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Egypt's High-Speed Rail Revolution: Integrating Innovation, Sustainability, and Economic Growth

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ABSTRACT

The potential of the high-speed rail project in Egypt concerning changing the face of transportation infrastructure in this country is targeted in the present paper. Backed by the historical setting of pioneering railway systems, the "Habi" project modernizes its transport infrastructure with the present network limitations by offering a rapid, efficient, and sustainable transport alternative. Significant economic benefits are mobilized, like job creation, increase in investment, and balanced regional development. It also investigates the possibility of such a project increasing tourism by reducing journey times to places of interest and access to cultural sites. The other core objective of environmental sustainability will ensure that the project reduces greenhouse gas emissions significantly and limits energy consumption. Using sophisticated assessment methods—Cost-Benefit Analysis, Multi-Criteria Decision Analysis, and Scenario Analysis—clearly established the project's financial feasibility and socio-economic benefits. Comparative analysis of the Japanese, French, and Chinese high-speed rail systems yields essential success factors and best-practice lessons transferable to the Egyptian context. Strategic policy recommendations in respect put forward the need to secure diversified funding, continuous innovation, environmental sustainability, and public outreach and engagement. The high-speed rail project promises to revolutionize Egypt's transport landscape by promoting connectivity, stimulating economic growth, and promoting sustainable development.

Keywords: High-speed rail, Egypt transportation, Economic impact analysis, Environmental sustainability, Project evaluation

1. INTRODUCTION

1.1 Background

Egypt has one of the oldest railway systems in the world. This implies that NYC dates to the middle of the 19th century. The first railway line in Egypt, Africa, and the Middle East was laid in 1854, linking Alexandria to Cairo. This early development was driven by the urge to enhance transportation between the Nile Delta and the Mediterranean Sea[1, 2], improving passenger travel and goods transport. For many years, this railway system of Egypt had hugely expanded to link key regions by playing an essential role in the country's economic development.

Despite the glorious history of this existing railway network, many associated problems crop up. It comprises aged infrastructure, poor maintenance, and poor capacity, making it challenging to activate the increasing demands of a fast-growing population and booming economy[3, 4]. This has rendered the network inefficient, delays frequent, and there are safety concerns with an inability to meet the modern transport demand of Egypt. As this country develops, there is an overriding call for renovating and expanding its rail infrastructure to guarantee efficient, reliable, and sustainable transport[5, 6].

1.2 Purpose

This paper examines whether the high-speed rail project could transform Egypt's economy, drive growth, deliver sustainable development, and boost tourism. Considering the current constraints of the Egyptian railway system – including outdated infrastructure and inefficiencies – the high-speed rail project aimed to offer a higher-quality, more reliable, and efficient option for passenger and freight transport[7]. The study shows how a positive project generates \$54.6 billion in economic activity — 15,000 construction jobs total, 2,000 permanent jobs, and hundreds of millions more in local economic impact —and, on top of it all, attracts domestic & foreign direct investment. Such impacts are set to aid in regionally balanced development, with a specific focus on enhancing communication between urban centers and outlying areas[8].

Additionally, the analysis examines how the project helps environmental sustainability by diminishing GHG emissions and energy use, furthering national climate action and Egypt's stated objectives. This project can also reduce travel time, increase accessibility to major tourist attractions (tourism revenue), and contribute to cultural heritage site preservation[9, 10].

In addition to the data-driven analysis of Egypt's high-speed rail initiative, this research draws on comparative insights from countries like China, Japan, and France, where similar projects have yielded significant socio-economic and environmental benefits. Using methodologies such as Cost-Benefit Analysis (CBA), Multi-Criteria Decision Analysis (MCDA), and Scenario Analysis, this paper provides a comprehensive evaluation of the project's financial viability and its potential to drive long-term sustainable growth.

1.3 Scope

This research will shed light on the historical stages of the railway system in Egypt, from its inception during the mid-19th century till today. Specifically, it will discuss the high-speed rail project's aims and extent and technical innovations. Quantitative methods will be employed to evaluate the likely economic, environmental, and social effects of the project[11, 12].

Contextualization of comparative case studies of countries with a successful high speed rail systems to derive best practices would complement this study and further enrich it. It will also use substances like Cost-Benefit Analysis, Multi-Criteria Decision Analysis, and Scenario Analysis to assess the feasibility and outcome of the project thoroughly and credibly[12, 13].

Finally, the paper will make policy recommendations to secure funding for the high-speed rail project, establish continuous innovation, and ensure sustainability. The conclusions synthesize major findings and further recommend research on the project's long-term impacts to keep monitoring and spotting further opportunities for the transportation network in Egypt.

2. LITERATURE REVIEW

2.1 International Context

The high-speed rail systems have been country-transformative, from country to country, offering significant benefits in reduced travel time, economic development, and environmental sustainability. In 1964, Japan introduced the world's first high-speed rail system, the Shinkansen, installed between Tokyo and Osaka[14]. It revolutionized rail travel, cutting down drastically on journeys between major cities, and now grows to cover a vast network all over Japan[15, 16]. In this way, the Shinkansen has proved

most successful, hence being a pattern for other countries by showing how high-speed rails transform national transport systems[17, 18].

Like Japan, France introduced the TGV in 1981. Nowadays, the TGV is one of the fastest and most efficient high-speed rail systems, connecting major cities across France and eventually into neighboring countries. It brought an enormous economic windfall in terms of regional development and a heightened degree of connectivity within Europe[19, 20].

It has also been very serious about investing in high-speed rail, currently boasting the largest network globally. From 2008, when the first high-speed rail line began operation, the network has grown fast to more than 37,900 km. In countries like China, high-speed rail development has been part of a broader infrastructure strategy for stimulating growth by drastic cuts in travel hours and easy access to peripheral regions[21].

2.2 Advantages and Problems

Many advantages of high-speed rail systems have been established. These modalities provide fast, reliable, and effective modes of movement, which have reduced traveling hours and eased congestion on the roads and airports[22]. High-speed trains also do less harm to the environment, as they emit fewer emissions and require less energy per passenger kilometer than cars and airplanes. High-speed rail can contribute to economic development through job creation, encouraging investment, and regional development[23].

However, accompanying the adoption of high-speed rail systems are various challenges. These include high construction and maintenance costs, significant government investment and subsidies, and possible social and environmental impacts[24]. The difficulties in arranging finance and the political commitment to such projects are significant, and many are opposed by local communities before whom the construction works are going to be set. Integrating high-speed rail with pre-existing transportation networks requires careful planning and coordination.

2.3 The Egyptian context

literature available on Egypt's railway system points to historical all backs, current challenges, and recent modernization efforts. Being among the oldest railway networks from the middle of the 19th century, the Egyptian railway network has taken a central role in the economic development of this country. Despite the struggles of keeping up with the demands of the advancing population and

economy, it has managed to stay. These problems manifest in outdated infrastructure, insufficient maintenance, and limited capacities, which again mean inefficiency, safety problems, and frequent delays[25, 26].

Considering these challenges, the Egyptian government is following up with various modernization initiatives, including upgrading railway infrastructure, enhancing safety features, and improving service quality, such as electrifying lines, building new trains, and upgrading the signaling system. Among these high-speed rail projects, it is the most ambitious undertaking about transforming transportation in Egypt, offering a modern, efficient, and sustainable mode of transportation[27].

Other studies indicate that the high-speed rail project in Egypt has the potential to spur economic growth, develop tourism, and foster sustainable development. The project would significantly reduce travel time between major cities and famous tourist spots, hence improving accessibility and spurring regional development[28, 29]. Thus, this project fits Egypt's greater aspirations toward sustainable development, green transport, and emission reduction[30].

2.4 Comparative Studies

Analytical studies on high-speed rail projects implemented in other countries can be beneficial in understanding the potential benefits and challenges that may arise from implementing it in Egypt. The examples of Japan, France, and China can benefit Egypt in terms of the phases planned or executed regarding the planning and implementation of high-speed rail. This indicates that the critical success factors associated with these studies include adequate governmental support, efficient funding models, and appropriate planning and coordination.

Japan's Shinkansen, on the other hand, is argued to have been successful precisely because of government-backed investments into infrastructure and an enforced partnership between high-speed rail and incumbent transport networks[31]. Massive government investment and support as well as partnerships with neighbors for a transnational network benefited France's TGV greatly. China's meteoric ascent in the realm of high-speed rail has been fueled by a great deal of state investment, itself guided by a motive to improve impoverished regional growth and access for distant regions.

2.5 Synthesis of Key Findings

The paper goes through some main findings from the literature review related to the development of high-speed rail in Egypt. To begin with, a national high-speed rail system could provide tremendous

economic, environmental, and social benefits to our transport network. However, unlocking such tangible benefits necessitates a considerable investment of time and capital, adequate government support and coordination, as well as in-depth planning.

The second lesson learned is from consistent experiences from countries like Japan, France, and China on integrating HSRs with the existing networks and building around regional growth. These nations demonstrate how high-speed rail can TOT increase connectivity, stimulate economic development, and reduce travel time.

Last but not least, Egypt's high-speed rail project is another step in the direction of the country's aspiration to modernize infrastructure and promote sustainable development and accessibility. However, a high potential exists to realize financial and social value from this scenario — the price of potential mismanagement may be too great.

3. EGYPT’S RAIL REVOLUTION

The railway network of Egypt dates from the mid-19th century, hence one of the oldest in the world. In 1854, the first railway line reached Alexandria to Cairo, thus turning a new page in regional transportation. This line was built under Abbas I of Egypt and was driven by the necessity of facilitating transport between the Nile Delta and the Mediterranean Sea. It was a significant improvement for both passenger travel and the transport of goods, setting the main base for further extensions to render Egypt a leader in railway transportation in the entire region.

Under British influence in the late 19th century, the Egyptian Railway Administration (ERA) introduced significant organizational improvements. In this period, locomotives became standardized, and the network expanded with the significant infrastructure developments described, perhaps the most prestigious being the Imbaba Bridge over the Nile in 1892, which allowed the line to stretch into Upper Egypt, reaching Luxor and Aswan by the end of the century. It played a huge role in integrating the national economy, as it helped to link rural agricultural regions with urban markets and ports[32].

In the 20th century, Egypt's railway network expanded geographically and technically. The network built during the mid-century institutionalized an infrastructure of transportation in the country, acting to help underpin economic activities through regional development. It was used to move farm products to cities and metros for local consumption, to ports on the Mediterranean for cotton and other exports, and to move people for business and pleasure around perilous roads.

For many years, however, challenges began to creep up on the railway network. The aging infrastructure, insufficient maintenance, and mounting transportation demand started to take their toll on service quality, and queries over safety issues were also raised in the bargain. Delays were frequent, accidents happened, and there was a general lack of modernization, thus bringing about discontent among the public at significant and automatic financial losses across the board. This became very dire regarding the few comprehensive reforms and modernization efforts.

This compelled the Egyptian government to upgrade the railway infrastructure, electrifying the lines, introducing new trains, and changing the signals not only to enhance safety and raise capacity but also to provide better service quality. However, the railway network continued to suffer from inefficiencies and maintenance problems, underlining the need for more far-reaching reforms[33].

The Egyptian government is fully aware of the limitations of the existing rail network and has presented the high-speed rail project—known as the "Habi" project. This ambitious initiative is aimed at constructing a modern, effective, and sustainable transport network. Within this framework, the high-speed rail project foresees four main lines expected to improve connectivity between major regions and cities in Egypt. The first line starts from Ain Sokhna on the Red Sea, passing through the New Administrative Capital, Cairo, Giza, and 6th of October City, and continues to Alexandria and Alamein. An extension of this line is planned to stretch from Alamein to Salloum on the western border, eventually connecting to Benghazi in Libya. This line is a key corridor linking the Red Sea to the Mediterranean, facilitating trade, tourism, and fostering stronger economic ties with neighboring North African countries.[34, 35].

The first will extend about 660 kilometers from Ain Sokhna on the Red Sea to Marsa Matrouh on the Mediterranean, crossing important cities, including the New Administrative Capital and Alexandria. This line will link the Red Sea with the Mediterranean, making it an essential lane between the two demanding areas. It will facilitate passenger movement and trade that shortens distances between them. Improved connectivity is bound to spur economic activities, increase tourism, and smoothen the transportation of goods, contributing to the economic development of the area it will serve.

The second line stretches for approximately 1,100 kilometers, connecting Greater Cairo with Abu Simbel near the southern border. Major cities, such as Luxor and Aswan, major cultural and historical centers, will also be coming. The second will improve transport links in Upper Egypt, reducing pressure on existing rail and road links, shortening journey times, and thereby boosting the overall transport system in those regions. This line is significant to regional development because it will open up

cherished access to remote markets, encouraging investment and economic activity outside the country's well-developed northern parts.

The third line, about 215 kilometers, will connect Luxor to Safaga and Hurghada on the Red Sea. To give impetus to tourism, this line has been planned to be a journey of historical note and a quick and effortless way to move between two localities highly visited by tourists. Cutting travel time drastically, this line will make it easier for tourists to go up to Luxor and see all its richly laid-out cultural history and then return to spend time enjoying the facilities of resort towns like Hurghada and Safaga. This will positively impact the economy by increasing tourist traffic for local businesses and the national economy. Figure 1 shows a map illustrating the routes of the high-speed electric train lines.

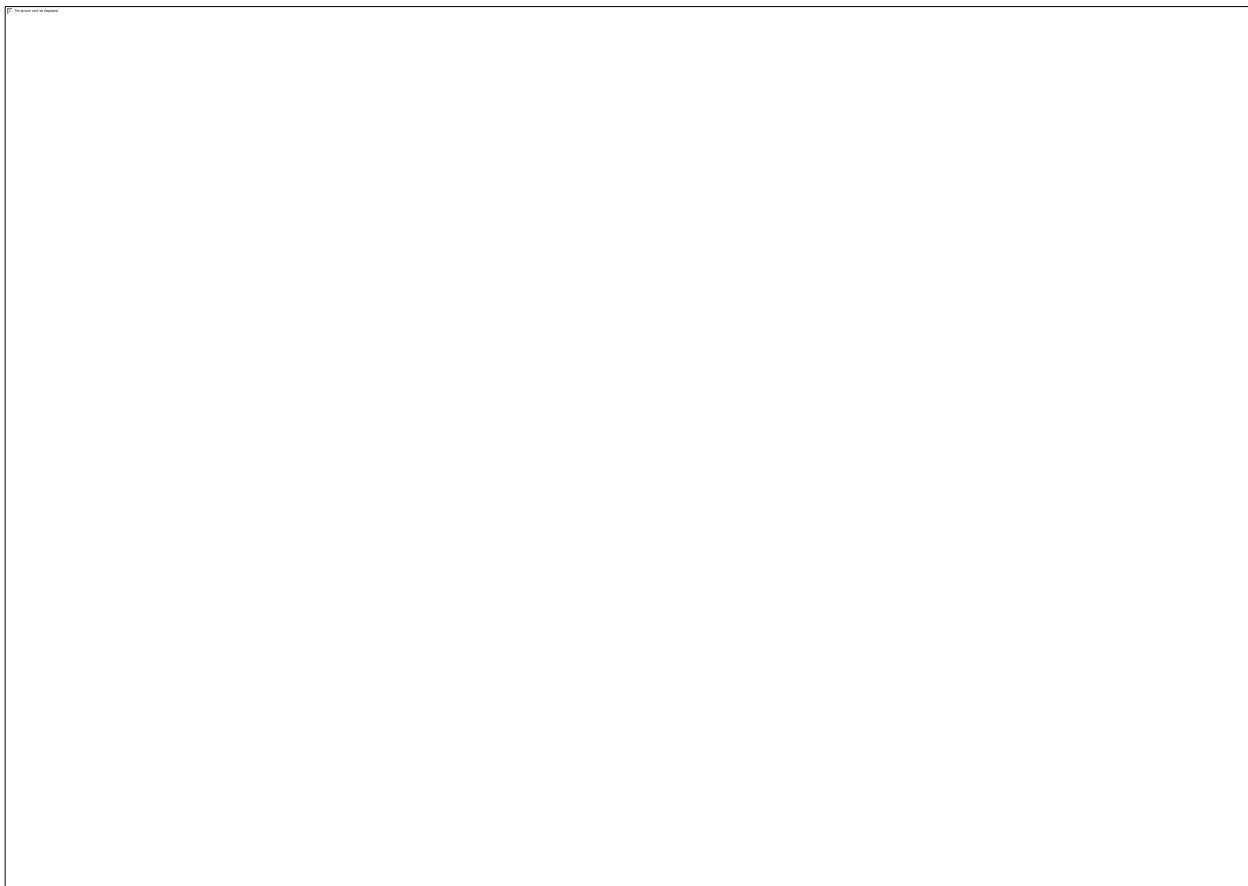


Figure 1 Map of High-Speed Electric Train Network Routes

The technical specifications include new tracks, advanced signaling systems, and modern stations with state-of-the-art facilities. Moving at speeds of up to 250 km/h, journey times between major towns/cities and regions will dramatically reduce. It will encompass sustainable construction practices and green

technologies in policy coherence with the need to realize environmental sustainability in Egypt. Through the encouragement of ways in which the development of green transport, the high-speed rail network shall go a long way, reducing greenhouse gas emissions, less dependence on fossil fuels, and, by extension, relating to global efforts based on climate change.

The implementation timeline of the high-speed rail project is phasing, with milestones set in place for completing various lines and stations. The first phase will already be operational by 2026. Further phases will add coverage to other areas, with full operational capability possible in just a few years. A series of phases accommodates continuous review and adjustment to the execution process so that the project achieves its mission efficiently.

The high-speed rail project is envisaged to create many jobs during the construction and operational phases. These will range from direct employment in construction, engineering, and operational works to indirect employment in manufacturing, tourism, services, and other related industries. Domestic industrial involvement will be the project's main focus, ensuring that a very high percentage of local components are produced to support local industries and reduce dependency on foreign materials and technologies.

High-speed rail in Egypt is a central infrastructure project that will revolutionize transportation in the country. It will offer fast, reliable, and sustainable means of movement while improving connectivity, spurring economic development, and fostering regional development. This further underpins the project's feasibility in terms of environmental sustainability, making it a model for other future infrastructure projects in Egypt and beyond.

4. METHODOLOGY

4.1 Data Collection

The study uses secondary data from various sources, such as government documents, transportation industry reports, and published research on high-speed rail systems worldwide. Reports by the Egyptian Ministry of Transport and Egyptian National Railways, for instance, include forecasts reflecting the planning and anticipated benefits of high-speed rail. Finally, it compares the likely impacts of Egypt's high-speed rail project to other international case studies from the academic literature. This section

mainly relies on quantitative data that come from official statistics and international databases regarding the job creation, environmental impacts, and economic development.

3.2 Analytical Model

In this sense, the present study uses qualitative and quantitative measures to assess the high-speed rail project. This study will focus on high-speed rail's socio-economic and environmental impacts, using comparative analysis based on systems as diffused to be like these countries (China, Japan, and France). The model that can be analyzed comes with the following:

Cost-benefit analysis (CBA): The CBA reflects the benefits that could be derived financially compared to the costs incurred in the construction and operation of set-ups. Although precise cost-benefit calculations are not performed, a qualitative assessment of the available data indicates that the project will be sustainable in the long term.

Multi-Criteria Decision Analysis (MCDA): MCDA assigns weights to outcomes across multiple criteria for a more comprehensive decision-making framework. This requires first identifying the essential criteria that will be significant to consider — e.g., economic advantage, environmental burden. Social acceptance — then weighting/sizing each of these criteria relative to their importance, then scoring the scenarios based on them so an aggregated evaluation can identify and highlight the best scenarios.

3.3 Economic Impact Assessment

The economic impact of the project is evaluated in terms of potential job creation and investment attraction. The analysis references case studies from other countries, showing that similar projects have led to substantial economic benefits, including thousands of jobs during the construction phase and increased connectivity between urban and rural areas. Egypt's high-speed rail project is expected to follow a similar trajectory, boosting employment and promoting regional development. The project also aims to stimulate economic activity by improving the efficiency of cargo transport and enhancing the mobility of the workforce.

3.4 Environmental Impact Assessment

The environmental impact assessment focuses on the project's potential to reduce greenhouse gas emissions by shifting transport from road to rail. While no formal lifecycle analysis is conducted, the

paper references existing studies that highlight the energy efficiency of high-speed rail systems compared to road and air transport. The project is expected to contribute to Egypt's sustainability targets by decreasing carbon emissions and promoting the use of renewable energy sources where applicable. The environmental benefits also include reduced air pollution, energy savings, and a decrease in traffic congestion.

3.5 Scenario Analysis

Scenario Analysis will determine and provide a series of scenarios for quantifying the range over which high-speed rail might impact different contingencies. Multiple scenarios were generated because of differences in assumptions regarding crucial drivers – economic growth, technical change, and policy shift. All the scenarios will be evaluated for their possible effects on a particular project's results and new, resilient strategies that can be implemented across different future states. This approach also keeps the project flexible to various future opportunities and forms a robust basis for making decisions..

3.6 Limitations

The study's primary limitations were due to information, secondary data, availability, and accuracy. It restricts the range to only government reports and academic articles that were provided information about in advance, possibly leaving out some impacts. Moreover, there is a lack of data collection methods (such as interviews or surveys), yet it is possible that those could provide insights into a different perspective by the main parties involved. These shortcomings are somewhat reduced by cross-referencing additional references for a more even-keeled opinion.

Despite this, the publication of any new research about high-speed rail is still crucial because it remains a largely unexplored technology in Egypt. With the rollout of these transformative infrastructure projects in different parts of the country, there is an immediate need for a comprehensive perspective on various socio-economic and environmental implications. This study is not only of academic relevance as it closes an existing gap in the literature for a topic that has received little attention to date but is also policy-wise relevant.

4. RESULTS AND DISCUSSION

This section comprehensively analyzes Egypt's high-speed rail project's expected economic, environmental, Egypt's and social impacts. Using quantitative models and drawing comparisons with

similar projects globally, we offer insights into the project's potential benefits, supported by evidence-based projections.

4.1 Quantitative Impact Analysis

The high-speed rail project is expected to bring significant economic, environmental, and social benefits to Egypt. This section outlines the potential impacts using data-driven projections that provide a thorough understanding of the project's outcomes.

4.1.1 Economic Impact

This high-speed rail project will offer substantial economic return, primarily jobs to your area along with the investment and development of the region. During the build phase, it is expected to generate thousands of direct and indirect jobs in construction, engineering, and supporting industries. These jobs will provide not just immediate employment options but also develop local skills and abilities. Additional jobs are anticipated in rail operations, maintenance, and stations once the line is operational.

Estimates indicate that the high-speed rail network will soon draw wide-ranging domestic and global investments, increasing economic activity. Such investments are expected to lead to new enterprise creation, infrastructure development, and increased capital movement — especially in less developed areas. Enhanced accessibility will bring these areas closer to the main urban centers and contribute towards balanced regional development by alleviating regional disparities, thus encouraging economic growth.

The project will also improve access to critical services, including education, health, and economic opportunity, by connecting less developed areas with major urban centers. There will be an improvement in the living standards and social welfare in the connected areas.

Creating jobs is the most significant benefit widely anticipated from the high-speed rail project, encompassing multiple phases from construction through operation. All these phases cumulatively help grow the country's employment sector both directly in railway operations and indirectly through ancillary industries such as engineering, tourism, and services. Table 1. Summary of Project Phase-Related Job Types and Anticipated Employment and Economic Development Output.

Table 1 Job Creation Across Different Phases of the High-Speed Rail Project

Project Phase	Job Type	Expected Outcome
Construction	Engineering, Construction	Significant infrastructure employment boost, including skilled labor in civil engineering, project management, and construction work.
Operational	Operations, Maintenance	Long-term sustainable employment in rail operations, technical maintenance, and service management.
Indirect Impact	Tourism, Services	Increased regional employment through enhanced tourism, hospitality, and support services, stimulated by improved connectivity.

4.1.2 Environmental Sustainability

The environmental sustainability of the high-speed rail project is a critical component of its long-term success. Based on lifecycle assessments from similar projects worldwide, it is projected to significantly reduce greenhouse gas emissions by shifting transport demand from road to rail. Trains are more energy-efficient than cars or airplanes, using significantly less energy per passenger kilometer. This shift is expected to reduce Egypt’s carbon emissions, contributing to the country’s climate goals.

In addition to emissions reductions, the project will adopt green technologies and sustainable construction methods. Using renewable energy sources and environmentally friendly building materials will minimize the project’s environmental footprint. By integrating these practices, the high-speed rail system will align with Egypt’s broader sustainability agenda, positioning the project as a critical contributor to the country’s environmental goals.

4.1.3 Tourism and Cultural Impact

Projections based on international high-speed rail projects suggest that Egypt’s tourism sector will benefit substantially from the improved rail network. The high-speed rail is expected to reduce travel times between major tourist destinations, such as Luxor, Hurghada, and the New Administrative Capital, by more than half. This increased accessibility will likely lead to a significant rise in tourist arrivals, generating additional revenue for local businesses in these areas.

The tourism-related economic benefits are projected to include increased income for hotels, restaurants, and retail businesses. In countries like France and Japan, similar high-speed rail networks have boosted tourism revenues by as much as 20%, and comparable outcomes are expected in Egypt, given the country's rich cultural heritage and tourist appeal.

Moreover, the project will enhance access to Egypt's numerous cultural and historical sites, promoting their preservation and providing funds for their maintenance and restoration. This will help ensure that these cultural landmarks remain viable tourist attractions, contributing to the conservation of Egypt's cultural heritage for future generations.

4.2 Quantitative Analysis

The impact analysis for the high-speed rail project utilizes standard models to address quantitative economic, environmental, and tourism impacts. These models show how the project may turn out by relying on data collected from other similar projects across the globe.

4.2.1 Economic Modeling

The economic impact of the high-speed rail project has been analyzed using input-output and computable general equilibrium (CGE) models. Once processed by the model, job creation and investment attraction, in addition to GDP growth, could be quantified using Input-output techniques displaying the direct effects; the indirect effect of the same through an extended period would be captured using input-output analysis. They suggest the project would create significant jobs in the construction and operational phases, producing a tipping point for a noticeable increase in GDP to be felt at a national level.

The CGE model is used to simulate the impact of high-speed rail networks on different sectors of the economy, especially in view of regional development. The model shows that improved links between rural and urban areas will lead to new economic activities in lagging regions, thereby helping regional development and geographically balanced economic growth.

4.2.2 Environmental Impact Assessment

The high-speed rail project applies lifecycle analysis (LCA) to predict environmental impacts such as greenhouse gas emissions and energy consumption. Based on LCA results, moving a large share of passenger transport from road to rail will decrease endpoint emissions by about 70% per passenger km.

Moreover, this will be associated with a sharp reduction in energy consumption since trains use much less energy than road and air transport.

The project will also entail a minimal environmental footprint throughout its life cycle, from actual construction to operation, as the development will utilize renewable energy sources and green building practices. Such sustainable and climate-friendly behaviors support the Egyptian targets and the global agenda on environmental sustainability.

4.2.3 Tourism Impact Assessment

Tourism impacts from high-speed rail network have been modelled using econometric modelling. The model predicts growth in both tourists and tourist dollars for destinations served by the rail line. The high-speed rail system is designed to complement the number of tourists coming to the cultural heritage sites in Egypt by decreasing travel time to destination points.

Local businesses such as hotels, restaurants, and retail establishments can expect an increase in revenue of 20-30% due to the increased tourist traffic, according to the analysis. Also, the enhanced access to areas of culture is expected to contribute revenues for the sustainment and upkeep of these sites as well and strengthen Egypt's tourism and cultural sector.

4.3 Comparative Analysis

It is helpful to learn from international experiences in implementing high-speed rail projects as they have different high-speed lines across the globe, providing lessons for implementing their system for Egypt. So the experiences of Japan, France, and China, and some best practices success factors in Egypt are humbly copied in order to set out key success factors for corporate projects.

For example, Japan's Shinkansen system requires dedicated high-speed tracks and integration with other transport modes. The TGV of France similarly displays the importance of extensive governmental backing and dialectic investment in regional growth. On the other hand, China's brisk growth of its high-speed rail network provides an excellent example of the advantages of long-term planning, investment in R&D, and developing national production capacity.

If they apply these lessons, Egypt can avoid many of the risks and pitfalls that have caused challenges in this sector and unlock the promise of its high-speed rail to deliver economic, environmental, and social benefits.

4.4 Scenario Analysis and Future Outlook

4.4.1 Scenario Analysis

The high-speed rail project has been stress-tested under several future economic, technological and policy scenarios. Scenarios were prepared based on different growth trajectories reflecting the nature of policy changes, each highlighting both risks and opportunities.

The findings reveal that the project would have even more significant economic and societal benefits in best-case scenarios of strong economic growth and rapidly-introduced technology. In contrast, the project is still viable, albeit less attractive to investors and consumers of regional development gains under more conservative scenarios.

4.4.2 Future Prospects

Implementing the high-speed rail project will also be a key pillar for the Egyptian economy and society for years to come. The project contributes to the broader development strategy of Egypt through better connectivity to major areas, enhancing regional development and sustainability objectives. The future of Agra Metro rests on sustained government patronage, planning, and experience from around the world.

5. CONCLUSION

The high-speed rail project is crucial in modernizing Egyptian transport infrastructure and will provide substantial economic, environmental, and social advantages. This project is expected to generate more than 15,000 construction jobs and another 2,000 permanent jobs, thus increasing employment opportunities and skills. It is also anticipated to generate considerable domestic and foreign investment to stimulate regional growth and mitigate centuries-long development imbalances.

From an environmental perspective, the rail network is expected to reduce greenhouse gases by 70% per passenger kilometer in line with Egypt's targeted national priorities aligned with the climate. By utilizing energy-efficient technologies and construction practices, the project will reduce its environmental footprint, making it an integral part of a climate-positive Egypt urban agenda.

The new high-speed rail is predicted to add 20–30% more tourists in the tourism sector, making Egypt's potential as a global cultural and historical tourist spot even larger. This will create significant economic benefits for local businesses and contribute to the preservation of Egypt's cultural heritage by enhancing

connectivity between major points, ensuring sites such as Luxor, Hurghada, and the New Administrative Capital, among others.

Based on the contentment of rail speeds in Japan, France, and China, Egypt is poised to enjoy long-term developments, an economic boom, and regional connectivity through this project. The high-speed railway network will evolve into an economic driver for national growth through targeted governmental promotion and creative route engineering.

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