Research Article

Train Stations Spatial and Technological Challenges in Iraq: A Case Study

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Abstract: Innovation has two key levers: the capacity to consider and predict consumer desires, on the one hand, and the building of collaboration between the economic environment, metropolitan players, and knowledge and development actors, somewhere else. Innovation is not just technical, and it disrupts traditions and station partners' aspirations and perceptions: planners, administrators, consumers or clients, and causes a change in locations and uses. The expansion of the rail network in Iraq is renewing station sites, especially in Iraq, which, at the cost of medium-sized cities between these cities, prefer the logic of productivity-focused on express services between major cities. On the field, this alternative translates into two styles of stations that are central base stations for significant towns, and medium- and small-town terminals—establishing stations benefits from an interconnected phase of all spatial organization types. Suppose we research the decision phase that led to the establishment of train stations in Iraq. In that case, we find that this option and construction strategies are a mixture of component elements according to the area details served and actors' strategies. Most chosen sites result from deep relationships between global, regional, and local reasoning.

Keywords: Smart Rail Station, Rail Station, Location Logics, Scale Conflicts, Smart Rail Transportation *Systems*

Introduction

TThe trains' speed is determined by the number of access points to the network, and the expansion of the line network poses the problem of locating the stations. Suppose the improvement of accessibility aims to spread and multiply the stop stations so that the largest possible number of users can easily access the network. In that case, the increase in trains' speed-reducing grid stops is required to increase system efficiency. The choice of implementing stations raises many questions. In turn, it may constitute a challenge to the possibility of planning the stations since the construction of the first train in Baghdad. The growth of the rail network in Iraq is renewing station sites, especially in Iraq, which, at the cost of medium-sized cities between significant cities, prefer the logic of productivity-focused on express services between major cities. On the field, this alternative translates into two styles of stations that are central base stations for significant towns, and medium- and small-town terminals—establishing stations benefits from an interconnected phase of all spatial organization types. Suppose we research the decision phase that led to the establishment of train stations in Iraq. In that case, we find that this option and construction strategies are a mixture of component elements according to the area details served and actors' strategies. Most chosen sites result from deep relationships between global, regional, and local reasoning.

Literature Review

In recent years, wireless technologies have evolved widely and can now satisfy the growing demands of connectivity networks to regulate, manage, and maintain intelligent transport systems (Osseiran et al., 2014). Established radio technologies include Wi-Fi (Caballero-Gil, Caballero-Gil, & Molina-Gil, 2015). Long Term Evolution (LTE), wireless sensor networks, wireless ad hoc networks and, in specific, emerging technologies of the fifth-generation (5G), with a heavy emphasis on designing intelligent terrestrial and aerial vehicle transport systems. This new technology will dramatically enhance passengers' service, performance, safety, and experience. Still, it is crucial to plan and customize each connectivity network to satisfy each transport system's unique specifications. Transportation networks already have a significant connectivity need, with stringent cost, power, and reliability criteria. High-speed trains are one of the best "test cases" for the study of communications in transport networks (HST). We may differentiate two communication forms in an HST communication network: essential and non-critical communications.

A descriptive approach to investigating extensive work on railroads or railway stations has been used in most recent research. The study of Baron and Hasan (2016), for example, focused on the forms of innovation that stations and urban crossing points can achieve to reach the smart terminal from a digital point of view. Another study by researchers (Facchinetti-Mannone & Bavoux, 2010). Le Choix de localization des gares TGV ('Le Choix de localization des gares TGV') focused on the role of sectoral entities in distributing railway stations

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between regions and the principles adopted in the division. Another study focused on researchers (Learning from Accidents: Machine Learning at Railway Stations for Safety:
An essential aspect of the overall structure is the plant's safety, but there are still accidents at the stations. They are using the latest technologies (such as machine learning) to analyze incidents and improve security systems in order to learn from these errors and improve traditional methods. ML has been employed in many fields, including engineering systems, and throughout our daily lives, he interacts with us. Therefore, the general technology and automated packaging available must be considered, particularly in safety in the railway industry. This paper explores how the station's location in the city and its essence with the station and its territories are changed by digital artefacts and uses. Digital developments influencing the station are modifying the broader urban environment in this region and can be converted into income, work or social utility. Of course, this is not automatic, but it relies on a strategic vision and a local-based approach. Many territorial actors are capturing digital mobility's capacity for initiation or experimentation. They are constructing projects in the commercial, social or cultural realms on the scale of communities or even parts of the world. Therefore, how the resources offered by the stations are captured and valued by urban actors must be observed here, and how they 'learn' together and drive change in the context of information multiplication, institutional support fragmentation, high expectations in terms of local public debate and financial resource constraints. This paper would explain the geographical distribution of Iraq's railway stations and their central and terminal divisions. An appreciation of the station-building possibilities arising from arbitration between the difficulties and barriers imposed by the spatial organization and subject to station-building and spatial dynamics modifications. Therefore, both stations may be turned into smart stations using modern technologies.

Advanced Location Options

Challenges and limitations in Site Selection and Planning

The options for establishing stations result from arbitration between the challenges and obstacles imposed by the spatial organization, modified by the stations and the spatial dynamics. As the difficulties in choosing stations divided into three types :

1. The Technical limitations relate to the characteristics of train lines and station models and designs.
2. The Physical, organizational and natural environmental restrictions relate to a particular spatial integration between lines and stations (Schorung, 2019).
3. Financial constraints represent a result of controlling infrastructure costs.

These constraints face challenges of a different nature (profitability and development), which are expressed in various levels, as shown in the following table :

Table 1: Multiple challenges of site selection

	Local and international format	*Regional layout*	*Urban landscape*	*Layout for stations location*
Profitability challenges	Ensure optimum network efficiency (reduce journey times)	Expand the station's sphere of influence	Attract important clients	Attracting travellers and other modes of transport to the use of rail transport
Accessibility challenges	Scalable high-speed train offers	Ensure accessibility to all territories of the region	Connecting train stations to other means of transportation	Ensure optimum work at the exchange terminals

The logic of profitability in the choice between cost and commercial requirements based on arbitration requires a site. It allows a large number of customers to be brought to the train station, whether they are railway users or to benefit from the services provided by the station as several players have taken up these concerns about economic viability, including the maintenance of the occupied assets to monitor the costs of its development and the fees charged by the railway carrier. Therefore, the station's management focuses on finding a compromise between operational expenditures and profits produced by its separate associated institutions (Passariello et al., 2011).

As the rationale of facilities places the level of mobility at the forefront, the problem is linked to the concept of a place that offers a vision for more effective connectivity for people and others associated with transportation in the area, to grow the supply of railway lines, arrival times for stations and multimodal transport. These questions of usability respond to the complaints of the following actors :

- The local administration's aim, which is the body responsible for organizing transport, is to ensure that residents of the region have optimal access to transport networks located on their land.
- The Users and economic actors are the national or local sectors who wish to take advantage of the highest service providers' level.

Lastly, regional development logic requires arbitration between planning issues and barriers to integration. We must choose the location that promotes the best possible spatial dynamic integration of the station and regional projects for the regions concerned. These planning issues reflect local authorities and regional authorities' concerns who benefit from improving the station's accessibility to implement development and development strategies. We must consider the local population and the problems they may encounter, such as noise and pollution, resulting from these stations' establishment. Planning is needed for all of this (Ko et al., 2008).

Multiple Interactions Between Challenges and Obstacles

Depending on the multiple interactions between obstacles and challenges, the decision-making process leads to selecting station locations results. Since the different obstacles that hinder selecting sites result in strong interactions, one of these barriers is the infrastructure's cost being realized in terms of spatial and technical barriers. Even if substantial spatial barriers surround one site, if accessibility can enhance the station's commercial profitability, it may be preferred over another (Gullo et al., 2019).
The interconnectedness of the challenges of station construction is the diversity in the accessibility of the station to all spatial levels, depending on the passengers' decision to use the train instead of other means of transport. On the contrary, the increase in traffic justifies the increase in the supply of services and services provided by the railway network and widening the preference for rail, which is likely to improve the site's attractiveness and development potential (Naphade, Tingre, & Thakare, 2011).
The arbitration at the centre of decision-making between challenges and limitations results from a complicated network of actors. Since the General Railway Company in Iraq is not the only company responsible for deciding on the location of the station, the company faces regional authorities and residents calling for restrictive reforms to alter the institutional context of the railway system utilizing the following:

- Local authorities have the power to make decisions and are increasingly seeking to be involved in financing high-speed train infrastructure.
- Change of procedures through consultations to allow public participation more effectively in the decision-making process.

In recent times, the General Railways Company's mission in Iraq has become to re-focus its function as a transporter and supervisor of the station with gradual reforms of rail transport, which has become one of its privileges to choose the sites of the stations.

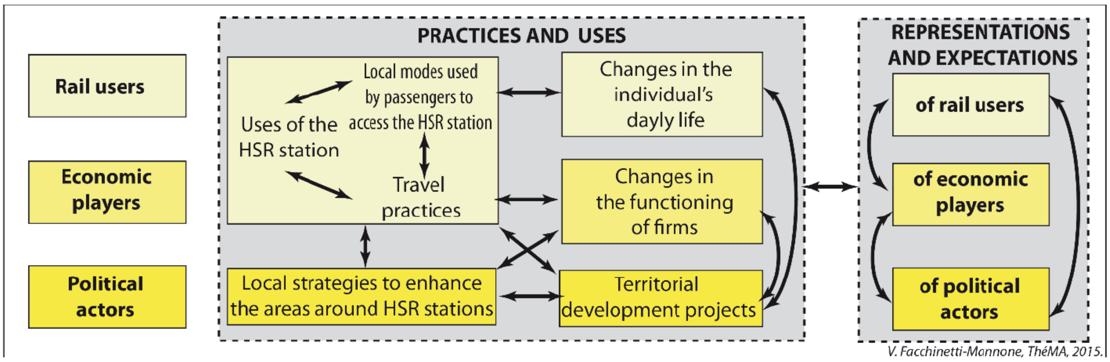

Figure 1: The Interactions between constraints and challenges
*Source: Facchinetti-Mannone,2019**

The spatial organization's characteristics determine the stations' locations and their work. The complexity of the actors' role results from the interconnectedness and interconnectedness between several levels. We notice at the national level that the network structure, the organization of the urban system, and the characteristics of the region affect the choice of the length of the fast lanes and the commercial opportunities that serve the areas concerned, and the type of site designated for establishing the station, whether it is (central or terminal). On the regional level, the customers' capabilities are related to the population distribution and their activities, the physical and environmental characteristics and the structure of the communication network all subject to many restrictions that allow for refining the choice of network lines and the location of the stations (Bernard, Jensen, Redding, & Schott, 2010). On the urban level, the population's economic and spatial dynamics and regional projects are supported by local authorities that determine their level of the decision-making process to achieve a quality of regional integration of the station. Finally, at the local level, the site, land use, and environmental characteristics of the requested site must conform with the restrictions imposed by a high-level spatial organization (Vazquez-Chantada et al., 2013). The characteristics of the plant depend on choosing its operation on the following:

- The station services' functions and characteristics depend on the local and international location of the network's area.
- The shops inside the station's characteristics affect travellers' frequency, the determination of the size of the buildings designated for travellers, and the service offerings provided by the station.
- Organizing and operating the exchange stations and modifying the flight path to another local or regional route result from its location within the regional and urban communications network.

The decision to establish a station is the culmination of a complex process that results from multiple interactions between different levels of spatial organization and the obstacles and challenges identified by the actors' strategies. In Iraq, these options are primarily determined according to economic profitability criteria related to their regions' accessibility and regional and local development (Albrecht, van Goor, Smit-van Oosten, & Stegeman, 2003).

Analysis of The Selection of Stations' Sites

Train stations in Iraq have two main types of central locations (Table 2) and terminal which appear in multiple spatial configurations and reflect the high-speed strategy's suitability for the spatial constraints in the regions they serve. The selection of station locations results from different strategies that are viewed unequally in the decision-making process according to the organization's spatial characteristics and local actors' ability to achieve their goals in the face of the national strategy.

Table 2: Train stations in Iraq (multiple spatial)

#	***The Station***	***Location***
1	Baghdad Central Station	Al-Karkh, Baghdad
2	Maqal train station	The stronghold, Basra
3	Karbala train station	Karbala
4	Baiji train station	Biggie
5	Al-Qaim train station	Based
6	Akashat train station	Akashat
7	Mosul train station	Mosul
8	Qayyarah train station	Qayyarah
9	Hammam Al-Alil train station	Hammam Al-Alil

Table 3: Train Stations in Iraq (High-Speed Strategy)

#	***The Station***	***Location***
1	Kadhimiya train station	Al-Kadhimiya, Baghdad
2	Taji train station	Coronary
3	Mahmoudia train station	Mahmoudia
4	Al Bayader Train Station	Fields
5	Shoura train station	Al-Shoura District
6	Mishraq train station	South Mosul
7	Abu Dsheer train station	Abu Dashir
8	Umm al-Tabbool train station	Baghdad
9	Abu Ghraib train station	Abi Strange spend

10	Fallujah train station	Fallujah
11	West Ramadi train station	Gray
12	Al-Musayyib train station	Al-Musayyib
13	Mahawil district train station	Eliminate Mahawil
14	Babylon train station	Hillah
15	Al-Khidr train station	Samawah
16	Tuba train station	Basra
17	Tikrit train station	Tikrit

Iraq's trains designed to compete with other transport lines and air transport. As the Iraqi train network represents the region's radial structure and centralization, and the urban structure's imbalance imposes its functioning. Operating methods are subject to the logic of commercial profitability, which aims to connect all Iraqi lands directly at the expense of intermediate spaces in cities excluded from rail services. The biggest cities benefit from central services by redeveloping their old station. It is complemented by establishing new urban stations when the old stations' carrying capacity is limited, as in Baghdad. These needs have led to the rapid management of infrastructure to circumvent large urban agglomerations through ring roads. An example is the interconnection of lines across Baghdad's suburbs and Nineveh which wraps around Mosul.

The small and medium-sized cities located in the regions, by connecting to the traditional network provide station services. This network's capacity allows, or through new medium-sized stations in urban cities explicitly built for train lines, such as the Basra region, where the train station has become the central station in the urban area. It aims to coordinate work better between central stations and terminals. Most of the new stations built outside the city centre are semi-urban or between several urban centres. The diversified distribution of train services enhanced these regional configurations between the traditional station and the new station and the unfair services in traditional stations. The diversity of the previous cases and the analysis of central and terminal stations, given the multiple interactions involved in the approval-making process, make it possible to clarify the actors' different roles in the selection process[2].

Technology and Railway

Smart Railway Stations

Innovative technology for railway infrastructure managers and train operating companies have gained from smart rail transport networks, allowing them to make more effective decisions and improve protection and security at railway stations. The data management insights boost timetabling, estimate demand and facilitate decision making (Alaba, Olubusoye, & Olaomi, 2017).

It could be necessary to extend the same definition of smart cities to train stations. The creativity of train stations, data providers, and utilities would bring additional value to smart cities. Smart agility, facilities, and maintenance are typically the stations' essential smart requirements. Since the dawn of the 21st century, the railway industry has understood that the study of big data could be critical to optimizing railway operations. The first uses of big data in railway activities can see vast volumes of data, such as timetable and train delays data. Data mining used to record and gather train locations on the route, including the effects of timetable deficiencies and the triggers of secondary train delays and online station delays, which is another source of data used. Data processing, including train case recorder data and GPS, has been extended to alternate train positioning data (Leusink & Folkeringa-de Wijs, 2017).

Railway Stations and Computer Learning

Data mining has received a great deal of interest from railway infrastructure researchers in recent times [18]. This concern is because data collection and integration offer a complete representation of an organization's state. In several areas, sophisticated computational technology has rendered it possible to use a machine-learning instrument to solve and enhance real-world systems such as industry, engineering, and research. With wearable devices or GPS data, the sheer amount of data that these devices will display on paper is overwhelming and much more so. Suppose they correctly put to work. In that case, they will revolutionize the training sector's infrastructure for the general public and dramatically change railway stations' potential layout. To investigate

[2] Iraq Republic Railways

railway wagons' vertical acceleration, we use regression algorithms performed utilizing machine-learning techniques for model prediction. Besides, artificial neural networks (ANNs) have used to forecast a train's derailment on the track (Hegde & Rokseth, 2020). Different methods have used in the area, such as Ang, Chong, and Li (2005) support vector machines (SVMs), Anderson (2009) kernel density approximation (KDE) and Lee and Lucey (2004) clustering. Variety as a consideration in the study of big data (BDA) refers to the many tools from which data can obtain in its different ways. There is more and more opportunity for the railway sector to use the data as more and more devices enter the increasingly growing IoT. A deeper review of data comes from various instruments for a high-performance model, as long as more detail required for the model design (Paszke et al., 2019). In both academia and business, which has culminated in improving emerging developments in large data processing (BDA) (Mandal, 2019).

An essential platform for the future is the machine learning tool (MLT), and it is one way to utilize massive volumes of data. The railway industry has access to an unprecedented volume of data with this extensive data and the Internet of Things. Still, without the infrastructure to transform it into actionable knowledge, change may be much slower than anticipated. In particular cloud technology, new technology allows it simpler and cheaper for business and enterprise railway stockholders to scale their IT networks to satisfy potential growing demand and achieve a high-performance and enhanced understanding of risk, safety, and security (Thekdi & Aven, 2016). Besides, cloud analytics will contribute to advanced and fast contact between operators by surveying data from wireless devices connecting to the railway station, obtaining a deeper understanding of danger profiles, effects and responses in emergency scenarios and tracking the railway station's dynamic infrastructure (Goverde, Corman, & D'Ariano, 2013). Smart train stations, which are part of potential smart cities, will communicate with emerging technology such as deep learning and underpin cloud services usage. A norm (PAS 182) for smart cities, for instance, provides those principles (such as location, monitoring, metric etc.). Various entities can exchange details about it, such as incidents or faults at train stations (Doytchev & Szwillus, 2009). To characterize a collective framework for linking data through organizations in a city where a city may connect concerted identifiers set for a category of entity.

Conclusion and Discussion

After a thorough review in both of the preceding situations, we infer that designing the smart station's necessary facilities is a step toward smart train stations utilizing digital communications technologies. Actors are among the components of the stations' geographic incorporation. The decision-making phase culminated in the strongest milestones for regional integration participation, which enabled reconciliation between the challenges and the limitations placed at different levels and mobilized local stakeholders' energies around the regional station initiative. The choice of station sites results from different numerical reasoning, a crystallization point for different spatial levels that is essential in the decision-making phase. It based on on the peculiarities of spatial organization and local players' capacity to impose their preferences against the economic viability logic that prevails. For converging multi-band problems correlated with high-speed tracks, central stations are better suited. According to the rationale of national competence, the terminals' positions are subject to difficulties relevant to connectivity and the area's growth. Mobilizing local authorities' actions supporting more balanced services between the historic station and the modern station, and incorporating the new station into the conventional network facilitates reconciliation between the respective areas. According to the organization's geographical features, and the willingness of local players to accomplish their objectives in the face of the national policy, station sites' selection benefits from multiple techniques. Create potential proposals for the development and connection of modern central and terminal stations in cities to other modes of transport, such as air transport (airports) and bus lines. Renewal and refurbishment of old stations By the construction of new lines and the provision of high-speed trains, planning enhances the reality of the General Railways Corporation's services in Iraq, ensuring convenient connectivity for travellers within a limited period and at low economic costs. To encourage sustainable transport in the cities, incorporating the modern stations into the traditional rail network helps build shopping areas inside the stations to provide passengers with different facilities. This connection pushes an additional amount of customers to the station, leading to the station's commercial sector's growth, enhancing their access methods and achieving regional integration.

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