If the two trains are too close together this causes at first a burst of air pressure when they first pass and then a drop in pressure during the coaches. Although this isn't enough to push the trains off the track, repeated stress on the windows may cause fatigue and they may break eventually. So for safety reasons two tracks in each direction are placed further apart than on normal lines.
- Gentle curves are a key in what high speed lines are about. Tight curves on HSR lines have a radius of about 3 miles or 5 km. Curves are also banked up a lot more than on conventional line. This is because slow trains will not run on them and it is extremely rare for a HSR to come to a stop because of a signal. The degree of banking is calculated to exactly balance centrifugal forces at running speed.
- Perhaps surprisingly greater gradients are allowed on high speed lines than conventional railways. There are two key reasons for this, first of all modern high speed trains are expensive for constriction a new line for this reason the HSR use the conventional railways track. The second reason is that the faster a train travels the less it will slow down for the same rise in height. This is because as it is going fast it takes less time to climb the hill and so gravity has less time to act to slow the train down.
- Generally should be trying and avoid tunnels on high speed lines as much as possible. This is because when a train enters a tunnel at speed it causes large pressure changes. This can be painful and harmful to passenger’s ear drums. A solution was thought to pressure seal trains. However with very high speed trains (300 km/h), the pressure changes can be so large it can shatter the windows, particularly when two trains pass in opposite directions in a tunnel with a closing speed more then 300 km/h in a confined space.

4.4 Analysis of High Speed Rail Projects in Europe and Other Countries

In the worldwide, the train passenger has a very different impact within the transport market. Despite, the ratio between rail and individual transport of passenger traffic in Europe about 1 to 10 the proportion of rail travel in the U.S. is 1/150 of those private individual transport[16][29, p. 6]. In the following points in this chapters are illustrated some of examples for several countries and fundamental differences in the field of long-distance passenger transport, also to interrelation of the different conditions, different approach on the public policy, railway company and the success of the objective measure of the situation. Therefore if successfully implemented policies to improve the position of railway transport (HSR system), finally it can be transfer this system to other countries (such as Egypt and developing country).

It can be observed an international comparison of travel behavior can not be made between countries without taking into account the specific cultural, population density and geopolitical situation. For examples there are some factors affecting on the average distance traveled based on the volume and population density of the country, the density of motor vehicles of the private transport and historical integration between regions, but also the costs referred to the use and quality of roads. Since Russia and China have a very developed system of cross-subsidization within the railway sector [30] however the considerations on the efficiency of the economy rail transport can be difficult. In addition, the long-distance for public transport is understood by masses in these countries in planning and operation of railway projects, also this from responsibility of state. The general economic benefits, not the economy has in the construction, operation and design of the first fare priority. Therefore, it will be compared between the developments in European countries and also Japan, China and USA. In Figure 28, page 113 gives an overview of the main high-speed projects in the countries.

European countries have implemented high-speed rail systems beginning in the 1970s. High-speed travel is an excellent solution for Europe because of the relatively short distances between its national capitals (from 200 km to 1,000 km, equivalent to a maximum travel time of only 4 to 5 hours during the day per TGV or ICE in 1993) [31]. France, Germany, Sweden, Italy, Spain, and Switzerland have implemented their HSR systems. France and Germany can be regarded as the representatives of the longer history and technology, although their approaches to high-speed rail are not identical. Following are brief accounts of high speed rail networks in selected Europe and other countries; except where otherwise indicated, these countries have high speed lines that currently enable trains to operate at speeds of 250-300 km/h or more.

4.4.1 France

Egypt like France, where France has always been a central government, this centralization is not only important for political decision processes, but also for transportation route. Therefore, all major transport axis leading to the capital Paris, the number of inhabitants in Paris is 2.14 million (the total inhabitants in greater Paris 10.4 million), where the political, economic and cultural center of country. Marseille is the second largest city in France with 800,000 inhabitants, and center of the Mediterranean. It can be also noted that, only six other city in France have more than 250,000

[16] Conversely, the ratio in the freight transport to rail is: In Europe is again in the midfield (traffic performance / rail transport services road: 7 / 40, or 15% of the modal split), in the U.S. ton-kilometers by rail more than by road (50 / 40, equivalent to 55% of the modal split) and in Japan, the transport of fright by rail is to be almost negligible (3 / 40, or 7% of the modal split) (see [29, p. 6]).

inhabitants.[17] There are no cities at a distance of more than 700 km from Paris. The population density in France is much higher than in Egypt.

These facts can be a great advantage in the design of high-speed rail links. The sparse population of rural areas is not only at the operating side, where the opportunity of the stop during transport on long distance can be a few. It is also noted that France has less mountainous region, geographically the route runs through flat territory so that there are fewer curves on the route. For example all curve radii on TGV-SE are over 4,000 meters and 4,500 meters for TGV-Atlantic except for the run around Tours, which has a radius of 3,250 meters. This made it easy to expand TGV network throughout France economically. Accordingly, all the new high speed lines in France used the existing route planning without needed to high and very high operating speeds. Furthermore, it has been shown that under the central administration of France planning and construction of railway lines can be completed much faster, but also involved parties countries and communities must be integrated in all stages of planning approval thus make their rights clear.

The French Train TGV began operations in 1981 with the opening of the Sud-Est (South-East) line connecting Paris and Lyon. TGV-Atlantic was added in 1989 with operations from Paris to Le Mans, and the TGV-Nord line between Paris and Lille started services in 1993. As of 1996, the TGV route was in service, along lines that primarily radiate out from Paris to other parts of France [32]. Before the construction of TGV, between Paris and Lyon, this line was most important transport path in France, however, this lines was truly one of saturation and has produced a rail traffic condition for which a separate high speed passenger train line offers the only practical solution. Therefore, the importance of this corridor in France is: There was never any doubt about the genuine necessity for the first TGV line in France. It creates out of the traffic saturation of the Paris-Lyon rail artery. This, make the most important transport path in France, runs from Paris to Marseille via Lyon. Investment in this major French transport corridor, which served about 40% of the French population, was prompted by severe congestion on the existing rail route [33].

TGV Sud-Est line connects the two strongest economic regions of France, Paris and the Rhone Alps region. Like the Japanese Tokaido Shinkansen line, just two years after the successful operation of the Tokaido line in 1966 the first study of a new HSR development in France was created. This TGV-SE has been an ideal route for a high speed line and has made a great success. The success of the TGV system is makes in very high traffic volumes at the speed routes [see Figure 28, page 113] and it can be noted that, in some cases significantly proportions of railways in the modal split it is higher. Moreover, total rail passengers on the corridor increased from 12.5 million in 1980 to 22.9 million in 1992 [34]. It is noted that the largest increase in ridership after the introduction of high-speed rail services between Paris and Lyon was in business journeys related to the sale or purchase of services. The dominant share of the air-rail travel market in several of the high speed corridors, taking over 90% in the Paris-Lyon market and approximately 60% in corridors where the TGV travel time is around three hours [35]. While total business journeys increased 56 percent, those related to the trade of services jumped by 112 percent [36]. It has to some extent the character of a long distance commuter line, which means that many daily return trips have been made by businessmen between two large cities. [34]

[17] In contrast, Egypt is containing into 29 governorates, and there are 27 cities in Egypt with more than 250,000 inhabitants.

Despite, the financing of the TGV Est it is consideration the first railway project to be financed by the France region and the European Union. Total capital investment in railways, including public contributions in France in the period (1991-2000) € 2 billion annually [30, P.19] these are estimates based on national government. This can be only limited, where it can be built of the HSR line cheaper in France, this led to the shorter planning, construction times and lower population density in rural area and predominantly flat topography. And as in Japan the planning or project development continued through a major reorganisation of French National Railways (SNCF, in which the infrastructure management and train operating functions were separated in 1997, though both remained in the public sector, and the introduction of a broader funding regime for new projects, including the participation of the private sector.[18] Unlike the Tokaido Shinkansen, the Paris-Lyon was the product of an integrated infrastructure and train design. It is noted that, the introduction of high-powered, lightweight trains, this led to enable the engineers to build a straight double-track route traversing the contours, thereby minimizing earthwork costs. As a result the construction cost was lower than with most other countries projects, because, there are no tunnels and very few valley spanning viaducts were made [36]. Where the cost is at around $4 million per kilometer, and even the more expensive French projects cost only $10-15 million. [37]

4.4.2 Germany

German high speed rail thus far the network , based on its ICE train, has been mainly aimed at overcoming particular bottlenecks in its current network. Conversely, with the French approach which has largely constructed a parallel network, using the existing network for access to the major cities where new construction would be difficult. In Germany, train speeds were restrained by the limitations of the infrastructure and by the railways traffic characteristics, with a mixed operating system of freight and passengers on the main network. The first high speed rail line in Germany was opened in 1991, and three a new line are currently in service, in addition, two lines under construction.[19] Germany's high speed trains also have more stops than those of France, whose system emphasizes connecting distant city Pairs with few intermediate stops. These considerations have led Germany to put more emphasis on upgrading existing rail lines to accommodate higher speed service, and less emphasis on building new high speed lines. [34] The German new lines have been much more expensive than the French lines. At the same time the more limited impact of the ICE, in comparison with that of the TGV and Shinkansen, this means that the pay-off in terms of traffic generation has not been as great as in Japan and France. Because, the mountainous terrain, and the requirement to build sections to easier gradients so that freight could also use the new infrastructure, made construction costs comparatively high. In addition, expenditure was affected by Germany growing environmental awareness and concern, and by a more complex, decentralised political milieu. One result is that Germany's high speed trains

[18] France's infrastructure operator has a limited capacity to invest. The organisational separation of infrastructure and operating, which was introduced elsewhere (e.g by Italy in 2000), was a response to EU directives 91/440 of 1991 and 95/19 of 1995.

[19] The new line under construction is: München – Augsburg completion in 2011, Erfurt- Leipzig/Halle in 2015, and Nürnberg – Erfurt in 2017. The new line in operation is: Cologne–Frankfurt , Mannheim–Stuttgart, Hanover–Würzburg, Karlsruhe–Basel and Hanover–Berlin high-speed railway [This line partially new line] like Nuremberg–Munich. There are also some HSR lines in Germany, this involving a mix of upgrading and new construction.

have longer average trip times than do those of France over comparable distances. However, it is noted that, the newly built ICE is not dedicated to high speed passenger trains. It is designed for multi-purpose use, by the very high speed ICE trains at 250 km/h, by traditional IC trains running at 200 km/h and by freight trains running at lower speeds, but requiring more expensive engineering. [34] It can be observed that, the impact of the high speed rail in Germany it is difficult to completely determine, as in France. In the first five years of operation ICE passengers more than doubled from just over 10 million to nearly 23 million and ICE traffic accounts for 28 % long-distance passenger revenues. **Thus, in most instances Germany, unlike France or Japan, did not build a separate HSR network, but rather focused on a phased approach to HSR implementation by systematically upgrading existing inter-city rail lines for multi-purpose freight and passenger use, with the exception of the line between Frankfurt and Cologne [179; 180]**.

Total capital investment in railways, including public contributions in Germany about € 7 billion annually in period 1991-2000 [30, P.19], although in the same period in France created new lines to increase the length than those in Germany. It can be noted that, Germany considered is one of the largest European countries investment in railways. Therefore, Germany considered the major repairs work as an investment to keep the level of investment by DB AG net at a high level. An overview of the magnitude of the cost of the rail network in Germany it is divided into as the following.

- The operating mode includes all activities related to operation of the infrastructure, activities in signal boxes, control centers investment is estimated at € 2.5 billion.
- The existing network investments consist mainly of replacement investments, the annual demand for replacement investment alone is estimated at DB AG at € 3.5 billion.
- Maintenance and replacement function together to maintain the infrastructure, and they are also grouped under the term Investment new construction / upgrading investment is estimated € 2.7 billion [38].

For the price levels in the long distance passenger traffic for the railways in the long distance in Germany it is found about € 0.09 passenger km [122: 118], where this price consider is the average price between each of the country (Spain, USA and Japan). Furthermore, the average price in Switzerland was about 0.13 € / passenger km [119].

4.4.3 Spain

Spain which is characterized by mountainous topography and large distances between the main major cities in relation to European countries, this lead to result of the large travel distance, this lead also to back the air travel as the most appropriate mode of transport in long distance services. Actually, the economic potential in Spain is still less than the average European country; however, there is a strong demand on the national air transport.[20] The railway in this time played the secondary role in the long distance. For the medium distance, it can be used the bus, where is as a cheap alternative to flying. Increasing motorization in the period 1982-1992, and there are no improvement of the train connections for passenger that could be achieved by lack of the train 50%

[20] Spain has a particularly high density of air travel, with each regional capital having its own airport. In the main route between Madrid, Barcelona and Sevilla, Valencia and Bilbao in the last 1970, the travel price of the airplane is higher twice on the share of the railway. [39] The cost of air travel in Spain in that time is already under the average of European. Also today, the air traffic in Spain is very high: Furthermore Egypt and Spain have a ratio of the population of 2 / 1, and the ration of the number of air passengers is (6.7 / 55.2 million) [4, P. 710]. The reasons for this difference leads to importance of the air transport in Spain, conversely, Egypt used other transport mode (road and rail).

[40]. The Spanish government decided in late 1988 for the construction of an entirely a new high speed line Liniea Alta Velocidad (LAV) mainly to ensure the new service was in operation by the Sevilla exposition in 1992 between Madrid and Seville. It can also be noted that the new system is not a compromise, but the new system is a complement to the already existing railway. Like French routes, this overcomes capacity problems on an existing route and also achieves a essential reduction in distance by taking a more difficult, but it is more direct route. Spain's conventional rail network was built using a wider gauge 1676 mm. High speed rail network is built to the international standard gauge 1435 mm, with new power system with 25 kV, 50 Hz alternating current due to the section of the line. The new type of train uses is the TGV Atlantique, and based this on the AVE S-100 due to high speed by marrying French traction technology with German signaling [34]. As in France, the easing of capacity constraints was a major stimulus, but the new AVE service produced a dramatic reduction in journey times and the impact in terms of traffic generation and abstraction from the airlines was large and instantaneous. Therefore, reducing the travel time from 6 ½ to 2 ½ hours and this leads to increased the market share of rail in this ratio from 16% to 51% has more than tripled. At the same time, the market share of air traffic fell from 40% to 13% and thus only slightly more than 1 / 3 of the original value [41]. The traffic growth between 1993 and 2003 increase the total number of travelers on the new line from 3.25 million passenger to 6 million passenger with increasing by 84%, at the same time the number of passenger increased over long distances on the conventional track by 18% from 10.7 million to 12.6 million, also it can be observed that, the volume of traffic in the Nord corridor to fell off again by 75 % [40]. It can be observed that, to make the achievement of modal split in Europe; it will be excellent with travel times on routes with a length about 400 and 800 km. The railway can be attractive almost all the passenger who can not carry, for practical reasons (luggage, physical disability, etc.), on the motor vehicle, or aircraft, because the rail can carry a connecting flight at their destination. It can be noted that, the increase the total traffic volume of approximately 1/6 to 1/2 from total traffic volume of the proceeds of the track.

Also, with the planning of the major high speed rail project in Spain, between Madrid and Barcelona, this planning was to change the modal split rather than more expansion of capacity reasons. Therefore, the scheduled of travel time is 2:30 hours for 630 km is the positive challenge to air transport. The corridor Madrid- Barcelona is the heavily used corridor in Europe. This led to the service connects by the air in the capital with capital Catalonia need to at least every 30 minutes. The reservations also are not necessary and to reduce the travel time, there are simplified security checks. It can be observed that, the attractive of air transport before construction of the new high speed line is possible to reach a total journey time of less than 3 hours from city center to city center.

The development of HSR network in Spain will be continued with unabated speed. In 2006 the Spanish government will be spend about € 83.5 billion for the development of HSR network and infrastructure plan in the period of 10 years.[42, P. 340]. By the 2010 Spain consider the worlds largest high speed network [43, P. 94]. Spain planning about 9000 km new line, and about 90% of the population are not stay lass than 50 km from the station of HSR network [42, P.340]. The financing of the infrastructure is 60% of the national budget and the rest is of the private capital and the garnet of other public [44, P. 86] the vehicles will be paid by the operating RENFE. The success of the development numbers of passenger is the right system. The utilization rate on the Madrid - Seville is 75% [45, P.416]. As in France is set by a differentiated pricing system to a uniform loading of the trains. For advance bookings for a specific train heavy discounts on the internet can be achieved, but also is a free ticket with no specific train - but then the absence of applicable discounts - available. The success of the Madrid-Seville corridor is partly a result of its pricing policy, with affordable tickets that help to keep demand high and trains full. The 471 km journey takes 2 ½ hours, and costs between € 0.076 and € 0.124 per kilometer prices. [64] Finally, it is to be rail competing offer. There must be the time of travel to ensure that the journey time is not on that of the mode of air transport. For the result of this in [40] the passenger prefer rail to air traffic, if the travel time by rail is not more than 20 % over that is by air.

4.4.4 USA/Canada

In North America, the basic requirements for an economically appear to be operated high speed long distance it is very bad: In addition to the polycentric orientation of the entire U.S. and Canada with large metropolitan areas without a center, and also a low price level of all modes of transport, and a very high level of motorization, this is due to the fact of the entire urban planning, and large areas depended on the day-to life availability of private transport are based. Despite having huge technological capacity in several industry sectors in the United States and Canada are showing greater interest in high-speed rail transit in specific regional corridors. Although a significant contribution to the public input has been received in the past about the challenges facing of the transportation sector, transportation planners in both the United States and Canada have chosen similar paths through the establishing a national railway system via rail, respectively. While high-speed rail transit has been studied over the years, pressures of lobbyist from other transportation sectors have prevented this type of alternative transportation from achieving its full potential. Thus, it seems that the degree of success of high-speed rail transit depends primarily upon adequate funding for its research and development, and public policy implementation.

Private railroad companies provided both freight and passenger service in the first 1970. While in the latter part of the 19th century rail had been the dominant mode of intercity transportation, by the mid-20th century competition from motor vehicles using the rapidly growing network of public roads, and a growing aviation system, was creating difficulties for the rail carriers. The only intercity rail effort moved forward by the federal government beyond pilot studies and technological research has been Amtrak. Ironically, the creation of Amtrak led to a stalemate regarding intercity passenger rail's relationship with other transportation modes and with government. In 1970, government created the National Railroad Passenger Corporation (Amtrak), a government-owned corporation. Then the government were invited Amtrak through out high-speed traffic on the Northeast Corridor between Boston and Washington. Since its creation, Amtrak's relationship with other modes has been characterized by a division between passenger and freight rail and the isolation of the former from earmarked tax returns and cooperative planning and management [54]. Both of these issues also plague HSR efforts, along with other political and financial difficulties. Therefore, some individual states initiative to establish additional projects of high-speed long-distance transport in the U.S. and also there are some studies to possible the implementation of projects as a high speed such as magnetic train or wheel / rail option were explored at different corridors.

While there have been many studies and proposals of high-speed rail over the past dozen years in many regions of the North American continent, it has been most difficult to advance beyond the planning phase [55]. The difficulties mainly come with the lack of profitability of various projects, historic policy bias toward rail compared to highway system, and environmental concerns. However, increasing congestion on interstate highways and airports in the U.S. would have made a high-speed rail more attractive to large portions of the population. Many empirical studies suggested that a HSR in the U.S. could be technically feasible, and could cover operating costs in some corridors, but it could not cover all the capital cost in a reasonable period [56]. Therefore, reduction of construction cost has been a key issue to realize high-speed passenger rail in the U.S. It is generally perceived that the only high-speed rail implemented currently in the U.S. is the incremental high-speed passenger rail service through the North-East Corridor from Washington D.C. to New York City. An incremental high-speed rail is defined as a high-speed and high quality passenger rail service that utilizes existing railroad infrastructure to share the right-of-way with slower freight trains or commuter trains. The major advantage of this concept is its lower construction cost, and passenger trains will be operated at speeds of between 110 and 150 mph with frequencies significantly higher than those currently offered by National Rail road Passenger Corporation (Amtrak) services. Part of the Northeast corridor, between Washington D.C. and New York City, is currently operated up to 125 mph and provide frequent service. These express trains have led fair success in attracting passengers from the air and highway mode so that Amtrak is now planning to extend this incremental HSR service from New York City to Boston via New Haven. However, with its lower construction cost, an incremental HSR has several issues to be solved.

Thus upgrade the existing railroad is the profitable to reduce the construction cost. Indeed, this is not profitable, which do not apply to a conventional high speed rail with dedicated railroad track. Firstly, the existence of grade crossings has caused concerns for the safety of incremental HSR. The possibility of accidents at grade crossing has been a significant problem for any rail operation; as the train speed increases, the seriousness of accidents at grade crossing may increase, although it may not be a linear increase. In fact, all grade crossings were removed on the New York Washington corridor where Amtrak operates at speeds up to 125 mph, during the Northeast Corridor since the late 1970 [56]. Although, installing advanced grade protection systems such as trapped-vehicle detection system can be another solution to this problem. Although both options are technically feasible, they will increase the infrastructure cost and may negate the advantage of incremental HSR to some extent.

The other problem comes with the line capacity. Since an incremental HSR allows different types of train running at different speed on a shared track, it may require additional infrastructure such as passing sidings. For example, a fast train will at times overtake a slow one and when this occurs, in order to let the faster (and presumably higher priority) train pass, the leading train must enter a passing siding. [56] Also on single-track mainlines, which are not uncommon in the U.S. the train schedules are constrained by the need to coordinate the meeting of opposing traffic at two-track sections installed for that purpose. In both cases, the addition or lengthening of passing sidings may be required to accommodate the additional meets generated by the high speed passenger service. This will become a major problem for higher speed and higher frequency passenger train operation, in that it will be extremely difficult to develop a working schedule that does not cause delays for passenger trains.

It is noted that freight railroads, which generally own the rights-of-way in the U.S. do not receive any operative benefits from this project. Rather, they will suffer from the slower speed of freight traffic and complicated operating practice. For example, passing by faster passenger trains will delay the movement of freight trains. In addition, the features of high speed and high frequency passenger service will make the operating practice of conventional freight railroads much more complicated and may require an advanced train control or dispatching system.

The best proposed high speed rail implementation currently in U.S. is the California high-speed project, which has been promoted by the CHSRA (California High-Speed Rail Authority). California is one of the few U.S. states that is promoting high-speed passenger rail and moving ahead to make it happen. However, commuter rail in California demonstrates support and some willingness to fund rail service as an alternative to the automobile. The support comes both from government agencies at state, regional, and local levels and from the public, as demonstrated by successful ballot measures to provide funding. A CHSRA ridership report predicts that a high-speed rail system between Los Angeles and San Jose will have about 45% of the transport market share. It can be observed, that, with compeer between JR and the California High-Speed Rail Authority initial fare estimate of 50 % of airfare is much lower than the established Tokyo-Osaka travel market, and the market share between air and rail is 66 % [49]. The infrastrucuer cost of the California high-speed rail proposal by an average cost 31.5 million € per km (price in 208), where the network will be established with operating speed 320 km/h, with total passenger about 68 million in years 2020 [57] The price level for public and private transport market usual lower. This led to the realization of higher revenue per seat kilometer for the railways, which are well above the alternative cost. Whereas, the U.S. level of price is by long distances of about € 0.079 / route km, [see Figure 28] a comparison of price levels in the long distance passenger traffic). The basic condition for a renaissance of passenger rail in the U.S is a few densely populated regions, where, the first time appears to be positive again for many years.

4.4.5 Japan

As in Japan 1959, started the construction of the first high speed line between Tokyo and Shin-Osaka, the national project that forever changed the physical landscape, national economy, and mobility of people between two of the most populated metropolitan areas in the world. It can be noted that, the response to the exceptionally high demand for passenger services to be on this corridor. Immediately after the opening of the Tokaido line in 1964 the popularity gave to law by the then Japanese National Railway (JNR) operated Shinkansen system planners. In many ways the concept was innovative, a new segregated railway built to the standard gauge 1435mm [one of the characteristics in Japans traditional railway network is the narrow gauge, 1067mm]. In addition, mainly due to large number of grade crossings on the network, the Japan’s Ministry of Transport (MoT) has required that every train must be able to stop within 0.6 km from its operational maximum speed to avoid or reduce the damage of collision (this means that every 600 meters there is the intersection and the train must be reduce the speed). This regulation of braking capability has been also a major obstacle to increase the maximum speed of trains running on the narrow gauge tracks, because the cast to eliminate existing grade crossings is not negligible. It adopted the international standard l435 mm gauge rather than the traditional narrow gauge so that no compatibility with the traditional rail network was realized. It is dedicated to passenger transportation and no freight trains are allowed to run on the routes. There are other reasons for establishment high speed line in Japan, this result in the problem on the road transport presented by a narrow, mountainous and earthquake.

The high investment costs for the new line and the excellent coordination system between vehicles and infrastructure provided a previously unknown level of travel comfort, speed, security and operational availability. This was rewarded by passengers through the higher traffic[21], which in turn has led to sustained profitability of this route. In fact, the Tokaido line was a phenomenal commercial success, and as early as its third year of operation its revenue exceeded its costs including interest and depreciation. In addition, high speed services received an important stimulus from investment in additional lines and/or upgrades which extended the range of existing services, today about 3000 km [see Table 1].

Japan's investments in a new high speed lines cost more per kilometre to construct and were less profitable than those of the 1960s and 1970 [47] Returns were more exlusive since the population density served was much lower than that of the Tokyo-Osaka corridor. Furthermore, costs were higher to formidable engineering challenges as well as the greater demands of environmentalists for noise reduction and improved segregation. Conversely, by attractive supply regarding travel time and price was able to compete against both the air and the road transport exist. In this context, will be not forget that the basic conditions for an independent commercial HSR line in Japan compared to other countries such as California, for example in the following points:

- The price level for public and private transport market usual higher [49]. This led to the realization of higher revenue per seat kilometer for the railways, which are well above the alternative cost. Whereas, the Japanese level of price is by long distances of about €0.187/route km, where this in the other country will be difficult to implement for customers [see Figure 28] a comparison of price levels in the long distance passenger traffic).
- Only about 29 % of Japan's total land area is habitable. The most of the population is lives within a few congested urban areas in the three largest cities of Osaka, Nagoya and Tokyo, which are very densely populated.[22] This offers the possibility of the medium and long distance transport to make a large number of people to achieve through direct service
- There have emerged in the last 40 years, high flows in the distance between the major metropolitan regions, large population based, and their economic and political importance centers of Tokyo and Osaka. The majority of daily commuters use the rail. [49].
- The relations between the major cities are within a distance range that can be covered with the high-speed rail in less than 3 hours, and the medium distance between the two major Japanese cities makes routine exchange of goods and services readily accessible by air, high-speed rail, and roadway.

It can be observed that, thereby, this advantage must be disadvantage for high speed rail transport in Japan are to be compared. Due to the special geological and geographical situation in Japan, the high speed services running through this type of terrain requires many long tunnels and bridges designed to withstand earthquakes, as well as countermeasures to earthquakes, floods, and deep snow. Furthermore, pass through densely populated cities, stringent noise and vibration environmental, this leading to the

[21] In the first full year of operation in 1965, the number of passenger was about 35 million passengers (110 trains a day). After seven years this figure is doubled, reaching to 85 million passengers [51].

[22] The population density in the metropolitan regions on Tokyo and Osaka is about 11.000 people / km^2 [49]. Such as a high population density within a metropolitan area in Africa, special Cairo [Cairo: 15.200 people /km^2, Alexandria: 4.675 people /km^2]. Despite, population density within a metropolitan in Europe area less than that, for example [Berlin: 3.840 P/km^2, London: 4.757 P/km^2, Paris: 3.646 P/km^2, New York City: 10.500 P/km^2].

need layout for a high-speed transport, and a very high proportion of the routes over bridges and tunnels. In today's prices, the average construction unit cost per mile of $45 million in Japan is quite a value when considering the fact that Japan consists of rough terrain, requires numerous tunnels and grade separations along the Tokaido Line. Today, Shinkansen system the benchmark on the performance of the railway system: only in the line between Tokyo and Osaka about 8600 employee, and the total time for operation 18 hour every day, the density of passenger train about 350.000 with 25 trains per hour in peak time (average 8 trains per hour/direction). The average delay time of train only 24 seconds, whereas the reached of the maximum limit of the possible operating performance of a mainline system. The average space utilization of the Shinkansen in the course of the day is already at 94% [51]. There are also a scope to include other revenue, is no longer available on some sections. The optimum ratio of costs and revenues has been set at a price level, which brings a lot of passengers on the route, which will be the performance of departments fully exploited. Japanese railway has worked to increase the fares in the recent years, and this happened before privatization years, even to compensate for operating loss [52, P. 39]. In particular, some individual Japanese railway companies make to dispense with the price increase. The ticket prices are exactly the same from Kagiyama in [49], and in the late of 1990, the level of high cost of living did not take place. Thus they were able to increase the supply and utilization of the infrastructure. The Japanese railways company is considered the one of the most profitable companies on the worldwide. However, since the establishment of the private sector these profits began decrease [52, P. 37].

4.4.6 China/Taiwan

Taiwan High-Speed Rail (THSR) is a high-speed rail network that runs along the west coast of Taiwan. Taiwan's western coastal strip a width of on more than some 50 km and is densely populated and highly industrialized throughout. Thus, about the 95 % of its 23 million inhabitants live on this corridor, between Taipei (with 5.9 million inhabitants) and Kaohsiung (with 2.6 million inhabitants). Taiwan has a network of fundamentally efficient but often congested motorways linking the big urban centers along the main corridor of economic activity in the western part of the Taiwan and there are regular flights between the most major cities. Furthermore, the conventional rail network is narrow gauge, and it is shape of a ring around the island. Consequently, this existing railway system is unable to meet the demands for faster and more frequent trains. THSR was the biggest transportation infrastructure worldwide project from the year 2000-2006. It is approximately 345 km long only 32 km have been built directly on the soil substructure, 47 km are in tunnels and 251 km are on bridges. It can be showed that the infrastructures parameters for the THSR in Table 20. It can be noted that, the HSR project is one of the largest privately managed and funded transportation projects up to 2007 [211]. The HSR in Taiwan is one of the world's largest privately funded railway construction projects. The original capital investment for this THSR project was estimated to be $15 billion 21% of the construction costs (3.1 billion USD) would be financed by the government, while the remaining 79% would be financed by private capital [160].

The following were the considerations and expectation that led to the decision of construction HSR in Taiwan as the above mentioned:

- The THSR project is a highly political sensitive project. The population in Taiwan is historically well distributed along the west corridor of the island. It is generally believed that the high speed rail project will help industries move jobs to rural areas.
- THSR is to reduce the journey time between Taipei and Kaohsing to 90 minutes.

Where the whole corridor is grow closer together and to from a single integrated economic region

- THSR is the only efficient means of transport as regards both speed and capacity along the metropolitan belt of western Taiwan
- THSR is to link together the local transport system of the cities it connects as well as existing Taiwan railway line from high capacity, highly efficient public-transport network.
- The Taiwan high speed rail will also be able to handle generation a new demand in future and provides the best conceivable quality of transport.
- The government estimates that the construction of THSR has created 480,000 jobs and may contribute 1 percentage point to annual economic growth [160].

For the financing of the THS, it is surprising to see that in Taiwan: the government only provides 21% fund for HSR construction, while the government has to provide 79%. Where, the principal funding agency comes from only Taiwan government and private companies. Consequently, HSR system in Taiwan isolated from other countries, this lead to the principal funding source are by the government fund, private capital and local bank companies. To compare the proposal HSR line in Egypt. it can be observed that, the proposal line will be runs along of north to south corridor in the middle of Egypt located on the narrow strip a width about of 50 km and is densely populated, addition to the Delta, which gather around most of the population and highly industrialized throughout. At the same time one reason that Egypt proposals HSR do not get any financing support from multilateral agencies like Germany, France, and other European countries, because proposal HSR system in Egypt isolated from other countries, this lead also to the financing are by the country.

China HSR, Railways are the most commonly used mode of long-distance transportation in the People's Republic of China. Almost all railways are operated by the Ministry of Railway, which is a part of the State Council of China. In October 2008, the Chinese State Council approved a new $292 billion railway investment plan to take it up to 2020. The scheme extended China's previously announced railway building program, which was allocated $182 billion in the 11th five-year plan from 2006 to 2010 [212]. As a result of the increased investments, the country's railway network grew to 91,000km by the end of 2010.

Over the years, countries such as Japan, France, Germany, Spain and South Korea has developed incredibly speedy train networks, in additional to this list can now China. Indeed in year 2009, China can boast the fastest express train in the world on what is considered the longest high-speed track on the planet at 1,068 km. The train runs from the central city of Wuhan, through the provinces of Hunan and Hubei and down to Guangzhou at the south coast at a top speed of 350 km/h, transforming a 10.5 hour journey time to no more than three hours.

This is but one example that demonstrates the continuing success of China’s ambitious and fast high-speed rail development program. As the country’s economy and population continue to expand, the need to spread economic development is an important aims that is best way to achieve if a proper and speedy rail network is in place. When the main rail lines are completed by 2020, it will become the bigger, fastest and more technologically advanced high-speed railway system in the world. However, China planned passenger-dedicated HSR network consists of four north-south HSR corridors and four east-west HSR corridors, with a total of 16,000 km of dedicated high-speed rail lines connecting all of China's major cities by 2020 [64]. This planned HSR network is connected within China but isolated from other countries. The designed speed for these new passenger-dedicated HSR lines is 350km/h, but China planned to decrease this speed due to safety concern and energy consideration.

China has the world's longest high-speed rail (HSR) network with about 9,676 km of routes in service as of June 2011. Nonetheless, The Beijing-Shanghai High-Speed Rail is 1318 kilometers consider the long HSR line that connects two major economic cities in China, the Beijing-Shanghai HSR line, a passenger-dedicated trunk line opened in June 2011, which reduced the 1,318 km journey between the largest cities in China to under 5 hours. The total construction costs of the Beijing-Shanghai HSR are about $32.48 billion [213].

The Chinese government has been generously funding the upgrade of conventional lines, and the construction dedicated high-speed rail passenger lines since 2004. Total investments in new rail lines grew from $14 billion in 2004 to $22.7 billion in 2006. Moreover, total investments in new rail lines including HSR lines reached $49.4 billion in 2008 and $88 billion in 2009. In all, the state plans to spend $300 billion to build a 25,000 km HSR network by 2020 [213]. The distribution of the value of $88 billion in 2009, about $ 68.8 billion was spent building new lines (mostly High- Speed Rail lines), about $18.7 billion was spent upgrading the existing conventional lines, and about $ 0.5 billion was spent on local railway projects [213]. Where, the principal funding agency comes from only the centre governments and provincial government. Consequently, HSR system in China isolated from other countries, this lead to the principal funding source are by the bond issued by Ministry of Railway.

High-speed railways are being operation, construction and planned in other countries including Spain, Italy, and Korea [Table 1; 2]. In some countries, high-speed trains operate on existing conventional lines by keeping to the 200 km/h maximum limit. For example, Switzerland’s mountainous topography allows no other solution that stays within reasonable cost limits. However, a number of other countries have been pursuing the development of higher speed (200–250 km/h) operation with minimal new construction. The major success has been that of the UK, where the diesel Inter-City 200 km/h which laid the foundation for the commercial success of the Inter-City network achieving a no subsidy operation during the 1980s and led to the electrification of the line East Coast Main on the basis speed about 225 km/h. Thus, in Sweden, despite very long lines that can only operate at a profit by connecting major conurbations, the low population density makes little sense of going overboard on high-speed transportation. In mountainous countries, a common solution is to use tilting trains permitting up to 30% [63] higher speeds on conventional lines.

4.4.7 High-speed rail in Africa

Construction of the first high-speed rail line in Africa has been launched today. The Tangier-Casablanca HSR is a landmark project - it is not only the first HSR project to be implement in Morocco, it is the first HSR project to be developed in Africa. Morocco is a country located in North Africa. It has a population of about 34 million and an area of 710,850 km². Morocco is making rapid strides in the development of a high-speed rail network. The railway network of Morocco consists of 2110 kilometres standard gauge and 1245 kilometres electrified [6]. There are connections to Algeria, and consecutively Tunisia, but since the 1990s the connections are closed.

Construction of the planned 330-km HSR line between Casablanca and Tangier is divided into two phases: Phase 1 under the plans, a 200 km high speed line is to be built from Tanger to Kénitra, and Phase 2 comprises a 130-km line between Kenitra and

Casablanca, where trains would use the upgraded existing line via Rabat to Casablanca. Services are expected to begin by the end of 2015, when journey times between the two cities should be reduced from 4 h 45 min to 2 h 10 min [253]. A future second phase is planned to extend the line from Kénitra to Casablanca.

There are two main factors that have guided the choice of the Tangiers-Kenitra link for HSR are:

- The need to end the isolation of Tangiers, a city with a fast-growing economy and demography, which is currently connected to the rail network only by a single line. In addition, passengers wishing to travel from Tangiers to Rabat have to drop to Sidi Kacem.
- Plans for building a tunnel beneath the Straits of Gibraltar to provide a fixed link between Europe and Africa.

Funding the high speed rail project costs is expected in Morocco to comprise Dirhams 20 billion ($2.4 billion or €1.91 billion)[23]. The project involves a total investment of which 50 per cent is for civil engineering works, 28 per cent is for equipment and 22 per cent is for rolling stock. The line is expected to handle 8 million passengers /year [253]. Morocco is moving quickly to make its high-speed ambitions a reality, and the first commercial services will run just eight years after the government decided to go ahead with the project. This sets an impressive precedent for other African nations to follow, and augers well for the expansion of the rail network not only in Morocco but across the region. It can be benefited from Moroccan experience in this filed for the construction and planning of high-speed trains in Egypt. Particular in the funding of this project, Egypt have not any external sources of funding, however, it can be taken the same path of Morocco.

4.5 Factors Affecting the High Speed Rail System

Any high-speed rail system must compete for riders with other public and private transport. Travel surveys show that ridership and choice of mode are influenced by several major factors: total trip time, speed, frequency, distance, cost, comfort, and convenience. Each of these factors, as well as the tradeoffs among them, must be examined in any market analysis of specific corridors. Therefore, after the analyzing the previous country, the important factors to create a new HSR system is the demand of passenger, in additional on the railroad and increase congestion on the highway and airport. It can be also noted that, the forecasting ridership in the next years after construction of any new system must be increased to achieve the project success. Despite, these factors already exist in most developing country special in Egypt, but the problem is lack of sufficient investment for this project [see this in next chapters]. Reducing travel time is critical to its success. However, the limits to which top speeds should be increased deserve careful scrutiny, and speed as the key factor of customer interest in high speed rail systems, but, of course, travel time is closely related to speed.

[23] The government announced it had finalized the financing of Dirhams 20 billion for 200 km line length (€1.81 billion), which is composed of the different external source [252] as: Two agreements for €74.7 million have been signed from the French government. The country is also set to receive €622.3 million and €219 milliom from the French government and commercial loans, and the French Development Agency respectively. Further the Saudi Fund for Development and Abu Dhabi Fund for Development about €143.46 million and €69.7 million €56.7 respectively. The Arab Fund for Economic and Social Development will contribute €626 million respectively. Meanwhile, Morocco will provide € 525 million through a budgetary allocation and through the Hassan II Fund for Economic and Social Development. In addition, the project will receive €99.6 million from the Kuwait Fund for Arab Economic Development.

Given speed's importance in high speed rail system planning, there are many important factors that should be kept in mind when considering HSR systems.

- **Trip time**

The total time required to get from the point of departure to the final destination is defined as the trip time. This includes travel to and from the station or airport, access time or waiting time in the station or while parking, actual travel time, and exit time (time to obtain transportation from main mode to the final destination). Generally what matters to a traveler is the total elapsed time it takes from origin to destination rather than simply the speed of the mode used for the main part of the trip. It can be noted that, in the case of high speed in Spain, the market share of rail increased by 51 %, this is the result to the travel time on the HSR relative from city to city.

The trip production step for internal trips involves the use of equations for trip production from area to area. Equations for internal trip attractions are based on an evaluation of alternative rates generated from the metropolitan area studies in [227]. The numerous special generator sites are evaluated as having attraction values only. The trips attracted to the special generator sites are only for the home-based social/recreational and home-based other purposes, since a preliminary analysis revealed that attractions for the other purposes were inconsequential.

Trip distribution is accomplished using a gravity model. The gravity model assumes that the trips produced at an origin and attracted to a destination are directly proportional to the total trip productions at the origin and the total attractions at the destination. The most widely used trip distribution model is the gravity model. As its name suggests, the gravity model for transportation planning is based on the gravitational theory of Newtonian physics. The gravity model of transportation planning predicts that the relative. The calibrating term or "friction factor" (F) represents the reluctance or impedance of persons to make trips of various duration or distances. The general friction factor indicates that as travel times increase, travelers are increasingly less likely to make trips of such lengths. Let us assume T_{ij} be the trips produced or trip frequency between i and attracted at j and D_{ij} the distance between areas i and j, let X_i the traffic generating size in the origins area i and the Y_j the traffic generating size in the destination area.

$$T_{ij} = k\frac{X_i Y_j}{D_{ij}^{\ 2}}$$

The gravity model is the most commonly used method of deriving trips where no existing trip matrix exists. In this example the gravity model forecasts demand directly based on the population served by each station and the generalized journey time between the stations. It is named from the gravity analogy in that the number of trips between two zones is directionally proportional to their mass (such as population/worker) and indirectly proportion to the cost of travel between them. It should be noted that the model does not account for the levels of accessibility, or competition provided, from other modes between stations. The analysis factor has been calibrated through liner regression method of rail trips against rail generalized journey time, the full model development is included in the proposal HSR in the case Study can be shown in section 6.7

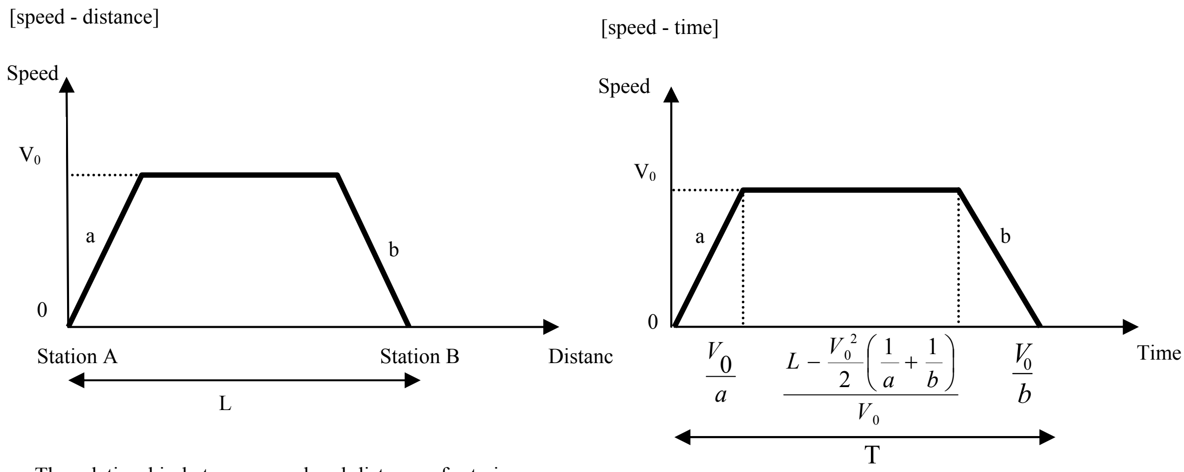
- **Frequency and speed**

There is a tradeoff between frequency and speed, where increased frequency can, to a certain extent, provide the additional attraction that increased speed can also give high speed. Where, Increases in maximum speed have decreasing marginal gains in travel time savings. Therefore, improving the speed of a slow train can have a greater travel time benefit for passengers than improving the speed of a fast train. The marginal cost of increases in maximum speed (in system design, construction, operating costs, and so forth) grows more than proportionately with speed increases. In other words, the level of infrastructure investment increases significantly as the maximum speed increases. This is partly because of the increased level of precision required in all aspects of the HSR system. Energy consumption also increases with the speed because of the exponential increase in air resistance [60]. For high-speed rail planning, this means that the maximum speed necessary to serve the market must be carefully analyzed because each increase in speed is more expensive in capital and operating terms. For example this case in the U.S, where it can be observed, that utilizes existing railroad infrastructure this leads to reduce of construction cost.

- **Distance**

Travel time reductions due to higher speeds depend very much on the distance between stations because trains need a significant amount of time to accelerate to their maximum speed and to decelerate and stop. Trains that stop and start frequently never reach their maximum speeds or reach it only for a short period of time, for planning purposes, this means that HSR systems are not cost effective on lines with frequent station stops.
For instance, in Figure 9 if assume the following:
- The distance between two stations is long enough for a train to reach its maximum speed and continue to run at the speed for certain time.
- There is no partial speed limit due to tight curves.

The relationship between speed and distance of a train running between the station *A* and *B* is represented as follows
Where it can be assumption that
- Trains movie between Station *A* and *B* as fast as possible using the maximum capability in terms of maximum speed and acceleration / deceleration rate.
- Terrain is flat and there is no gradient between two stations so that maximum speed and acceleration/deceleration rate are nearly constant.



The relationship between speed and distance of a train running between the station A and B

Then the relationship between train's speed and travel time

Figure 9: The Relationship between Speed, Distance, Acceleration and Deceleration

Where,

L: distance between station A and B

t: required travel time between two stations

V: average speed between two stations

V_0: maximum speed (constant)

a: acceleration rate (constant)

b: deceleration rate (constant)

The travel time t is a function represented as follows:

$$t = \frac{L}{V} = f\left(L, V_0, a, b\right)$$

It can be assumed in the above case that, the distance between two stations is long enough for a train to reach its maximum speed. However, if the distance between stops is not long enough, a train may not reach its maximum speed. This is not efficient and should be avoided because that train can not take advantage of its high speed. Therefore, the average speed in this case is not a function of maximum speed, but of acceleration and deceleration rate, and distance. It is obviously that a short distance among stations such that a train cannot reach its maximum speed is not useful for increasing average speed and thus reducing travel time; thus, keeping a minimum distance between stations is recommended. This minimum distance will be equals L average $L_{average} \geq \frac{V_0^2\left(a+b\right)}{2ab}$

This shows that the benefits from high speeds are great on long inter-station distances but very small or negligible on short distances. Therefore, the relative value of speed and travel time will vary with distance, as shown in Figure 19. At short distances, the transit bus and automobile dominate the market in both convenience and trip time. Rail is attractive for short trips only where special circumstances nullify the advantages of the automobile, such as peak time commuting access to a major city, center city congestion, and cost of parking, access to airports or other major attractions for large numbers of people such as an exhibition center. In these cases, at short distances, frequency of service is essential, as is a single point of access. Travel time to and from stations is increasingly important to the individual traveler. For instance in Egypt people live in city or close from city centers, thus reduce travel time to and from station, Conversely, the distances from cities to all the airports it is large, where in this case the travel time will increased to and from airports.

- **Comfort**

Comfort is a subjective judgment. For the rail mode, it involves the travel environment seating, company, catering facilities, relaxation, and ability to read, work, or sleep. While other modes offer comfort in seating and environment, flying, or driving or riding in an automobile all present added concerns. Food choice will be more limited on short-haul flights and an automobile trip will require stops. In addition, the fare is the very important factors for the passenger, but it is a fundamental determinant of demand and the financial viability of any public mode of transportation is the price. Thus the success of high speed rail in the beginning operation depends on the fare, the best example of this the Spain high speed rail (see section 4.4.3)

4.6 Analysis of the Factors Affecting the HST system in Case Study

There are, however, significant differences between developing and emerging countries such as Egypt and other countries, such as Japan, France and Germany, which have developed successful high-speed rail projects. It is still not sure whether high-speed rail will truly allure Egypt citizens to get out of their congestion on the road and choose high speed rail as an alternative. In Egypt, because of the dominance of the national roadway system, and intercity passenger by air transport is neglected. However, with the emergence of problems such as congestion, accidence, environment protection, as well as energy saving, high speed intercity train that has already demonstrated a great success in other countries starts to gain new attention in the Egypt.

Given these facts, it is not clear what factors affect on the ridership, or which factors contribute to the growth of ridership performance. Before a nationwide high-speed rail project construction, an empirical analysis of the current high-speed rail ridership becomes necessary in order to understand the relative factors that affect high speed rail projects' success.

Based on the analysis previous section, there are many factors affecting rail ridership, such as population density, levels of private vehicle ownership, trip length, mode choice, topography, service frequency, fares, system reliability, and cleanliness. Studies also show that ridership increases with increased income, whether for business, personal, or leisure travel.

As a result of the case study the importance factors affecting on the establishment a new HSR line are;

- First, in terms of political conditions, most countries that have HSR systems have relatively centralized governments compared to Egypt. Most HSR countries have strong national governments that have very close ties and authority over, or provide significant funding for, regional, state, or local governments. This allows decisions to be made in more of a top-down manner, where national directives are implemented without much resistance from regional or local government. It is important to note that funding for HSR systems almost always depends on external capital contributions. This is because HSR almost always requires significant financial resources, as well as the financial leverage to be able to borrow such resources. For example, to meet the financing requirements, the government of Morocco signed agreements for external financing. These agreements have enabled the securing of new financial resources through concessional loans with favorable interest rates (between 1.2 and 3.16 per cent) and longer grace periods (up to 20 years) [252].
- Almost all HSR systems, especially with regard to infrastructure, have been implemented by, or with the help of, national governments. While there is a move towards market liberalization and privatization, the up-front capital costs associated with building HSR are enormous and almost always require the financial support of the national government to begin with. In some countries, HSR service has been either privatized or turned over to independent public companies or is run by international consortia comprising state companies. Privatizations and the breaking apart of monolithic state companies are usually done because of the losses incurred by the state-run companies and because of perceived gains in efficiency and profits from making public HSR companies more competitive or from privatization. In several cases where privatization or the breaking apart of public companies has happened, such companies become profitable in terms of operations. However, these companies have usually either been relieved of the debt associated with initial capital costs, or receive government assistance, in the form of subsidies or low-interest loans, which help them to pay off the debt. Levels of government subsidies range from places to other like Japan, where three of the six railways have been fully privatized and receive no government assistance, to the TGV in France, and some companies in western Europe, where many routes are profitable and self-funding, to places such as Turkey, where the national railway has heavy losses and requires

significant subsidies. Egypt also can benefit from the external experiences in terms of the private sector, where the most common structure for providing HSR services generally includes the following:

- 1. A state backed independent public company and/or private companies, which have responsibility for rolling stock and operations.
- 2. A state-backed, independent rail infrastructure company that owns and manages track and allows both the state-backed operator, as well as other private operators (which tend to be much smaller than the state company), to purchase access to infrastructure.
- 3. A division of the debt incurred by the previously unified (operations and infrastructure) state railway company among the operator and infrastructure manager, perhaps with government assistance in paying debt service.

- The geographic and demographic size of countries with HSR systems, as well as the population density within the countries and the portion of the population that lives in urban areas. The geographic size of a country is an important consideration with regard to HSR because of the potential land area that must be crossed, or served, by HSR.
- Population density and urbanization are important considerations in that, in order for HSR to have economies of scale, enough people must be willing to regularly commute or travel from one place to another. This means HSR works best when connecting large, densely populated cities or population centers. According to previous analysis on the subject, given the current state of technology, HSR works best when connecting population centers less than 800 and more than 200 km apart.
- Despite the trend is not quite as strong as with land area, countries with HSR appear to have high population densities, with the large majority having densities over 1000 people/sq. km. Compared to most other countries with HSR, the Egypt high population density within a metropolitan area in Africa. Thus, urbanization rates in Egypt are significantly different from those in other countries with HSR, implying that Egypt population centers are likely as dense as in other or more than other countries.

4.7 Summary

This chapter should be viewed as an attempt to identify some of the definitions of the high speed rail service, by the technological and features analyzing. Moreover, in this chapter, the current technological of high speed rail in Japan, Europe and the U.S. were discussed. In Japan and Europe, further construction of high speed rail is likely to occur, also in the U.S. after success the California high-speed project, further construction of high speed rail is likely to occur. Furthermore of the basic obstacles facing development of high speed rail lines is that the direct economic benefits of such lines rarely exceed the direct costs. Nevertheless, Japan, France, Germany, Spain, and China are among the countries that have built very high speed rail networks with trains operating at higher speeds. **As the important results to reach by this chapter after an analysis of some high-speed rail projects in European, USA, Japan is the price of passenger kilometers. While, it was found that the price of passenger kilometer is varies from country to other country and this is depending on the size of the passenger traffic. It can be observed that the price of the passenger km ranged from 0.076 to 0.13 € / passenger km in Europe [Figure 28].**

Also in this chapter was concerned with the success that a transportation investment and specifically HSR have on the society and the benefits. Many kinds of benefits were discussed at the outset as well as the opinions of different of countries on the subject. The modern HST was developed mainly to substantially increase railway capacity on the route. This was achieved, in part, through high-speed operation, which also led to substantial reduction in travel times and it improved the competitiveness of the train against other modes. Therefore it can be not forget the cost of investment of the new project it is costly, In addition to this the ticket prices it is higher if compared with the benefits.

Thus, the justification for HST relies first on very high demand, which currently is not properly served by available railway transport services. The long distance between two cities is another important requirement to justify HST, but it is not sufficient on its own to justify the expensive investment. Therefore, the high speed rail was success in the above country where the line is considered to be useful if passes between major urban agglomerations, with over one million populations, where the agglomerations are organizer along linear corridors, with cities spaced at approximately 200 km intervals. Vickerman adds the requirement for demand of between 12 million and 15 million railway passengers a year between two urban centres to justify HSR line [34]. Whereas, different methods, approaches, and tools for evaluating the HSR project in the different countries were analyzed. The advantages and disadvantages of most were also noted. After this analysis, there was a similarity between Egypt and France in terms of the density of population, where the density of population in Egypt on the proposal corridor HSR higher than France, and the topography in Egypt is flat territory, this make the proposal route runs through flat area so that there are fewer curves on the route [see section 6.3.3].

All the previous result, led to the suggestion of a method that can be used in developing and emerging countries for example the case study. This method could be adopted for the assess evaluation of a project, with the objective covering as many impacted aspect as possible. Supporters of HSR often cite the networks in these countries, with the implication that their adoption of HSR makes the feasibility and desirability of building HSR lines in the Egypt unquestionable in the future. But to extrapolate from the adoption of HSR in other countries to the conclusion that the Egypt should follow a similar path [see section 6.7 and 6.7]. The motives that led other countries to implement high speed rail lines are varied; some, like Japan and China, did so originally in part to meet the demand on already overcrowded conventional rail lines, while others did so in part to try to preserve rail's declining mode share in the face of the growing role of car and air travel. In most cases, the regions served were less densely populated than most areas in the Egypt

The relative efficiency of HSR as a transportation investment varies among countries, as its level of usage is likely to depend on the interplay of many factors, including geography, economics, and government policies. For example, compared to the countries with have high speed rails the population densities in this country is lower than Egypt. Moreover, there is some country have smaller land areas (such as France), and the levels of car ownership is higher than Egypt. Therefore, it can be noted that the levels of car use in Egypt it is very lowe (measured both by number of trips per day and average distance per trip), this lead to higher levels of public transportation on the road. Also, there is a significant difference in the structure of the rail industry in these countries compared to the Egypt. In virtually all of those countries, high speed rail was implemented and operated by state-owned rail companies that also operate by a state-owned rail network. Whereas, the passenger rail network service was far more prominent than freight service even before the introduction of high speed rail. By contrast, in Egypt the conventional rail network is almost entirely government owned, and passenger service is far more prominent than freight is service. As result from this chapter is the explained the basis of strategy follows a similar path from the analysis project in the previous country. These bases include to the important factors that help to create a new HSR line in developing country such as Egypt. Therefore, the increased population in country under study in the next years, congestion on the road and the number of road accidents, this led to thinking of the implementations a new rail system. Furthermore high-speed rail have a common thread in their reasoning. Trains are fast and enjoyable to ride, but when scrutinized with rigorous cost-benefit analysis their high cost simply cannot be justified. The previous analysis typically considers benefits like reduced travel times and reduced congestion for those who drive and fly, and reduced pollution emissions, conversely, construction and operating costs of high speed systems it is higher than other model of transport.

It should be mentioned that, which also helps to increase investment of the HSR by countries is too connected with neighbouring countries (such as European countries). Because the HSR systems connected with other countries are more likely to get financial support from multilateral agencies such as (EU, the European Investment Bank, World Bank, the Asian Development Bank, etc.) On one hand , HSR systems is isolated from other countries, for instance, Taiwan, China, and Japan HSR systems don't get any financial support from multilateral agencies is probably that these HSR systems can not generate external benefits for other countries. At the same time the proposal HSR in Egypt can not generate external benefits for other countries, therefore, the government should contribute by the construction of this projects. There is one proposal high-speed rail transportation potential corridor, in which large cities are in intermediate distance (from Alexandria to Aswan via Cairo, Asyut, and Luxor) in two phases. In Egypt, as the whole country is large, and the length of line about 1000 km from north coast to south desert, high-speed rail is not effective, but there are still a proposal high-speed rail transportation potential regional corridors in the first phase between Alexandria Cairo and then Cairo to Aswan and other regions located in the same line.

Despite, considering all these different factors, it seems quite impossible to give a unique answer, either positive or negative, to this system. There is no doubt that there is great potential to create of high speed rail in the developing and emerging in the future. But determining the very moment of the best time, or the relative influence of the limiting factors, is too adventurous and this is more a matter for construction process. However, this do not prevent from having in mind the main parameters described above when discussing these factors and the other factors in the following chapters in country under study.

Finally, the question is what are the important bases that lead to the establishment of high speed rail lines in developing countries in this chapter**? In this chapter, also has been reached to the second of the bases that are adopted upon in the construction of HSR rail lines such as: a high population density within large cities and high volume of demand with enough economic value to repayment for the high cost involved in the providing and maintaining the line. It is not only that the number of passengers must be large; however, a high willingness to pay for the new facility is required.** Egypt hopes and expects its proposal high-speed railway to be a success; but how conversion is this hope? Many countries including Brazil, Russia, Turkey, the United Kingdom and the United States are think the merits of investing in high-speed rail. What can learn from these experiences? How does Egyptian rail system comparing with other presently high-speed railways in the world? Why are high speed railways an case of development significance, and what are the circumstances in which they can become an economically justifiable investment? This research briefly explores these questions.

In the next chapter, the country of Egypt will be presented the statues of railway including a comparison between other modes of transportation, with some developing country. In the next chapter will be presented of screening model for HSR. The aim is to establish a model for understanding whether a country should start considering building a HSR network or not. The characteristics of these countries will be used for the formation of this model. They will also serve as examples of its application. Moreover, it will be interested into seeing which of the country is ahead in the issue of HSR and if for example Egypt is, then what the rest country can learn from the Egypt experience in also to go forward as well.

5 REVIEW REALITY OF THE RAILWAYS IN DEVELOPING AND EMERGING COUNTRIES (AS A CASE STUDY EGYPT)

5.1 Historical Developed

The overall of this thesis is to understand the role of HSR in developing and emerging country especially in Egypt. This is interesting because of the location and participation of Egypt in North Africa and geographical position of the country, located the northeast border of the Africa. Therefore, located in the geographical location is important for different means of internationally and locally transportation. Where, Egypt considered the important link between the Africa and Asian countries. Moreover, the author has particular interest in Egypt, since it is the country of her origin.

To begin, this chapter focuses on the country of Egypt and its demographical, economical and cultural characteristic. It is a country, which consists part of the Mediterranean countries, thus part of a greater whole. However, it is interesting to investigate to the role of the country in the rest of the Arabic region and North Africa through the perspective of the transportation sector and specifically railways. Thus, emphasis will be given in the transportation system of Egypt, the organization of the government regarding this sector and the Egyptians transportation systems in general. Serious question is whether Egypt can be better with integrated into high-speed rail to transport. This thesis lays a foundation for this kind of study.

The objective of this chapter is to review the existing railway, and then compared with other means of transportation. In this chapter will be studied the status of the railway in the country under study, special Egypt, terms of the lengths and the capacity...etc. First will review the railway in the countries of Egypt, India, Iran, and UAE, these countries are represent some of the development and emerging countries, but the result of this research can be applied on the development and emerging countries. Therefore, it will be begun the reality of the railways in the Egypt and then the rest of the countries.

5.1.1 Geography of Egypt

Egypt is located on the north east corner of the African continent, with a surface area of about one million square kilometres, representing about 3% of Afric [46]. Egypt has coastlines on both the Mediterranean Sea and the Red Sea. The borders of the country are Libya to the west, the Gaza Strip to the east, and Sudan to the south. Egypt has a land area about twice the size of Spain, four times bigger than that of the United Kingdom, and twice as big as that of France. Egypt has a strategic location in the centre of the Middle East and North Africa (MENA) region and has links to the three continents of Asia, Africa and Europe. Egypt it is the hub for the world’s maritime traffic, with commercial ports on the Mediterranean and Red Seas. The capital of the country is Cairo, which is located on the mainland along the northwestern coast. The longest straight-line distance in Egypt from north to south is 1,024 km, while that from east to west measures 1,240 km. More than 2,900 km of coastline on the Mediterranean Sea, the Gulf of Suez, the Gulf of Aqaba and the Red Sea constitute Egypt's maritime boundaries. Nevertheless, due to the dry of Egypt's climate, population centres are concentrated along the narrow Nile Valley and Delta, meaning that about 99% of the population uses only about 5.5% of the total land area [65] The Nile valley extends approximately 800 km from Aswan to the outskirts of Cairo. On the east side the terrain encompasses mountainous areas, with the highest peaks in the country. While on the west side, the terrain is almost featureless, with prevailing desert land, littered with a number of oases

5.1.2 Demographics

According to the census of the 2010, which is conducted every one years by the official statistical agency of Egyptian (Central Agency for Public Mobilization And Statistics) the Egyptian population is about 80 million people [66] live near the banks of the Nile River. The other 94.5% of the area is simply untouched desert. About half of Egypt's residents live in three major regions of the country, with most spread across the densely populated centers of greater Cairo, Alexandria and other major cities in the Nile Delta. From an administrative point of view, Egypt consists of 29 regions [see Figure 10]. The regions contain towns and villages. Each governorate has a capital, sometimes carrying the same name as the governorate. Where, the Greater Cairo consider is the largest metropolitan area in Egypt. It is the largest urban area in Africa, Mediterranean Countries and North Africa. It is also consider the world's 16th largest metropolitan area [67] consisting of five governorates. Therefore, In the Table 5 shows the important region in the Egypt with the high population, and also most this government located on the Nile Valley; this will be useful on the transport system. [It will be seen this in the next chapters].

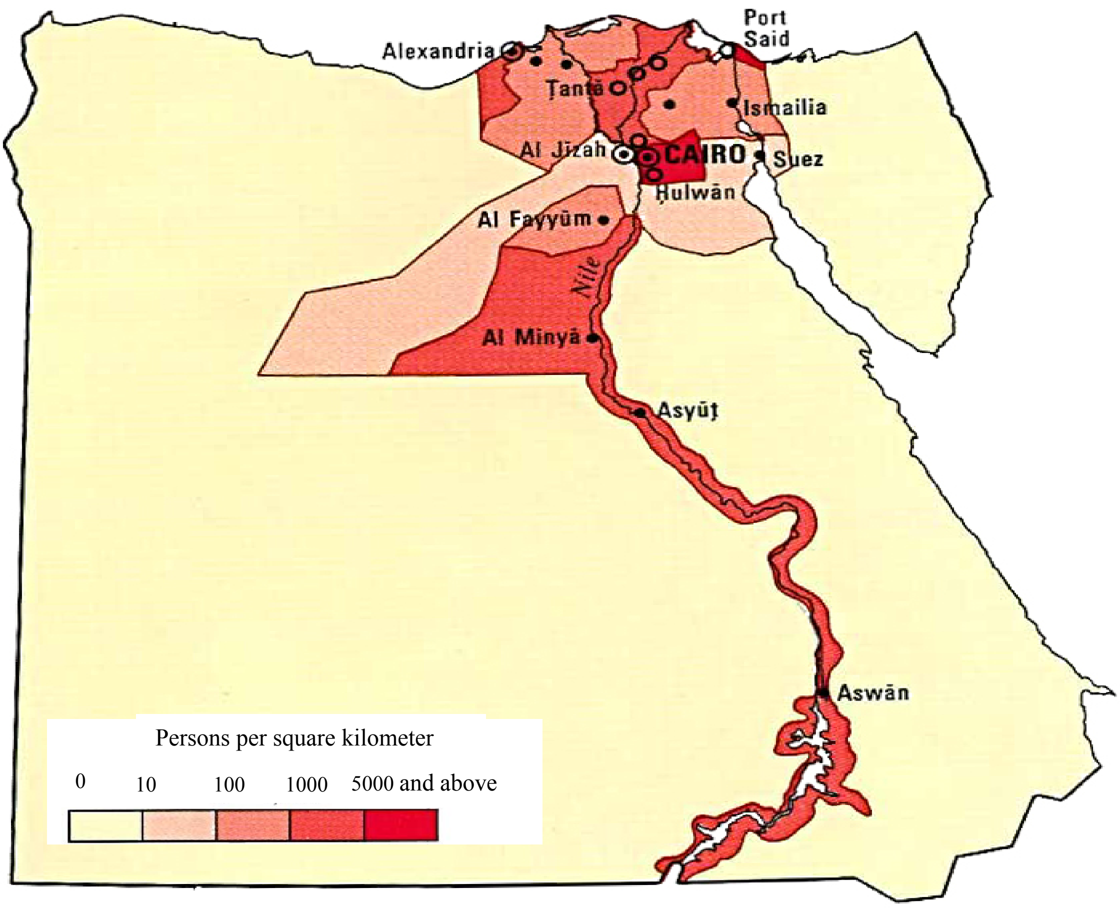


Figure 10: Map Detailing for the Governorates in Egypt and Greater Cairo

It cab be observed that, in the Table 5 the densely-populated concentrated in centers of the major regions of the country Greater Cairo, Alexandria, Asyut, Luxor and Aswan. Egypt's population is concentrated in and around the valley of the Nile River, using up 5.5 % of Egypt's one million km^2 area (the size of Texas and California together, twice the size of Spain, & 4 times the size of the UK). The other 94.5% of the area is simply untouched desert. Thus, this led to there are one way to serve all of these areas from north to south [see Figure 1].

Table 5: Detailing for the Governorates in Egypt - Area - Population

Nr.	Name	Area (km^2)	Population (million)*	Capital
1	Alexandria	2,679	4,51	Alexandria
2	Cairo	214	10,77	Cairo
3	Giza	100	6,98	Giza
4	Beni-suef	1,322	2,60	Beni
5	Minya	2,262	4,70	Minya
6	Asyut	1,553	3,90	Asyut
7	Suhag	1,547	4,21	Suhag
8	Qena	1,796	2,80	Qena
9	Luxor City	55	1,06	Luxor City
10	Aswan	679	1,323	Aswan

*Population Estimates by 2012 Source: [66]

5.2 The Transportation Sector

Egypt has formulated a revised national strategy for the transport sector, the Multimodal transport and logistics system of the Eastern Mediterranean, while all modes of transport are being reformed in parallel. The Ministry of Transport is in charge of land and maritime transport and oversees a number of public sector holding companies as well as the Port Authorities. According to the Master Plan for the transport sector, the aim is to achieve a more balanced development of transport modes with an increased role for rail and (inland waterway) transport. Also the goal of the national strategy is increased the required transport investments over the next 20-25 years [70]. It can be observed that, the growing exports and continued growth in the tourism industry will continue to place extra demands on Egypt's transportation infrastructure. Thus, Egypt set up a special unit in the Ministry of Transport in order to launch a number of Private Public Partnership projects in the road and rail sectors.

Egypt's road and rail network was developed primarily to transport population and was most extensive in the densely populated areas near the Nile River and in the Nile Delta. Thus, transport in Egypt is focused in the capital of Cairo and largely follow the pattern of settlement along the Nile. **Road sector** is the dominant mode of internal transport, both in passenger and freight operations, while urban transport is shared by public sector transport companies (‘holding companies’) and private companies. where, the badly maintained road network has expanded rapidly to over 52,000 km paved roads, [69] covering the Nile Valley and Nile Delta, Mediterranean and Red Sea coasts, the Sinai, and the Western oases. As for freight transport services, its more than 90% of services is provided through the roads between sea ports and the production/consumption area [75]. In 2006–2007 the volume of people transported by road had reached about 35.27 billion passenger /km, while freight transport amounted to nearly 43.94 billion [See Table 6]. Thus, Road safety is a major issue of concern, with one of the highest incidences of traffic fatalities in the world. Egypt is party to a very limited number of international conventions in the sector.

In the railway sector, the state-owned Egyptian Railways and highly subsidized from government: While rail has a relatively high share of the domestic passenger market, however freight transport service is limited to less than 8% of the total tonnes/km capacity. Rail in Egypt running through the populated areas of the Nile Valley and the coastal regions. Most of the track was 1435 mm standard gauge, and railway network runs from Alexandria to Aswan and it is operated by Egyptian National Railways (ENR). The rail system delivered 54.400 billion Pkm in 2006/07 (about 700 km/passenger and year); while freight was 4.4 billion tkm (about 2320.5 t/day). ENR is presently undertaking significant investment in order to only modernize and upgrade the railways and extend its network [Table 6]. Despite, the entire system was unable to keep up with rapid population growth, particularly in the large urban areas, and expansion and modernization of all forms of transportation were under way.

In the aviation sector, the civil aviation sector is regulated by the Egyptian Civil Aviation Authority. Air transport in Egypt is an important element in economic development in its broader context, given its direct impact on tourism, export and urban development programmes. Besides, it links inland regions with each other and the outside world. It can be noted that, this sector is limited in the transport of domestic passengers. The first air line was Egypt air, where it is the national carrier's parent company, was converted into a holding company in 2002. To mitigate losses over the following two years; in 2004 the national carrier trimmed its route network and raised prices on domestic routes. More recently, and after years of losses, Egypt Air has turned a profit, but the airline's domestic operations, nearly half of all passenger traffic, have been unable to break even due to high ticket prices and inconvenient flight times. Most domestic flights depart late at night or early in the morning to connect with international flights. Some routes, such as its Cairo to New Valley or Assiut flights, average between 40 to 60% occupancy, while tourist destinations average just over 60% occupancy, according to published studies, domestic flights must exceed 70% occupancy to cover costs [71]. Currently, Egypt Air is moving ahead with plans to launch a low-cost airline, called Egypt Air Express, to serve its short domestic routes and economize operations, while private carriers are seeking licenses to transform their growing charter operations into regularly scheduled services. Egypt Air Express will primarily serve the domestic market, but could also offer regional services according to market demands. This move allows Egypt Air to better utilize its fleet of jets in more profitable international operations. In addition, air passengers carried include both domestic and international aircraft passengers of air carriers registered in the country. The Ministry of Aviation established a new company that will operate to serve the domestic market by business community. Finally, the following table illustrates, the main quantitative Indicator of transport sector in Egypt.

Table 6: Development of Railway activity in Egypt and main Transport Indicator

Years	Railways					Road			
	Passenger [Mio./a]	Pkm [Mio.]	Ton [Mio./a]	tkm [Mio.]	Length	Passenger [Mio.]	Passenger /km [Mio.]	Ton/km [Mio.]	Ton/km [Mio.]
1999	424	53,424	10,83	3,464	-	-	-	-	-
2000	698	87,948	12,121	4,000	5024	-	-	-	-
2001	367	46,242	12,026	4,217	5121	-	-	-	-
2002	451	56,826	11,903	4,188	5150	1276,07	113,570	218,7	41,450
2003	368,5	49,431	11.237	4,104	5145	1301,63	115,845	227,5	43,11
2004	425,7	53,64	11,814	4,231	5150	1447,76	128,835	231,56	43,88
2005	435,9	54,93	11,309	4,383	5150		142,026	-	46,445
2006	451	54,440	10	4,300	5195	1519,89	135,270	237,15	44,94
2007	451	40.837	10	3,917	5195	-	153,000	-	52,607
2008	451	40.837	12	4,188	5063	-	160,800	-	58,330
2009	451	40.837	10	3,840	5195	-	180,340	-	58,776

Source: [69; 82]

5.2.1 History of the Railway Sector

Railways were introduced into Egypt in the tumults of the international political competition between the two major world colonial powers at that time; France and Britain during the 19th Century to gain control over Egypt. On the one hand, France was trying hard to obtain the Suez Canal digging concession, persistently persuading Egypt's rulers since Muhammad Ali era to recognize the importance of this project. On the other hand, Britain was struggling to inhibit the project. British tried to persuade Muhammad Ali to accept an alternative project; namely a railway line between Alexandria and Suez. The proposed line would make it easy for Britain to deliver mail more rapidly between Britain and India across Egypt. Eventually, Muhammad Ali rejected the proposal of digging the canal and for sometime accepted. In 1830 the British successfully completed their premiere experiment with railways by starting the Liverpool-Manchester line. The construction company commissioned its supervision engineer for that line, Thomas Gallaway who became Muhammad Ali's engineer, to persuade him to build a railway line between Cairo and Suez Port instead of the then existing and risky land route.

The proposed line was highly important for Egyptians especially for pilgrims to the Holy Land (Jerusalem, Makkah and Madina). Gallaway convinced Muhammad Ali and travelled to England in November 1834 to purchase the project requirements, he was not sure that the railway line would yield rewarding returns. However, the British were not enthusiastic, as they felt expected returns did not warrant such assistance. After Muhammad Ali's death and accession of Abbas in 1849, British hopes were revived. Making use of the political circumstances, they kept pressing on Abbas Pasha to construction the railway line.

The first railway road was made in Egypt on the 12th July 1851, and started working after the Suez Canal opening ceremonies in 1854 [68] during the ruling period of khedive Ismail Bashe and under the supervision of the English engineer Robert Stevenson, the son of the famous train inventor George Stevenson. In 1853, the fist part of this railway between Alexandria and Kafr-el-Zayat was opened and this line completed from Alexandria to Cairo two years later; it was the first in Africa and Middle East. Egyptian railways now are considered one of the oldest track services in the world, and the oldest after Germany and England. Egypt was strong on railway connectivity. Building the railways in Egypt started in the eighteenth century far ahead of other underdeveloped countries, with one of the highest railway mileage at the time, the railways were used mainly for transporting Egypt's main export crops (cotton, rice, and onions), and imports, (coal, timber, building material). Given that all materials and skills remained to be imported, the railways were not utilized to develop Egypt's indigenous capacity.

5.2.2 Situation of the Railway Sector

The Egyptian railway was designed for the movement of passenger and single car-shipments over a network connecting all of Egypt's major cities and traffic generators. The system, for the most part, serves the Nile Valley and the delta, as shown on the Figure 11. Because of the deserts and seas surrounding Egypt, the railway operates as an isolated system. The Egyptian Railway Authority was established in 1956 as a semi-autonomous agency responsible to the Ministry of Transport and Communications, whereas the railway was previously operated as a government department.

The railway sector plays a significant role in the Egyptian economy and is an essential mode of transport for low-income people. Railway sector in Egypt is managed and operated by Egyptian National Railways (ENR) created in 1980. It is responsible for managing the railway infrastructure and operates railway transport services on the entire network. In 2010, the railway network measures about 5195 km of track line between cites [Table 6] and serves the main activity and population centers in Egypt, consisting entirely of standard gauge track. The railway also carried heavy passenger traffic, especially in Lower Egypt (i.e. the Nile delta). In many cases, lines operated close to their design capacity, and freight services suffered the effects of severe congestion. Furthermore, passenger traffic was growing more rapidly than freight. Nevertheless, freight revenue, which was once as great as passenger revenue was only half as great in the mid-1980. However, in the year 2004 the revenue of passenger traffic increased more than 2/3 from the freight revenue [81].

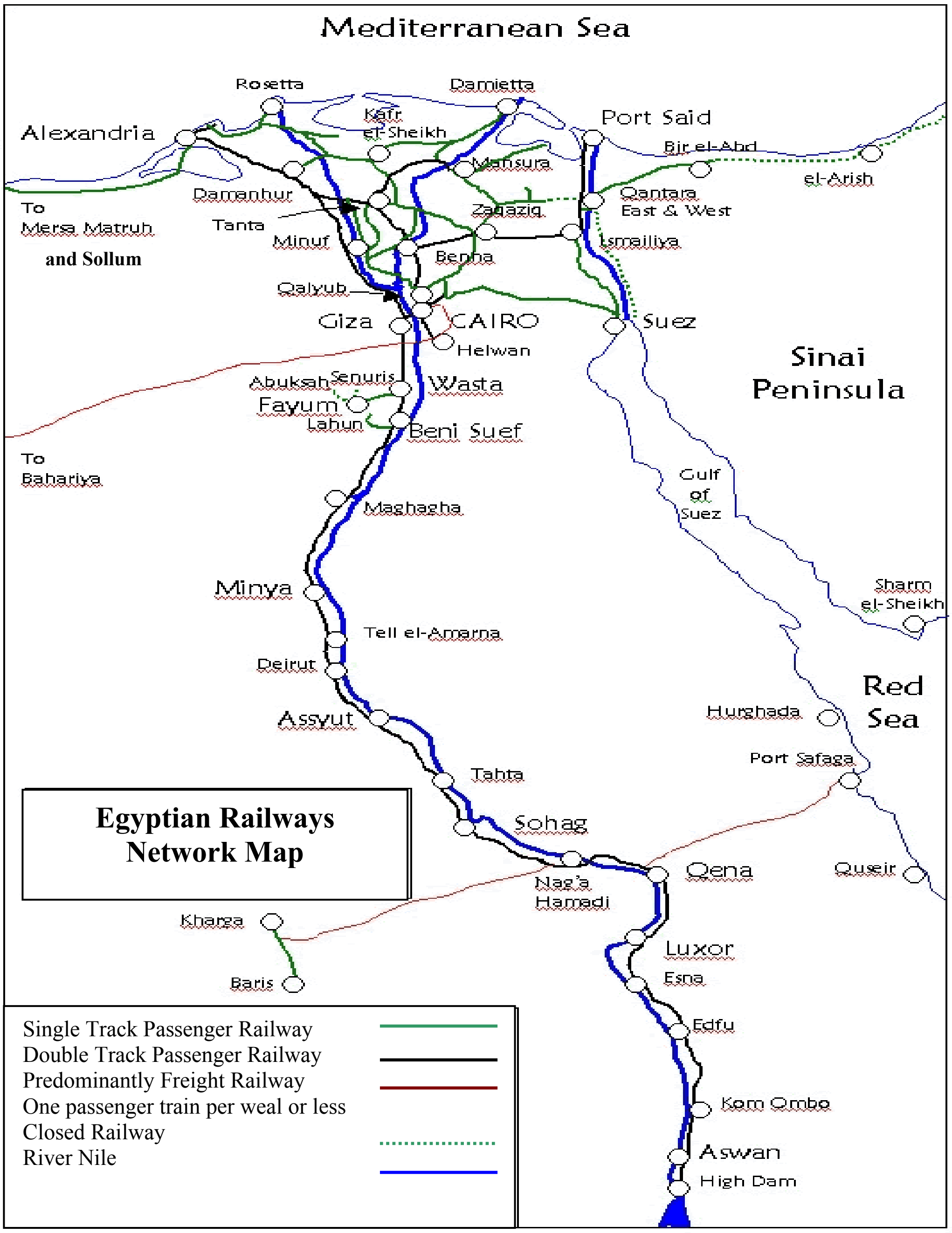


Figure 11: Major line of the Egypation Railway Network

ENR joins the whole delta, it also connects most of the inhibited and economic points like harbors on both the Mediterranean and the red seas, together with all the cities in a huge network of extended modern railway roads, ally equipped to operate all types of high speed trains. Where sixty percent of all networks which is concentrated in the Nile Delta (Alexandria, Cairo, Port Said, Ismailia, and Suez), and along the Nile Valley (up to High Dam, beyond Aswan). In the north-south direction it spans from the Mediterranean Sea to High Dam, where it connects with the river steamers of Sudan Railways. In the east-west direction it runs from (Salum, at the Libyan border, to Beer Al-Abd on the Sinai Peninsula). There is another east-west link from the (Red Sea port of Safaga to Abu Tartour [freight line]) in the west desert. Other lines in the desert provide connections to iron or phosphate mines [see Figure 11]. The railway reaches most of the Egyptian population even relatively small population centers, which are served by minor lines and small and poor quality trains. Rail infrastructure is owned by, and rail services are provided by, the ENR, a public entity created in 1980 and reporting to the Ministry of Transport (MoT). Egyptian Railway is one of the big economic institutions in Egypt and Arab nation. It the largest in transportation of passengers and freight, and is considered the backbone for transportation people in Egypt, where the volume of passenger transport by rail about 1.5 million passenger daily, and 12 million ton of freight [74]. Railway operations became a matter of deep concern to the Government due to several issues, in particular, acute safety issues, deteriorating quality of service, and the significant impact of the sector on the public budget.

In order to address these challenges, the Government developed a strategy for the railway sector based on policy recommendations from the Bank, and with the assistance of an international consulting firm since 2006. The strategy's main pillars are to gradually restructure operations to create safer, more dynamic, responsive, and competitive rail services, while continuing to provide transport services to poor people and remote areas under Public Service Obligation arrangements. In order to achieve these objectives, the Government is fully committed to a far-reaching transformation plan that will take several years to implement and will entail costly investments, financial restructuring including the capitalization of ENR debt.

Moreover, the restructuring of ENR's organization along strategic business lines (Long-distance Passenger Service, Short-distance Passenger Service, Freight Services, and Infrastructure Services), and the private sector's role in railway activities. The restructuring strategy, were began implementation in 2007 is expected to be implemented over three to five years [76]. Despite, the ENR were carrying this number of passenger and freight, before the crashes 2006, however, it can be observed that the number of passenger is reduced due to this crashes. After the crashes, MoT and ENR instituted new regulations that spaced trains at greater intervals among other measures, thereby reducing service and passengers carried to just over 1 million per day.[24] Because of locomotive shortages and other service problems, in additional to, the most of grade crossings are protected by attendants, who place chains across the roadway

[24] The neglect and underinvestment, in the sector of Egypt's railway will receive a significant renovation in response to a series of recent fatal rail accidents. In August 2006, fifty five people were killed and nearly 150 injured when a Cairo-bound passenger train traveling at high speed ploughed into the back of another stopped at a station in the Nile Delta region. Barely two weeks later, have two trained collided, killing two people and injuring dozens. The collisions and the loss of life brought back memories of unfulfilled government promises to make the railways safe after Egypt's worst ever rail disaster of 2002: a horrific fire on a train to Upper Egypt that killed 373 people [71]. That disaster focused attention on the state of the railways and given rise to demands for serious repairs of a system used daily by more than 1.2 million passengers, mainly from rural or working class areas, and which transports approximately 11 million tons of goods per year.

when a train is approaching; furthermore, there are significant numbers of road vehicle and train collisions, injuries, and deaths each year, as shown in Table 7. In additional, the Egyptian government has long been greatly concerned about the financial costs of railway operations, the declining rail market share, and other evidence of fundamental problems in the Egyptian transportation system. They believed, for example, that the declining market share hurt the economy because less efficient modes were handling more of the freight. The government's Transport Planning Authority therefore carried out a multi-phase National Transportation Study that addressed all modes and both passenger and freight transportation [78]; [79] .The study basically concluded that, even with massive improvements in both management and facilities, it would still be extremely difficult to compete with trucks by providing traditional rail service.[25] It therefore recommended that Egyptian railway drop wagons service and concentrate on unit trains:

Table 7: Accident History of the Grade Crossing in Egypt, 2004-2006

Years	At Grade Crossings			Not at Legal Grade Crossings			Total		
	Collisions	Injuries	Deaths	Collisions	Injuries	Deaths	Collisions	Injuries	Deaths
2004	64	42	22	85	29	15	150	71	37
2005	69	62	19	75	10	10	144	72	29
2006	51	69	21	73	6	7	124	75	28

Source: Data collection from the Cairo University, Egypt

Many of the collisions take place when a vehicle many of which are in poor repair becomes disabled on the active tracks with insufficient time to clear before the train comes through. It can be noted, the declining freight market share has been of concern to the management of ENR and MoT, as it has caused revenue losses and resulting increases in truck traffic congestion around metropolitan areas. Thereby, rail passenger transport has a share of about 8% both railway and metro in all passenger modes in Egypt and this led to the decline the share of this sector in the transport of passenger and freight. Indeed, after analyzing the government developed of strategy for the railway sector. It can be observed that, the government is concentrate on the reform and restructuring of railway to 2012 according to the upper part. Thus, led to that, there are no a new project in this period. However , in this study will be concentrated on the how can establish a new HSR line in Egypt, because, the upgrade the existing network to used higher speed is difficult as show in the previous Table 7 and will be explained that in the next's chapter.

5.3 Performance Analysis of the Egypt Railway

5.3.1 Passenger Transport Service

Passenger transport is the backbone of transport in Egypt. It can note that, the number of passenger by rail transport is decreasing in the recent years, due to the poor service and the accidence. Furthermore, passenger traffic steadily developed from the early 1995s until 2003 (when it reached a record 46,431 billion passenger-kilometers). Since 2004 traffic has reached 53,638 billion passenger- kilometers until 2006 (approximately the same number of passenger in this period), after this the number of passenger/km is

[25] Egyptian railway should concentrate on the transport of large quantities of freight between specific origins and destinations. It is then possible to operate unit trains in closed systems, with their own specific stock and according to fixed schedules. These transports are to be organized in close cooperation with the customers, with special emphasis on handling procedures at the terminals. Costs are to a large extent influenced by the turnaround times of the cars and these in turn are often long because of delays at the terminals which are beyond the influence of Egyptian railway.

decreasing [Table 6]. However, decreasing is probably due to the increase in first class fares 10% and the introduction of passenger insurance levy to all classes [80]. The present market share of the railway is reportedly about 40% of the total public passenger transport market. It is clear that, the activities of ENR have been divided in four business units since 2008, this activities including: Long distance passenger services; Short distance passenger services; local services; suburban and special service; additional to the freight transport services. Thus, the important categories will be discussed in this study is the long distance passenger serves, while this term of the serves is the most important in the long-distance transport of passengers in Egypt. In addition to revenue may be significant to cover operating costs. In the following Table 8 will be explained these categories in term ENR total seat, passenger revenue and the profitability/disability for each service.

Table 8: Performance Passenger Transport service in Egypt

Categories of service	% ENR total seat km	% passenger traffic revenue	Average revenue by Pkm	Profitability And disability
Intercity Passenger Services	20	55	0.015- 0.03 €/ passenger-km	profitable
Express Services	45	28	0.005 €/ passenger-km	deficit
Local Services	29	11	Less than: 0.005 €/ passenger-km	deficit
Suburban Services	3	3	----	deficit
Special Services	3	3	----	deficit
Categories of service	% ENR total trafic volume	% freight traffic revenue	Average revenue by tkm	Profitability And disability
Freight Service	7.67	18	0.008 €/ ton-km	deficit

Source [80]

It is clear from the preceding Table 8 that, the key indicators above show the Egyptian railway is operated very useful and assets are generally used efficiently. However, operating the Egyptian railways under the current rules of the game imposes high financial costs and therefore direct and indirect fiscal cost on the Government. The main reason is that railway services are sold at a very low price (below operating cost coverage rates for all intercity services and freight transport) and that some services are provided by rail where it would be more economical to provide them by road (for example, local, suburban and special passenger service and possibly express services). Also, in the next points will be analyzed the impact of operations rail service on Egypt's in terms of public expenditures and fiscal situation.

- **Intercity Passenger Services**

These long-distance, high-quality services (in terms of comfort and speed) serving only big cities operate on the direct route Cairo/Alexandria (32 pairs of trains per day), and the direct route Cairo/Luxor–Aswan (19 pairs of trains per day). Main competitors to intercity passenger services are private cars, bus services, and air transport. Intercity passenger services account for about 20 percent of total seat-kilometers produced by ENR, and generates about 55 percent of passenger traffic revenue. Moreover, currently revenue per seat-kilometer is LE 0.024 (0.03 €/passenger-km between Cairo and Alexandria, while between Cairo and Aswan the revenue per seat-kilometer is LE 0.124 (0.015 €/passenger-km).[26] Cost recovery was above 120 percent before tariff increases

[26] These figures tariff in accordance with the current prices in 2011 through the ticket prices of ENR web site March 2011 and Exchange Rates in the same year, taking into account that, these prices to the existing network in Egypt.

in 2008, meaning that intercity passenger services are profitable. ***It can be observed that, in the Intercity Passenger Services or in the long distance passenger railway, there is no deficit.*** Furthermore, intercity passenger services, which are considered as commercial services, offer excellent prospects for expanding services along existing routes and favor expansion on other routes. On the other hand, the study of a new railway system such as high-speed rail in Egypt must be consideration by the government. Therefore in this study will be analyzed all the factors that help the government to adopt appropriate in this regard.

- **Express Services**

These are long-distance, lower-quality services that utilize non-air-conditioned coaches and operate at lower speeds. They serve medium- and large-sized cities on routes that are also served by intercity services, and provide services in the Nile Delta, including from Cairo to Damietta, Cairo to Port Said, Cairo to Suez, Alexandria to Damietta, and Alexandria to Port Said. Customers are primarily lower income passengers who cannot afford the more expensive intercity services. Competitors are mainly buses, mini-buses (14 seaters), and taxis (7 seaters). Intercity services accounted for about 45 percent of ENR's total seat-km in FY2006, but generated just 28 percent of passenger traffic revenue. Revenue per seat-kilometer is LE 0.04 (0.005 €/passenger-km). Cost recovery is estimated to be around 50 percent in FY2007. ***Despite that, it can be noted that, express services run a substantial deficit, estimated by ENR at LE 182 million (Euro 23, 12 million price in 2009)***. Development prospects for these services are likely to be limited, as competition from low-cost buses and mini-buses should increase in the future.

- **Local Services**

Although they cover short distances and are of low quality, local services serve an important social dimension by connecting lower-income residents of rural communities with cities and markets. Services are concentrated in the Nile Delta and one route in Upper Egypt. They accounted for 29 percent of ENR total seat-km in FY2006, just 11 percent of passenger traffic revenue, and cost recovery level was only about 25 percent in FY 2005. ***Thus, clearly generating an estimated deficit of some EGP 57 million (Euro 7, 24 million price in 2009)***. This significant deficit was derived from the combination of: (a) high production costs of small capacity, short-distance trains[27] and (b) low revenue per seat-km. The latter is due to low fares set by the Government for social purposes, and poor train occupancy ratios. Mini-buses and taxis operated by the private sector are fierce competitors and often offer better quality services, particularly in terms of service frequency, a factor that explains the low occupancy ratio of trains.

- **Suburban Services**

Suburban services are operated by the ENR in the Cairo and Alexandria areas. They accounted for about three percent of the total seat-km produced by ENR, and two percent of ENR total passenger revenue in FY06. ***In FY2007, these services reportedly generated a deficit o f EGP 10 million (Euro 1. 27 million price in 2009).***

- **Special Services**

ENR also operates special passenger services for the military (almost 90 percent of the services), police, and some factories. This activity is marginal, accounting for only 3 percent of total seat-km and total passenger revenue. ***These services also produced a deficit of some EGP 12 million (Euro 1.52 million price in 2009) in FY2007***.

[27] According to ENR, fully-allocated cost per seat-km is 35 percent higher for local services than for express services

5.3.2 Freight Transport service

There are only two liens for freight in Egypt as in the Figure 11. The 346 km line from the el- Bahariya Oasis in the Western desert, to the Helwan iron and stell works in south Cairo to carry phosphate and iron ore. The other line is from Abu Tartur- Qena- Safaga, a length of 680 km and this line passes over the River Nile at Qena (Figure 11) also to carry only the phosphate between them. Egypt's railway sector can be described as not adequate to handle the country's needs, although currently its operational capacity is stretched to its limits. The importance of Egypt's railway for freight transportation is forecast to reduce slightly over the medium term, from 12% in 2005, 8.34% in 2008 to 7.67% in 2012 and the freight traffic provided about 18 percent of revenue in FY2007 [81; 83]. It is clear that, it does not cover the fully allocated cost; freight traffic is quite likely to cover its direct costs.[28] Freight tariffs are relatively low: US$0.008 per ton-kilometer, well below average U.S. tariffs (US$0.01–0.015) generally considered the lowest economically based tariffs in the world [81]. The ENR mainly transports mineral resources, including iron ore, phosphate, and clay, coal and coke for the steel industry, petroleum products, and imported wheat and containerized goods across the land-bridge from the Red Sea in the east to the Mediterranean Sea in the north.[29] Over the past decade, especially in 2009 rail freight traffic has stagnated globally at around 10 million tons and about 3.84 billion ton kilometers (similar to the 1999 level Table 6), also it can be noted that in the past four years the rate of freight transport is decrease by 11.5%. During this period, substantial competition from the trucking industry has developed and rail market share in national freight transport has declined. The aggressive private trucking industry generally provides good and flexible service, enjoys total freedom in setting prices (in ENR this is not possible), and reduces its costs by overloading trucks. The railway has not been able to adjust its commercial and operating practices to keep a competitive edge in highly competitive segments of the market, which have therefore been lost to the trucking industry.

5.3.3 Loss of Revenue and Problem in the Egyptian Passenger Railway

Part of the problem with the railway is that the fares are too low to create a sufficient revenue stream for the efficient running of the company. Even with substantial state subsidy. ENR which oversees all of the railway operation Estimate the value loss in revenues of passenger transport in the ENR around $1.25 billion since 2002, according to ministry of figures. These due to fare evasion, also due to the small revenue it receives which are not enough to buy the necessary spare parts or improves its facilities, especially on express and local services as shown in Table 8 (40 percent, and even as high as 80 percent on some services). In addition, increases in full price for passenger services over long-distance have not kept pace with inflation, leading to more losses. A fare increase of 15 percent (for 1st and 2nd class air-conditioned coaches) was approved and implemented in fiscal year 2008, and ENR hopes to institute another increase when the quality of services has improved, with subsequent increases at the level of inflation. Fare increases are not proposed - nor would they likely be approved - for lower classes

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[28] ENR utilizes an Independent Traffic Costing Model, which is part of a Business Evaluation and Management System. The system has several capabilities to assess the profitability of ENR various services, but they are not fully-used. In particular, only fully-allocated costs are computed, but there would be benefits to calculating direct costs (short-, medium- and long-term), as well. Utilizing replacement values, rather than historical values to calculate the depreciation of assets, would be preferential in many instances. Simple adjustments to Independent Traffic Costing Model and Business Evaluation and Management System would make them more efficient management tools

[29] Domestic traffic of import-export containers (between ports and main cities) is low, part of which is due to the complete lack of intermodal rail connections with inland container terminals

of service. Despite these necessary increases, the general revenue strategy is not to increase fares significantly, but rather to improve the quality of services, including changing the fleet structure to include more air-conditioned coaches, to increase the percentage of 1st class coaches. With respect to fare evasion, ENR is running a public awareness campaign as well as increasing controls on trains and in stations. The investment in a new system for long distance passenger is more profitable. The passenger business has been reorganized in two business units: short distance passenger and long distance passenger. ENR revenues from these two business units have been reconstituted assuming no tariff increases will be implemented. Indeed, growth on short distance lines is in line with population growth forecasts lower; while growth on long distance lines is driven by a soaring demand on the main corridors will be increased due to economic development. Revenues are expected to grow due to the implementation a new HSR line for long distance. In addition, the ENR suffers seriously from lack of funds to modernize and the poor maintenance depot is typical of the problems. But some passengers still try to hitch a free ride

5.4 Political Aspects in Egypt Transport and Development Strategies

At the beginning, the development policies are decision, action, or measure related to various development programs is referred to as a policy. Thus, transport investment policies include those investment projects that are instituted to restore or upgrade the initial condition of a transport facility, complete renewal of an existing one, or construction of a totally new facility. It can be observed that, transport regulatory policies include the broad spectrum of market and operating regulations: exit and entry regulations, price regulations, taxes and subsidies, and the regulations related to the level of transport services. Organization policies related to the transport sector include the institutional arrangements, organization procedures, and the processes that formulate, implement and coordinate the various programs of the transport sector. Moreover, the consumer forms a link between transport and the forms of housing, since he is both a transport user and he rents or owns his dwelling. He is characterized by a level of income and a varying sensitivity to the tariff and comfort of available modes of transport.

It also includes, the various development policies related to each sector (such as transportation) may be classified according to the different subsectors or branches of that specific sector. Thus the development policies related to the transport sector may be classified into the development programs of railways, the development programs of a particular trucking company, and so on. In this section will be focused on the based the review of Egypt development plan, where this part encompassed the following tasks: identification of the goals that are related to the transport sector and are consistently stated in Egypt's development plans, determination of specific transport policies, and comparison of these policies with some of the goals on transport sector. Also discuss investigation under each task: Egypt's transport influenced development goals are documented. The investment policies specified in the plan documents are compared with the stated development goals, and examples of the regulatory policies that implicitly govern Egypt's transport sector. Additional to the role of the organization that coordinates the various programs of the transport sector is analyzed

5.4.1 Transport sector Influence Development Objectives

Although the several development plans reviewed reflect changing priorities, they have generally emphasized a number of development goals. In fact, among the plans will be reviewed, there is a high degree of consistency in the articulation of certain specific development objectives. From these goals, those that are related to the transport sector are extracted and authenticated here. Thus, as proposed in the plan documents, Egypt's transport-influenced development objectives may be summarized in the paragraphs below. In addition, in order to indicate the links between transport policies and development goals, examples are provided for the ways stated goals might influence Egypt's transport sector and the kind of policy implications they might have. It is clear, the proposed in the next plan transport policy in Egypt does not include the establishment of new lines (such as rail), however, depend on the development and maintenance only.

- More equitable distribution of income. An example of policy implications of this goal is that if the government subsidizes the transport sector, the distribution of subsidies among the various transport modes should be in line with the goal of income distribution. That is, transport subsidies should focus on services that are used by lower income passengers or that carry goods commonly used by lower income people.[30]
- More uniform distribution of population. One policy implication of this goal is that the development of, and investment in, transport facilities of new communities will be compatible with this goal of Egypt policymakers. That is, by providing suitable access to and from new communities, and by improving the infrastructure (including transportation) of new towns, the achievement of this development goal will be facilitated.
- Expansion of employment opportunities: This goal implies that transport projects to be undertaken be those which will generate new employment opportunities. Consequently, in the process of choosing and implementing transport projects, and in connection with the kind of employment opportunities that the policymakers intend to generate, thought is to be given to such issues as the technologies used in the design and implementation of transport projects, and importing new fleet versus improving existing transport facilities.
- Stimulation of private enterprise: The transport-policy implication of this goal is that appropriate programs should be implemented to stimulate the role of the private transport companies in Egypt. That is, the regulatory policies related to the private trucking companies, the intercity taxis, the private barges, and the private buses should be compatible with this goal of Egypt's policymakers.
- Improvement of the public sector and establishment of a comprehensive planning system: This goal influences the regulatory and organizational policies of Egypt's transport sector in several ways. For instance, it implies that the programs of Egypt's transport sector should be formulated and implemented in the comprehensive fashion described in Egypt's development plans; that is, transport investment programs should be supplemented with compatible regulatory policies, planned policies should be flexible to cope with changing situations, and organizational procedures should ensure adequate coordination among the various programs of the transport sector.[31]

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[30] Indeed, for the railway sector is a key to low-income passengers as shown above in Table 8. Consequently, this is a great problem in this sector, in additional to this the previous and current policy were work to take into account the low-income, especially in the railway sector and this led to the deficit in the railway comes.

[31] The development objectives have, in turn, led to a subsidiary set of goals within the transportation sector itself. That is, these broader intersectoral goals are translated into more specific goals for transport-policy formulation; as stated in the plan documents, these goals include the following: Increased emphasis on the intercity railways; Priority for maintenance and rehabilitation projects, as opposed to new investments; Focus on the completion of the projects that are already underway, as opposed to new

It can be noted that, the transport affected objectives in Egypt's development plans; the next step is to identify some specific transport policies and compare these policies with some of the stated goals to determine the links that exist between transport policies and development goals in Egypt. Where, there are three categories of policies are identified: transport investment policies that have been embodied in the various plan documents; some transport regulatory policies that implicitly prevail in Egypt; and the role of the organization that coordinates Egypt's transport programs. In the following sections, it will be compared each of these policies with the stated goals identified earlier.

5.4.2 The Policies Transport Investment and Development

The Government investments have typically consisted of more 42.5% of the total investments specified in Egypt's on the 2008/2009 development plans. In fact, only in the present development plan is private sector investment estimated to research any significant level 57.5 percent. For instance, during the years 1984 to 1990, private sector investment within the transport sector was only about 19.3% and 23%, respectively whereas the investment of the private sector in 2008 was 48.2 % and the figure declining to be arrived at 38 % in the year 2011[85], as well as the investment public sector within in the transport sector in this period was about 80.7% and 77 % made by the government.[32] Consequently, in an attempt to identify specific transport investment policies and compare them with the stated goals, we have focused on the public investments embodied in the plan documents and have made an analysis of the following:

- The share of public investments allocated for transportation versus other socioeconomic sectors;
- The distribution of investments among the different intercity transport modes; and
- The allocation of investments between rehabilitation versus new transport projects.

It can be noted in the following sections each of these analyses is discussed and will be analyzed the transport policies are compared with the goals identified.

5.4.2.1 Investments in the Transport Sector

To make sure that, the share of the public investments devoted to the transport sector, we have maintained a consistent classification of the activities related to each distinct part of the economy (sector). Nevertheless, the programs attached to the irrigation, drainage and land reclamation are included in the **Agriculture sector**. The programs of building materials, construction, utilities and new communities are included in the **Housing and Public Utilities sector**. **Services** include aids for health and education as well as the support for local governments. In line with current thinking of Egyptian policymakers, the investments devoted to petroleum, tourism, Natural gas and the Suez Canal are included in the **Export sector**. The programs related to **Communication** are treated as an independent group of activities. Finally; the **Transportation sector** encompasses (1) programs of the Ministry of Transport, (2) programs of the Ministry of

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commitments; Priority for the expansion and development of the existing facilities, as opposed to new infrastructure; and Concentration on certain vital new investments rather than spreading the resources too thinly over a large number of projects.

[32] In this analysis private sector investments comprise capital expenditures to provide common carrier service; example are purchase of vehicles (e.g., taxis, buses, trucks, barges), and construction of related facilities (e.g., garages, shops). Not included are capital expenditures for private use (e.g., private autos, trucks for haulage of own goods), recurrent or variable operating expenses. In addition, private sector investments capital expenditures in year 2008/2009 is the following; Natural gas and other extractions 87%to 100%; Communications 85%; Real estate activities 97%; other Manufacturing 75%. The investment on the transport section is only 34% [84].

Maritime Transport and Ministry of Civil Aviation, (3) transport programs of the Ministry of Housing and Reconstruction, and (4) the activities of urban-transport organizations.

Based on this classification, it will be compared the public investments embodied in the various development plans and presented the results in [Table 9]. These data show that in the development plans under investigation, the public investment allocated for the transport sector has continuously increased, especially over the past five years when the transport sector's budget has increased from LE 10331.2 million in the 2004-2005 plans to LE 16764.2 million in the 2009/2010 plan. In percentage terms, however, the specified investments do not suggest rising patterns.

It can be noted that, however, the specified investments do not suggest rising patterns. As mentioned earlier, however, these development plans differ in their scope, content, and stature. Some are more detailed, have played more important roles in Egypt's development, and provide a more realistic picture of the thinking of Egypt's policymakers; these include the 2003/2004 until 2008/2009, and the current 2009/2010 development plans.

Table 9: Public Sector Investments (in LE million)

Sector	2004/2005		2005/2006		2006/2007		2007/2008		2008/2009		2009/2010	
	Projected budget	(%) of total	Projected budget	(%) of total	Projected budget	(%) of total	Projected budget	(%) of total	Projected budget	(%) of total	Projected budget	(%) of total
Agriculture, irrigation & reclamation	3170.1	8.13	2799.7	7.1	2433.7	5.7	2849.5	5.7	2743.3	4.8	2878.1	3.7
Industry Manufacturing	1406.6	3.6	1434.3	3.6	5118.7	12	4425.3	8.8	5851.4	10.3	6921.3	9.0
Transportation & storage	10331.2	26.47	7868.3	20	10313.3	24.2	12902	25.7	15542.8	27.4	16764.2	21.7
Housing and utilities	489.9	1.25	576.1	1.5	562.2	1.3	857.8	1.7	1626.4	2.8	2933	3.8
Social & Personal Service	5401.9	13.8	4599.3	11.7	4563.1	10.7	6435.8	12.8	7573.8	13.3	8267.2	10.7
Crude oil, Natural gas, Other mining, Oil Products	8260.1	21.17	11961.5	30.3	11150.5	26.2	10398.7	20.7	5771.1	10.2	21259.7	27.6
Electricity	7951	20.37	7940.8	20.1	7621.1	18	10724.8	21.4	15574.7	27.4	15862.6	20.6
Communications	2026.2	5.2	2259.8	5.7	804	1.9	1566.1	3.1	2142.4	3.8	2195.1	2.8
Total	39037	100	39439.8	100	42566.6	100	50160	100	56825.9	100	77081.2	100

Source: [85]

If we focus on the investments specified in these six development plans, the patterns indicated by the outlays [presented in Figure7] allow us to make the following observations:

- The public investments specialized for the transport sector has risen continually from 2006 to 2010, while the industry sector falling somewhere between the investments specified for housing and agriculture sectors in years 2005 to 2006 and then began to increase again until 2010. The highest share of investment has generally gone to transport; the allocation of the lowest share for the agriculture sector, under the 2005 -2007 plan, may be explained by the to reduce requirements of the Irrigation and reclamation projects in Toshka, due to foreign investment in this project.

- The increasing investments specialization for the housing sector during the 2006 to 2010 plan (which includes new communities, construction, and utilities) may be linked to several of the goals stated in Egypt's development plans. Specifically, this policy may reflect the goal of uniform population distribution (through investments in new communities), the goal of uniform income distribution (through provision of low-cost houses), and the goal of expanding employment opportunities.

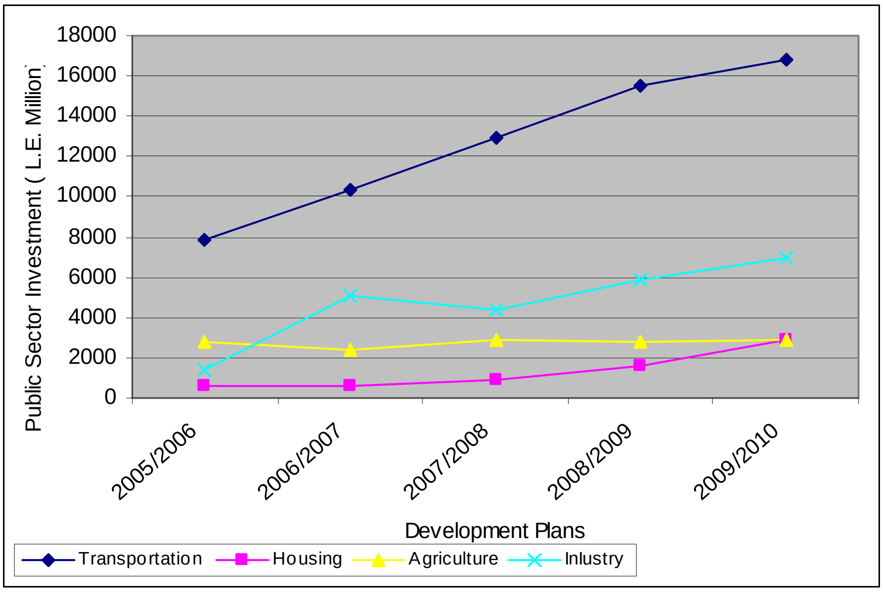


Figure 12: Inter-sectoral Investments in the Public sector

Finally, all investment by the government, aware of the need for an extensive modernization and upgrading of the rail system, allocated funds of around $7.04 billion only to improve the ENR. Upgrading the system now is one of Egypt's top priorities and private sector involvement is being sought to plan, develop and operate railway projects. It can be observed the World Bank signed a loan of $270 million to finance the upgrade of the Egyptian railway [83]. Also this amount aims to improve the efficiency, reliability, and safety of rail services. Investment will be focused on upgrading the signalling systems and laying new tracks. As to the establishment of other new projects, there is no investment from the government was regulated so.

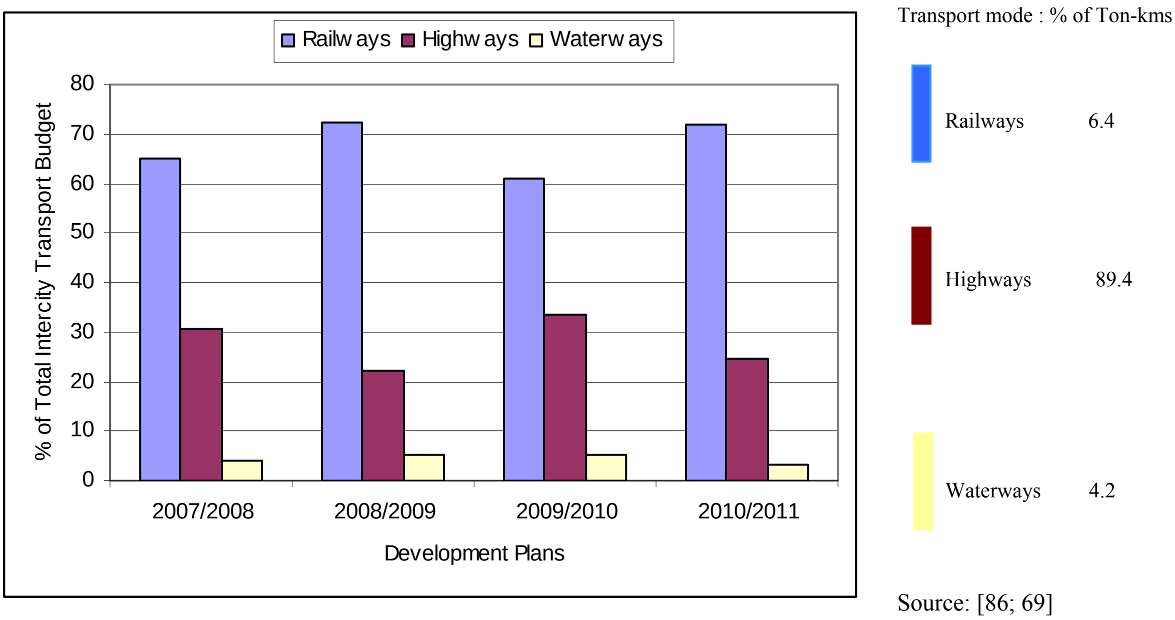
5.4.2.2 Investment Distribution between Intercity Transpiration Modes

Within the transportation sector, it will compare the public investments devoted to the intercity railways, highways, and waterways. Before discussing some results, however, there are two points to be mentioned:

1. This analysis of modal investments is limited to the outlays specified in Egypt's most Sixth Five-Year Plan 2007 – 2012
2. The Sixth Five-year budgets of the 2007-2012 plan documents are not allocated at the level of different transport modes. However, the 2007 budget of the 2006/2007 plan, and every year has its own budget like the previous plan are available. We have therefore compared the modal investments in the first years of the respective plans and have assumed that these outlays are indicative of the investment patterns throughout each of the respective five-year periods. This is a reasonable assumption, since the review of Egypt's development plans has revealed that the budgets specified in these documents are usually distributed uniformly over the duration of

each plan.

Based on these premises, the public investments referred to the different intercity transport modes are indicated in Figure 13. Although the percentage of the public sector investments allocated for a specific mode of transport is not the only measure of the relative importance given to that particular mode, nevertheless the data in Figure 13 indicate the focus of the public investments on the intercity railways.[33]



Source: [86; 69]

Figure 13: Investments in the Intercity Transport Modes in Million EL

Consequently, in the three above cases it can be analyzed, the proportion of intercity railways were 65.0 percent, 72.4 percent, 61.1 percent and 72.1 percent respectively, of intercity transport investments. The order of priority for the other intercity modes has been highways and waterways; the intercity highways have claimed 30.8 percent, 22.3 percent, 33.6 percent and 24.8 percent of the investments, and the intercity waterways have obtained 4.2 percent, 5.3 percent, 5.3 percent and 3.1 percent. We may therefore infer that this policy is in line with the goal stated in Egypt's development plans to emphasize the intercity railways.[34]

This inference is further supported when we compare these expenditure with the production of different modes, as estimated by Egypt's National Transport Study for the year 1979 and presented in [Figure 13], it can be noted that, there are not significant differences between these figures. It can be observed that, from Table 9 only 6.4 percent of the intercity ton kilometers and the railroads take the highest share of the intercity investments (65.0 percent, 72.4 percent, 61.1 percent and 72.1 percent). The highways, on the other hand, with the highest share of the intercity ton-kilometers (89.4 percent), take only 30.8 percent, 22.3 percent, 33.6 percent and 24.8 percent of the investments. The waterways, with ton kilometers close to that produced by the railways (4.2 percent against 6.4 percent); take the lowest share of the investments (4.2 percent, 5.3 percent, 5.3 percent and 3.1percent).

[33] The expenditure target from the Ministry of Transport and bodies during the period [2007/2008-2010/2011], it can be note that the projects of roads, bridges and subways has been take a great part of the investments, approximately 60% in 2009/2010 plan.

[34] Also it can be note that, in this analysis the railway is the only intercity transport authority having combined responsibility for transport infrastructure, fleet and operations.

5.4.3 Transport Regulatory Policies

Despite, the review of Egypt's development plans reveals that transport regulatory policies are rarely explicitly stated in the plan documents, a certain regulatory environment implicitly governs Egypt's transport sector; some of these policies have been identified and compared with the goals stated in Egypt's development plans. For example, we have looked at the distribution of government expenditure among the intercity modes and among the railway services.

5.4.3.1 Expenditure among Intercity Models

According to the National Transport Study, the tariffs of all the intercity transport modes in Egypt are lower than they should be, if the value of all the resources necessary for providing the services is taken into consideration. Government expenditure is therefore required to meet the deficits of these transport modes. In order to look at the distribution of government spending among intercity modes, the production of different modes is compared with their costs and revenues which were in 1979 as reported in National Transport Study; [78] the results are indicated in Figure 14. Despite, the figure is based upon financial costs and ton-kilometers of various intercity modes.

The data presented in Figure 14 suggest that the spending are not distributed according to modal production [see in 86]. Otherwise, one would expect the highways, with the highest share of the total ton-kilometers, to be more heavily subsidized; the waterways, with the lowest production rate, would be the least subsidized mode; and the railways share of the spending , similar to its production, would fall somewhere in between.

In Egypt, however, the distribution of spending in connection with modal production is such that the railways claim 72.1 percent of the total intercity transport subsidy and only produce 6.4 percent of the total intercity ton-kilometers [see Figure 14]. The highways, on the other hand, claim only 24.8 percent of the spending that go to the intercity transport, but produce 89.4 percent of the intercity ton-kilometers. Finally, waterways, with a production rate close to that of the railways (4.2 percent as against 6.4 percent), have spending of only 3.1 percent of the total intercity spending.

We may therefore infer that, among the intercity modes, government spending emphasize the railways; this policy is in line with the goal stated in Egypt's development plans to support the railways. Furthermore, since the investment outlays emphasize the railways, s well as indicated in [section 5.4.2.2], we may also infer that this policy on transport spending is compatible with the investment programs embodied in the plans documents. Consequently, the performance of rail transport is lower than highways (in terms of ton kilometers and the passenger kilometers) when compared with the expenditure. Also, thus lead to a significant deficit in this sector, as shown in the next part.

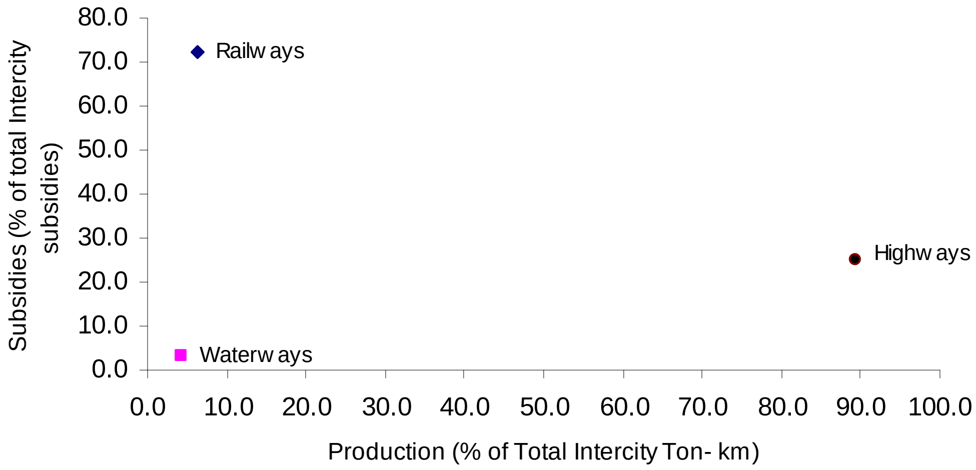


Figure 14: Performance/Subsidies of the Intercity Transport Modes

5.4.3.2 Expenditure in the Railways Service

The production of different railway services, in terms of ton-kilometers and passenger-kilometers, are compared with their deficits in the railway sector, it can be observed the results are indicated in Figure 15. The distribution of expenditure among railway services shows some imbalances, especially in connection with the average income of the passengers who use these services. For instance, the tourist and first-class services (Intercity service), which are used by persons of sizeable income, are more subsidized than the suburban services, in addition there is no deficit, while the production of the latter service is six times more and the average income of the passengers is significantly less. This policy, therefore, appears to be incompatible with the goal of more uniform income distribution. The data presented in Figure 15 suggest that the performance/deficit in the deference railway service, thereby this data and figures come after analyzing the Table 8.

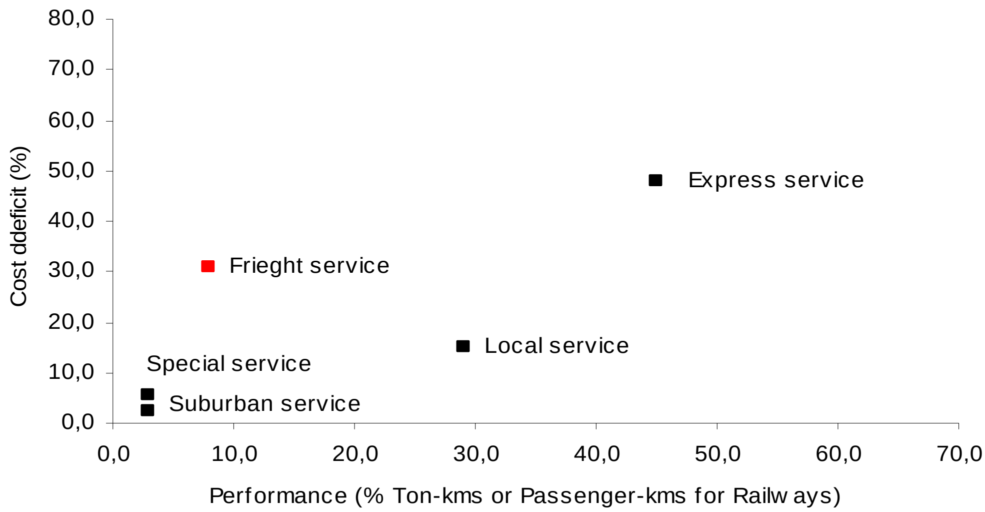


Figure 15: Performance / Deficit of the Railway Service in Egypt

According to Table 8, it can noting that; a similar distortion exists when we compare the local service and the suburban services. That is, local service, with lower production rate and some with air-conditioned trains, receive nearly twice the subsidies of the suburban services, whereas the latter services are normally used by the lower-income passengers. While the special service will be serve the military, police, and some factories.

Within Egypt's transport sector, the goals stated in the plan documents are:

- increased emphasis on the intercity railways;
- priority for maintenance and rehabilitation projects;
- focus on the completion of the projects that are already underway;
- priority for the expansion of the existing transport facilities and infrastructure; and
- concentration on certain vital new investments rather than spreading the resources too thinly over a large number of projects.

Moreover, infer that, the current development plans and current budget in Egypt government does have not any investments for new projects. This indicates that the previous government alone is not able to generating new investments, especially if thinking in high-speed lines. This due to that, financial transfers and subsidies to the railways sector it does not be transparent.[35]

5.5 The Underdevelopment the Railway in Developing Countries

Why the railway in most developing countries is underdevelopment, and why the railroad is neglected with the other modes of transportation, this is due to many reasons. First, the colonial, in the nineteenth-century colonies established by Europeans in Africa and Asia it was often the case that the railway were developed, for reasons already noted, by the colonial government and such railway for the most part remain state controlled in the post independence period. Second, the railways established in the early colonial period were for reasons of stinginess often built to low design standards and at least cost and in many cases have proved incapable of satisfactorily accommodating the traffic of expanding economies. The railways of developing and emerging countries provide good examples of initial considerable impact but are network on which even the traditional traffic is now handled with great difficulty and where there is no possibility of rail induced economic development taking place.

Most of the national railways in the world face the large challenge, and how best to structure the railway to be successful in competitive transport markets; how to create\ incentives for railway managers to provide efficient and high quality services to the economy and the public; and how to channel public support for passenger services or network extensions in ways which will ensure cost effectiveness. While detailed solutions vary with circumstances, nearly all railway reform programs have been built on structures which create individual business units (lines of business) with their own financial accounts, ending of cross-subsidy between the units, transparency and targeting in the financial flows between railways and the countries.

Many developing countries inherited from colonialism and have rail systems built cheaply and to design standards which are far from adequate by any present day criteria, limit their capacity and increase their costs. When originally built the railways often had a virtual monopoly on mechanized transport but this has been steadily corrosion especially by road transport which in many places provides a from of transport better suited to the needs of developing countries. Also lack of capital and foreign exchange has limited essential investment and maintenance so that the efficiency and capacity of railway systems and hence their ability to compete, has been further reduced. Declining

[35] Lack of transparency due to the political corruption that was in the era of the previous government, where most of the investments were dedicated in transport sector especial in the railways sector

traffic means declining revenue and with large throughputs necessary to cover operating and maintenance costs that remains in existence until now.

In many developing countries the railways are heavily workers in relation to throughput and while this may be justified on social reasons it does little to help operating finances. Most railway operation is capital intensive and there is only limited scope for utilizing low cost labour. Because they are capital intensive, railways will be economically viable only where they are used extensively and there are only certain market conditions which will satisfy this requirement. It has already emerged from the above discussion that large volume of bulk freight (fuels, ores, forest products, agricultural products where not too seasonal) provide the best potential for railway transport except where water transport is available can be used.[36] Such freight the most likely basis for further railway development but the movement of containers in large numbers over long distance and also the movement of large numbers of passenger over short to medium distance, possibly in an urban context, also provides suitable markets. However, large parts of the developing world have low traffic generating potential, the distance are often great, the demand slight and highly dispersed and possibility of rail revenue covering cost is virtually negligible. Governments have seriously to consider whether in these conditions rail transport is justifiable although there may well be non-economic arguments to be taken into account.

Therefore, the network, operation and economic characteristics of rail transport make it an inflexible mode, lacking adaptability and ability to respond to changing market conditions. The possible role of railway as a factor influencing wider aspects of development can only be assessed in these terms and in consequence is often likely to be limited. Where the conditions are right and the whole properly managed, rail transport can still be a powerful factor and as roads become ever more heavily congested must certainly if the present governments improve, maintenance and enter the modern technology in the scope and speed of existing rail network

It would be wrong to imply that great capital investment is necessarily needed to improve railway capacity. In all forms of transport the first priority must be to ensure that the existing capacity is use to maximum efficiency and its fullest potential before money is spent on replacement, improvement or extension. There is certainly considerable evidence to suggest that many of the railways in developing countries, if they started with inadequacies of design, have not been well managed and properly maintained.

Consequently, the situation in many less developed countries is even worse. Their topographical and climatic conditions are generally less convenient to railways as a means of transport, with mountain ranges and heavy rainfall making operations both expensive and unreliable, eliminating the cost advantage the railways usually have over roads. The situation is worsened through the use of outdated equipment and inadequate maintenance. Finally, the organisational ability to run a large complex organisation such as a railway system is scarce in developing countries. Because the railways are generally government owned, salaries are comparable with those of civil servants and therefore not enough to attract the best professionals from the private sector.

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[36] On the contrary, the revenues of the transport of goods cover only a small portion of total costs, increasing traffic may simply increase a railroad's deficit. As a result, increasing traffic and reducing the deficit can be conflicting goals. This is most evident when a railroad is required to carry traffic at a loss for the good of the national economy. It is therefore important that a government owned railroad like ER have clearly defined goals that address traffic volume, traffic mix, and financial performance.

Despite these differences, the principles of network rationalization are basically the same for railways in both developed and developing countries. For all railway systems, the construction of a new line or the closure of an existing one must be evaluated according to its effect, not only upon the remainder of the railway system, but also upon the use and efficiency of alternative and complementary transport modes. It can be also noted that, the impact of network changes on the nation's economic system must be considered by taking account of the changes on the relocation or closure of industry in certain areas and economic effects and it’s social. Thus, the networks of transport in developing countries are generally much simpler than those in developed ones and so these system effects are more easily identified.

5.6 Analysis the screening Model for Proposal High Speed Railway in the Country under Study

This section will be presented of a screening model for HSR. The aim is to establish a model for understanding whether a country should start considering building a HSR network or not. The characteristics of these countries will be used for the formation of this model. They will also serve as examples of its application. So, the reader will be able to understand the use of the model more easily.

Before exercising the model, the country under study will be presented. The choice of Egypt, Iran, India and UAE for comparing and contrasting was not random. The fact that constitute of the Egypt and Iran are with their similar situation in term population, income per capital. India and UAE are with a great difference between incomes per capital. Screening the countries under study, it represents the most of developing and transition countries in term of the: A large number of populations with low income and the density of demand for rail transport is large [India], the number of population is little with high income and there is no rail transport [UAE]. Moreover, we are interested into seeing which of the country is ahead in the issue of HSR and if for example Egypt is, then what the rest country can learn from the Egypt experience in also to go forward as well.

5.6.1 Review of the Railways in the Country under Study

The Country of Indian

Indian is a country in South Asia, and with an area of 2, 287,563 km² and the population of 1166 million inhabitants. Bounded by the Indian Ocean on the south, the Arabian Sea on the west, and the Bay of Bengal on the east, India has 35 cities and urban agglomerations with more than 1.0 million persons. The most populous cities are Mumbai with 21.26 million people, New Delhi (21 million), Bangalore (7.15 million), Kolkata (Calcutta, 15.54 million), Chennai (Madras, 7.55 million), Hyderabad (6.72 million), and Ahmadabad (5.37 million) [87]. At the time of independence Indian in 1947, about 40 per cent of the railways then went to newly-created nation of Pakistan. A total of forty two separate railway systems, including thirty two lines owned by the former Indian princely states, were amalgamated as a single unit which was christened as the Indian Railways. The existing rail networks were abandoned in favors of zones in 1951 and a total of six zones came into being in 1952. As the economy of India improved, almost all railway production units were indigenised (produced in India). By 1985, steam locomotives were phased out in favour of diesel and electric locomotives. The entire railway reservation system was streamlined with computerization between 1987 and 1995.

Current Existing Railway in Indian

The first railway system in India was put forward in 1832, but no further steps were taken for more than a decade. In 1844, the Governor-General of India Lord Hardinge allowed private entrepreneurs to set up a rail system in India. The East India Company (and later the British Government) encouraged new railway companies backed by private investors under a scheme that would provide land and guarantee an annual return of up to five percent during the initial years of operation. The companies were to build and operate the lines under a 99 year lease, with the government having the option to buy them earlier. Two new railway companies, Great Indian Peninsular Railway (GIPR) and East Indian Railway (EIR), were created in 1853/54 to construct and operate two experimental lines near Bombay and Calcutta respectively. The first train in India had become operational on 1851 for localized hauling of canal construction material in Roorkee. A year and a half later, on 1853, the first passenger train service was inaugurated between Bori Bunder in Mumbai and Thane, where the distance between them about 34 kilometers [88]. In 1854 Lord Dalhousie, the then Governor-General of India, formulated a plan to construct a network of trunk lines connecting the principal regions of India. Encouraged by the government guarantees, investment flowed in and a series of new rail companies were established, leading to rapid expansion of the rail system in India. Soon various native states built their own rail systems and the network spread to the regions that became the modern-day states of Assam, Rajasthan and Andhra Pradesh. The route mileage of this network increased from 1,349 kilometres in 1860 to 25,495 kilometres in 1880, mostly radiating inland from the three major port cities of Bombay, Madras, and Calcutta.

At the beginning of the twentieth century India had a multitude of rail services with diverse ownership and management, operating on broad, metre and narrow gauge networks. In 1900 the government took over the GIPR network, while the company continued to manage it. With the arrival of the First World War, the railways were used to transport troops and food grains to the port city of Bombay and Karachi en route to UK, Mesopotamia, and East Africa etc. By the end of the First World War, the railways had suffered immensely and were in a poor state. But in 1923 the tow company GIPR and EIR were nationalized with the state assuming both ownership and management control [92]. However, the Second World War severely crippled the railways as rolling stock was diverted to the Middle East, and the railway workshops were converted into munitions workshops.

Indian Railways is considered the lifeblood of the nation. It constitutes the lifeline and the mainstay of the country’s transport infrastructure. It is one of the largest and busiest rail networks in the world and important form of public transportation in the country. Since their inception 153 years ago, where the Indian Railways Beginning in 1853, Indian Railway has been witnessing a historical turnaround in its fortunes in recent years due largely to the responsiveness of the organization to align itself to the growing market competition and to adopt the strategy of lower unit cost and higher volumes. Therefore India had the fourth largest national rail network in the world in the early 1900 [90]. The network continued to expand after this year. It has also been fulfilling its larger social obligations as a common carrier by providing affordable transport services for the masses. In 2007-08, India Railway carried 18 million passengers and 2.18 million tones of freight traffic per day on a network spread over 63,273 route kilometers [91]. It has an established route, all route divided into three gauges broad, meter and narrow.

Indian Railways is a department of the Government and the Ministry of Railways functions under the guidelines of the Railways Minister assisted by Minster of State for Railways. The administration of Indian Railways is done through the Railway Board headed by a chairman and having six members.

Indian Railways is divided into zones, which are further sub-divided into divisions. The number of zones in Indian Railways increased from six to eight in 1951, nine in 1952, and finally 16 in 2003 [92]. Each zonal railway is made up of a certain number of divisions, each having a divisional headquarters. There are a total of sixty-seven divisions. Indian Railways have reached today a significant phase and are at a threshold of an uncertain future. IR will be required to make necessary competitive adjustments to deal with the pressures of market forces in a liberalized economic environment, not only to remain financially viable, but to be able to satisfy the growth in demand for rail transport. As Railways stare into the dark-tunnels, the only source that can probably shed the light to carry it blazing into the future is the Information Technology tool, which many successful organizations are using to their profit. In additional the number of cars per 1000 persons was about 12 in 2007.

The Country of Iran

The Islamic Republic of Iran, with an area of 1.65 million km² and more than 66, 4 million inhabitants, is strategically located in southwest Asia and is among the Middle East Countries. Iran has seven populous cities above 1 million, with 15 million inhabitants in total. Tehran, Mashhad, Esfahan, Shiraz, Karaj and Ahwaz and Tabriz are the largest cities of Iran, in which millions of people travel everyday to reach their workplaces, schools, universities, shopping centers and finally coming back to their homes. The central government of Iran has recognized the need to provide efficient access and mobility in and around these cities.

The capital, Tehran is the seat of the central government. Due to its geopolitical location, it is the centre of large sections of Iran’s economy and commercial activity, industry, services and banking activities. Tehran covers 800 km² and has a population of about 8 million inhabitants, growing at a rate of 1.1%. Together with its satellite townships it is home to almost one sixth of the country’s population - nearly 11 million people. Over 12 million trips are made daily.

In the period between the end of the First World War and the start of the Second World War in the September of 1927, the construction of the nationwide railway network in Iran according to international standards began, extending from Bandar Imam Khomeini (formerly called Mahshahr) in the south to the port city of Turkmen in the north. About the 1,389 kilometre railway project was completed in the summer of 1938 [94]. At the same time, preparations were made to build other railroads which were all left unfinished because of the outbreak of the Second World War and its subsequent occupation of Iran by the allied forces. during of the World War II and due to the pressure exerted on Iran by the occupation forces, Only been building of a 123 kilometre railroad connecting Ahvaz and Khorramshahr in southern Iran started in 1943 and was finished in the same year.

Current Existing Railway in Iran

The expansion of railways network in Iran which came to a halt as a result of the outbreak of the World War II, continued slowly after the end of the war to an extent that the total main railroads of the nationwide network increased to 4,602 kilometres until the year 1978. On the 2002 the railway network in operation launched about 7265 km main lines single track with the standard gauge. Nearly 2,000 km were added over the last ten years reflecting the importance given to railways by the Government. Some of new lines are reported under construction, two-third of which corresponds to Esfahan-Shiraz, Bafq-Mashhad, Quazvin-Anzali, and Kerman-Zahedan. While the Iran railway network in 2006 reached about 8273 km standard gauge and 94 km broad gauge. Then, the total route length of the railway network and of its component parts by gauge: broad, dual, narrow, standard, and other equals 8348 km [95].

Iranian railway carried 26 million passengers and 33 million tones of freight traffic per years on a network [6]. Iran's railway network services approximately 11% of the total freight transported in the country. The train commercial speed is rather slow at 60 km/h and 40 km/h for passenger and freight traffic respectively. On the whole, the Iranian railway's productivity appears very good by international standards in year 2002 such as: Locomotive productivity, Fright wagon productivity, and Passenger coach productivity.

The Country of United Arab Emirates

The United Arab Emirates is a federation which consists of seven emirates: Abu Dhabi, Ajman, Dubai, Fujairah, Ras Al-Khaimah, Sharjah, and Umm Al-Quwain. The area of UAE is 83,000 sq Km and the population about 4.599 million people. The majority of the population (2.5 million) is urban and lives in the two largest emirates Abu Dhabi and Dubai; Dubai has the fastest growing population in UAE.

UAE citizens constitute approximately 20 percent of the population. The rest are foreign workers, predominantly from South and Southeast Asia (approximately 60 percent of the population). The remainder of the expatriate population includes a significant number of other Arabs and Iranian.

Transportation and Railway

The UAE's modern internal transport system was developed primarily in the 1960s and 1970s, with the construction of main roads to link the major cities. Maritime trade is a mainstay of the economy because of the UAE's strategic location on the Persian Gulf, and Dubai's ports at Mina Rashid and Mina Jabal Ali (the largest man-made port in the world) are considered the UAE's premier maritime facilities. The road network is well advanced in urban areas, and Transport within the UAE is almost entirely road-based. Development of the road network has been rapid, and the quality of the roads is good, particularly in Abu Dhabi and Dubai. At present the air traffic for the UAE is conducted via the six international airports of Abu Dhabi, Al Ain, Dubai, Sharjah, Ras Al-Khaimah and Fujairah. In order to keep up with the increasing volume of passenger and fright, the airport capacities are extended continuously. Since the opening of the new Sheihk Rashid Terminal the air port has a capacity of 22 million passengers. Passenger numbers are to continue to rise to 40 million by 2010.

Railway the UAE currently has no rail network, but construction the Dubai Metroa light rail system began in early 2006, about 70 km two-line urban light rail system. This project, slated to be operational in 2010. And in the year 2010 an underground line with 30 stations will link Dubai Airport with the port and indusial area of Jabel Ali in the south of the emirate. This train will be able to transfer 10,000 passengers an hour in both directions on a railway track that will run below ground for about 30 % of this distance [96].

5.6.2 Nature and Characteristics of the Proposal Corridor

The nature of any corridor it is very important, because it is determine the average construction cost for a new high speed railway. Therefore, the construction cost it is not depends only on the technology, but depends mainly on the landscape. If there are a lot of hills and mountains, this leads to build more tunnels and bridges. This means, the first step of a high speed railway construction testing the earthmoving to identify the geological nature of the ground, its geotechnical characteristics and the presence of cavities. Therefore, in the developing and emerging countries there are difference landscapes of the proposal corridor for high speed rail. The implement of high speed rail in the developing countries has revolved around the concept of regional corridor. Consequently, if high speed rail will going to be successfully built in the country case study such as Egypt, it can be observed that most of the developing and emerging countries can used case study for example to be created this systems, if they meet the requirements of that.

So, it can be determine the nature and characteristics of the proposed corridor by the high levels of population and expected population growth along a corridor, strong business and cultural ties between cities as factors that can lead to higher demand for intercity travel. In some corridors, riders are expected to come from business travelers and commuters due to the strong economic ties between cities along the corridor; while in other corridors, a larger number of tourists and leisure travelers comprise the expected riders. Thus, the importance of connecting several high-population areas along a corridor as a key factor in the high number of riders on their system, to effectively serve several travel markets, including commuters and travelers from cities along the corridor.

For example, in country under study the corridor between Tehran and Mashhad, Tehran and Esfahan, these cities consider the largest cities in terms of population density in Iran. On the other hand the corridor between Cairo and Alexandria in Egypt it is one of the most populous regions in Egypt, and the corridor between Cairo and Aswan via Luxor, this corridor considered the backbone for transporting people (both the riders and tourism) in Upper Egypt. Despite, the population density is not higher on this corridor. High-speed rail able to cover the construction and operating cost of this corridor (Cairo and Aswan via Luxor) it will dissection this point later. Where, the importance of connecting several high-population areas along any corridor as a key factor in the high number of riders on their system, to effectively serve several travel markets, including commuters and travelers from cities along the corridor. In India the corridors are unique in that it is one of the most populous regions in India with multiple urban areas of several million inhabitants located along on these corridors. This corridor attracts the highest number of riders than other any corridor in India. However, all this corridors today have not similar levels of population and topography. [Figures 16; to 16C] shows the population distribution of cities on proposal lines in country Egypt, India, UAE and Iran.

Table 10: High Speed Rail Projects Proposal in the Developing and Emerging

Corridor	Distance
High Speed Rail Projects Proposal in the developing and emerging countries	km
Proposal Lines of High Speed Rail in Egypt	
Cairo- Alexandria	208
Cairo-Aswan	879
Proposal Lines of High Speed Rail in Iran	
Tehran-Mashhad	926
Tehran-Isfahan	387
Proposal Lines of High Speed Rail in India	
Delhi- Patna	1101
Hyderabad- Chennai	773
Delhi –Amritsar	477
Pune -Ahmedabad	705
Chennai- Ernakulam	864
Proposal Lines of High Speed Rail in UAE	
Abu Dhabi- Dubai	142

A key element in the development of any passenger transport system is it air or ground based, is the establishment of the corridor network, i.e. the linkages (direct and indirect) between points of major demand. The essential purpose of fast train systems is to provide a high speed transport system linking major areas of population that exhibit a strong demand for linkage. Suitability for the proposed infrastructure based on the functional requirements of the facility/service and the physical, environmental and socio-economic characteristics of the study area. Providing the most direct linkage between the two cities, linking areas of high passenger travel demand this relates to the propensity of a given population to travel and the location of land uses or attractions that generate strong travel demands rather than just sheer population size, the ability to integrate and provide an interchange with other transport modes

The following Figures [16, 16A, 16, and 16C] it can be showed the characteristics of the proposed corridors in terms of population density and the distances between cities. But there is a question. Why has been chosen these corridor in these countries only without others corridor, and if it implementation these corridors in these countries, what is the economic feasibility of it implementing. This question in the next chapter it will be discussed.

For example in case of Egypt data on current Egypt travel, received on a national basis, show that automobiles are the most extensively used modes for intercity travel. Railways it operates at a deficit and its revenues are insufficient to undertake necessary investments in rolling stock and infrastructure (see section 5.3.1). As a result ENR attracts significant government subsidy. Underinvestment and neglect in the network were also suggested to have contributed to serious crashes in 2002 and 2006.

Nationally, rail's share of the intercity market is not likely to increase dramatically. However, if the increases speed maybe this make the rail's is more attractive on the other mode. There are only two corridors may be likely candidates to increase speed [see Figure 13]. These proposed corridors are going through in the most cities in Egypt from north to south

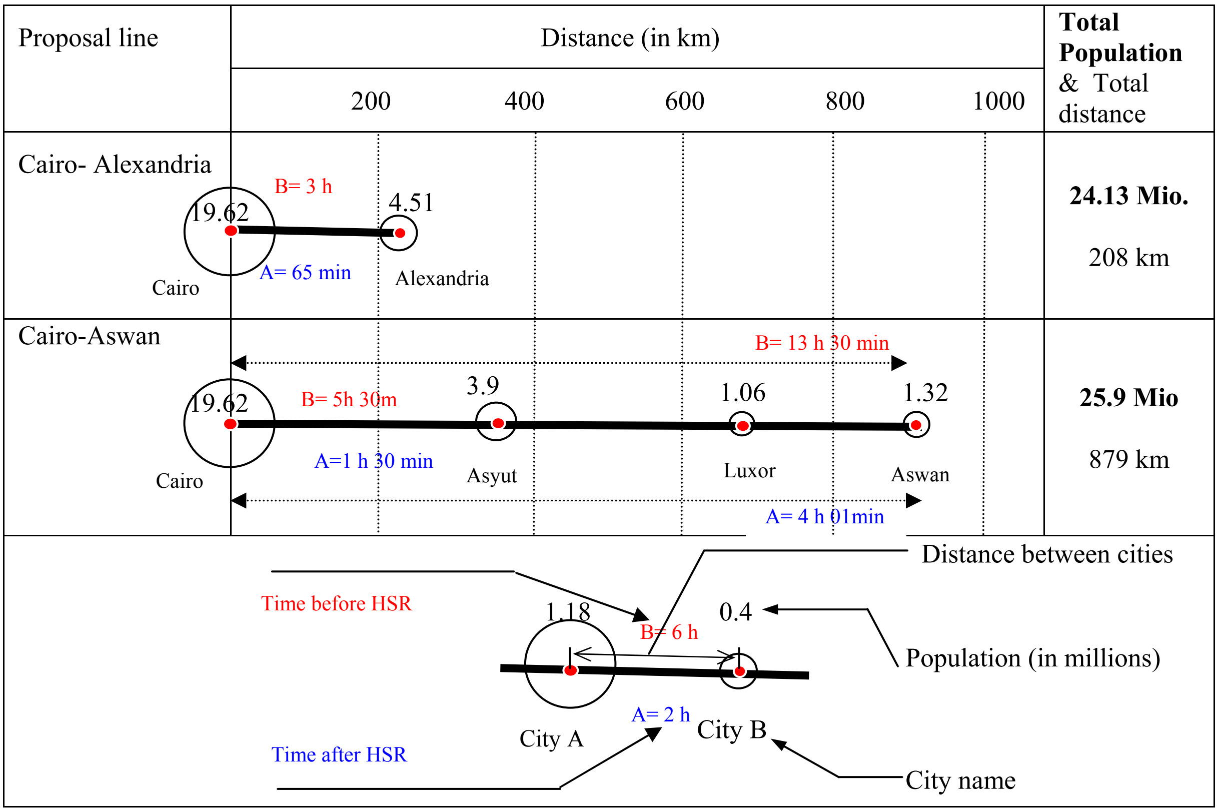


Figure 16: Population of Cities on the Proposal Lines of High Speed Rail in Egypt.

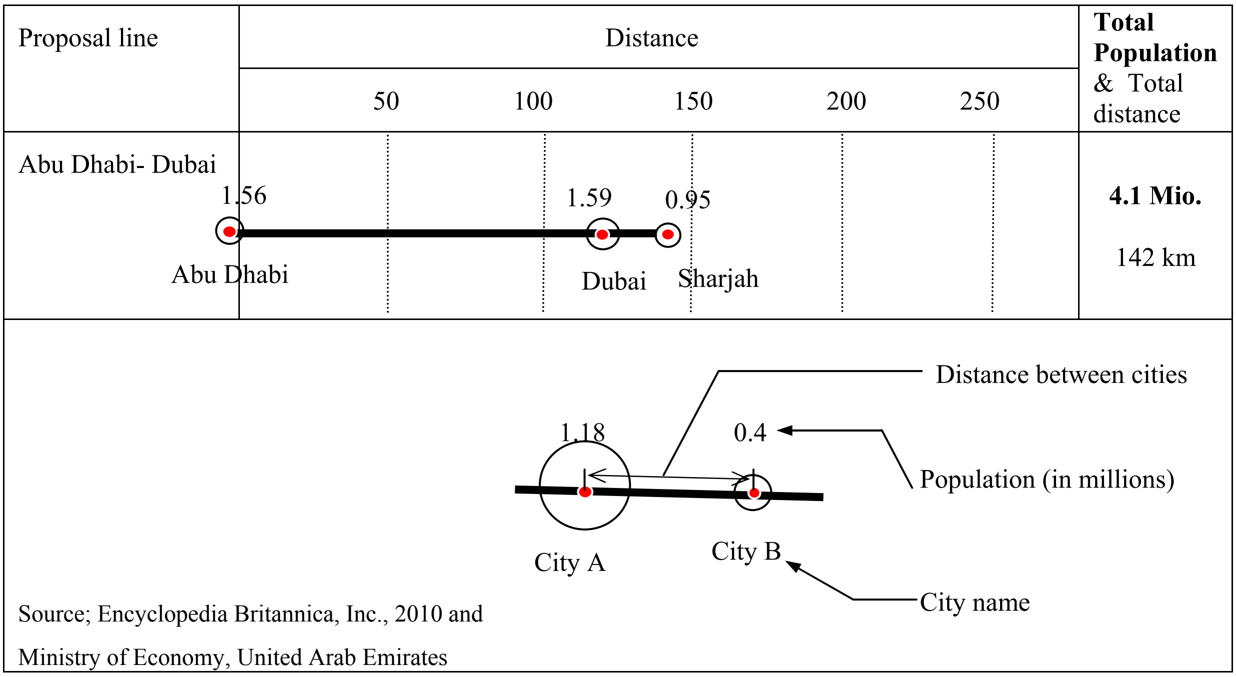


Figure 16A: Population of Cities on the Proposal Lines of High Speed Rail in UAE

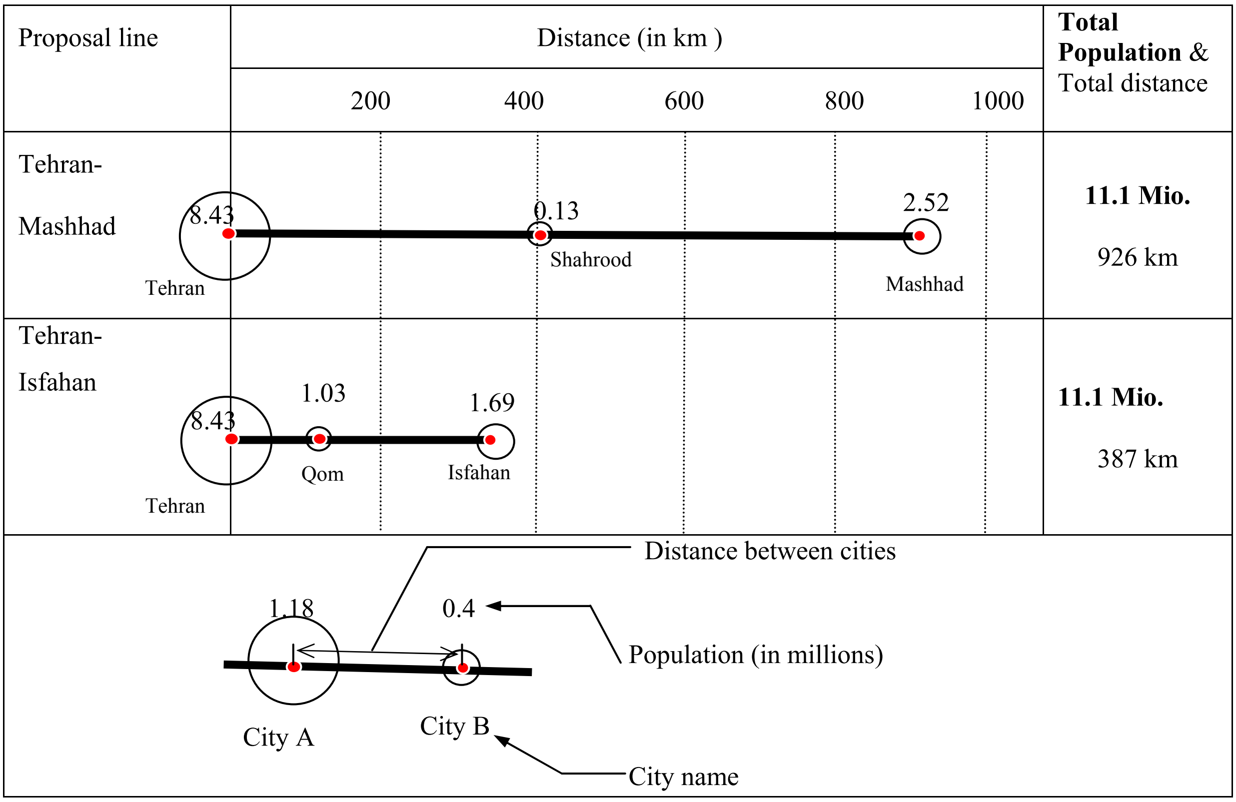


Figure 16B: Population of Cities on the Proposal Lines of High Speed Rail in Iran

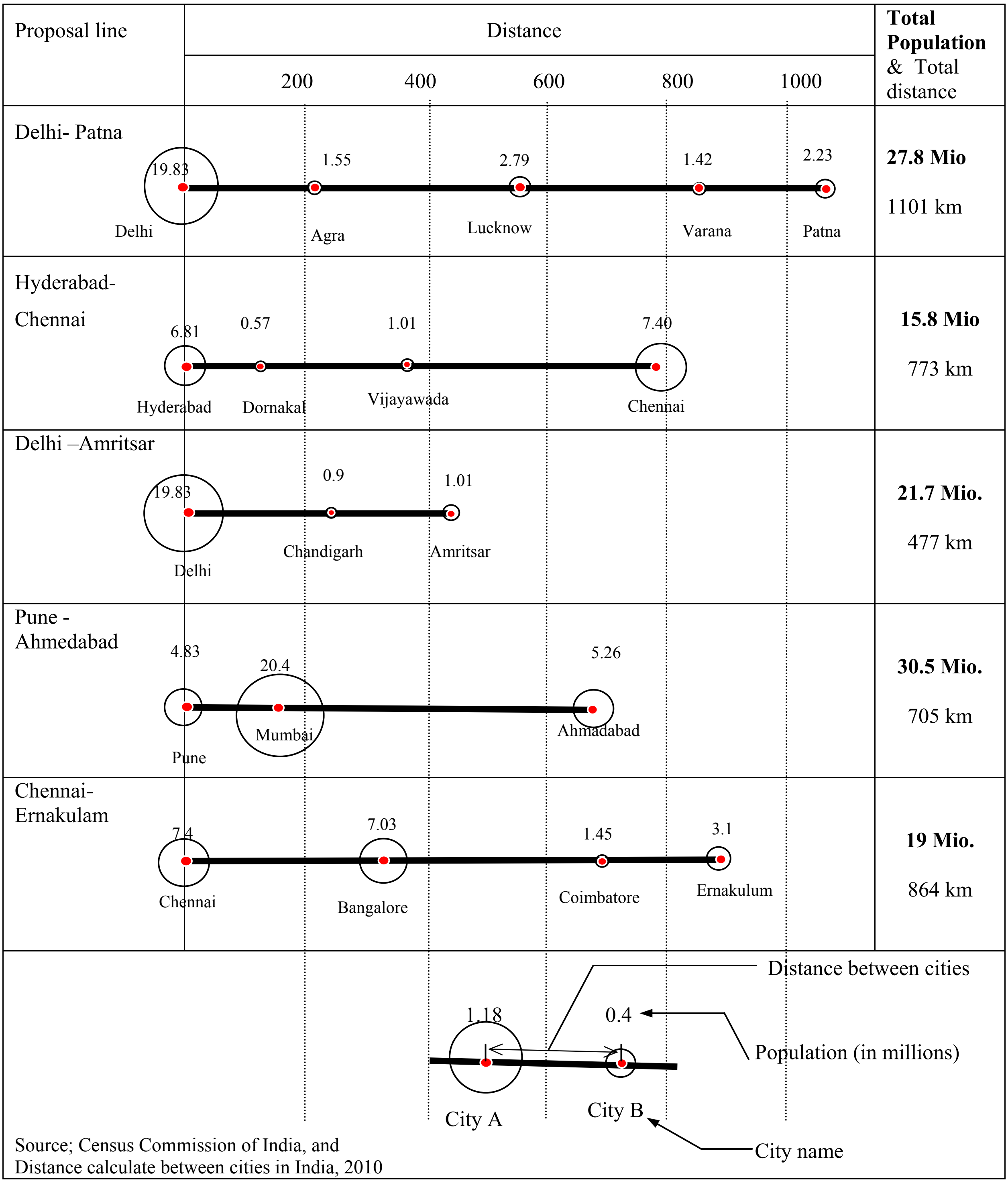


Figure 16C: Population of Cities on the Proposal Lines of High Speed Rail in India

It will be selected these corridors based on number of population and the residential areas and commuting. Consequently, the economic business case for HSR is to link big central cities to each other or enough to large regional cities with few intermediate stops [34; 239]. This means that the last points of most high speed lines are large cities.

Many researchers place the ridership threshold at approximately 12-15 million riders a year. According to (Rus and Nash 2006) the estimate an isolated 500 km line would need approximately 12 million annual trips to justify the construction of the line solely on the travel and time savings benefits. According to [34] places the minimum regional city volume at 750,000 people in order to reach 12 -15 million riders. Lower passenger routes would be viable if they are constructed to relieve over-capacity infrastructure rather than new or expanded airports or highway.

Accordingly, the lines that have been selected in the above countries, depends on the number of population in major cities. The proposed HSRs line n the previous countries. The number of population system far exceeds the market necessary for HSR to be a justified on travel and time savings benefits. As shown in above Figures where this figures explain the number of population and the distance between main cities and metropolitan areas.

The size of a city and its metropolitan area has been important as a critical factor in how HSR service affects the development of that city. As previously Figures, it will be observed that in the most of the proposals lines in the previous countries the cities have a population more than 750,000 to justify the construction of a HSR line to serve that city. Thus, big cities that act as regional centers it appears that to benefit far more from economic development related to HSR than smaller cities [41; 223].

As mentioned before, HSR services that provide a travel time of less than an hour to a major employment center can attract long-range commuters. On the on hand the impact of HSR services on a labor market is divided to the service allows current residents of the cities to commute to the other city, lastly leading many of them to move to the city they work in. On the other hand residents who live and work in the same city may move to a more distant location they find more desirable that is now HSR accessible [238].

5.6.3 Mode Choice for Screening Variables that Describe Model of High Speed Rail

Variables used to explain model choice include two sections: socio-economic demand variable and level of service or supply variables. As we shall see in the example presented in this section, many variables have been used to explain observed mode choices. Thus, a screening model of HSR is proposed for the developing and emerging countries. This model aims to be used in countries with similar size characteristics to Egypt, in order to judge whether it is worth it to start thinking about constructing a HSR network or not. As with other demand analysis, a model can always be attached to observed data if a sufficiently large number of variables are used. The challenge in better mode choice modeling analysis is not only to select the variables that are significant but those that can be used to reflect the type of policy analysis or planning for which mode choice modeling intended in the first step.

It is important to note that the assumption regarding the underlying utility maximization process is just that. The selection and continued use of modes of travel is largely a social behavioral phenomenon. The attempts to characterize it as an economic process can only be partly successful. Therefore, there is little reason to take the highly complex model of mode choice too seriously. It is always desirable to keep the mode simple. A number of parameters that are necessary and related to the development of HSR according to the viewpoint of the author will be presented in the next table. The model will be in the form of a matrix and the countries that will serve as examples in Egypt and Iran and India. The following table is showing some of the socioeconomic demand variables used to explain mode choice performance.

The size, the population and income are used as indicators in order to show what kind of countries can use this screening model. For example, income this is by far most commonly used demand variable. The choice between modes can be often by characterized as differentiation between expansive, comfortably, and inexpensive but less convenient modes. Where, income is often seen as a determinant of such differentiation. In addition, notwithstanding the influence of income on the valuation of travel time, it is also a proxy for other less quantifiable variables that reflect some of social aspects of mode choice. Mode choice is partly determined by transport time and the relative costs of the different modes available for a specific journey. The importance of travel time relative to cost, the value of time, increases with income. In developed countries, an average income elasticity of the value of time of about 0.5 [250] has been found. However, as incomes rise, people have a stronger preference for faster modes of transport (car, high-speed trains, air). Increases in income also lead to an increased desire for comfort during the tour, as well as the ability to afford more comfortable modes. As a result, increases in income tend to lead to further shifts toward automobiles and, to a lesser extent, to train. For long-distance interregional transport (above ca. 150 km), higher incomes shift travel from car and coach transport to high-speed train and air transport, especially in the developed world.

As far as *the Age and role in the residence* this variable is used to express the different model favorites of people at different stages in their live. Where, the very young and the very old (e.g., under 15 and over 65)[37] are less likely to travel and will depend more on collective modes of travel than people in the vocational active years of their life.

Regarding of the *information about the whole network* is necessary to determinant the average employees and railway density per population and railway density per area.

[37] The Age structure in Egypt case study are: 0-14 years: 32.7%, 15-64 years: 62.8%, and 65 years and over: 4.5%

Consequently, can be identified the corridors with a high density of passengers to determine the path of the expected line in the future to create a line-speed trains

Car ownership, the number of car available to residence has repeatedly been found to explain much of their mode choice performance. It is clear, the more cars that are available, the less likely are member of residence to use transportation. Where, mode choice modes usually assume car ownership to be an exogenous variable and hence do not reflect the possible mutual interaction between mode choice and car acquisition decision. As far as the Motorization rate (vehicles/ thousand inhabitants) it is low then the construction of HSR might increase it.
The market share of each transport mode in passenger sector has changed over the past decades, (Table 10). Nevertheless, crucial parameters affecting the market share of each transport mode vary with the mode: The market share of private car depends on car ownership index and cost of fuel. And the market share of railways and buses depends on car ownership index, GDP, rail fares, fares of competitive modes, (for example bus, railways and airplane), and travel time.

As far as *the modal split of passenger transport* is concerned, it refers to the percentage of the each mode's trips out of the total number of trips that are being done in the country. According to the percentage of its network, a bigger picture of the each network's situation can be seen. These numbers can help into understanding the existing trends and preferences of the population. Regarding the rail mode percentage, if it is low, then the construction of HSR might increase it.

Regarding of the *condition of the rail network* is concerned, it is important to know which is the situation are the moment of the study. If it needs improvements, then HSR should be considered, since an investment will be made anyway. Also, if the attractiveness of the network is poor then it might be possible that an upgrade could enhance it up. If the attractiveness is already high, then overcrowding might exist and the consideration of HSR could also help reduction the problem.

Regarding of *the existence of major cities*, along with some parameters that will be explained here, it will be addressed to the serious consideration of HSR. First, major cities generally create a great number of business travelers who might be better served if HSR is offered. Consequently, the business traveling percent between those cities is important. Also the distance between major cities is also critical because it shows whether it is worth it to consider constructing a high speed line. The distances that the major cities have in the countries for example Egypt distances ranging between (208, 375,879 km), Iran (387, 926km) and India (135, 477, 705, 864 km) are enough to justify the construction of a high speed line.

In addition, *the modal split of passenger transport between major cities* is critical in order to understand the current preference of business and leisure travelers, realization whether there exist crowding problems and if HSR will contribute into improving the current situation. Therefore, parameter is indicating to the mode shares for the origin-destination pairs of the proposal corridor for Egypt, Iran and India; thus from the total number of trips being concluded between those cities, which are the percentages of each mode. Finally, the rail share percent which either originates of the major cities of the country as destination is also a good parameter for HSR. This number maybe leads to the consideration of more HSR lines, other than the one between the major cities.

Table 11: Variables Screening Model of Hsigh Speed Rail in Developing Countries

Parameters	Egypt	Indian	Iran
Area (km²)	1,001,000	3,287,263	1,648,000
Population (Mio.)	80	1166	66,4
Population density (Population/km²)	79	355	40
GDP Per capita incomes in 2011 [97]	3110 $	1124 $	4973 $
The total length of rail network (km)	5195	63,273	7555
Of which double track or more	1545	18942	1482
Passenger/ kilomrtres (Pkm/km) (Mio. Passenger)	40,837	838,032	15,312
Of which electrified lines (km)	65	1299	148
Track gauge (m)	Stander gauge (1.435)	Broad gauge (1.676) Meter gauge (1.000) Narrow gauge (0.762 and 0.610)	Stander gauge (1.435) Broad gauge (1.676)
Average Employees (thousands)	91	1,395	13
Railway Density per population*	0,065	0,054	0,11
Railway Density per Area**	0,0052	0,019	0,0046
Motorization rate (vehicles/ thousand inhabitants [58]	31	10	113
The modal split of passenger transport	Rail: 40% bus and mini bus 60%	Rail: 15%, bus, car and minibus 85%	rail: 6%, bus and car: 94
Railway attractiveness	high	middle	poor
Rail network condition	poor	poor	poor
Major-center cities	Yes (5)	Yes (7)	Yes (2)
Distance between major-center cities	208, 375, 879 km	135,477,705, 864 km	387. 926 km
Percent of total population in major-center cities [114;232:233]	43.4 %	51 %	61.31%
Rail connection with neighboring countries	no	no	no
Sources of funding	National	National	National
Economy in the neighboring country	middle	strong	weak
Amount of money coming from sources other than national	not	not	not
Existence of HSR network in neighboring country	no	no	no
Share of rail trips that have Share of international	no	no	no

* Railway Density per population (rail route km / 1000 inhabitance),
** Railway Density per Area (rail route km/ km² land)

Particular for the *rail mode share between major* cities, it is a better indicator for HSR connection between them, because if it is high, then why not increase it even more (the desire of increase the rail share originates from its benefit of being environmentally friendly when compared to the rest of the modes such as car and air) and if it is low, then why not improve the situation and make rail attractive. Regarding the air mode shares between major cities in the developing countries is not higher than the rail share; thus, the building of a HSR line maybe might increase the mode share of railway.

The sources of financing is another important factor, since both the construction and maintenance of HSR is very expensive. If a country has many sources outside of the national ones, then the construction of such an expensive network is more easily achievable. But in the most of the developing and emerging countries their are not have any source from outside, this leads to the construction of this project corresponds to many challenges and obstacles. In contrast, the countries in the EU have outside sources to help them to create these projects. However, the amount of money from sources other than the national is very important. The financial support that a country has is crucial, because it is very helpful when the level of this support is high.

It can be also observed that, the data of whether there is already *rail connection of the country with the neighboring* ones is also essential on the one hand, because if there is then along with the percent of the rail trips that have international destinations, HSR might increase this number, thus contributing to the increase of tourism and business relationships as well. On the other hand, if there isn't any rail connection with the neighboring countries, then depending on the relationship that exists, HSR might be a better idea. In the case of Egypt there is no connect with the neighboring countries. This leads to the lack of integration between countries

Finally, *the economies of the neighboring countries* and the *existence of HSR networks* in those countries are useful parameters. In the case of Egypt maybe this leads to the bordering with neighboring countries and contributed in the development of the idea of HSR. This has motivated Egypt to also work towards the application of such a network in the future e.

As mentioned before, it is likely that one or two socioeconomic variables, say income and age, would explain as much of mode choice performance as can be expected on the basis of quantifiable demand variable. The rest is probably to be found in unquantifiable social factors and, of course, in the supply characteristic of the modes available. The following are some of the more important supply variables used to explain this mode choice performance and these factors are not explain in the table of models

In-of-train time or change of the travel time in train, the line haul travel long the time will be needed is a major component of the total travel of the trip time. Thus, in situations where a change of the train in the middle of the road is necessary, such as when transferring between train lines, it is customary to separate out the transfer and the waiting times and to identify them as different components of total journey time. The reason for this is because the implications of the various components of travel time might be perceived differently by travelers.

Waiting, Access, and transfer travel time, the time necessary to get to the begin point of service of the model used and to get to the final destination from the end point of service consider fro the components of the travel time. Thus, this component is more relevant in the case of the travel by HSR line where it would be the time required to get to and from the station or stops used. In the case of the railways transportation the corresponding travel time component would be the access and exit time required the time required from the house to the station, especially at the ends of journey, compared to other media of transportation. Regarding of the waiting time is component relevant to scheduled mode where the traveler must wait for arrival of the train. It can be observed sometimes possible to represent that component of travel time by including the frequency of the service. The third component is the transfer time of travel time included in this terms which would be spent in cases where a transfer of HSR occurs.

Based on the decision with which trip data are obtained from a traffic survey, it may be required to aggregate all these component of travel time into one variable, referred to as *out-of-train time* as opposed to the in-train time. So, this difference between the two is important, for it is often found in mode choice studies, where the mode choice is more sensitive to out-of-train time than to in-train-time. It can be noted that, the policy option which would affect in the out-of-train time may have more impact on mode choices than option which would result in similar effects.

Travel cost in which model the importance factor was the cost of the travel, this factor is usually also depending into to component, one is in-train cost, and the other out-train cost. The first would be the fare paid on the passenger for the journey. The second term of cost would include cost associated with access to the mode used.

Qualitative and attitudinal variable this factor it is very important affect in the choice mode, because this factor is depending on the comfort, reliability and safety. So, recent attitudinal surveys seem to indicate those passengers who perceive such factor differently are likely to have different mode choice performance. Especially, in the developing an emerging country, the safety of the on the road is very poor, and the mode of the railway consider one of the most secure means.

Impact on route choice: route choice depends on the differences in travel times and costs between alternative routes. Due to the increase in the value of time, higher incomes result in an increased preference for faster routes, even if these are more expensive.

Key parameters of analysis by model of intercity passenger rail demand in Egypt and other developing countries.

The explanatory variables of rail passenger demand are:

• The private car ownership index, which impact negatively the rail passenger demand,
• The user cost of the private car (related to changes in fuel prices), which effects negatively the rail passenger demand (because of the increase of car ownership),
• The social-economic indexes such as the GDP per capital or the household consumption for transportation. Increase of social-economic indexes may induce the railway passenger demand (because of the increase of human mobility), but in the most of cases increase of social-economic indexes deduce the railway passenger demand, because the conventional rail services in most of the cases are considered as a lower quality product,
• The ratio of rail fares to the fares of competitive modes of transport, especially coaches. Increase of this ration effect negatively to the rail passenger demand,
• The rail fares, as a parameter which generates trips. Decrease (in constant prices) of rail fairs induce the passenger demand,
• The frequency of services of railways and of competitive modes of transport,
• Unpredictable factors, (strikes, energy crises, elections, weather conditions, etc.).

5.7 Summary

In Egypt the density of the vehicles per 1,000 inhabitants it is very low [58]. Despite this downward trend appeared to have bottomed out in 2003/2004, however, railway passenger numbers in Egypt, which accounted for 80 % of all passengers transported by rail [59]. It should be noted that, in contrast, the rail networks in Egypt grew by about 60% between 1990 and 2007. Where, this gives great importance to travelling by train in Egypt. Because the decline of the passenger cars and the higher price for the planes, this lead to the opportunity of conventional railway to attract the passenger. Whereas, if the railway is able to transport the passengers to/from all the city and region in a short travel time, compared with other modes of the transport such as airline, this lead to railway more attract for passenger. **Furthermore, the question is what are the important bases that lead to the construction of high speed rail lines in developing countries in this chapter? In this chapter, has been reached to the bases that are adopted upon in the construction of HSR rail lines such as: the long-distances travel by railways it will be useful and much more flexible than the short distances travel, consequently, this leads to the absence of deficit in the revenue for the long distance travel as in section 5.3.1**

Moreover, this chapter has presented the current geographical, performance of the railway, political aspect, and background to funding in transport sector such as railway sector. The expenditure in the intercity models ware discussed. It can be observed that, the performance of rail transport is lower than highways (in terms of ton kilometers and the passenger kilometers) when compared with the expenditure. Thus, lead to a significant deficit in this sector. Moreover, this service use for the business traffic for long- distance between Cairo/Alexandria, Cairo/Luxor–Aswan. As a consequence, intercity service which already had a dominant market share of 55 % in passenger rail transports service in Egypt and this figure is not lead to great market for the rail. The expenditure in the railways intercity was discussed. It can be noted that, local service, with lower production rate and some with air-conditioned trains, receive nearly twice the subsidies of the suburban services, whereas the latter services are normally used by the lower-income passengers. While the special service will be serve the military, police, and some factories. The characteristics of the lack of development of the railway in the country under study such as Egypt and the screening model for the proposal HSR line are presentation in the country under study. **As a result the distribution of spending in connection with modal production is such that the railways claim 72.1 percent of the total intercity transport subsidy and only produce 6.4 percent of the total intercity ton-kilometers. This leads to the negative condition for railway. If the expenditure was dedicated to increase the speed or to establish new high speed line, may be this is profitable and this is the forth condition to construct of HSR rail lines.**

In this chapter, a screening model of HSR is proposed, and this model aims to be used in countries with the same size characteristics to Egypt. In order to rule on whether it is worth it to start thinking about building the HSR network or not, the number of parameters that are important and related to the construct of high speed rail will be presented. The model will be in the form as a road and the countries that will serve as example in Egypt**.** ,husT the main obstacles that are faced, particularly regarding the application of HSR, are two. The first is the issue of money: high sped rail is expensive both for building and maintenance. The second, the mountainous terrain on some country and the steep slopes that the rail must follow present engineering challenges. This not only does make construction more difficult, but it also increases the budgetary requirements.

Whereas, public transport forms the skeleton of the transportation systems in the big cities are especially in the developing countries. The rate of the population depending on public transport is quite high. The state of public transport especially in the railways sector between the cities of the developing countries differs widely from those of the developed countries. This difference brings different conflicts to the surface. Railway transport in the cities of the developed countries can be considered adequate, at least when compared with the developing countries. However, this adequacy is not sufficient enough to attract the car-users to public transport. In the developing countries, urban demand on public transport is higher. Nevertheless, there is no existent public transport capacity that will attract the car-users. In this situation, congestion created by the relatively low car ownership comes to forefront and the unfair and illogical sharing of the transport facilities establishes the main conflict. For example, car ownership in Egypt as stated before, and there is a density of about 10, 113 and 313 vehicles per 1,000 inhabitants in India, Iran and the UAE, respectively [58]. The results of the next figure on the railway transport systems, in the major cities of the developing countries are quite interesting. It can be noted that (in the section 5.5.3) the proposal corridor in most city in the country under study with the population and distance between them. Thereby, in the Figures 16 it can be showed the results from 18 different cities including Cairo, which have high speed rail systems in operation or have rail system projects under construction, are evaluated. A comparison made between these 18 cities regarding their populations and incomes per capita. The average total income (i.e. population × income per capita) in the graph indicate that most of the cities having an income of over \$10000 have HSR systems; whereas, most cities having an income of lower than \$10000 do not have them. This means that even cities with populations over 20 million do not possess HSR systems.

The results of the main different in the developing countries and their cities are that the capacities (especially rail systems) which are necessitated by the demand cannot be created or there is an important delay in this process. Where there are three natural results of this are:

- This confirms the first result, which is that the income of people affects to use the transport model.
- Required transportation support is not given for a healthy urban development; furthermore, hope for a healthy city disappears.
- The delay compensation resulting from the delay in constructing the high-capacity transportation system rises rapidly and surpasses the investment cost. For example, this situation is present in Egypt. Costs of investments of maintenance such as rehabilitation are increasing rapidly while alternative costs as operating costs reach quite high values.

In terms of their economies, countries with HSR tend to be well developed, with large GDPs overall and on a per person basis. This is likely because of the financial leverage required to fund HSR projects. However, some economies that are relatively poorer, on a per person basis, such as China and Turkey, nonetheless have the financial heft, from the overall size of their economies, to afford HSR. In this aspect, Egypt should be compares with these countries. On the other hand, as a measure of how much Egypt actually does spend on transportation infrastructure overall, instead of how many resources it could mobilize, Egypt commits a significantly smaller portion of its GDP to investment in transportation infrastructure, compared to other countries.

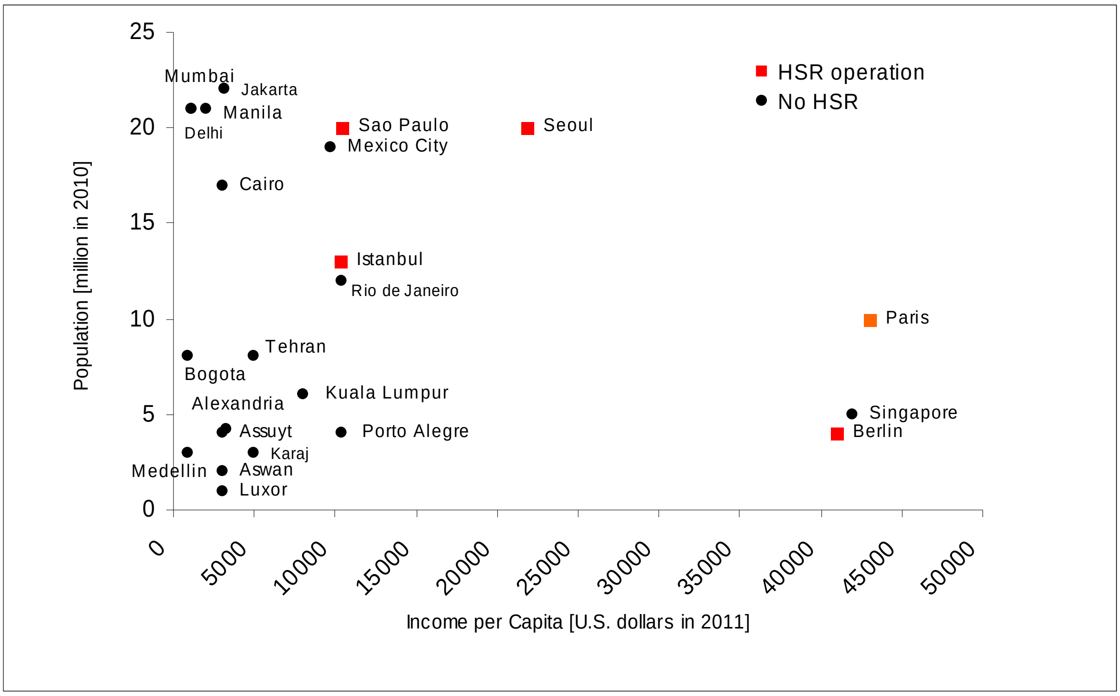


Figure 17: Comparison of Incomes, Population of some Cities in D&E Coun tries

Lastly, a comparison between Egypt and other countries was presented. The results show that the countries have a great deal in common. However, as far as HSR is concerned, Egypt is better organized in the track (Where we have one line that serves all the cities of Egypt from Alexandria to Aswan via Cairo, Asyut, and Luxor, excluding the Delta cities). Although, HSR does not exist in Egypt yet, the proposed process is on a very good track. Perhaps Egypt should follow the example of other countries in order to improve the current situation on the rail sector. The main other lesson that can be learned from other countries is that institutional changes are needed within the railway sector for high speed rail to become a reality. If Egypt can manage to develop such an organization, perhaps the implementation of HSR will be accelerated.

From the model which can be analyzed to conclude that, the parameters that show the need for applying a HSR network do exist. One could say that those parameters can be used as signs along the way to the use of HSR. From this basis of the model, the main conclusion is that the GDP of the country does not play a major role in the construction of HSR. It is definitely a parameter that is vital, but the fact that the GDP is high does not mean that HSR will be built. If it was so, then UAE would be ahead of Egypt and Iran and India.

In the next chapter, the parameter which helps us to calculate the building and operation HSR such as (demand of passenger, travel time, travel price, construction and operation cost, etc...) will be analyzed. So, it can determine the cost of building and operation HSR by using the methodology of cost calculation. Finally, the countries were used as a basis for the formation of the screening model for High Speed Rail, which has been presented and explained in the previous section.

6 POSSIBILITY OF ESTABLISHING HIGH-SPEED LINES IN D&E COUNTRIES (CASE STUDY EGYPT)

The main objective of this chapter is to discuss some characteristics of the HSR services from an economic viewpoint, while simultaneously developing an empirical framework that should help us to understand, in more detail, the cost and demand sides of this transport alternative. This understanding is especially useful for future projects, since it will lead to a better analysis of the expected construction and operating costs, and of the number of passengers to be transported under different economic and geographic conditions. Such understanding is particularly relevant because the economic magnitude of high speed rail large investments.

A new high-speed line in the developing and emerging countries would represent an investment in new railway infrastructure unparalleled in recent railways history. However, unlike many other countries (such as Marko, Turkey, Chine, and S Korea), these countries had a little or did not have any experience in evaluating whether high-speed rail lines should be constructed or not.

But the system of project evaluation adequately has of all potential costs and benefits of high speed rail, and whether changes should be made to these policies and processes to better capture these costs and benefits. Also to evaluate whether the reason other countries have constructed high speed rail lines can be attributed to their different system of project valuation, or whether this has been due to other reasons (such as the potential market, construction costs, or political reasons). New high-speed railways are based on completely different ideas from conventional railways. Because the track bed, structures, track, electrical equipment, control techniques and rolling stock are not extensions of conventional railway technology. Therefore, each is a complete technology in itself, while needing to be integrated with the other technologies However, the developing countries such as, India, Iran, Egypt and UAE for example lags far behind other European countries and Asian countries, in developing a high-speed rail network. In this chapter will be discuss how to establishment a new high-speed rail and what are the reasons for the creation and appreciation of high-speed rail line.

6.1 Requirements for Establishing a High-Speed Rail

High-speed railways are mostly required in regions with many densely populated cities, but if they are constructed in sparsely populated areas, do not have any economic feasibility, because this is due to the low ridership. To build a new high-speed railway, it is important to solve these contradictions. Valuation of high speed rail in the case study of countries the most commonly used appraisal method is cost benefit analysis. This is used, if not always consistently, in all of these countries (France, Germany, Spain, Italy and Britain), and its use is being considered even there. However, between the countries that use it, there are significant differences in how cost benefit analysis is applied, in terms of:

- Whether cost benefit analysis is applied for rail projects, as in France, Germany, Spain and Britain, or for some countries, as in Italy and Australia [100].
- The scope of the quantified monetary costs and benefits included in the analysis for example, whether and how environmental effects are included
- The values that are used for key inputs, such as accident costs and the value of time

Nevertheless, in the developing countries there are differences in the nature of the appraisal procedure used in each country, there are also differences in the extent to which it forms a central part of the decision making process. These factors have a significant effect on the policies that determine the decision-making include the following points

- The economic appraisal appears to directly determine whether projects are included in the national transport infrastructure plan, although in some respects the appraisal criteria appear to have been constructed to favour, in advance, specific anticipated policy outcomes; whereas
- Economic appraisal is required but it only determines the prioritization of projects and more detailed aspects of them, such as the route to be taken for a high speed rail line. The main policy commitment to the scope of the high-speed network has already been taken appraisal is used to help inform the "when" and "how" of program delivery, rather than determine whether the investments should be undertaken at all.

Indeed, that economic analysis is an element of, but is not a substitute for, the key policy decisions to undertake investment in high-speed rail, the high-speed rail projects and other major projects of national importance, and decisions on whether or not to proceed are likely to be based on a number of issues other than the appraisal framework including ability to bear costs. Decisions as to whether to proceed with a high-speed rail project will ultimately be taken by the government, and the economic appraisal will clearly only be one input to such decisions.

A key point that cost benefit analysis cannot be sufficient as a basis for decision-making because it is not possible to put monetary values on all impacts. Although some benefits such as time savings are always included in cost benefit analysis, other benefits, such as environmental effects, road congestion, comfort, and safety. It is clear that in some of the countries, to put monetary values on as many inputs to the appraisal as possible, but this has led to the use of inputs that do not have a clear economic rationale.

In some cases, there are problem with appraisal in developing countries with lack of transparency in some variables (such as noise and emissions) are quantified; they have not, had monetary values placed on them and therefore are not included within the benefit to cost ratio[38]. Other countries (such as Europe countries) tend to include the benefit of the some environmental effects in cost-benefit analysis.

The interest in developing new high-speed rail systems in the developing and emerging countries have not been growing in this countries, substantially in recent years as technology becomes available to make the objectives of such a system feasible. In very general terms, these objectives are to provide much of the speed and luxury of air travel while also providing the frequency, reliability and convenience of entry and exit which is possible with rail travel. In general terms, there are two types of information or requirements are necessary to predict demand for a new transport mode for the proposed HSR in developing and emerging countries.

[38] For example in Egypt, while increased transparency will not reduce the fiscal burden in itself, it will provide a basis for making better fiscal decisions. Egypt is currently in a transition period, where financial transfers will remain at the current level. Increased transparency will not directly reduce transfers, but it will provide the basis for improved decision making. The financial reductions will come from more fundamentally restructuring the railway sector, which can be successfully achieved only by making fiscal transfers more transparent.

1. A detailed understanding of the travel market without the new alternative, in terms of: [101]

- The number of travelers in each of these sub-markets.
- The travel alternatives available to them.
- Their criteria for choosing between those alternatives.
- The expected changes over time in the size of the sub-markets and the characteristics of the travel alternatives.
- The different sub-markets which are relevant (in terms of origin/destination, travel purpose, etc.).

2- A means of understanding the changes in each sub-market which will result from the introduction of the new alternative, in terms of:

- The diversion of travelers from existing alternatives.
- Pricing are important for travelers to estimate the destination.
- The generation of additional travelers resulting from improved travel opportunities.
- The sensitivity of diverted and generated travel to the characteristics of the new system and to exogenous factors.

Most travel studies tend to focus on developing only one of these two types of information: either the first by means of observing actual travel choices, or the second by means of eliciting travel choices under hypothetical situations (stated preferences). It can be noted that the required to provide all of the types of information listed above, and thus provides a rather unique example of the integration of different transport demand survey and analysis techniques.

6.2 The Main Factors that help create A High Speed Rail

Undoubtedly, the introduction of high-speed train services on new tracks serving major cities may achieve success. If there are compilation of factors that help to achieve this success in developing countries, important factors to effect on the new high speed rail line in D&E countries is investment of this project. From example a broader perspective, aggregate factors depends on macroeconomic (such as distance need to travel, the population density, the distribution of personal income), or cultural factors (traditions and history associated to rail travel) related to any corridor. However, establishing of HSL in these countries does not achieve the feasibility, but if there are some factors that help create this line such as the landscape. While they perform best with flat grades and large curve radii there is always some latitude. It can be observed that the lower tunnels and bridges to be built or probably do not need it. HSL services can only be attractive on the routes with high-demand (such as in France and Spain). it can be noted that in the developing and emerging countries such as India, Iran and Egypt, the volume of traffic on rail is higher [Table 10] in most city. Hence, cities with a great dense (in terms of population and/or employment) are more attractive for HSL services. Therefore, in any new transport system the transport investment acts as a complement to other more important underlying conditions, which must also be met if further economic development is to take place. Additional transport investment is not a necessary condition, but acts in a supporting role when other factors are at work such as:

- The economic conditions include the existence of underlying positive economic externalities, such as communities and labor market economies, the availability of a good quality labor force and underlying dynamics in the local economy. This is a prerequisite condition, as only when all these factors are positive and the local economy is prosperity will new transport investment, in conjunction with the other necessary, have an economic development impact.

- There are investment condition that relate to the availability of funds for the investment the scale of the investment and its location, the network effects (are there missing links in the network), and the actual timing of the investment. Transport infrastructure investment decisions are not made in isolation, so the nature of the investment, including its place in the network is also one of the necessary conditions that need to be considered.

It is certainly the mission of high speed railways to shorten travel time by increasing the maximum speed. Because reducing travel time is also an important reason for introducing HST services, although not the main reason in most cases. Obviously, shortening the travel time leads to expanded market share. However, if increased speed leads to increased energy consumption, or degraded environmental conditions, the business does not pay. The problem is how to solve these difficult contradictions technically. Everybody wants to increase the maximum speed, which is the driving force in further development of high speed railways. However, the high speed railway thus developed cannot be said to be successful unless the new technology improves the environment and secures business.

Therefore, the main reason for the construction a new high speed lines was increasing route capacity and this was also the case for many other lines. In the country under study like Egypt we find that the main reason to consider the establishment of new transport routes (such as high speed lines) is the congestion on road and traffic accidents between larges cities, especially Cairo and Alexandria and the corridors between Cairo and Aswan see Figure 16. In Iran there are two proposal routes between Tehran Mashhad and Tehran Isfahan see Figure 16A these two corridors contains higher population density. In India construction of high speed rail consider a new product driving by changing customer preferences and requirement imposed by economic growth. Another compelling reason to implement of HSR in India, this reason is the higher air pollutant emissions in the India, while that the HSR is a few emissions. As well as the important reasons there is imminent danger to society in the existing transport model now based on an economy driven by automobiles and air crafts. The large population living in major cities leads to the higher capacity of passenger to move from / to cities. The rapid urbanization in the country has a growing demand for intercity traffic between major cities and towns from two to three times.

It can be observed that the factors to success for High Speed Rail can be derived in the developing countries which should at least be met for rail lines to be feasible

1. High speed rail linking cities with population density more than 0.80 million inhabitants thereby, it can be showing these in the above Figure (16, 16B, and 16C), where the entire proposal line passing large cities with inhabitants more than one million people. However, this is the first stage to estimated the now HSR in the country case study.

It should be obvious that the previous equation of interaction equation (see section 4.5) can be applied to population from one area (sizes) to another. Changing the symbols slightly, the total volume of to human societies from a particular origin sizes, *i*, to a single location, *j*, is directly proportional to the respective populations at *i* and a tractions at j, and inversely proportion to the squared distance between them.

The gravity model was based basis of many applications to human societies and has been applied to social interactions since the 19th century. Application of the concept to the analysis of migration by arguing that, the tendency to migrate between areas is inversely proportional to the squared distance between the regions.

it will applied the law of retail gravitation Newtonian gravity model directly and suggested that retail travel between two centers would be proportional to the product of their population s and inversely proportional to the square of the distance separating them:

$$I_{i'j} = \alpha \frac{P_i P_j}{L_{ij}^2} \quad , \qquad I_{ij} = f(Pi, Pj, L)$$

where I_{ij} is the interaction between centers i and j, P_i an d P_j are the respective populations, L_{ij} is the distance between them raised to the second power and is a balancing constant . In the model, the initial population, P_i, is called a production while the second population, P_j, is called an attraction.

The applied the concept to a variety of phenomena (passenger movement, freight traffic, in formation) using a simplified form of the gravity equation. Whereas the terms are as in tea above equation but the exponent of distances only constant. Given a particular pattern of interaction for any type of goods, service or human activity, an optimal location of facilities should be solvable. Where, the two Populations were both population sizes. However, in modern use, it is not necessary for the productions and attractions t o be identical unit s (e.g., *Pi* could be population while *Pj* could employment).

2. Connectedness from the HSR to the end destination of passengers is important. There should be good transfer possibilities to complementary transportation modes on both:

- lower level: local and regional networks
- higher level: international and inter-continental networks

At the same time if the access time to competing transportation modes is disadvantaged by poor connections to the major cities like for instance at Cairo due to the position of Cairo Airport (23 km from the city without rapid transit connection). Consequently, the average travel time and travel costs from the city to the airport are relatively high.

3. Socio-economic returns due to reduction of congestion and accident costs on roads in areas[39], where there are substantial problems might attribute to the desirability of HSR.

4. The ability to serve a wider area than just the major urban centers helps utilize the infrastructure and increases the financial return on investment. The cost and benefits also consider the important factor to implementing HSR in development countries, these cost and benefits such as;

- Variation in costs and revenues of other transport operators.

[39] The importance of estimating the cost of road traffic accidents stems from the importance of drawing attention to this problem not only as a social problem that costs a lot of people their lives but also as an economic problem that costs the society a lot of money and adds an undesirable economic burden on it. Moreover, cost estimation helps to clarify the size of this problem and the economic benefit arising from preventing such accidents. In Egypt the total cost of road traffic accidents in 1986 was about 54 million Egyptian Pounds with an average cost of approximately 14 thousand Egyptian Pounds per accident [102]. In year 1993 estimates the cost of road traffic accidents in Egypt about $US 577 million (0.8% of GDP) with an average cost of $US 8190 per accident [103]. In 2005/2006, the average cost of a fatal or a serious accident, which causes at least one fatality or one serious injury, is 118 thousand Egyptian Pounds [104], in the same year, the average cost of a slight accident that causes one or more slight injuries with no fatalities or serious injuries is 13.4 thousand Egyptian Pounds. Moreover, the average cost of a property damage only accident for the year 2005/2006 is 12.8 thousand Egyptian Pounds.

- Time savings for HSR users, time savings for road users due to the reduction of traffic congestion on road.
- Changes in quality of service, reduction of traffic accidents on road, regional economic development, and environmental impact.

However, when customers decide on which travel mode to choose the comfort are factors that consumers take into account. Social responsibility e.g. benefiting the environment or reducing the number of accidents is increasingly important in public and private decisions.

Where it would be advisable though that governments also keep in mind the possibility of failure of commercial rail systems. If a country still wants to have rail as a transportations means while it is profitable, the value of operating it themselves might be relevant. In India, Egypt and Iran which are large economically on the countries in the developing and emerging world , the establishment of high speed trains can provide a profit that covers the costs if use it to transport of freight. High speed rail is almost non-existent because the lack of participation of the private sector, which are investigating feasibility of the now HSR system.

6.2.1 Competitiveness of the Railway with other Transportation Modes

High Speed Rail needs to be considered as not making just a marginal change to relative speeds and generalized costs within the transport system. Most transport demand forecasting models work from the basis of relatively marginal changes and an assumption that traffic can be assigned to the least (generalized) cost route [34]. The nature of HSR is both that it has substantially different characteristics from conventional rail and that it affects competition with both road (private car) and air, and thus is more likely to have a non-marginal effect. This makes less likely the ability to use simple demand forecasting models which are based on the (usually rather low) own and cross-price elasticity for rail travel. The high speed train is a technological break through in passenger transport which has allowed increasing railways share in modal split in medium distance, competing with conventional rail network, road and air transport. The main important factor to effective the competitive of rail, air and road is the trip time and the price. Also travel time depending on the difference of the public transport, this kind of travel contains of the direct impact on customer demand and combined with high information, Figure 18 shows the competitive of current situation of the transport modes in Egypt in terms of travel time from origin to destination.

The date of time of travel for railway was obtained from the schedules of the ENR in 2011. The main competitive strength of other transport modes also varies significantly between the case study countries. Consequently, over long distances, the main competitor is the air line in Egypt and then road and in the end rail. However the recent development of higher cost airlines presents competitive with the rail a road operators[40]. All of the case study countries have significant domestic air networks,

[40] In Germany, France, Spain, GB and Japan the development of low cost airlines presents a serious challenge to rail operators, many of whom have historically faced little pressure to contain their costs. All this countries have significant domestic air networks but in France in particular, high domestic air fares, which have been sustainable as a result of limited competition, probably have increased the demand for high speed rail travel. Where low cost airlines have recently begun to compete against high speed trains – for example on the Paris- Cologne route and some routes in Japan they have reduced rail's market share significantly (for example, traffic between Paris and Cologne on Thalys, the HSR operator fell 14% after the entry of German wings, a low cost airline [99]). As a result the proposal high speed rail line in country under study (Egypt, India and Iran) would probably face more attractive by the passengers. This

however, particular in Egypt, high domestic air fares, which have been sustainable as a result of limited competition, probably have increased the demand for the conventional rail and road travel. It can be also observed from the Figure 18 the car and bus and min bus are better than rail, however, the large number of accidents on the roads to make the railways of opportunity in order to attract passengers, although the travel time is long. From experience with the French TGV suggests, that traffic generation is much large than would usually be expected [34]. This is not necessarily a monotonic relationship however; there is clear evidence of thresholds. These are typically time thresholds which relate to the lower and upper bounds of the distance/time where HSR has a clear advantage. At shorter distances the flexibility and lower access-to-network times of car make it difficult for rail to complete, at longer distances the faster line haul speeds of air can overcome the higher access-to-network and inconvenience factors in air travel.

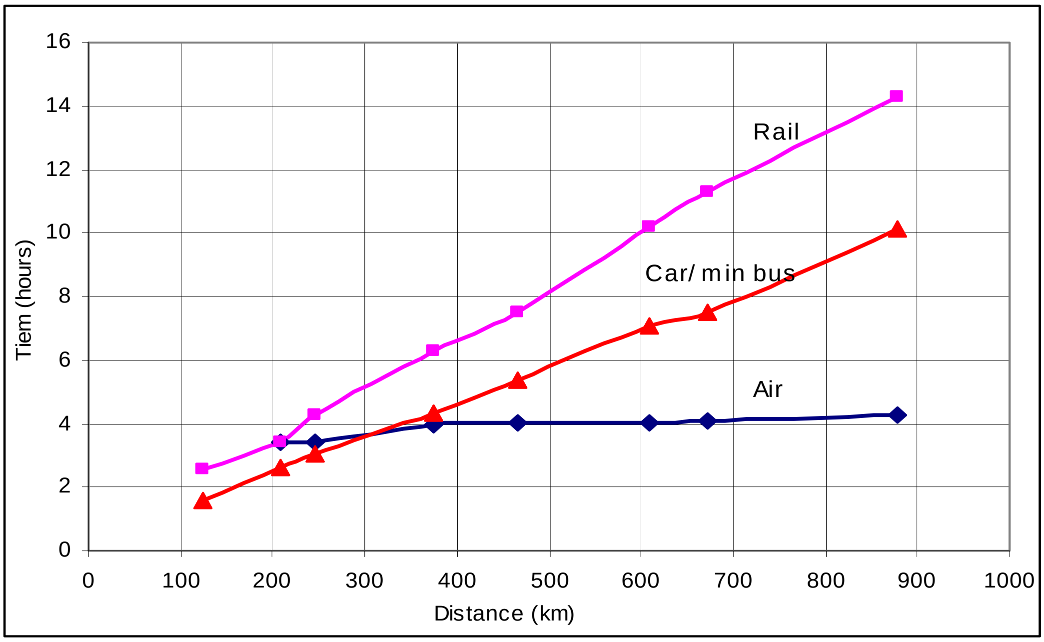


Figure 18: The Current Travel Time on Transport Modes in Egypt.

Moreover, in the Figure 19, it can be observed that the competitive between the transport modes. So, it can be calculated the travel time, where the total time required to get from the point of departure to the final destination is defined as the trip time. This includes travel to and from the station or airport, access time or waiting time in the station or while parking, actual travel time, and egress time (time to obtain transportation from main mode to the final destination). Generally what matters to a traveler is the total elapsed time it takes from origin to destination rather than simply the speed of the mode used for the main part of the trip. Figure 19 portrays the modal choices for a hypothetical 100-mile (160km) trip available to a potential rider desiring to reach his arrival point at a set time. As the Figure 19 shows, all modes have a similar total elapsed time at a 100-mile (160km) distance despite the differences in speed between the main modes, assuming an hourly frequency for the public modes. Other assumptions concerning terminal entry and exit access and egress, and the speed and frequency of the public modes, would swing the balance one way or the other. In general, the speed of the airplane may be offset by the time spent getting to / from airports or of getting around within airports. Conversely, the lower speed of the

will be in the interests of price competition high speed rail while the air travel is too expensive, unlike other countries(Germany , France, Spain ,GB and Japan) automobile largely is offset by the fact that it does not involve the access and terminal service time of the public modes. Thus, the speed of the main mode cannot be considered apart from the extra access and service time required by that mode. The above distance is consider 100 mile (160 km), and the market areas of transport is, automobile v = 100 km/h plus 15 min break, aircraft v = 500 km /h and the arrived and departure time equals 3 h from/to air port, and the train v = 150 km/h plus 1 h for arrived and departure time from/to station [105].

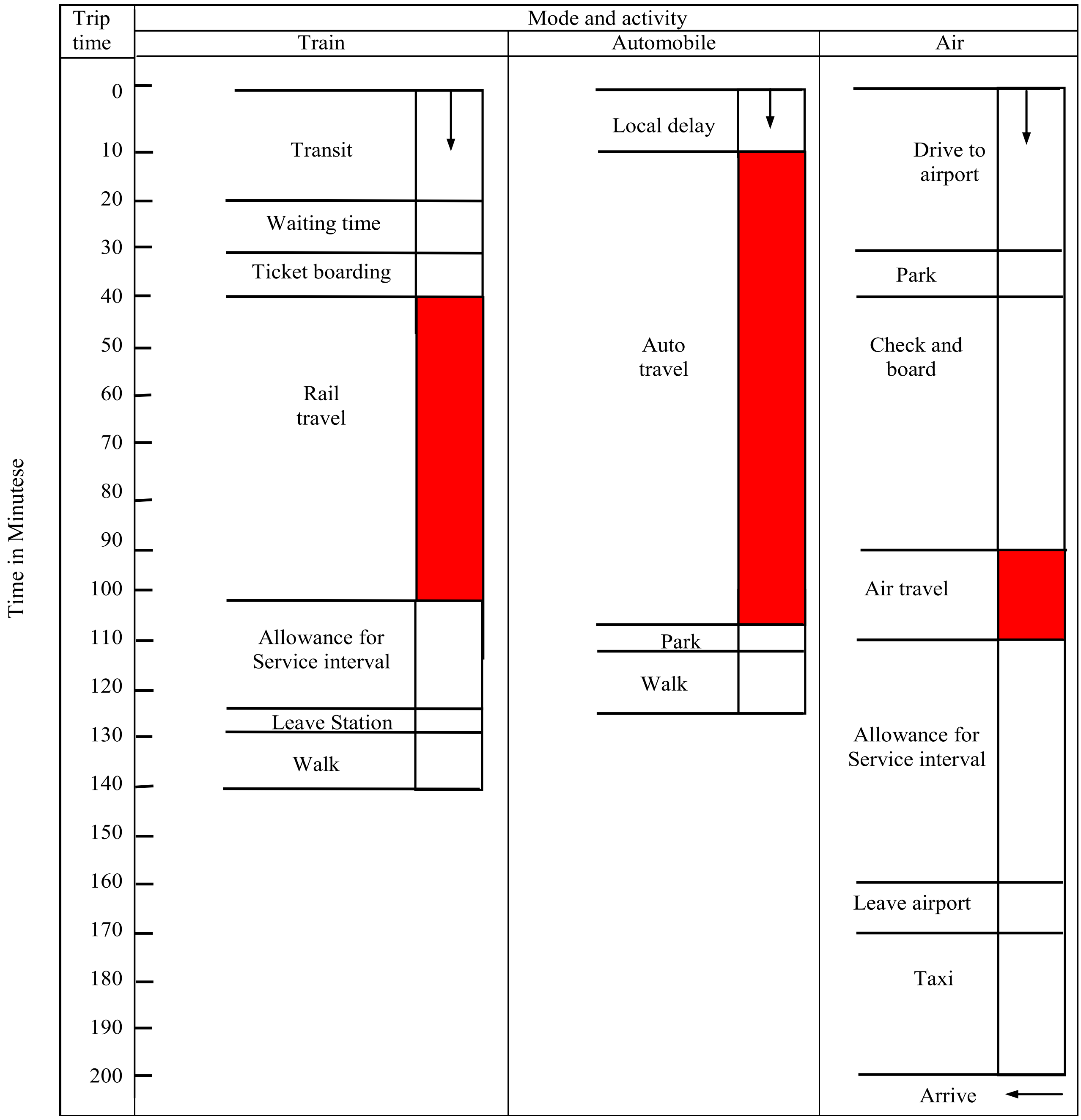


Figure 19: Elements of the total trip time for a trip of 100 miles (hypothetical)

Convenience to competitive between the all modes of transportation it will look the convenience between them and the questions which is more convenient? Figure 19 will be explained the answer. Thus, the total time needed for the journey of travel will be calculated according to: the actual time, where this time includes both of the constant time (the time depending on assumptions about time required for station and airport

access time, check in, etc. and the egress time. Thus, in the hypothetical case the fixed time is; car 20 min, and conventional railways; 65 min., and airplane; 180 min., as show in the Figure 19. The detailed show the travel market without the new alternative in terms of the speed each model and the total time of journey trip.
The train total time = 20+10 +10+ **64**+20+5 = 129 min.
The automobile total time = 10 + **96** +10 = 116 min.
The air total time = 30+10+50 + **19.2**+ 50 +10+ 30 =192.2 min.

In the method only in the a hypothetical distance 100 mile , and when this distance change , then the only actual travel time will changes (the above rod number) according the above Market areas of transport. For example the distance 500 km the airplane will be better than rail and car, and followed this rail.
The train total time = 20+10 +10+ **200**+20+5 = 265 min.
The automobile total time = 10 + **300** +10 = 320 min.
The air total time = 30+10+50 + **60**+ 50 +10+ 30 = 240 min

Conversely, in the distance 300 km it can be noted that the rail will be better than car and air. Despite, the train speed here does not exceed the conventional rail speed. Also it can be observed the following results from the Table 12.

- For trips of about 160-200 km it can be observed that the car offers higher than conventional rail. Conversely, for journey less than about 200 km, high speed rail offers higher advantage over car and conventional rail and maybe this depending on the location of stations, be less convenient for most passengers.
- In the journeys of approximately 160-400 km, rail is faster than air travel even if there is no high speed line, and high-speed rail will instead serve to make that advantage more robust.
- For journeys with distance between 400- 900 km, high speed is considering the best modes in term of time and thereby makes significant mode switches realistic.
- In journeys of more than about 900 km, even with dedicated high-speed infrastructure available for the entire route, air travel is faster.

It can be observed that, in terms of costs when railways increase speed and reduce travel time, then for a specific value of distance, where this leads to the reduced the cost and some traffic can divert from airplanes, buses and cars to the railways. In contras, if a traveler has a high value of time, he will easily accept an increase of the direct cost; if this leads to a reduction of the cost of time spent; due to an increase of speed [see Figure 19 and Table 12]. Consequently, if increase of speed can be a result of passing of waiting times, then somebody is willing to pay an increased monetary component. And this even, more when revenues increase, which in general leads to increase of the value of time [168].

Table 12: Relationship between Time and Distance in Difference Transport Modes

Distance	Time (min.)*			
	Car [100 km/h]	Conventional rail [150 km/h]	High-speed rail [250 km/h][41]	Air [500km/h]
160	116	129	103	192.2
200	140	145	113	204
300	200	185	137	216
400	260	225	161	228
500	320	256	185	240
600	380	305	209	252
700	440	345	233	264
800	500	385	257	276
900	560	425	281	288
1000	620	465	305	300

* This is the actual time, where this time includes both of the constant time (the time depending on assumptions about time required for station and airport access, check in, etc. Thus, in the hypothetical case the fixed time is; car 20 min, train and HST; 65 min., airplane; 180 min., as show in the Figure 19) and journeys time.

Although there is a tendency to think in terms of time, and thresholds time, there is clearly objective evidence relating to the comfort / convenience factor. City centre to city centre travel by a single mode with higher comfort characteristics than either car or rail has difficult to quantify advantages. However, it is still true that many journeys do not both begin and end at the middle city centre, for example they are home to business appointment. Homes may often be better sited with respect to airports than to city centre rail stations. Similarly, many modern businesses are situated in circumferential locations (often dictated by airport access). This suggests important consideration needs to be given to the quality of the access network. In order to predict and considering competition the key issue is to include the pattern of total trip times.

Finally, it can be also noted from previous Table 12 the high speed rail offers relatively little advantage for either very short or very long journeys.

As the result from the previous analysis in the case of countries under study there are strong correlations between significant population centers that are distances apart that make high speed rail a competitive transport option. Consequently, the previous analysis was based on conventional rail network, assuming that conventional rail would be able to sustain a standard operating speed less than of 130 km/h. High Speed trains have higher seating capacities than other modes of transport. So, HSR offers mobility unmatched by other modes. A network of high speed trains can carry more passengers than cars and airplanes combined.

6.2.2 Existing Demand and Supply

The key benefit of high-speed rail is its ability to move a large number of people quickly over medium distances. Many countries have constructed high speed rail lines to provide extra capacity, rather than speed. Capacity was the main justification for construction of the world's first high speed rail lines, from Tokyo to Osaka and Paris to Lyon. The construction of high speed lines provides additional capacity for many different types of trains, because it frees capacity on the conventional routes. The potential demand for HSR may be divided broadly into business and leisure travelers. The business travelers are usually travelling at their company’s expense, and are willing

[41] The For speed 250 km/h it can be observed this in capital 6.2.3, where this speed considered the favorite maximum speed for proposal a new high speed line in country under study. Also it can be noted that the figure assumes a nonstop rail between stations.

to pay highly for time reduce, comfort and convenience. Door to door travel time is key variable in determining their choice of mode. The leisure market is normally much more very sensitive for price, with lower values of travel time. Nevertheless, improved rail speeds may lead to some replacement from the main leisure rival the car as well as some diversion from coach amongst those with no car available. It is also in the leisure market that one would expect that the potential for generating totally new trips, for example by making a day or weekend social or recreational trip feasible where it was not before, would be highest[42]. The evidence to provide high speed services to match up to these expectations? And history of high-speed rail services in does not exist so far in the countries under study. In order to achieve high-speed services in these countries has to be demand and supply have a large and this depends on the commuter and market the railway. Analysis of any a new system of transportation such as HST within the intercity takes place within an equilibration process between demand and supply. On one side of the equilibrium are those factors affecting transportation demand factors influencing the need or propensity to travel, the types and numbers (or quantities) of people and goods desiring to travel, the geographic locations at which demand for travel arises and the characteristics of individual travelers or goods determining preferred modes of travel. On the other side are those factors affecting transportation supply factors determining the kinds of transport servicing different passengers or commodities, the levels of service provided, the costs seen by users for various levels of service and resource consumption, and associated costs seen by owners and operators of the system.

Demand of high-speed rail it is widely recognized that the demand for a new HSR is not a direct demand but rather a derived one. Transportation demand arises through a combination of spatial, physical, economic and social factors leading. Although macro-economic predictions are not included within the Intercity, shifts in demand between major cities like Cairo/Alexandria and Mumbai- Delhi. The factors effective in the demand of HSR are:

- Structural changes or growth in various sectors of the economy: e.g. creation of new industrial or manufacturing plants, development of natural resources, investment programs in housing or public or private facilities, opening of new areas for tourism, changes in defense needs.
- Encouragement of, or responses to, changes in production and consumption of goods: e.g. adjustments in regulation of imports or exports, changes in the system or personal consumption habits, technological innovation in industry, shortages of scarce commodities (forcing reductions in demand or diversion to substitutes), changes in price of raw materials or finished goods.
- HSR make changes in the geographic dispersion of people and goods: opening of new areas for development, construction of satellite cities, increased urbanization of areas surrounding Cairo and other major cities.

[42] The holiday travel in Egypt is importance because most people travel to Alexandria to spend the summer holiday. Thus, leisure travelers face when choosing a travel agent other issues: firstly, the luggage transportation, especially for families with several children, often decisive for the decision to rail transport. The second point is crucial are valid for trips to the price of the trip. Especially for multiple individuals to achieve the same goal, so families are trying to travel on a train.

- Changes in the social fabric of Egypt: e.g. programs to control rates of population growth, shifts in the structure, composition, and demographic characteristics of families, imposition of income redistribution schemes and ignition of rising expectations among the general population.

It can be noted that demand of the conventional rail in the D &E country is higher. Thus, high population and high population densities are probably the most important characteristics of a potential high-speed rail corridor in this country because they make possible the ridership levels and the support for the local transit infrastructure required for successful high-speed service. Table 13 illustrates the traffic volume and traffic performance of the whole railway network in Egypt. It can be observed from this table the total passenger numbers fell dramatically from the period 1999/2000 onwards, only recovering in the beginning year of the 2003/2004 until data available 2009 and this is due to the many reasons as; low quality service of the ENR network, time of travel is longer and lack of discipline in the time and timetable…etc. Based on the total number of passengers and the total number of passenger kilometres, the average distance per passenger was 67 km in 1995 [81]. This average distance had tripled by the year 2004/05 to 126.46 km, but now this value about 91 km (see that in detail in section 6.7.3). The average number of passengers per train was calculated accordant to data in [81] by using the linear regression models from year 1995 to 2004.

The lack of investment is especially serious in the railways. Rates for passenger transport do not cover costs (see section 5.3.1), and the network therefore runs a substantial deficit that prevents spending on maintenance, making rail less competitive than other forms of transport. Roads carried more than 90 per cent of total domestic traffic (in millions of tones kilometer) in 2004/05 and railways less than 10 per cent. Lack of control over lorry traffic, especially overloading, damages the roads. In addition to this there are some accidents in last 8 years in the rail network (see section 5.2.2)[43].

Table 13: Volume and Performance Traffic of the all Railway Network in Egypt

Year	Volume of traffic	Transport performance	Average travel distance	Average passenger
	Mio. P	Mio. Pkm	Km	per train
2004	418	52,86	126	1003
2005	436	40,85	94	1231
2006	451	54,44	121	1217
2007	451	40,84	91	1204
2008	451	40,84	91	1190
2009	451	40,84	91	1176

Source [6; 81]

In order to estimate the travel demand evolution (all modes) a growth model is used. This model forecasts, using a linear regression model, the evolution of traffic between years based on the Gross Domestic Product (GDP) and the difference price evolution between various models. The model was calibrated using time series for the three cases. Starting from case 0 (1990-2009) data of whole the network, and case 1 (2001-2007) data of the existing traffic Cairo –Alexandria route, and case 2 (1983-1987) data of the old traffic Cairo Assuyt route will be explained detailed in section 6.7. The model is used to derive elasticity's of demand with respect to GDP growth for periods of

[43] About 6 000 people are killed and 30 000 injured each year in road accidents, the country's second biggest cause of deaths. Speeding, failure to observe traffic regulations, the poor condition of the roads and the country's antiquated stock of vehicles are the most common cause of accidents, which are leads to cost an annual $520 million (3 per cent of GDP) [106, P.11].

increasing economy and for periods of recession. Different assumptions have been made to identify the threshold between those periods.

A Supply of HSR: supply of high speed rail service arises through the allocation of resources and regulation of operations and prices by owners of transport links and operators of transport fleets throughout the network. The transport industry in Egypt comprises many individual owners and operators (both public and private), and the net level of service perceived by users is the result of interactions among all actors in the network: e.g. the interaction of highway owners (the Government) and trucking operators (public or private companies) to make available truck freight service to users; interferences among many operators on an owner's link (congestion); and, competition for fleet capacity among potential users, where the railways is run only by the government sector. There is no private sector for operation, maintenance, or even construction of rail line in Egypt such as highways. However, the equilibrium between demand and supply on high speed rail, those aspects of system performance (supply) will be relevant to user choice? Of transportation services (demand) are typically reduced to actual or equivalent monetary costs. Individual cost terms (e.g. fare or tariff; travel time costs; perceived costs attributable to loss or damage, reliability of travel time, and so forth) are then assembled within a Generalized Cost Function which forms the basis for calculating equilibrium. In any system of transfer the Generalized Cost Function has traditionally been evaluated on a link-by-link basis; system-wide effects have not been included in any of the cost terms [107]. For Egypt, however, this limitation was not possible to justify in among cities. Questions of investment and maintenance of the railways, and allocation of the available fleet to competing commodities, are highly significant in assessing Egyptian intercity transport performance and costs. These are system-wide considerations, and our models of Egyptian transport policy have treated them in the Generalized Cost Function as dependent upon network, rather than individual link, characteristics. Some examples of the types of policies that affect the provision of transport services (in terms of performance and cost of transport) and can be considered in the context of the cities are as follows:

- It should be linked the proposed line with the high population density cities.
- Connected and facilitate the services for industrial zones along on the proposed line the line of such as the city
- It can be linked the proposed line with the conventional network to increase the efficiency of transport

There are some implications of transport policy (supply and demand) alternatives, where requires estimates of high speed rail performance and costs for various physical and operating between cities. These performance and cost data (demand and supply) are provided by a set of computational models at different levels within each of the intercity modes considered railways. These models are referred to collectively as the "link cost models". The models are structured around three categories of actors within intercity transportation:

- Owners-those who control transport infrastructure (e.g. Egyptian Railway Authority in Egypt, Islamic Iranian Republic Railways (RAI) in Iran), and Indian railways are now entirely owned and operated by India Railway Board (IR)
- Operators-public or private entities which employ vehicle fleets to transport people or goods (e.g. Egyptian Railway Authority in Egypt, RAI track for private sector in fields that include operation, maintenance, and rolling stock procurement in Iran)
- Transportation users-those who, by their production or consumption of goods, or

their need or desire to travel themselves, generate demand for transportation.

In the above three items it will be noted that, the ENR Authority is to demonstrate accountable for infrastructure and operating and does not have any involvement of the private sector or any other company in the area of the Egyptian Railways. Within this framework the demand and supply of the high speed rail depends on four types of transport policies:

- Investment (in each links and fleets).
- Maintenance (of both links and fleets),
- Operations (such as scheduling, allowable operating hours, allowable speeds, weight limits), and pricing (tariffs, loading and unloading charges).

There are also economic scenarios that determine, for example, the relationship between financial and economic costs, and inflation rates relative. The interaction between owners' policies and the behavior (demand and supply) of other actors in the any system is evident. Improving the condition of existing line haul links (or building new ones) affects travel speeds (and hence travel times) and trip reliability, and therefore encourages operators and users to use the improved this system (or take advantage of the new access provided such as HSR).

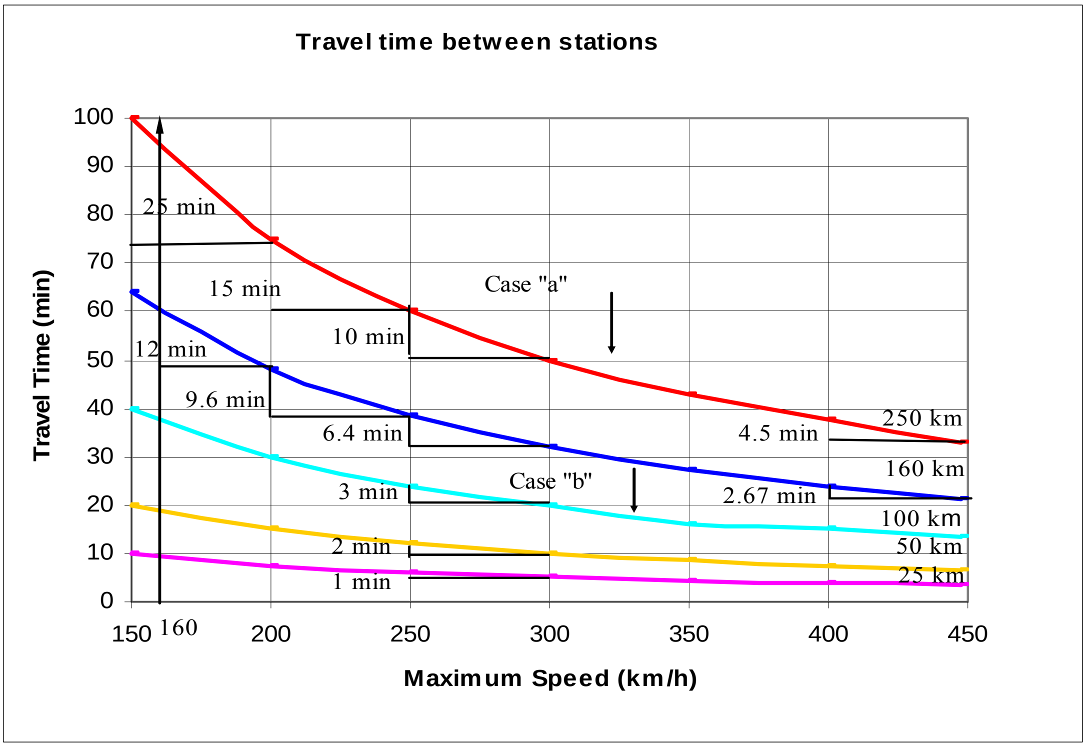
6.2.3 Journey Time and Distance

The growing need for HSR: The need for high speed rail systems has greatly intensified in recent decade. Most of the developing and emerging countries such as Indian, Egypt and Iran have faced two serious transportation problems in urbanized regions and in major intercity corridors. First, highway and street congestion have become a chronic problem, causing longer travel times, economic inefficiencies, and deterioration of the environment and quality of life. Second, congestion problems are occurring on the roads leading to high incidence of accidents as a result of the high speeds of drivers, with the lack of respect for drivers to signals and instructions roadway safety. Here there is a problem only in industrialized countries and this problem in addition to previous problems caused by the need to establish a high-speed line in these countries, congestion problems are occurring at airports, with similar high user and social costs. Under these worsening transportation conditions, high speed rail has emerged as a vital concept. HSR is by far the most efficient means for transporting large passenger volumes with high speed, reliability, passenger comfort, and safety. While highway and air traffic consist of thousands of vehicles driven by individual and in this section the relationship between speed and travel time will be focused.

The importance of high speed and optimum values: One of the goals in building HSR systems has been to increase the domain in which railway is the superior mode not only in convenience but also in speed or travel time. This goal has been successfully achieved in many locations. The railways model should offer average speed travel approximately twice higher than the car and half as high as air travel [108] include the advantage of railway in center city delivery, instead of remote airports). Therefore, based on these advances of high speed railway in increasing its optimal domain, it is now considered the range in which it can have a dominant role for example the distance between 100 and 1,000 km, depending on the relative speed of high speed and its competitors in a given corridor. Therefore, it can be tack for example some of the distance 25, 50,100,160, and 250 (hypothetically distance) to explain the impact of increase speed on travel time between stations. Thereby, the relationship between distance, speed and time saving it can be shown in Table 14.

Reducing travel time is critical to its success[44]. However, the limits to which top speeds should be increased deserve careful scrutiny as the following:

Case ''a'': The increases the speed has reduce the marginal gains in terms of travel time. In Figure 20, on a 250 km long inter-station distance an increase in speed from 150 to 200 km/h reduces travel time by 25 minutes; from 200 to 250 km/h saves another 15 minutes. A further speed increase from 250 to 300 km/h saves only 10 minutes. Also on a 160 km long inter-station distance an increase in maximum speed from 160 to 200 km/h reduces travel time by 12 minutes; from 200 to 250 km/h saves another 9.6 minutes. A further speed increase from 250 to 300 km/h saves only 6.4 minutes. If speed would be increased from 400 to 450 km/h, the gain would be only 4.5 minutes at (250 km) and 2.67 minutes at (160 km). This shows that for any given distance, the marginal value of increasing the average speed results in decreasing travel time savings. The result from this analysis means, the speed increase from 160 to 200 km/h and 200 to 250 km/h is much more effective than increase (hypothetically) from 400 to 450 km/h because the time saving in the first case is better than the last case.



Source [60]

Figure 20: Impact of Increases Speed on Travel Times between Stations

Case 'b': Travel time reductions due to higher speeds depend very much on the length of run between stations. It can be observed that in Figure 20 and Table 14, for example, if speed is increased from 250 to 300 km/h, travel time will be reduced by 10 minutes on a 250 km long run; and also if the speed increased from 250 to 300 km/h, travel time will be reduced by 6.4 minutes on a 160 km long run, the same speed increase would bring only a 3.0 minute travel time saving on a 100 km long run, and a negligible saving of 2.0 minutes on a 50 km long run. The result shows that the benefits from high speeds are great on long distances between station 100-250 km, but very small or negligible on short distances 50 km. Therefore, it must be taking into account the marginal cost of

[44] It can be also heir noted, the higher speed in railways leads to higher investment cost, and additional to this the ticket price will be higher as a result of high speed.

increase the maximum speed (in system design, construction, operating costs, etc.) grows more than proportionally with speed.

Table 14: Time Saving in Different Speeds.

Saving time		150 - 200 km/h	200 - 250 km/h	250 - 300 km/h	400 - 450 km/h
Casa “b”	Dist .25	2.5	1.5	1	0.42
	Dist .50	5	3	2	0.83
	Dist .100	10	6	4	1.67
Casa “a”	Dist .250	25	15	10	4.5

In addition to increase precision required in guide-way and vehicle design, energy consumption increases with the speed due to the exponential increase of air resistance. The cost-effectiveness of investments in designing higher speed systems decreases as the maximum speed grows. These facts show that the optimal domain for proposal high speed rail in the case study is on long distance, such as 200 to 700 km [see Figure 22]. On shorter distances, the gains in travel time are so small that it is difficult to justify the high investment. For example, very important and functional lines between center cities and airports (Frankfurt, Zürich, and London-Heathrow are outstanding examples) may not be candidates for HSR (as proposed for Munich, Stuttgart and Shanghai) [109] because they require much higher costs and bring very little additional benefit, regardless of technology.

To summarize, the aim of Figure 20 and Table 14 is to determine the speed at which run on a new high speed line in the countries under study, and know the time, which is stored at each speed. Therefore, the speed of train depends upon many factors such as: the cost of establishment and design the track, where the greater of the speed lead to higher construction costs (because it will need to the especial control system ,it will need to a special tracks (slab track), and protection of land, noise, and special barrier), in terms of methods of controlling, use ballast track or slab track (where conventional ballasted tracks cause less noise and cost much more than conventional slab tracks, cost of rolling stock...etc. Consequently, it can be observed that, the favorite maximum speed can be used to establish and design a new high speed line in countries under study is 200-250 km/h.

6.3 Possibility to Construct HSR liens in the D&E Countries

In the previous chapter the first steps for requirements and the factors that lead to the creation of a new high-speed line. In this section the study of the proposed corridor line in Egypt and the costs required in accordance with the experiences of foreign will be analyzed. So, high speed rail line imply significant environmental costs (land, noise, barrier effects, visual intrusion and global warming) the train still retains a good environmental image, through the actual environmental balance depends on the volume of traffic and its composition. The interest of high speed rail is shared by most governments, and, obviously, by the industrial lobbies that supply rolling stock and other rail inputs, as well as by user, who generally enjoy its speed comfort and price and there are three elements responsible for the dramatic recovery of the railways market share over medium distances. If user, governments, industries support such a technological option for passenger travel, it could be in a situation improve the development. Nevertheless, the price that user pay for HSR infrastructure, operation and services in many routes is far from covering construction, maintenance and infrastructures operation costs. Therefore, there must be, in fact, a partnership between all parties as is the case in most public projects and investment.

The question is not whether user and other possible beneficiaries of HSR would vote in favor of the construction of high speed rail lines. The question is whether they will be willing to pay (independently of who they actually pay) their social cost. The answer to this question varies widely depending on the local characteristics of the project routes, crossed urban zone, required bridges and tunnels, volume of demand, per capital income, and the level of capacity in competing modes. Social benefits of HSR due mainly from user time saving and the willingness to pay of generated traffic. To these benefits we should add those that users experience by reducing congestion and accidents in alternative modes. The benefits obtained from the release of capacity in the traditional network should also be added[45].

Deciding to reject (or delay) the construction of a high speed rail line is not necessarily a position against progress. If the best information available previous proves that there are other transport options with a higher net social benefit, the most appropriate decision is to select such options and not the larger, more costly or newest technology. So, the question when is the investment in high speed rail profitable from a social perspective? The answer, as in so many aspects of economy, is not black and white. However, it depends on the conditions of the country where the new line is to be built and the expected volume of demand. Choosing an investment option without comparing it with relevant alternatives is, at best, contrary to good economic practice. The primary function of high speed railways is to solve a transport problem, and their advantage over other feasible alternatives has to be demonstrated on a case-by-case basis. Investment in building HSR lines and the associated rolling stock to operate them is very expensive, and their indivisibility and irreversibility increase the cost of errors. Constructing new lines with an optimistic demand bias translates into a waste of taxpayer money, because this mode of transport is being developed in Europe within the public sector, without private participation and with revenues far from covering total costs until 1997 [110]. Constructing a new high speed rail line may reduce congestion and accidents in road and air. If the volume of demand is high enough, the project may be socially profitable. In addition, when a high speed line is linked to a network, it multiplies its connectivity, making new origins and destinations accessible. This factor and the release of capacity in the conventional rail network or in congested airports increase the probability of a positive net present value.

6.3.1 Analysis of the Passenger Travel Price and Travel Time

The mode-service choice model

The mode-service choice model is a set of interfere logit with the overlapping structure to capture higher degrees of substitutions among specific subsets of modal alternatives, particularly compares between the existing model new in Egypt and proposed HSR as alternatives provided on the same route: This model using comparison between the various model, based on the evolution Gross Domestic Product (GDP per capita) and

45 When benefits are higher than costs, the investment is probably socially worthy, although even with a positive net present value, there may be other alternative projects providing a higher social benefit. But what happens when the flow of expected net benefits is lower than the investment costs of the project under evaluation? Or, in more intuitive terms: what happens when the society is willing to pay a price for a high speed rail line which is inferior to its cost? The answer is clear reject (or delay) the project.

the difference price evolution between various models. Travelers are assumed to have the following 4 alternatives:
1) Auto, 2) Air, 3) Covenantal railway, and 4) Proposed HSR
The model leads to a hierarchy in mode-services choices which is based on 3 levels (see Figure 21):
- At the first level, it is supposed that the travelers chose the transportation mode (air, car, rail), based on the quality of the offer, on his own profile and on the specificities of the mode.
- At the second level is, a traveler who selected rail as a mode, chooses between High Speed Rail services (HSR) or Conventional rail based on the same criteria as level 1.
- At the fourth level, a traveler who selected High Speed select or Conventional rail between first and second class.

The models were estimated for two trip purposes (i.e. "Business" and "Non-Business") using Maximum Likelihood method. The estimation was based on disaggregate data obtained from the ENR and the Egypt air and the MoT in 2012.

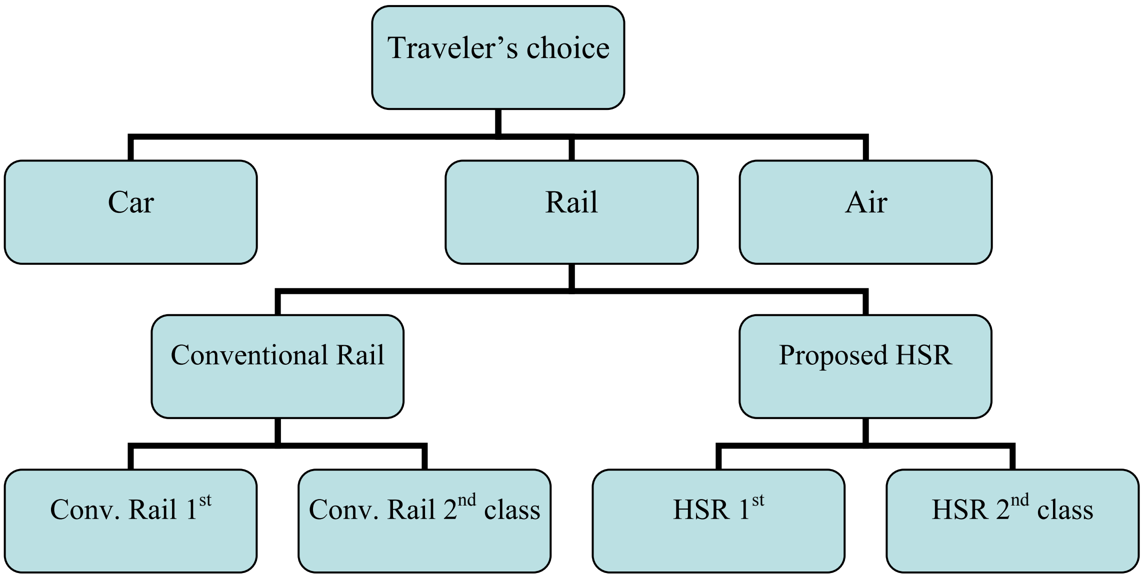


Figure 21: Overlapping of the Mode- Service Choice Model.

Thereby, countries under study such as Egypt, the proposal corridor for a new HSR line between Cairo- Alexandria, and Cairo/ Assyut, and Cairo- Aswan, the question is why has been chosen these corridor? And this corridor is a meaningful economic corridor in Egypt? Or, not, if it is already establishment high speed rail line will be profitable for Egyptian passenger. This depends on the how may pays passenger when used the new system [price/km], also this dependent on the income for Egyptian people per month, demand of passenger, volume of traffic, and how many passengers travel per years and also distribution of employment. In Table 15 the number of passengers between Cairo-Alexandria and Cairo- Aswan corridor [111] can be showed. Indeed, it is important to consider HSR connected between cites have high population density, where it is able to generate a higher volume of traffic per years. Also the factor load must be not less 50 % of carrying capacity of the train. As for the capita income in Egypt, the average income among Egyptians is differences between people. Because incomes are vary greatly, and there are so many people on different categories. Therefore, the average income for Egyptian people is 2450 US$ per years [4, P.724], this value will be effective on the travel trip price (ticket price). It is clear that in the Table 15 the number of passenger in year 2008 is 73 and 91.25 million passenger between Cairo/ Alexandria and Cairo/ Aswan respectively.

Table 15: Volume of Rail Traffic between Cairo/Alexandria &Cairo/Aswan in 2008

Cites	Distance (Km)	Passenger (per day)	Passenger (per years Million)
Cairo/Alex.	208	200.000	73
Cairo/Aswan	879	250.000	91.25

Source: [111]

According to Table 15, the volume of traffic between Cairo/Alexandria and Cairo/Luxor–Aswan are the total traffic for the route, this means that 73 million passenger per years is not direct from Cairo/Alexandria rout, but for all the cities between them. Also the rout Cairo/Luxor-Aswan the number of 91.25 million passengers per year for all cities located on this line until Aswan or the Cairo.

For example, it can consider the following data in Table 16 to calculate the relationship between distance and travel time between car, air, conventional railway and the proposal HSR in Egypt. It can be observed from the Figure 22 that the cars/bus and mim-bus are better than trains in both short and long distances; this lead where the conventional train speed in Egypt are not more than 80-90 km/h. The total time for the proposal high speed rail can be show in the Table 16, where this time between each city from/to Cairo (the start point is Cairo). For the total time with the proposed HSR line it will be used the next equation to calculated the total time by high speed rail.

Total time between each to cities by proposed $HSR_{time} = 1 + \frac{d}{V_{max}}$ + stop time; where d distance between cities and V_{max} is the maximum speed.

Table 16: Relationships between Distance and Travel Time

Cities	Alexandra	Cairo	Bein Suef	Minia	Asyut	Sohag	Qena	Luxor	Aswan
Distance	208	---	124	247	375	467	609	671	879
Air	3,45	---		3,45	4	4,05	4,05	4,1	4,25
Rail	3,45	----	2,55	4,3	6,3	7,5	10,2	11,3	14,3
Car	2,6	---	1,6	3,05	4,35	5,35	7,1	7,5	10,15
Proposal HSR	1h 55m	----	1h 30m	2h 04m	2h 40m	3h 07m	3h 46m	4h 06m	5h 01m

Car/ min-buse: 90 km/h 20 min break, Train: 80-90 km/h Exit/ entrance time 1 h, Airplane: 500 km/h Exit/ entrance time 3 h, Proposal HSR train 250 km/h Exit/ entrance time 1 h. The proposal line Cairo/Luxor-Aswan the train service will be stop in six stations, so, the stop time it will be added in the total time about 5 minute for each stop.

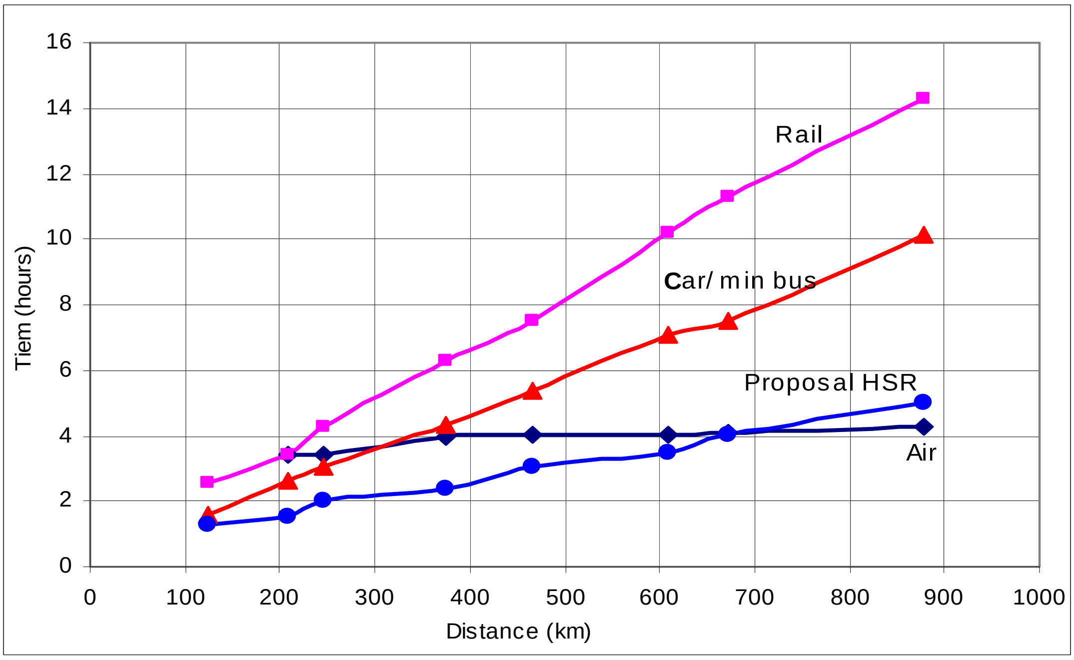


Figure 22: Travel Time in the Important Modes in Egypt with the Proposal HSR

On the other hand most of the people used the car more than rail especial in the distance to 500 km, despite there are many accidents on the road. Also as a result the proposal HSR will be cut the distance 879 km (between Cairo and Aswan) in 5.01h, this main that HSR will be better than other mode in Egypt [46] when compeer it with other model as a result from analysis the mode-service choice models.

The following attributes of the systematic utility of the alternatives resulted to be statistically significant:

- Level of service attributes:
  - Travel time
  - Travel cost
  - Access/egress time, for Air and Rail
  - Service frequency, for Air and Rail
- Socio-economic attributes:
  - Professional condition (high or low)
  - Degree (yes or no)
  - Travel frequency

For the comparative between travel time and price of each transport mode the results from Figure 22, for the two proposal lines between Cairo /Alexandria and Cairo/Aswan can be showed. Thereby, the price and journey time of the current transport modes (car, train, air) with the prices of proposed HSR will be analyzed.

- **Travel Price in Air Transport:** Egypt Air is the airline with the highest prices per kilometer in Egypt, because it is the big airline company in Egypt[47]. For the air fares

[46] There is no significant difference between Figure 18 and Figure 22 where as Figure 22 is a special in the case study in Egypt with the proposal high speed rail and this given a general overview in developing countries, where train speeds reaches to 100 km / h in some countries.

[47] Egypt Air, the national carrier, and Cairo Airport Authority still enjoy monopoly rights in the provision of services and infrastructure which are contributing to high costs for passenger. Passenger service is the core business of the aviation sector in Egypt. Tourism, a major source of Egypt's foreign exchange earnings, is a determining factor in the number and size of aircraft serving both international and domestic

the figures in the Figure 23 considers is the average fares per Passenger km. Moreover, it can be noted that in the short airline distance the fares price ranges between 1.19 to 2.37 LE/Passenger km (0.15€/km to 0.25€/Passenger km), however, in the longer airline distance the fares price ranges between 0.64 to 1.21 LE/Passenger km[48] (0.11€/km to 0.15 €/ Passenger km)

- **Travel Price in Rail Transport:** for rail price the ticket prices by train in Egypt dependent on the kilometer and the class, there are also some factors determine the fares by a variety. On the one hand, there are fares based on the distance, where the declining of basic price dependent on the route length. Therefore, there are many differences maximum[49] price between 1st and 2nd Class fares. So, the fares per kilometers is 0.06 to 0.17 LE/Passenger km for the 1st and 2nd Class, however relations between the 1st Class fares and distance is 0.12 to 0.24 LE/ Passenger km [112] as show in Figure 23. Moreover, for student if they have an ISIC student card, this gives you a 33% reduction. In addition [113], children aged 0 to 3 travels free, children 4 to 9 travel at two-thirds fare, children 10 and over pay full fare (fares are one-way fares, the price is the same in either direction).
- **Travel Price in Public transport:** Transportation by bus and minibus in Egypt is the most economical way to travel and there are many bus companies servicing nearly all cities throughout Egypt. One of the better bus systems are operated by Super Jet and provides transfers between all major cities. For bus ticket prices and mini buses are generally comparable with the cost of 2nd-class train tickets, for the mini buses which are a lot cheaper than bus. Furthermore, the average cost per kilometers in the bus about 0.15 LE/ Passenger km, taking into account the average load over long distance between cities can be take 0.10 LE/ Passenger km [114]. The results are presented in the form of a cost driver analysis in Figure 23 and Figure 24.
- **Travel Price in Proposal HSR Rail Transport**: for the proposal HSR, Egypt do not have this system of train, therefore it can be take advantage of foreign expertise in this flied, according to the analysis in section 4.4, it can be observed that the cost of passenger kilometers in deference country. Consequently, it can calculate the price of the trip in Egypt using these values. However, there are many differences in the price per passenger kilometer between countries[50], therefore, it can be take the average price about 0.07€/Pkm to 0.11€/Pkm [0.68 –1.1 Egyptian pound, status May 2011].

Application

The induced demand model is based on a relationship between existing models demand (dependent variable) to existing models travel times and costs. The covariates include socioeconomic variables related to population and employment in the zones connected

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destinations. There are several airline companies in Egypt in addition to Egypt Air. Most of other Egyptian airline is charter carries mainly operating inside Egypt, Arabian Gulf and Europe.

[48] For example the Egypt air flight (www.egyptair.com) between Cairo/Alexandria the average flight price is 348 EGP and 765 EGP between Cairo/Aswan in April 2012, where this price include taxes, fees and charges.

[49] For example cost price for the 1st and 2nd Class fares within Egypt is 52, 36.4 EL, and 26, 19 LE for single trip between Cairo/Alexandria respectively. For the route between Cairo/Aswan the fares ticket is 113.4 LE and 57.20 LE respectively (www.enr.gov.eg/ticketing/public/smartSearch.jsf, status 10. May 2012).

[50] In the Spain the cost per passenger km is 0.076 to 0.124 €/ passenger km. whereas, the Japanese level price in long distance about 0.187 €/ passenger km. In Germany and U.S. estimated the cost per passenger km about 0.092 €/ passenger km and 0.079 €/ passenger km receptivity [See Capital 4.4].

by the proposal HSR services. This model was calibrated by mean of a before study carried on travel in the proposed new lines in the case study corridors, when the new HSR services was proposed.

The application of the models system to hypothetical transportation scenarios has shown the following flexibility's:

- Elasticity of proposal HSR demand travel cost and time to travel cost and time by car equal to +4.74 and -1.68 times for Cairo/Alexandria; and +6.0 and -2.03 times Cairo/Luxor-Aswan receptivity.
- Elasticity of proposal HSR demand to travel cost and time by airport (access/egress time, check-in, security pass,…) equal to -2.1 and -2.23 times for Cairo/Alexandria; and -1.28 and +0.85 03 times for Cairo/Luxor-Aswan receptivity.
- Elasticity of HSR demand to travel cost and time by conventional rail between +3.02 and -2.23 times for Cairo/Alexandria; and +5.26 and -2.85 times for Cairo/Luxor-Aswan receptivity.

The model will be applied to predict the impacts on national passenger volumes, of the new proposal HSR services and operators. Different scenarios will be tested for different macroeconomic assumptions and marketing strategies of the main passenger transportation competitors on the long distance.

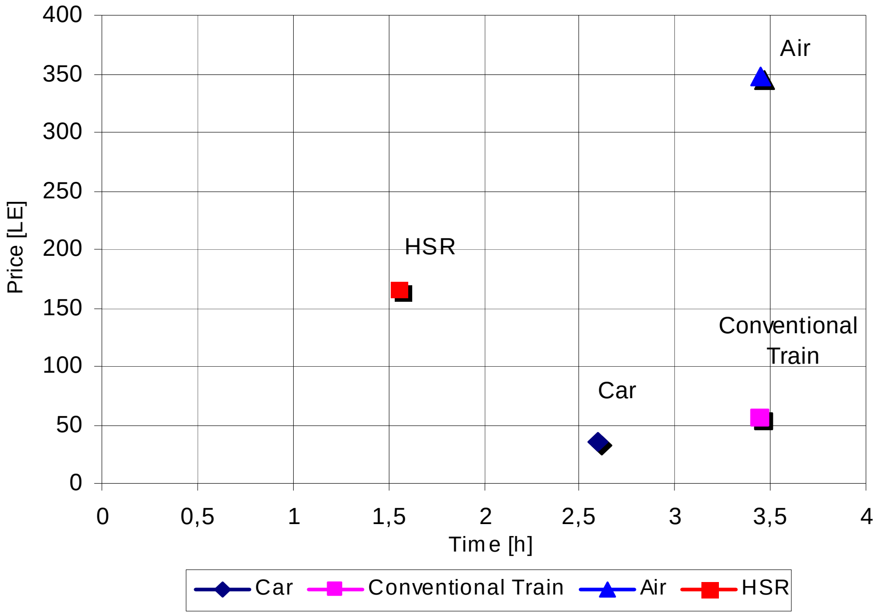


Figure 23: Ranges in Fares Price in Corridor Cairo/ Alexandria

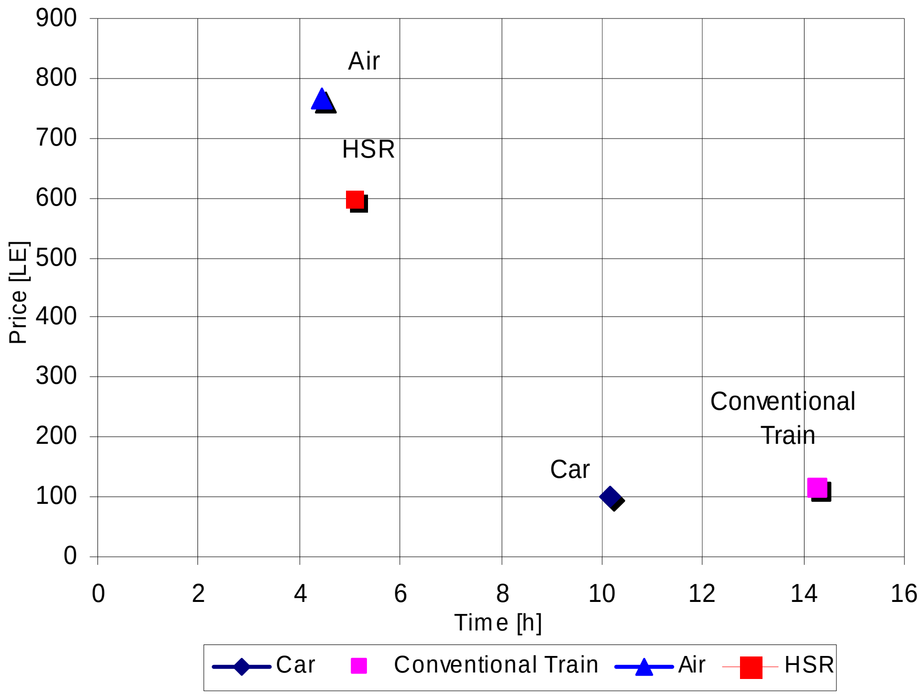


Figure 24: Ranges in Fares Price in Corridor Cairo/ Aswan

6.3.2 Topography of the Proposed Corridor in the Case Study

The propose corridor for the establishment of high-speed line between Cairo and Alexandria, will be in western desert, and go directly non-stop between Cairo and Alexandria. Thus, this corridor passes through a flat land and they are no mountains or valleys, this means when creating and building a proposal new line of high-speed rail does not need to dig tunnels, also do not need to build bridges, where this in turn will reduce the investment cost of infrastructure. In hilly or mountainous areas this leads to the necessity of the construction of numerous civil structures, such as tunnels, bridges, embankments and cuttings, all of this leads to higher construction cost. This is useful in infrastructure cost building. Therefore constriction of routes through tunnels or over viaducts is shown to be 4-6 times more expensive per kilometer then construction over flat land [99, P. 33].

The proposal line start from Cairo on the pyramid St. in the west Cairo, the now proposal line will be runs parallel to Cairo-Alexandria desert road Figure 25. Alexandria ended this line with a new station. The new railroad lines typically follow the existing topography. Therefore, whenever possible and economically feasible new dedicated lines are the preferable alternative. In the Figure 25a show the currently existing line of railway (blue line) passing in the center of cities (Banhe, Tanta, Damanhur, Kafer el Dower). Indeed, upgrading of the existing line is not possible to achieved higher speeds. Because the existing railroad lines typically follow the existing topography and are characterized by tight curves and a mixture of freight and passenger traffic. The latter can also severely obstruct high-speed operations.

Furthermore, high-speed trains on conventional track can also be constrained by having to mix with slower services on the tracks. Addition one limitation of this approach is that the existing network usually has many limitations on train speed curves, at grade road crossings, etc. that limit the potential speed improvements. In addition, the cost of upgrade conventional network in the America estimated about $7 million per mil [120]. In UK the average price for upgrading conventional network is £3.4 million per kilometer [121]. In Germany 1991 the cost of upgrade kilometers is 5 DM about €2.55 million /km [122]. Today the costs of kilometers upgrade in Germany between 3-4 million Euros. It can be noted that, the cost of upgrade the existent network is costly, additional to the previous obstacle. In Figure 25 b the red line shows the new proposed HSR line direct between Cairo and Alexandria, this line passes in the western desert. Therefore, whenever possible and economically feasible new dedicated lines are the preferable alternative. Key factors for developing high-speed trains are safety and ecological priorities. In any event considerable construction work is necessary which requires significant investment.

Indeed, when entering the proposal line in Cairo or Alexandria will need some bridges. On the one hand, to avoid intersections with roads or existing lines, and also during the proposal line passing parallel to the highway there will be some bridges. On the second hand, of any a new project for railway the topographic is the first step to determine the initial costs of this project. Therefore, different cost of any project from countries to countries depended on the topographic. Consequently, the proposal corridor will be straight track or at least large radii, where can be a prerequisite this of high-speed operation over long and medium distances. But turning to operating and maintenance costs, the variations by country do not appear to be as great as for construction.

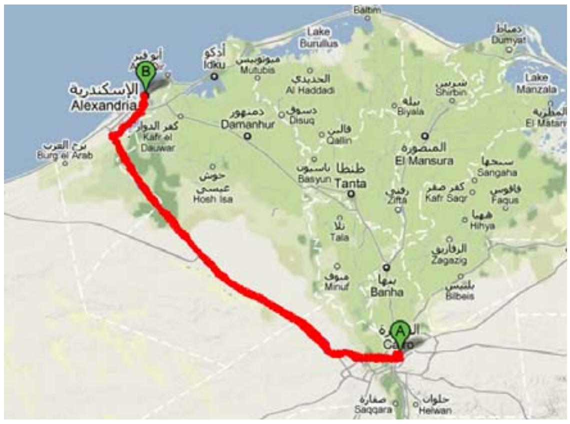
	
a) The Exstein Railways Line	b) The Proposal a new HSR Line*

Figure 25: Existing and Proposal a new HSR Topography

*I suggest this new layout, which will lead to reduce of construction costs as a result of the passage this line in western desert and also suggest the entrance proposal line in the Cairo city and Alexandria city. On this bases it can be determine the approximately length of the bridge and number of crossing as in the Table 19.

6.3.3 The Cost of a new High Speed Rail Line

First step: As a gross figure for the investment cost of any transport system on a regular basis on the cost ratio: cost/km. In most cases, this is the route kilometers, also can used as double kilometer [Dkm]. This cost ratio is easy to understand and easy to identify, but also harbors a variety of dangers and drawbacks. Each figure represents the specific project characteristics and therefore can be transferred only with the greatest care to other projects. However, there are no identical projects! The use of ratios is therefore only possible if one knows the characteristics of both projects and can take it into account through appropriate adjustments. The cost of transport projects will depend on the:

- The topography (number of tunnels, bridges, etc.)
- The geology (of given building)

- The alignment parameters (minimum curve radius, maximum gradients)
- The existing building structure (hence the need for noise insulation in homes and office buildings, for over and underpass building structure with other infrastructure)
- The Ecology (compensatory measures for animals and plants, and habitats).

Table 17: Comparison the Average cost per kilometre of the HSR line Infrastructure

Country	HSR Project	Length [km]	Investment Cost [million EUR , 2005]	**Average cost /km [million]**	**Average Maintenance cost/km [Thousand]**
France	TGV Méditerranée (Valence-Marseille	295	3800	**8.80**	**28,420**
	TGV Intersecteur	102	1020		
	TGV Rhône-Alpes (Lyon-Valence)	122	1293		
	TGV Nord (Paris-Brussels-London-Cologne)	333	3330		
	TGV Atlantique (Paris-Tours-Le Mans)	282	2225		
	TGV Sud-Est (Paris-Lyon)	417	1978		
	LGV Est	344	1400		
Germany	Hannover - Würzburg	425	7883	**17.80**	**30,0**
	Hannover - Berlin	264	5551		
	Köhl - Frankfurt	215	6213		
	Ausbourg - Munich	62	560		
	Berlin - Leipzig	205	1637		
	Leipzig - Nuremberg	192	6328		
	Saarbrücken – Mannheim	200	195		
	Nuremberg - Munich	123	2654		
China	Qinhuangdao – Shenyang	405	4046	**8.68**	**---**
	Beijing - Shanghai	1337	9869		
S Korea	Seoul – Taegu	409	13981	**34.20**	**---**
Japan	Tokyo - Osaka	515	2806	**27.70**	**---**
	Osaka - Hakata	554	11104		
	Omiya - Morioka	466	20936		
	Tokyo- Niigata	300	12130		
Taiwan	Taipei - Kaohsiung	346	13652	**39.50**	**---**
Spain	Madrid - Seville	471	3860	**11.00**	**33,46**
	Madrid - Lleida	481	4971		
	Lleida – Barcelona - French border	374	4923		
	Cordoba - Málaga	155	1847		
Belgium	Brussels - French border	88	1420	**14.60**	**31,7**
	Brussels - German border	139	1810		
Austria	Attnang - Sankt Pölten	186	3448	**29.10**	**---**
	Sankt Pölten - Vienne	50	1980		
Italy	Florence - Rome	254	5080	**26.00**	**12.92**
	Rome - Naples	204	5200		
	Fortezza - Verona	190	590		
	Turin – Milan	125	7000		
Netherlands	Amsterdam - Belgium border	102	4454	**43.70**	**43.70**
Turkey[51]	Istanbul-Ankara	533	2600	**4.90**	**4.9**
Morocco*	Tangiers- Kenitra	200	1910	**9.00**	**---**

Source: [123]

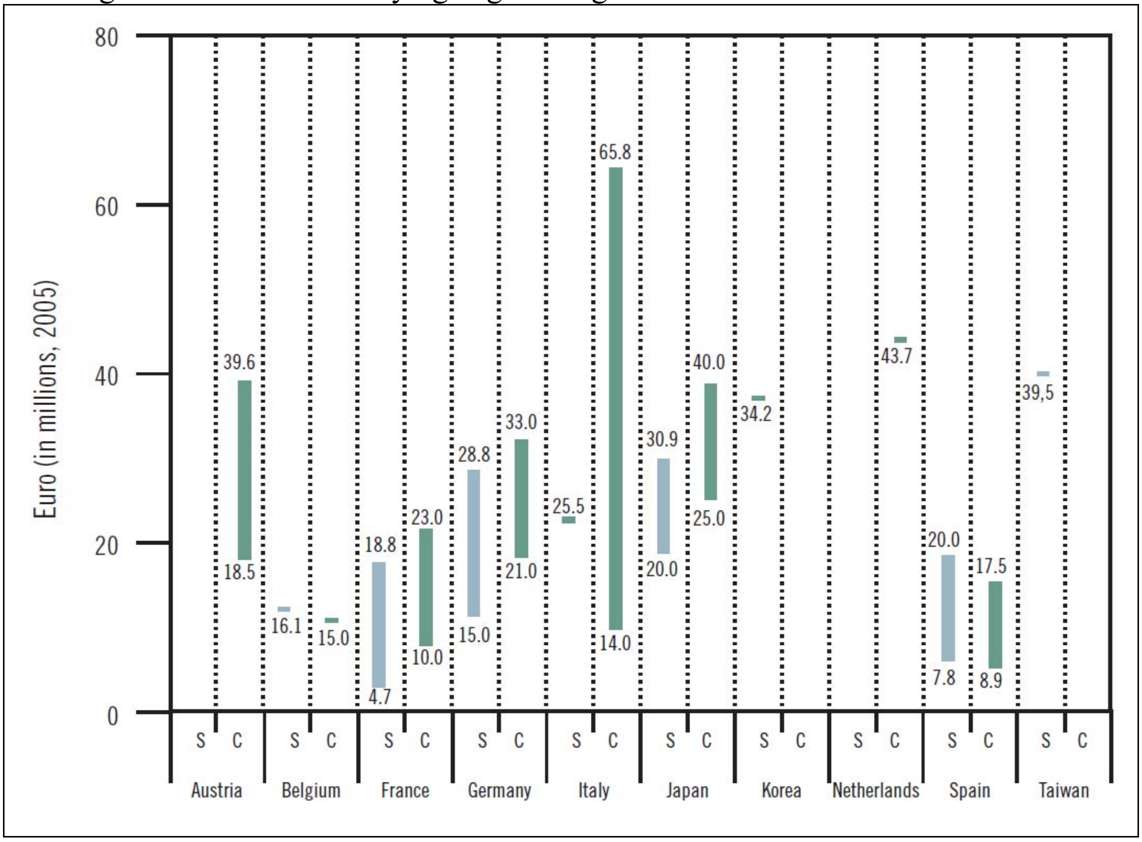
* The Tangiers- Kenitra line now under construction and expected to begin by the end of 2015 [252].

The second step of determine cost of a new HSR is know the speed design of a new line, because the all cost such as costs of building HSR infrastructure, costs of operating HSR service, maintenance cost and external costs depend on the speed. In countries

[51] DLH, Demiryollari Limanlar ve Hava Maydanlari Insaati Genel Müdürlügü Online at; http://mt.gov.tr/tr/dlh (last Publication, 16.06.09)

under study, and according to Table 14 the favorite speed can be used to establish and design a new high speed line is 200-250 km/h, these basically also the level of crossings, stops and sharp of curves, etc. Therefore, the design of these common features does not means that all HSR project are built the same way. Just the opposite, the comparison of construction costs between the different HSR projects is difficult since the technical solutions adopted in each case for implement of these features do not only differ a large scale (depending on terrain and geography), Whereas the proposal corridor between Cairo and Alexandria, the construction cost will be less than other project in the Europe, because the topography of terrain is flat land. Despite the investment cost for HSR lines vary from country to other and that the reasons related to the difference topography of terrain as shows in Table 17. It can be observed from Table 17 and Figure 28 the compression of the average HSR line cost in the difference country in Europe and Asia. So, this is not all projects in this country, but we chose some of project and calculate the average cost value.

In additional to the previous Table 17 and Figure 28 summarizes the average cost per kilometer of building HSR infrastructure in euro million (in 2005), and this cost include infrastructure and superstructure cost without planning and land cost. Overall, it can be observed that the average construction cost per kilometer on the some project was about € 17.5 to 18 million in the flat area [Table 17]. Indeed, these figures exclude the cost of planning, land, and rolling stock. In Table 17, infrastructure maintenance costs per km of single track are, on average, about €13.000 to €33,000 per km/year. These unit costs are particularly useful for analyses the cost of high speed rail in developing and emerging countries such as case study Egypt, because financing and project management costs, which also may have been less in Egypt, are separately identified, allowing a focus on the underlying engineering factors.



[Where, S Line in Service, C Lines under construction] Source [186]

Figure 26: The Average Cost per kilometers of a HSR Infrastructure

It can be also observed from the previous analysis in countries project, and according to the Figure 26, the highest costs in Europe were found in Italy, Germany and Belgium. The reason for this, for example the initial NBS in German (Berlin-Hanover) were constructed using slab track, and corridors passed through difficult terrain, and these costs also increase with the population density. Converse, the proposal corridor in Egypt will be constructed the type of pre-stressed concrete in the flat terrain. Also this proposal a new line will passes in the western desert with a little densely populated area. Also in Europe the lowest costs there are in Spain and France. The TGV in France appeared to be lower cost then high-speed projects in other countries, because the HSR lines are dedicated to passengers (see Figure 7 the exclusive exploitation model (Model 1)), grades of 3.5%, rather than the previous maximum of 1-1.5% used for mixed traffic. One possible reason for this could be lower capital cost and slightly lower building costs.

In any project to calculate the investment cost it should be know the all component of this project. From the Germany experience in this field it can be tack for example the new line Hanover-Würzburg as in Table 18. The aim of the Table 18 is give bases of the determined weighted cost for every double kilometre. However, the component for environmental protection and the planning today are lower. Thereby, the value in the Table 18 that relate to the whole distance and not to the component length. This is especially in tunnels and bridges. It can be noted that the higher value is the tunnel as in the table.

Table 18: Composition of the investment costs of the railway lines to be Constructed Hannover-Würzburg and Mannheim Stuttgart (price as of 1988/1991(

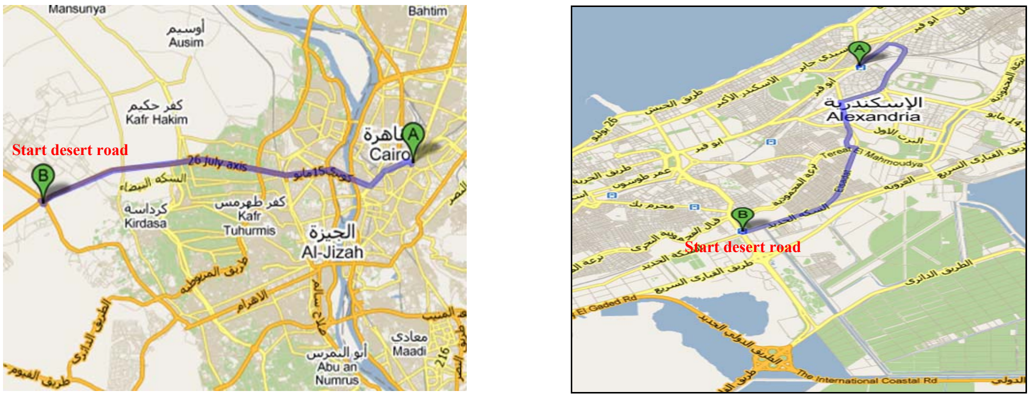
Real Investment Cost items of the NBS in Germany and their respective share of the total project costs	Cost per kilometer (base average trip costs) [M € / Dkm]	Average annual maintenance cost as % of investment costs
Land acquisition	0,61	0
Formation Sub-grade	2,30	0.5
Retaining walls	0,22	0.5
Tunnel	6,53	0.2
Viaducts	1,27	0.6
Crossing structures	0,70	0.6
Structural Works	0,26	4.0
Environmental Protection	0,28	0.1
Tracks and switches	1,21	2.0
Signaling	0,92	3.0
Telecommunications Equipment	0,37	5.0
Overhead Line Systems	0,92	3.0
Traction power supply. and substations	0,61	0.4
Third operation	0,96	-
Planning	1,20	-
Sum	18.36 M € / Dkm [10,56 M € / Dkm without tunnel and viaducts]	

Source [128]

The result from the previous table is for new lines in wheel / rail technology without bridges and tunnels (in flat area) in Germany could already be built for approximately €10.56 million per double km. However, to be necessary even in the lowland routes bridges, such as the intersection of other transport modes. Where this is the lowest cost to be adopted for new lines in Germany (Hannover - Berlin) reached the considerations that the separate project. For the difficult mountain range routes the costs will an up to twice the expected cost rate. By legislative requirements, such as bundling constraint of alignment with other transport modes or dams and tunnels on a regular basis for environmental reasons, this leads to an increase in infrastructure costs. Addition to the changes resulting from the new political leadership and planning, and time delay in achieving the construction also provides a threat to the increase of project costs.

6.3.3.1 Infrastructure Investments Cost

The investment cost of classically railway project is distinguished in infrastructure cost and expenses for vehicles. Each of the sub-systems does not differ from each other in terms of the lifetime, but also in the type of applicability. While the rolling material - if technically compatible - can be used on other routes, if the costs incurred for the infrastructure are absolutely committed the same purpose. Whereas the proposal corridor in Egypt is consider as a new project for HSR. In the life cycle of a railway project are the initial investment is the major cost. This is especially true for high-speed projects, which have because of their special requirements on the alignment and the associated need for extensive special structures (tunnels and viaducts) extremely high construction costs.



The length of bridge line in entrance of Cairo 20.3 km

The length of bridge line in entrance of Alexandria 6.4 km

Figure 27: Bridge length in the Proposal Corridor between Cairo and Alexandria[52]

There is a relationship between alignment and construction costs on the example of longitudinal slope and minimum curve radius. Adapting a line to hilly and flat terrain

[52] In Table 19 and Figure 27 listed the routes infrastructure parameters suggested between Cairo – Alexandria. On the total line length of about 208 km, only 26.7 km are on bridges, whereas 181.3 km will be built directly on the soil substructure [but in this case it need to build the retaining walls or well protection]. In the curves the choice of small radius this leads to achieve the minimum construction, operation and maintenance costs, and also it is depended on the design speed (because proposal maximum speed is 250 km /h). These results come of practical experience in implementation, then; the value of the minimum radius to use is 6247 m. Furthermore, there are other alternative to this method, where this alternative is the proposal HSR line can begins from the pyramids with a new station. Thus, the master plan of Metro in Egypt consist the establishment the fourth line between Nasr City to pyramid, and this line can be connected the passenger from the pyramid (start HSR line) with the centre city and we can avoid extra cost

depends on the maximum possible longitudinal gradients that a railway system can tolerate. According to the TSI (Technical Specifications for Interoperability) on infrastructure for new high-speed rail line, the maximum longitudinal gradient is not to exceed 35 ‰ [124] for new lines. According to the EBO regulation applicable in Germany 40 ‰ is admissible (only for passenger railway) for new construction. Therefore, the relevant line layout parameter of the vertical section is the maximum longitudinal gradient. The maximum longitudinal gradient of HSR is 3.5 %. But also the radius of the leveling curve of gradient changes has a significant influence on the longitudinal profile because of its quadratic dependency of speed. Thereby, the proposal line between Cairo and Alexandria (Figure 25 b) will passes in the western desert then could be taken the normal grades 25‰. The line routing of high speed rail network is governed by the line layout parameters and by topography, settlement and existing infrastructure as well. Relevant parameters of line routing of high-speed rail in ground view are the minimum radius is 3662 m with the speed 300 km, it gives the maximum a lateral acceleration of 1, 0 m/s^2 and the standard or normal radius is 6247 m in case also speed 300 km, gives for a lateral acceleration of 0, 46 m/s^2 [125].

Nevertheless, the new proposal line in Egypt about 208 km (85.47%) will be built directly on the soil, then the curve radii is more then 6247 m with lateral acceleration 0,5m/s[53]. Because the minimum radii applicable without additional expenditures the standard radius should be used. For possibility use the minimum radius of a new high speed line, can be construction the new line parallel with the highway. As an example, Figure 27 the characteristic of the proposal corridor Cairo /Alexandria line is the greatest line coverage in grade line (85.47%), and the smallest proportion is bridges 14.53% and no tunnels in this line [Table 19].

Table 19: Infrastructure Parameters of the Proposal HSR Lines in Egypt.

Characteristic of the line	Cairo/Alexandria line	Cairo/Assuyt line	Cairo/Luxor-Aswan line
Length of line [km]*	208 km	375	879
Proposal maximum speed [km/h]	250	250	250
Proportion of tunnels [%]	0	0	0
Proportion of bridges [%]	14.53	N.A	N.A
Crossing with major road [numbers]	4	N.A	N.A
Minimum radius [m]	6247	6247	6247
Acceleration [m/s^2]	0.46	0.46	0.46
Maximum cant deficiency [mm]	180	180	180
Track type	Ballasted track		
*The track gauge will be standard gauge 1435 mm, for maximum speed 300 km /h			

As a consequence is referred to as the smaller cost driver for new high speed rail lines, when the lines are straight. Converser, the biggest cost for new HSR lines are a tunnels and bridges. This infrastructure consider on the long-lived extremely. Infrastructure components building costs: The amount varies widely across projects depending on the characteristics of the terrain project, but usually this cost between 10-25% of the total

[53] The line layout of high-speed rail may be designed with a higher lateral acceleration and accordant lower radii as well when a rigid slab track and tilting technology is applied.

investment in new rail infrastructure[54]. Proportional costs for planning, the indirect costs to obstacles during the construction phase to keep in a typical framework for capital, and land cost; this cost of about 10-15% of the total investment amount. Superstructure costs, this cost includes the guide way, sidings along the line, signaling system, communication and safety, etc. but usually this cost between 5-10% [126].

The elements of planning, which are determined by the technical characteristics of the system and that is also determined by the operating speed, therefore, the construct a new line not only depends on geography and geology of the site, but also depends on the infrastructure costs in terms of using the interpretation (Slab track/Number of crossovers / etc.) that may have an important role in the operation quality, and plays in monitoring of the investments. Therefore, given that there was no comparable high-speed rail projects within Egypt, but which can be between Cairo - Alexandria in future could be directly compared with a project-wide standard analysis of the costs of steel wheel on steel rail systems was undertaken with a global focus. Costs were developed in general on a per km basis using similar and relevant high-speed rail projects planned and completed around the world. Information on these projects was obtained from various sources.

Table 20: Comparison of the Infrastructure Parameters of the Proposal HSR in Egypt and other Project.

	Turkey	**Germany**	**Taiwan**	**Egypt**
Project	Istanbul-Ankara	Cologne-Frankfurt	THSR	Proposal Cairo-Alexandria
Enter in service	**2009**	**2002**	**2007**	**---**
Length of line [km]	**533**	**180**	**345**	**208**
Maximum speed [km/h]	**250**	**300**	**300**	**250**
Proportion of tunnels [%]	**43 tunnel 40 bridge 21 viaduct 56 overpasses**	**22**	**18**	**0**
Proportion of bridges [%]		**2.7**	**73**	**14.53**
Minimum radius [m]	**3500**	**3350**	**6250**	**6247**
Acceleration [m /s2]	**0.48**	**0.344 to 0.75**	**0.86**	**0.46**
Maximum cant deficiency [mm]	**170**	**170**	**180**	**180**
Maximum cant [mm]	**130**	**150**	**100**	**100**
Type of track	**B70 type monobloc pre-stressed concrete**	**Slap Track, Rheda with trough Züblin**	**Slap track; J-Slap and Rheda 2000**	**B70 type monobloc pre-stressed concrete**
Gauge [mm]	**1435**	**1435**	**1435**	**1435**

Source: [93; 243]

Table 20 lists the proposal HSR routes in Egypt compare them with the Germany new high speed line, Istanbul/Ankara high speed line, and the Taiwan high speed line. It can be noted that the unbelievable that as much as 73 % of the on the Taiwan high speed line should be on bridges, and in the Germany new high speed line the proportion of tunnel is 22 % this is the main reason the total costs exceed to approximately 41 million EUR and 33.4 million EUR per route kilometre. Conversely, the high speed rail line in

[54] In most project the need of singular solution (such as viaducts, bridges, or tunnels) to geographic obstacle about double this amount about 40-50% in more technical difficult project.

Turkey is the lower cost per kilometre and this cost do not exceed 5 million EUR [see Table 17]. Thus, after comparing the proposal HSR line in Egypt with the other HSR in country, it can expect that the cost per km may be like Morocco, because it has the same condition of the topography and the parameter of transport planningg. Moreover, in Figure 28 there are the national HSR projects and it can use this table to compare with the proposal HSR project in Egypt.

	Route data				Route plaining / Building					Costs and funding					
Land	Project	Start operation	Operation type	Road length	Operation speed	Tunnel proportion	Bridges proportion	Max. slope	Minimum curve radius	Investment costs	Million € / D km (in prices 2008)	Financing	Current operator	Fare/pkm	Volume / capacity
Japan	Tokaido (Tokyo - Osaka)	1994	Pt	515 km	220 km/h	13%	33%	20 ‰	2.500m	$ 1,0 billion.	27,3	Fully funded by the state. Long term deferred by the operating companies in the form of lease payments	JRCentral	0,17 € (full price) Sales: 65 € / passenger on Tokaido Line	130 million. P (1999)
	Sanyo (Osaka - Hakata)	1975	Pt	554 lm	260 km/h	51%	37%	15 ‰	4.000 m	$ 2.1 billion.	27,6		JR West		
	Joetsu (Omiya - Niigata)	1982	Pt	270 km	260 km/h	39%	60%	15‰	4.000 m	$ 6,6 billion.	65,5		JR East		
	Tohoku (Omiya -Morioka)	1983	Pt	465 km	240 km/h	23%	72%	15 ‰	4.000 m	$ 19,8 billion.	48,9		JR East		
France	LGV Sud-Est (Paris - Lyon)	1981	Pt (+ Ft)	428 km	300 km/h (start with 260 km/h)	0%	1%	35 ‰	4.000 m	3,5 billion. € (in preices 2007)	8,4	- 90% by RFF - 10% by State - Participation of communities in New station	RFF	0,13 € - 0,17 € (2nd. class) 0,17 € - 0,23 € (1.Klasse)	20 million P annually Currently, 12 trains / h, Spacing trains: 3.5 min degree of efficiency: 75%
	LGV Méditerranée (Lyon - Marseille)	2001	Pt (+ Ft)	365 km	300 km/h	0%	1%	35 ‰	4.000 m	3,8 billion. €	12,7				18 million P annually (In the first year of operation)
	LGV Atlantique	1989	Pt (+ Ft)	287 km	300 km/h	2%	5%	25 ‰	6.000 m	2,6 billion. €	14,5				10,83 billion Pkm
	LGV Est Européen (Paris - Baudrecourt)	2007	Pt	300km +44 km Connections	320 km/h (Design speed 300 km/h)	0%	2%	35 ‰	7.150 m (exception with 5.550 m)	4,1 billion. €	12,2	- 39%: France government - 23%: Regions - 22%: System Operators (RFF) - 10%: European Union		0,05 € - 0,16 € (2nd. class) 0,12 € - 0,25 € (1.Klasse)	
Germany	NBS Hannover - Würzburg	1991	Pt (+ Ft)	327 km	280 km/h (in tunnal 250km/h)	36%	10%	12,5 ‰	5.100 m	5,7 billion. €	21,6	-Mostly federal funds (contribution to building costs, interest-free loans - in some cases non-refundable) - DB nets own contribution: 15%	DB Netz AG	€ 0.20 (full price 2nd class) Realized: 0.084 € net (Including free-riders and compensation payments from the federal government)	
	NBS Mannheim -Stuttgart	1991	Pt (+ Ft)	99 km	280 km/h (in tunnal 250km/h)	31% (Additional 50% cuttings and embankments)	7%	12,5 ‰	5.100 m	2,2 billion. €	28,2				
	City entrance Berlin	1998	Pt (+ Ft)	25 km						0,9 billion. €	46,1				
	NBS Hannover-Berlin	1998	Pt (+ Ft)	264 km	160-250 km/h (Design speed 300 km/h)	0%	1%	12,5 ‰		2,6 billion. €	12,7				
	NBS Köln - Rhein/Main	2001	Pt	177 +42 km Connections	300 km/h	21%	3%	40 ‰	3.350 m	6,0 billion. € ((Original plan: about 3 billion €))	33,4				
	NBS Nürnberg - Ingolstadt	2006	Pt (+ Ft)	89 km	300 km/h	30%		20 ‰ (Compromise between cost and routing of dedicated)	3.700 m	2,2 billion. €	26,0	Federal funds, EU funds, land Bayern, DB AG			About 12 million.P annually
	ABS Ingolstadt - München	2006	Pt (+ Ft)	82 km	160-200 km/h					1,4 billion. €	17,5				About 8,5 million P annually (Regional and long distance services)
Spain	Madrid - Sevilla	1992	Pt	471 km	300 km/h	3%	2%	12,5 ‰	4.000 m (exception with 3.250)				Adif	0,11 € - 0,13 € (2nd. class)	6 Mio.P annually (20 trips / day * direction)
	Madrid - Barcelona	2008	Pt	621 km	350 km/h	5%	5%	25,0 ‰	7.250 m (exception with 4.000)	8,7 billion. €	14,0	Partly through loans from the European Investment Bank and stock market		0,18 € - 0,19 € (1.Klasse) Discounts for return trip	Quadrupling the revenue expected (market share of 12% to 49%)
Netherlands	HSL-Zuid	2009 (planned)	Pt	100 km	300 km/h	75% civil engineering works		40 ‰		7,2 billion. €	76,0	6.5 billion €from the state (base, substructure, civil engineering works, etc.) 1.2 billion € compensation for infrastructure providers			Spacing trains: 3 minutes 800 pass per train (theoretical capacity of over 100 Mio. P annually)
	Betuwe	2007	Pt	160 km	120 km/h (Axle load to 25 t)	11%	8 %			4,8 billion. €	30,8			(Freight)	Spacing trains: 6minutes
USA	California HS Project San Francisco - San Diego	Planned 2020	Pt	836 km	200-320 km/h					25,6 billion. €	30,9		Private company or consortium	€ 0.07 (Average)	90 million P annually (Partly transport commuters)
	Florida Overland eXpress Project (FOX)	Studies 1994-2004	Pt		270 km/h	Adoption the LGV / TGV system planned of as low-risk				7,3 billion. €		Operating subsidies from petroleum tax for 30-40 years ($ 70 million annually, 4% escalation)			6 million P annually

Figure 28: International High-Speed Railways Projects.

6.3.3.2 Factors Influencing in the difference of Costs of Rail Projects

The cost structure for HSR (or cost per kilometre) can also vary significantly compared to other HSR projects and projects in other transport sectors. It can be concluded from the analysis of the previous Tables and Figures [Table 17; 18 and Figures 26; 28] that, there are some factors effects on the cost of the HSR track. The Factors influencing the cost of rail projects primarily include the following.

- Land purchasing costs.
- The design train speed
- Structures: Evidence indicates that construction of track through tunnels or over viaducts is four to six times more expensive per kilometre than construction over flat land [99]. Where tunnels in particular are difficult to cost, as they can be subject to geological issues during boring works.
- Stations: Evidence indicates that these are expected to cost between 6% and 8%the total cost of the line.
- Compatibility: The line may be required to accommodate access to a variety of rolling stock types.
- Professional staff costs, associated with project, planning, design, management and legal issues, for example, in the Channel Tunnel Rail Link project the proportion more than 25% of total costs, compared to just 2% to 3% for Madrid-Lerida [214].
- Passenger and Freight: The elasticity to run heavy freight trains on high speed lines considerably increases the cost of construction.

6.3.3.3 Investment Costs of Trains

Investment costs of the trains, of course, depend on many factors, including:

- Type of train: Trains can be a seemingly identical to each other for the average person, but they vary in prices caused in part by technical equipment. This leads to large price differences, this not inconsiderable from the costs.
- Number of trains that are purchased, it is easy to understand that lower unit prices are obtained, for example, if 20 units instead of 10 trains will be purchased.
- Technical specifications of the trains, the national railway systems differ primarily in three areas: Track, Power supply (voltage and frequency), train control

There are different kinds of trains in the world, but which one is the significant when needs the construction a new HSR line in Egypt or country under study. Therefore, the choice of the type of trains dependent on the demand of passenger or the traffic density, if the demand of passenger it is large, then it should be chosen the train with a high density (which means that the number of train sets must be large). In Table 19 can see the forecast passenger traffic volumes in the proposal line in Egypt; and find that for the each corridor Cairo/Alexandria and Cairo/Aswan, the number of passenger increase substantially in next 30 years. Thereby, choice the train with large number of sets, Table 21 shows the specific technology data for some world HSR trainsets, where almost every country has developed its own technological specifies, suited to solve their specific transportation problems. it can be also observed in Table 21 each of these train models has different technical characteristics in terms of length, composition, mass, weight, power, traction, titling features, etc. but in this Table 21 itemizes only those related to capacity, speed, the number of seats, and it gives an estimate of the acquisition cost per trains. HSR technology in the world: type of train.

Despite, the number of seats on the train it is a significant effect on operating costs, as well as the cast of train (acquisition) can see this in the following aspects.

Train Capacity. The supply of seats between station increases with train frequency, also the demand of travel will be grow by frequency. For example, the lowest value 10 daily departures with 685 (ICE 1) seats each one, gives a total supply of **6,850 seats**, converse, the upper value with 20 train daily departures with 368 (ICE 2) seat in every train, this gives **about 7,360 seats.** It can be observed from this example that, the number of seat approximately it is equal, but with the twice number of trains. This means that operation cost per seat kilometer increase with shorter trains [129]. The cost of rolling stock depended on the number of seat, according to the De Ru the estimated of cost of rolling stock per seat goes from 30,000 to 65,000 Euros [130]. So, it can be used the train with the large number of seat, because this lead to the reduce operation cost.

Table 21: HST Technology in the World: Type of Train

Country	Type of train	Max. Speed [km / h]		Train length[m]	Total seats	Cost per train
		Design	Operation			
France	TGV Duplex	320	320	200	512	20.8 Mio. EUR
	TGV-Réseau	320	320	200	375	17.0 Mio. Euro
	Thalys PBA(*)	320	300	200	377	24.8 Mio. Euro
Germany	ICE1	328	280	358	685	25.6 Mio. EUR
	ICE2	310	280	205	391	18.2 Mio. EUR
	ICE3 (series 403)	330	300	200	441	18.92 Mio. Euro
	ICE3 (series 407)	330	300	200.72	460	33 Mio. Euro
	ICE-T(series 411)	230	230	185	376	11.76 Mio. Euro
	VelaroE/S103	350	350	200	404	25.2 Mio. Euro
Italy	ETR500	300	300	354	671	34.1 Mio. Euro
	ETR480	300	300	237	480	21.1 Mio. Euro
Spain	AVE	300	300	200.15	329	23.7 Mio. Euro
Russla	Velaro	300	250	250	604	34.5 Mio. Euro
China	CRH 3	350	350	400	1026	32 Mio. Euro
Japan	Shinkansen 700	300	300	404.7	1323	34.35 Mio. Euro

Source [131; 132; 133; 134]

*THALYS is used on international services between France, Belgium, The Netherlands and Germany.

6.3.4 Operation Cost

In any system of the HSR and after the infrastructure has been built, the operating costs divided into to the two types (1) cost related to the exploitation and maintenance of the infrastructure itself, (2) cost related to the provision of transport services using that infrastructure. In Europe, Council Directive 91/440 set out the objective of unbundling infrastructure from operations by either full separation or, at least, the establishment of different organizations or units (with separate accounts) within a holding company. Because in these countries, where infrastructure is separately managed, access charges may represent an additional operating cost for operators. Many countries outside Europe have still opted for the full vertical integration model, where all the HSR operating costs are controlled and managed by a single entity. These countries included Egypt, where there is a problem as will be seen in section 6.6, where the railway system in Egypt is now an integrated system. This means that the infrastructure costs and operating costs will be paid by the government. And this leads to more transfer of funds, when considered from the perspective of a new HSR system as a whole.

A HST to be competitive, a new train concept must not exceed a certain level of operational costs. Where different costs can be characterized into, for example, direct operating costs and indirect operating costs. Direct operating costs, which are strongly dependent on operations, are energy costs and infrastructure user fees. Staff costs must in general be characterized as intermediate and capital costs (rolling stock) as well as administration and selling costs. Having the ambition to be competitive for leisure travel also requires active yield management, since the marginal cost for an extra passenger in a car is small. However, high speed is a means to achieve both low operational costs and higher revenues through a more attractive services supply. Due to the absence of data on high speed rail operating costs in the Egypt, carrier operating and vehicle costs has been used as a baseline from Europe.

6.3.4.1 Infrastructure Operating Costs

This kind of costs includes the costs of the labour, energy and other material consumed by the maintenance and day-to-day operations of the guideways, terminals, stations, energy supplying and signaling systems, as well as traffic management and safety systems. Some of these costs are fixed, and depend on operations routinely performed in accordance to technical and safety standards. In other cases, as in the maintenance of tracks, the cost is affected by the traffic intensity; similarly, the cost of maintaining electric traction installations and the catenary depends on the number of trains running on the infrastructure.

Under the cost aspects considered and including maintenance activities, the target of the state maintained-generating system to preserve, increase its availability and to extend its life. These activities are conducted by maintenance personnel, resulting in staff costs. All components susceptible to wear and have a defined depreciation factor or a potential wear. If this is exhausted, the components must be replaced, whereby creating material costs. The ratio of material to personnel costs for rail projects usually given to 60/40[55], and depending on the maintenance concept may vary. Especially when long daily operating times are specified (i.e., maintenance of infrastructure during the operational time is necessary or a higher reserve vehicle must be selected) or a very high system availability is required, this will affect the maintenance costs. For example, the maintenance expenditures in East-Asian railways are about three times the European levels about € 163,300 per track-km [136]. This is partly understandable as the utilization is very high and the focus lies clearly on service reliability. Performance standards are very strict. Rail service has an artery function such that non-availability can bring urban areas to a halt. Hence cost consequences of breakdowns are valued much higher than incremental maintenance cost for highly performing infrastructure. This compares to € 19,900 compared to cost per track-km in the U.S., where the existence of heavy freight transport takes place, and the infrastructure is used intensively and the assets deployed are very much restricted to the specific demand. In effect the cost level is only one third of the European sample while having a utilization that is four times higher.

In Europe is with approximately 57,000 € in turn in the middle (with maintenance 33,000 € and renewal of 24,000 €) [see Figure 29]. These values include the maintenance / renewal of energy supply and the control and safety technicians. The actual cost for the maintenance of the infrastructure remains dependent on the axle loads, curve radii and length of stay of the tracks. Generally, costs increase gradually decreased with the service

[55] Available for vehicle maintenance: 1/3 material costs and 2/3 wage level [135, P.128; 136] for infrastructure maintenance a material ratio of 40% of maintenance costs, and for infrastructure renewal, this figure increases to 70%.

on the route operational performance. Stalder speaks of € 2 million for 2 million passengers, but 18 million € for 50 million passengers per year [136]. Here it is clear that a high line capacity but is more expensive, but because of the dominant fixed costs for rail systems is the key for low specific costs, and therefore lead this to the economic success of the railway project. Typically labour cost is roughly 60 % in maintenance and roughly 30 % in renewal if the respective labour input from subcontractors is included. Hence, despite of ever ongoing mechanization, labour costs are still "number 1"of maintenance cost. The effective labour cost is basically a combination of cost per unit time worked and productivity But what is the benefit of this analysis in the countries under study or in the counties established a new high speed rail line such as Egypt, it can be observed from the above analysis that, axle loads of trains must be reduced in order to achieve a positive effect on infrastructure cost (see the next point), and besides other objectives such as engineering considerations in planning such as curvature, where curvature consider a major cost driver. Due to particularly high wear maintenance and renewal depend heavily on the amount of curves and the degree of curvature. As much as possible to reduce the number of switch in the new line, because switches show that on average the maintenance cost of one switch are equivalent to those of 330 m track [136]. In heavy utilised circumstances this percentage can be much higher. This proves that switches are the most important cost element in the track. Also, a low switch density imposes penalties on traffic capacity and makes track access for maintenance work difficult. The lower infrastructure cost may thus be partly offset. Thereby, maintenance and renewal expenditures can be installed as a part of new infrastructure projects and upon regular replacement. Hence a dedicated maintenance and renewal expenditures calculation is necessary in both cases. Often initial expenditures may be higher and the benefit will arise from lower maintenance cost and/or enhanced lifetime for a new lines.

6.3.4.2 Rolling Stock Operating Costs

Rolling stock costs can be grouped into three categories: acquisition, operation and maintenance of the trains needed to run the services. In the Table 21 shows the investment costs of the different type of the trains, and the cost of every train depending on the number of seats. Rolling stock operating costs can be grouped into (train operations, maintenance of rolling stock and equipment, energy, and sales and administration) vary across rail operators depending on the specific technology used by trains and traffic volumes. So, in Table 21 it can be observed that, each train has its different technical characteristics in terms of length, number of seats, features, etc. Thereby, the train operating costs per seat goes from 40,000 to 72,000 Euros and rolling stock, maintenance costs from 3,000 to 8,000 Euros for seat. Tack into account the train runs about 500,000 km per annual.

6.3.4.3 Energy Cost

The fuel and energy costs depended on the number of trains-km and speed of the trains that means; when the speed of train is higher the energy consumption will be higher and the distance will be running this increases the energy. In the calculation of the energy cost of traction the first step must be estimated the needs of energy. Costs that depend also on the propulsion/speed should reflect legitimate differences between technologies and routes. Also energy consumption increased during the acceleration phase (Which reach to the maximum value of energy), but this power will be decreasing during braking.

High speed rail can be use fuel (diesel fuel) or electric energy, where the energy needed for operation HSR system. In Egypt the electrical power was available and it’s cheaper than European countries, because the energy source was available of the Aswan High Dam. Where, hydropower played a significant role in satisfying Egypt's energy needs in the

1970's by providing more than two thirds of the electricity demand. By the late 1980's until now the situation was completely reversed with oil and natural gas providing more than two thirds of the electricity demand. The energy demand in Egypt the transport section needs is 29.2 % and considered the second large sector to use energy after industries. Therefore, the assumed diesel fuel cost on the operating side is consistent with the level of gasoline prices that were assumed for development of the demand forecasts. The fuel price spikes of 2007 and 2008 show the difficulty of predicting short term energy prices. However, economists are in more general agreement that long term energy prices are only going in one direction to higher. Thereby, all equipment in Egypt is operating by diesel. However, electric traction has an advantage over diesel since it can be powered from any energy source, not just petroleum based fuel. Whereas, even taking typical peaking demands into account, electric energy is typically less expensive than diesel fuel. For example: If the cost of a locomotive traveling at 250 km hauled electric train was just $2.61 per train mile as compared to $6.10 for the diesel [137]. It is interesting how is high the energy costs [€ / km] to overcome one kilometer for high speed rail. **The prices of the electricity in Egypt's dependent on the consumer's demand and then the price will rise with a consumer's demand increases; however, tariffs for electricity thus range from €0.007 to 0.075/kWh [138]. Thereby, a large share of demand is consumed by energy intensive industry, whose current tariff is approximately €0.03/kWh (EGP 0.24/kWh).**[56] Table 22 show the energy consumption of train in Germany at a constant speed over a distance of 1 km and also the energy costs related to the distance (for travel at constant speed [€/km]). As a result, electric traction has advantages where high acceleration is required, or where (as in high speed trains) the weight of the train must be controlled in order to reduce the forces which the train exerts on the track. Which leads to high maintenance costs of infrastructure (see the previous point infrastructure operating cost)

Table 22: Energy Consumption and Energy Costs Related to Speed [km/h]

Speeds [km/h]	100	150	200	250	300	350
Energy consumption ICE 3 [kWh / km]	3,4	5,8	9,0	13,1	18,0	23,7
Energy costs [€ / km]*	0,24	0,40	0,63	0,92	1,26	1,66

Source [134, P. 192-193]

* This energy cost for the new train, its will be in future installation in Egypt and this value depended on the pricing of the kWh.

Additionally, the cost calculation of the secondary energy demand is of about 19 %[57] from the total energy. This price for traction power consists of a share of power supply; this price it is of imported for energy and tax component together. For example, the secondary energy of railways, its own power (produced by a subcontractor) obtained from the rail network must be paid instead of the supply price. This includes the maintenance of overhead lines and equipment of energy supply. According to the German experience in this area, the traction power for long distance service with the full power control and the full rate under the Law on the primacy of renewable energy (green taxes). If a rough estimate for the price of railway power is indicated, this is about € 0.085 / kWh.

[56] The prices for residential consumers follow the same pattern but are more extreme, with the first lifeline 50 kWh of monthly demand costing approximately €0.007/kWh (EGP 0.055/kWh). In contrast, demand over 1000 kWh/month now costs approximately €0.061/kWh (EGP 0.48/kWh) (price in October, 2009).

[57] For example the total energy demand in DB Germany about 11 Twh annual, addition the energy requirement of 2 Twh. this energy include the sub-station supply, energy demand in the stations, parking facilities, washing plant and maintenance facilities, energy for switch point switching stations, switches and control and communication system.

Finally, it can be noted that the energy requirement for km route is 25 kWh for the line Frankfurt and Hamburg. Nonetheless, the energy requirement depended on the speed of train. Where in the line between Hamburg and Berlin the energy requirement were 12.5 kWh / km for speed 200 km/ h, and this value reach to about 24.9 kWh/km when speed increase to 300 km/h [144]. According to the [134] the price of energy per km depended on the speed, and the price of energy needed for km can be show in the Table 22. The total cost of energy and additional power forms can be calculated by multiplying amount of energy consumed by the unit price of imported energy and the total travel kilometers per trains [train-km]. Thus, the cost of energy can therefore be expressed as follows:

$$EC_{Total} = d_{train\ /km} \times E_{need\ /km} \times EP_{price\ /km}$$

Where:

EC_{Total}	=	Cost of the total energy consumption (€/ train-km per day or year)
$d_{train\ /km}$	=	train productivity in train km (train / km)
$E_{need\ /km}$	=	Energy consumption per km (kWh/ km)
$EP_{price\ /km}$	=	Energy price per km (€-ct/kWh)

6.3.4.4 Operating Personnel Costs

Under this section, it can be observed that, in addition the personnel costs, there are more costs it can be taken into account. The costs include the social costs of accidents, air pollution, noise, and congestion as well as the internal costs of providing and operating infrastructure and vehicles, and users travel time. Meanwhile, the personal providing services in the operation (either affiliating to the operators company or through service companies employ) can be classified into two main parts;

- The first part is: Personal providing station services: this may in turn be operating personnel (for example personnel for reception and welcoming at stations, information ticket sales, administration and information, after-sales service), or indirect staff (dedicated to the management or business activities. They also include costs for automated ticketing machine and travel agency commissions. In the INRETS/INTRAPLAN study, sales and administration costs have not been estimated on the basis of the required number of staff and automated ticketing machine, but assumed this cost to represent 10% of the passenger revenue [50].
- The second part is: Personnel providing services on board the train: this is the case of personnel for train operation, ticket inspection and those serving passengers on board.

To calculate the personal cost on the train, it will use the next equation;

$$PC_{\cos t} = N_{staff} \times P_{\cos t\ /annual}$$

Where:

$PC_{\cos t}$	=	Total cost of personal / year
N_{staff}	=	Number of staff
$P_{\cos t\ /annual}$	=	The annual cost of the worker

6.3.5 Reinvestment Cost

Trains and infrastructure, but also the subsystems of the infrastructure itself, differ in terms of their life. Particularly for projects with a long operating life or the new projects will be build in future, this fact in order to become necessary reinvestment of particular relevance. The usual life span for some, are with the use of wheel-rail trades shown in Table 23 where the knowing the costs of re-investment is useful in rail projects in the future, such as the proposed line in Egypt. However, that opposition other capital goods due to the longevity of railway infrastructure only experience of older projects may be specified to apply in the future at this stage can not be regarded as safe. On the one hand, some 100 years old bridges and tunnels have not yet reached the end of its life, the other, have meanwhile changed construction methods and the life of old systems to new seems to be transferable (interlocking equipment) not readily available. Railway is composed of many kinds of parts and components, such as station, rolling stock, rail, bridge etc. and the serving conditions and required performances are very diverse. They are divided into two major groups of the wayside installations and the rolling stocks. The former is represented by railway track, structure, electric equipment etc. These are long and big, and their total life times amount to 50 to 100 years. They are maintained at each place. The latter, rolling stocks life expectancies are 20 to 40 years and they are maintained in the workshops.

Table 23: Technical Life of the Infrastructure and Trains

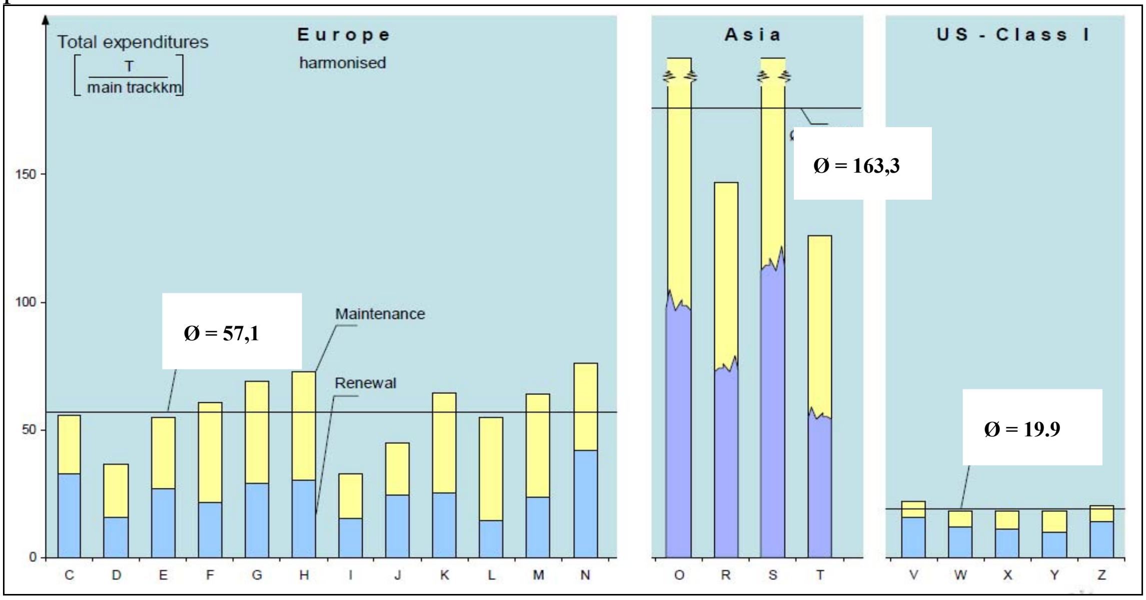
Type of investment	Lifetime (Years)
Tracks	40
Tunnel	75-100
Bridges	50-100
Lane-changing facilities	20-30
Building works	50
Noise protection	25-40
Sub-stations / substations (power supply)	30-60
Operations control technology	30*
Trains	20-30**

* The average lifetime according to subsystems: Source: [140]
60 years for fixed equipment (20%)
25 years for outdoor facilities (point machines, signals) (40%)
15 years for interior installations and electronic interlocking (40%)
** The current service life of rail cars is 30 year, the average age of 15 year

The lifetimes of the individual subsystems are almost always over the amortization periods and can often be extended very far, if a good maintenance takes place. Schuchmann goes so far in the consideration of project costs, the periodic renewal to question and instead renovations complete to pass on the annual maintenance rates "The used average renewal expenditure, the actual reinvestment reflected in the existing network and would be at steady-regeneration cycle of the infrastructure exactly which values consumption, correspond to the depreciation [119]. Renovation expenses fluctuate over time. This is due to changing availability of funding, capacity restrictions, one-time charges due to major projects, etc. The consideration of only one annual value would be a distorted image in the cross-comparison results.

The renewal of the trades escalated to the then existing price levels reflected in the project cost. By Schuchmann if the approach pursued and replacement costs will be fully written to maintenance is as and if life is a very high value to write and to increase the pay rates for maintenance accordingly. Investment in expansion of infrastructure is not included in this figure and can be considered as a separate project and calculates.

In Figure 30 a conceptual model is presented, which is discussed extensively. The performance of the railway infrastructure is defined in this figure as the level of safety, riding comfort, noise, vibrations, reliability, availability, re-investment cost and the costs of ownership. Safety and noise standards indirectly influence the life cycle costs, since they determine the tolerances and thresholds for design and maintenance parameters. Other functional parameters, like maximum speed, minimum headway and maximum axle-load supported, constrain the feasible design or maintenance strategies as well. The physical design directly determines the costs of ownership (amount of investment). This investment is also determined by, for instance, the accessibility of the construction site. The design also influences the asset degradation (initial quality) together with other conditions, such as traffic intensities and axle-loads, the quality of the substructure and the effectiveness of performed maintenance.



Source: [142]

Figure 29: Life Cycle Cost of infrastructure in Europe, Asia and the US

The life cycle costing (LCC) is a technique to establish the total cost of ownership over the life of an asset (such as government). It is a structured approach that addresses all the elements of this cost. The results of an LCC analysis can be used to assist management in the decision-making process where there is a choice of options. The accuracy of LCC analysis diminishes as it projects further into the future, so it is most valuable as a comparative tool when long term assumptions apply to all the options and consequently have the same projects in the anticipated life-span. While reinvestment cost is the part of the LCC, this means that the LCC equals the reinvestment, maintenance and renewal costs for the project. Figure 30 explain the life cycle cost of infrastructure in Europe, Asia and the U.S. consistently reflect the different markets, operating conditions of railways, and it can be benefited from this experience in our countries in the future. It can be observed also from the previous analyses determine the operating and maintenance costs of infrastructure (by country) and services (by type of train), The results vary again across projects ranging 19,9 thousand Euros in Class I and 57,1 thousand Euros in Europe, but the major value in is 163,3 thousand Euros in Asia per main track kilometer. This analysis of result considers obtaining empirically based on approach to the actual costs of high speed rail.

Life cycle cost drivers rail infrastructure management

(Excluding overhead infra manager, inflation, external safety risks and disruption caused by new construction)

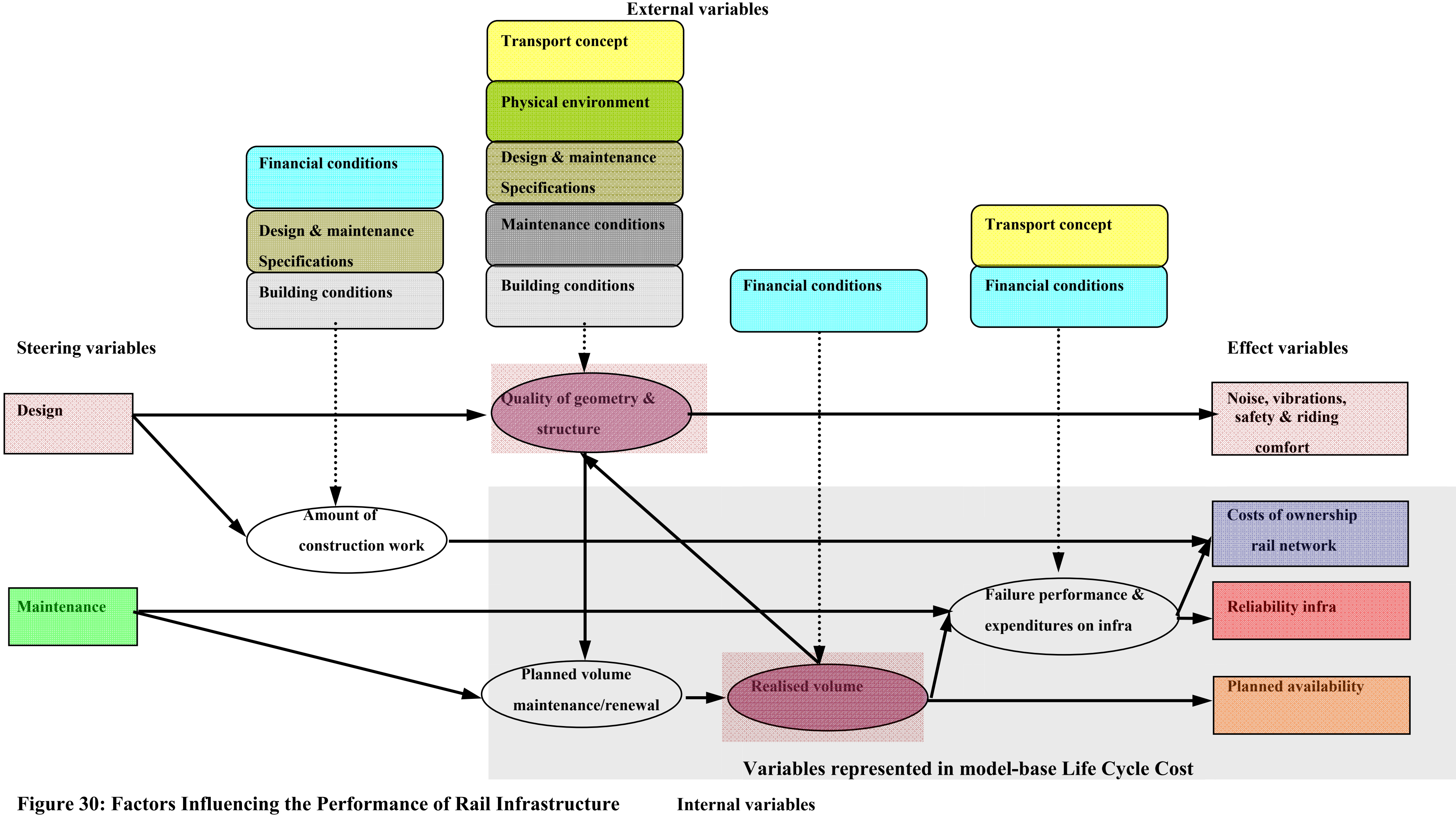
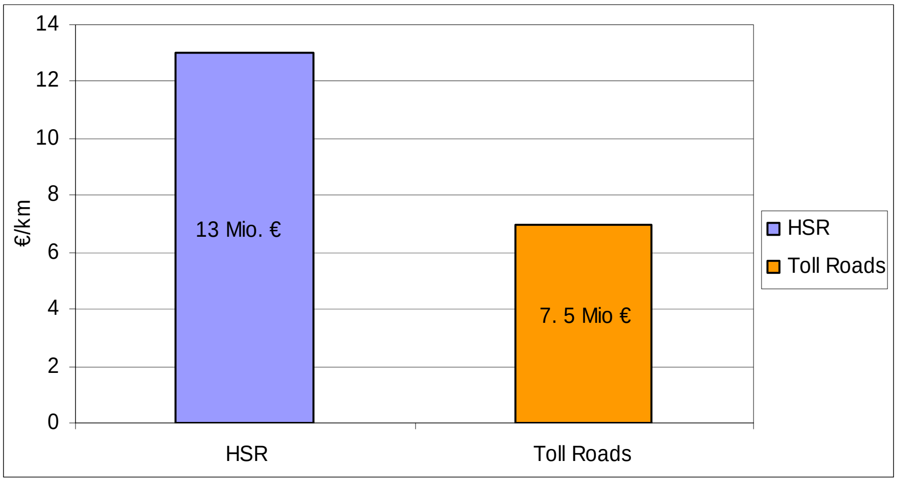


Figure 30: Factors Influencing the Performance of Rail Infrastructure

6.4 Characteristics Cost of High-Speed Rail Investments

In this point, it will be compare the average cost between the HSR line and the toll road. It can be observed that in Figure 31, the average cost of HSR infrastructure is about 13 million Euros per track-kilometer, whereas the average unit cost of toll road infrastructure is only about 7.5 million Euros per lane-kilometer. In addition, the unit cost of one HSR project can vary significantly. For example, the unit cost of the Hokuriku Shinkansen in Japan is 4 times higher than the unit cost of the Spanish HSR line between Madrid and Lérida because of major local topographic differences [214]. In addition to the infrastructure costs, rolling stock and signal, communication system, protection walls, and noise protection are also very expensive. According to FitchRating 2010, the total capital costs of HSR projects usually exceed €1.00 billion, or $1.5 billion primarily due to the long distance nature of HSR projects [214]. Therefore, infrastructures cost of HSR investments account for a larger portion of total costs than infrastructure costs of other transportation projects. The goals of this point is comparison between HSR and road costs, and this give the government the basics of infrastructure cost and then give the government decision to determined the project.

For instance, in Egypt, the expected of the total construction investment for the Cairo-Alexandria Cairo/Assuyt, and Cairo /Luxor-Aswan HSR proposal project is estimated at about €1.650 billion €2.974 billion and €6.971billion respectively. Taking into account, rail projects are usually more capital intensive than most other transport sectors both in total cost and cost per kilometer



Source: [214]

Figure 31: Comparison Cost of HSR and Toll Roads

6.5 Appraisal of Investment Cost

The process of evaluation investment requires comparison of a base case with a series of options. It is necessary to be clear what the base case is and to ensure that a realistic range of options is examined. A base case that literally assumes situation may be very unfavorable, particularly in the face of growing traffic between Cairo and Alexandria, and Cairo-Aswan passing through Luxor and thus exaggerate the case for undertaking a particular option, on the other hand the base case should not be padded out with unnecessary investments, as that may have the same effect. In general the base case should be a minimum and other likely investments should be examined as alternative options. These alternatives should be compared on an incremental basis to see whether the additional cost of moving to a more expensive option is justified, and the phasing and timing of options should also be examined. The fact that a particular option is better than the base case is thus not in itself evidence that it is desirable. For example the passenger and tourism today needs to 5h 10 min. between Cairo/Assuyt [375 km], and 9h 45min between Cairo /Luxor [671 km] and 13h 20 min between Cairo/Aswan [879 km] this mean that the average journey speed V_R = 65-75 km/h. Indeed the most tourism using the trains in Egypt, because this service of trains in Egypt attractive to tourists who can spend the night or day on the train as it covers the stretch between Cairo, Luxor and Aswan. Consequently, tourists can see all Egypt cites from trains. However, the trains or the HST are the best alternative for tourism in Egypt.

In the case of high speed rail, the base case should therefore include such investment as is necessary to maintain the operation of existing services, and consideration should be given to how to deal with any foreign growth in traffic. This might mean investing in additional rolling stock or revising fares structures and levels. More major changes should be considered as alternative do something options. These might include upgrading existing infrastructure, indeed construction of additional road or airport capacity. There will also be options regarding high speed rail how far to extend for new line to which alternative points to run the new trains, what service frequency and pricing policy to adopt [as shown in the Figure 23; 24 compare the price between difference transport mode in Egypt]. It is essential to examine sufficient alternatives to be confident that the best alternative has been identified. The range of potential options makes appraisal of high speed rail a difficult task. It is also necessary to consider the timing of investment. High speed rail might turn out to have the highest net present value, but if the demand for HSR and the other benefits from it are forecast to grow then it might still be better to the investment, in the section 6.7 will be shows the demand of passenger traffic volumes in the next 30 years are in the line Cairo-Alexandria, Cairo Assuyt, and Cairo, Luxor and Aswan.

Transport infrastructure problems in Egypt relate to the quality, maintenance and security of equipment. With the lack of investment is especially serious in the railways. Rates for passenger and goods transport do not cover costs, and the network therefore runs a substantial deficit that prevents spending on maintenance, making rail less competitive than other forms of transport. Non-participation of the private sector on public-private partnership continues to hinder government efforts to get the private sector to invest more in major public works such as railways.

Railway operations became a matter of deep concern to the government in the past decade due to several issues, particularly the significant fiscal liability of the sector, poor safety, and the deteriorating quality of service. During the 2000-2007 period, ENR generated an accumulated deficit of EGP 6.53 billion (equivalent to US$1.18 billion), almost equivalent to its cumulated gross revenue (EGP 7.24 billion). Its operational deficit totaled EGP 3.91 billion over the same period, where the interest totaled EGP 3.83 billion[58]. ENR revenue was not able to finance needed investments in infrastructure and rolling stock, let alone repay investment loans provided by Egypt's National Investment Bank (NIB), Egypt Central Bank, and foreign banks, which amount to a total of about EGP 12 billion.

Currently, one of the newest financial systems for environmental projects is the Build, Operate, and Transfer BOT concept, which is starting used increasingly worldwide as a

[58] There is a serious a problem for the business travelers is that fares are set at very low levels, which means that the state should provide a subsidy of E£ 2 billion every year [175].

project delivery system by which governments obtain the infrastructure projects by private sector after a concession period free of charge. In the Egyptian environment up to now, promoters and investors have had many fears toward declared projects. Despite, there is railway project between Ein Shams to Tenth of Ramadan, and it is the first electric line under the BOT system, however, until now the BOT not used widely in Egypt, because privatization is seen as key for the private sector's long-term growth, but it will not suffice by itself. Where, Egypt is still rated low on the list of emerging economies. Aware of the need to improve governance and fight against embezzlement embezzlement and corruption[59] in June 2005 the government put five heads of state-owned firms on trial for misappropriating nearly $145 million [106, P.10].

6.6 Transport Projects and Service Funding Methods

Transport projects infrastructure in Egypt need huge investments for new construction, upgrading and maintenance. ENR responsible for establish and operate the railway network on the national level. The ENR law sets the legislative background and article 2 of the law specifies that: (1) ENR should establish the railway networks and operate them and their related services throughout Egypt. (2) ENR should establish, manage and maintain the firms and bodies necessary to perform these services. (3) ENR should implement the projects necessary to achieve its objectives. The Ministry of Transport is the relevant authority for the railways sector. Transport projects are infrastructure projects represent an important part of any states assets. Due to the fact that the investments required for transport projects in Egypt are huge and scarce at the same time, funding of these projects has become one of the biggest challenges. A scarcity in funds has resulted in a situation when transport services always lack upgrading. There is an urgent need for drawing up funding methods that support the amounts of money the government allocates in this respect. Applying international models in this regard is important. First, transport infrastructure and management funding in Egypt at present. The following Table 24 sums up the current situation of funding and managing transport services in Egypt.

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[59] The most expected risk factors in the Egyptian environment found by the following factors.(1) Political Risks [termination of concession by government, increase in taxes, changes in Law] specific, and changes in law general. (2) Construction Risks [cost overrun, land expropriation, increases in financing costs, variations, and time and quality risks]. (3) Operating Risks [termination by Project Company, government department default, and project company default]. (4) Market and Revenue Risks [monopoly, insufficient tariff, and insufficient income]. (5) Force majeure Unavoidable events interrupt the construction or operation due to [Nonpolitical events, Domestic political events and foreign political events]. Use, these entire factors affect on the parties involved to use BOT system in Egypt, but after Revolution 25 January may be the economic situation will be improving.

Table 24: Current Situation of Funding and Managing Transport Services in Egypt

Operation environment	**Type**	**Funding**	**Management & operation**	**% of funding**
Inter governorate	**Infrastructure** Road **Railways** Nile transport	**Government**	**Government**	100 %
	Operation Bus Taxi/microbus /Service Goods transport **Railways** Nile transport	 Public Enter /private Private Public Enter. **Government** Public Enter./private	 Public Enter. /private Private Public Enter **Government** Public Enter/ private	 50 % 100% 100% 100% 100%
Inside the cities	**Infrastructure** Road **Railways** Metro Tram	**Government**	**Government**	100 %
	Operation Bus Taxi/microbus /Service Goods transport **Railways/Metro** Tram	 Public Enter /private Private Public Enter. **Government** **Government**	 Public Enter / private Private Public Enter. **Government** **Government**	 50 % 100% 100% 100% 100%
International outlets	**Infrastructure** Airports (excluding Marsa Alam) Port (excluding privet ports)	**Government**	**Government**	100 %
	Operation Airports (excluding Marsa Alam) Port (excluding privet ports)	**Government**	**Government**	

The previous table shows that the government is responsible for transport infrastructure. (Also the government is responsible for operation and infrastructure, and there is no private operator, as is the case in some other countries such as Germany, France, and Japan). At the same time, services are offered by government bodies, Public Enterprise sector organized and disorganized private sector. The private sector is still unable to take part in the execution of infrastructure projects like roads, bridges, and railways. The government perceives as important the presence of integration between the government and the private sector in realizing economic development goals in an atmosphere of transparency and stability. Accordingly, the Egyptian government feels the need for augmenting the following precepts:

- Given economic alterations worldwide, governments alone can not be left to shoulder the burden of financing infrastructure projects solely.

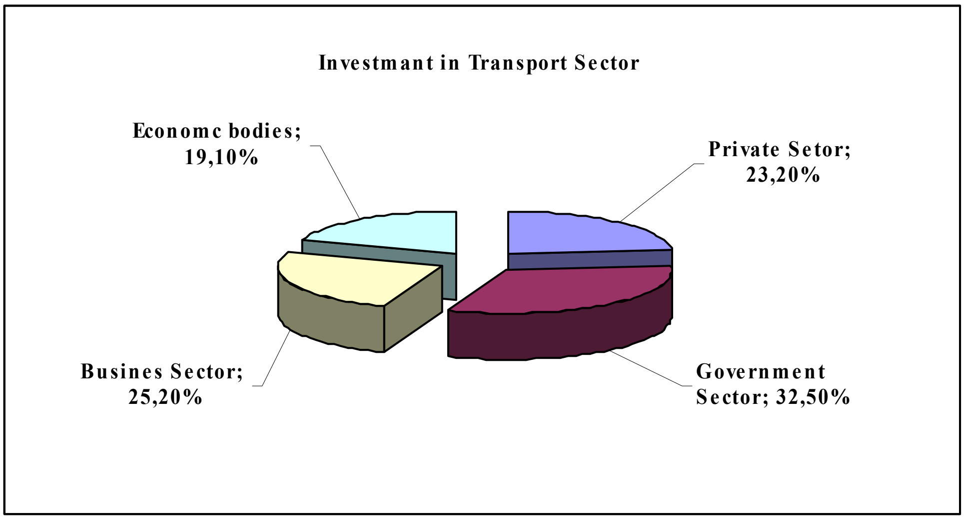
-The government can not expect the private sector to stretch a hand out in help in financing transport infrastructure projects in the foreseeable future. Yet for the government to be the only player in this field may not be enough to execute all transport projects.

-True transport infrastructure is costly. But transport projects can be profitable. That is why this field can attract many investments.

Hence the need for ways to stimulate the private sector is to be partner with the government in the management of transport infrastructure projects. It can be observe from the next figures the value of the investment in the transport sector in Egypt. Figure 31a explains the estimated target investments in the transport sector in 2009/2010 about

28.8 billion EP (5.05 billion dollars in status 2010), the percentage of the private sector about 23% of the total investments and the business sector about 25%. While the investments of the government and the economic organs about 52% [86].

While the estimated of public investment (government and economic organs), which distributed on the transport sector about 12.2 billion EP (2.14 billion USD in status 2010). But the concentrated about 80% of them in the field of roads, bridges, subways and rail. In Figure 32 it can be observed that the most important public investments by (government and economic bodies) in transportation sector. Also as can be seen that the investment cost of the railway sector about 2.9 billion EP (0.51 billion USD), and this value is now in Egypt to develop and improve rail services and renovation of some parts of the existing network.



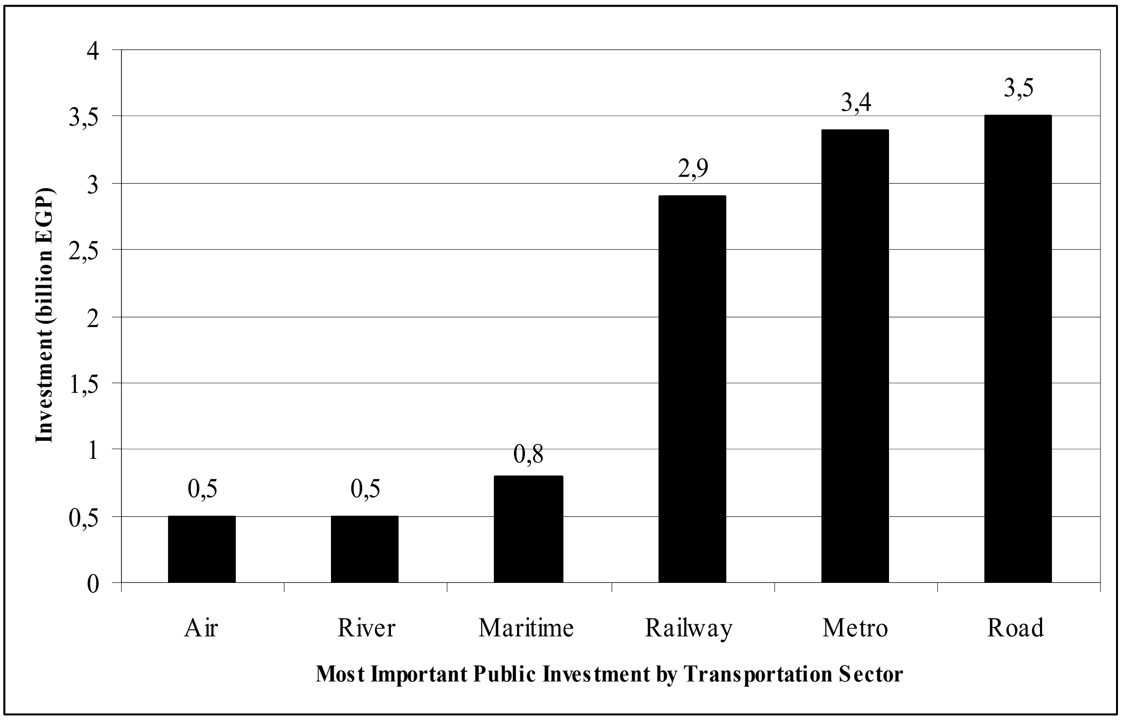
Source [86]

Figure 31a: Investment in Transport Sector by EGP/ 2009-2010

Whereas the construction a new line with higher speeds needs a huge investment costs compare with road as show in Figure 31a, and the government can not do this project alone without PPP (private sector participation). Also it can be observed that; in Egypt don't have any experience for the cost estimate or cost evaluation, because this project considers the first project in Egypt. It can take advantage of foreign experience in these projects. Generally, it should be noted that are to be determined particularly in infrastructure projects of the ENRs, the expected cost in the early planning stages very difficult. Also in the larger projects in recent years, the actual costs in some cases significantly higher than the very detailed forecasts calculated. The risk of such price increases for a railway project can be addressed with more risk premiums in the early planning stages, as with a very detailed cost accounting.

Methodology for determining the cost of the investment in the field of construction with the first planning considerations has occurred subsequently in several stages, to be determined in the end after the completion of the final cost. Cost determined in four steps: (1) cost estimates during the planning, (2) calculate the cost with the initial design, (3) Estimate for the awards (4) costs pursuant to the completion of the construction project. In Germany for example the cost estimates according to DIN 267 "building construction" have cost estimates for a deviation of up to 25 or 30% [155] for infrastructure projects of the DB AG has been found, however, that these deviations mentioned more (to see lower limit). This reasons will be called of the strong influence of the ground of cost, but also there are some reasons such as a long construction time, relatively compensatory measures and indirect costs, which will become apparent only in later stages in the full amount of planning, It may be a case similar to the specific costs per double km for a new line to that listed in some projects in the world. Figure 28 shows the international high-speed railways projects and the specific cost for individual systems [for example to the German experience for new HSR line between Hannover-Würzburg] it can be showed that in Table 18.

Therefore, the perception of the investment cost is a function of the specified construction period automatically distributed to various construction phases. Thus, the planning costs at the beginning of the construction period are taken into account, the payments for vehicles but only in the years immediately before the operation



Source [86]

Figure 32: Public Investments by Government and Economic Bodies in Transport Sector in EGP/2009-2010

6.7 Forecasting Demand Methodology for the Case Study

In this section, the methodology of demand forecast of the construction a new line in developing and emerging countries will be explained. For example the case study in Egypt as was analysis in chapter 5. The demand forecast of the new proposal HSR project will be calculated, depended on the forecast passenger demand for a HSR corridor in 2015. This methodology depended on the traffic volume in the last years; therefore it can be calculate the change rate of the traffic volume for the forecast in the years 2015. Consequently, this methodology is applicable to project activities that establish and operate a high speed rail passenger transport system between urban areas. The methodology is applicable under the following conditions

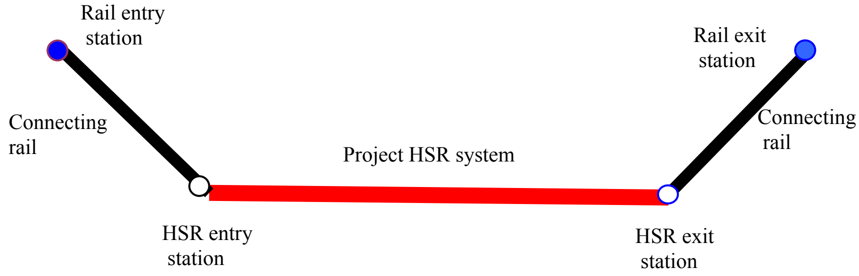
According to the Definitions of HSR in Chapter 4: For the purpose of this methodology, the following definitions apply in the case study:

- The proposal project establishes a new rail-based infrastructure for HSR. The average design speed between the origin and the destination point of the new HSR must be at least 200 km/h and the maximum speed 250km/h.
- **HSR entry station** refers to the station where a surveyed passenger enters into the new, upgraded or extended HSR system established under the project activity;
- **HSR exit station** refers to the station where a surveyed passenger leaves the new HSR system established under the project activity;
- **Rail entry station** refers to the rail station where a surveyed passenger starts their trip on a rail based system. This includes non-project rail system that connects to the project HSR and may be conventional rail line. If the passenger starts the trip on a station of the project HSR system, then the rail entry station corresponds to the HSR entry station;
- **Rail exit station** refers to the rail station where a surveyed passenger ends their trip on a rail based system. This includes non-project rail system that connects to the project HSR and may be conventional rail line. If the passenger ends the trip on a station of the project HSR system, then the rail exit station corresponds to the HSR exit station.
- The methodology is only applicable for passenger transport
- The entire project HSR system (origin, destination and urban areas serviced by the project HSR) must be located in the countries that need to create a project
- Only electricity and no liquid, gaseous or solid fuels are used for the propulsion of the project HSR system;
- The average distance between all stations served by the HSR system is at least for example 60-100 km.

The definitions of the HSR entry and exit station and the rail entry and exit station are illustrated in the following schematic figure. The methodology is only applicable if the procedure to select the baseline scenario leads to the result that a continuation of the use of current modes of transport is the baseline scenario. In addition, the applicability conditions included in the tools referred to above apply.

Rail Ridership Forecasts

One of the most critical elements of the feasibility assessment is the estimate of ridership for different service level alternatives. Ridership is the leading indicator of benefits for the benefit-cost analysis conducted as part of this case analysis. For the purposes of understanding the affected market of trips, ridership estimates assessed opportunities for the entire through-length of the Cairo/Alexandria, Cairo/Assuyt, and Cairo/Luxor-Aswan corridors. This section describes the method, data sources, assumptions, alternatives and forecast results developed in forecasting difference scenarios. The forecasting method applied here was designed to be applicable for evaluating the feasibility of a variety of proposed passenger rail mobility improvements along the proposal corridor. In this point will be comprised of the following sections:



Study Area

The case analysis area for many purposes concerns only the proposal corridor between Cairo and Alexandria a distance of 208 km, Cairo/ Assuyt 375 km, and Cairo/Luxor-Aswan 879 km. For the purposes of understanding the affected market of passenger rail trips and to accurately model ridership, however, the study area coverage needed to include the entire through length all regional area. The forecasting methodology needed to be applied to a geographically large enough area to account for the size of the area potentially affected by the scenarios considered. At the same time, the forecasts needed to be detailed enough to be sensitive to local or regional changes in demographic characteristics and patterns of journey making. The ridership analysis was developed to account for the enlarged nature of the project.

Model Design

Several different elements were established prior to developing the ridership model

- Determination of Trips

Since some of the service improvements being considered involve improvements in travel times in north corridor, travelers on the intercity service traveling in Lower Egypt from (Cairo to Alexandria) or, in fact, anyone traveling from Cairo to any cities in the Upper Egypt (Cairo/Assuyt and Cairo /Luxor-Aswan) would be impacted by the potential improvements. As a result, these travellers justify analysis in the model. In order to keep the analysis control, however, the trips on the Cairo and other intercity services not entering the cities in the North-East were not included in this study. For example, the model makes no attempt to model all rail trips between Cairo and Damietta, Suez, and Port Said cities.

-Station Universe

The model displays results expressed for each and all of the station cities along the proposed route. For simplicity's sake, there are only two stations between Cairo/Alexandria are grouped into one station describing Cairo and Alexandria. Thus, the southern corridors between Cairo/Luxor-Aswan all station between them are grouped into one station describing Cairo and South. The remaining stations are treated individually, so that the universe of stations analyzed in the model, and for which a station-to-station trip matrix is developed, is as follows:

- Alexandria
- Cairo
- Bein Suef
- Minia
- Asyut
- Shoag
- Qena
- Luxor
- Aswan

-Key Point-to-Point Markets

Within the overall study area, several key point-to-point travel markets are of interest. Hence, the essential principle of most travel demand analysis, including this model, is that a traveller's decision to use a particular mode between two points is a function of their perceived time from origin to destination over each of the available mode choices. It is therefore not sufficient to analyze the station-to-station travel time of the proposed rail service without taking into account some understanding of the time on competing travel modes (walling, bus, auto, etc.), and also taking into account some evaluation of access and egress between the stations and the ultimate origin or destination. Table 25 shows a sample of anticipated point-to-point travel times from a number of different importance sources for a representative sample of key origin-destination pairs.

Table 25: Modal Travel Time Comparison, Representative Sample O/D Pairs Cities

Between point		Distance	Drive time (Car, min bus)	Rail service	Air Service [60]	Proposal HSR
		Km	hours + 20 min.	hours + 1 hours	hours+ 3 hours	hours + 1 hours
Cairo	Alex.	208	2.35	3.45	3.45	1.05
Cairo	Bein Suef	124	1.50	2.40	---	1.38
Bein Suef	Minia	123	1.50	2.40	---	1.40
Minia	Assuyt	128	1.50	2.45	---	1.40
Assuyt	Sohag	92	1.18	2.20	4.00 (1)	1.30
Sohag	Qena	142	2.10	2.15	4.05 (1)	1.45
Qena	Luxor	62	1.20	2.00	4.10 (1)	1.30
Luxor	Aswan	208	2.40	5.25	4.25 (1)	2.00

(1) This time from Cairo to Luxor and Cairo to Aswan

Car: 100 km/h 20 min break, Train: 100 km/h Exit/ entrance time 1 h, Airplane: 500 km/h Exit/ entrance time 3 h, Proposal HSR train 250 km/h Exit/ entrance time 1 h [see Table 14]

6.7.1 Forecasting Methodology

Formulation of the Model

This section describes an effort to develop forecast for a variety of alternative alignments for intercity HSR for the Egypt will be estimated. This was especially significant challenges, because no prior intercity travel-demand models existed in the developing and emerging countries such as Egypt, and there existed very few data on intercity movements that could be used as the basis for calibrating a mode-choice model. Hence, the method adopted was to create synthetic demand and mode choice models, using parameters from the number of other recent models. The synthetic models has been modified to Egypt and the other developing and emerging countries by using available data, together with increase and modification of the data. In this section describes also the basis of synthesizing the demand models, the available data, the steps taken to adjust and increase the data for the purposes of model modification, and summaries of the results of some of the estimation runs. The purpose of the analysis

[60] The Air transportation in Egypt is limited only to fly between certain points, such as Cairo/Alexandria, Cairo/ Port Said, Cairo/ Ma-rsa Alam, Cairo/Sohage, Cairo/Abu Sambile, Cairo/Marsa Matrouh, Cairo/Luxor, Cairo/Aswan, Cairo/Hurrahed and Cairo/ Sharma El Sheikh. As for the rest of the city, which lies along on the line between Cairo and Aswan, there are no air services between them

was to develop preliminary estimates of HSR ridership and revenue that would determine whether to proceed with further, more detailed estimates and plans. The analysis was structured to be done rapidly and without time to put in place the data and models that would be desired for a detailed planning effort.

Different forms of intercity passenger-demand models are explain in the literature. They range from direct-demand models, first initiated in the 1960s, through abstract-mode models of the 1970s, to incremental travel-demand and discrete-choice modal-split models commonly used today [227;228]. Direct-demand models conduct the entire demand-estimation and modal-split process within a single model. They were developed this model for use in the developing countries project as example in Egypt and have generally not been used until now. It will be reviewed the past practice and identified model forms and parameter values from past studies. Based on this and the data available, a procedure was put forward that appeared to best commensurate with the conditions of the cases analysis and that would provide the most reliable demand passenger forecasts estimates possible in the limited time and with the limited data available.

At least in the countries are involved in most international studies, each generally having its own distinct approach to demand modelling, and coordination (of both data collection and forecasts) is a major issue. For example, the approach to coordination adopted on this study is described in the next four sections. These four main areas of coordination are; **Travel surveys** included the locations of the survey in the country, the modes to be intercepted (cars, coaches, train and air passengers). **Planning data:** A specification of requirements for the base and future years (for example in the case study between 1983 & 2015) was agreed, as well as the level of geographical disaggregation which was feasible in the country. **Network information**: it will be common model networks were adopted. Thus, for example, the information is provided on planned road and rail improvements between 1983 and 2015 and **Model Forecasts.**

The forecasting model formulation will be explained in this section. The most common form of intercity travel-demand model in use today appears to be the incremental total-demand model. The most widely used model for urban as well as intercity mode choice is the multinomial logit model [226]. Thus, the direct demand model relates the numbers of trips between each city-pair to socio-economic characteristics of the zones and the generalised cost of travel between them. It is of the conventional multiplicative formulation form with elasticities controlling the sensitivity of the trip estimates to each variable, expressed as a ratio of current and future conditions. For instance, the model estimated for business intercity travel in the HSR and Intercity Rail Market and Ridership Study in Florida is as shown in Equation 1 [225]. Separate direct demand models were estimated for each cities pair, and "k factors[61]" were also needed for certain zones within country. There are three types of

[61] The model has an elaborate passenger occupancy step but no mode split step. The demand passenger occupancy step consists of three sub-steps. First, a county-level transit share is developed for work trips based on average the Census of passenger from Ministry of Transportation and ENR shares, and extended to other purposes by using work/non-work ratios from the CAPMAS. The resulting shares are applied to every traffic analysis area in the county. Second, person trip and passenger trip data from are developed to account for trip length based again on the ENR. After applying these occupancy factors, the ENR authority are used to develop average occupancy rates by trip purpose for each classification categories the corridors (three cases in Egypt). Finally, adjustment factors it will be analysis the three corridors in the case study.

geographic adjustment factors (K-factors) are also used in calibrating the model. These K-factors are based on information regarding existing (1) country-to country, (2) major city-to-city, and (3) out city/in-city traffic flows, and the values of the K-factors listed in the documentation range from as low as 0.10 to as high as 9.67 [241]. The impedances for intra-area trips are calculated separately from the network, however, to avoid complications due to the arbitrary placement of traffic analysis area centred with respect to route links.

The elasticities and the values of time used in the calculation of generalised cost will be calibrated on the case study travel data. Therefore demand model relates the numbers of trips between each pair of zones to socio-economic characteristics were drawn from population, secondary employment and tertiary employment, while the all-mode generalised cost was a weighted average of that for the available modes (taking account of price, in-vehicle journey times and excess times at the start and end of the journey).

$$\frac{Vol\ (i,j)^f}{Vol\ (i,j)^b} = \frac{POP\ (i)^f}{POP\ (i)^b} \bullet \left[\frac{EMP\ (j)^f}{EMP\ (i)^b}\right]^{0.4448} \bullet \left[\frac{HOT\ (j)^f}{HOT\ (i)^b}\right]^{0.07524} \bullet \left[\frac{LOS_{car}\ (i,j)^f}{LOS_{car}\ (i,j)^b}\right]^{0.3260} \bullet \left[\frac{LOS_{car}\ (i,j)^f}{LOS_{car}\ (i,j)^b}\right]^{0.1630} \quad (1)$$

Where

i,j = origin and destination cities, respectively
f,b = future year and base year, respectively;
Vol(i,j) = volume of trips from city i to city j
POP(i) = population in city i
EMP(j) = employment in city j
HOT(j) = number of hotel bed in city j
LOScar(i,j) = level of service of automobile travel between cities i and j
LOSair (i,j) = level of service of air travel between cities i and j

For estimates the future volume, $Vol(i,j)^f$, are obtained by multiplying the right-hand side of the equation by the current volume between *i* and *j*, $Vol(i,j)^b$. Forecast of population, employment, and hotel rooms must be provided exogenously, whereas level of service *(LOS)* is usually taken as the utility from the mode-choice model. This formulation makes demand sensitive to level of service; thus, with an improvement in level of service, demand will increase. This is a particularly attractive feature of this model formulation because the issue of induced demand is often discussed in the literature. It does mean, however, that the modal- split model must be run in advance of the travel-demand model to provide the level-of-service values to insert into the model.

Consequently, other variables can be used in the model formulation, despite population; employment, income, and level of service are common. *Other variables used include hotel rooms (for example as in the Florida model), dummy variables for large cities, or a dummy variable for a particular province.* Most studies have separate models for at least business and non-business trip purposes, so it will use this model in Egypt and developing countries. The parameters of the above type of intercity travel-demand model are established **by linear regression models** after taking logs of both sides of the base-year expression. For example, for the Florida business model above, base-year data for all city pairs would be used to estimate the parameters a, b, g, d, and q in Equation 2: For example, the analysis in the case study, it was used this method for model above, base-year data for all city pairs would be used to estimate the factors $\alpha, \beta, \gamma, \delta, and \theta$ as show in the equation 2

$$VOL(i,j)^b = \alpha\left[EMP(j)^b\right]^{\beta} \bullet \left[HOT(j)^b\right]^{\gamma} \bullet \left[LOS_{car}(i,j)^b\right]^{\delta} \bullet \left[LOS_{air}(i,j)^b\right]^{\theta} \quad (2)$$

Implementation of the Model

Given the short time available for this study, it will be selected the conventional simple multinomial logit model. The modal-choice model is described in greater detail in this sections. This model is reported to the above described; the forecasting methodology is based on the development and application of two incremental models. One is an incremental demand model that estimates the change in total level of demand as a function of the populations of each pair of point, the GDP of each pair, and the overall levels of service between them. The other is an incremental logit model of mode choice. Because available data did not provide a breakdown of the purpose of interchange-pint trips, the methodology was applied without separating trips by purpose. The mathematical form of the first model (estimation of point -to-point volumes) which is applied to each matrix cell is shown in Equation 3:

$$VOl_{ij}^{fut} = VOl_{ij}^{base} \times \left(\frac{Pop_i^{fut}}{Pop_i^{base}}\right)^{\alpha} \left(\frac{GDP_i^{fut}}{GDP_i^{base}}\right)^{\beta} \left(\frac{Pop_j^{fut}}{Pop_j^{base}}\right)^{\gamma} \left(\frac{GDP_j^{fut}}{GDP_j^{base}}\right)^{\delta} \left(\frac{LOS_{ij}^{fut}}{LOS_{ij}^{base}}\right)^{\varepsilon} \quad (3)$$

where

VOl_{ij}^{fut}, VOl_{ij}^{base} = base and future year volumes, respectively, between point i and point j;

Pop_i^t, Pop_j = population for point i and point j with similar designations of base and future;

GDP_i, GDP_j = gross provincial product for point i and j for the base and future years; and

LOS_{ij} = level-of-service function over all modes for movement between point i and point j (the denominator of the logit model shown below was used).

The second model is an incremental mode-choice model that predicts the change in the proportion of trips by a given mode as a function of the changes in levels of service of all the modes. This was also applied without attempting to distinguish between trips for different purposes. Equation 4 shows the form of the incremental logit model:

$$S_{rail}^{fut} = \frac{S_{rail}^{base}\exp(\Delta I_{rail})}{\sum_m \left[S_m^{base}\exp(\Delta I_m)\right]}$$

S_{rail}^{fut}, S_{rail}^{base} = rail share of the market for a specific *ij* pair for the base year and the future, respectively;

S_m^{base} = share of mode *m* in the base year;

ΔI_{rail}, ΔI_m = difference in impedance for rail and mode *m,* respectively, between the base and future year

Moreover, the both models require calibration, and the following subsection describes briefly how this was accomplished. However, the impedance expression in the logit model would require detailed data on intercity travel that was not available for a new proposal HSR in developing countries

Consequently, some important properties of these additional models led to the choice of the models. An incremental model, as is shown by the formulas in Equations 1 and 2, estimates a future volume or market share as a function of the base-year volume or market share. This is done because it removes problems associated with other characteristics of a specific point pair or mode of travel, where such biases cancel out between the present and future year in the additional formula.

This property makes additional models particularly valuable in circumstances in which data are limited or unavailable and in which local calibration of a model cannot be undertaken. However, it also introduces an important limitation: no demand can be estimated if the base-year volume or share is zero. For a few point pairs in Egypt and in the developing, emerging countries there appears to be a zero base-year volume of travel. For these pairs, no estimated demand was produced for the future.

Of more importance is the fact that, in any point pair in which a new alternative is to be introduced, no estimate can be made of a new share of the market for the new alternative. This required that HSR be treated as part of the rail mode for estimates of future travel, with the assumption that all rail trips between points served by HSR stations would be on HSR, while all rail trips between a point without a HSR station and any other point would be on conventional rail. This assumption probably leads to conservative estimates of HSR ridership. It also means that no market share can be estimated for a new rail line providing service where there was no base-year rail ridership, and the same restriction applies to any other mode, such as bus and min-bus or air

Data Sources and Models Utilized

To calibrate the incremental direct-demand model, base-year data on population, GDP, base-year travel demand by mode, and base-year level-of-service characteristics by mode were required. Different sources were searched to develop the needed input data. The ridership estimates incorporate historical, current and projected population and employment data obtained from:

- Historic data has been obtained, from the 1996 Egyptian Railways Master plan Study and ENR.
- CAPMAS: Central Agency for Population Mobilization and Statistics, Population Estimates by Sex & Governorate Egypt in Figures 2012.
- Ministry of Economic Development in Egypt: Report of follow-up economic and social performance 2008/2009
- Ministry of Transportation.
- The environmental impacts of transportation in the Arab Republic of Egypt, Faculty of Engineering, Cairo University, 2008

The only complete bus and mini bus data available were from 1996, documented in the Intercity Bus Company by Ministry of Transportation. These data were brought up to a 1993 estimate by applying growth factors to the 1985 figures that reflected growth in national population from 1996 to 2006. This represented approximately a 15 percent growth and assumes that bus travel grew neither faster nor slower than the population during the period. All these calculations have already been made in chapter 5, but in this point will be identified only the study of HSR.

Level-of-service data were also developed from a variety of sources. For air, recent schedules of domestic air service were used to develop travel times from airport to airport, frequency of service, and fares. To estimate an average fare, it was assumed that wherever more than one fare class was available the split would be approximately 15 percent for first class and 85 percent economy class according to Egypt Air. Access and egress times were estimated by assuming an average distance to be travelled to an airport on the basis of the size of the cities in which the airport was located, as noted earlier. In addition, in-airport times of 1 hour and 30 min at the origin airport and 1 hour and 30 min at the destination airport were assumed. (All this calculation can be shown in the section 6.3.1 and Table 25)

A custom forecasting model was developed to estimate ridership for the proposed realignment of the high speed rail, enhanced intercity, and commuter service scenarios. It utilized applicable data and network features where available from existing demand models and frameworks. The model specifically considers travel time comparisons between passenger rail and alternative modes on the highway and air as show in Table 25. Other key factors include the frequency of rail service, and the level of jobs and population within walking distance of railroad stations. The ridership estimates assume that the current, low-cost high-frequency mine-bus and bus service will be maintained as well as other car connections in the region. Information and assumptions related to the price of gas, average fare price, and levels of highway congestion were also considered in the ridership analysis. Finally, the potential for induced development (transit-oriented development) near the stations for the enhanced intercity and commuter service scenarios was also incorporated. Data on rail and air travel volumes were provided in Ministry of Transport and in ENR and the Egypt Air line reports for 1996 on point -to-point basis. These figures were adopted for this study as the base-year values for these two modes. Data were also available from 1995 for rail on the split of passengers among the three modes levels. These data were used to estimate the fractions of riders using each fare level and were used in both the base and future years.

6.7.2 Summary Results of Application of the Demand Models

The models, in general have not made effective use of the considerable amount of literature (largely from academic sources) on intercity travel passenger demand. Intercity models can essentially be divided into four types on the basis of two categories: data source and structure of models. The models can use either aggregate or disaggregate data, and can be of a direct-demand. Intercity travel passenger demand models can be further classified by whether they encompass only a single mode (mode-specific) or multiple modes (total demand- it will use the total demand in this analysis for the case study) and by which trip purposes they include.

It will be use the function of the population and the number of passenger by railway, the total demand changes with each corridor tested. However, the main underpinning of the forecasts of demand is forecasts of passenger to 2015. These forecasts, from ENR data sources available, provided national growth changes shown in Table 27 (The forecasts of passenger of all cases are based on the regression model of trip generation). At the time, however, these were considered to be reasonable estimates [See all tables in the cases 01, 1 and 2].

Due to, the increased toll on automobile, and the addition of motorway bus service and there are offered only at fares. There is also no accounting for new links created, such as new air services and new rail lines. The impact of the build scenario is for automobile to draw heavily from bus, as a result of the toll motorways and accidence. Rail also picks up a substantial addition of bus trips, because it is more competitive against the motorway bus. Air declines slightly as a result of the motorway improvements. After

adjusting for the congestion and increased frequencies that these levels of demand would produce, the increase in highway travel time affects automobile severely, with most automobile trips shifting to rail. There is a slight increase in bus trips due to the combined effects of the increased frequency and decreased speed. Air drops further, mainly because the impedance improvements for air are not competitive with rail, in this case.
For the purposes of the case analysis, several alternatives or cases were conceived and enumerated. These cases were developed to represent generally additional changes to the level and type of passenger rail service in the region. The forecasting tool needed to be sensitive to the types of service changes implemented in each case. In order to best understand the markets for service improvements to the region's rail network, a stepwise, incremental approach to developing the cases was used. Each of these cases is described below.

It will be noted that, as a set of forecasts was produced for the opening/implementation years and for the long-term year 2040. It should be noted that the 2040 forecasts include not only the effects of the changes in regional demographics between 2010 and 2040, but also the impact of the economically induced trips. Additionally, it should also be noted that the calculations are based on the entire study area routing, from Alexandria/Cairo, and Cairo/Assuyt, and Cairo/Luxor-Aswan. According to this analysis, the costs of three phases and ticket price will be calculated. Table 26 indicates that the whole number of passengers between Cairo/Alexandria and Cairo/Aswan corridor [111]. Indeed, it is important to consider HSR connected between cites have high population density, where it is able to generate a higher volume of traffic per years.

Table 26: Volume of Rail Traffic between Cairo/Alexandria & Cairo/Aswan in 2008

Cites	Distance (Km)	Passenger (per day)	Passenger (per years Million)
Cairo/Alex.	208	200.000	73
Cairo/Aswan	879	250.000	91.25

Source: [111]

Table 26 show the total volume of traffic for the routes between Cairo/Alexandria and Cairo/Luxor-Aswan. **This means that 73 million passenger per years is not direct from Cairo/Alexandria, but for all the cities located between them. Also the Cairo/Luxor-Aswan route, the number of 91.25 million passengers per year is for all cities located on this line.** It can be noted that, the forecast of passenger traffic volumes in the bases years 2010 and 2015 for the line Cairo/Alexandria and Cairo/Aswan will be calculated as illustrates in the Table 27 Using the estimate growth factor in the first five years will be calculates the number of passenger forecast traffic in year 2015 for the cases 1 (Cairo/Alexandria), and case 2 (Cairo /Assuyt, and Cairo/Luxor-Aswan) as show in Table 27. It can be observed that, the forecast in the next years estimated by using the growth factor in the case 1 (Cairo/Alexandria) and case 2 (Cairo/Assuyt, and Cairo/Luxor-Aswan).

It can be also noted that, in the case 0 (whole ENR network) will be only shown the performance of the whole total network in Egypt and the estimated growth factor also for whole network. Thus, can be observed that, when compare the growth factor between the whole network and the other cases, it can be found that about 1.45 growth factor estimated in the whole network, and 2.81 growth factor in the Cairo/Alexandria corridor, and 1.30 growth factor in the Upper Egypt network in year 2040. This means that, the growth of passenger in the Cairo/Alexandria corridor increases are greater than the total network. However corridor in the Upper Egypt will remain almost equal to total network. So, in the next analysis will be calculated the total costs of the proposal HSR line, depended on the number of passenger accordant to case 1 (Cairo/Alexandria), and case 2 (Cairo /Assuyt, and Cairo/Luxor-Aswan).

Table 27: Forecast Passenger Traffic Volumes in the bases years 2010

Year	Cairo – Alexandria (Mio. Pass/year)	Cairo/Luxor-Aswan (Mio. Pass/year)
	Estimated with 1.21 growth factor	Estimated with 1.08 growth factor
2008	73	91.25
2010	91.2	95
2015	110.2	102.6

6.7.3 Regression Analysis Method

Regression analysis is a statistical tool for the investigation of relationships between variables. Usually, the investigator seeks to ascertain the causal effect of one variable upon another. In this section, it will provide an overview of the most basic techniques of regression analysis how they work, what they assume, and how they may go awry when key assumptions. To make the discussion concrete, it will employ a series of illustrations involving a hypothetical analysis of the factors that determine passenger demand market. This approach involves setting up model, usually, liner, that relate the passenger generated to the socioeconomic characteristics of the passenger markers. The models of forecast of passenger demand can be specified and estimated as the people demand models, say at the passenger level, or as aggregate market demand functions typically at area level. In the latter case, passenger forecasts are grouped according to some data variable classification on the basis of traffic analysis areas and assumed to be disproportionate for the purpose of modelling passenger demand. The area regressions for passenger demand are usually estimated separately for different trip purposes, and attempts are made to select explanatory variables appropriately for each trip purpose.

Passenger forecast demand regression models can also used the forecasting based on market surveys. Where, traffic forecasting through market surveys aims at analyzing the characteristics of the railway passenger transport market in order to examine empirically how the use of a new or the improving of an existing railway line varies across different sectors of the population and passenger. Consequently, the all results of the regression are shown in Table 28, and they clearly the potentially misleading good fit that one can obtain with aggregate models of forecast passenger demand. Therefore, it will calculate the coefficient and the Ratio of the explanatory variables. Thus if the coefficient of determination (R^2 = 90) is high and the acceptable values of the statistic [229] and other diagnostic tests assure the statistical validity of the model.

The first model (whole network in ENR) with an R^2 = 68 explain 68 percent of differences in models of forecast of passenger demand rate on the basis of differences in the number of years (2004 to 2009) in area and estimated forecast passenger demand. **The second model** (Cairo/Alexandria line) with an R^2 = 95 explain 95 percent of differences in models of forecast of passenger demand rate on the basis of differences in the number of years (2001 to 2006) in area and estimated forecast passenger demand. Thus, the results are considered very well and the model appears to be widely significant. **The third model** (Cairo/Assuyt line) on the other hand with an R^2 = 94 explain 94 percent of differences in models of forecast of passenger demand rate on the basis of differences in the number of years(1986 to 1987) in area and estimated forecast passenger demand. Thus, the results are considered also very well and the model appears to be quite significant. Thus, the forecasting ability of the proposed models is tested with the coefficient of determination R statistics method. This method allows the examination of residuals and appraisal of the forecasting ability by employing appropriate statistical tests.

Analysis by Linear Regression Model of intercity passenger rail demand in Egypt

As will be presented in the next section, in the case 0 (whole network in ENR) the period of analysis of railways in Egypt from (1990-2009), a drastically change (happened in 1999/2000) due to the tariff policy which affects on the number of passenger demand. It will be considering that, this case the basis case of all networks in Egypt. Thus, it will be consider, the main cases to calculate the future passenger demand for proposal HSR in Egypt are the case 1 (Cairo/Alexandra line) and case 2 (Cairo /Assyut, and Cairo/Luxor-Aswan line). Because of this event, it will be chosen two different linear regression models. The first model, takes into account all the period of analysis (2004-2009) and the second is similar with the first one, taking into account the period of analysis (1983-1987) accordant to a variable data.[See all calculation in the Table 28]

A regression is a statistical analysis assessing the association between variables. It is used to find the relationship between these variables. This described methods to predict the size of the passenger number yearly will be explained. In contrast, regression analysis, independent variables in the form of economic variables are used to explain base. It will use the data set for each approach, annual average traffic volume of the ENR. These annual values have been calculated from daily observations archived by the ENR. Also this data depending on whether one includes one or more independent variables to explain the dependent variable, a distinction is made between the

- Simple regression and
- Multiple Regressions.

Regression analysis models formula:

Regression Equation(y) = a + bx

Slope (b) = $(N\Sigma XY - (\Sigma X)(\Sigma Y)) / (N\Sigma X^2 - (\Sigma X)^2)$

Intercept (a) = $(\Sigma Y - b(\Sigma X)) / N$

Where; x and *y* are the variables

b = the slope of the regression line

a = the intercept point of the regression line and the y axis.

N = Number of values or elements

X = First Score

Y = Second Score

ΣXY = Sum of the product of first and Second Scores

ΣX = Sum of First Scores

ΣY = Sum of Second Scores

ΣX^2 = Sum of square First Scores

ΣY^2 = Sum of square First Scores

R = Coefficient of Determination

Table 28: Analysis of the Volume of Traffic and Forecast Demand of Passenger by Regression Models

$$Y = a + bx$$

$$b = \frac{n\sum(xy) - \sum x \sum y}{n\sum\left(x^2\right) - \left(\sum x\right)^2}$$

$$a = \frac{\sum y - b\sum x}{n}$$

$$r = \frac{n\sum(xy) - \sum x \sum y}{\sqrt{\left[n\sum\left(x^2\right) - \left(\sum x\right)^2\right]\left[n\sum\left(y^2\right) - \left(\sum y\right)^2\right]}}$$

Cairo /Alexandria line

	Year (x)	**Pass. (y)**	**xy**	**X^2**	**Y^2**
	2001	56	112056	4004001	3136
	2002	59	118118	4008004	3481
	2003	66	132198	4012009	4356
	2004	72	144288	4016016	5184
	2005	73	146365	4020025	5329
	2006	73	146438	4024036	5329
∑	12021	399	799463	24084091	26815

Y = a + bx = 3.8x-7546.8
R^2 = 0. 947
X variable = 3.8
Intercepta (a) = -7546.8

Statistic	Value
b	3.8
a	-7546,8
r	0.9475
R^2	0.898

The whole Network

	Year (x)	**Pass. (y)**	**xy**	**x^2**	**y^2**
	2004	418	837672	4016016	174724
	2005	436	874180	4020025	190096
	2006	451	904706	4024036	203401
	2007	451	905157	4028049	203401
	2008	451	905608	4032064	203401
	2009	451	906059	4036081	203401
∑	12039	2658	5333382	24156271	1178424

Y = a + bx = 6x-11596
R^2= 677
X variable = 6
Intercepta (a) = -11596

Statistic	Value
b	6
a	-11596
r	0,823
R^2	0,677

Cairo/Assuyt line

	Year (x)	**Pass. (y)**	**xy**	**x^2**	**y^2**
	1983	25.92	51399	3932289	671.9
	1987	27.42	54483	3948169	751.9
∑	3970	53.34	105882	7880458	1423.8

Y =a + bx= 0.38x –717.7
R^2= 0.936
X variable = 0.38
Intercepta (a) = -717.7

Statistic	Value
b	0.38
a	-717.7
r	0.967
R^2	0.93

6.7.3.1 Case 0-Base Line

This case represents the current ENR service as it operates today, Egyptian train per day in each direction travelling to Lower Egypt (Cairo to Alexandra, Damietta, Port Said and Suez) and Upper Egypt (Cairo /Luxor-Aswan) with station stops at major cities. Based on data obtained from ENR, annual ridership was 451million passenger and 40.84 million Pkm in year 2009.

The forecasting tool for the intercity market was developed to be an incremental type model based off of current 2004/2009 ENR ridership statistics for the new proposal HSR line service. The intercity market is more episodic than the relatively consistent commuter market, as intercity passengers with some rare exceptions do not generally travel the same trip every day. Moreover, the existing service provides the best proxy for how the service can be expected to operate in the near future.

According to historic data obtained, from the 1996 Egyptian Railways Master-plan Study and ENR for the performance of the overall national rail network. Data for the total number of passengers and passenger kilometres, for the period 1990 to 2009, is shown below in Table 29. Also the total number of passengers per year is shown in Figure 33.

Table 29: Historic Data for ENR, 1995-2009

Year	Passenger (million)	Passenger km (million)
1990	578	36,25
1991	612	40,95
1992	637	42,59
1993	663	44,74
1994	670	46,73
1995	718	48,24
1996	735	50,46
1997	771	52,96
1998	810	55,00
1999	831	59,64
2000	698	57,86
2001	367	46,24
2002	450	39,50
2003	367	46,19
2004	418	52,86
2005	436	40,85
2006	451	54,44
2007	451	40,84
2008	451	40,84
2009	451	40,84

As shown in Figure 33, total passenger numbers fell dramatically from the period 1999/2000 onwards, only recovering in the beginning year of the 2003/2004 until data available 2009. This period, however, coincides with a general increase in the level of ticket prices i.e. revenue increased from LE 0.47 per passenger in 1998/99 to LE 0.63 in 1999/2000, with continual further increases for the next 3 years, slight decrease in the year 2003/04 to LE1.35.

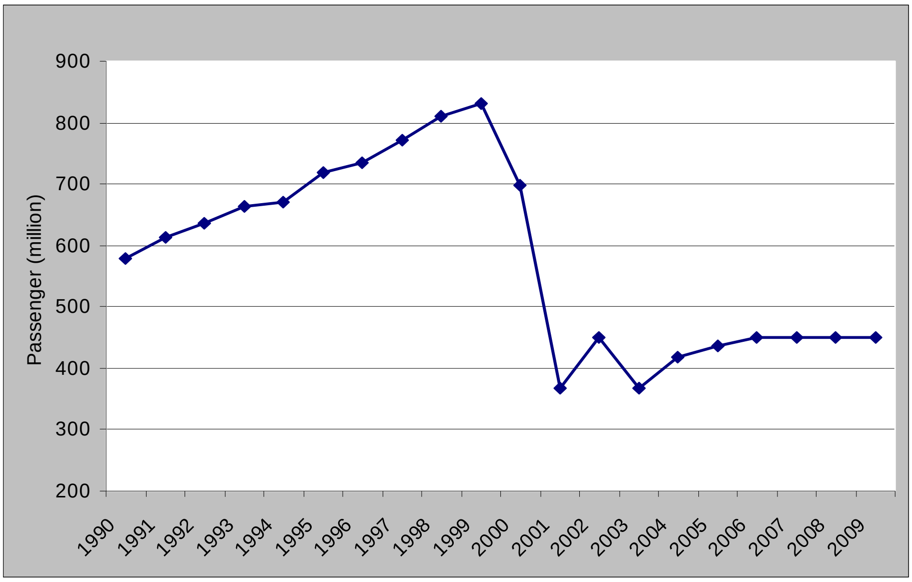


Figure 33: Total Passenger ENR, 1995-2009

Over the period 1990 /2009, the distances travelled by passengers have been increased. Based on the total number of passengers and the total number of passenger kilometres, the average distance per passenger was 67 km in 1995. This average distance had tripled by the year 2008/09 to 126.46 km. Excluding the period from 1998/99 to 2003/04, as high tariff changes has a considerable impact on passenger demand, there was a reasonable consistency of growth over the preceding period. Based on this basis will be calculated the running a simple regression for the period 2004 to 2009 it will be use the regression analysis method (See all calculation in the Table 28)

Average passenger model = -7546.8 + 3.8 × (the number of future years)
Coefficient of Determination R^2 = 0.68

Accordingly, it will be continue with the same growth pattern, for account in the future. Thus, passenger traffic will be increasing by a growth factor of 1.45 by the year 2039/2040 than in the year 2009/2010. For this study, it is assumed that passenger growth on the whole rail network follows national characteristics. It is further assumed that increases in traffic volume size to those observed over the period 2004 to 2009. Traffic volume sensitivities will be applied in the economic evaluation, in order to take into account possible changes in the price of tickets. Table 30 gives an indication of the passenger growth factors that must be applied, assuming the base year to be 2009. After year 2040, passenger demand will remain constant as calculations indicate that the railway will be at capacity by this year.

Table 30: Passenger Growth factor ENR whole Network 2010 -2040

Year	Traffic volume forecast	Estimated passenger growth factor
2009	451	1
2010	464	1.03
2015	494	1.10
2020	525	1.17
2025	552	1.24
2030	584	1.31
2035	614	1.38
2040	644	1.45

6.7.3.2 Case 1: Intercity Service Case Study in Lower Egypt

The Cairo-Alexandria railway line, 208 km long, is one of the main lines of ENR. Now ENR service operates on the Northeast Corridor similarly to other Northwest Corridor regional services. Each major city has a central train station. In Cairo, it is Ramses Square; and in Alexandria, it is Sidi Gaber and Masr station. The daily number of passenger trains operating on the line is 65 in each direction. Some of these 32 are express trains (air-conditioned trains, mixed trains, and those that are not air-conditioned) that operate on the whole distance between Cairo and Alexandria. The other 33 are local trains that operate between one point and another on the line [224]. The line has the highest passenger density (200 to 214 thousands passenger per day) of the entire ENR lines. It can be seen in the Figure 34 that the all number of trains from Cairo to cities located in the Cairo/Alexandria corridor. However, there are about 30 trains passing between Cairo to Alexandria.

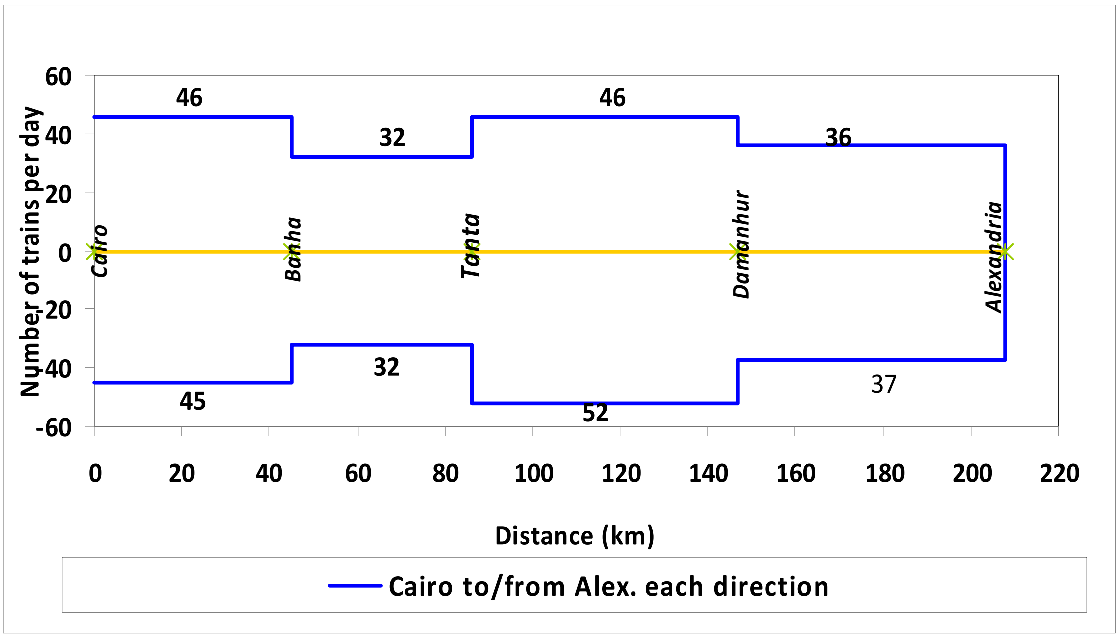


Figure 34: Indicative cumulative train path per day (+ve = Down Direction, -ve Up direction, 2011)

The existing Cairo/Alexandria rail corridor is close to maximum capacity utilisation in a number of passenger, and increased future passenger growth. Figure 34 shows current services within the corridor (in the up and down direction). Over 30 long-distance passenger services per day operate over the north route direct from Cairo to Alexandria. Although the demand for passenger will be increase in the future according to the increase the population in Egypt. In addressing future requirements for infrastructure capacity in the corridor, practical consideration must also be given to the effect of the wider network constraints imposed by the Cairo/Alexandria rail passenger corridor.

In order to forecast passenger flows in the future years, accordant the data of the ENR. In order to do this, the population and GDP growth rates in the short, medium and long term has to be estimated at first. Forecast growth of rail traffic is based on estimates for the Transformation Program prepared by MOT [80, P.71]. To calculate the forecast of rail demand on the passenger traffic for the proposal HSR line can be show in the Table 31. The average annual change of the period, from 2000 to 2007, showed in the same table. Therefore, the volume of passengers annually expected can be determined.

Table 31: Rail traffic on the Cairo Alexandria line 2000-2007

Year	Ton (thousands)	Annual Change	Passenger (million)	Annual Change	GPD (growth)
2000	580	-	-	-	5.4%
2001	834	43.8%	56	-	3.5%
2002	855	2.5%	59	5.4%	3.2%
2003	955	11.7%	66	11.9%	3.2%
2004	894	-6.4%	72	9.1%	4.1%
2005	1036	15.9%	73	1.4%	4.5%
2006	1036	0.0%	73	0.0%	6.8%
2007	669	-35.4%	-	-	6.8%

Source: [80]

As can be seen from Table 31, total passenger numbers increase dramatically from the period 2001 to 2005 onwards. In this period, however, coincides with a general increase in the level of ticket prices as mentioned before in the previous case 0. Consequently, to calculate running a simple regression for the period 2001 to 2006 the previous regression analysis method will be used (See all calculation in the Table 28)

Average passenger model = -11596 + 6.00 × (the number of future years)
R^2 = 0.95

Continuing with the same growth pattern, where future passenger traffic increasing by a growth factor of 2.81 by the year 2040 than in the year 2010. For this study, it is also assumed that passenger growth on the Cairo/Alexandria rail link follows the same characteristics. It is further assume that increases in traffic volume size to those observed over the period 2001 to 2006. Traffic volume sensitivities will be applied in the economic evaluation, in order to taking into consideration the possible changes in the price of tickets. Table 32 gives an indication of the passenger growth factors that must be applied, assuming the base year to be 2006.

Table 32: Passenger Growth factor Cairo/ Alexandria Rail 2010 -2040

Year	Traffic volume forecast of the whole route million passenger /year	Estimated passenger growth factor	Annually Traffic volume forecast between point Cairo and point Alexandra direct million passenger /year
2006	73	1	--
2010	91.2	1.24	13.7
2015	110.2	1.51	20.7
2020	129.2	1.76	24.11
2025	148.2	2.03	27.81
2030	167.2	2.29	31.4
2035	186.2	2.49	37.11
2040	205.2	2.81	38.5

According to Table 32, **the volume of traffic between Cairo/Alexandria is the total traffic for this route, this means that 73 million passenger per years is not direct**

from Cairo/Alexandria, but for all the cities between them[62]. Based on these projections and on the elaboration of the trip models (generation, attraction and distribution) presented above, this analysis built up estimated O/D passenger flow matrices for the years 2001 to 2006. Thus, this analysis estimated that the annual volume of passengers would be from 37 500 thousand per day[63] (13.7million passenger per years) in 2010 between point Cairo and point Alexandria. Consequently, in 2040, the total passenger flow is forecasted to be 38.49 million passengers, which represents a 2.81 growth factor between 2010 and 2040. According to the ENR, Figure 36 explains the distribution of the passenger in year 2010 between Cairo/Alexandria on the Lower Egypt railway line.

Based on passenger volumes on the Cairo/Alexandria rail network for the period 2001 to 2007, results of the regression calculation estimates that, future passenger traffic will increase by a growth factor of 2.81 by the year 2040. This growth factor has been used for the calculation of future passenger volumes on the cities located in this line. However, for the proposal HSR line, it will use the number of passenger direct from point Cairo to point Alexandria in year 2015. The expected costs and ticket price for this line, based on the number of passengers 20.7 million passenger in year 2015, can be calculated.

According to the Egyptian Railway Authority there are approximately 37500 passengers from Cairo to Alexandria daily. In the 2010 ENR data presented in Table 32 estimates that 13.7 million commuting trips per year are currently made on all railways direct from Cairo to the Alexandria. Figure 35 show the movement of passengers in all stations between Cairo and Alexandria in both directions. Also Figure 35 shows the movement of passengers from Cairo to other cities located on this line. These estimates represent an average over the route as a whole and reflect current train patterns and operating practices. The capacity available on any particular section of the route between any two cities, and under differing train operating patterns, will vary but will continue to be primarily influenced by the physical characteristics of the network.

[62] The Cairo/Alexandria railway line is one of the most densely populated areas in the world, linking the largest population centers in Egypt and several of the country's larger towns. The currently line provides a railway linkage for the capital cities of six governorates and a total human population of approximately 31 millions [116], most of them live in the urban areas of Cairo and Alexandria and delta towns. It provides a key transportation service for passengers, goods and mail service

[63] For this case study, data was obtained from ENR regarding passenger volumes on the Egyptian rail network, for daily passenger Cairo/Alexandria direct route from 32 400 to 40 000. Also all this data was obtained through interviews and contacts by people working in the Egyptian railway, and also by the Egyptian Railway Authority (https://enr.gov.eg/ticketing/public/login.jsf). The passenger demand from city to city formed a matrix of flows which were assigned to the available railway lines on an all basis using the shortest distance. No scheduled services between provinces have been modelled so capacity constraints within the railway system have not been considered. Zone connectors for each province have been placed on the network at representative centres of population such as large towns. The resulting annual rail passenger volume for all cities on the Cairo/Alexandria rail line was shown in Figure 35 and Figure 36.

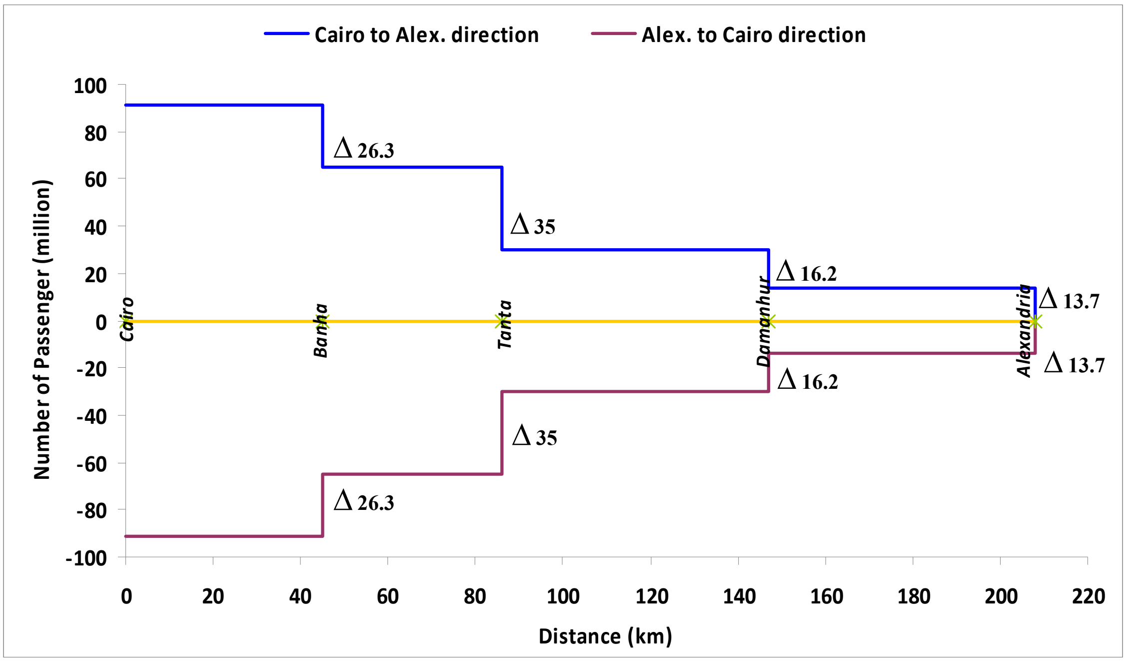
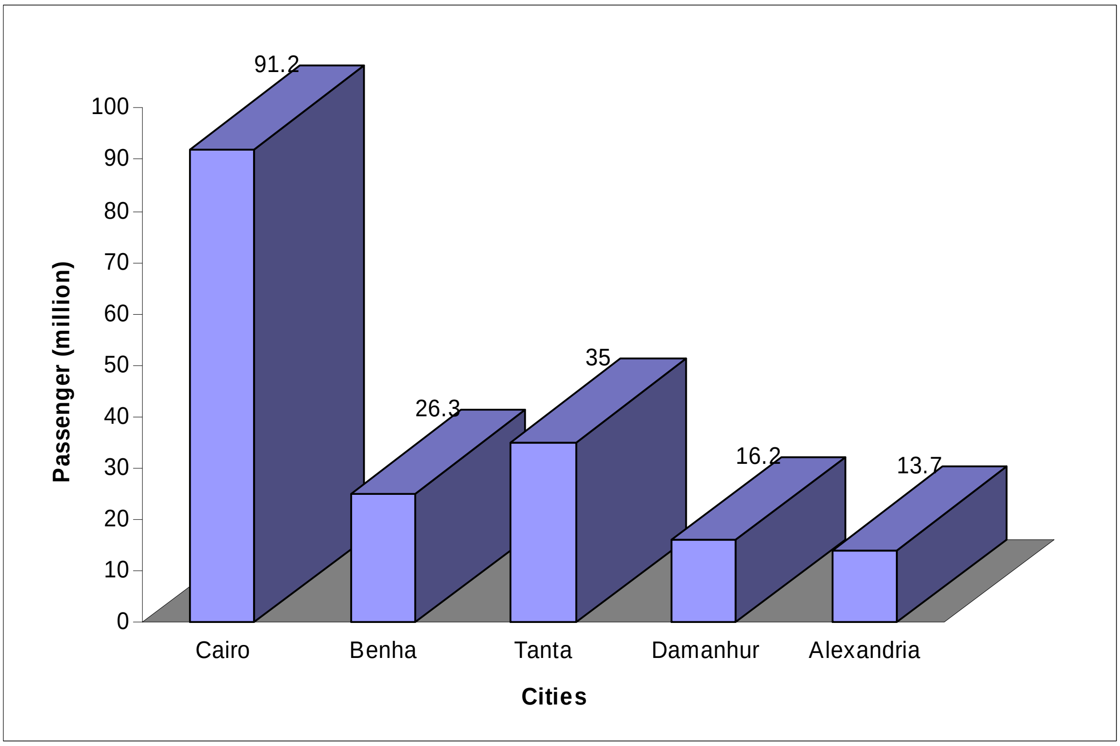


Figure 35: Diagrammatic representation of passenger capacity utilization (passenger in 2010)



Source: ENR

Figure 36: Number of Passenger in the Cities on the Cairo Alexandria Railroad line in 2010

6.7.3.3 Case 2: Intercity Service Case Study Upper Egypt

This data was based on analysis of Egyptian railroad operations in the Cairo/Assyut corridor made by the railroad specialist of the Egyptian Consultants Consortium. Some data on current operations were also provided by the Egyptian National Railway Authority (ENRA). The segment of the ENRA network between Cairo and Assyut is a double-track standard gauge rail line comprising a route length of 375 km. The rail line is located in the west of the Nile River and follows parallel a major north-south irrigation canal (the Tur et el Giza from Cairo to Beni Suef, then the Ibrahimiya to Assyut). Each major city has a central train station. The daily number of passenger trains operating on the line is 32 and 19 in each direction between Cairo/Assuyt and Cairo/Aswan respectively. All of these 32 and 19 are express trains (air-conditioned trains, mixed trains, and those that are not air-conditioned) that operate on the whole distance between Cairo/Assuyt and Cairo/Aswan respectively. It can be seen in the Figure 37 that, the all number of trains from Cairo to cities located in the Cairo Luxor-Aswan corridor. However, there are about 19 trains passing between Cairo to Aswan and 32 trains passing between Cairo and Assuyt.

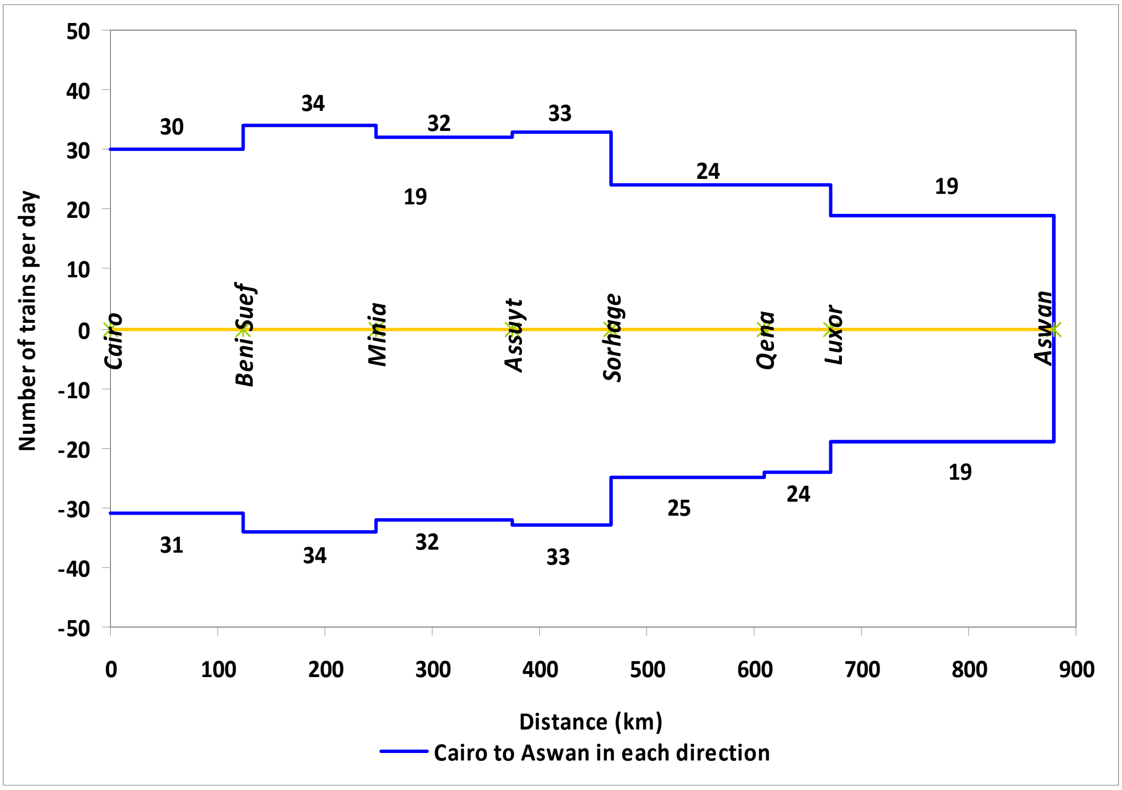


Figure 37: Indicative cumulative train path per day (+ve = Down Direction, -ve Up Direction, 2011)

The existing Cairo/ Assuyt rail corridor is close to maximum capacity utilisation in a number of passenger, and increased future passenger growth. Figure 37 shows current services within the corridor (in the up and down direction). Over 32 and 19 long-distance passenger services per day are operate directly from Cairo to Assuyt and Aswan receptivity. Although the demand for corridor capacity will be increased in this corridor, when add the number of tourism yearly to the volume of passenger capacity.

The current alignment includes significant gradients and no curvature which slows the passage of conventional passenger trains and limits the infrastructure capacity. Figure 37 demonstrates the distributed the volume of passenger in the all station located in this line. The topography of this corridor is flat and the rail line is generally level and relatively straight with no apparent problems due to gradient or curves, nevertheless, the speed is limited. South of Assyut, the line becomes also double track until Aswan. Rail passenger figures supplied by ENRA indicated that there are only 16 million passengers per year in the corridor compared with about 26 million estimated by Egypt National Transport Study Phase III (ENTS) for rail in 1984. It is possible that ENTS included military movements which showed in the ENRA estimates for 1986 supplied to the Study, but which were excluded from Table 33. ENRA forecast 25 million passengers per year for 1990, which was near the ENTS 1987 estimate. However, this rapid increase must be viewed as somewhat optimistic in the light of the assessment of the railroad specialist presented earlier

Table 33: Traffic volume forecast of the Cairo /Assyut 1983-1987

Year	Traffic volume forecast of the Cairo / Assyut route million passenger /year
1983	25.92
1987	27.42

Source: ENR and [230]

There will used the past data and identified model forms and values from past studies. Based on this data available, a procedure was put forward that appeared to best suit the circumstances of the case analysis and that would provide the most reliable forecast estimates possible in the limited time and with the limited data available. As shown in Table 33, the total passenger numbers increase from the period 1983 to 1987. Consequently, to calculate running a simple regression for the period 1983 to 1978 it will be use the previous regression analysis method will be used (See all calculation in the Table 28)**.**

Average passenger model = -717.7 + 0.38 × (the number of future years)
R^2 = 0.94

Table 34: Passenger Growth factor Cairo- Assyut and Cairo/Luxor-Aswan 2010 -2040

Year	Traffic volume forecast of Cario/Assuit route million passenger /year	Estimated passenger growth factor	Traffic volume forecast of Cario /Luxor-Aswan route million passenger /year	Estimated passenger growth factor
2005	**44.2**	**1**	**6.42**	**1**
2010	**46.1**	**1.04**	**6.7**	**1.04**
2015	**48.0**	**1.08**	**6.9**	**1.08**
2020	**49.5**	**1.12**	**7.2**	**1.12**
2025	**51.8**	**1.17**	**7.51**	**1.17**
2030	**53.8**	**1.21**	**7.8**	**1.21**
2035	**55.6**	**1.25**	**8.03**	**1.25**
2040	**57.6**	**1.30**	**8.35**	**1.30**

Continuing with the same growth pattern, where future passenger traffic increasing by a growth factor of 1.30 by the year 2040 than in the year 2010. For this study, it is assumed that passenger growth on the Cairo/Assyut rail link and Assyut to Luxor-Aswan follows the same characteristics from point to point[64]. It is further assumed that there is an increase in traffic volume size to those observed over the period 1983 to 1987. Traffic volume sensitivities will be applied in the economic evaluation, in order to take into account possible changes in the price of tickets. Table 34 gives an indication

[64] The Cairo/Aswan railway line links the largest population centres in Upper Egypt to Cairo. The line provides a railway linkage for ten governorates with a total human population of more than 41 millions [116], which is less than one half of whom live in urban areas. The line represents the most important transportation service for passengers including tourists travelling archaeological attractions of Upper Egypt. The line is also a key transportation artery for cargo within Upper Egypt and between Upper Egypt and Lower Egypt and Cairo.

of the passenger growth factors that would be applied, assuming that the base year is 2010.

According to Table 27, **the volume of traffic between Cairo/Aswan is the total traffic for this route, this means that 95 million passenger per years is not direct from Cairo/Aswan, but for all the cities located between them.** Thus, this analysis estimated that the annual volume of passengers would be from 18 300 passengers per day[65] (6.7 million passengers per years) in 2010 between point Cairo and point Aswan. Consequently, in 2040, the total passenger flow is forecasted to be 8.35 million passengers, which represents a 1.3 growth factor between 2010 and 2040. According to the ENR, Figure 39 explains the distribution of the passenger in year 2010 between Cairo/ Assuyt and Cairo/Alexandria in the Lower Egypt railway line.

As for the line from Assyut to Aswan it will be take the same estimates for the line Cairo/Assyut. Because the number of annually passengers from Cairo to Assyut almost equal to the number of annually passengers from Assyut to Aswan. Consequently, based on passenger volumes, on the Cairo Assyut railroad line, for the period 1983 to 1987, a regression calculation resulted in estimates of future passenger traffic increasing by a growth factor of 1.30 by the year 2040. This growth factor has been used for the calculation of future passenger volumes on the cities on the Upper Egypt railway network. According to the ENR, Figure 39 explains the distribution of the passenger in year 2010 between the all cities located in the Upper Egypt railway line. On this basis will be calculated the expected costs and ticket price for the Cairo/Assuyt, and Cairo/Assyut- Aswan lines based on the number of passengers 48.00 and 6.9 million passenger in year 2015.

According to the Egyptian Railway Authority there are approximately 120 to 130 thousand passengers daily direct from Cairo to Assuyt and about 18 300 passengers daily direct from Cairo to Aswan[66]. In the ENR data presented in Table 34 estimates that 46.1 and 6.7 million commuting trips per year are currently made on all railways from Cairo to Assuyt and Aswan respectively. Figure 38 show the movement of passengers in all stations between Cairo and Aswan in both directions. Also Figure 38 shows the movement of passengers from Cairo to other cities located on this line. These estimates represent an average over the route as a whole and reflect current train patterns and operating practices. The capacity available on any particular section of the route between any two cities, and under different train operating patterns, will vary but will continue to be primarily influenced by the physical characteristics of the network.

[65] For this case study, data was obtained from ENR regarding passenger volumes on the Egyptian rail network, which are from 16 200 to 20 000 passenger daily on Cairo/Alexandria direct route from. Thus, the passenger demand from province to province formed a matrix of flows which were assigned to the available railway lines on an all basis using the shortest distance. No scheduled services between cities have been modelled so capacity constraints within the railway system have not been considered. Zone connectors for each city have been placed on the network at representative centres of population such as large towns. The resulting annual rail passenger volume for all cities on the Cairo/Assuyt and Cairo/Aswan rail lines was shown in Figure 39.

[66] All of this data was obtained through interviews and contacts by people working in the Egyptian railway, and also data obtained in Table 13, and also by the Egyptian Railway Authority (https://enr.gov.eg/ticketing/public/login.jsf)

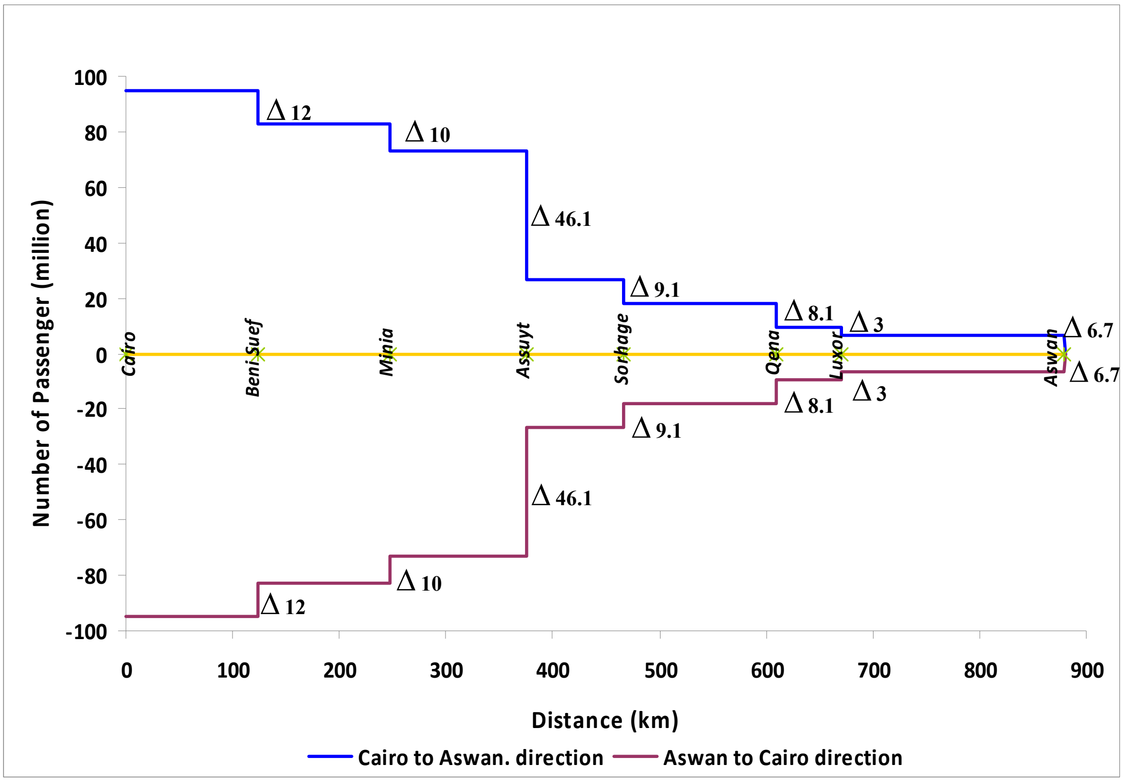
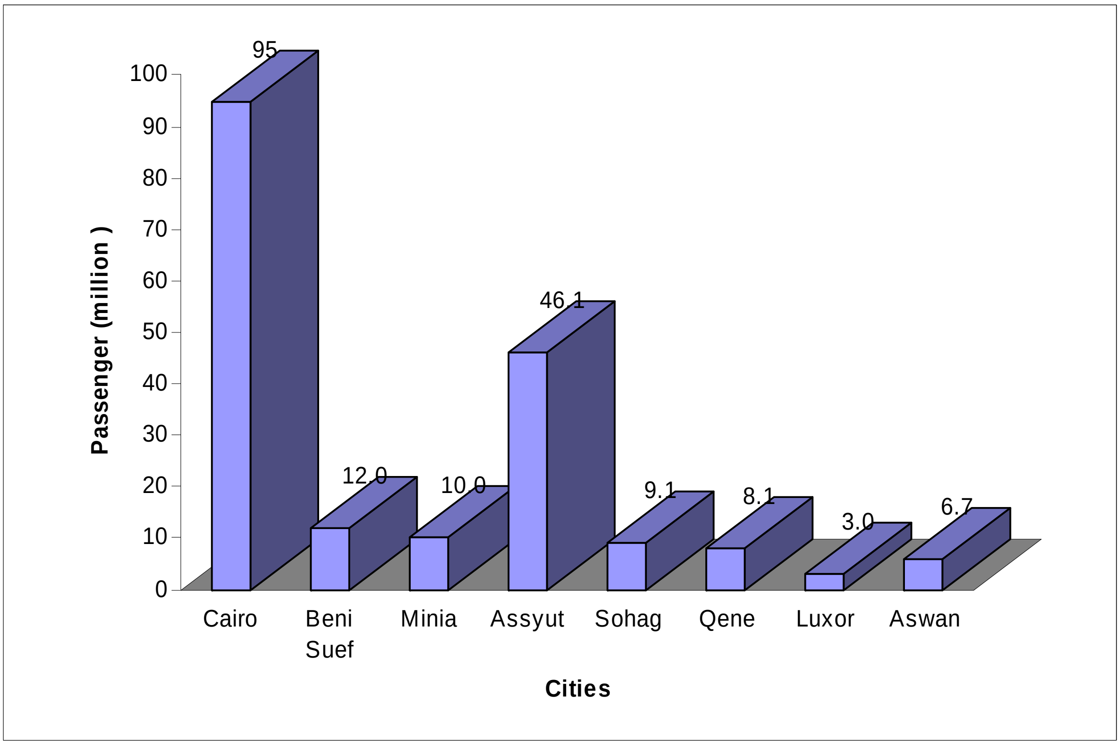


Figure 38: Diagrammatic representation of passenger capacity utilization (passenger in 2010)



Source: ENR

Figure 39: Number of Passenger in the Cities on the Cairo/Assyut- Aswan Railroad line in 2010

Finally, in this methods of forecasting railway demand are suggested: linear regression model of intercity passenger rail demand in Egypt and market survey. The appropriate explanatory variables are determined and an econometric and model are suggested establishing important relationships important for the future demand of railway services.

Using the similarity ratio it will be compared models that come from different set of data. It can be observed that the relationship between models which can be extracted by the similarity ratio is linear regression model compatibility relationship. Application of the method in the case of the intercity rail demand in Egypt is conducted. Based on the historical data of demand in Egypt, several combinations of data are tested with regression models analysis. Similarity ratios are calculated and the more appropriate set of data is concluded.

6.8 Methodology of Cost Calculation for the Case Study

6.8.1 Cost Calculation

Based on all the data available, a procedure was put forward that appeared to best suit the circumstances of the case analysis and that would provide the most reliable passenger forecast estimates possible in the limited time and with the limited data available. Consequently, the number of passenger of the Cairo/Alexandria rail route and territory of is forecast to increase from 13.7 million passengers in 2010 to 38.5 million people by 2040. It is predicted that approximately 20.7 million passengers could travel on a HSR network between Cairo and Alexandria in 2015 and 48.0 million passengers between Cairo/Assyut in 2015, and 6.7 million passengers between Cairo and Aswan. The details of the overall figure for these proposed corridors are shown in Table 35.

Table 35: Estimated Forecasts Passenger by Corridors 2015

corridor	Cairo/Alexandria (208 km)	Cairo/Assyut (375 km)	Cairo/Luxor Aswan (879 km)
Years	2015	2015	2015
Forecast passenger (million passenger/year)	20.7	48.00	6.9

Using these figures, the next step was to perform the analysis of the costs calculation for new proposal corridors, based on the base year 2015. Depending on these costs, the far of the ticket per passenger in the journey will be estimated. Currently there are no railway tracks appropriate for high speed rail in Egypt. A new route from Cairo to Alexandria has been proposed, which route which is a very important connection for Egypt. Addition to the other route Cairo/Assyut and Cairo/Luxor Aswan also is very important to tourism, business and leisure passenger.

6.8.2 Cost calculation for the Case 1 (Cairo/Alexandria railroad line)

The main aim of this section is to estimate the total cost value of construction, operation, maintaining of HSR. According, to the case analysis that was carried by the previous Table 28, in case of building the proposed high speed rail line is from Cairo/Alexandria and Cairo/Luxor-Aswan corridors. The key variables are for application of the model in 2015 with three modes are **costs of building, service frequency, and rail fares** to be competitive with road, air travel. Because the fare price of passenger depended on the whole total cost of the HSR. These result is in forecasts ranging to 20.7 million passenger/year for the mainline[67], thus, in this study will used only one of many possible demand estimates in year 2015, though the general results

[67] It can be noted here that, this figure estimated the passenger in 2015 for the conventional rail and for the proposal HSR. Thus, it can not say that this whole figure will be used for the proposed HSR line, but let us assume that the ratio of each to other, this ratio about 80% for HSL and 20 % for used conventional rail after building HSR line. Adding the ratio is about α =10% for the balance with change the transport demand on the day [peak hours].

are expected to be relatively insensitive to small variations in demand. Consequently, the expected demand of proposal HSR equal $Q_{HSR} = 20.7\times\ 0.80 = 16.6$ Mio. Passenger/year, the number of passenger per day and direction in year estimated by the Eq.1, where: ${days}/{years}$ is the work day per years, and n is the number of direction.

$$q_t = \frac{Q\times\alpha}{n\times {days}/{years}} \qquad (1)$$

$$= \frac{16.6\times10^6\times1.10}{2\times {365}/{1}}$$ = 25014 passenger/ day- direction in year 2015.

For example, in this method the initial demand in year 2015 will be used (in corridor for example Cairo/Alexandria, Cairo/Assuyt, and Cairo/ Luxor- Aswan), the train capacity, and the line length and the design speed. Despite all of these values can be adjusted modified upwards or downwards to illustrate their particular impact on the results of cost. Consequently, it will be restrict the comparative statics exercises only to the changes in the initial demand, the train capacity, the design speed and the line length, since these four factors summarize the most salient economic characteristics of any HSR line. As for the level of changes in speed do not affect the capacities of this mode and the number of train that was calculated do not vary with the speed. In this example a HSR it is important to determine accurately the basic parameter namely the estimated demand value in order to specify the number of provided trains for this demand. Additional to this the occupancy rates and the average travel line speeds of these trains and the parameters of the railway characteristics.

To calculate the number of trains used in day, this will be based on the average load factor. However, in most existing HSR projects in the word the load factor take about 80 % or higher than this value[68]. In particular it can be use the average speed s = 200 - 250 km/h accordant to Table 14, and will be taken the average train capacity is q = 1026 seat[69] also accordant to Table 21. Thus, the actual load capacity of train is $q_e =$ 0.80×1026 = 821 seat. Adding to this it will be taking into account the train will runs from 0.3 to 0, 5 million km per year (or about 1200 km / day). Using these data, it can be determine the daily number of train for the high speed rail at the demand value was determined shown in the Eq. 2. Where, the operation time of train takes 20 hours day (from 04:00 to 24:00). The number daily of servers is calculated by

[68] The most existing HSR services in the world are characterized by relatively high load factors (above 70%), or at least larger than other equivalent rail services. This is explained by the fact that HSR lines are specifically designed for passenger traffic in dense traffic corridors, with minimal intermediate stops and a marketing focus, centered on the travel time and price. However, note that a load factor close to 100%, for example, is impractical because it would imply that all trains would be always fully booked and some travelers could not use them.

[69] At present time, most train models can be easily depended on the project specific needs (passenger density, legal requirements, cultural differences, intensity of use, etc.) and therefore, their costs vary accordingly. In this case of Egypt it will chooses the train with large number of seat, about 1026 seat because the volume of demand is higher, therefore, in this way it can reduce the number of trains thus reduce the total costs of purchase of trains.

Number of service $N = \dfrac{Q \times \alpha}{n \dfrac{day}{years} \times q_e} = \dfrac{q_t}{q_e}$ (2)

$\dfrac{25014}{821}$ = 31 servers daily, whereas the number of servers per hour's or the Frequency it will be determinant by Eq. 3.

Frequency per hours $F_h = \dfrac{(q_t / q_e)}{20}$ (3)

= $\dfrac{31}{20}$ = 1.55 servers per hours this means that every server will be turn in about 39 minutes[70], thus, it can be assumed about two services every hour.

As the demand is equal in both directions and total travel time of a return trip (including boarding is 3h 00 minutes (time of circulation μ = 3.00 hours, according to average speed 200 km/h, and boarding time 50 minutes, about 25 minutes for every side), the (minimum) number of trains (of capacity q, at speed s, distance 208 km and with a load factor of 80%) needed daily in the O-D corridor would be given by the ratio

= $\mu \times \dfrac{q_t}{20 q_e}$ = 3× 2 = 6, (Note the total number of trains will increase by 1.15)[71]

The supply of total servers required would be given by the Eq. 4

Total train number per day = 1.15 $\mu \dfrac{q_t}{20 q_e}$ = 1.15× 6 = 9 (4)

The fleet needs between Cairo / Alexandria is RS_t= 9 trains

6.8.3 Cost Calculation for the Case 2 (Cairo/Assyut and Cairo/Luxor-Aswan railroad line)

1- Cairo/Assyut

In this case will be calculating the cost for two phases the first phase is corridor of the Cairo/Assyut and the second phase is Cairo/Luxor-Aswan. The number of train it will use the previous equations 1, 2, 3, 4 to determine the number of trains in these corridor.

So, Q_{HSR} = 48 × 0.80 = 38.4 million passenger/year. Thus, the number of passenger per day and direction in year 2015 according to Eq.1 can be calculated by;

$q_t = \dfrac{Q \times \alpha}{n \times {}^{days}\!/_{years}} = \dfrac{38.4 \times 10^6 \times 1.10}{2 \times {}^{365}\!/_{1}}$ = 57863 passenger/ day- direction in year 2015.

Number of service $N = \dfrac{Q \times \alpha}{n \dfrac{day}{years} \times q_e} = \dfrac{q_t}{q_e} = \dfrac{57863}{821} \cong$ 71 services daily

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[70] This is a low value when compared to the real world. It corresponds to an initial demand of 20.7 million passengers per year. In subsequent years, when the demand grows, the frequency would also increase, reaching more reasonable values of one service every 15 or less minutes.

[71] This is the average value when compared to the world. So, the maximum train per hours and direction is 11 -15 trains /h and direction [143]. Addition to this, it will be increasing this number about 10-25% this factor is the safety factor against risk or accident, which occurs during operation depending on the corridor.

Frequency per hours $F_h = \dfrac{(q_t / q_e)}{18} = \dfrac{71}{18} \cong$ 3.94 services per hours this means that every server will be turn in about 15 minutes.

Furthermore, this demand is equal in both directions and total travel time of a return trip (including boarding is 3h 3 minutes[72] (µ =3.05 hours), the (minimum) number of trains (of capacity q , at speed s, distance 375 km and with a load factor of 80%) needed daily. Where, in this case the operation time of train takes 18 hours day (from 04:00 to 22:00).

The number daily of servers is calculated by in the O-D corridor would be given by the ratio = µ × $\dfrac{q_t}{18 q_e}$ = 3.03 × 3.94= 12.21

Total train number per day = 1.15 ×12.21 = 14

The fleet needs between Cairo / Assuyt is RS_t = 14 train

2- Cairo/ Luxor-Aswan

In this case will be calculate the cost for second phases in the Upper Egypt railway the phase II is corridor of the Cairo/ Luxor-Aswan the number of train it will use the previous equations 1, 2, 3, 4 to determine the number of trains in this corridor.

So, Q_{HSR} = 6.9 × 0.80 = 5.52 million passenger /year. Thus, the number of passenger per day and direction in year 2015 according to Eq.1 can be calculated by;

$q_t = \dfrac{Q \times \alpha}{n \times \frac{days}{years}} = \dfrac{5.52 \times 10^6 \times 1.10}{2 \times \frac{365}{1}}$ = 8318 passenger/ day- direction in year 2015.

Number of service $N = \dfrac{Q \times \alpha}{n \dfrac{day}{years} \times q_e} = \dfrac{q_t}{q_e} = \dfrac{8318}{821} \cong$ 10 services daily

Frequency per hours $F_h = \dfrac{(q_t / q_e)}{18} = \dfrac{10}{18} \cong$ 0.56 services per hours this means that every server will be turn in about 107 minutes[73].

Furthermore, this demand is equal in both directions and total travel time of a return trip (including boarding is 6h 4 minutes[74] (µ =6.07 hours). Where, in this case the operation time of train takes 18 hours day (from 04:00 to 22:00).the (minimum) number of trains

[72] The proposal line Cairo/Assuyt the train service will stop in two stations. While this service connects those cities along line from and to Cairo/Assuyt. The travel time between Cairo and Assuyt is 1 hours and 53 minutes according to average speed 200 km/h. Every station is characterized by a 5 minute stopping time, which exceeds the actual time the train stops at the station in order to take into account the delay due to deceleration and re-acceleration. In addition to this 1 hours boarding time, about 30 minutes for every side. Assuming two stops, Beni Suif, Minia, (see Figure 1) thus the total train travel time is 1.88 + 1.00 + (2 × 5 minutes) = 3h 3 minutes.

[73] This is a low value when compared to the real world. It corresponds to an initial demand of 6.7 million passengers per year. In subsequent years, when the demand grows, the frequency would also increase, reaching more reasonable values of one service every 15 or less minutes.

[74] The proposal line Cairo/Luxor-Aswan the train service will stop in eight stations. While this service connects those cities along line from and to Cairo and Aswan. The travel time between Cairo and Aswan is 4 hours and 24 minutes according to average speed 200 km/h. Every station is characterized by a 5 minute stopping time, which exceeds the actual time the train stops at the station in order to take into account the delay due to deceleration and re-acceleration. In addition to this 1 hours boarding time, about 30 minutes for every side. Assuming eight stops, Beni Suif, Minia, Assyut, Sohag,Qena, Luxor, Edfu and Kom Ombo (see Figure 1) thus the total train travel time is 4.24 + 1.00 + (8 × 5 minutes) = 6 h 4 minutes.

(of capacity q , at speed s, distance 879 km and with a load factor of 80%) needed daily in the O-D corridor would be given by the ratio = μ × $\frac{q_t}{18q_e}$ = 6.06×0.56= 3.40 (4)

Total train number per day = 1.15 ×3.40 = 3.91

The fleet needs between Cairo / Aswan is RS_t = 4 train

The Cost

The costs of high speed rail for the example are divided into to groups: which are not dependent on the traffic (fixed costs) and dependent on the traffic (variable cost). While, the traffic dependent cost are affected from the amount of traffic and change in speed, whereas the traffic independent costs are defined to be not dependent from the amount of traffic.

The fixed cost: by using the average kilometer construction cost (Cc) it will be taken two cases with difference length in Egypt. Because the fixed cost dependent on the line length (L), only multiplying the number of kilometers by an average unit. Where, the depreciation and interest cost of the rail and related construction are calculated annually. In the Table 36 it will be show all parameter in the Cairo/Alexandria, Cairo/ Assuyt and Cairo/Luxor- Aswan

It can be noted that the actual values of the average construction cost per km were estimated in the section 6.3.4 from analysis some HSR project. Therefore, in particular it will not consider one value, but three values: the lower value, average value and the highest value of construction costs [see Table 37]. Because it had been taken difference routes and every road has features topography different from each other. Addition to this the planning and land cost is α = 10 % to the construction cost. In addition it will be calculate the construction cost of the difference road in Iran and India.

Table 36: The main Parameter in the Reference Case

	Cairo- Alexandria	Cairo/ Assuyt	Cairo /Luxor- Aswan
Line length (km)	208	375	879
Average cost per km	10 million	10 million	10 million
Project timeline	40 years	40 years	40 years
Initial annual demand in 2015	20.7 million passenger	48 million passenger	6.7 million passenger
Growth factor (g) every 5 years	2.81	1.30	1.30
Train capacity (q) seat / train	1026	1026	1026
Load factor (l)	80%	80%	80%
Operating hours (daily)	20 hours	18 hours	18 hours
Average commercial speed (s) =	250 kms/h	250 kms/h	250 kms/h

1- Total fixed cost

Infrastructure costs include investments in construction and maintenance of the tracks including the sidings along the line, terminals and stations at the ends of the line and along the line, respectively, energy supplying and line signalling systems, train controlling and traffic management systems and equipment, etc. It can be consider the Total Infrastructure costs = Construction costs + Maintenance costs

$$I_c = C_c + M_c \qquad I_c = \sum(c.L)(1+\alpha) + \sum(m.L)$$

$$C_c = \sum(c.L)(1+\alpha) \qquad M_c = \sum(m.L)$$

Table 37 shows the results fro these calculation fro the reference case in Egypt [where the line length is 208 km, 375 km, and 879 km] and some other routs set out in Table 10 and [Figures 16 to 16C], (Note the life time of project assumed 40 years).

The cost of building the new infrastructure has been estimated to €1.65, and €2.974, and €6.971 billion as shown in Table 37 using methodology outlined in [186]. Briefly, the methodology estimates for each segment the detailed cost of earthworks, structures, buildings, rail, power and signals, and the track. While the cost per kilometer through the flat land is less than € 7-10 million, construction costs through the urban segments and mountain passes are significantly higher, averaging € 12 to € 30 million per km [186; 123]. The average cost for the proposal new high-speed line corridor in Egypt is €10 million per km as show the Table 32.

Table 37, show the some results from the calculation fro the case study as reference case (three proposed corridor in Egypt) with some other routes in developing and emerging countries. The lowest building (maintenance) cost per km is €10 million (€13,000 respectively), whereas the highest value is €30 million and €33,000 respectively. It can be note that, the total infrastructure cost are fixed cost that means evolve linearly with the length of route: for instance the largest case (879 km) in the case study construction costs might reach a peak of €5.23 billion per year in the worst case.

In additional to the previous calculation of costs in the Table 37, it will be consider the **residual value of the infrastructure** at the end of the project (at time = 40 years). Where this value (once discounted in the beginning of the project) reduces the total infrastructure cost. Obviously, there are different elements (tracks, building, signals, rail, power structure, etc.), with different useful lives and **depreciation rates**, it is very difficult to provide an accurate value for this residual value. Thus, to simplify calculation it will just assume that value equal 30 % of total construction cost for each scenario according to [187]. Furthermore, it will be also assumed the 3.0 % of the annual total cost is typical of expected market of **interest rates**[75]**.** Moreover, for the calculation in the above Table 37 for the reference case in Egypt the best value, will be used this following equation to calculation the total costs.

Total construction costs = $[D \times C_{km} \times 10\%] - RV$ (5) where,
D = distance between cities
C_{km}= building cost per km
10 % = planning land cost
RV= residual value

From this Eq. 5, it can be calculated from the previous table the total fixed cost that evolves linearly with the length of the corridor. As shown in the table it was chosen the different corridor in countries and then the construction cost was calculated with three difference scenarios (these scenarios, according to the characteristics of the route and the land topography). It was found that the increasing construction cost is not depending on the line length, but depending on the quality of the topography. Thus, for the reference case in Egypt the best scenario with a total construction cost of =208×10 million×1.1=€2288 million, and =375×10 million×1.1= €4125 million, and 879×10

[75] The total cost of building may differ from the assumed value of 3.0% interest value for Infrastructure. Because the interest value may be different interest rates (1%–10%) between the unit cost of infrastructure, rolling stock, and noise damage. where Infrastructure is assumed to be depreciated over an infinite time period (live time of project), rolling stock over 25 years and noise damage over 15 years.

million×1.1 = €9669 million (for Cairo/Alexandria, Cairo/Assuyt, and Cairo/Luxor-Aswan respectively). So, the residual value at the end of project (at t = 40 years) is 2288×0.30 = €686.4 million, and 3125× 0.3 = € 1237.5 million, and 9669×0.30 = € 2900.7 million respectively. The total cost of building for these lines is according to Eq. 5 are 2288- 686.4 = €1601.6 million, and 4125- 1237.5= € 2887.5 million and 9669-2900.7= €6786.3 million respectively, add to this value the interest ratio 3 % annual.

The total building cost is €1649.6, and €2974.13 and €6971.3 million respectively [see Table 37]. **To calculate the annual cost for building dividing the total construction costs of €1.650 billion €2.974 billion, and €6.971 billion by 40 life period of project, gives an average building cost per year of €41.24 million, and €74.35 million, and €174.28 million respectively as shown in Table 39**. For instance, the all total value of construction costs per years will be calculated on this basis. Obviously, from the table for the two lines in India and Iran, it can be observed that the cost of the line in India in the medium value almost equals the cost of line in Iran on the worst value. Whereas the line length in India about twice the line length in Iran. It can be say that the building cost depended on the difficult of the topographical.

Table 37: Annual Infrastructure Cost under Different Line Lengths

	Egypt						Iran		India	
	Cairo- Alexandria		Cairo- Assuyt		Cairo- Luxor- Aswan		Tehran-Isfahan		Pune -Ahmedabad	
	Construction	Maintenance	Construction	Maintenance	Construction	Maintenance	Construction	Maintenance	Construction	Maintenance
Line length(km)	208		375		879		387		705	
Cost value [€ per km]*										
Lower value	10,000,000	13,000	10,000,000	13,000	10,000,000	13,000	10,000,000	13,000	10,000,000	13,000
Medium value	17,000,000	30,000	17,000,000	30,000	17,000,000	30,000	17,000,000	30,000	17,000,000	30,000
Higher value	30,000,000	33,000	30,000,000	33,000	30,000,000	33,000	30,000,000	33,000	30,000,000	33,000
Planning and land cost [α]	10 %	-	10 %	-	10 %	-	10 %	-	10 %	-
Interest ratio in years	3 %		3 %		3 %		3 %		3 %	
Residual value (-)	- 30 %	-	- 30 %	-	- 30 %	-	- 30 %	-	-30 %	-
Total value [€ per year]										
The best value	41,240,000	5,400,000	74,353,000	9,750,000	174,825,000	22,854,000	74,950,000	10,062,000	139,784,000	18,330,000
The medium value	70,110,000	12,480,000	126,400,00	22,500,000	296,300,500	52,740,000	130,450,000	23,220,000	237,633,000	42,300,000
The worst value	123,720,000	13,952,000	223,060,000	24,750,000	522,850,000	58,014,000	230,197,000	25,,542,000	419,352,000	46,530,000

* Source: [123]

2- Total variable cost

This cost divided into three groups; rolling stock acquisition, operation cost and maintenance cost. Where the acquisition cost depended on the number of seat, but the operation and maintenance costs of the rolling stock are heavily dependent on the volume of traffic along the line. In the case of the operation costs ($RSC_{Operation}$), its main determinants are labour and energy[76]. Accordant to the data and analysis in section 6.3.5.2 and Table 21 it will be calculate the acquisition and maintenance costs (where the maintenance cost here without persons cost) using the following equations.

➢ **The Acquisition and Maintenance cost for Rolling Stock**

$$RS_{Acquisition} = \sum (RS_{number}) \times C_{seat} \times q^{-}$$

$$RSC_{maintenance} = \sum RS_{number} \times r_m \times D_{train}$$ Or ∑ Number of $train_{seat}$ × 3000 to 8000 euro per seat

Where;

RS_{number} = number of train

C_{seat} = cost per seat [ranging between 30,000 to- 65,000 euro per seat/year]

q^{-} = average capacity

D_{train} = average distance travelled by each train is about 0.5 million km

r_m = the value about 2 € / km for train running around 500,000 km in year

From Eq. 4 and Eq. 5, the total train's number of the project can be calculated; the number of trains between Cairo- Alexandria is 28 trains per day and 70 trains between Cairo/Luxor-Aswan. Accordingly to this will be determent the variable costs (the acquisition and maintenance costs) of train in Table 38 (Note the life time of project assumed 40 years)

Table 38: Annual Rolling Stock Cost fot the Reference Case

	Egypt		
	Cairo- Alexandria	Cairo- Assuyt	Cairo- Luxor- Aswan
$RSC_{acquisition}$	(9× 30000 × 1026)= 277.02 million 9 × 30,780,000= 277.02 million	(14× 30000 × 1026)= 430.92 million 14 × 30,780,000= 430.92 million	(4 × 30000 ×1026)= 123.12 million 4× 30,780,000= 123.12 million
$RSC_{maintenance}$ include the interest and depreciation of rolling stock	(9× 3000 × 1026) = 27.702 million 9 × 30,780,000= 27.702 million	(14× 3000 × 1026) = 43.092 million 14× 30,780,000= 43.092 million	(4× 3000 × 1026) = 12.312 million 4 × 30,780,000= 12.312 million
Sales Tax costs	(9×30000×1026)×0.05= 13.85 million 9 ×1,539,000 = 13.85 million	(14×30000×1026)×0.05= 21.55 million 14 ×1,539,000 = 21.55million	(4×30000×1026)×0.05= 6.16 million 4 ×1,539,000 = 6.16 million

The general sales tax on train is assumed to be 5%, because the tax is applied to all sales transactions, the value of tax sales is €1,539,000 per train. Thus, multiplying 9, 14 and 4 trains by €1,539,000, gives the interest all sales tax of rolling stock as shown in the above Table 38. For the capital cost of maintenance for the rolling stock is then to be

[76] The number of staff members per train depends on its technical specifications and is usually set in transport regulations. Conversely, there are no minimum standards on cabin attendants and staff assistants personnel, and their number depends on the level of service provided to passengers. For the energy consumption is calculated in accordance to the technical specification of the rolling stock.

€3,078,000 per train and per year, assumed this value including interest and depreciation of rolling stock. Multiplying 9, 14 and 4 trains by €3,078,000, gives the maintenance, interest and depreciation of rolling stock.

For the expected life assumed of 20 year and no residual value. From the above table it can be fond that the cost of rolling stock depends on the number of seats, so the train with large capacity seats is better to be chosen, because this lead to reducing maintenance costs, in addition to reduced the number of departures [see ;129].

➢ **The Operation costs**

$RSC_{Operation} = EC_{Total} + PC_{Cost}$
Where;
EC_{Tota} = Energy cost
PC_{Cost}= Personal cost

- **Energy cost**

The total cost of energy and additional power forms can be calculated by multiplying amount of energy consumed by the unit price of imported energy and the total travel kilometers per trains [train-km]. Where, the operation costs related to energy do not include any labor cost. Table 22 gives the average energy consumption for the ICE 3 running in the new infrastructure. The unit cost rate for energy pricing in this analysis will be assumed to be €0.075 kilowatt-hour, implicitly assuming full cost pricing within the electrical generation sector. According to Table 22, the energy consumption for proposal new HSR in Egypt cruising at 200-250 km/h is 13.10 kWh per kilometers like the Germany ICE 3[77]. It can be observed that, energy consumption per passenger varies with the speed and increases rapidly when the speed is higher. Thus, the cost of energy can be expressed as follows:

$$EC_{Total} = d_{train\ /km} \times E_{need\ /km} \times EP_{price\ /km}$$

Where:

EC_{Total} = Cost of the total energy consumption (€/ train-km per day or year)

$d_{train\ /km}$ = Total distance served by trains (train / km)

$E_{need\ /km}$ = Energy consumption per km (kWh/ km)

$EP_{price\ /km}$ = Energy price per km (€-ct/kWh)

The total energy for Cairo/ Alexandria line is $EC_{Total} = [(31\times 208 \times 2) \times 13.1 \times 0.075]$ = € 0.013 million / day
The total energy for Cairo/ Assuyt line is $EC_{Total} = [(71\times 375 \times 2) \times 13.1\times 0.075]$ = € 0.052 million / day
The total energy for Cairo/ Luxor -Aswan is $EC_{Total} = [(10\times 879 \times 2) \times 13.1\times 0.075]$ = € 0.017 million / day
So, the total energy cost per year for the line Cairo/ Alexandria about €4.75 million / years, Cairo/ Assuyt line about 18.98 € and Cairo/ Luxor –Aswan about €6.21 million / years.

- **Operating Personal Costs: The first part is**: Personal providing station services: this may in turn be operating personnel (for example personnel for reception and

[77] There are very difference value from the energy consumption, and all this dependent on the type of train used and the speed for example: TGV in France energy used estimated in range 16.5 to 22 kWh per train km for speed 300 km/h, ICE line connecting Hamburg, Frankfurt and Munich with average speed of 131 km/h the energy used 24.09 kWh per train km, for the energy consumption for Spanish AVE about 17, 66 kWh where the average speed is 208 km/h [188].

welcoming at stations, information ticket sales, administration and information, after-sales service), or indirect staff (dedicated to the management or business activities. They also include costs for automated ticketing machine and travel agency commissions. Furthermore, the average operating costs for sales and administration are expected to differ between Egypt and Europe, especially when labor cost represents a significant percentage of the total average cost. Nonetheless, since there is no currently operating high speed rail system in Egypt, it is difficult to estimate specific average costs for Egypt. Thus, it will use the data from INRETS/INTRAPLAN to estimate the forecast of the sales and administration cost of proposal high speed rail in Egypt [50]. Sales and administration costs are dependent on the required number of staff and automated ticketing machine for a given level of expected traffic volume. Assuming that they represent is 10% of the passenger revenue in Egypt. Thus, it can be assume the fares ticket about €10, 15 and €20 for the three corridors in Egypt respectively. The average passenger revenue estimated multiplying volume of demand by the fares and then takes 10% of these values. Sales and administration costs for the **Cairo Alexandria** = 16.6×10×0.10 = €16.6 million, for the corridor **Cairo/ Assuyt Sales and administration costs** about = 38.4×15×0.10 = €57.6 million. Thus, the sales and administration costs for the **Cairo/ Luxor-Aswan** = 4.85×20×0.10 = €9.7 million

- **The second part is**: Personnel providing services on board the train: To calculate the personal cost in train it will use the next equation;

$$PC_{\cos t} = N_{staff} \times P_{\cos t\ /annual}$$

Where:

$PC_{\cos t}$ = Total cost of personal/ year

N_{staff} = Number of staff

$P_{\cos t\ /annual}$ = The annual cost of the worker

In this example the number of train serves in Cairo/Alexandria is = 31 × 2 = 62, Cairo Assuyt is = 71× 2 = 142 and Cairo/Luxor-Aswan 10×2= 20 and the number of train every hours about 2 train serves, 4 train serves and one train serves respectively. Consequently, the shifts are required for the employment 62/2 = 31 shift and 142/4 = 36 shift, and 20/1= 20 shift respectively (note, this is the number of the staff in each direction and lines). Whereas, it will be taken the number of employ per train is 5 workers. So, the number of all staff N_{staff} = 5×31 = 155 personal for the Cairo Alexandria, and N_{staff} = 5×36 = 180 personal for the rout Cairo /Assuyt and N_{staff} = 5×20 = 100 personal for Cairo/Luxor-Aswan.

The total number of staff per year will be determined by using the total working hours for each person[78].

Number of staff in the all corridors is

Cairo/Alexandria $= N_{staff} = \dfrac{365 \times [31 \times 5 \times 8]}{1880} = 241$ Employees.

Cairo/Assuyt $= N_{staff} = \dfrac{365 \times [36 \times 5 \times 8]}{1880} = 280$ Employees

[78] With staff working on the trains, there is a clear link between their costs and the average speed of the trains on which they work. This personnel does in fact have a fixed working timetable (typically 40 hours a week or 1,880 hours a year), and if the trains move more quickly, employees who travel on the trains will cover more kilometres in the same time, thereby reducing the number of people required to offer the same service and, therefore, the labour cost per unit of supply.

Cairo/Loxur-Aswan = $N_{staff} = \dfrac{365\times[20\times5\times8]}{1880} = 155$ Employees

This is a number of the staff worker, therefore should be taken into account the sick leave and normal holiday. Consequently, the number of worker will increased about 30 %, beacons of the above mentioned. So, the total number of worker will be 241×1.30 = 314 employees, 280×1.30= 364 employees, and 155×1.30 = 202 employee's receptivity. It can be observed the income per capita in Egypt in year 2015 is 4104 U.S. dollars (3109 U.S. status 2011) [185], and this value not much and the personal cost is not higher than other county. For this reason

The cost of the personal on the Cairo/Alexandria corridor

PC_{cost} = 314 × 4104 = 1.3 million USD about € 0.91 million/ year.

The cost of the personal on the Cairo/Assuyt corridor

PC_{cost} = 364 × 4104 = 1.5 million USD about € 1.06 million/ year.

The cost of the personal on the Cairo/Luxor-Aswan corridor

PC_{cost} = 202 × 4104 = 0.83 million USD about € 0.57 million/ year.

5- Calculate the Price Cost per Trip

For calculate the cost per passenger trip in the three proposal corridors, it will need to know the volume of demand. Table 32 and Table 34 show the forecast passenger volume in the nest 30 year. Thus, it will be take the volume of demand 16.6, 38.4 and 5.52 million passengers in the three proposal routs respectively to calculate the price cost in year 2015. The average fixed cost (construction and maintenance infrastructure) per journey, and the average variable cost (rolling stock acquisition, operation and maintenance) per trip show in Table 39.

The average infrastructure cost per passenger is simply the annual capital cost divided by the number of passengers, and thus declines with increases in passengers. Dividing the total infrastructure cost estimate of €387.47 million per year by the estimate of 3.453 billion passenger-kilometers per year, gives an estimate of the average cost of infrastructure of €0.11 /Pkm and this value for proposal Cairo /Alexandria line. For the Cairo/Assuyt corridor the average cost of infrastructure calculated by dividing the total infrastructure cost estimate of €658.30 million per year by the estimate of 14.14 billion passenger-kilometers, thus the average cost of infrastructure of €0.047 /Pkm. Whereas the Cairo/Luxor- Aswan the average cost of infrastructure calculated by dividing the total infrastructure cost estimate of €355.10 million per year by the estimate of 4.852 billion passenger-kilometers, thus the average cost of infrastructure of €0.073 /Pkm. **Table 39 explains the fare price in the proposal corridor, where the fare price per trip will be €23.34 , €17.14 € and €64.33 € respectively for the proposed three corridor.**

As these values were calculated by the main cost (construction cost and rolling stock cost), the energy cost, and added employee cost. Finally, the average cost per trip is clearly very critical to the volume of demand and the average trip length. Furthermore, the price per km can be calculated from the previous table, where can use this price to apply between any two cities [as show in Figure 40]. Meanwhile, it can be argued that the cost per km, ranging about €0.04 to €0.12/Pkm, for the Cairo/Alexandria, and Cairo/Assuyt and Cairo/Luxor-Aswan corridors.

The total cost on the previous example was calculated on the basis the whole expected demand volume of passengers for proposal high speed line in Egypt. But this is not possible in the first years of operation of a new system.

Table 39: Fare Price Expected on the A new Proposal HSR Project in Egypt

		Cairo/ Alexandria	Cairo/ Assuyt	Cairo/ Luxor-Aswan
Line length [km]		208	375	879
Fixed infrastructure cost per year [million]	Construction cost	41.24	74.35	174.28
	Maintenance cost	5.40	9.75	22.85
Variable cost per year [million]	Train acquisition	277.02	430.92	123.12
	Train maintenance cost per year	27.702	43.092	12.312
	Train sales tax costs	13.85	21.55	6.16
	Labor cost on board the train per year	0.91	1.06	0.57
	Sales and Administration costs/year	16.6	57.6	9.6
	Energy cost per year[79]	4.75	19.98	6.21
Total cost per year [million]		**387.47**	**658.30**	**355.10**
Passenger-kilometers [billion Pkm]		3.453	14.40	4.852
Cost/ train-km [€/train-km][80]		15.3	12.46	4.53
Cost of passenger-km [€/Pkm]		0.112	0.046	0.073
Average demand volume of passenger [million/year]		**16.6**	**38.4**	**5.52**
Fare price per journey		**23.34 €**	**17.14 €**	**64.33 €**

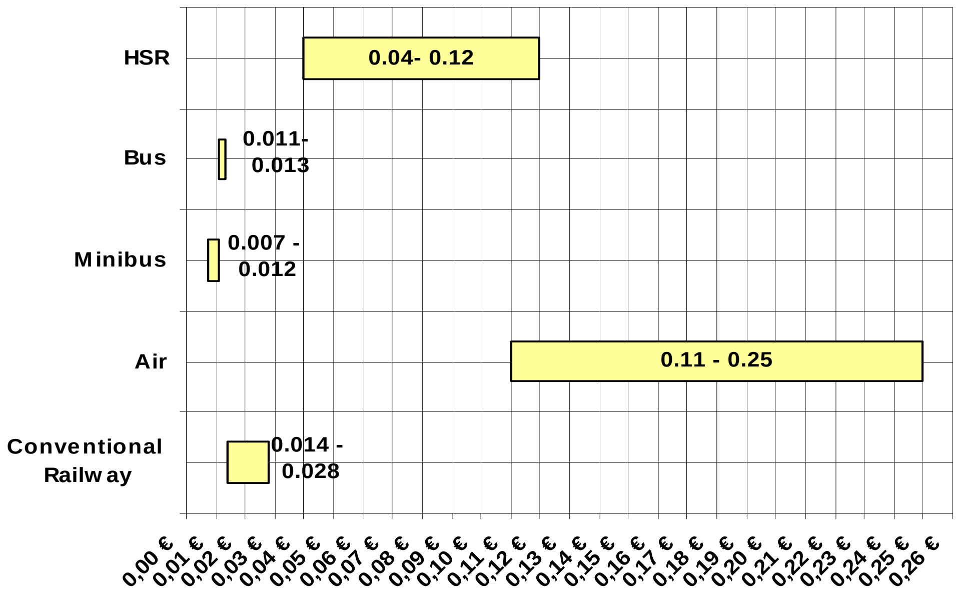

Figure 40: Range in Fares per Passenger-km in Transport Model with Expected Price for HSR [€ Price value 13.06.2011]

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79 The energy cost depended on the total travel kilometres per trains [train-km] in years multiplying on the energy needed per kWh/km, where the average cost per kWh/km is €0.63- 0.92 km for speed 200-250 km/h [see Table 22]

80 In order to calculate the price per train km, it can be noted that, the price calculated here according to operation cost. This cost only for the variable cost per year, especially the operation cost (labor cost on board the train, sales and administration costs, and energy cost). It can be observed that, in section 8.5 will be explaining the method of the calculation of the operation tariff in the variable cost.

Therefore in the next Table 40 will be considering the total construction cost is constant or will be assumed the same construction costs which determined by the demand of passenger of 16.6 and 38.4 and 5.52 million passenger/year[81]. Thus, it can be calculating of the ridership, and the fares for the different rates of load capacity. In the following analysis in [Table 40] it will be calculate the loading capacity 50%, 60% to reach the 90% of capacity load from the total demand per year 2015. Thereby, this analysis is for the each proposed corridors in Egypt.

It is important to note that the assumption regarding the underlying utility maximization process is just that, the fare and continued use of passenger of HSR is largely depended on the load factor. Thus, the fares prices for one direction determent by the average infrastructure cost per passenger and the annual capital cost divided by the number of passengers, and thus declines with increases in passengers. Estimates of the number of passengers vary, being determined together with the service level provided, as well as the fares. The method for forecasting which provides the results reported here is based on growing existing ridership to the year 2015, and then apportioning the demand to the new mode of high speed rail based on this growing. The key variables are loading rate, service frequency. It can be noted that the ticket price will decline with the greater rate of loading trains.

A number of the various fares that are vital and related to the loading rate ratio for passengers according to the authors will be presented in the Table 40. Thus, it will be assumed the different of the loading rate factors, however, it will be assumed that the total volume of passengers in each corridor, for example, the volume of passenger on the corridor Cairo Alexandria line 16.6 million passenger /year equals 100% of the passenger will be used the HSR trains. Hence, in Table 40 will be calculated fares for different loading ratios with the assumption that annual total construction cost are equal the basis case (will be assumed the annual total construction cost of the volume of passenger is 16.6 million passenger = 100 % constant for all the various loading rate, because it is considered the highest costs for construction in the case of loading rate 100%)

As the result from the Table 40 the load factor 50 % will increase the cost of passenger km of €0.22 Pkm, and the loading factor 60% will make about €0.19 Pkm Cairo/ Alexandria [208 km]. In contrast, the minimum value for passenger-km on loading factor between 50% and 60% ranged € 0.09 Pkm and €0.076 Pkm respectively on the Cairo/Assuyt [375 km]. Consequently, the average value will be shown in the Cairo/ Luxor- Aswan [879 km] about €0.15 Pkm and €0.12 Pkm respectively.

Thus, the best loading factor shown in the Table 40 will be between 80% and 90 % where this value of loading ratio gives the average value of passenger-km of €0.051 Pkm to €0.12 Pkm in the three cases. It should be noted that this result in the Figure 40 will be dependent on the loading factor, thus when load factor are 80% to 90 % this will gives the average cost of passenger of €0.05 /km to €0.12 Pkm. From the analysis in Table 40 can be calculate the expected price for first class and second class. Consequently, when the volume of demand is 80 % and 90 %, it will be found that, the maximum and minimum ticket prices (it will be assumed this fare for the second class) ranging for the proposal Cairo/Alexandria line between €28.18 and €25.94, and

[81] In this case it will considered that, the annual total cost of construction is constant based on the total passenger value on 2015, (16.6, 38.4 and 5.52 million passenger annual for the proposal HSR line in Egypt), thus, the fare and the total passenger volume will be calculate with the differences loading factors the Table 40.

maximum and minimum ticket prices ranging for the proposed Cairo/Assuyt between €21.43 and €19.05. Lastly in the corridor Cairo/Luxor-Aswan line the maximum and minimum ticket prices ranging form €80.34 and €71.45 respectively. In additional the politic situation also plays the importance role to determinant the price ticket. But according to Table 39 the basic prices of tickets for all the different three cases are €23.34, and €17.14 and €64.33 for the trip.

Table 40: Construction Cost and Fares Rates under Alternative Scenarios of Loading rate of Volume Passenger Demand

Loading rate	Cairo/ Alexandria [208 km]				
	Annual total construction cost [million]	Ridership /year [million]	Fare price per trip [€]	Passenger-km /year [billion]	Cost €/Pkm
50%	387.47	8.3	46.68	1.73	0.22
60%		9.96	38.90	2.07	0.19
70%		11.62	33.35	2.42	0.16
80%		13.28	28.18	2.76	0.14
90%		14.94	25.94	3.11	0.12
Loading rate	Cairo/ Assuyt [375 km]				
	Annual total construction cost [million]	Ridership /year [million]	Fares in one direction [€]	Passenger-km/ year [billion]	Cost €/Pkm
50%	658.30	19.2	34.29	7.20	0.09
60%		23.04	28.57	8.64	0.076
70%		26.88	24.50	10.08	0.065
80%		30.72	21.43	11.52	0.057
90%		34.56	19.05	12.96	0.051
Loading rate	Cairo/ Luxor- Aswan [879 km]				
	Annual total construction cost [million]	Ridership /year [million]	Fares in one direction [€]	Passenger-km/ year [billion]	Cost €/Pkm
50%	355.10	2.76	128.66	2.43	0.15
60%		3.31	107.28	2.91	0.12
70%		3.86	91.99	3.39	0.10
80%		4.42	80.34	3.89	0.09
90%		4.97	71.45	4.37	0.08

6.8.4 Results of Applicability conditions

The uniqueness of Egypt's transportation system stems from the fact that 97% of its population, or almost 80 million people, live in a narrow (the population lives in the 15 to 20 km wide Nile Valley), densely populated corridor along the main corridors between Alexandria/Cairo, and Cairo/Luxor-Aswan. This corridor is ideally suited for rail operations. Because of the extreme economies of density, the ENR network has lack of the trade frequency for accessibility. Consequently, ENR railway companies are in the enviable position to be able to provide high speed, high frequency, and easily accessibility because the high demand for their services is very strong in a narrow, densely populated corridor ideally suited for rail operations.

It can be observed that, the proposal line for passenger operations, capacity operations will depend on the level of passenger traffic on the line. While passenger of transportation has high social benefit that includes reduction of crowding on roads, only high volumes of high-value passenger (something that is not expected) will benefit the line financially, through the provision of a large amount of big revenue to cover initial investment costs.

Due to more detailed information on the forecasts of passenger traffic, as well as operating scenarios, a more detailed tariff rate study can be performed to better define the values for a proposed tariff system, including analysis of peak and off-peak periods and weights for each. Therefore, a study about marginal operating costs needs to be performed in order to calibrate marginal costs precisely to the track deterioration Profile of each train type.

At the beginning of the project it can be determine the price for the first and second class accordant to the cost of passenger-km. At the beginning project it can be determine the price for the first and second class accordant to the cost of passenger-km. The proposed tariff scheme's structure of the cost of the first class are calculated on the basis of the highest value for passengers-kilometer and the second class are calculated on the basis of less value to the passenger-kilometer.

For the proposed tariff structure includes concepts from other lines, as well as innovative concepts from other industries, such as origin and destination pricing is able to pick up a high percentage of readiness for the operator to pay. Where, the proposed tariff structure of the system is able to send clear messages to operators on the quantity and type of traffic is desirable and provides discounts for higher levels of traffic. This will depend on the volume passenger traffic on the line of the proposal.

The number of passenger of the Lower Egypt railway (CairoAlexandria rail route) and the Upper Egypt Railway (Cairo/Assuyt, and Cairo/Luxor-Aswan) and territory of is forecast to increase from 20.7, 48, and 6.9 million passengers in 2015 to 38.5, 57.6 and 8.35 million passenger by 2040 respectively. On the basis of demographic forecasts, assumed fares and operational characteristics, the demand forecasts of passenger suggest that by 2040, as mentioned above may use an HSR network each year.

Over 110.2 million long-distance passengers in the rout Cairo Alexandria in 2015 (note; this figure for all cities which is located on the railroad between Cairo and Alexandria) are made on the north coast of Egypt with the growth factor 1.25 each 5 year, and this is forecast to grow to 205.2 million long-distance trips over the next 30 years. On the basis of demographic forecasts, assumed fares and operational characteristics, the demand forecasts of passenger suggest that by 2040 as mentioned above the passenger may use an HSR network. It can be observed that, the approximately 20.7 million passengers could travel on a HSR network between Cairo and Alexandria in 2015. Thus, regional demand represents a significant component of total demand, with approximately 23 per cent of travel found to be related to Alexandria. On the other hand, the other railroad Cairo/Assuyt and Cairo/Luxor-Aswan in 2015. It can be also observed that, approximately 48, and 6.9 million passengers could travel on a HSR network between them. Consequently regional demand represents a significant component of total demand, with approximately 51% and 7.3 % of travel found to be related to Assuyt and Luxor-Aswan respectively.

It can b noted that, abut 20.7 million passengers could travel on a HSR network between Cairo and Alexandria in 2015, and 48 million passengers between Cairo/Assuyt in 2015, and 6.9 million passengers between Cairo/Luxor-Aswan. Where there is no comparison with this demand of the passengers with the road or air travel. These forecasts assume inter-city HSR fares comparable with inter-city air fares and road fares. Consequently, these forecasts assume HSR fares between Cairo and Alexandria would be €23.34 for commuters, €34.01 for (one way in 2011 dollars). Between Cairo and Assuyt, HSR fares are assumed to be €17.14 for commuters and €37.5 for business travellers (two-way in 2011 dollars). For the third corridor between Cairo/Luxor-Aswan, HSR fares are assumed to be €64.33 for commuters and €91.99 for business travellers (one-way in 2011 dollars) [all these fares calculated from the Table 39 and Table 40]. It should be noted that passenger forecast demand was found to be sensitive to changes in HSR fare levels, but less so to changes in road or air fares, as regional travel demand, of which air and road travel is a relatively small component, especially in the developing countries. However, HSR was also found to be sensitive to HSR travel time, with mainly inter-city travel affected, due to the close competition with air and road.

Key project parameters

Key project parameters for the proposal HSR routes study included:

• Economic analysis assumed an appraisal period of 25 years from 2040, being an indicative operational year for an HSR network.

• The network infrastructure would be a double-track standard-gauge electrified line with maximum operating speed of 200 km/h within urban areas and 250 km/h elsewhere.

• Services would initially be operated by 4 sets with the potential for train size to be increased to 12 or 16 cars as required by demand of passenger, and would be a mixture of inter-city express services and regional services stopping at intermediate stations.

• A maximum route planning capacity of 9, 14, and 4 trains per day in each direction (expected the number of HST according to analysis in the previous sections).

• Non-stop travel times between the major centres would depend on the precise alignment selected but would typically be around one hour between Cairo/Aleaxndria and Craio/Assuyt around 2.30 hours and 2.30 hours between Assuyt and Aswan.

• The patronage forecasts allowed for accessibility of HSR stations, as well as the relative costs, travel times and service frequencies of alternative modes.

• Non urban stations would serve major regional centres, either directly or as parkway stations. These would typically be at intervals of 70 to 100 kilometres, although closer spacing is likely if sections also carry outer suburban regional services.

• Access from the urban boundary to city centre stations in major metropolitan areas would largely be through dedicated tunnel.

• HSR fares were assumed to be similar on average to current inter-city air fares, air travel times were assumed to be similar to current times, and HSR service frequencies were assumed to be hourly or better, depending on route and service type.

• Commuter demand modelling for the Alexandra to Cairo corridor was based on fares of €23.34 and €17.14 and 64.33 for Cairo/Assuyt and Cairo to Luxor /Aswan respectively (one-way in 2011 EUR). Lower fares for commuters reflect a potential subsidy for these trips.

• Estimated demand forecast for proposed new line if built to its extremities would attract nearly 38.5million, 57.6 million, and 8.35 million passenger trips per year in 2040, although most of these would only use part of the route. This high figure reflects the high population density of Egypt and the large number of origin-destination pairs that the line would serve. Of these passengers expected around 80%would be diverted from existing rail routes to the proposal HSR line and the remainder split almost equally between diversion from other modes and newly generated trips. Most of the forecast diversion occurred from car and buses the forecast of diversion from air was surprisingly higher, thus, this dependent on the experience of the impact of HSR on air traffic elsewhere.

• Results of the appraisal of three options are shown in Table 43 phase 1 is the line from Cairo to Alexandria which is the obvious first phase of any high speed rail programme in Egypt , and is seen to be well justified in its own right. But phase 2, the extension from Cairo to Assuyt via the major cities located between them are also shown to be justified that. For the phase 3 Cairo/Luxor-Aswan it is obviously important; however, to examine the issue of timing and phasing for tourism and business, however, this phase is not justified in economic terms. Consequently, the study showed that, if feasible, construction of the first two phase’s lines was the best options to construct new lines.

6.9 Summary

The first part of this chapter aims to identify factors that stake-holders to set up HSR as well as identify the requirements that must be seriously considered in the design and establishment of these lines.

The corridor demand that the railway is expected to serve is usually determined as a function of several factors, including times of journey, distance, value of time, market share capture rates and the type of route. In any new transport system shall be at the beginning comparing it with the other current established transportation systems. And that has already been analyzed and compared to high-speed system with the other systems generally in the developing and emerging countries, and this analysis has reached to the following:-

- A high population density shall be available for the proposed high speed lines, as this density is the most important factor that helps creating setting up this type of transportation systems.
- Railway - conventional and high speed- is better at serving markets where demand is located around key nodes. Consequently, for HSR can serve a higher proportion of the potential market in areas with densely populated cities (for instance most European and Asian regions) than in regions where most of the urban population lives in heavily populated suburbs (eg North American regions). Similarly, demand is easier to forecast for countries with large populations in linear corridors (eg Taiwan and Italy and the proposal HSR in Egypt) where a relatively high proportion of the population can be served by the line, than for countries with more dispersed populations (eg Germany). The distance between major destinations also plays a strong role speeds as in Figure 22, as it will affect modal competition (road below 200 km, air above 700 km, and these values for the design speed reach to 250 km / h, as it is evident in Table 14.
- It was found that traveling time which is interrupted by the new system compared with the other systems (such as aircraft, buses, etc), is even the shortest time, in addition to that the capacity of passengers in the new system is big and up rates at an average of 400 passengers in journey.
- As a result of the increase population growth in each year especially in developing countries, the predictions of an increase of passengers getting on the means of transport which lead to an increase in demand resulting in congestion on the roads, so the new system resolves this problem as a result of its need to a high number of passengers .
- It was found that the best design speed control which gives the best time for the trip compared with the other speeds is between 200-250 km / h, Table 14. In addition, the speed affects directly in the cost of investing.
- In this study, prices for all travel and transportation means were analyzed in addition to the identification of the expected or the potential price for high-speed (and that by taking advantage of the foreign expertise through analysis of previous projects in Europe, Asia and America. It was also found that the prices of the high-speed lines in the middle distance (such as Cairo- Alexandria) is better than prices in aircraft but in the long distance (such as Cairo-Aswan, Cairo -Luxor), the price of air travel is better than fast trains, but in terms of time, trains are the best in both see Figure 23 and 24.

The main result of the second part of this chapter has been to explain the properties of the HSR technology from a construction standpoint, providing some information on the cost and demand sides of this transport alternative. Thus, understanding will be particularly useful for future projects, because it will lead to a better analysis of the expected construction and operating costs, and of the number of passengers to be carried out under different economic, geographic and topography conditions.

The cost of proposal high-speed rail construction in Egypt appears to be much less than in other countries like Iran or India [Table 37]. Some of this difference probably can be in land costs, for example, are lesser in Egypt than in other countries and these in turn are affected by wider differences in the structure of the countries property markets. Despite, there is no project in Egypt to take comparison figures in term construction cost but from the previous analysis to determine this cost [in Table 17]. However, we have found that some cost differences between Egypt and other countries are rather hard to justify. Costs are likely to be lower if countries undertake major high speed rail construction programs in a number of stages over time, rather than establish a one of high speed line. In Egypt, the construction of proposal high speed line from Cairo to Alexandria could constitute such a programs, as the line would probably be constructed in several stages, also like proposal high speed line from Cairo to Aswan.

It can be determine the value of the cost per km of the previous analysis as show in Table 17. This cost per km in Egypt depends on the topography and political decisions for the selection of route that have appropriate profits proportional with the investments cost. The most likely this it can be tack the cost per kilometers from the country experience particular Germany experience as show in Table 18, the costs per double kilometer on corridor about € 10-15 million/Dkm in flat land, which will be the lower value according to the previous analysis, comes after this France, Japan, Turkey and Spain[82] about € 4.7, € 5.4, € 4.9 and 7.8 million respectively [see Figure 26 and Table 17]). In other country especial in Iran the cost maybe higher than this costs due to the difficult topography on proposal line as show in Table 37.

In fact, the use cost data based on information from the analysis of other countries should therefore only serve as a rough assessment of the various cost parameters, always keeping ratios into account. Thereby, cost data from tracks (tunnel, bridge, station, etc) for high speed constructed during recent years can give us a first assessment of the construction cost of a new railway line. Furthermore, the distribution of building a new railway line to the various components of the rail system differs greatly and depends on the specificities of each particular situation. The application of the assessment framework developed in this research for the Cairo/Alexandria railway line shows that the scheme is applied on a financial basis. Since the calculations of financial benefits were based on the future fare being applied on the line, the financial results also will be improved through fare increases based on the potential for a significant improvement in the quality of service provided. Examining the broad social benefits of the scheme proves that the investment in the HSR gives is highly profits with large demand. Obviously, there factors influencing the cost of rail projects include the following.

- Land purchasing costs and t he design train speed

[82] It be clear that, the cost of high speed rail line Madrid-Barcelona is € 6.1 million/km, unlike the Cologne-Frankfurt in Germany which the cost about € 21.6 million/km [169]. Despite, the proportion of tunnels and bridges is almost equal. In additional, the length of the line Madrid-Barcelona in Spain about three times the Cologne-Frankfurt line in Germany.

- Structures: Evidence indicates that construction of track through tunnels or over viaducts is four to six times more expensive per kilometre than construction over flat land.
- Stations: Evidence indicates that these are expected to cost between 6% and 8%the total cost of the line.
- Compatibility: The line may be required to accommodate access to a variety of rolling stock types.
- Passenger and Freight: The elasticity to run heavy freight trains on high speed lines considerably increases the cost of construction

Thus, it could be a comparison the proposal project in Egypt with others projects is necessary to maximize present values and or promote progressivity [see section 4.4]. Moreover, uncertainties in information and assumptions are high because of the rather simple nature of this analysis. Therefore, more sophisticated behavioral modeling and project evaluations and comparison are desirable and are recommended before investing the billions of Euro required to finance this project. Beyond these estimates of the projects net benefits and return rates, one must consider the projects equity implications. Such consideration entails identification of these who lose and those who benefits from the systems implementation [will explain this point it will be come in detail in section 7.3.3].

The result of the third part is: As the important result when comparing prices between different types of transportation it is found that: with the middle distance (about 200 km) the price of air compared with the travel time is proportional (this means that long travel time with higher price) [Figure 23]. In contrast with the long-distance (more than 900 km) the fares of the high speed rail is higher than air [Figure 24] and the travel time (in case of speed 250 km/h) will be short than air [Figure 24]. On the one hand, in this regard, an important implication of the fares comparisons is the effect of transformation from the air, road mode to high speed rail. If, as is commonly predicted in demand studies, HSR is designed to divert traffic from road, air, then there will be an increase in the total fares of transportation in the long distance. On the other hand, for business user and holiday user can pay the fares ticket. But, it can be noted that the high speed rail forecast will more success is based on suitable fares for the leisure user, student and workers.

Additional to this the number of tourism in Egypt reach to 14.5 million tourism in 2010 [83], and all tourism maybe used the proposal HSR line, because this better for tourism when they need to see all Egypt and also the expected price ticket is suitable for them. Moreover, in terms of sectoral participation in GDP increase in Egypt, the tourism sector ranked thirty contributing by (0.85 percentage points) [84] after manufacturing industry and transport sector. Addition to this the fare for sleeper train must be paid in foreign currency for tourism and this fare about € 42 - € 56 (for Cairo-Luxor /Aswan corridor one direction) [113]. Furthermore, the time need on conventional train that takes about 12 hours. But when it is compare these fares with the price in Table 40, it can be see that the fares for the proposal HSR line it is much lower than conventional

[83] Egypt received 14.5 million tourists in 2010, making tourism the second largest revenue source, after expatriate remittances, according to government figures. Egypt forecast 16 million tourists for 2011 before the uprising [177]. In addition, the tourism sector industry is very important for the country and employs about 12 % of the total Egypt's workforce [178]. Despite leisure tourism still the largest market segment, business and conference tourism is increasing, as is health tourism, with Cairo as an ascendant healthcare hub within the region. Egypt alone accounts for 25% of all visitors to the Middle East and 33% of visitors to North Africa

rail line. Add to this the travel time will be reduced at least to a quarter of total time in the conventional line. Despite, if it is increase the ticket price for tourism ridership, it can be noted that the tourism will be used HSR line because this is the best chose for them, add to this saving time and comfortable.

In Egypt, the proposal high speed rail line will take about 64 minute journey times between Cairo and Alexandria costs approximately € 23.34 against €6 on a conventional train that takes about 3hours. The proposal corridor between Cairo and Assuyt, the 1hour and 53 min high-speed rail journey costs about of €17.14, against €7.93 on a conventional train that takes about 5 hours In addition the proposal corridor between Cairo and Aswan, the four hour high-speed rail journey costs about of €64.33, against € 13 on a conventional train that takes about 12 hours. Thus, it can be expected many of passengers still prefer the slower, cheaper alternative, but transfer to high-speed is expected to increase steadily as incomes increase (after revolution 25 January 2011) and more people will be try the new HSR service for the first time.

The comprehensive fiscal performance of the high-speed train services adopt on a sufficient number of people being able to pay ticket price for their use. Moreover, the previous analysis for the fares in Egypt lead to the expected price will be four times higher than conventional train (Cairo /Alexandria corridor) and about twice higher than conventional train (Cairo/Assuyt) about five times higher than conventional train (Cairo-Luxor /Aswan corridor). Whereas, to compare these value with some countries such as Chain and Japan, it can be observed that in China there is a surcharge for high speed train, where ticket price are about three times conventional train price. In Japan also high speed rail fares are about twice conventional services ticket price. However, in order to of engender the required size of passengers it should usually be necessary not only to base the most richer travelers but also to depend a fare structure that is reasonable price for the middle and under middle income population and, if any spare capacity still exists, to provide discount tickets with restrictions on use and availability that can fill otherwise unused seats.

It is clear that to understand the connected between demand, supply, and cost. If the cost position is dominated by large constant costs, as is the case with high speed rail, which must be provided independent of the number of passenger, then providing more passengers will lower the average cost of user. In the our analysis cost estimates were made based on demand forecasts through ENR, and though the precise numbers may change with changes in forecasts, the general result will remain. It should be noted that the high speed rail forecast success is based on fares. It is likely that if market fares (to recover the infrastructure and operating costs) were in place without subsidy, that the system would be possible. Thus, this is considered to the fourth of the bases that are adopted upon in the construction of HSR rail lines

Finally, it is a base introduce of microeconomics that price affects the demand and that the demand consumed effects of price. The price which determines a quantity that gives back the same price is considered a balance point. In railways the principle that price impacts demand manifests itself by the greater number of shorter journeys than longer journeys, where travel time and cost form a popularize price. Similarly, effects price, in the case of highway travel, price (in terms of travel time) rises as roads become congested, while in the case of public transit systems, total travel time between points may drop when increased demand increases service frequency, consequently reducing schedule delay [Figure 23; 24]. However, if social costs are to be included in the price miss by individual travelers, it can be expected that their demand for travel would be reduced. An aim of this chapter should be to develop a model which finds that supply and demand balance point for various infrastructure scenarios and various numbers of demands (such as factor of load see Table 40).

For freight transport: In Egypt, to increase the use of rail requirements of freight transport to be used to route planning, but also because of additional time to be scheduled and make overtaking a slow increase for regional services, the infrastructure costs will be increase, if a new line will be designed for mixed traffic[84]. That means the cost of high-speed lines for passenger traffic has been shown to be about 20 % lower than those of mixed-traffic HSL [136]. Breimeier talks about a potential savings of one third of not following mixed operation with freight [122]. Also, higher investment costs must be balanced against additional route earnings. There are some reasons for the strong influence of the land in terms of cost, but also the long time of building, this leads compensatory measures will be asked to relatively indirect costs, which will become clear only in the later stages of planning in the full amount. In particular, as a result of politically motivated in terms of changes to the plans during construction.

[84] The infrastructure costs if a new line designed for mixed traffic will be higher costs per route kilometre. The increase of costs it is due to use freight transport on the new line, this lead to use it to especial requirements of alignment parameters, also costs increase due to additional palming for switches or simplifying signalling for slower trains and freight trains. For the freight train, it can use the new line at the night or it can use the existing network between C/A, because the volume of traffic on the existing network maybe reduces after building a new proposal HSR.

7 THE ECONOMICS BEHIND OF HIGH-SPEED RAIL

Regarding the decision implementing significant investment is very difficult and carries numerous responsibilities. Especially, when this investment concerns the transportation system, the responsibilities are even greater. Consequently, the important question for governments and international development organizations such as the World Bank is how to view plans for high-speed railways in the context of economic development. Many different elements have to be considered before making a final decision, and the process is often quite lone time consuming. On the one hand all the costs and benefits of a specific investment must be determined, and in the other hand many different scenarios should be investigated. Such as, the investment made be in the highway network or the railway network? And if there are needs in the network of one mode, what is the better way to achieve them? Before answer this questions, will be estimated the process an investment to facilitate actually, there are many different methods to calculate that. On the one hand there are method focus on the change of travel time by several HSR projects and see how different technologies of HSR will have impacts on travel time. On the other hand there is method focus to help decision makers to choose from a set of different alternatives [Multi-criteria analysis[85]], and other used to compare alternatives or measure the regional impact of a project [Methods for evaluating regional and urban effects] and method used to approach for the appraisal of a transportation infrastructure investment project [Banister and Berechman's method[86]]. All of this is one of the ways to assess economic benefits. However, in this chapter will focus on the one method, this method is the costs benefit analysis. Thus, will be analysis this method for evaluating the economic benefit of transport investment practically of HSR investment, and the contribution of this modern technology to economic growth before advancing the analysis of the method. Also in this chapter will be discuss how to finance these projects by the government or the private sector. In additional, the participation of the public and private sector will be discussed.

7.1 A Cost-Benefit Model for the Estimation of HSR

Assume that a proposal new HSR project is beginning. The first step in the economic evaluation of this project is to determine how the investment alternative compares with the case without the project. A strict economic estimate would compare several relevant alternatives with the base case. These alternatives include upgrading the traditional infrastructure, management measures, road and airport pricing or even the construction of airport capacity and new road. It will be assume here that relevant alternatives have been properly considered. However, in the HSR infrastructure investment can be contemplated as a way of changing the generalized cost of rail travel in routes, where traditional rail, road and air transport are complements or substitutes. Instead of modelling the construction of HSR lines as a new transport mode will consider this certain investment as an improvement of one of the currently modes of the railway

[85] The advantage of this method is that dose not needs all impacts to be expressed in monetary units, like BCA does. But usually this method uses a set of criteria with a set of weights in order to reflect the preferences of the decision maker.

[86] There are two types of models are developing the production function and cost function models. The main assumptions for the construction of the models are that: The increase of capacity of businesses stimulates investment in private capital and Infrastructure capital expansions helps in the increase of efficiency and profitability of businesses [146].

transport. Therefore, it is possible to concentrate for the benefits of HSR on the incremental changes in surpluses or, alternatively, on the changes in resource costs and willingness to pay. It can be also noted that, the classified rail related intermodal investments and made a model to estimate net present value and economic rate of return. Where, classified benefits into three categories: direct user benefits, indirect user benefits and non-user benefits. If the result of CBA is positive, the project may generate growth equal to the amount of the NPV [164]. Thus, the cost of high speed rail and benefits can be divided into two groups according to Pickton [145]; quantifiable benefits and non-quantifiable benefits.

The first one is: Quantifiable benefits

- Travel time savings for HST user in money
- Travel time savings for road user due to the reduction of traffic congestion
- Reduced vehicle operating cost
- Reduction of traffic accidents
- Shorter travel time
- Cost and revenues of the construction and operation of the project benefits
- Air quality changes
- General system improvements

The second is: Non-quantifiable benefits

- Economic Competitiveness
    - Increased access to labor and other input
    - Expanded market reach
    - Depend on level of investment in other states
- Quality of life
    - Local air quality improvements
    - Access to jobs and service
    - Increased leisure time
    - Improved public transportation in metropolitan area
- Benefits to tourism
    - Increased visitor days
    - Increase the foreign income due to increase number of tourism
- Short term construction benefits
- Efficient transportation investment

It can be noted that, the first benefits as show is the travel time saving (the journey from door to door). Where, travel time is one of the most important levels of service variables for transportation modes. Thus, fare and travel time level directly impact the passenger. Whereas fare level is relatively easy to modify, travel time is very difficult to change because it is related to several issues including technologies and in many cases, the operational speed is decided before other characteristics. HSR could be more success and this will make attracting more passengers by reduction in travel time. The economic benefits quantified here represent only a portion of the total benefits of additional investment. Quality of life improvements, new jobs, better access to recreation and other improvements are difficult to quantify but also have positive implications for proposal corridor in future in Egypt. Additionally, the benefits of increased investment will continue maybe well beyond 2030, the end date for our analysis. Thus, transportation improvements under the current performance maybe improve the quality of life for Egypt residents and lead to a more robust state economy. Short-term construction benefits, increased economic competitiveness, benefits to the tourism industry and quality of life improvements are substantial benefits of transportation investment. While the economic impact of these benefits is largely unknown, these benefits are important in the evaluation of additional transportation investment.

Certainly, the impact and benefits of the HSR in the urban area and regional in our research depended on the Europe countries experience. Where, in the country under study such as Egypt the HSR project not started yet. Therefore, it will be review the most important economic benefits and regional impacts of the high-speed rail in Europe and Asia country and how can apply this in development and emerging countries.

Indeed, the reducing transport costs may lead to benefits or costs that are not reflected in a standard cost-benefit analysis, due to market deficiencies such as uncompetitive labour markets or agglomeration externalities, however, generally these have been thought to be small. On the one hand wider economic benefits of schemes would not generally exceed 10-20% of measured benefits [222], whilst a specific study of the TENS network suggested that it would not change regional GDP by more than 2% [108]. On the other hand there may be specific cases where effects are much larger. The impact of HSR on Lille is often cited, whilst a study of a proposed high speed route in the Netherlands found wider economic benefits to add 40% to direct benefits [141], but this was in the context of a relatively short route specifically designed to integrate labour markets in the north of the country with that of Amsterdam. In the Koln – Frankfurt high speed route of it was found that smaller towns on gained substantially in terms of GDP compared with other local towns [192], whilst it has been suggested that the remarkable development of cities such as Lille, and of the areas surrounding the HSR station in Lyon is due to HSR [223]. In both cases, it is not clear whether this is a net benefit or a relocation of economic activity. Summing up the evidence, Vickerman (2006) concludes that whilst high speed rail may have major wider economic benefits, the impact varies greatly from case to case and is difficult to predict.

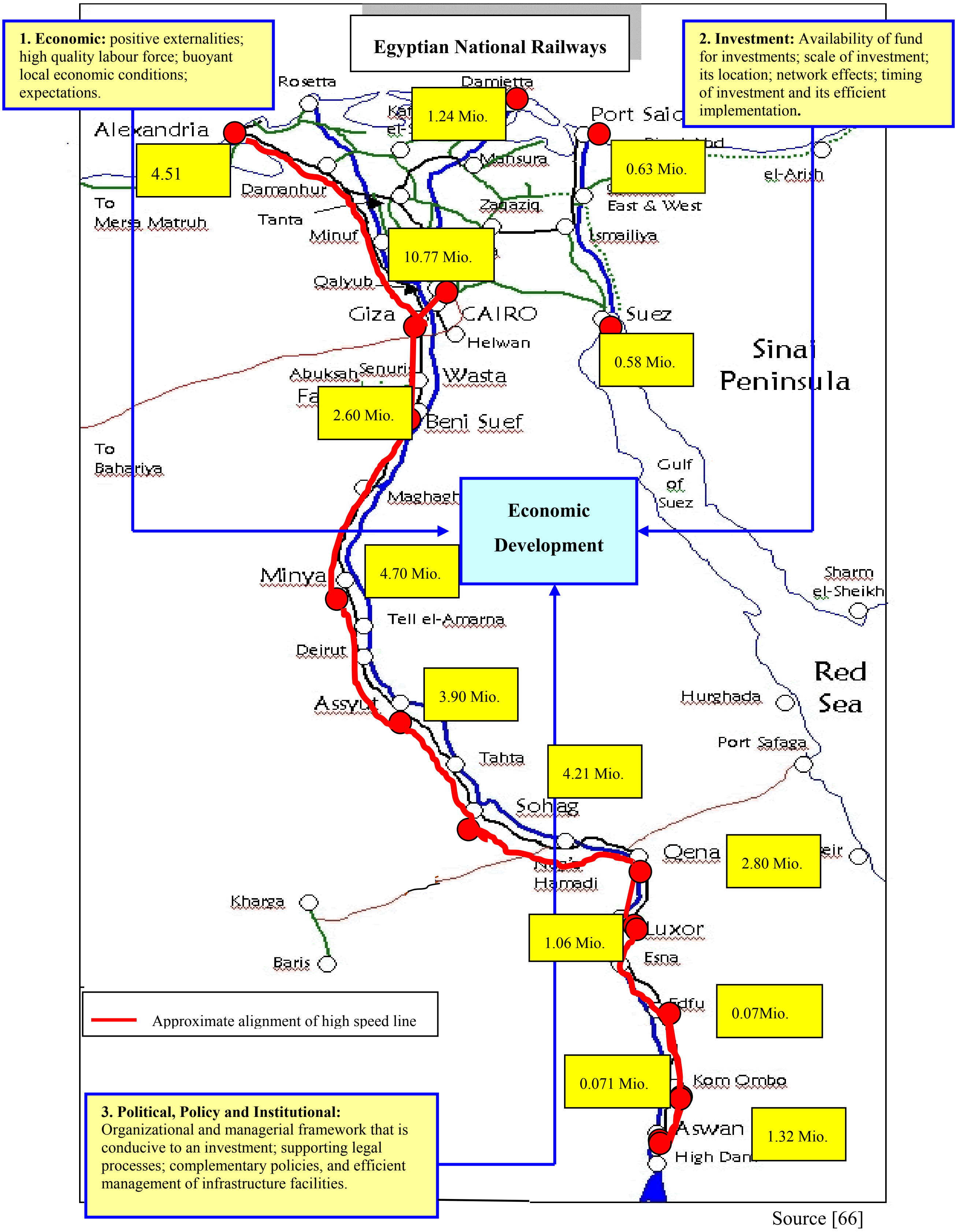
7.2 Economic Evaluation Expected of HSR Projects in the D & E country

Certainly high-speed trains are fast and enjoyable to passenger, but when scrutinized with rigorous cost-benefit analysis their high cost simply cannot be justified. This type of analysis typically considers benefits like reduced travel times, reduced congestion for those who drive and fly, and reduced pollution emissions, weight them against the considerable construction and impact on the urban economy and operating costs of high-speed systems. Consequently, the benefits of high-speed rail are generally conceived as reducing costs and reducing problems (accessibility problem, pollution, travel time) rather than expanding growth [10]. Economic history of HSR is full evidence of forward-thinking infrastructure investments that could not be justified by the assessment tools of their time but ultimately proved transformative to the economic system.

Thus, a HSR effects on the urban actors of all residents, companies and government actors. On the one hand, it expands the labour pool available to employers, bringing talented workers from nearby centers within commuting distance and thus expanding the quantity and quality of available employees. So, for example, the proposal high-speed rail would enable a company in Alexandria or other cities looking for a mobile user-interface designer to draw on talent living in Cairo. In economic terms, an efficient transportation system improves productivity because it helps allocate labour inputs more effectively. On the other hand, high-speed rail increase the size of the job market available to workers. Because it increases the distance that passengers can travel for work, it allows them to look for a job through what were once numerous, separate labour markets. This is especially important in an era when self-employment, contract-oriented work, and part-time work are all rising, meaning that workers are searching for jobs more frequently than ever. Therefore, eliminating the need to move to a new home to follow economic opportunity saves significant financial and social costs. It can be also observed that, are concerned with the relationship of transport infrastructure and economic development. Therefore, in the developing countries and cities, the relationship does exist and is quite clear, but in developed countries those links are unclear. Specifically, for developed countries, they argue that additional transportation investment has little impact on the overall accessibility and results in a change of business patterns and mode trends and not economic growth. Furthermore, they claim that further investment in a well connected transport infrastructure network of high quality, dose not result in economic growth on its own [146]. It should be noted that positive economic externalities, investment factors, and political factors have to coexist in order for a transportation investment to result in economic growth as shown in the Figure 41.

Thus, it will observed from the Figure 41 that, the number of inhabitants along on the proposals corridors from Alexandria to Aswan, thus there are three condition to achieved the economic development [48]. The first necessary condition is the presence of underlying positive economic externalities, such as the availability of a good quality labour force, and labour market economies, agglomeration, and underlying dynamics in the local economy. This is a basis condition, as it is only when these factors are positive and the local economy is buoyant that new transport investment will, in parallel with other necessary conditions, have an economic development impact [87].The second element as shown in the Figure 41 is the investment factors which relate to the availability of finance for the investment, the actual timing of the investment, the scale of the investment and its location, and the network effects. Moreover, transport infrastructure investment decisions are not made in isolation, so the nature of the investment, including it is place in the network, is also one of the necessary conditions that need to be considered. Finally, political factors, which are related to the broader policy environment within which transport decisions, must be taken. To achieve economic development, complementary decisions and a facilitating environment must be in place, otherwise the impacts may be counterproductive Included in this group of factors are the sources of finance, the level of investment (local, regional or national), the supporting legal, organizational and institutional policies and processes, and any necessary complementary policy actions.

[87] There are some news cities in Egypt located in the western dissert such as Sohag city and Aswan city, the proposal new line maybe increased the local economy and generation a new jobs. Also the high-speed trains can solve the problems of accessibility, where HSR constitutes a good substitute to air travel (all airport in Egypt are outside of the cities and the go to it takes a lot of time additional to the prices of access to airport is higher by public transport) and, it triggers the creation of a new economic corridor with high interregional accessibility.



Source [66]

Figure 41: Impact of the HSR Line on the Urban Area

Now can be analysis these three factors, this three requirement individually will have little or no impact on development. Even if they are combined on two pair basis, their effect will be limited. For instance, in Figure 41, if assumed only the investment and economic requirement are located together, the economic development effects from the investment may not follow for the lack of supportive, or because of the presence of conflicting transport and land use policies. Similarly, if assumed only the investment and policies requirement are located together, it can expect accessibility changes, but since the economic requirement are not exist, economic growth affect will not clear. In that case, the relative attractiveness of certain locations may change, but this is just a redistribution of existing economic development instead of the additional growth. It is only when all three necessary sets of conditions are present. It is at this scale that the impacts on local economic development, income levels, accessibility and employment should be assessed.

According to Pol the HSR will influence of the development of cities, reinforcing the assets hierarchical position of cities in different ways [167]. The growth pole effect which is defined by unbalanced economic growth across the region might be marked. Then, the spread effect might be illustrated as a result of the growth pole effect, where economic activities are not center located but are spread in the periphery. There is also the possibility of backwash effect. Those will occur in regions that lack accessibility to HSR, for example the cities Suez, Port Said and Damietta these three cities located on the east and northeast Egypt. Moreover, the new proposed surface networks between cities that are not connected with proposal HSR (such as Suez, Port Said and Damietta) will be formed, and the interaction among such cities will be enlivened, through the connected of conventional rail with speed about 140-160 km/h to this areas. Add to this, HSR will bring cities closer together in terms of transport cost and travel time, but also increase the competition between them. The net impact of HSR is pictured in Figure 41. It can be noted from the Figure 41 that, the lower level of the flow of HSR impact, where the regional economic of the city can be affected in tow terms. Either high speed rail can have a catalyzing or a facilitating role. Thereby, the catalyzing role is occurs when new activities are attracted and the economic growth and potential. The facilitating role is noted when the city is already prosperous and the new network facilitates economic also growth.

Nevertheless, it can be concerned with the wider economic impact of HSR especially in the European Union. Where, the HSR has the potential to be recognized as an instrument that enhances competitiveness and cohesion. It can be also seen the changes of accessibility and regional economic activities in area benefited by HSR services are studied. Vickerman is concerned with the relationship between HSR networks, regional and local transport networks and the role of accompanying policies. Wider economic benefits can be viewed in two ways [147]. One is the increase of the total welfare which is greater than the measured increase in consumers' excess to users during time savings, reductions in accident rates etc. On the other hand these benefits can be seen as the increase in GDP which occurs due to changes in economic activity which derive from the transport change. Moreover, HSR make stability in the jobs and income in the region by diversification to reduce dependence on declining industries [176].

The question that presents itself is what kind of method someone uses in order to appraise all of the benefits previous presented. Not all of them can be quantified, since some cannot be measured in monetary values, but still there are parameters that should be taken into account in the assessment process. As presented in the transit cooperative research program 1998, there are variety of different ways for evaluating the economic impact of the investment in transportation infrastructure and according to the nature and characteristic of each project, and the most appropriate can be applied. They can be categorized into predictive and evaluation. The first attempts to forecast the economic impact of a possible transportation investment, whereas the second objective to gauge the effects of a transportation investment after its application. In the following section will be presented of the most used methods.

It can be noted that, the analyses of most economic impact are depending on the different scenarios, whereas each of which an alternatives constitutes project (see a schematic imaginary example on the Figure 42. For example, the comparison can include the alternatives A and B of investing network.[88] Thus, projects about the same mode but with different characteristics, such as different routes, different population density, number of crossing, are considered as different scenarios. In the series of alternatives usually no project scenario is also included, in order to investigate the option of not applying any investment.

With the analysis of each scenario, each link to be built is studied. Therefore, different standard are being realization. On the one hand, from the economic impacts that each alternative presents and the level to which each helps economic growth, the economic condition of the country plays an important role as well. On the other hand, this depending also on the amount of money that is available, an alternative might directly be rejected. Furthermore, the time that each alternative needs to actually be establishment is critical. The requirement to improve a network or built a new might be urgent and can lead to the choice of the quickest alternative. Especially for the high speed rail there are some of the criteria will be taken into consideration when the alternative of HSR is built.[89]

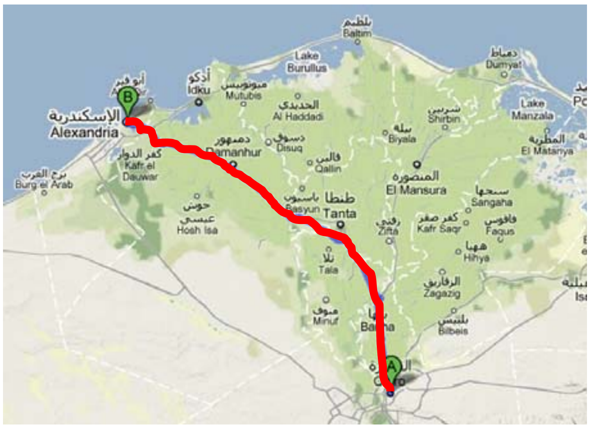
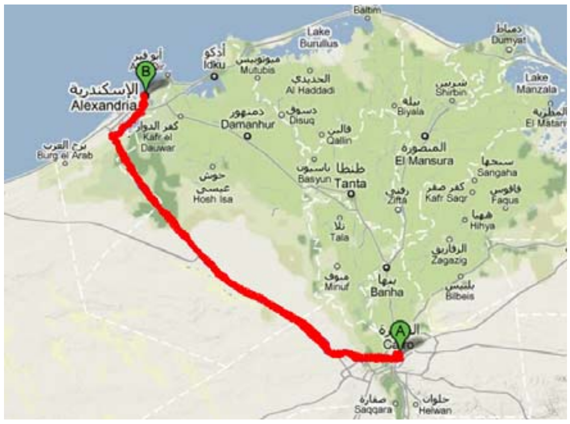
	
A) Alternative 1 of HSR parallel with conventional rail line (in the delta region)	B) Alternative 2 of HSR separate line in the western desert

Figure 42: Different Alternative for HSR to Compare the Economic Impact

It is also noted that, when the number of users increases or decreases the transportation costs will change. The more people sharing a fixed cost, the lower the per-passenger cost, while the more people using railroad , a road, , or airport, the increase the delay. However, properly measuring costs requires knowing how costs vary with use [165]. It would be noted that performing a CBA will need several assumptions (such as the demand for a certain level of service) and no unanimous agreement has been made on

[88] In this case, the investment cost of the alternative A will be higher than alternative B, because there are very high population densities located on the alternative A and it will need to build of many bridges, as well as this lead to increase the number of train stop. So, this leads to reduce the train speed and increased the travel time and will be not feasible on economic.

[89] The most criteria to increase the feasibility of HSR is: environmental constraints and habitation, stakeholder concerns, station access, costs including construction, land acquisition, rolling stock purchase etc, and technical constraints and affordability.

how to make estimate accurate. The methodologies used in CBA have varied. So, it will be chosen the one method to estimate the CBA this method is Benefit Cost analysis. Whereas, the important benefit for the Egypt people and other developing countries from the proposal HSR is environmental effects. Where, increase the number of vehicles especial in Egypt in the coming years[90], will be lead to raise the proportion of air pollution. The transport sector is a major consumer of fossil fuels and therefore contributes a significant share of the country's emissions of greenhouse gases. Consequently, spur negative benefits and regarded as indirect costs of transportation infrastructure investment that may that inhibit growth. According to INFRAS/IWW [150], the following table will explain the size of the external factors to effects on the environmental in west European countries.

From the Table 41, it will be noted that the increase of the number of vehicles in Egypt will be lead to the raise the air pollution and CO2 emissions. As show in the Table 41 the railway considered the less kind of transport in terms the external effects on the environmental. Moreover, environmental effects regarded as indirect costs of transportation infrastructure investment.

Table 41: External Effects from Transportation in EU 17 Countries

Mode	Average external cost [€ / 1000 pkm]*						Total
	Accidents	Noise	Air pollution	Climate effects	Up-Down stream	Urban effects	
Car	30.9	5.2	10.1	17.6	5.2	1.6	70.6
Bus	2.4	1.3	16.9	8.3	3.95	0.4	33.25
Rail	0.74	3.9	5.1	5.9	3.22	1.3	20.16
Air	0.37	1.8	0.2	46.2	1.0	0.0	49.57

Source: [150]

*This cost without nature and landscape and ground sealing

On the one hand, in the case study in Egypt the new proposal HSR line will savings in highway maintenance cost, particularly between Cairo Alexandria corridors. Tow highway link Cairo to Alexandria, namely the agriculture road and the desert road. Converted traffic from road to rail could help reducing the annual equivalent standard axle loads on both and thus reduces the costs of highway maintenance. The estimated annual cost of periodic maintenance for the road section from Cairo to Alexandria attributed to road damage from vehicles is then evaluated assuming an adequate level of funding for annual highway maintenance of EGP 1.1 billion [181] on 22,000 km of arterial roads in years 2006 (about 50,000 EGP/km/year). Based on estimated road ton and passenger kilometers, the potential road maintenance savings are finally computed.

On the other hand, the economic analysis from the proposal HSR line is improvement in safety level. It is the expected that, the proposed investment of a new HSR will improve dramatically the level of safety on the Cairo to Alexandria and Cairo Aswan routes. Those benefits will occur mainly to the passenger traffic and will be derived from two sources:

- Reduce accident risk for the current traffic: in fact, in the new system, the railway line would be operated under the electro-signaling system, no crossing with road, thus the level of safety on the line is similar to the one observed in the past (about 4.20 rail accidents per billion traffic unit); while in the a new system of rail the level

[90] The proposal number of the vehicles in Egypt according to [82] in year 2022 will reach to about 2, 31 million cars, and about 0.6 million minibuses, 1, 16 million heavy truck, and finally about 0.14 million bus.

of safety is improved and the number of rail accidents per billion traffic unit maybe drops down to 0.10[91].

- Reduce the risk of traffic accidents for the converted traffic from road to rail the increased line capacity in the proposal HSR allows transfer of road traffic to the railway. This converted traffic will benefit from reducing the accident risk from 47.9 road accidents per billion traffic unit observed in the past to 0.10.

For each category of accident (road and rail), an average cost is associated, estimates are based on the following Table 42. Also the number of rail accident from year 2000 to 2010 will be show in the Table 42a. The aim of this table is calculate the accidents costs for the railway and road. Obviously, from Table 42a the total average accident cost about 5.76 million EGP/ accident and 1.77 million EGP/ accident (€0.76 and €0.23 million/accident status 2009 respectively). The total cost of accidents can be calculated by multiplying the number of accident in the year by total average cost per accident (€0.76 and €0.23 million/accident), thus, it can be obtained on the average cost over the past nine years from the Table 42a. It can be observed from Table 42 and Table 42a the average cast accident per year for road about €5.3 billion[92] five times greater than average cast accident per year for rail, and for rail about €0.9 billion. So, the result from this analysis is the new proposal HSR system will be decreases the accidents in the road and railway.

Table 42: Accident Cost for Rail and Road

Category	Fatalities	Injuries	Material damage cost	Value of time lost due to traffic interruption	Total average accident cost
Rail	615,000 EGP/accident	363,000 EGP/accident	4.50 Million EGP/accident	190,000 EGP/accident	**5.67 million EGP/accident**
Road	400,000 EGP/accident	465,000 EGP/accident	900,000 EGP/accident	---	1.77 million EGP/accident

Source: [182]

Table 42a: Average Accidents Cost per years for Rail and Road

Years	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Nr. of Rail accidents	978	975	1043	1118	1231	1293	1577	1259
Total costs € million	743	741	793	850	936	983	1198	957
Average accident cost per year	**€ 900.125 Million / year**							
Nr. of Road accidents	27575	24658	21352	18061	22900	20938	22793	25353
Total costs € million	6342	5671	4911	4154	5267	4816	5242	5831
Average accident cost per year	**€ 5279.25 Million / year**							

Source: [20; 21]

[91] It can be noted that, in order to take into account the fact that the newly proposal HSR system maybe can falls at some point, the accident risk maybe equal to zero, or maybe give a small ratio of accident risk per billion traffic unit.

[92] In general, the problem is bad driving and poorly enforced highway regulation. Thus, the problem in Egypt does not seem to be improving. Something definitely needs to be done about the culture of reckless driving, which is endemic on Egypt's roads.

7.3 A Cost Benefit Analysis from the High-Speed Rail Lines

In this section, it will be discuss methods to estimate the benefits of high-speed rail. Rather, it will focus on the change of investment costs by HSR projects and the benefits of these projects and see how different technologies of HSR will have impacts on net cost analysis (for example in the case study in corridors in Egypt). Consequently, economic growth has the benefits of higher levels of employment and increase of the GDP of the country. These lead to the strengthening of the economy and increase of inflows of money. Also it can be defined economic growth is a goal that most governments are aiming for when they set strategies and decide where to allocate funds. On the one hand, if it occurs quickly, then it might result in negative impact, such as an increase in effects or uneven distribution of welfare. While in the different project are considered for application, the contribution to economic growth is an important aspect that is studied. The Benefit cost analysis (BCA) is a method that can help in the above concern. BCA is used in the evaluating of whether a proposed project, programme or policy is worth doing, or to choose among several alternative ones. It involves comparing of the expected total costs of each option against the total expected benefits. It is a way to weigh the benefits that a project has against the costs that it require if it is application

7.3.1 Description

Benefit Cost analysis is a method that is used in order to valuation project and help in the decision making process of deploying it or not. Usually, this process involves the calculation of total expected costs compared to the total expected benefits during lifetime of project. Those are general expressed in monetary values adjusted at the time of the study, thus that everything is expressed on a common basis. Consequently, it can be calculated the cost-benefit ratio by dividing the benefits over a period of lifetime by the project costs (including the construction, operation and maintenance costs). According to the country and sector applying the method differences can be noted, like the type of benefits and costs appraised and discount rates. By using this equation can be determine the benefit cost ratio:

$B_{CR} = \dfrac{P_{VB}}{P_{VC}} > 1$, Where: B_{CR} = Benefit Cost Ratio, P_{VB} = Value of Benefits (€/year), P_{VC} = Value of Costs (€/year)

The high-speed train system will benefit the country in a number of ways. Many of the benefits are quantifiable and can be estimated based on detailed ridership and revenue forecasts. For projects such as the high-speed train system that require public investment, if these benefits are greater than the total costs, then the project is said to be economically justified. Therefore, the total social costs for building and operation high speed rail line can be divided to: User cost, Producer costs and External costs.

Thus, in order to perform a BCA analyses, it is important to gather specific data. Since the procedure involves the measurement of benefits and cost associated with the investment, which is the information that need to be found. Whereas, the cost of the HSR line of proposal project in Egypt in particular were discussed in the section 6.8. Regarding the benefits of HSR line and transportation investment in general, that was presented in the section 7.1 and 7.2. It will be measurement of benefits and cost of the proposal a HSR lie in Egypt as example. Before calculate the benefits it will be note to the popularity of BCA are due to several reasons, but there are also some disadvantages for this method that should not be overlooked.

7.3.2 Advantages and Disadvantages

A cost benefit analysis is a widely accepted method for estimate economic impact of transportation. Thus, it is the best tools available in order to determine and understand whether society will be better off economically, setting aside all political considerations. It is stated that when transportation demand models are used for forecasting cost changes, then travel time based benefits are easy to measure, also it's highly desirable that all political considerations are put aside [148]. Nevertheless, with BCA the decision process of implementing a project. Indeed, that everything is expressed in monetary values can help in finding large costs that can lead to the prevention of making expensive mistakes. Furthermore, there are some issues that have to be taken into account when BCA is performed. It can be also noted that investment, maintenance, and operation cost can be easily found date of analysis of previous similar projects. As for the travel time savings, it is not difficult to compare the time with and without the effects of the transport investment. Models are used to forecast demand of passenger and volumes of freight. Addition to this the value of time for expressing into monetary values is very useful. This means value of time differs according to modes, income classes, and other characteristics of travel and travelers.

There is danger of the misusing BCA. This is due to more specific; there is the possibility of overstating benefits associated with a transit investment. Redistribution impact, which refers to spatial shift of economic activities do not add to economic growth and might lead to double counting**. However, direct benefits like travel time savings and reduce congestion are capitalized into land value and cannot be omitted from BCA**. There must be caution when measuring such benefits not to include them twice [148]. Another disadvantage of the cost benefit analysis is the costs easier to calculate than benefits, but the fact that they can be quantified dose not means that they are more certain. And also it is not good evaluative method since it dose not tell explicitly who is benefiting and who is losing, also there are some long term benefits that need time to be realized.

Lastly, the aim of performing BCA is to understand whether society is going to benefit from the actual project that is starting studied or project under proposal in future. The question is whether the new infrastructure will contribute to economic growth and if the new service is going to be profitable for the managing entity whether this is the government or a private company.

7.3.3 Analysis and Evaluation

The aim of this step is to determine whether the annual revenues from proposed high speed rail constitute a significant proportion of the total annual operating and maintenance costs of the project HSR. The aim of this analysis is to determine whether the proposed project activity is economically or not economically through the application of that in the developing and emerging countries such as a case study in Egypt.

In this section the costs and benefits of a HSR proposal in Egypt will be estimated. Using the data analysis in the section 6.7 and 6.8 (methodology of the demand forecast, and methodology of cost calculation). Where, a comprehensive cost-benefit analysis enables public and private sector decision makers to evaluate the net value of policy investment. This is done by considering and calculating the expected benefits and cost of project over its lifetime, and discounting values to common year. The valuation of certain benefits and cost may be impractical especially when markets do not currently exist to price particular result such as air pollution and noise (the indirect benefits of HSR can be see in Table 41). Consequently, it will be taken the previous proposal projects in Egypt to determent the cost benefits analysis. In the following sections will be present detail on the calculation of each category of costs and benefits.

Costs Estimation

The construction and operations costs considered; all direct and transacted according to the previous section 6.8, particular in Table 39. In this section have been identified all the costs for the three proposal corridors. Whereas, figuring in essential contingency and add on costs, estimated their systems fixed cost at €1.650 billion and €2.974 billion and €6.971 billion. In additional, the maintenances costs €5.4 million/year and €9.75 million/year and €22.85 million/year will be added to this value (for each of the corridors in Egypt) respectively[93]. Thus, it can be assumed to represent a conservative estimate for an average €10 million/km. This figure covered the necessary land purchases and planning cost is 10%. Addition to this, the purchase price of each trainset of fourteen passenger car and two power cars is estimated at about €30.78 million, again based on the conservative assumptions used by Table 38. Every train can carry up to 1026 passenger, but it will be taken the loading factor of less than 80 %. Therefore, total of nine and fourteen and four trainsets (for fares €23.34 and €17.14 and €64.33 scenarios [See Table 39], respectively) are expected to be necessary for project implementation, assuming that about 15 % of the train are not in service at any given time, and should be avoided this value. But in this example, will take the all acquisition costs of trainset to estimated benefit cost ratio. It can be also estimated that rolling stock have useful lives of 20-30 years [see Table 23], requiring that trainset be acquisition during lifetime (40 years) of project and that their price be figured into the economic analysis. Moreover, the total cost of acquisition rolling stock estimated their systems fixed cost at €277.02 million and €430.92 and €2154.6 million respectively [according to Table 38], addition rolling stock must be purchased as demand increase throughout the project life; these too are included in the calculation of costs. Addition to this the maintenance cost and sales tax costs which were calculated in Table 39. The capital costs also will include the operation cost of (energy and personal labor costs)[94], this value estimated of €5.66 million/year and €21.04 million/year and €6.78 million/year respectively, for the sales and administration the value will be €16.6 million/year and €57.6 million/year and €9.6 million/year. Thus, the maintenance €27.702 million/year and €43.092 million/year and €12.312 million/year respectively will be added. For the sales tax costs will be adding these values only one times for the total costs this value about €13.85 million and €21.55 million and €6.16 million respectively [See all calculation in Table 43].

Benefits

The benefits that can be obtained through implementation of the proposal project include three elements; direct revenues, a reduction of the negative external factor and indirect benefits

Direct Revenue Benefits; Direct benefits can be obtained by multiplying appropriate fares by the number of passenger per year, after accounting for trip routings, yield an expected total yearly fare revenue of about 16.6×23.34 = **€387.44 million** for the €23.34 per tripe in corridor Cairo /Alexandria (this result according to the data from a Table 39). For the other second rout Cairo/Alexandria yearly fare revenue about 38.4×

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[93] It should be noted that, these costs are the total fixed cost, with adding the interest rate and discount the residual value.

[94] In the case of estimated the NPV it will be add the operation costs, because each traniset is expected to require increase a crew of employs, pulse food servers and this value have no significant effect on the operation cost, also add to this the energy cost will be added and sales and administration.

17.14 = **€ 658.2 million**. For the line Cairo/Luxor-Aswan the yearly fare revenue about 5.52× 64.33 = **€ 355.10 million**.

Non traded Benefits and external factor; The other non traded but direct benefits exist, like as do reductions in the negative external factors. In theory benefits can be traded they include increases in consumer surplus and safety and diminished noxious emissions[95]. As for the external factors, such as air pollution, occur when one persons actions and impose either cost or benefits upon others. Also it is promises abated noise, lessened land taking, congestion reduction and accidents.

Riding a train is safer, on average than traveling by cars but not quite as safer traveling be airplane. Thus, cars are currently responsible for about 1.61 deaths, 61 injury accidents and 374 other (such as solely property) accidents per 100 million passenger miles travel. Conversely, railway claim about 0.06 deaths and airplane about 0.03 deaths per 100 million passenger miles [149; 151]. Life, injury, pain and suffering are not costs upon which one can easily place a value, but attempts have been made. The claims that road traffic accidents cost Egypt in year 2008 estimated 16 billion EP [2 billion Euro] [154]. Comprehensive costs to account for quality of life aspects and in some case, where now in Egypt people's willingness to pay more to prevent accidents, on this basis, safety of train is the most important way to benefits of reducing accidents. Consequently, it can be found that the cost of accidents about € 30.9 for cars and € 0.74 for rail and €0.37 for air per 1000 passenger kilometers [150]. To be conservative in valuing the accidents quality benefits of HSR, it can be assumes according the date in Table 42; 42a the cost of accidents about €0.009 per passenger kilometer save accidents costs in Egypt[96]. But it will use the data as estimated by [150] about €0.00074 Pkm. Consequently, using this value the HSR would generate yearly accidents saving by multiply the total number of passenger kilometer by the cost per passenger kilometer, and this give about €2.56 million, and €10.66 million, and €3.60 million per years respectively for the three the proposal HSR in Egypt [See all calculation in Table 43]

Air pollution through emissions is currently an externality and not priced directly. It is generated could be priced, however, if transport mode such as trains, automobiles and panes were charged according to emission performance kilometer driven and number of cold starts. According to Envitrak the airplane used an average 2.88 kWh per passenger kilometer and car used an average of 1.44 and the high speed train only need to 0.38 kWh [152]. It can be observed that, the average cost of the automobile about € 10.1 per 1000 passenger kilometer, €5.1 Pkm for the rail, and € 0.2 per 1000 passenger kilometer [150]. Thus, to be conservative in valuing the air quality benefits of HSR, it can be assumes according this date in a cost of € 0.0051 per passenger kilometer air pollution cost[97]. It can be multiply the total number of passenger kilometer by the cost per

[95] It can be observed that, in the section 7.1 the direct user benefits include consumer surplus. Thus, if we define it as benefits that HSR users receive but do not pay for, the direct user benefits can be represented as a combination of the system proceeds and consumer surplus. Theoretically the consumer surplus could include even quality benefits such as comfort and passenger convenience. Their calculated the value of consumer surplus during assuming travel demand at certain speed-level and prices level

[96] According to Table 42 and 42a, the cost of accidents save value can be calculated, where the average annual accident cost of € 900.125 million, and the number of passenger-km about 3.453 billion, 14,400 billion and 4.852 billion Pkm respectively for the three proposal HSR corridors in Egypt (See Table 39). From this data it will be calculate the save accidents costs in Egypt about €0.009 to €0.049 Pkm. Then can be taking the low value for estimated the benefit of lives saved about €0.009 for passenger-km.

[97] It can ne noted here that the average cost per passenger mile for cars is 5 cents air pollution cost. Assuming that emission and thus their costs are proportional to energy use, air travel can be assessed at 10 sects per passenger mile and HSR at about 1.33 sects per passenger mile [152; 153].

passenger kilometer, yield the total cots benefits from the air pollution. Using these as estimates, HSR would generate yearly emissions saving about €17.61 million and €73.44 million and €24.75 million per years respectively for the three the proposal corridors.

Travel time savings: The total user travel time includes access and egress time, waiting time and within vehicle time. According to [130], when the original mode is a conventional railway with operating speed below 100km per hour, the HSR will save 45-50 minutes for distances in the range of 350-450 km. While comparing the proposal three routes in Egypt with the conventional railway, assuming that they both have the same access, egress and waiting time, HSR will save about 40 minutes. In addition, the average value of travel time savings is equal to €1.32 per person per hour with an assumption of the traffic composition of 50% business trips, 30% commuting trips and 20% others [245]. Therefore, the average annual social benefit of travel time savings could be derived as €22 million, and €50.7 million, and €7.3 million respectively.

Reliability improvement: The unreliability in travel time is one of the biggest problems in transportation. HSR can effectively reduce such kind of uncertainty and improve the reliability level in terms of avoiding congestion and delays. Compared with roadway and conventional railway, HSR has outstanding reliability benefits which should be included in the CBA [246]. The value of reliability improvement is estimated based on the ratio of value of travel time savings, which is about 13.7% [244]. Thus, the annual social benefit of reliability improvement is about €3.01 million, and €6.95 million, and €1.00 million respectively.

Indirect Benefits and cost: in addition to those benefits mentioned above, the high-speed train system will bring other opportunities and benefits to the country that cannot be quantified. First and foremost, the high-speed infrastructure is the ability a major transportation improvement that can be exploited by future generations in ways as-yet unimagined. The economic vitality and stability of Cairo has adopted historically on the ability to move people, goods, and information freely and efficiently between population centers, agricultural markets, and ports of entry. This improvement to the country level infrastructure will support passenger as well as intercity passenger traffic. It will be complement and connect to airports and highways, providing a substantially greater degree of mobility for those who travel in between Cairo and other Egypt cities. In Figure 1 it can be observed that the proposal high speed rail in Egypt will run in the western desert, this mean that HSR line may be increase generate and a new movement and transfer of congestion of population from the Nile Valley to the Western desert. Also it can be to enhance a more connected urban from at station locations, avoiding some sprawl. Thereby, it will provide a means to directly access urban centers, bypassing the congested roadways leading in the Nile Valley from intercity highway corridors. In addition to this, promote intrastate mobility has potential to generate new, outside investment in the country be increasing tourism within the cities, reducing business cost and improving the quality of life for employees and their families. It is clear that the volume of investment is hard to predict.

Lastly, high speed rail maybe helps to reducing the major problem in Egypt, this problem is related to accidents on the roads, where in section 6.2 were explain this problem. As well as airplane in Egypt did not use a key alternative in the transport of passengers, due to the high cost and takes a long time [See Figures 23; 24]. Rail fixed investment with localized nodes helps concentrate development by making urban expansion along the country of thousand kilometres [from Alexander to Aswan via Cairo and Luxor] of highway less attractive. Under this way growth and construction would be refocused toward urban areas, as long as stations are built relatively close to city and regional centres. **Nevertheless, all cost and benefits of the project are tabulated in the Table 43 to exhibit clearly the results of the different corridors in Egypt. Those that are evaluated monetarily are shown at net present value assuming a project life of 40 years and estimated the GDP growth factor 1.07 per year [97] during the lifetime of the project (40 years). The values are in million of 2011 Euro, and all rates is real.**

As a result from Table 43, in the proposal HSR project in Egypt can be use the data available, the project seems worthy of serious consideration because of its competitive comprehensive rates of return and ability to be self financing. The overall net present values for two corridors are positive and so the proposed project would increase net benefits to society. Furthermore, because the net effective on low-income population are likely to be positive (during improved air quality and promote ability to move between cities speedily without possession a car or paying higher fare for airplane) the project also maybe realizes criteria: avoiding regressivity. For the third section (Cairo/Luxor-Aswan) the net present values for this corridor is negative (less than one). In order to realize the benefits of this route, revenues should be sufficient to cover the costs of the project. But, ridership must pay more than €90 for the second class, at least to cover the costs of the project [See Table 40].

Table 43: Result of the Benefits Costs Analysis Proposal HSR in Egypt

	Corridor Cairo/Alexandria	**Corridor Cairo/ Assuyt**	**Corridor Cairo /Luxor- Aswan**
COSTS (€M)			
Infrastructure Costs	1649.5	2874.13	6971.3
Maintenances Infrastructure costs	5.4 ×40 = 216	9.75×40 = 390	22.85 ×40 = 914
Acquisition Rolling Stock	277.02	430.92	123.12
Train Maintenance Cost	27.702 ×40 = 1108.1	43.09 ×40 =1723.7	12.31×40= 492.48
Train Operating (Energy and labor personal costs)	5.66 ×40 = 226.4	21.04 ×40 =841.6	6.78 ×40 = 271.2
Sales and Administration Costs	16.6 ×40 = 664	57.6 ×40 = 2304	9.6 ×40 = 384
Sales and Tax Costs	13.85	21.55	6.16
Total Costs $[P_{VC}]$	**3877.85**	**8154.98**	**9162.26**
BENEFITS (€M)			
Passenger Ticket Revenue	387.44× 40 = 15497.6	658.2× 40 =26328	355.10× 40 = 14204
Lives Saved	2.56 × 40 = 102.4	10.66× 40 =426.4	3.6 × 40 = 144
Air Quality	17.61 × 40 = 704.4	73.44× 40 =2937.6	24.75× 40 = 990
Travel time savings	22 × 40 = 880	50.7× 40 = 2028	7.3× 40 = 292
Reliability improvement	3.01 × 40 = 120.4	6.95 × 40 = 278	1.00 × 40 = 40
Total Benefits $[P_{VB}]$	**17304.8**	**31998**	**15670**
Net Present Value (€M)			
Economic*	11619.75	18173.02	5041.74
Comprehensive**	13426.95	23843.02	6507.4
Benefits Cost Ratio for Economic Case $B_{CR} = \frac{P_{VB}}{P_{VC}}$	**2.99**	**2.23**	**0.6**

* Economic net present values **exclude** live saved, air-quality, time savings, and reliability improvement benefits.

** Comprehensive net present values **include** live saved, air-quality, time savings, and reliability improvement.

Despite, resident of other cities in the delta region like (Tanta, Damanhur, El-Mansura, Dumyat, Suez, and Port Said) for example would realize few benefits for them, from the proposal project and people in this region can get the benefit of this project by indirectly ways.[98] In all probability, the primary beneficiaries of the new project likely would be those who travel along the project corridors and thus would benefit from a new travel alternative, perceived total cost savings, possible fare reduction by the competing airlines, improved air quality and reduced road and air traffic.[99]

Despite the net revenue more or less covers operating costs for the three proposal corridors, the capital cost can only be justified by non financial benefits and released capacity. According to the NASH (2009) about 75% of the non financial benefits take the form of time savings or reduced traffic congestion with the remainder mainly taking the form of reduced road congestion and accidents [108]. On balance it was thought that the absence of quantified environmental benefits were slight. This is the interesting question whether more of the user benefits could be arrested as revenue by more advanced return management techniques than the simple fare structure modelled. For instance yield management methods are already in use on other high speed services, including for example Eurostar services between London, Paris and Brussels.

Table 43 compares unit costs and unit incremental revenues. However, the incremental direct revenue also rises quite substantially. The reason for this is clearly that the longer route attracts more traffic raising load factors. Thus in the case study in the difference route in Egypt the more limited network (Cairo/Alexandria and Cairo/Assuyt) covers a much greater share of its costs from incremental revenue than the more extensive network (Cairo/ Luxor-Aswan).

7.4 Possibility of Funding such Projects in the Countries

The willingness to create a more competitive, market based transport system has led to the involvement of the private sector in infrastructure investments. Nevertheless, there are different aspects are still in many cases that make the investment in transport infrastructure is attractive to private parties [233]. In this section definition of the characteristics of investments in infrastructure in general, in order to clarify the frequency of private investors. One specific class of infrastructure investments, such as railway, is discussed here as an interesting case

Egypt railways are mostly financed with a whole involvement of government. From a comparative study between investments in railway and other investments in infrastructure, the researcher argue that the railway market has several features (such as imperfect competition and a high participation share in the transport of passengers railway), which lead to a lower risk for private parties. Because of these characteristics, public-private partnerships occur rather often and seem to be attractive. A situation of a fully competitive railway market without government intervention is in the long-run

[98] The majority of residents of those areas would receive at least benefit from the project (as a result of cleaner air, less highway congestion, greater tourism and so on). In additional, this area with densely populated, which leads to high construction costs of a new HSR line. As well as it will be a few benefit, because distance are between all the cities are 40-60 km. Additional to that, the number of passengers twill ravels in these routes maybe a few number of passenger kilometers.

[99] These possibilities as a result of several reasons, including the high cost of airline tickets on the other hand, long time which is taken to go to airports, adding to extra waiting time at airports, especially in Upper Egypt cities, where there are airports at the long distances between cities (such as that the distance from Kom-Ombo city and Edfu city to Aswan Airport of 65 and 125 km respectively) [see section 6.3.1]. Consequently, this leads to use passengers the railway, where rail running in all Egyptian cities. As for the roads, the increased number of accidents caused, addition to the large distances between the cities and the provinces, this leads to make travel is uncomfortable [see 154].

possible and clearly more realistic than in other infrastructure markets. It should be realized however, that a common Egyptian policy is required to avoid distortion of competition among rail transport due to different subsidy regimes.

In Egypt, the approach to transport infrastructure has been based on detailed government intervention, ostensibly to protect and promote the public interest. In the case of infrastructure, direct provision has been the norm (including financing). However, in recent years profound changes in economic and spatial policy have brought about a re-orientation so that the dominant role of the public sector is increasingly questioned.

There are some of developments have often led to the desire to create a more competitive, market based transport sector in which the government does not need to finance all investments in infrastructure. Thus private financing far of transport infrastructure has been most significant in many developing countries [234]. The current section pays particular attention to the problems and possibilities in private financing. And then outlining some of the characteristics and risks of private investment in infrastructure, the focus will be on a particular kind of infrastructure; namely high speed rail. The aim of the this section is to elucidate on this theme and to identify particular issues that demonstrate why HSR are likely to be attractive for private investors, consequently Egypt Railways can be benefited from such direction in enhancing its efficiency. This will be based on a desk comparative study.

In recent years however, it has become understood that, mainly due to government failures, financing of all types of infrastructure by governments is not an appropriate solution, and certainly not in a situation of high public sector deficits. These failures of government agencies lead often to problematic cost estimates and in several cases to inefficient spending of public money. On the other hand, it is overly optimistic to think that these failures will completely disappear with private financing of infrastructure investments. However, from a financial point of view, private involvement is attractive, for attention is focused on economic and commercial value

7.4.1 By the Government

Unfortunately, the financing of railway projects in Egypt so far are by the Egyptian government. All of the transport projects are infrastructure need to large investment. The Ministry of Economic Development, Planning spent a great amount of money on the transportation and specifically on new transport infrastructure system, maintenance of the current system and research and development. In the budget of 2010 the Ministry has dedicated an amount equal to 11.3%, however, as compared with the year 2009, which were 14.6 % of its total budget to transportation [84; [156]. As far as the Ministry of Transportation is concerned, it is very interesting to note that it divides its budget in the subcategories of transportation (generally), and the rail system. In Figure 32 shows the sectoral distribution of total implemented investments in the transport sector. Although there is no money allocated for the rail system in 2010, but this money is only for the maintenance, repair and improvement. Furthermore, in all the governments' official documents on revenues and expenditures, the rail system is always separated from the rest of the means transportation. Thus, this likely reflects the government's great interest in investing and upgrading existing rail network.

As mentioned above, in section 6.5 the program of public investment (The Sixth Five-Year Plan 2007–2012) includes actions, through large investments in transportation improvement. Moreover, total investments are estimated to be LE 1295 billion [€ 308.95 billion in statues 2011] divided according to implementing bodies among government, economic organ, and public business sector. The transportation sector investments are estimated to be LE 156.64 billion [€18.42 billion status 2011] during the Sixth Five-Year Plan [156]. The business sector and the economic authorities are anticipated to implement about 85.4% of total investments, and the rest to be executed by the government body. In Table 44 it can be explain the distribution of the overall investment in the Egypt. It can be see from this table that, the great role that business sector is expected to play in implementing the investment plan, as its contribution is almost 84% to total investments, of which two-thirds are expected from the private sector.

It can be observed that, the investment in the transport sector during business sector is higher than other, and according to Figure 32 and Table 24 concentrated on the term of the operation of the bus, taxi, microbus, service and goods transport. Constantly, in recent years however, it has become understood that, mainly due to government failures, financing of all types of infrastructure by governments is not an appropriate solution, and certainly not in a situation of high public sector deficits. These failures of government agencies lead often to problematic cost estimates and in several cases to inefficient spending of public money. On the other hand, it is overly optimistic to think that these failures will completely disappear with private financing of infrastructure investments. However, from a financial point of view, private involvement is attractive, for attention is focused on economic and commercial value.

Table 44: Distribution of all Investments for the Sixth Five-Year Plan and the Proportion of Transport Investments

<table>
<tr><td colspan="2" rowspan="2">Budgets</td><td colspan="2">Total investment in period 2007/2008-2011/2012</td><td colspan="2">The proportion of transport and storage</td></tr>
<tr><td>LE billion</td><td>%</td><td>LE billion</td><td>%</td></tr>
<tr><td colspan="2">Government</td><td>158.5</td><td>12.2</td><td>22.9</td><td>14.6</td></tr>
<tr><td colspan="2">Economic Authorities</td><td>51.4</td><td>4.0</td><td>17.71</td><td>11.3</td></tr>
<tr><td colspan="2">Business Sector</td><td><u>1085.1</u></td><td><u>83.8</u></td><td><u>116</u></td><td><u>74.1</u></td></tr>
<tr><td rowspan="4">Business Sector</td><td>Companies under Law 97</td><td>19.9</td><td>1.5</td><td>1.8</td><td>1.15</td></tr>
<tr><td>Companies under Law 203</td><td>4.9</td><td>0.4</td><td>-</td><td>-</td></tr>
<tr><td>Holding Companies</td><td>210</td><td>16.2</td><td rowspan="2">114.2</td><td rowspan="2">72.95</td></tr>
<tr><td>Cooperative and Private Sector</td><td>850</td><td>65.6</td></tr>
<tr><td colspan="2">Total</td><td>1295</td><td>100</td><td>156.6</td><td>100</td></tr>
</table>

Source: [156]

7.4.2 By the Private Sector

Private financing is concentrated of the manufacturing and industrial sector. Where, the investment of industrial (manufacturing and extractive) estimated about 49 % of the total private investment. Figure 43 explains the all important investment in the private sector. It can be noted that, the private sector is still unable to take part in the execution of infrastructure projects in transport sector. Furthermore, as show in the Figure 43 private sector contribution to the biggest part in the sectors are petroleum industry

(33.1%), communications (13.9%), building and construction (13.9%), and education (6.2%). For the transport sector proportion of private sector financing does not exceed 5.8%, and this value is used only in the Nile transport, good transport [see Table 24]. From the above analysis it will be found that, the government lone and private sector alone can not make a huge investment project such as HSR project. Consequently, it should be a partnership between the public and private sector in order to implement these future projects in developing countries.

From the Figure 43, it can be observation, the scale and manner in which the private sector contributes funding in order to transport infrastructure provision and operation will differ between sectors. But generally the private sector can be engaged in all phases of the project cycle in the sectors. When a government first decides to engage the private sector in infrastructure, it might consider outsourcing services that were previously conducted in-house. This will enable competition between private firms and costs will most likely come down. Various options for outsourcing are possible and typical examples are design work, maintenance contracts, etc.

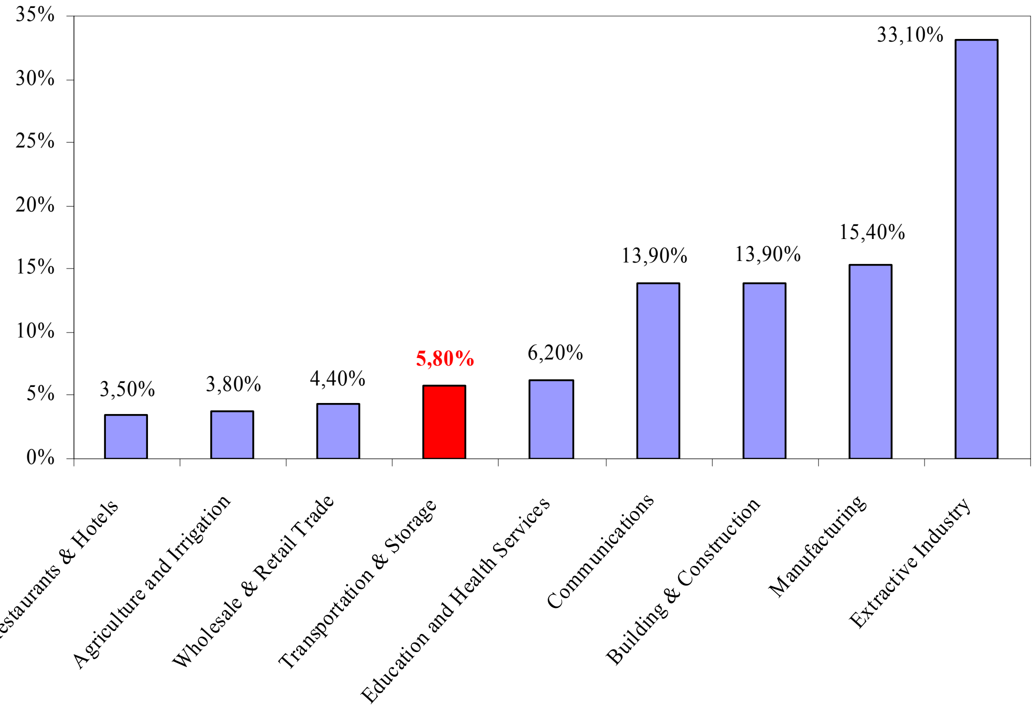

Figure 43: Distribution of Private Investment Target by Economic Sectors in years 2009/2010

Despite, the rationale for private sector involvement in rail projects is primarily the same as for any other project to enhance the use of private sector funding and expertise and improve allocation of risk for the cost-effective and efficient delivery of a project. At the global level, particularly during the past century, the railway projects have rarely been commercially self-supporting. This is primarily a result of several factors, including the large investments in advance, the difficulty in developing stable and the economic challenges in passing the true cost of usage to the direct user. Over the years, governments have buy varied strategies to follow-up quality rail services at the lowest cost and have developed public policies that aim to making public transportation accessible and affordable. This aims has at best only been partially fulfilled under both public and public-private approaches.

Private financing of construction is generally associated with continuing public sector responsibility for strategic network and location planning. There are many ways in which the private sector can contribute to the development of the transport system [235]. For instance, the private sector can be engage directly in financing new investment, as is the case in many rail projects, with the operator of the infrastructure repaying the loan. This introduces the issue of the impact of private sector objectives, surely the financial return on investment in the specific measures covered. Another possibility is that the private sector can be involved in the operation (and possibly also in the financing) of the infrastructure, deriving its revenue from the user. This leads to the imposition of user charges through fares and parking or road use charges. These are usually determined in order to maximize revenue, and this can significantly impacts the result of the overall strategy.

The private sector generally sought commercial profit either through return on investment, or as value taken over through the introduction of improvements in the transportation system. Although the higher costs of capital raised from HSR and the need to cover risks and achieve profitability, it has often been reason that the overall cost to society could be lower with private financing, than if the government were to provide the facilities through charge of tax proceeds. The following goals of private financing can be determined [236]:

- Minimization of the impact of additional taxation, debt burden or financial guarantees;
- Introduction of the benefits of private sector management and control techniques in the construction and operational phases of projects (possibly leading to lower costs);
- Promotion of private entrepreneurial initiative and innovation in infrastructure-true projects; and
- Increase in the financial resources that might be available for the projects.

Finally, the order of the government and private sector arrangement may be, it is important to note that finance for HSR systems almost always depends on the contributions of external capital. This is because HSR almost always requires substantial financial resources, as well as the financial leverage to be able to borrow such resources. Whereas some HSR systems are able to cover the cost of operations and maintenance from the revenue received from fares alone, the upfront capital costs, in the form of track and other physical infrastructure, are usually prohibitively expensive, without the financial assistance of government. Even the most successful private companies in Japan were initially government-owned entities that benefited from government investment in capital. While successful independent companies in Europe usually own and operate their own trains, but run those trains on track that was initially paid for by the state. Whatever form HSR government and ownership might take in Egypt, it is likely that it will require an infusion of capital from the public sector, and private sector.

7.5 Partnerships of Public Private in the Transport Sector

Egypt witnessed a lot of accidents in road, trains and ships over the past five years to the point that citizens are beginning to describe the government as a disaster government. Despite the increase of population of more than 78 million people in Egypt, where Egypt is the one of the most populous in Arab country, the ratio of spending on infrastructure of national income in the past twenty years. As transportation, energy networks, which bear on its need to develop processes billions of dollars to get to the level of economic growth that the country needs to find enough jobs for the rapidly growing labor forces. The government is trying facing a large deficit in the budget to attract the attention of private companies for works projects such as rail, ports and highways, energy and others. Where this approach might be fruitful, but has not been tested to a large extent:

Transport infrastructure and transport services have strong features of public goods, which distinguish them from goods that are sold and bought on the free market. Economic theory and practice show that the free forces of supply and demand will in many cases produce the economic optimal solution. Public authorities, therefore, will often find it necessary to regulate transport infrastructure and transport services. Even in countries were entire transport sectors are privatized, there is usually some form of public regulation. However, this does not mean that the private sector cannot and be involved in transport infrastructure and transport operations. The aim is to combine private sector efficiency with public sector policy setting and regulatory oversight in an optimal way.

7.5.1 Public Private Partnerships, PPPs

The first question what is Public Private Partnerships (PPPs)? What conditions do affect the building of a PPP? Define PPP as a sustained collaborative effort between the public sector and the private sector to achieve a common objective while both players pursue their own individual interests. This definition means that in a PPP each partner shares in the design; contributes a fraction of the financial, managerial and technical resources needed to execute, and sometimes operate, the project in accordance with each partner's comparative advantage. Thus, partially takes on the risks associated with the project and obtains the benefits, expected by each partner, which the project creates. So, in order to fulfill the criterion of a partnership there must be some ongoing set of interactions, an agreement on objectives and methods as well as a division of labour to achieve the goals. If private companies take on more risks than usual contractor risks and are also engaged in the project's financing, the projects are called PPPs. In PPPs, especially in its most known form of Build Operate Transfer (BOT), a private company designs, finances, constructs and operates transport infrastructure. Nevertheless, before starting a PPP process, public authorities should ask themselves whether a PPP is the solution to their problem. It is a wrong to believe that PPPs are solutions for basic problems facing a transport sector [53]. PPPs are often started in the hope of overcoming such sector-wide problems. However, PPPs on their own cannot solve sector-wide problems; they are solutions to concrete project issues.

It can be suggest when starting to implement PPPs in Egypt should probably start with simple and small projects before engaging in large and complicated projects. Because of the existence of user charges, port and airport projects are normally easier to implement than road or railway projects. Because the airport sector have dedicated revenue stream and the contractual arrangements between the different parties are less complicated than in other sectors. However, in the railway sector it is more difficult to engage the private sector, as railways are often integrated companies with each other. Where, possible to open the field competition for design, construction and maintenance can be introduced in such integrated companies, but in order to introduce competition for operation, railway companies will have to be unbundled. **While it may be possible to some privatize railway lines as integrated companies, particularly some freight lines, if governments want service competition they will have to unbundle the railroad tracks. One option is to establish a separate company for infrastructure and allowing (private) operating companies to use this infrastructure.**

7.5.2 Public Private Partnerships in Egypt

The Egyptian policy intends to offer infrastructure projects such as highways, airports, and power plants to investors. The role of investors is to finance a project's studies, design, construction (and operation) through a predetermined concession period. The current evaluation situation of private sector participation in the Egypt, private companies are involved in all areas of transport; however, the extent varies from sector to sector. In Egypt private sector involvement within the road and railway networks is limited to design, construction, and maintenance. However, within the road network, the majority of the construction and the maintenance works are carried out by publicly owned companies. Besides the transport sector, private companies have a strong influence within the telecommunication, water, and electricity sectors [Figure 43]. Since 1991, private companies have partnered with the government to implement 16 projects, mostly in telecommunication but also contain little of transport projects. Thereby, within the transport sector, the majority of private participation takes place in the port and airport sectors. There are several laws for these sectors governing private sector participation. since year 2006 the government of Egypt adopted a new long term policy of pursing partnership with the Private Sector to provide a new source of investment capital for required infrastructure projects, reduce the government of Egypt sovereign borrowings and associated risks, drive the creation of local long-term funding markets, create a new private sector facility management market, expand the economy, stimulate job creation and increase the quality of public services to the Egyptian Citizen.

It should be mentioned that, in line with Egypt's strategy to promote and increase private sector interference in the social development plan and countries economic especially in the area of public facilities services and infrastructure, the government has taken the initiative to introduce Egypt's PPP programme, which has culminated in the establishment of a PPP Central Unit within the Ministry of Finance. The PPP Central Unit is charged with coordinating the national PPP programme across ministries and public bodies and reports directly to the Minister of Finance and the Ministerial PPP Committee on the progress of PPP projects[100]. A specific action plan has been implemented to determine a number of infrastructure and services projects that could be offered to investors under a PPP structure. Examples of such projects include in Transport among others:

- The Ain Shams 10th of Ramadan Railway project
- The Cairo/Alexandria Desert Road project
- The Port Said/Matrouh Road project

Some PPP mega projects in transport sector particularly in the railroad system are shown in Table 45.

PPP in Transport Sector The Ministry of Transport has submitted its request to the Ministry of Finance for the initial study and implementation of projects under the umbrella of Public Private Partnership. This can be applied if the PPP application is approved by the Ministry of Finance, The procedure of applying for a PPP scheme is the same for all Ministries. When a Ministry wants to support a project with the use of a

[100] The Egypt PPPs are key to the Government's economic reform agenda and strategy to increase private sector involvement in public services through leveraging private spending against public spending; where It can be noted that, the PPPs in Egypt will be; Provide a new source of investment capital for required infrastructure projects; Reduce Government sovereign borrowings and associated risks; Drive the creation of local long term funding market; Utilize efficiencies of private sector in running public services; and Expand economy and stimulate job creation Increase quality of public services to the Egyptian citizen

PPP, first it has to make an application to the Ministry of Finance. The application not just simple paperwork, a folder with many documents has to be submitted, and, if it is accepted, then the project is enlisted in the program of public investment [161**].** The choice among similar projects is made according to the lowest costs. The Ministry of Finance prepared this new legislation, which will govern the relationship between the government and the private sector in future, PPP projects. The destinations for investment in infrastructure in developing and transition economies in the 1990–2003 period such as Egypt is $689 million and about 0.7 % from the total investments of private sector involvement [157]. For instance, in Egypt, the contribution of the expected investment of the PPPs in transport project about $7 billion in the period from 2009 to 2013 [162].

7.5.3 The Specific Aspects of Private Sector Participation in the Railway Sector

The responsible authority for the national railways and metro systems are the Egyptian National Railway, a body of the Ministry of Transport. The Governorate of Cairo and the Governorate of Alexandria take responsibility for rail systems in their area. While, about 50% of railway expenditures are covered by fares and other revenues such as advertising. The public budget does not have enough allocated to construction a new high speed rail, this meaning the private sector needs to join in completing such projects. In the previous Table 24 shows the transport infrastructure and management funding project in Egypt at present. Since 1981, the Egyptian National Railways entered into two joint venture companies, one with a German partner and another with a French partner. These companies, Egyptian German Railways Construction Company and Egyptian French Railways Construction Company are responsible for the rehabilitation, maintenance and new construction of lines.

A comprehensive restructuring plan for the ENR is under implementation. A new organizational structure was launched in 2008 to support the reform programme of the railways, this reform programme includes PPPs. There are two projects with total investment cost of $792 million in planned and under study for the Egyptian railways [Table 45]. These two projects under the PPP beginning the government of Egypt are planning. The first project is establishment of the line between Cairo and the Tenth of Ramadan City, the project characteristics of this line is: The project will include two components:

1- Upgrading the existing single line, while constructing a second line (making it a two-way or double track) between Ain Shams (Cairo) and Al Robaiky (45km in length).
2- The construction of a new, double track line from Al Robaiky to the 10th. of Ramadan industrial and residential area (32km in length) A connection to the Delta Network by extending the line to Belbais (30 km in length).
3- A connection to the Delta Network by extending the line to Belbais (30 km in length)
4- Operation and Maintenance of the whole line (including the Belbais Link)
5- Refurbishment of existing stations and construction of 6 - 12 new additional stations
6- Procurement and operation of new rolling stock for passenger services and maintenance of the new railway
7- Provide for future further growth of the railway and allow access to new train operators.

The aims of this line is the facilitate movement of the employers \population from Tenth of Ramadan City to Cairo and the opposite the number of passenger transport more than 20 thousand employer per day to and from the Tenth of Ramadan City. In additional the exploitation of the line to transfer the goods to and from difference ports through a network of railways. The project Ain Shams -10th of Ramadan railway line with total investments about $727 million[101], and the second project is relocating the Matrouh railway line[102] with total investments about $65 million [158;159]. The cost of this line is high compared with the second line because in the first line passes in the densely populated areas, for the second line will be passed in the desert areas.

Although the large variety of approaches to financing rail services and facilities, however, there is a discernible current trend towards greater private sector participation in rail activities, especially those of mostly commercial nature such as passenger handling. Railways are rapidly becoming a normal industry through the introduction of private money that ensures greater competition, higher productivity and probably lower costs. So, the financial transfers and subsidies to the railways sector must be made more transparent from the policies to the private sector.

Table 45: Expected Status of Railway PPPs Projects in Egypt

Railway Project Name	Length	Investment Cost	Project Stage
Ain Shams- Tenth of Ramadan	104 km	$727million	Green field
Relocating the Matrouh Railway	60 km	$65 million	Yellow field
Alexandria – Marsa Matrouh	300 km	N/A	Red field
Sidi Gaber/Borg Al Arab	60 km	$150 million	Green field

Source: [62; 158:159]

As yet, the benefits of private involvement in rails are strictly limited to construct some lines such as in Table 45. Until very recently, political interference and the structure of rail management had not changed to meet the new circumstances. Therefore, must be to make the financial transfers between the Government and the railways sector much more transparent. Also so far, commercial services are services operated for profit, in a competitive and deregulated environment, with no direct or indirect financial support from the Government. The railway operator enjoys full freedom to determine the configuration and tariffs of commercial services, without any Government intervention. For this reason the private sector have a limited impact to financing of rail infrastructure. Almost all railways in Egypt are subsidized which means that a new rail will almost certainly have to be subsidized too. But if it is to compete with other transport, to be necessary to develop and improve services by involve the private sector.

From the above analysis it can be observed that, to use of PPPs requires a stable legal and political framework, otherwise it is unlikely that the private sector will be willing to enter into a long term contract to provide public infrastructure. Only if a country's political system is stable and the government reliable wills the investors and financiers be assured about their property rights. PPPs also require transparent procedures and

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[101] The total distance between Ain Shams and the10th of Ramadan link is 77 km; and the possible extension link between the 10th. of Ramadan City and Belbais is 30 km in length. The project aims at giving concessions to the private sector to construct, operate, maintain and finance a railway line from Ain-Shams to the 10th. of Ramadan city (with the possible extension to the city of Belbais) under the comprehensive PPP scheme supported by the Ministry of Investment.

[102] Relocating the Matrouh Railway line from Fukkah to Samalla area (from the north side of the international road to its south) with a length of 60 Km. The relocation would avail the land for better investment utilization as it enjoys a sea front with 1.52- Km depth, also the project aims at giving concessions to the PPP to construct, operate and maintain.

rules, which are defined before concessions are tendered and awarded. Governments sometimes use PPPs in order to reduce significantly the burden for the public budget. However, this often assumes that revenues to repay the investments are collected from users, via tolls, fees, etc. This requires certain willingness to pay and sufficiently high traffic volumes. However, many of the countries do not have very high income levels, which make it unlikely that users will pay the required fees for the infrastructure usage. Revenues from users in many countries will, therefore, not be high enough to repay the investments. A large portion of the funds necessary to repay the investors, especially in the road and railway sectors, will have to come from the government's budget. Investors will want to have assurance that the public authorities will be able to pay shadow tolls, availability fees or subsidies during the concession agreement period.

It can be observed that, the best known PPP model applied in transport is probably the BOT scheme. The private concession company is not the owner of the physical infrastructure, but only has the rights to manage and charge for the usage of the infrastructure. The legal owner of the infrastructure is the public authority. For example in Taiwan the THSR is one of the world’s largest privately funded railway construction projects. The total project is estimated at US$15 billion and is being funded by the THSRC under a concession agreement by which the consortium has a 35-year franchise to design, finance, build, and operates the THSR and will then return back the entire project to the government or a third party nominated by the government [160]. Consequently, if Egypt had followed the same path to applied this kind from privately funded in the proposed HSR line in Egypt, it can be get great benefit from the private sector. In the next section will be showed the importance advantages and disadvantage for the PPP and the obstacles factors which impact on the PPP. Where, can be used this into account when needs to make the PPP with future project in the transport sector in order to make more successful.

Finally, Egypt has PPP more experience only in the port and airport sectors, only a few tasks are conducted by private companies within the road and railway sectors[103]. For example, the majority of road construction, road maintenance and road operation are still fulfilled by the General Authority for Roads, Bridges and Land Transport. However, there are many projects under study, study underway, and under preparation and the private sector might soon play a major role in the road and railway sectors. In order to strengthen market forces within these sectors, the Egyptian Government should withdraw, step by step, from the construction, maintenance, and operation within the two sectors. Initial PPP projects in these sectors could be achieved as pilot-projects in order to assess and modify the approach if necessary.

Consequently, reform could be continued with the aims of regulation competition within the market. This could be done by making the infrastructure unit a separate corporate entity charging toll for the passage of trains and liberalizing the train operating market. Where, new operators would be attributed licenses to operate trains on existing tracks and pay a toll for the infrastructure usage. Thereby, operators would compete on ticket prices, rolling stock, on-board services, attractiveness, the most convenient timetables, etc. It should be mentioned that, Barriers to entry for private

[103] Even though Egypt does not restrict foreign investors from full participation in privatisation projects, the government does use some post-privatisation control devices, mainly in the form of maintaining minority shares in part-privatised companies [174]. Government monopolies exist in some sectors such as fixed-line telecommunications, electricity distribution, gas distribution, railway infrastructure, and postal and delivery services.

sector operators are much lower in this kind of competition than in PPP plans, where heavy investment in new tracks is needed. It should be noted that such a scheme would not require privatizing ENR. Private competition would do pressure on ENR to improve its service quality while remaining a state-owned enterprise. The PPP unit within the Ministry of Finance is responsible for overall PPP regulations and setting up the PPP guide. The PPP unit in the line ministries, as in Ministry of Transport, is responsible for the ministries PPP projects. Coordination between the two units occurs at different stages of the projects cycle.

7.6 Findings of the Private sector in Developing Countries such as Egypt

The corporation arrangements of infrastructure of railway finance in Egypt vary widely, reflecting the significant differences in their ownership and organizational structures. Railway management often depends on public authorities and is subject to various degrees of regulation. Railways infrastructure has long been regarded, which is a pure public good regulated and financed by the government. However, fully privatized rail activities are rarely identified, as it is still not attractive to private investors to invest in infrastructure without government

But it seems that there is a clear trend in recent times towards greater participation in the activities of the rail. Financing of particular infrastructure rail facilities (particularly those with predominantly commercial services) is increasingly becoming the responsibility of the private sector, while the government (or public ENR authority) tends to restrict itself more and more to its landlord role.

However, fully privatized rail activities are rarely identified, as it is still not attractive to private investors to invest in rail infrastructure without government involvement. This is primarily due to some specific risks caused by several properties (public interest) of transport infrastructure. In analyzing investment projects of the railway in Egypt in particular, it will be found that in all projects both the government and private parties play a role see Table 45.

In order to find some solutions for financing in the developing countries it is important to explain the three main axes according to [237]:

1- Established a various tools able to attract and secure money for the long term at a limited cost, especially the sovereign funds, pension funds and other funds related to public enterprises, in order to combine institutional guarantees (management of multilateral aid like EIB and WB) and financial guarantees not sovereigns (funds of financial guarantees on voluntary basis), due to cover the repayment of loans which will be applied to pay an interest rate acceptable..
2- Establishing procedures for a significant increase of public subsidies geared towards priority infrastructure projects, especially with the EU's budget, focussed at funding feasibility studies which are often inadequate or to significantly improving the internal rates of return of the selected priority projects.
3- Stimulate the development and the adoption of a regional system for legal protection and juridical branches of the investments related to the priority projects, with a homogeneous, simple and simple and attractive to advocates of national and foreign investors.

The previous parameters are inter- dependent components of an unique architecture, amid to attract investors for this kind of projects, which have to be well selected and prepared, within a robust institutional frame essentially multilateral which can benefit of significant subventions and of juridical and financial regulations, in order to guarantee investors, promoters and lenders. It should be noted that, in this context to decide if some pilot can be firstly selected, in order to deep the analysis for the following priority projects.

It can be concluded that, it is appropriate for the private and public sectors to cooperate and jointly fund transportation and promotion of infrastructure project. Therefore, policymakers should ensure that replacement of public investment for private investment while does not favour one private company over another. If not properly structured, government support for infrastructure projects could actually lead to the overall reduction in net investment by government away private investments that cannot compete against public investments.

Thus, should railroads be expected to fund investments for which they derive little or no benefit of the ridership mobility. The benefits of the new HSR rail or line relocation projects, for example, are overwhelmingly public benefits, so the public should fund such projects. However Railroads in most developing countries such as Egypt have limited funds available for rail investments. Whereas public sector for alone can not implement this project. Also forcing them to fund projects for which they derive insufficient benefits would necessarily mean reduced private investment and diminished rail capability.

Finally it is necessary, as current Egypt policy is aimed at fair competition without deforming market regulation; it is likely to expect that the Egypt will inhibition of financial involvement of public authorities in the railways sector. This means that, despite the risks, existing subsidies may be reduced and new lines will be built without tax payer's money.

7.7 Some Cases of Privatization of Railways over all the World

At the international level, the private sector is involved in the provision of transport services and infrastructure in various forms:

- Direct private ownership and operation of transport infrastructure (such as worldwide, railways in USA, UK, Australia or South America).
- Private operations of state owned assets in the form of concessions (such as railways in the UK, airport terminals in Asia).
- Various forms of PPPs where the public and private sector work together to build and operate transport infrastructure (mainly roads worldwide).

Mostly, the reasons to participate the private sector in transport are twofold: achieving efficiency gains and fund raising. Consequently, if the operation of transport services is separable from that of infrastructure, transport operations by the private sector will usually be more efficient than state provided services, and able to finance investments in equipment and the subsequent operations without government interference

The most exciting privatization was that of the former British Railway in 1995. the Rail infrastructure of the railway was given to Rail-track, a private company, which due to economic problem and a series of accidents was re-nationalized partially in 2003 (the establishment of the rail network). It was therefore possible to conceive of a core railway that could be transferred to the private sector without need of subsidy. In spite of evidence that railway in Britain were operated much more cost efficiently than their European counterparts. It was the provision of track, station and depots to companies wishing to operate trains, the responsibility of Rail-track and Rail Network. Therefore, passenger train service in the UK are provided by 25 train operating companies, which submitted their offers successfully for the right to operate service in a specific area, for a period of 7 to 15 years, with a medium state support of 81%, some of them being subsidized at even 351% [170] [171]. Privatization in the BR was supposed to bring improved customer, service and many rail lines have seen improvements in this field with better on-board and station services. In addition to this, safety where the railway can point to continued improvements in safety under privatization.

Also there are another successful privatization was that of the former Japanese Railways in 1987, which were taken over 6 private companies for passenger transport (each one owing its infrastructure) and one company for freight (which pays fees to use the infrastructure of the above-mentioned 6 companies). In 1999 the state of Victoria in Australia, all public transport (trains, buses and tramways) were private. For concession period of 10/15 years, the successful bidders were those who asked for the lowest state subsidy. Privatization of railway was also successful in New Zealand, without any claim from private operators for state subsidies [172]. The World Bank has been promoting and facilitating railway privatization since 1991, in most developing and transition countries have been applying the privatization since 1991 to 2007. In fact seven countries in Latin America and 16 in Africa have privatized whole or parts of their railways (in some cases, two countries share a railway, and the concession arrangements have continued that arrangement). The benefits of privatization railway also lead to the retrenchment workers, and loss of jobs, for example Brazil now large-scale retrenchments to occur both in preparation for and following privatization [173]. The standard approach has been long term concessions, usually lasting for 25 or 30 years. Responsibility for maintenance of infrastructure, such as track, signalling and depots, and for running freight and passenger services, passes to the concessionaires. In the big countries, there have mostly been several concessions [173]. For example, Taiwan the THSR (see section 7.5.3), and Brazil (which has Latin America‘s largest railway by far) began with seven regional concessions, although their ownership has since consolidated into three companies

7.8 Advantages and Disadvantages Public Private Partnership

The overall aim of Public-Private Partnerships projects is to find solutions to problems in which the advantages of the public sector are combined with the advantages of the private sector. When done right, PPP projects can be very powerful tools to rapidly construct new infrastructures quickly and operate them efficiently. Experience has also shown that they may sometimes go wrong, creating transportation systems that are inefficient, under used and loss making [53]. However it will now take a look at the advantages and disadvantages in some more detail. A PPP offers many advantages for the public partner, for example improved the quality of service, more value for the invested capital, lower project costs, lower risk, faster construction, better budget fulfillment and increased revenue. The private partner benefits from increased economic activity, higher margins, entry to new markets, and long-term revenue streams. According to The US Department of Transportation lists six reasons for the public sector to enter Public Private Partnerships [72]. They include:

- Accelerating the implementation of high priority projects by packaging and procuring services in a new way,
- The provision of specialized management capacity for large and complex programs by the private sector,
- Enabling the delivery of new technology by private firms,
- Drawing on the private sector expertise in accessing and organizing the widest range of private financial resources,
- Encourage private entrepreneurial development, ownership and operation of transport systems,

- Improved efficiency in construction, operation, and maintenance of the infrastructure should arise from innovations in service delivery, incentives in the PPP contract, and better institutional integration throughout the life of the project
- The identification and allocation of risks among the partners leads to efficient risk mitigation, monitoring and management systems.
- The true costs of transport facilities during the entire lifecycle are made transparent. This favours projects with high economic benefits, although they may have less political support.
- Because the private sector invests part or all of the funding needed, public sector funding requirements are reduced.
- Because private funding is available, projects can start earlier.
- Because of private project management skills, projects are often implemented faster and cheaper.

Nevertheless, these advantages are only available if the PPP is properly prepared and executed. Otherwise, the disadvantages can override any potential benefits such as:

- Because the private sector has higher borrowing costs than the public sector and because of the requirement to remunerate the equity, the capital costs of PPPs are higher. This needs to be offset by cost savings arising from competition resulting from a properly executed public tender and by the efficiencies arising from the introduction of private sector skills.
- Because public funds are committed over a long-term, the public sector has limited financial flexibility.
- Private partner may be exploited in the PPP project by other private partners. The most typical example of this is the Euro Tunnel project, in which the company that owns the tunnel is forced to pay very high interest rates to the financing partners [73].
- The costs of planning the PPP solution may be very high compared to the perceived gains from increasing the involvement of the private sector. One way to handle this type of cost and risk in PPP projects is to develop competencies in the national education and innovation system, for example by means of a knowledge centre.
- The advantages with increased private involvement in infrastructure projects may deter by badly designed contracts that may either include way too high or way to low compensation to the private actors in comparison to their efforts and bearing of risk
- Preparations for a PPP are more complex, more expensive and more time consuming than preparations for a conventional project.
- To prepare, implement and monitor a PPP project requires dedicated resources from the public and private sector.

All the above parameters it must be consideration in the PPP before start any project, especially if the project is a national project and with high costs.

7.9 Obstacle faced by the Parties Involved in BOT Projects in Egypt Transport Sector

Until now in the Egyptian environment, investors and promoters have had many fears toward announced projects. In this section the obstacle which facing to implementing of the BOT system in the Egyptian environment will be discussed. Thus, it can be achieved by giving a clear view of BOT and of its problems, risk areas, and features, pertaining to the Egyptian environment, in order to maximize the benefits and minimize the risks to the maximum extent possible. The BOT projects may face some problem and risk; risk is in the nature of such projects. Some of these problems concern the promoters, but if it is taken into consideration that contractors and suppliers are shareholders and promoters, then the problems of BOT are also problems that face contractors, suppliers, and so on. Thus there is some of the Risk factors are classified into six categories, namely;

- Political Risk
- Financial and Commercial Risk
- Legal and Environmental Factors
- Technical &Management Risks
- Construction & Delay risk
- Market and Revenue Risk

In the Table 46 will be shows the major problems and risk areas that may face the BOT projects in Egypt. Moreover, Table 47 shows the different phases of BOT projects and their problems. According to [163] and based on the questionnaire survey, it can be noted that, the most anticipated risk elements in the Egyptian environment are Political Risks; finish of privilege by government, raise in taxes, changes in law. Construction Risks; cost overrun, land confiscation, increases in financing costs, variations, and time and quality dangers. Operating Risks; Finish by Project Company, government department default, and project company default and Market and Revenue Risks; Monopoly, insufficient tariff, and insufficient income .

All of these risks make it difficult to estimate costs and demand for reliable, all the risk of has its own distinct influence on these variables. A shift in policy, for example, may lead to building a tunnel to protect natural areas, while at the beginning of the project the road was planned to cross the area. This leads, of course, to higher costs that could have never been estimated at the start of the project. There is a clear example of business risk is that of the OE Resund bridge between Sweden and Denmark have been overestimated traffic too, which led to the loss of revenues have been disappointing.

In conclusion, the risks of infrastructure investments are comparatively high and, thus, private sector interest commensurately low. Clearly, the public sector has a role to play here by making investments more attractive. This could be done, for instance, by means of joint-risk arrangements (guaranteeing a public subsidy if the use of infrastructure is below expectations), or by guaranteeing a minimum profit ratio. Interestingly, however, some types of infrastructure, such as telecommunications and seaports, seem to be more appealing to the private sector as show in Figure 43.

There are also some factors leads to affect of a BOT project. Whereas, government should guarantee a helpful environment to BOT project delivery method. To achieve this status, an assessment of BOT feasibility factors must be carried out on the country level (Government and investors need to evaluate the factors which make the host country attractive to foreign investors.) and the project level. For project level, there are many factors to assess the viability of a BOT project and there are three main levels; BOT project viability, three major categories (legal and environmental, technical, and financial and commercial), and the relevant attributes the three major categories. In Figure 44 displays the flowchart of BOT project case analysis for any country and the project levels [166].

Table 46: Major and Risk Area of BOT Projects

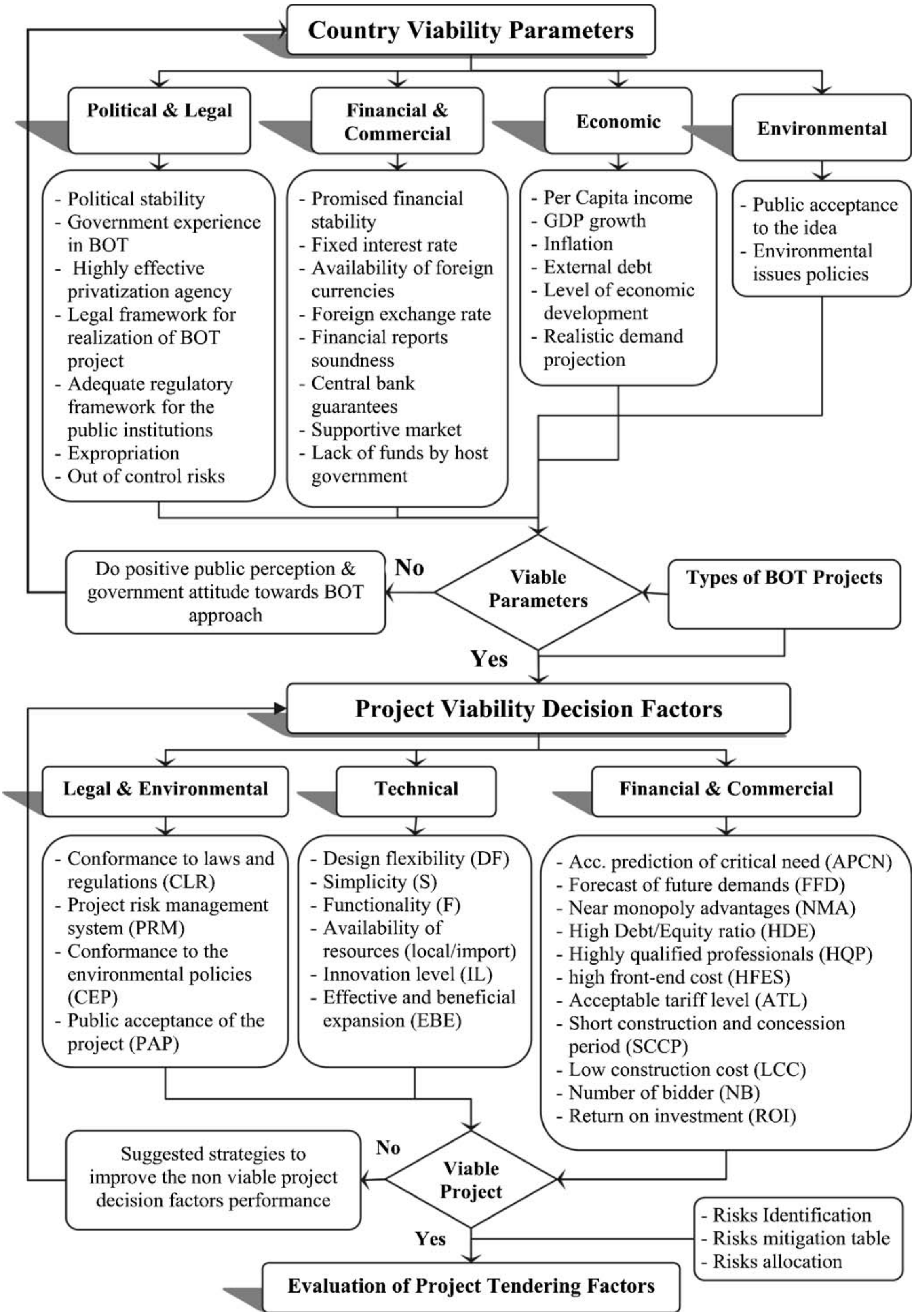
Problems and risk areas	description
Off-take arrangement	Uncertainty of total product Distribution (take or pay) agreement
Supply arrangement	Inability to obtain the necessary quantities of production requirements (e.g., fuel, water, raw materials)
Environmental laws	Additional-cost technical problems due to use of recommended technology or method of construction
Force majeure	Unavoidable events interrupt the construction or operation due to • Nonpolitical events • Domestic political events • Foreign political events
High development costs	Time and cost-intensiveness of developing a typical BOT project

Table 47: Problems of BOT Projects Related to Their Phases

Phases	Problem
Identification	Lack of consistency and poor governmental management
Government preparation for tender	• Unrealistic or unclear government's criteria for project award • Unclear or unapplied terms of competition in the request of proposal
Sponsor's preparation of a bid	High development costs • Choice of attractive equity/debt ratio • Determination of shortest concession period
Selection	• Legal constraints in applying evaluation criteria
Development	• Problems related to project company formation. •Problems of contract drafting
Implementation	Construction risks
Operation	Operating risks
Transfer	Applying concerned terms in concession

Sources: [163]

Final, infrastructure is fundamental for the quality of life. Because of the changes in technology, size of projects, and economics in the last decades, a viable mechanism was necessary to take charge of important projects in transportation, and other areas. BOT has featured as welfare and adequate option to build infrastructure projects with private financing particularly in developing countries. There are so many factors that affect the decision for BOT providers on either to take certain projects or not. There are some factors on the country level and there are some other factors on the project level [Figure 44]. After deciding the project is feasible, the private sponsors must assess the risks involved with the project to expect solutions for them. There are financial, political, construction, operation, and market risks that need to be evaluated carefully. Learning from others experience is very important particularly when mistakes' cost is very high, bankruptcy for example.



Source: [166]

Figure 44: Partnerships between Country and Project BOT Feasibility Analysis.

7.10 Summary

In this chapter beginning with the discussed a cost benefit analysis and also this chapter presented various aspects benefits of HSR. This benefit includes the travel time saving, passenger safety, cost savings, comfort and convenience for passenger. Additional, the non user benefits such as highway congestion, maintenance cost and safety cost savings, also airport reduced congestion savings. In term of the consumer surplus, however, it is usually impossible to derive the value of consumer surplus carefully because the estimation of demand at various level of service is very difficult. Rather, decomposition of above benefits has been often preferred to make analysis more accurate. Consequently, CBA is useful to decompose the fuzzy word of regional benefits of HSR into concept sub-benefits that can be estimated quantitatively. It is noted that financial viability is a key issue in any project of transportation, but a CBA can include other benefits outside the entity responsible for the process as long as these benefits can be measurable in a quantitative way and without double-counting. However, if a thorough and comprehensive net-cost analysis is positive for a specific HSR project, it would be safe to say the project is feasible and may have positive impact as a whole. Therefore, assessment should be on the basis of each case; general conclusions are difficult to derive. The problem arises when the cost-benefit analysis fails to prove feasibility of a project.

It can be seen in the Table 43 that, the two proposal corridor are positive in viewpoint of the CBA. In this chapter, the methods to calculate benefits by various HSR projects were discussed and the proposal HSR line in Egypt were analyzed by using CBA models. For the corridors Cairo (with population 10.77 million)/Alexandria (with population 4.51 million) and Cairo/Assyut (with population 3.9 million), **the results of the economic analysis in terms of the Net Present Value (NPV), and the Benefit Cost Ratio (B/C) are presented in the Table 43 for these two proposal corridors in Egypt. The economic analysis indicates that the HSR of the proposed project is economically viable; returning a positive NPV of €11.62 billion and €18.17 billion respectively, following an investment of €3.88 billion and €8.15 billion respectively, and the estimated B/C ratio is 2.99, and .2.23 which supports a decision to invest in the project.** It was found that the net present values for both corridors are positive and so the proposed project would increase net benefits to society. Thus this may be attracting more passengers by HSR and also reduction in travel time is the key for success of high-speed rail. **But for the corridor Cairo/Luxor-Aswan (**with population 1.32 million**) the net present values for this corridor is negative and the NPV of €5.04 billion, while the total investment costs about €9.16 billion. So, the estimated B/C ratio is 0.6 which are not supports a decision to invest in this section.** The results obtained suggest that the introduction of the HSR in Egypt was not justified in economic terms in this corridor. It will be compare this result with the case of building HSR between cities in Spain. According to [240] it was found that, the comparative economic evaluation of the net present benefit of two Spanish HSR lines illustrated the factors needed for an economically successful system. On the one hand, the line connecting Madrid (with population 5.5 million) to Seville (with population 1.1 million) results are a negative net present value under all sensitivity tests. On the other hand, the line connecting Madrid to Barcelona (with population 4.9 million) would generate a positive net present value under all sensitivity tests. This leads to the a multi-million person regional city was needed to anchor the first stand alone line, thus, Spanish case of an initial, isolated, unique gauge HSR line in a middle income country.

Table 43 shows the sensitivity of results to different assumptions: life of the project (40 years); and estimated the GDP growth factor about 1.07 every year. A cost-benefit analysis of the proposal high speed rail line in Egypt is carried out based on the best available information about demand and cost with data provided by ENR and other transport operators, and with the values of time and accidents used by the GARBLT. In order to estimate the demand increase, and estimated benefits have been tested with a sensitivity analysis extending the life span of the project to 40 years, raising the GDP growth factor to 1.07, using shadow prices for labour and increasing generalized costs of train, to allow for differences in quality. The results obtained suggest that the introduction of the HSR in Egypt was justified for the two corridors (Cairo/Alexandria and Cairo/Assyut) in economic terms, and not justified in economic terms for the third corridor (Cairo/Luxor-Aswan).

For example in the proposal HSR in Egypt may be the benefits of the regional development increase. In the short term, it is argued; jobs will be providing in planning, designing, and building HSR. Moreover, there are many values are often claimed as benefits of high-speed rail. However, many of them are indirect and may lead to double-counting and therefore would be treated carefully in a cost benefit analysis such as; population increase; increase of gross regional product; increase of income per capita and development around stations. Nevertheless, new HSR will make profits to represent accessibility, where, travel time reduction due to infrastructure development will increase the accessibility of the regions connected by the HSR.

As indicated above in Figure 41 the types and directions of travel by high-speed trains linked closely to the conditions that they are developed and operated. Just make a high speed service does not of itself enhance the city's economy, nor necessarily support it. It can be observed, if a high-speed rail service is to play a really positive role, then it has to relate to the activity patterns and developments in the workplaces. This could involve the design of the development of cities that are being modified to the opportunities arising from the construction of high-speed line. It can also include the design of the high-speed line being related closely to the development and economic patterns for the city and region. Thus the focus is very much on the service sectors of the economy: business, public administration, leisure, commerce, and tourism. It follows that the economic activities which benefit from high-speed train service provision lie in these fields. By improving accessibility, HSR, it is thought, will stimulate economic development and the creation jobs of long-term, particularly around high speed rail stations, especially in the areas of Alexandria and Greater Cairo. However, accessibility of a region is affected not only by travel time but several other aspects such as frequency of service and reliability of the transportation mode.

This chapter has presented the current economic background to funding and programs for recent transportation development in Egypt. Details about projects planned by the Egypt government were discussed. Moreover, the distributions of private investment target by economic sectors were discussed [See Figure 43]. Thereby, the development of high speed rail and its contribution to Egypt economic development were also discussed. The aim of explain the distribution of the overall investment in the Egypt, it can be see in Table 44, where, it can be found that the great role that business sector is expected to play in implementing the investment plan.

Certainly, through this chapter it can be observed that, a high-speed rail investment will have positive impacts on regional economy to some extent when we view it as public infrastructure investment, but its magnitude is not guaranteed to be as high as other public investments. Investment this project need to greater from finance, but the Egyptian government it can not alone implement this project in future without private sector. Furthermore, the private sectors in Egypt focuses on projects that yields high profit. It can be clear that these projects can generate high profits over the years, in order to encourage the private sector to support the government and participate in the implementation of these projects. Transportation infrastructure may be a necessity for regional development, but it is not sufficient alone. It can be noted that, there are non-traditional sources of funding for rail projects, which must be taken into account. Projects is the establishment of railway lines and safely the accessories and tools of the biggest projects and the cost of such a burden on state budgets, which own these networks the establishment of the railway lines project and secure the supplies and tools of the biggest projects cost, therefore, it constitute a significant burden on country budgets, which will be create a new high speed rail line in the future [as shown in section 6.8]. In the developing countries the funding of the railway project usually it bears the burden of funding by government. Therefore, it will take in thinking about a new climate for financing railway projects (especially in the new high-speed lines projects) such as: getting aids with special conditions, to contract loans with international banks; implementation of some projects by BOT; try partnership with specialized and participation in accordance with the laws and regulations of investment.

Infrastructure is essential for the quality of life. Due to changes in economics, technology, and size of projects in recent decades, it was necessary to create a viable mechanism to take over the responsibility of important projects in transportation, and other areas. BOT has emerged as a valid and sufficient option to construction infrastructure projects with private financing particularly in developing countries. There are so many factors that influence the decision for BOT providers on either to take certain projects or not. There are some factors on the country level and there are some other factors on the project level [Figure 44]. After deciding the project is feasible, the providers draft resolution must assess the risks involved with the project to expect solutions for them. There are financial, construction, market, operation, and political risks that need to be evaluated carefully. As seen in the previous section 7.7 partnerships of public private such a BOT contract is not easy. The process is difficult and it needs time and money. Despite, there are some factors leads to success the BOT projects, in order to enhance the chances in contributing to support governments in the implementation of new projects, especially high-speed rail.

This analysis in this chapter and chapter 6 may suggest to some lessons for evaluation procedures. It shows that many social and environmental costs and benefits can be included in the economic evaluation: these highlights out the critical elements in the policy decision within a coherent and consistent framework. There is a real need; many assumptions about externalities were required. However, reasonable and coherent results were achieved, although the extreme difficulty to obtain the required data. It was also possible to rely on international data to make reasonable estimates of some social and environmental benefits.

Finally, the current chapter also focused with the benefits that a transportation investment and specifically HSR have on the society and the economy. Many kinds of benefits were discussed at the outset. Then, different methods, approaches, and tools for evaluating the socio-economic impacts were analyzed. The advantages and disadvantages of most were also noted. All the above, led to the suggestion of a method that can be used in Egypt or other developing countries. This method could be adopted for the prior evaluation of a project, with the objective of covering as many impacted aspects as possible. The countries of Egypt will be used as a basis for the formation of a screening model for HSR, which will follow. This is considered to the fifth bases that are adopted upon in the construction of HSR rail lines.

In the Master Plan of Infrastructures of the Egyptian Government in future, for the proposal new high-speed lines are in the next years. The conclusions of the chapter 6 and Chapter 7 suggest that the new projects should be seriously evaluated. Especially, a major effort should be made to undertake demand analysis to lay the foundations of sound traffic forecasting for future projects in Egypt and developing countries. Lastly, the importance of time savings in HST projects justifies a major research effort in the estimation of the value of time for different types of travelers and different transport modes, in order to improve the socio economic evaluation of transport projects.

8 PRICING

In this chapter will be discussed the effective of pricing on choosing between the difference transport system. So, the people or user will be choice option the best opportunities reflect on the costs of the fare. In order to establish a reliable and effective intermodal transport system in Egypt, the current situation of all modes of transportation need to be studied which could be summarized as follows. Firstly, at present the road network is very congested and already leads to some other serious problems such as road safety, noise, and pollutions within cities; secondly, despite the rail transport is already in operation, the operational capacity is very limited due to the fact that in Egypt the priority of track use is given to passenger transport; thirdly, the airline in Egypt is limited for the tourism and some of business people.

Meanwhile, in any kind of travel demand depends on the density of population between the two cities and the distance between them. Efficient transportation market offers various travel modes, price and quality options (for example, being able to choose between cheap, basic public transport and not more expensive, premium services). In this chapter will discuss some cost and revenue of the project in the country already have HSR. In addition, the difference of price between the current situations of pricing in the difference model in Egypt will be discussed.

8.1 Transport Calculations of Railway, Road and Airline Transport

In any project the cost and benefits information provided by the project allows the comparison of the total social costs of transport and the corresponding transport fees, taxes and revenues for each country. According to the Nash there is method basically consists in the determination and estimation of transport cost and revenues by mode of transport, with further a rating of by different groups of vehicle and users [183]. On the one hand, the cost side, the accounts differentiation between infrastructure costs, accident and environmental costs, supplier operating costs, with a further distinction between external and internal costs. On the revenue side, the user accounts to distinction between fees and taxes, and the discussion is open on whether fuel tax should be considered part of revenues earmarked to road or part of general taxation without any transport relation. Revenues include user charges, ticket revenues and transport related taxes that differ from the standard tax rate. General taxes that do not differ from the standard rate of indirect taxes are excluded from the accounts as these are not specific to the transport sector.

In this section some data according to the [183] for the country will use to analysis in the Tables 48, 49 and 51 will be presented. The question is why will be begun in this chapter to collect the data of cost and revenue? Tables 48, 49 and 51 show this comparison for some country in Europe. There are not specific reasons for choosing these countries beyond data quality, and this country already has introduction HSR. It can be used simplified a method for the road, rail and air transport accounts in order to show, in general terms, how far costs are from being covered by revenues in each mode, and then it can be benefit from this experiences in the country under study.

For the cost it can explain that in the following points. Infrastructure costs include (capital costs and running costs). Cost of supplying the transport service by the provider (for rail transport)[104]. Accident costs only include the external costs of

[104] For air, supplier operating costs are not quantified. It is assumed that usually these are covered by the user through prices; despite certainly subsidies do exist in this sector, as discussed in Table 51.

accidents, so the internal costs of accidents, as time costs, are user costs, internal and external accident costs divers between countries[105]. The costs include impacts of transport like noise and global warming, air pollution (Environmental costs). Tables of revenue were the distinction between direct contributions and taxes related to transport user. In addition, direct subsidies as much as they increase revenues (referring mainly to support for concessionary prices) are presented in tables of revenue [Tables 48, 49, 50].

Now what can take advantage of this analysis in Egypt or in developing countries? Given the difficulties of gathering or the lack of the data in the accounts between transport mode in our countries and the differences in data quality by country, it is not sensible to go too far comparing countries or transport modes. Furthermore, some useful information comes up from a quick look to country have experience and data. The following comments are not specific for this countries in the tables and can be applied this to a wide group of our countries or developing and emerging countries.

It can be observed that, Table 50 shows the cost as a percentage of GDP in the above five European countries [183], the highest percentage of the cost on the roads of the GDP is infrastructure costs about 1.5 %. The lowest rate of the GDP is accidents costs 0.5 %. It is seen that also on average for congestion and the environmental costs the ratio is are about 1.0 % from GPD. Despite it is only the marginal external cost of road congestion that is relevant for pricing, on certain assumptions the average cost of road congestion in Table 49 may be used as an approximation of this. In fact they are probably less border.

In Table 48 show the costs of railway transport and the different types of revenues including subsidies of explicit. It can be noted that for the calculation of these costs and revenues must be taken into account to calculate the transport provider. Because the addition of all costs or all revenues would cause double counting (with respect to access charges paid by the train operators). In comparison between the road and rail, the railways are the transport mode that shows the lower ratio of social cost (accident and environmental costs) covered by commercial revenue or specific taxes. In contrast the cost of infrastructure and the costs of supplying transport services are dominated costs[106]. Moreover, it can be observed that, this is not the situation of road or air transport with a rate of revenue or total social cost nearer to one. However, these modes present higher environmental costs, especially in the case of air transport. When the environmental costs are exclusion, road and air transport revenues of more than cover infrastructure and the costs of operating.
As can be seen from Table 48 for the revenues, taxes and subsidies for rail transport is not complete. This leads to the losses, due to reduced tax levels or exemptions. Indeed, the railway sector is characterized by a high level of subsidy. Thereby, the high level of subsidies is for the provision of services and for concessionary fares. Thus, this leads to failure of total revenue (including explicit subsidies) to cover total social cost[107]. The

[105] Accident costs, these costs are not paid by the transport use accident costs that are paid for from public funds(national health insurance costs, costs of rescue, the costs of police and the costs of material damage to property not covered by insurance companies, loss of production due to accidents

[106] This is due to the fact that infrastructure costs were identified by using all investment expenditure on infrastructure for capital evaluation, independent of the source of funding; straightforward subsidies are included in the cost figure but cannot be separated. Consequently, construction subsidies for stations and tracks, however, can take a great deal. In many countries most or all capital investment in the rail infrastructure is provided in the form of a government grant [183].

[107] The railways companies generate passenger and freight revenue that sometimes is not enough to cover supplier operating costs (for example in Egypt operating losses and investment expenditures constitute a

rail system costs are covered by revenue from passengers and freight varies substantially between the above countries, the average for all the countries in the study is 36%, this value is not improbable for all countries. It can be noted that in Table 51 for air transport and analysis the cost/revenues, in most case of above countries, landing fees fail to cover the costs of airport infrastructure and make no contribution towards external costs.

Table 48: Calculation Cost of Railway Transport [€ Million 1998]

	France	Germany	Netherland	Spain	UK
Costs					
Infrastructure Costs	**4790**	**12621**	**1095**	**3500**	**3288**
Transport operating costs	**10944**	**7336**	**2339**	**2013**	**6664**
Accident cost (external)	**3**	**83**	**58**	**19**	**26**
Environmental Costs	**129**	**1403**	**34**	**296**	**504**
Total	**15916**	**21443**	**3526**	**5828**	**10482**
Revenues					
Passenger and freight revenue	**7326**	**13180**	**1365**	**1495**	**9125**
Fuel tax	**41**	**251**	**--**	**--**	**--**
Explicit subsidies	**5974**	**11419**	**162**	**1925**	**2297**
Other specific revenues	**--**	**--**	**--**	**--**	**--**
Total	**13341**	**24850**	**1527**	**3420**	**11422**

Table 49: Calculation Cost of Road Transport [€ Million 1998]

	France	Germany	Netherland	Spain	UK
Costs					
Infrastructure Costs	**25520**	**26176**	**4411**	**6224**	**12728**
Accident costs (user external)	**1528**	**14592**	**1421**	**2307**	**1994**
Environmental Costs	**20687**	**18505**	**2479**	**6506**	**13352**
Congestion Costs	**17293**	**17381**	**3103**	**3312**	**19371**
Total	**65028**	**76554**	**11414**	**18349**	**47445**
Revenues					
Charges for infrastructure use	**4167**	**411**	**91**	**919**	**259**
Vehicle taxes	**4983**	**7757**	**4298**	**2174**	**7500**
Fuel taxes	**34866**	**33548**	**5897**	**9777**	**36224**
Total	**44016**	**41716**	**10286**	**12870**	**43983**

Source: [183]

Table 50: Calculation Cost of Road Transport for the above Countries, developing countries and Egypt as a percentage of GDP

Categories	Infrastructure Costs	Congestion Costs	Environmental Costs			Accident costs
			Air Pollution	Noise	Global warming	
Costs as a % of GDP	1.46	1.119	0.59	0.326	0.210	0.46
Costs as a% GDP in developing countries	0.16 – 1.24					
Costs as a % GDP in Egypt	0.7					

Source [180] [183]

major burden on Egypt's public finances: in 2004 they added up to about 0.85 percent of total annual public subsidy expenditures and 0.63 percent of gross domestic product (GDP). Operating losses alone constitute a burden of 0.42 percent of subsidy expenditures and 0.30 percent of GDP [81]).

Table 51: Air Transport Calculations [€ Million 1998]

	France	Germany	Netherland	Spain	UK
Costs					
Infrastructure Costs	**8110**	**3488**	**98**	**411**	**2236**
External Accident Costs	**91**	**874**	**226**	**458**	**860**
Environmental Costs	**-**	**35**	**0,4**	**4**	**5**
Total	**8201**	**4397**	**325**	**873**	**3101**
Revenues					
Airport revenues	**1687**	**3121**	**224**	**501**	**--**
Air traffic contral revenues	**1117**	**767**	**--**	**341**	**137**
Other specific charge and subsidies	**279**	**300**	**1.3**	**77**	**1238**
Total	**3083**	**4188**	**225**	**919**	**1375**

The aim of this analysis is compare this figure with the revenue of road, rail and air transport in developing countries especially in Egypt. Where, very high investment is needed to extend and upgrade road networks. According to the World Bank, new road construction accounts for between 0.16% and 0.5% of GDP in developing countries [179]. In Egypt investment in roads in 2007 is currently at an adequate level, representing 0.7%[108] of GDP (about $ 1.53 billion) and exceeding the investment to GDP ratio in developing countries, which range from 0.16% to 0.5%). On the other hand, all vehicles travelling along Cairo-Alexandria desert road are levied full toll rates. Revenues generated by current tolls in year 2000 are very low compare with investment. It can be noted that, in Egypt, several rural roads (such as Cairo- Alexandria Desert road and Cairo- Alexandria Agriculture road) are operating with toll charging. However, the charged toll rates are determined based on political consensus rather than on a benefit analysis. Over the years, proceeds revenues were lost due to such low toll rates. Such toll rates ought to increase if the toll roads are to sustain their operation without any government support. However, this is still not the optimum toll rate in terms of revenue maximization. Rates maximizing toll revenue are almost in the range of 0.78 L.E. /km to 2.3 L.E. /km [about €0.097/ km to €0.288/km] per vehicles [89; 117]. In an Egyptian context, these can be considered as very high toll rates.

The pricing of transport has two components: cost of time and financial cost. The financial cost is determined largely by the price of fuel, tolls, vehicle cost, and taxes associated with vehicle usage, as well as by the supply of road transport services, like trucking, buses, and taxis. However, time can cost the business climate more dearly. A deal or a customer lost because of a missed meeting or a late delivery is far more costly than the mere money spent on transport from one point to another. The financial cost of transport in Egypt is very competitive internationally. The price of fuel is much lowers than the average in neighbouring countries while highway tolls are also very low and unrelated to distances travelled.

For the investment in the conventional railway and to improve efficiency, service levels and operational safety Egypt has earmarked an additional EGP 5.4 billion (€640 million) for investment in rail infrastructure, only in the modernization and extension of signaling systems, and in new rolling stock. Where, annual investment expenditure in the railway sector averaged about €150 million between 2000 and 2004 according to World Bank [81]. This amount has increased to an annual level of about €350 million, according to the Ministry of Transport[109]. On the other hand, the revenue of the ENR

[108] Egyptian GDP at nominal exchange rate: USD 218.5 billion in 2010 [77]
[109] Despite the ENR every day carry about 1.2 million Egyptian travels by train and rail contribute account for 40% of all intercity passenger transport in Egypt a very high modal share [139]. It can be

are losing money in spite of very substantial state subsidies and fairly high ridership (the highest in North Africa), according to industry experts. So, the revenue of the ENR in 2008 and 2009 was € 29.9 million and € 31.6 million respectively, but for the freight the revenue is less than 10.65 million € in year 2009 [206]. Losses are due to very low fares, which do not provide adequate cash flow for maintenance of the network. Another problem is ticketless travel, according to industry observers. In section 5.3.3 were discussed the most problem in the revenue of the ENR faces many problems, notably an excessive headcount, frequent strikes due to low salaries, lack of skills for want of training, faulty equipment, and non-compliance with safety rules.

For the case air transport in Egypt, the airports serve major economic centers and tourist destinations. A total of €260 million per annum has been earmarked for investment in airport infrastructure [180], of which half is for improving existing airports, such as the renovation of Cairo Terminal 2, and the other half for building new airports. On the other hand, the revenue from sector air transport is by far the largest revenue generator, accounting for €48.55 billion out of a total €52.65 billion [189]. Air transportation recovered somewhat in 2010 following a value decline during the economic downturn. **From the previous analysis, it can be compare the prices of investments and costs between Egypt and some European countries as mentioned in the above tables. It can be found that, prices of investments in Egypt is much less than other countries and this leads to the in poor services operation, maintenance and safety in the road and rail transport**.

But in the case of the proposal HSR line is in Egypt and according to the analysis in above mentioned in the section 6.8 and 7.3. It can be observed that, the new system as proposal HSR line will attracting more passengers by HSR and also reduction in travel time, where the price will be reasonable for passenger as show in the previous analysis in Figure 40 and Table 40. Despite average rate of cost coverage is not equals on the long network. For example in France higher substantially are in infrastructure charges for the HSR line than for the traditional network about 3 to 4 times marginal cost. However, the full costs are not covered by subsidization. So, the financial costs of HSR lines are not included in the cost calculation [184]. In Germany also about € 4.5 billion in 1998 were paid by government which amounts to nearly two thirds of total investments of DB [183].

The immediate result is that the enforcement of the precept of each mode covering its own social costs would lead to a substantial increase in the railway fares compared to the increase of air and road transport. Internal and externalities would affect more to freight than to passenger road transport. Two relevant questions appear here with respect to HSR investment and pricing. So, the pricing depending on the total construction cost of the mode of transport to cover all this costs. But in some cases the revenues can not alone cover all costs; so, the government helps by paying subsidies. One affects to the optimal prices to be charged in the already existing HSR lines, the other concerns the prices that should be considered when evaluation the construction of new ones. It can be used this method in our countries to benefit from this analysis, when make a new proposal HSR in developing and emerging countries. Because the price of transport mode are the importance way to determines the means of transport user. Both

observed that, the investments can not be compared with the revenue and number of passengers per day and the revenue consequently, the number of passenger and investment is higher opposite revenue and service.

questions have to be solved together and lead to the discussion of principles of the pricing to be followed in the next points.

8.2 Optimization Pricing, Investment between Modal Split

As it can be seen in section 6.8 the comparison between the intermodal in Egypt with the HSR proposal. Where, the intermodal competition require a sound and clear pricing policy that allow the transport user to choose the best option within a transport mode or when choosing between road, air, maritime, or rail transport. Clearly (equity issues side) that for the best user option to be the best form the point of social view, prices should reflect the opportunity costs of his choice. This is the reason for intermodal competition on the proposals corridors is critical. Increased competition from high speed rail services benefits transport users mainly by comparable or lower transport costs. Actual or potential competition from road operators drastically limits the railways' pricing power, even in the cases where railways enjoy commanding market shares [190]. Consequently, there are two dimensions of optimal pricing on HSR, road and air market shares. The first one is the marked differences in the way in which, in general, air, road and HSR infrastructure[110] and operation affect the generalized cost of travel in each mode of transport. The second one is to figure out what the opportunity cost is when a significant proportion of total costs in railways are constant.

8.2.1 Infrastructure Costs Measuring and Charging

Infrastructure costs

In estimation infrastructure cost it is fundamental to make a distinction between: **capital costs** where this cost consider the provision of these assets implies real costs. It is clear that, the capital invested in the saving of a transport infrastructure leads to raise a fixed cost that carries no relationship to the actual use of the infrastructure. The capital amount of the transport infrastructure increases over time with additions made by new investments. Secondly, **operating and maintenance cost.** Examples of these types of costs are: the maintenance expenditure per years (annual), the expenditure for worker and expenditure energy.

Charge for infrastructure costs

This is an important point in this chapter, in principle, there are three key objectives of infrastructure pricing, where Infrastructure cost charging can be divided to:

1- The charges as far as possible to actual costs (i.e. marginal cost pricing) at the level of the individual user: Pricing marginal cost is important for the efficiency of the transport system because it gives individual users an incentive to reduce the potential costs because cost provision is rewarded by lower charges. For instance, road traffic induced wear and tear can be taxed comparatively easily and efficiently by charging

[110] In the railway sector it should be access the systems of charges serve to improve the exploitation of the available capacity, undertaking rights of use to the most valuable services for society. Despite certainly eligible, this aim is not the only one that can be reached by the infrastructure charging systems, which can also be set to recover a given level of costs, to improve the network management, to orient investment decisions or to encourage productivity gains in the operation and maintenance of the infrastructure [204]. Unfortunately, there is not a pricing principle able to meet all the goals at the same time, as a finding of the especially characteristics of the railway infrastructure business, namely the presence of economies of scale, density and scope. Where, the high value of fixed costs makes incompatible to reach optimal efficiency and cost recovery at the same time. So, the choosing of a pricing principle implies a trade-off between alternative goals of infrastructure pricing. In turn, the choice of the objectives that shall drive the choosing of a pricing principle will result from the political.

trucks on the basis of their axle weights[111] (which determine the damaging power) and their mileages. Such a system gives hauliers an incentive to use configurations with lower axle weights, to lowering empty runs or, in some cases to use combined transport.

2- Infrastructure charges should recover total infrastructure costs: If large parts of total costs are not use dependent - as is the case with capital costs then marginal cost pricing alone will not lead to full cost recovery. Thus, cost recovery is important for a number of reasons. On the one hand, infrastructure owners by private have to recover costs privately owned ports, toll-roads and airports[112] have all developed pricing schemes that relate charges to other parameters to recover full costs [201]. The secondly, in the absence of full cost recovery in the transport sector as a whole, the general budget would have to fund the sector through imposition taxes/charges in other places. Thereby, there is generally felt that, although for reasons of economic efficiency marginal cost pricing has major advantages; large transfers between sectors are undesirable. So, in principle, it should recover the total costs of infrastructure in long-run.

3- Price for the different users and elasticities: Operators can market-driven train, such as the different freight operators, can reasonably be said to have a price elasticity of demand with respect to the level and structure of access charges. , They will respond to the cost signals that the access charges send. Although, train services proponent by public funds, especially those of suburban passenger train operators, generally see access charges passed on to their public patron and comparatively insensitive the price signals infrastructure charges provide. In this case the signals that charges provide to the political body determining service levels are important. If these services are provided under a concession operating for many years, the main responses to the pricing infrastructure costs should be recovered in the long run. Marginal cost for long run may then be a more appropriate basis for charging than short run marginal cost, but if there is some flexibility in schedules then a two part tariff with separate charges for capacity and for use will be the best way of doing so.

Obviously the infrastructure charges as a percentage of total journey costs are much larger for railway than for toll roads or airports due to the highly capital intensive nature of the former. For instance, in France, infrastructure charges represent about 30% of the total journey costs (ticker price), compared to an average of 10% for toll roads and airports [214]. A slight increase in the rail infrastructure charges can therefore have a much greater impact on the ticket price for the end user (even relative to other pricing

[111] The important aims for rail infrastructure charges are to enhance the effective use of the rail network. Charges of rail infrastructure may also play a key role in enhancing the, efficiency provision of rail infrastructure. In additional enhance efficiency in other parts of the rail industry, especially between train operators. Level of infrastructure and structure charges can have a significant influence on the nature of competition, if any, among train operators. Thereby, these aims will be enhanced by a system of charges which is cost-reflective, so that the charge for each train reflects the additional costs (to society) which result from allowing that train onto the network. Moreover, some of governments have set a further objective of raising a minimum amount of revenue from charges infrastructure. Thus, this applies when governments limit their contributions to rail costs infrastructure, leaving infrastructure charges to compensate the difference between total infrastructure costs and contribution of the government.

[112] For the railway infrastructure charges which cover these costs should ensure an appropriate level of infrastructure use, and also that scarce capacity is allocated efficiently between competing train operators. The only costs which should be excluded are the disruption costs associated with delays caused to the train operator's own services, since that operator will already carry the cost of this disruption (for example, through the proceeds of discount tickets).

signals such as increases in fuel costs),resulting in greater elasticity of passenger traffic compared to initial forecasts.

The infrastructure business may have an incentive to try to convert as much of its costs (particular fixed costs) as possible to the least sensitive customers. At the same time, customers in the public sector of the infrastructure manager tend to try to reduce their payments by political fiat. This is regrettable since the supported services have the most predictable and demanding capacity requirements, and perhaps should bear a large part of the cost burden. It is important to realize that State support to operators, but strictly regulated, can act to lessen or even defeat the function of access charges as price indices.

To restore the price elasticity of demand to access charges for publicly subsidized services the capacity costs need to be made the subject of a direct convention between government and the infrastructure supplier which lasts for a number of years. In this way the major element of price sensitivity will be assigned where the real responsibility lies. Where, under a concession or competitive bidding system for these services, if the operator includes within his bid the changing access charges at his expected demand levels, and if the government support does not change with actual demand, then the operator will be sensitive to the variable part of the access charges.

Finally, a number of considerations have to be kept in mind when implementing the cost recovery standard. First, it is quite common and perfectly legal to invest in infrastructure for non-transport related policy reasons, such as regional balance. It seems unbelievable to require transport users to cover the infrastructure cost imposed on these bases. This highlights the need for a clear system of accounting. Secondly, past decisions on infrastructure projects that no longer meet present day transport demands have, in some cases, generated high costs which cannot be recovered by users. This kind of infrastructure has to be given special treatment.

8.2.2 Infrastructure Cost Recovery: Rail and Road

The question arises whether the individual modes cover their infrastructure costs and whether there are significant differences across modes. Road expenditure averages some 1.0% of GDP in the Union; total tax revenues from road users (tolls and vehicle and fuel taxes) equal 2.0% of GDP. Where the studies by European Commission suggest that road users also cover infrastructure costs and the taxes paid by road users are significantly larger than current infrastructure expenditure [200]. In the rail appear to have much lower cost recovery rates than road haulage. For example, the average infrastructure cost recovery rate of European railways is 56% [199]. However, it has to be pointed out that in case of rail significant problems of measurement play a role and that, on balance, the problem seems to be as much one of accountancy and transparency as of uncovered costs. It can be also noted, for rail the cost recovery figures can be questioned because it is unclear to what extent the figures have been corrected for public service obligations that have been, and are, imposed on railways.

In principle, there are two key objectives of infrastructure pricing. These are, firstly, to promote efficiency of use, so that users do not impose greater costs on society than they are willing to pay for in the short-run and, secondly, to promote efficiency in investment, so that total costs for society over the longer run are minimised through adequate and timely investment. In the absence of a certain supply of external funding, the latter objective will imply that prices charged should cover total long-run costs. In applying these objectives to road and rail freight infrastructure, it is necessary to take account of two complicating factors, firstly, economies of scale and/or of density, where the marginal cost of providing the service is less than the average cost and, secondly, the phenomenon of joint or multiple use of the infrastructure, with its implication that many costs will be effectively joint or common and unlit.

Moreover, the method of financing HSR can also be significant in determining the outcome. Accordant to UIC find that the access charges levied on train operators vary substantially, but absorb between 25 and 45% of the revenue of high speed rail operators [220]. As such, they significantly impact the competitive position of rail as opposed to other modes. Figure 45 show some typical track access charges for HSR. Nonetheless, the number of Trans European Network corridors can justify high speed rail in cost benefit terms, with operators able to run profitable services on a marginal cost basis, but that high track access charges will preclude profitable operation [221].

8.3 Long-run or Short-run or marginal cost

In the short run, the marginal costs pricing of rail infrastructure are the maintenance, operation and renewal costs that arise when an additional train runs in the network (makes optimal use of existing capacity)[113]. Pricing railway infrastructure according to them minimizes the exclusion of railway operators, as every train able to pay its marginal costs will be admitted in the network.

For instance, it will assume that, the supplier operating costs, variable maintenance and operating infrastructure costs and external costs are already included in the generalized cost. The investment costs and the quasi- fixed maintenance and operating costs should be also included in the full price? In the case of the European Commission proposes a charging system based on each mode of transport internalizing its social costs, to reach an efficient distribution of traffic across different modes and ensure that these operators are treated equally to achieve fair [204]. Now what is relevant for pricing, however, is the marginal cost of increases in transport a specific route. Whenever extra capacity can be provided by running larger vehicles or longer trains this is likely to be less than the average cost. Even where this is not the case, however, due to transport services, whereby increases in patronage lead to more frequent services, existing benefit of passengers, leads to a general case for subsidizing scheduled transport services, with the case being stronger the more important schedule delay or waiting time is in the total generalized cost [191].

Consequently, how much a rail operator should be charged for the use of the infrastructure in a particular time or demand conditions? In principle the answer is the marginal social cost of running the train in that particular situation. Therefore, given the presence of economies of scale, significant indivisibilities, and fixed and joint costs, pricing according to marginal social costs is far from being an easy task. It can be noted that, the passenger rate in Egypt in third class trains is €0.007 Pkm, this figure consider one-fifth of the Middle East and North Africa country average. In first class carriages rates are about € 0.03 Pkm. Despite, Egyptian trains are generally on time and delays of as long as half hours are rare. As mentioned in the above, Egypt has capitalized on railway’s very high about 40% modal share in intercity passenger traffic. In the new proposal HSR system the price will be more than road, but when will be compared this price with time, accidents it will be observed that, the new system attracted more passenger as show in Figure 40.

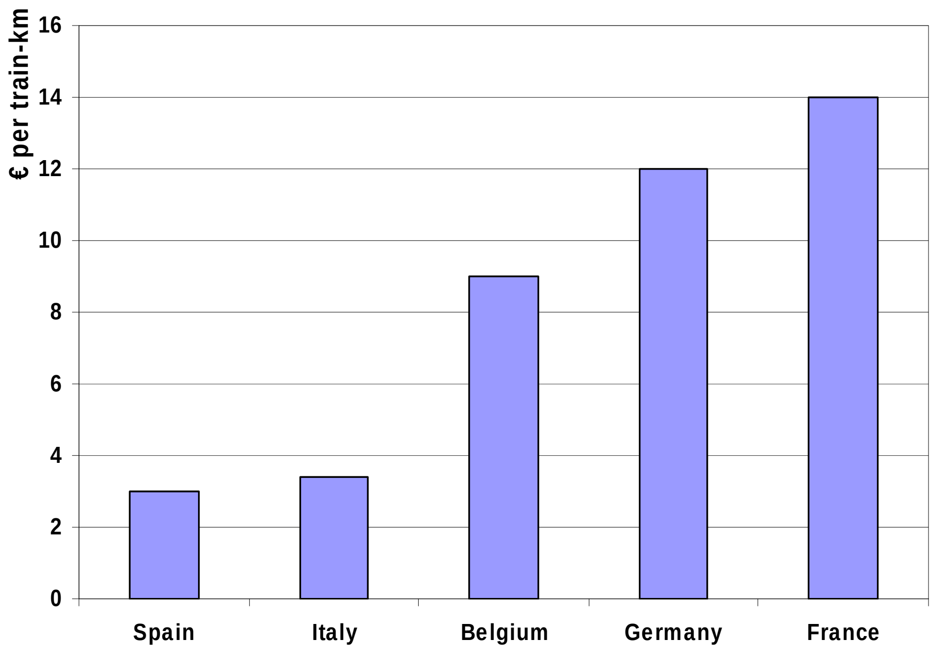
[113] The period of time considered for the definition of marginal costs, it is possible to differentiate between: 1) Long run marginal costs, obtained on the basis that all costs may be deemed variable with the output on the long run; and 2) Short run marginal costs, calculated on the assumption that some production costs are fixed in short term (e.g. infrastructure)

Furthermore, governments should follow-up other goals rather than short term static efficiency, making the enforcement of this charging system more complicated. Infrastructure charges should differ by mode and location when the local conditions vary, but should not discriminate between users by nationality or location[114]. The user pays and fair competition principles are also invoked when arguing that each mode of transport should cover its total social costs. According to charging for short-run marginal cost is incompatible with cost recovery when the infrastructure rail network is constructed and there is a surplus of capacity. Some critics say that the natural alternative is long-run marginal. Short-run marginal cost is equal to the change in total costs when new traffic is added, given a fixed network capacity. In the long-run marginal cost, accounts for the change in total cost allowing for an optimal adjustment of capacity.

Nonetheless, the short-run and long-run marginal costs may be equal assuming ideal demand forecast and quite clearly from the capital, but both assumptions are unrealistic in the field of transport and consequences of choosing a pricing principle are quite important in practical terms. Consequently, for the case of HSR investment, the short-term marginal cost pricing means prices below average costs and the need for public funds to cover costs of infrastructure. In the case of the construction HSR with government funding, the opportunity cost of that funding should be taken into account by use of the price of public funds, or by requiring proportion of a benefit-cost ratio well in access of one. Where private financing is involved, this will need to be serviced, and the most obvious source of income for this is via track access charges.

Pricing according to short-run marginal cost, with the possibility of retail and economies of scale, leads to insufficient revenues for the recovery of infrastructure capital costs. Additional taxation needed to cover the gap has an additional cost in term of the distortion imposed on the rest of the economy. The second problem is related to incentives as subsidization usually reduces effort to minimize costs. **Another drawback comes from the way in which capacity costs are covered, as usually pay variable costs and non users pay capacity costs.** In addition to the equity side (it is difficult to think on HSR passengers as an equity target) it will be face a dynamic efficiency question: are the users willing to pay for capacity? If the corridors where this is not the case the government would be providing more capacity than optimal. Consequently, from the analysis data in the Figure 45, it can be observed that, the marginal social cost pricing in the rail sector is only optimal to the extent that it is adopted on competing modes as well. To the extent that air transport is not charged appropriately for scarce runway capacity and for environmental costs, there may be a case for charging rail below marginal cost on routes that are competitive with air. On the other hand, pricing in the rail sector is optimal, when infrastructure charges for high speed lines not be higher than 6.4 €/train-km taking 2 €/train-km as an upper limit to the marginal infrastructure cost per train km for high speed rail [108].

[114] The Egypt air runs daily flight all major tourist destinations in Egypt. But the all foreign nationals when they need use the travel by Egypt air, they paying the foreign currency. Conversely, the Egyptian people pays in local currency, then there are discriminate between users by nationality or location especial in the Egypt air company.



Source [108]

Figure 45: Access Charges for HSR trains € per train-km in 2008

As seen from Figure 45, the typical mark ups for access to high speed lines in France greatly exceed these levels. The impact of high track access charges on the new route could be even more problematic if open access competition is permitted on the existing lines at much lower charges. Where high speed rail was introduced with a low track access charge of € 2 per train km, they found high speed rail to be socially worthwhile, even though a profit maximizing monopoly rail operator would use much of the benefit to raise price rather than increase market share. However, when access charges were raised to € 10 per train km, services ceased to be profitable (where users can not pay) and would not operate without subsidy. In general, a high access charge will limit the frequency of service offered below the optimal level, and thus also limit the benefits. Even if assume that users are willing to pay for capacity (due to equal prices in the short run marginal costs), it may be said that demand is receiving a misleading signal in terms of the cost of expanding capacity in the long term. It may well be that a price structure which includes some charges or long-term replacement costs would be associated with a social surplus insufficient to justify the investment.

Whereas, it is not necessary to defend long-run marginal cost to recognize that deviating from short-run marginal cost is the norm. Prices should not only follow costs but also demand considerations. So, revenue adequacy is required for long-term investment. This is a real problem and the way out is to price in a way in which short-term marginal cost is covered plus an additional charge to contribution to fixed and common costs. This additional charge should be set to minimize efficiency losses, and the way to achieve this is, in principle, through discrimination depending on the value of service, but political acceptability and information problems make pricing difficult to implement. According to (European Commission, 1995, 1998, Nash, 2001), the Commission seems to favour a short-run marginal cost pricing [193; 194; 195]. Where it is expected that marginal cost charging will allow full capital costs recovery, given that prices in congested corridors[115] and the internalization of congestion and external effects will produce enough revenue to satisfy financial constraints, at least across the modes. It can be also noted that, railways are long-term investments and relatively inflexible whereas the factors that influence demand are frequently variable over the shorter term.

Finally, the consequences for charging to short-run marginal cost on the expansion of HSR lines are significant. Thereby, low prices favour the reallocation of traffic from competing modes (and attracts more people on the new system) and encourage traffic generation, with a reactions on the future expansion of the proposal network. Pricing according to short-run marginal cost leaves a key question unanswered: are the rail users willing to pay for the new technology? Unless this question is answered before investment decisions are taken, marginal cost pricing is not a guarantee for an efficient allocation of resources[116].

8.4 The Generalized Cost of Travel in the Road and Airport Crowding

Local public transport is subsidized in most Egypt cities and rural areas. However there is little sign that marginal cost pricing principles are used to determine fares. Rather, a combination of political factors including revenue needs and resistance to price increases combines to create prices that are high in some countries and very low in others. Road transport is more complicated to calculate the levels of charging for infrastructure use. Generally, vehicle owners pay an annual fixed sum to license for use of vehicles, in addition to the fuel tax when using the vehicle. It is clear that, this allows a degree of differentiation by type of vehicle, but that differentiation takes the form either of a fixed sum not related to the use, or of fuel tax, the relation of which to vehicle type is determined by fuel consumption rather than by any variable that is of use to policy makers. Some countries have supplementary tolls on motorways, or require purchase of a vignette to use the highways system, while a few cities have toll rings to enter the city. All of this adds up to a pricing structure unsuitable to reflecting the variation in marginal social cost by time and place. There are very few cases, predominantly relating to infrastructure charges in the developing countries, where the marginal social cost is made in the determination of pricing structures and levels. Therefore, it appears that currently very little use of marginal social cost pricing is made in practice in these countries. As mentioned in the above sections 8.2.1, it was consider some of these reasons for this, and the prospects for overcoming them.

For the airport, it can be observed that, airport delays and traffic road crowding increases the generalized cost of travel, but the HSR is punctual and reliable. This is not

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[115] In the most of the developing countries the number of passenger is higher on the corridors, for instance in the case of study in Egypt the proposal two corridors Cairo Alexandrina and Cairo/ Luxor-Aswan are more congested and the expected number of passenger in 2020 about 164.4 million and 205.5 million passenger respectively, according to Table 19.

[116] The Pricing in the short-term marginal cost is likely to recover only a small proportion of total infrastructure costs; whereas investment may be obstacle by the short run marginal cost pricing, as measures to mitigate a capacity constraint might lead to a significant reduction in charges. Where charges based on the short run marginal cost may vary greatly over time and between different parts of the network, which may make it more difficult for train operators to plan future services. So, the short run marginal cost pricing may fail to reward good performance, for example because the benefits of a reduction in infrastructure costs would be passed on immediately to train operators. On the other hand, other government policy objectives (for example to correct for distortions in the pricing of road transport) may require departures from the short run marginal cost pricing. It can also be observed that, in the natural disasters or terrorist attacks, the airport close to several days.

always the case with air transport. The road congestion is pervasive at peak times[117]. The asymmetries between HSR and road are self evident. Obviously, road infrastructure and operations are vertically separated. HSR infrastructure and operations are vertically integrated in practice. There is a single HSR operator by country. There are thousands of motorists entering simultaneously into a limited-capacity infrastructure without any planned scheme. It should be mentioned that, the standard of treatment of crowding is well known in the economic literature: users will have to pay for costs imposed on other users who share the road, thus absorption the costs they impose upon other will take decision according to marginal social costs. A practical application of this principle is to responsible users during peak-hours, aiming to redistribute those users with a lower valuation for trips to alternative routes or time periods [196; 197].

In the case of airport in Egypt a few number of passenger used it. Because, passengers are suffer the increase in the cost and generalized cost of air transport in Egypt, especial by Egypt Air Company. Consequently, airport demand is closer to capacity at peak time and similar solutions to road are offered: managing demand by peak-load pricing and capacity investment. Nevertheless airport crowding and road crowding are far from being the same phenomenon. In principle, airport congestion should be the consequence of bad weather or any other uncontrolled factor[118].

Consequently, when airlines take decisions on flight schedules, they impose some external costs on themselves and also on passengers. Therefore, airport crowding should not be reduced to a peak pricing problem. Congestion occurs as an externality which is not internalized, and this happen in the peak and the off-peak. Agents causing delays should pay for the marginal cost of congestion. Internalization of congestion costs could be achieved, simply by using congestion fees which force airlines and airports to compensate each other and passengers for the external congestion costs imposed by flight delays [198].

8.5 Result of Case Studies

Transport policies have in the past largely focused on direct regulation. Whilst rules have not brought significant improvements in some field especially in the railway sector in Egypt, they have not been able to unlock the full potential of response options that can be triggered through price signals. Price based policies give citizens and businesses incentives to find solutions to problems. The target of ensuring sustainable in Egypt and other developing countries in transport requires that prices reflect the scarcities of potential, because otherwise these scarcities will not sufficiently be taken into account. Decisions made by individuals with respect to their choice of mode, their location and investments are based on prices. So prices have to be right in order to get transport right.

[117] The congestion in the peak-hours on the road in Egypt is a waste of time and increase the number of accident. It arises when infrastructure networks carry more transport users than their design capacity. In such a case every user responsibility delays and imposes delays on others. These delays represent economic losses because people value time and, in addition, energy use increases with delays. The delays increase more than proportionally as more user access the network until traffic comes to a standstill. This is why, in congested networks, a small decrease in traffic levels can significantly speed up flows.

[118] There are flight can be out of schedule due to problems experienced at the airport of origin, at the destination airport, or during the flight itself. There is other reasons beyond bad weather or other exogenous causes that explain airport crowding. A combination of all these factors frequently occurs, but the explanations of these delays are quite often attributable to the decisions of the airlines regarding fleet size, maintenance schemes, etc. Moreover, delays can be also the consequence of the airport management policy

In this dissertation indicate that in transport - as a general rule in the case study in Egypt - the relation between prices and costs is weak at the level of individual transport users especially in the railway. Where some costs - related to infrastructure, accidents, noise, environmental pollution, and congestion - are only partly covered or not at all. For instance, in some transport users seem to pay too much (an airplane), others too little (by railway and road). This situation is both unfair and inefficient.

Consequently, the question is how progress across acceptable and effective pricing can contribute to solution some of the potential problems by giving transport users incentives to adjust their behavior. The goal of such a policy would obviously not be to raise taxes, but to use charges to reduce congestion, accidents and pollution. If this policy is successful it will improve the competitiveness of the economy by reducing the wastage of scarce resources, for example which currently occur in the case study in Egypt about €0.9 billion and €5.3 billion per annum in accidents costs alone for the rail and road accidents respectively [See Table 42; 42a].

In this section will be examine practical implications of improved transport pricing, that is, prices for transport use that more effectively reflect the social costs that transport users impose on others, and the implications for modal shares for the year 2015. Moreover, it has been shown that transport and logistics services are of the paramount importance for economic development. Railways, road, airport, and port infrastructure is the main mediator for trade and investment. It was found that the elasticity of trade with respect to transport costs is -2.5, which means that a 10% increase in transport costs decreases the volume of trade by 25% [203]. From the previous analysis for pricing situation in Egypt between the difference intermodal air, bus, minibus and conventional railway as show in Table 52.

Table 52: Changes in the Currently Passenger Prices and the Proposal Price for HSR Line in Egypt

Case Study	Cost Estimates	Minibus	Bus	Conv. Rail	Air	Proposal HSR*
Price €/Passenger km		0.007-0.012	0.011-0.013	0.007-0.028	0.12-0.25	0.04-0.12
Cairo/ Alexandria (208 km), €	low	1.45	2.28	1.45	25.00	8.32
	high	2.5	2.70	6.5	35.4	24.96
Cairo/ Assuyt (375 km), €	low	2.63	4.13	2.63	39.25	15
	high	4.5	4.88	10.50	69.4	45
Cairo/Luxor-Aswan (879 km), €	low	6.2	9.67	6.2	105.5	35.16
	high	10.55	11.43	24.61	130.43	105.5

* This figures is expected price in years 2015 for the a new proposal HSR line

Table 52 shows the current prices for passenger implied by the low and high valuations of externalities. It is seen that for all the inter-urban case studies, the price of difference modes should be reduced, with the reduction naturally being very much more for the low values than the high values.

The reason for this is the relatively high level of taxation on modes, and the expected reductions in externalities by 2015. In particular, it has been assumed that full implementation of the proposals high speed rail regarding tighter emissions controls has taken place, greatly reducing the level of air pollution, and in all the inter-urban corridors further road building is assumed, leading to modest levels of congestion in 2015. Of course the question should be asked whether the proposed high speed rail infrastructure investment is justified, and it may be that investment is justified to enhance quality rather than to reduce accidents and congestion.

It can be also in the situation that between city bus, minibus, conventional railway, and air transport all seems to be exaggerated according to this case study. In the situation of air, this is because all the cities concerned have some form of taxation on air transport, and also foreign airline company may be use the travel between the inland cities in Egypt. To other situations, the main reason is the application of pricing systems in the commercial sector where there are effectively economies of scale, established in the case of railways partly through economies of scale in infrastructure, but also for all modes the combination of economies of large vehicles or trains together with the impact whereby additional passengers lead to the provision of more frequent services, which confers a benefit on existing passengers. The net impact of these changes in price is a general increase in traffic between urban areas on all modes, but especially for HSR and air. Where operators' rail seems well aware of low marginal costs in relation to average costs, as in the practice of price discrimination most reduced fares will be well below the average cost.

Of course, the urban case study is very different. Even at the low value of external factors, car prices should increase significantly, especially in the peak. Table 52 indicates an overall reduction in minibus and bus fares, although this disguises a dramatic increase in peak fares (due to increased subsidies in excess of marginal production and external costs) which is more than offset by off-peak prices that are actually to zero (as essential excess capacity means that service levels would not increase with additional passenger demand). For rail a modest comprehensive decrease is called for, again the net impact of essential peak period rises and large off-peak reductions

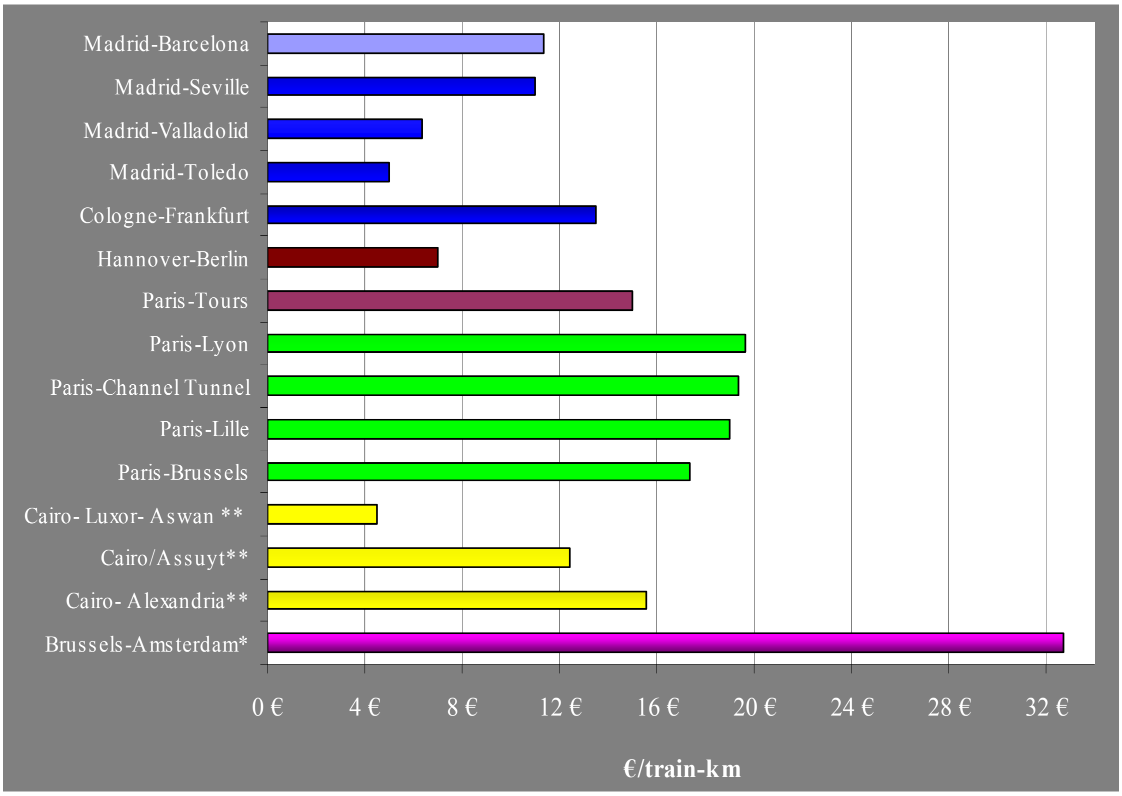
8.5.1 Approaches in Pricing of High-Speed Railway Lines

In order to better evaluate current tariff systems, they will be applied to existing lines, and then compared. The following main European high-speed lines and the proposal HSR line in Egypt will be evaluated: in Spain, Germany, France, Belgium and Netherland. But this evaluation in European will be tacking the high speed train with 350 seats (in case study in Egypt for example the train seat about 1062), the peak-hours factors and service type is long-distance train for most appropriate type.

In order to calculate the price per train km, it will be take this from the example or the methodology of cost calculation for the proposal HSR in Egypt in section 6.8. It can be noted that, the price were calculated in Table 39. According the Table 39 it can be estimated the **Average Operating Price for trains or Tariff**[119] (for the variable cost) imposes a charge for every used train-kilometre. It is also differentiated based on the line and service type. Because the value of a train slot, this varies depending on the time of day. The values for this fee are between €20.3 and €11.24 and €4.8 per train-km respectively **for train maintenance.** For the **train sales tax** the values for this fee between €10.14 and €5.62 and €2.4 per train-km respectively for the three proposal high-speed lines corridors in Egypt. **For also the variable cost** in part of operation costs (labor cost on board the train, sales and administration costs, and energy cost). The values for this fee are between €16.3 and € 20.52 and € 6.4 per train-km respectively for the three proposal corridors. Thus, the average operation tariff or price for the corridors

[119] Average costs can be calculated in the short run by dividing the total costs of delivering all infrastructure services, given current capacity, by the number of services delivered. In the long run approach they will also include investment costs for capacity enhancement and enlargement. The average cost pricing principle is equivalent in most respects to fully distributed cost pricing, with which shares its main advantage (cost recovery). The average cost pricing principle argues for setting prices equal to the average cost of provision of infrastructure services, so that prices cover both marginal costs and fixed costs through past investments.

are **€15.58€ and €12.46 and €4.53 per train-km**. Thereby, it will be take the average value of the pervious figures to compare this value with other existing lines in Europe. In Figure 46 shown the average values per-kilometer in some European countries (this comparison for European countries in year 2010) and the average per-kilometer values expected in Egypt for proposal HSR line in 2015, were obtained in this comparison: it can be observed that, the proposal line in Egypt have the highest per-km charge (almost €15.58 higher than the next-highest line in Spain and Germany), and lower than Netherland, due to the high-speed surcharge on the high-speed line, and almost equal with France. The differences between Egypt, France and Germany are not great, when the peak period effects of the Egypt and French system are discounted.



Source [205]

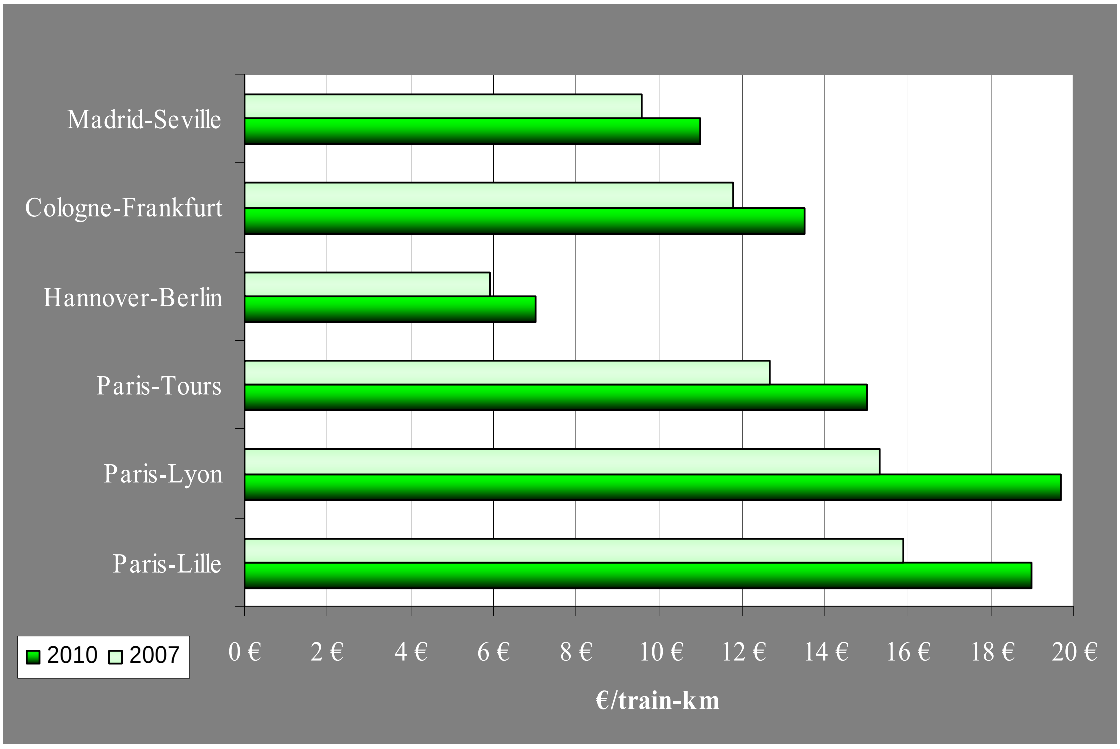
Figure 46: Price levels Comparison of High-Speed Lines between European Countries and Proposal HSR in Egypt

* Noted Brussels - Amsterdam uses values from 2011,

** These two corridors in Egypt use values expected in 2015 for the new Proposal HSR line

In fact, in the country case study and the developing and emerging countries there are have not until now the HSR system. Nonetheless, it will take an example to illustrate the impact price on the line. Thus, in this example it will compare the levels of price between difference lines. The aims of this analysis, it will benefits from these cooperation, when building the news system in Egypt or in developing countries. Indeed, in the Figure 47, it can be observed that, the prices have significantly increased on a per-km basis, between 2007 and 2010. Consequently, in these two years France completely overhauled its tariff system, in additional a surcharge for trains, which increases the base price about 25% in 2010 with comparison to the normal tariff in the same period. Where, the increase in tariff fees leads to the conclusion of an increasing willingness to pay of railway users (on average) and of increased cost recovery value for infrastructure manager.

In Figure 47 a tariff consists of an access charge independent from the quantity consumed and a variable charge set as a price for every unit consumed. It can be observed that, when applied to railway infrastructure, the fixed charge is generally aimed at recovering fixed costs, while the variable charge usually reflects marginal or variable costs. Consequently, there are two-part tariffs may be compulsory or optional (with self selection). In the first case, the operator must accept the payment of the fixed charge in order to access the network, while in the second he will be able to choose between the two-part tariff and a linear tariff. Nevertheless, the operator will choice one or another charging option depending on the total amount of produce consumed. The economic theory proves that in the special case of a two-part tariff with self-selection there is an improvement with respect to a mandatory two-part tariff [210]. Therefore, in the Figure 47 the objective of the trend between 2007 and 2010 has been to increase line cost recovery up to the prospect as possible, by passing infrastructure usage costs on to users.



Source [205]

Figure 47: Assess the Levels of Prices on High-Speed Lines

Thus, when the tariff structures are compared, most of the resulting charges are for usage of lines. In the few cases where the effective of station costs on the thorough cost is high, this is often because the shorter length of the line instead of the high station charges, and with some exceptions in Spain, the efficient of stations on the total cost is very limited. In terms of various tariff principles, more high-speed lines are moving to the margin cost with high markups or full cost principle, from a purely margin cost principle for HSR lines as is clear in the Netherlands [as show in Figure 46], which have recently implemented a surcharge on the Dutch part of the high speed line between Brussels-Amsterdam. Finally, countries that have already implemented HSR have shown increase in rail usage (for example, in France about +42% between 1995 and 2006, and Spain about +33% over the same period) [214].

8.5.2 The long Term Effect of Pricing

Prices have different economic functions. The marginal costs of rail infrastructure, in the long run include the capital costs of expanding capacity to absorption an increase in output. Where, prices as a device to maintain the balance in the markets and avoid both excess of demand or capacity unused. Furthermore, prices are signals in competitive markets directing the allocation of resources where the consumer willingness to pay is at least equal to the opportunity costs of these resources elsewhere. Consequently, pricing according to the rail infrastructure of them determines the price that is equal to the value of resources that should be used for the production of transport performance in the future, and ensure the financial balance of the Infrastructure Manager. Entry and exit in these markets, these price adjustment when demand is higher or lower supply.

Transport prices are not various in this way to other prices in the economy. Competitive transport markets behave in the same way. Therefore, when price is higher or lower than marginal social costs in certain mode of transport, the traffic volume, and the level of economic activity in this mode is suboptimal unless this is compensated in other markets related to the primary market through substitutability or complementarily relationships. Nevertheless, this approach finds difficulties because of the indivisibility of infrastructure assets when implemented in a new system for railway, which imposes a long term forecast of which capacity enhancements will be carried in the future and at what cost. In addition to the selection of the time horizon in which to calculate marginal costs, the marginal cost pricing principle may choose to include or not external costs, derived from price quantity impact on society such as ecological damage, accidents, congestion, noise, etc

It can be noted that, the transport user chooses a special mode of transport in a particular place and time imposes a marginal cost to himself (the share of the producer cost infrastructure and user cost and vehicles- included in the price), to the rest of society (external cost of accidents and environmental externalities) and to the taxpayers (the share of the producer cost that has been subsidized). When the generalized price is lower than the marginal social cost, for example as happen to be when freight is transported by a heavy vehicle in a congested road, the amount of freight transport on that road and time is higher than the optimal one. Thus, pricing according to marginal social cost would increase the generalized price of this transport option, reducing the amount of road traffic and inducing long-term adjustments from increasing rail freight transport share to reducing the need of specialized labour in the production of spare parts for trucks.

Consequently, the problems of budgetary are especially common in transportation because transport services often exhibit economies of scale so that marginal cost pricing does not generate enough revenues to cover costs (especial in the railway sector in developing countries). Ramsey pricing is often suggested to be a solution in order not to deviate too much from efficient pricing. Ramsey pricing minimises the distorting effect of charging more than marginal cost by increasing prices more in those markets where demand is least sensitive to price [209]. The basic idea is to charge those customers with the least price elastic demand the largest mark-ups to cover marginal cost and thereby minimise the reduction in consumption that occurs from charging prices that are higher than marginal cost.

A pure marginal cost pricing trend would therefore differentiate between peak and off peak, as well as between other determinants of marginal cost such as the quality of rolling stock and on-board services provided. To the extent that the financial performance of such a regime is unacceptable, price differentiation is likely to be the appropriate way forward. Therefore, for passenger services, differentiation can take place in terms of origin, destination, class and time of travel, person type (e.g. pensioner, child, and family group) and when the booking was made (at least in terms of longer trips where booking ahead may be reasonable). But such differentiation will almost inevitably be cruder than for freight, because it is not feasible to negotiate a separate price with each passenger.

In the case of railway, what is the difference when HSR fares are short to cover infrastructure costs? It can be noted that, economies of scale and strong possibility justify the deficits, but the question is that users should be willing to pay for the HSR infrastructure before new lines are built? High speed rail prices as signals that transport users take as key information on where, how and when to travel, or even whether to travel or not. If infrastructure costs are not included in transport prices, according to the rationale of short-term marginal social cost, the problem is that the price signal is telling consumers that is effective to attractive from road/air transport to rail transport, and this, of course, could be true in the short-term when optimal prices are not affected by the fixed costs of the a new HSR network.

The problem is that prices that do not reflect infrastructure costs in a transport mode where these costs exceed 50% of total producer costs, act as long-term signals for the consumers in their travel decisions and consequently in the future allocation of resources between transport modes or between transport, education or health. Where for the success of any a new high speed rail (for example in the case study in Egypt) it should be the load factor on trains not less than 70-80 %. For this reasons and according to Table 40 and Table 52, the maximum ticket price for one-way are €33.35 and €24.50 and €91.99 for Cairo/Alexandria and Cairo/Assuyt and Cairo/Luxor-Aswan proposal corridors respectively, however, when the load factor is 70-80 % of the total traffic volume. So, passenger in Egypt can willing pay for the high speed rail price ticket as show in the next section 8.5.3[120]. In case of the cost-benefit analysis in this context is quite relevant. If accepting that short-term marginal cost is the right pricing policy, investing in a new HSR line requires that the willingness to pay for capacity is higher than the investment costs and any other demand not related cost during the time of life of the infrastructure. This does not solve the problems of fair competition between different transport modes or the equity issue of taxpayers paying HSR constant costs, but at least it puts a filter on the most socially unprofitable projects.

8.5.3 Analysis of Ticket Prices

In this section the ticket price in the proposal HSR line in Egypt compare with the existing high speed rail in the some European countries will be analyzed: in the case of the European countries ticket price data was collected in the fall of 2011 by Aleksandr Prodan. Data was collected during five working days (Monday to Friday) during one week for the some European countries and then it will be compare the result with the proposal pricing ticket in Egypt. On each day the ticket price was checked for three time periods (AM Peak, Midday, PM Peak) for both first class and second class. This process was repeated twice (two weeks total). Table 53 shows the comparison between Egypt and some European countries in term of the minimum, maximum and average ticket prices for each of the lines considered. It can be noted that, the minimum and maximum of the first and second class can be determine from the Table 40 in section 6.8.

[120] For success a new HSR, should be the factor of load not lass than 70-80 %, So, in the Table 53, Figure 48 and Figure 49, it can be show the maximum and minimum average price ticket for the passenger in the proposal HSR in Egypt. However, the average ticket price almost 23.34, and 17.14 and 64.33 for the second class and 33.35, and 24.50 and 91.99 for the first class for Cairo/Alexandria and Cairo/Assuyt, and Cairo/Luxor-Aswan proposal corridors respectively. These figures depending on the load factor as show in Table 40. Where, if the load factor ranges from 70-80 % this lead to reasonable of the ticket price and user can pay for the high speed.

Table 53: Comparison the Ticket Price between proposal HSR in Egypt and European countries

	Line	Distance [km]	Ticket Prices					
			Second Class			First Class		
			Min	Max.	Average	Min	Max.	Average
Spain	Madrid-Barcelona	630	69.00 €	115.00€	101.32 €	69.00 €	207.00 €	157.37 €
	Madrid - Seville HS	471	48.00 €	81.40 €	78.23 €	122.20 €	146.50 €	134.35 €
	Madrid - Valladolid	184	21.30 €	35.40 €	29.32 €	28.20 €	55.00 €	53.06 €
Germany	Cologne- Frankfurt	197	39.00 €	67.00 €	49.00 €	69.00 €	109.00 €	79.00 €
	Hannover – Berlin	258	49.00 €	65.00 €	52.00 €	69.00 €	105.00 €	84.00 €
France	Paris – Tours	291	41.00 €	55.20 €	45.93 €	76.60 €	76.60 €	76.00 €
	Paris – Lyon	430	64.30 €	83.90 €	73.12 €	68.00 €	114.80 €	111.90 €
Italy	Rome – Florence	248	37.00 €	44.00 €	40.97 €	53.00 €	62.00 €	55.70 €
	Rome – Milan	560	49.00 €	89.00 €	63.77 €	97.00 €	114.00 €	100.40 €
Taiwan	Taipei- Zuoying	345	44.7 €	44.7 €	44.7 €	58.5 €	58.5 €	58.5 €
Korea	Seoul-Busan	409	17.73 €	35.53 €	33.73 €	31.93 €	49.73 €	40,00 €
	Seoul- Mokpo	411	14.60 €	29.27 €	27.80 €	26.27 €	40.93 €	35.20 €
China*	Beijing-Shanghai	1318	51.10 €	51.10 €	51.10 €	81.01 €	81.01 €	81.01 €
	Wuhan-Guangzhou	1069	55.36 €	57.85 €	56.60 €	88.48 €	92.22 €	90.35
Egypt	Cairo- Alexandria	208	22.88€	25.94€	23.34 €	25.94	46.68€	33.35 €
	Cairo-Assuyt	375	15.00€	19.05€	17.14€	19.05	34.29€	24.50€
	Cairo-Luxor-Aswan	879	64.33 €	64.33 €	64.33 €	71.45€	107.28€	89.4€

Source [205]

* For the HSR in China the price dependent on the type B: this mane that HSR with the speed of 250 km/h. and the data of the price for China, Taiwan, and Korea are collected from the websites of the railways in each country and also through talks with people (price as of 2012).

It can be observed that, the price of ticket in Egypt consider the lower price than other countries, taking into account the line distances between cities. So, this is due to several factors, the first factor is the lower operations cost for employees, where the wages in Egypt cheaper than European countries. The second factor is the construction cost also lower than some European countries, for example when compares the Cologne-Frankfurt line with Cairo/Alexandria, it will be observed that, the line distance almost equals, but the price in the line Cologne- Frankfurt is twice the price in Egypt Cairo-Alexandria in the first and second class, this due to the higher cost of the Cologne-Frankfurt per km. Finally, there are also many factors affected in the ticket price and has been explained this factors in the previous chapters (such as traffic of volume, topography, income, etc).

It can also noted that, in the Figure 48 and Figure 49 show the average price ticket for the proposal corridors in Egypt in the two cases (average price in the First and Second class), it was found that, the price in this analysis are lower than other countries. Despite, the price almost equal or sometimes less than this countries for example in the Cairo/Luxor-Aswan corridor (879 km) with the Rome-Milan (560 km) and Roma-Florence (248 km) in the case of First class. The result from this analysis is the price for the proposal high speed rail in Egypt is suitable for the Egyptian people in the case of the long distance and medium distance as show in the Figures 48 and 49, if compare with other countries.

It has been applied to analyze the fare price from the proposal corridors in Egypt and compare with the other rail line in European countries. It can be noted that, the calculated of the average prices for the first and second class through Table 53, where it was considered that the loading factor of 50% give the maximum fare price and load factor 90% give the lowest fare price for the first class in all corridors. For the second class it will take the minimum value of the passenger-kilometres according to the figures in the Table 39 and Figure 40 to calculate the maximum fare price and minimum fare price in the second class.

For the proposed tariff structure includes concepts from other lines, as well as innovative concepts from other industries, such as origin and destination pricing is able to pick up a high percentage of readiness for the operator to pay. Where, the proposed tariff structure of the system is able to send clear messages to operators on the quantity and type of traffic is desirable and provides discounts for higher levels of traffic. This will depend on the volume passenger traffic on the line of the proposal and the distance between the major cities.

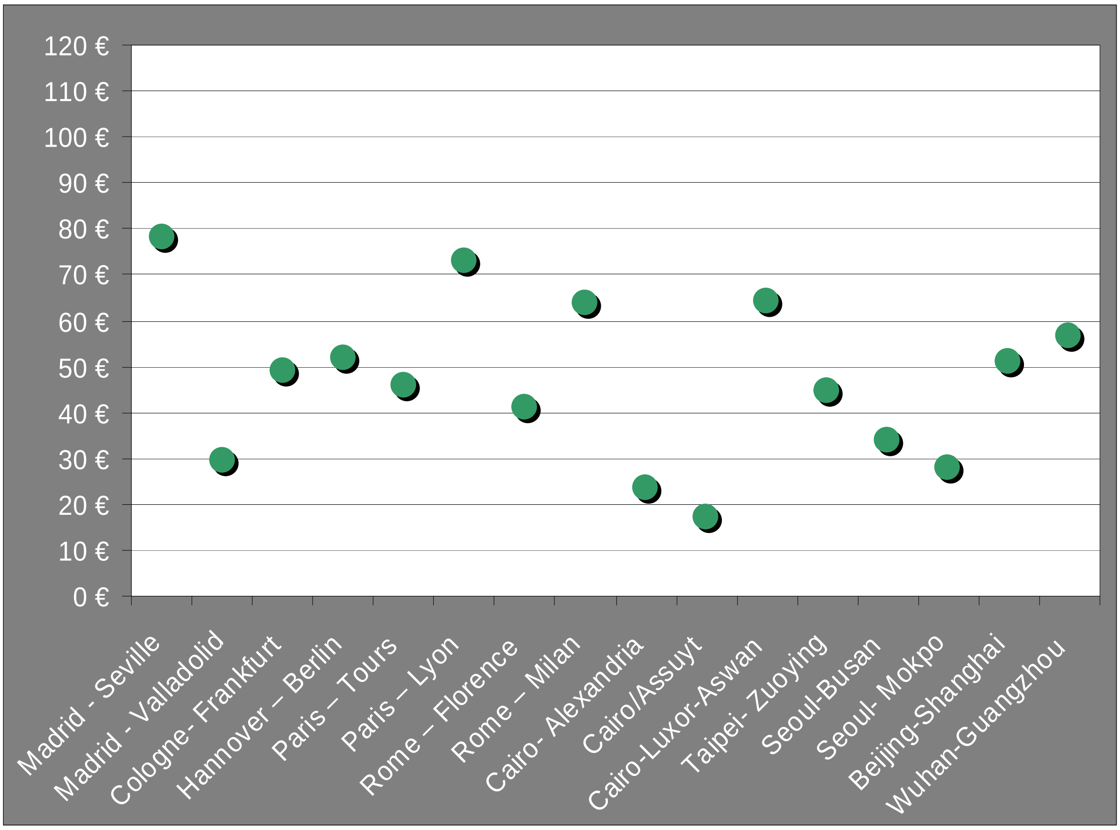


Figure 48: Avarege Ticket Price in Second Class

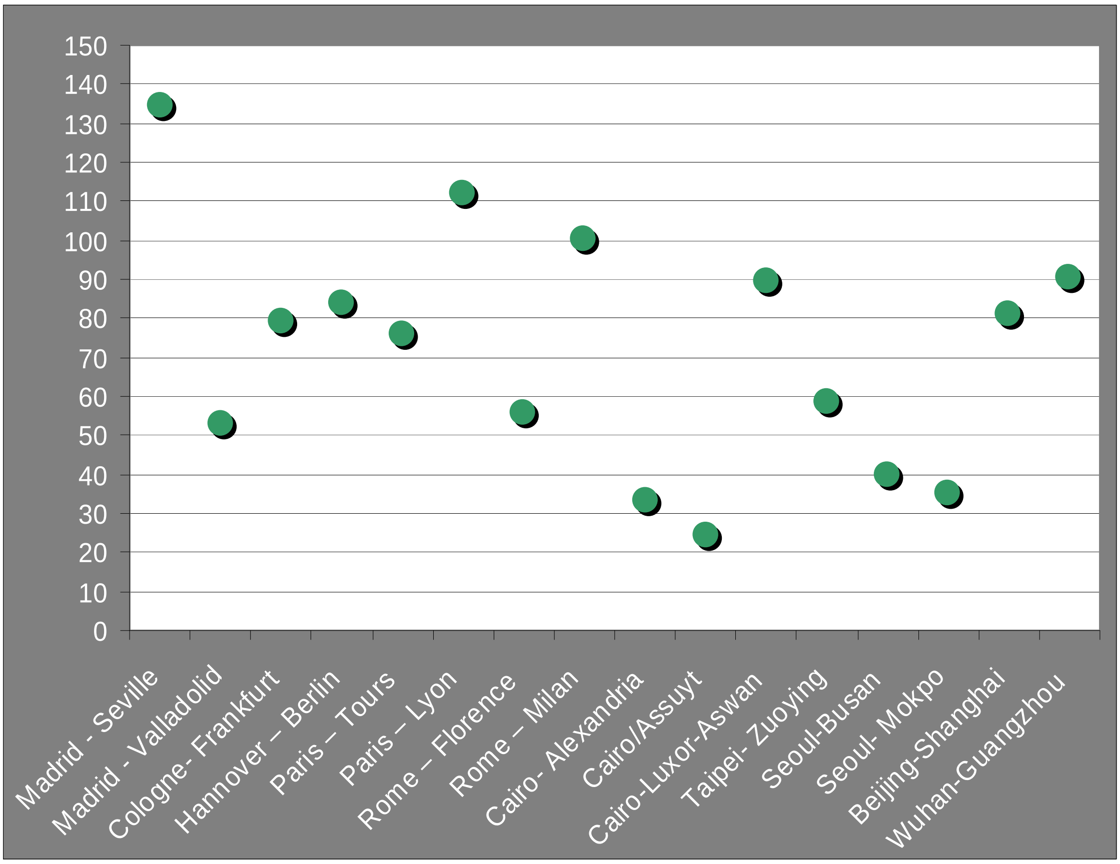


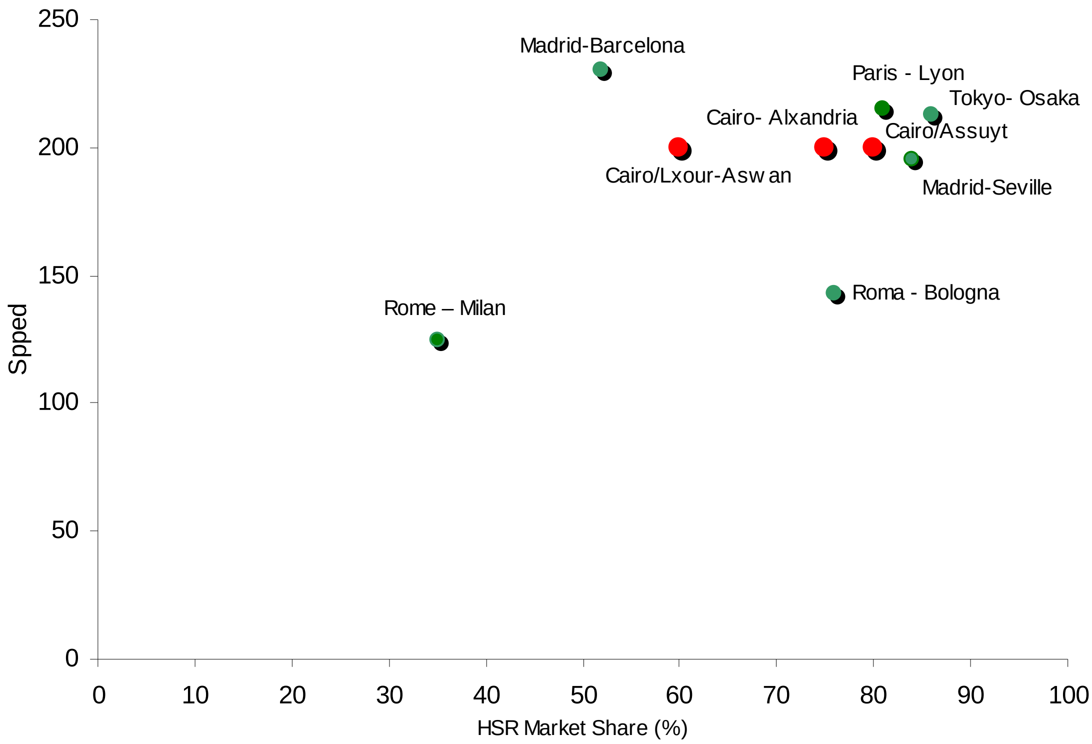
Figure 49: Average Ticket Price in First Class

Finally, the intermodal impact of HSR is stronger in lines with a longer period in operation. The impact of the establishment of HSR in medium distance corridors where conventional rail, car and air were the previous alternatives is quite significant as illustrate in Figure 50. Where, the HSR market share is correlated with rail commercial speed and, in those lines where the average speed of rail is around to 200 km the market share of the HSR is difference, where the train can achieve market shares of between 50 and 90 percent [208]. The high market share of rail in the medium distances has been an argument in favour of investment in the HSR technology. If passengers freely decide to move often from road and air to rail it follows that they are better off with the change. For the good examples are city pairs such as Paris-Lyon, Madrid-Seville and Rome-Bologna as show Figure 50. In Egypt the currently market share of the conventional railway is about 43 percent of the total public transport market. Despite, the average speed of train is not more than 100 km. Consequently, the expected market share for the proposal HSR line in Egypt may be about more than 70% and 80% in the Cairo/Alexandria Cairo/ Assuyt and Cairo/Luxor-Aswan corridors respectively.

These figures are based on the increase of the expected volume of traffic in the next 30 years, where the volume of traffic increases rapidly in Egypt and also in developing countries. In additional to this, the price of HSR ticket compare with air[121], safety,

[121] The domestic flight in Egypt by Egypt air (www.egyptair.com) between Cairo/Alexandria in one direction about €31 to €61.63, and between Cairo/Assuyt from €39.25 to €69.4 and between Aswan raining from €70.63, €95.63, €83.13, to €113.13 [for example this it will take the price from (16.04.2012 to 30.04.2012) to compare among air and HSR proposal and price status in December 2011]. Thus, when compare this value with the price by proposal high speed in the Table 53 and Figures 44 and 45; it will be observed that, the HSR better than air in the proposal corridors in term of ticket price and travel time (for

increases the speed, punctuality of the services, and shorter travel time, etc, as has been explained in the previous chapters in this research. Furthermore, the HSR services find reliability and punctuality important factors that contribute to the high market shares. Punctuality improvement makes it also attractive for business travellers to plan their return journey over longer distances on the same day (for example the corridors Cairo/Alexandria and Cairo/Assuyt).



Source [207]

Figure 50: Comparison of HSR market Share and Railway Speed between European countries and Expected Proposal HSR in Egypt

travel time can see in Figures 23 and 24). Add to this, travel time and travel costs to and from the airport terminal to the city center or downtown area determine the accessibility of the airport.

8.6 Summary

In this chapter were discussed the effective of pricing on choosing between the difference transport system. So, the people or user will be choice option the best opportunities reflect on the costs of the fare. In order to establish a reliable and effective intermodal transport systems in Egypt, the current situation of all modes of transportation were studied which could be summarized as follows. Firstly, at present the road network is very congested and already leads to some other serious problems such as road safety, noise, and pollutions within cities; secondly, despite the rail transport is already in operation, the operational capacity is very limited due to the fact that in Egypt the priority of track use is given to passenger transport; thirdly, the airline in Egypt is limited for the tourism and some of business people, add to this the higher fare ticket and the time.

Currently, the rail, air and road transport modes in Egypt are at different stages of application of pricing schemes. Where, railway and road are the most advanced, due to the major reform in these systems. The important cases behind the reform in rail transport have been the need for the separation of infrastructure and services operations. However, this case (separation) is still questioned, as there is a widespread belief that the interaction between vehicles and infrastructure in the rail sector is so complex that only an integrated management can operate it efficiently. It will be noted that, separation of infrastructure and services established in many countries, in order to encourage rail to achieve equal status with other modes (road, air transport).

The aims of this chapter is to measures appear to support pricing for total cost recovery of the transport sector. Indeed in each argument are based largely on the volume of demand of the affected corridors and several key local conditions, as the degree of airport or road crowding, the currently capacity in the conventional rail network, values of time, travel distance, construction costs, or the source of electricity generation and the proportion of urban areas crossed by the trains.

Moreover, this chapter has presented the current effects of moving to a more efficient pricing system are likely to be diverse, both because of differing circumstances between countries and because of different starting points. As show in the Figure 48 and Figure 49, its clear that to understand the for the proposal high speed rail line in Egypt as show in this chapter the price ticket lower than some the European countries. For example, in some countries rail fares are held very low, while in other cases was close to commercial levels. This makes it difficult to generalise about the effects of efficient pricing from a small number of case studies. However, the simple belief that a move to more efficient pricing would universally benefit the more environmentally friendly modes at the expense of other modes is found to be not true

As a result in the analysis of pricing the distribution of the pricing for the transport sector is not necessarily uniform. There can be different schemes for different modes (road, rail, and airline). A pricing scheme is not the only way to influence behaviour. Therefore it has to be adjusted to the regulatory environment and the taxation system. Where, in the case of study in Egypt user often chooses the cheaper price among the transport system. So, when compare the proposal HSR line with the existing mode of transport, it will found that the expected price for the proposal HSR is suitable for passenger. Also there should be flexibility in the pricing system to include learning effects over time.

The proposed share structure includes concepts from compare with other European lines [See Figure 50] as well as innovative concepts from other industries, such as origin-destination pricing and is able to capture a high percentage of the operator's willingness to pay. The proposed share scheme's structure sends clear messages to the operators regarding the volume and type of traffic desirable and provides discounts for higher traffic levels.

Pricing directly affects the way financing of HSR systems translate into actual benefits, mainly through:

- Incentivising behavioural change of individuals and allowing sustainable patterns of transport to become more financially attractive relative to one based on private motorised transport.
- Providing a strong signal to the private sector to invest and innovate in HSR.
- Raising the revenue required for additional investments to be made in HSR.

Finally, the railway in Egypt consider the backbone of the passenger, and introduction of a new system such as HSR line will attract the users, due to prices of HSR line compared to other means of transportation (such as road and air). In the next chapter will be show the result from this work and the condition and pre condition for the establishment a new high speed rail in developing and emerging countries.

9 CONCLUSIONS

This chapter concludes the thesis, which has investigated the opportunities of high speed rail in developing and emerging countries and the basics upon which the construction of new HSR depends. Firstly, it will be briefly summarized the prior conditions necessary for new high-speed rail systems and the principle findings drawn from the preceding chapters. The section that follows gives a final summary, contribution of this thesis, and future areas/directions of study.

9.1 Basic Preconditions for new high-speed rail systems

Intrigued by what they have seen happening in Europe and Asia, the worlds transport makers' policies have become increasingly attentive to high-speed rail. Increasingly congested airways and airports, road congestion, the human and economic costs of road traffic accidents, and the threat of global warming have all contributed to the vision that railways should and can play a much bigger role in transporting of passengers, especially in developing and emerging countries. Consequently, the same policy makers know that conventional passenger rail services in developing and emerging countries, with average commercial speeds typically in the range of, 100 to 130 km/h (often less in the case study) have been increasingly unable to hold market share. It was concluded that, much of the role of the slow transport services of passengers by rail on the main transport routes between cities will become increasingly marginal. High-speed rail, which can out-perform both air and road transport measured by different quality criteria and over a significant range of typical intercity trip distances, may be the answer.

It can be observed that, there are no experiences or projects in most developing countries (as case study in Egypt), thereby, according to the international experience, what are the main preconditions or success factors for reasonably getting started on a high-speed rail project?

The starting point in the most favorable case for high-speed rail is an already congested of railway corridor (if there is no rail link, or the corridor of transport is congested) operating in markets with strong growth potential. If the options for extending the capacity of existing lines have been depleted, then it is physically necessary to build new railway capacity anyway. The cost of constructing new railway lines already is expensive but if the new line is required in any case, the more sensitive variable for a decision on high-speed rail is the incremental cost of provision that additional capacity with high-speed capability.

The first condition is that depends on the terrain and geography and the speed of trains and other factors, etc (as see in chapter 6 Table 17), but it can be seen from international experience that between 25 % and 60 % of the costs of high-speed tracks would in any case be required to build conventional railways with 160 km/h speeds. Where, project appraisal should then focus on the incremental benefits of high speed operation versus the additional costs to achieve this goal.

Secondly the promising indicator of economic potential feasibility is a corridor of a high population density within large cities and high volume of demand with enough economic value to repay the high cost involved in the providing and maintaining the line. It is not only that the number of passengers must be large; however, a high willingness to pay for the new facility is required**.**

The third precondition is a high-speed rail service that can deliver competitive advantage over airlines in our example for journeys of up to about four hours or 700 km (see chapter 6 Figure 22), particularly between city pairs where airports are located far from city centers. For short journeys, say up to 100 kilometers, then private car transport is likely to be the main competitor, offering door-to-door travel not requiring a connecting trip to a high-speed train station. One suitable type of corridor is that which connects large cities such as in Egypt rang from 200-900 km apart (Cairo-Alexandra, 208 km; Cairo-Asyut, 375 km; Cairo-Luxor, 671 km). But another promising situation is a longer corridor that has a very large number of urban centers located on the line (eg: Cairo- Aswan, 879 km). On these corridors high-speed rail has the ability to serve multiple cities in Egypt in one line.

The fourth condition: depending on the incremental cost of constructing high-speed rail systems it can be recovered in an environment of intensive use of the available capacity. For example a proposal route in Egypt that operates for example 18 hours a day with an average of four trains per hour in each direction, each train carrying 800 passenger (1062 seats load factor 80%), will have a commercial capacity of about 57600 passengers per day or some 21.03 million passengers per year in each direction. In our opinion, whilst the day-to-day working expenses of a high speed line can be covered at a relatively low traffic volume, in the developing counties one must reasonably expect at least 20 million passengers per year with enough buy power, just to have the possibility of covering the working expenses and interest costs of providing that capacity with high-speed service, and perhaps twice that number to have any possibility of recovering the capital cost. Consequently, and of particular importance in developing and emerging countries, even if the physical passenger flows look good, it is prudent to question if they have the purchasing power to deliver the revenue needed to avoid an unsustainable government budgetary burden.

Indeed, passengers have a choice of using alternative means of transportation, or in some cases of whether to travel at all. Selection between these models will be impacted by the perceived convenience, safety, comfort; value of time saved, and so on, but behind this variable is the basic fact of passenger affordability (the ability of passengers willing to pay). In order to generate the volume required of passengers in developing and emerging countries it will be necessary not only to target the richer travelers but also to adopt a fare structure that is affordable for the middle income population and, if any spare capacity still exists, to provide discount tickets with restrictions on use and availability that can fill otherwise unused seats. In countries of both low incomes and low growth in incomes, affordability by a sufficient number of full-fare passengers will be a critical limitation

The fifth condition: Is the price of passenger kilometers, as was arrived at after the analysis of high-speed railway projects in Europe, USA and Japan. International experience generally, and the analysis of the newly proposed HSR line for passenger in Egypt, have confirmed that the market is price sensitive. The average ticket is priced at € 23.34 and € 34.01 in Cairo/Alexandria and €17.14 and €37.50 Cairo/Assuyt for the 1st and 2nd class (or about € 0.03 to € 0.12 per km) respectively, as compared with other countries. For the third corridor between Cairo/Luxor-Aswan, HSR fares are assumed to be €64.33 for commuters and €91.99 for business travellers (one-way in 2011 euro) [all these fares calculated from the Table 39 and Table 40]. It was found that the price of passenger kilometer is different from country to other, and this is depending on the volume of the passenger traffic. Conversely, in Europe the price of the passenger km range from 0.08 to 0.13 € / passenger km. It should be noted that passenger forecast demand was found to be sensitive to changes in HSR fare levels, but less so to changes in road or air fares, as regional travel demand, of which air and road travel is a relatively small component, especially in the developing countries. However, HSR was also found to be sensitive to HSR travel time, with mainly inter-city travel affected, due to the close competition with air and road.

9.2 Summary of Findings

Do we need HSRs? In many ways the answer is as much a political as well as an economic one. The historical evidence suggests that in the development of HSR projects there has always been an important political dimension. Most active countries – France, German, Spain Japan, and, more recently, China - have all offered a long-term political commitment to modernization, and include the increase of rail services as part of their agenda. Whereas this is not to say that their pro-rail policies have enjoyed total support, HSRs are obviously important where demand and supply for travel between large cities is high.

This thesis begins with an introduction to the mode of rail speed in some developing and emerging countries, a mode that is slower in comparison to other modes in developed countries. The reduction in train speed is impediment to the progress of this country; therefore, not paying enough attention to rail transport and the lack of strategy of transportation affects the national economy of these countries because it is the connection between economic resources, production sites and markets.

This research reviews the difference between countries with respect to the following: classification of country according to income per capital and effects of the high speed rail building. Secondly economic geography literature focuses on urban hierarchy and concepts of major cities regions. We then explored experience studies linking the effects of high speed rail and other transportation infrastructure to formation of major cities in some developed country. These studies of international experiences with high speed rail were undertaken in Japan Shinkansen, France TGV, Spain LAV, US/Canada and Germany ICE, focusing on specific high speed rail corridors. It was found that many of these HSR lines have received positive public evaluation to some extent and further extension or integration of current HSR networks has been planned in these countries.

This thesis also deals with the importance of the rail infrastructure in developing countries. The development of rail networks is often associated with the beginnings of the railway in the 18 century. Moreover, the rail infrastructure today is suffering from poor conditions, especially in case of many densely populated countries. Consequently, in economic terms, in the industrialized countries today, the applied theoretical concepts to the starting point for efficient railway companies would include: infrastructure and operations are separated, from during fixed prices to cover costs.

HSR is becoming an increasingly important and popular mode of transportation as roads and airports become more congested and greenhouse gases levels increase. It took twenty years after the implementation of the first high speed rail line in Japan until the interest in high speed rail reached Europe. But it has been in the last several decades that high speed rail has gained acceptance worldwide, with new lines having been constructed in China, South Korea, and Taiwan, Turkey, and being seriously considered in Saudi Arabia, Morocco, the United States and other countries.

Implementation of high-speed rail lines plays an important role in restructuring of the travel time patterns and activities of people and thus changing the ways cities develop. This thesis has explored the chance of high-speed rail in developing and emerging countries, and the effects of HSR on urban areas along the proposed corridors (such as the Cairo/Alexandria and Cairo/Assuyt corridor). An interesting implication of high speed rail studied is the possibility for major city or an integrated economic urban created by fusion of multiple cities. The objectives of the case studies were to study the phenomenon of chance major cities to connect with high speed rail. However, basis on the some conditions depended on along the selected corridors find evidence of economic development effects on urban areas in the corridors and identify the positive or negative for this corridors. The findings of and lessons were applied to the Cairo/Alexandria, Cairo/Assyut, and Cairo/Luxor- Aswan proposal high speed rail corridor case and the possibilities of future scenarios of major city formation and the associated effects were discussed and analyzed.

However, in developing countries the railways are owned by the State (laws often prevent the privatization), which can hardly reap revenue due to low prices and income to maintenance costs of the network. On the one hand privatization in the form of concessions, etc. at least enables the efficient operation of profitable routes (mostly freight). The problem of low payment of the pubic for the ticket however makes the passenger lines often unprofitable. On the other hand, it can be noted that, an important point for or against the importance of rail will be the development in road traffic. Rail lines are profitable, when private participation operate and maintain them efficiently. If not there should be an agreement between the State and the international bank to assist in achieving these projects.

In conclusion, the planning and construction of high-speed rail network currently is an important issue of passenger transportation. However, the implementation of high-speed rail is a mixed attempt, and all wisdom must be coordinated for the realization of any HSR projects. It is necessary to integrate all the components of transportation to take the full advantage of high speed rail. For example, the construction of high-speed rail itself is not enough; good access to its stations is necessary to attract more ridership. Maximizing the benefits as well as minimizing costs is critical issue for every HSR project. The discussion of HSR impacts still remains, and an integrated plan is necessary to fully ensure the benefits of HSR.

This thesis concludes by presenting informational background regarding chance high speed rail in developing and emerging countries. It also provides two tools (a method for evaluating transportation investment in Egypt and the screening model of HSR) that can be used as a platform to consider transportation investments in other countries.

9.3 Major Conclusions and Results

The intention of this section is to point out major achievements or scientific conclusions of this thesis for the developing and emerging countries.

- **Currently HSR are mostly to be found in developed countries than developing and emerging countries.**

In the chapter 1 discussed the different countries classification, and observed that all countries owning high speed rail networks have an income per capita that is higher than countries that do not have this system. Still there are rich countries, but there is no HSR network.

- **The fundamental contribution of the high-speed rail that it is currently an important option for efficient intercity passenger transportation around the world.**

This phenomenon is seen not only in Europe or Japan where rail transportation has been popular, but also beginning in some developing and emerging counties such as China, Morocco, South Korea, Brazil, Turkey and Saudi Arabia. These are countries, where, cars and air transportation have dominated the intercity passenger transportation market. Consequently, the environmental concern and congested highways and air corridors have made more regions interested in HSR.

- **An important option and ideal solution in case of natural disasters or terrorist attacks**

There is a very important feature of the high speed rail, and that is it an excellent solution in natural disasters between countries (especial in Europe). An example can be given by the volcanic eruption in south Iceland in March 2010, which leads to biggest disruption in aviation. Thereby, making passengers find alternative transportation to their destinations. Many used railways inside countries or between countries. Another reason for the benefit of HSR line for passenger is the time necessary to complete additional security requirements when flying following the attacks on September 11, 2001: this led to increased interest in HSR rail market in world wide

- **A major obstacle has been high construction costs for HSR implementation, but now lower costly options are now available in case study and similar countries.**

The high initial cost has been a significant impediment for the implementation of HSR, because it is considered as a big financial risk when demand is not certain. Nevertheless, it could be taken into account the benefit from constructing a new HSR in developing and emerging countries before building these projects. Consequently, there are now less costly options such as the incremental HSR developed in France, China, Turkey and Japan, which generate less construction cost compared to the traditional HSR which requires a dedicated track. Utilization of existing tracks is key to reduction of construction costs, in additions the flat terrain will be plays a great role to reducing the cost of the implementation of HSR line. It was noted that the size of HSR success depends on the specific projects and reduction in construction cost has been very important, because the economic feasibility of HSR project will always remain a major issue, because demand forecast is always uncertain.

- **Travel time saving is the major criterion for HSR implementation, and is a function of many other characteristics.**

Travel time, which is a major variable for level of service, is an output of a complicated function using not only the maximum operational speed of the train, but many other characteristics such as acceleration and deceleration rate, distance between stations, or partial speed limits (this case when the HSR line service cities with long distance as a result in chapter 5). Using the models and hypothetical regions, it will be found that raising maximum speed itself may not be enough to reduce the travel time effectively (if the distance between cities it is very short). It is necessary to see a HSR line as a whole system, and the suggested strategy might be different case by case.

- **HSR increases quality and productive time**

In today's hectic world quality time for oneself and chances to relax are precious for each individual. When travelling by rail, travellers gain time which they can use to do things they could not do if travelling by car or plane. Besides its eco-friendliness, rail, and particularly HSR, offers numerous advantages for its customers such as reliability, punctuality, comfort, time savings, access for all, the ability to work, direct travelling from city centre to city centre and last, but not least, personal safety.
Regarding quality time as uninterrupted time which is not reserved for transfer (using public transport/taxi/walking), waiting, security screenings or time when use of electronic equipment is not allowed HSR has a significant advantage to air and car travel. The total of travel time is comparable between air and rail; furthermore time allocation is at the advantage of HSR because customers benefit from a less segmented journey. Travel time on a train can be more productive due to fewer interruptions. So, when journey times are slightly longer than air travel, HSR still attracts customers,

which is reflected in the high market shares it achieves. With HSR, time spent travelling is not wasted time. During travel one can mix business with pleasure: reading, playing, sleeping, and working, watching videos or the landscape. Some half of business rail journey time is used for working or studying; by comparison with other modes HSR journeys can be highly productive journeys

- **A cost benefit analysis is a useful tool for HSR in principle, it is also a difficult task. But the methods differ and unanimous agreement on how to perform these analyses has not been gained. It can include external impacts of HSR.**

It is difficult to make an accurate cost-benefit analysis, due to the difficulties in defining a system boundary and allocating shared costs. The effect of HSR on the external system (such as accidents, environmental externalities, congestion reduction, and social benefits), is also hard to derive, because causality is often unclear. The availability and accuracy of data is another problem. Moreover, the benefit cost analysis is a method that is used in project evaluation and can help in the decision making process of executing it or not. Usually, this process involves the calculation of total expected costs compared to the total expected benefits. It can be noted that, this method was used in the analysis of case study in Egypt. In the proposed HSR project in Egypt the data was used available (this method can be used in other developing country, if all the conditions that help in doing so these are available). The project seems worthy of serious consideration because of its competitive comprehensive rates of return and ability to be self financing. The overall net present values for tow corridors in country case study are positive (Cairo/ Alexandria, and Cairo/Assuyt corridors) and so the proposed project would increase net benefits to society, but the third corridor is negative So, the estimated B/C ratio is not supports a decision to invest in the third corridor. A careful cost-benefit analysis is necessary to assure the feasibility of any HSR projects, and general conclusions about the economic impacts by HSR are hard to establish

- **A high speed rail may have implications for maintaining the regional economies**

A HSR may have a catalytic effect on the economic development; it may not be sufficient to cause regional economic development, but could lead to development, particularly where there is a bottleneck in terms of capacity transport. The effects of HSR on the regional economy can be further classified into two different impacts: redistribution effects and generative impacts. The effects of redistribution is just a transfer between regions at the national level, but can be counted as a benefit of HSR for a specific region. The HSR is dependent on the maximum transportation distance of each individual and is closely related with his/her income, mobility, and purpose of travel. Moreover, if the HST will cause changes either in urban actors' transportation behavior or location behavior, it is necessary to explore the way they value transport costs. Consequently, the analyses of HSR impact on regional development tend to be qualitative. Finally, economic development is a broad field with different meanings to different people especially in the Egyptian cities; it tends, in general, to enhance the level of economic activity in a number of areas:

1- Income: to improve the economic welfare of population through increasing employment and higher levels of personal income

2- Jobs: HSR can improve new job opportunities for the regions, by expanding the types of jobs available quality of life to expand

3- Quality of life: by expanding opportunities for local marketing activities, social and entertainment in the region.

4- Stability: to improve stability in jobs and income in the region by diversification to reduce dependence on declining industries.

Finally, as it will be mentioned in chapter 7; the terms of wider economic benefits remains one of the hardest to tackle; such benefits could be significant, but vary significantly from case to case, so an in depth study of each case by experts and the researcher.

9.4 Findings in Egypt

Railway construction in Egypt was discussed through the research to outline the main shortcomings resulting in its ineffectiveness to the raising of speed that leads subsequently to different types of deficit. Hierarchical organization, lack of the knowledge and experience with regarding to management, random system of management, inappropriate payment system, inefficient dealing with unforeseen conditions, bureaucracy were examples of such obstacles:
(a) High production costs of small capacity, short-distance trains (According to ENR, fully-allocated cost per seat-km is 35 percent higher for local services than for express services)
(b) The fare level is held low and the railway suffers seriously from lack of funds to modernize, the poor maintenance depot is typical of the problems. Also in some times passengers still try to hitch a free ride
(c) Low revenue per Pkm. The latter is due to low fares set by the Government for social purposes, and poor train occupancy ratios.

Regarding Egypt, a step-by-step method for new HSR line evaluation has been proposed in chapters 5 and 6. Aside from the details, the main conclusion is that a combination of methods provides a more accurate evaluation. This combination assures that many different aspects of impacts will be included in the ex-ante evaluation in order to take the most appropriate decision at the time of study.

This thesis has examined the opportunities of HSR line investments on other transportation projects, and compared HSR lines in developed countries with the proposed HSR lines in developing and emerging countries such as Egypt. To make opportunity of HSR line more applicable, this thesis has also identified innovative methods that can be used for building lines with lower investments costs of HSR, and explored appropriate value capture mechanisms that can be used to capture the economic benefits of HSR on large areas and costs of building HSR projects in Egypt and other developing countries.
Egypt is in a position to learn from many countries that have planned, built, and operated high-speed rail systems over the past four decades. Their experiences, coupled with an analysis of the potential benefits of high-speed rail for Egyptian travel behaviors, land use patterns, and urban and regional economies. Based on the earlier results, it will be made the following conclusions for Egypt with regard to the potential for the formation of major cities and development effects of the proposed HSR line, specifically focusing on the proposed Cairo/Alexandria, Cairo/Assuyt, and Cairo/Luxor-Aswan HSR corridors:

- **Creation or development of a major city is possible in different forms along the planned Cairo/Alexandria, Cairo/Assyut and Cairo/Luxor-Aswan HSR corridor as a result of improved accessibility and increased interaction between the cities**

The benefits of a high speed line may be maximized by locating it where it may carry traffic to a wide number of destinations using the proposed high speed rail line. The advantages of the rail line topography in Egypt make the most of the cities located on the one line from Alexandria to Aswan via Cairo, Assuyt, and Luxor. This makes all the cities benefit from the proposed HSR line. Consequently, the time distances between the cities planned to be connected by the new proposed Cairo/Alexandria HSR line will be reduced significantly relative to travel times by any currently available mode of transportation. The proposed HSR link has the potential to reduce the 208 km (Cairo/ Alexandria) corridor to around 50 minute travel time (**this mean a new proposal HSR line will reduce the rail journey times from 2hr 45min to just about 50 minute**), making it an area of one-day activity and potentially forming a major city. For the 375 km (Cairo/Assuyut) corridor the proposal HSR link has a potential to reduce the trip to 1h 30 minute (**this mean that a new proposal HSR line will reduce the rail journey times from 5hr 30 min to just hour and a half**). For the 879 km (Cairo/Luxor-Aswan) corridor the proposal HSR link has a potential to reduce the trip to 4.0h 01minutes (**this mean that a new proposal HSR line will reduce the rail journey times from 13hr 30min to just over four hour**). If the new HSR line between Cairo/Alexandria, Cairo/Assyut and Cairo/Luxor-Aswan are successful in generating new demand between the pairs or a group of cities, it could lead to the incorporation of these cities into a large economic or several smaller integrated economic area and up-growth of one or several major city. Between which city pairs or group of cities this major city could evolve would in part depend on the origin-destinations that register the higher traffic increase.

- **Cost of building HSR lines are great, but are within reasonable limits for spending on infrastructure.**

In fact, constructing a new HSR line is costly. The use cost data in chapter 6 based on information from the analysis of other countries should therefore only serve as a rough assessment of the different cost parameters, always keeping ratios into account. Thereby, cost data from tracks for high speed constructed during recent years (in developed country) can give us a first assessment of the construction cost of a new railway line. Furthermore, the funding requirements for HSR investments may differ depending on the model of the network (more costly to build a mixed-use than a dedicated line), terrain and geotechnical factors, and the choice of technology. Most HSR lines were supported by public subsidy at the construction phase, but more recently, the private sector has also become participated in HSR investments (e.g., in Taiwan). Consequently, the cost of the proposed high-speed rail construction in Egypt appears to be much less than in other countries, for topographical reasons. To meet the financing requirements for the new proposed HSR in Egypt, the government of should be signed agreements for external financing. These agreements will be enabled the securing of new financial resources through concessional loans.

- **The most difficult obstacle for HSR projects in Egypt is the funding or financial resources.**

In chapter 7 it can be noted that, the international evidences of the PPP application in HSR development are mixed: some countries use PPP as their HSR procurement method, while others don't. Moreover, the ability to attract private capital depends heavily on the project's profitability itself, and does not depend on the transportation mode of the project. Usually, when compared to airport, road, and seaport projects, HSR projects are relatively harder to attract private capital and rely more on the government's funding capabilities because the profitability of HSR projects is lower. This case is not true in Japan, in which HSR projects are more profitable than road projects.

It should be mentioned that, what also the factor to helps to increase investment into HSR by countries is the close proximity to neighboring countries (such as European countries). In some cases HSR systems are isolated from other countries (for instance, Taiwan, China, and Japan HSR systems don't get any financial support from multilateral agencies) and that is probably because these HSR systems can not generate external benefits for other countries. That is the same case for proposed HSR in Egypt; therefore, the government should contribute to the construction of these projects. There is one proposed high-speed rail transportation potential corridor, in which large cities are in intermediate distance (from Alexandria to Aswan via Cairo, Asyut, and Luxor) in three phases. In Egypt, as the whole country is large, and the length of line about 1000 km from north coast to south desert, high-speed rail is not effective, but there are still potential regional corridors in the first phase between Alexandria/Cairo, and Cairo/ Assyut and Cairo to Aswan and other regions located on the same line. However, competing modes, such as car, and airport are not useful in saving time. For the high-speed rail project in Egypt, public investment is necessary. However, as the costs of the project cost are huge, the approval of this public investment is the most difficult hurdle for HSR projects in Egypt.

On the other hand HSR systems connected with other countries are more likely to get financial support from multilateral agencies (e.g. the World Bank, the European Investment Bank, the Asian Development Bank, etc.) than HSR systems isolated from other countries because the HSR systems connected with other countries may generate positive external effects internationally. For example, German and France HSR systems both get financial support from the European Union and the European Investment Bank because of their contribution to the Trans-European Networks of Transport HSR network in Europe.

- **HSRs are primarily for transportation between cities, and a new dedicated track are necessary for HSR.**

Upgrading existing lines is ineffective solution, and there are question why it cannot simply upgrade our existing infrastructure to deal with this capacity of passenger. But no upgrade of existing infrastructure can deliver the huge improvements in journey times and the transformation of the economic geography that a new high speed network would bring. For high speed rail to be able to compete with other modes of passenger transport, such as airlines and cars, dedicated tracks are necessary to achieve required level of service. Unfortunately, an upgrade of the conventional tracks is costly and this is difficult to apply on the existing lines in Egypt. Whereas, a new tracks progress of safety of transportation without the conflict and incidents of road crossings, heavy weight freight trains, and traditional passenger rail traffic. Since dedicated HSR tracks cost more than incremental HSRs, financial resources are necessary proposing another hurdle. However, all the successful HSR cases in this thesis (in developed country) are with dedicated tracks. From the successful HSR examples are those in France, Japan, and Germany, the primary purpose of HSR is intermediate distance intercity passenger transportation. At the same time, in Egypt; there are no HSR by definition. There were one a study of a HSR projects in the Egypt in year 2009, but none has been constructed.

- **High speed rail can reinforce tourism attractiveness in Egypt.**

The tourism sector industry is very important for the country and employs about 12 % of the total Egypt's workforce. In chapter 8 identifies the importance role of the infrastructure of transport in tourism destination development. In the case of the HSR, the effects are selective and conditioned by existing tourism resources. In general, HSR permits the development of business tourism and urban tourism. In the result in chapter 6 it can be found that the number of tourism in Egypt to be about 14.5 million in 2010. It can also be shown that the implementation of a HSR between two regions brings them closer and thus strengthens the competition between them. It is also clear that the HSR can facilitate the development of tourism activities, in particular for example in the case study (especially in Egyptian cities). These effects may appear only if a previous tourism potential exists and the public or private sectors set up measures of accompaniment. One of the main conclusions of the basis for the developing and emerging countries is to suggest that an area confronted with an increased spatial competition due to a new transport facility should invest in a differentiated tourism product. Regarding the case of Egypt (Cairo, Alexandria, Luxor, and Aswan), each city has to take advantage of the implementation of the HSR between them to better differentiate its tourism supply (sustainable tourism, luxury tourism, etc.), in order to eliminate competition with other. Consequently, high speed rail will allow people to see/visit new place, especially attractive would be that they can see all the main Egyptian cities from a train window. Although this case can be applied for any countries, here it will be taken Egypt as an example. In chapter 8 pricing the expected pricing for the proposed HSR line in Egypt were discussed. In the case of Egypt user often chooses the cheaper price among the transport system. So, when compare the proposed HSR line with the existing mode of transport, it will found that the expected price for the proposed HSR is suitable for passengers. Also when comparing this pricing with the prices in some European countries, it was found the price in Egypt lower than European countries. This leads to the attraction of more tourists and passenger to use the proposed HSR line.

- **Regional differences may not be decreased along the corridor, but on the contrary, may actually increase, resulting in winners and benefit.**

The way that the urban areas are affected by a new high speed rail related to conditions to the high speed connection between the cities. It is important to consider the effects of the network; the benefits of a high speed line may be maximized by locating it where it may carry traffic to a large number of destinations using currently routes. It is clear, this implies technical compatibility. In fact, all the cities connected to the Cairo/ Luxor-Aswan proposed HSR link will gain better accessibility; however, the benefits to the cities of Cairo, Luxor and Aswan will be greater compared to the smaller urban areas along the proposed HSR line. In scenarios, derived for the proposed Cairo, Luxor/Aswan HSR link in chapter 5, the cities located at intermediate stops along the HSR route (Beni Suef, Minia, Assiut, Sohag, Qena, Luxor and Aswan) may have some development gains. Consequently, all the cities located directly along the corridor connected to the HSR may gain economic activity and popularity. Furthermore, Cairo’s dominant position as a major economic center may be strengthened further as the HSR network expands to north and to the south. However, the changes in travel time and accessibility will be essential enough for the economic growth to take place on the corridor level given that the good connectivity and access to conventional railways in the corridor already exist. HSR tends to favor urban areas with service and information exchange industry foci and to a lesser extent manufacturing and agriculture-oriented region. Other factors that may maximize HSR's positive impacts are compatibility with the conventional railway, inter-modal connectivity, and station location in city center. Cities not directly connected to the HSR line (such as Hurghada and Suez) are the most disadvantaged cities from this development, especially if they are not linked to HSR by conventional feeder services.

- **Finally**

In chapter 6 the competitiveness of the railway with other transportation modes were analyzed. The impacts of HSR technologies on passenger travel time were discussed, since the time saving benefits has been considered the primary benefit of HSR. It was analyzed several methods including the travel time with the price of each model. The Cairo/Alexandria, Cairo/Assyut, and Cairo/ Luxor- Aswan in Egypt were discussed as a case study of HSR technologies and their impacts in chapter 6. It was discussed one proposed HSR lines in the region in terms of level of service and competition with other intercity transportation modes. It is also noted that station spacing is critical to reach the highest potential of high-speed rail. The technology implemented in a corridor must be determined by the geography and pattern of demand (link areas of high population density). It was found that these HSR lines are strong enough to compete against air transportation. It was concluded that the proposed HSR line in Egypt will contribute to regional development to some extent, although there is not decisive evidence.

It was found that a HSR investment will have positive impacts on regional economy to some extent from in viewpoint of public infrastructure investment, but its magnitude may not be as higher as other public investments. Although the transfer of technology from the developed country to Egypt is straightforward, the process of implementing the HSR in Egypt is not as simple. Due to differences in geography, history, and socio-political, Egypt needs to find it is own model of implementation and strike a balance amongst disparate coalitions of voices and interests. From lessons learned in the TGV France, Germany, Spain and other country, future attempts at implementing high speed rail in Egypt will first require reassessing the economic and commercial feasibility of high speed rail, improving its commercial viability by increasing public-sector support, and taking a completely different perspective on financing, marketing and politics. Consequently, most successful applications of HSR appear to arise when there is both a need for more capacity and a commercial need for higher speeds. It appears difficult to justify building a new line just for purposes of increased speed unless traffic volumes are very large, however when a new line is to be built, the marginal cost of higher speed may be justified; conversely the benefits of higher speed may help to make the case for more capacity.

Lastly, a comparison between Egypt and other countries was presented. The results show that the countries have a great deal in common. However, as far as HSR is concerned, Egypt is better organized in the track (where there is one line that serves all the cities of Egypt from Alexandria to Aswan via Cairo, Asyut, and Luxor, excluding the Delta cities). Although, HSR does not exist in Egypt yet, the proposed process is on a very good track. Perhaps Egypt should follow the example of other countries in order to improve the current situation on the rail sector. The main other lesson that can be learned from other countries is that institutional changes are needed within the railway sector for high speed rail to become a reality. If Egypt can manage to develop such an organization, perhaps the implementation of HSR will be accelerated

9.5 Further areas of research

HSR is a rapid and modern of rail transport which is make more distinguished every day because of the benefits it offers. After considering this analysis, it would be very interesting to investigate how the paths of the Egyptian rail network could be transformed into a new high speed rail. Furthermore, research is needed for constructing new rail lines that will connect densely populated places that are currently not or poorly covered by the rail network and thus help to bring those areas closer to the rest of the country.

From the figures in chapter 5, it seems that the government is expenditure target from the Ministry of Transport and bodies has been take a great part of the investments, approximately 60% (the projects of roads, bridges and subways has been take a great part). Where, hold the same view regarding the future of Egypt transportation.

Consequently, the conclusion is that railway transportation issues are lead to delayed, at least from the analysis that has been made regarding these government. Further research might investigate whether this observation which is true in Egypt, is also held in other countries. This investigation would require the analysis of the transportation strategies that were followed by the government. Governments would need to take into account the necessity of investing in fast rail network projects in the future.

Further research is also needed regarding the estimation of the socioeconomic benefits of a transportation investment and especially of HSR. There is a need for detailed evaluation to assess all the benefits of HSR. Furthermore, further investigation is needed to determine the negative aspects and disadvantages that may result from this construction. There is need to estimate the revenue scale of these value capture mechanisms before starting to build the new HSR network. Such an analysis needs data and time, but it is something that can be done, which is necessary in order to make the correct decisions. These researches may include:

- Detailed investigation of the economic conditions of large area in which new HSR projects are built, particularly the economic conditions of the urban adjacent areas of HSR stations.

- Quantitative cost estimation of new Egypt HSR projects.

- Detailed quantitative study of the economic benefits that Egypt's HSR can bring to large area, such as, the percentage increase in land and real estate price around HSR stations, the revenue increase of retail and residence businesses around HSR station, the revenue increase of information exchange industries, the comprehensive regional impacts of HSR, and so on.

This thesis provides a basic model, which can be used for a HSR development in developing and emerging countries. It provides a powerful, user-friendly analysis in which all possible factors affecting the creation of a HSR system are considered. In addition, the base of implementation should be widened to more case studies. It is recommended to use the proposed model in the developing country with integration system framework for several case studies to enable us to benefit from this experience. Hence, for the active application of succinctness of the investment railways passenger relevant to the high speed rail just account of high speed rail as a potential option to address demands on the transportation system in the country, it is recommend that the government with Ministry of Transportation, in consultation with ENR and other stakeholders, take the following actions:

- Develop a strategic vision for a HSR, especially in relation to the role high speed rail systems can play in the transportation system in the country, clearly determine potential objectives and aims for high speed rail systems and the roles of government and other stakeholders should play in achieving each objective and goal.
- Overall, the historical decisions to build high speed rail lines were mostly not mainly based on economic assessment, and therefore changes in evaluation criteria cannot explain why other countries have invested so much more than Egypt or developing and emerging countries. Governments must take into account the economic progress and the effect of political decision-making on the creation of a new HSR.

- Develop guidance and methods for guarantee reliability of passenger and other forecasts used to determine the feasibility of high speed rail projects and support they need from the private sector. Thus, identifying and implementing ways to structure incentives to improve the accuracy of passengers and cost estimates that can ensure a high degree of reliability of such forecasts.
- Financial costs of the railways sector are high and fiscal transfers are not allocated transparently. The upcoming government must adopt a high level of transparency, especially when dealing with the finances concerned with financing large projects such as HSR construction. More transparency in the distribution of public funds, as well as improved marketing and operation of the railways in the right environment (in terms of laws, tariffs, private sector participation, and so on), should provide the basis for a final reduction of fiscal transfers to the sector, therefore it is recommended the government to take three actions:

  1- Restructuring the relationship between the Government and ENR is the key element of any reform.
  2- While increased transparency will not reduce the fiscal burden in itself, it will set the basis for making better financial decisions
  3- Financial transfers and subsidies to the railways sector must be made more transparent.

Finally, this thesis has suggested several options for the construction a new HSR line in developing and emerging countries especially in Egypt. This alone is not enough to solve both HSR financial resource problems and the inner city traffic congestion in this country, and I hopes this thesis will going to be helpful for future investigators and executives considering this option.

9.6 Closing words

This thesis adds value by systematically studying the opportunities and methods for building HSR in Egypt and developing countries based on the assumption that Egypt will build new HSR lines only when the economy of Egypt has significantly recovered. This thesis has many contents, including country classification, high speed railways in developed countries, high speed rail in developing, emerging countries, methods and methodology of cost calculation for a new high speed rail, the economic benefits of the high speed rail and the pricing of HSR. Finally it requires a substantial amount of time and patience to finish reading this thesis and, here we would like to thank the reader for dedicating time to this thesis. We hope that this part of work will be involved in reality for the benefit of researchers and motivate them to continue the analysis that has been started, and hope that it brings value to researchers and those in the railway industry in Egypt and other countries

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