

# Appraisal on Rail Transit Development: A Review on Train Service And Safety

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**Abstract:** The ever increasing problems faced by population around the world have made demands that transportation need to be improved as an effective and efficient communication means. It is considered as a necessity especially when rapid development and economic growth of a country is the agenda. Among the transportation modes being focused as critical facilities are the bus system, rail system, road network, shipping system and air transportation system. Rail transport is a means of conveyance of passengers and goods by way of wheeled vehicles running on rail tracks. In Malaysia, the railway network has evolved tremendously since its inception in the early 19<sup>th</sup> century. It has grown proportionally with the national development. Railway network does not only mean for rural transportation, but it also considered as a solution to urban congestion challenges. Currently, urban rail transit is the most popular means of urban transportation system especially as big cities such as Kuala Lumpur. This paper presents the definition of rail transportation system and its role in urban or sub-urban operation. It also describes the brief history of world railway transportation including a discussion on Malaysian rail history perspective. As policy and standard are important in operating a railway system, this paper also illustrates and discusses some elements which have an impact on the effectiveness and efficiency of train operation. Towards the end, this paper also shares the importance of railway safety based on real case studies around the world. Thus, it is hoped that this paper will enable the public to understand the rail transit development and appreciate its existence as a public transportation system.

## Introduction

Rail services have become a significant mode of public transportation in the world when engineers and planners were not able to reduce congestions in cities. [4] Many options were being considered in the last decades to enhance mobility among the city population. Similarly, in Kuala Lumpur, the war against congestion started in the early 1980s whereby Kuala Lumpur population has increased from below one million to 1.3 million people. Currently, the population has increased to more than 2 million with many of them came to the city to work and conduct their business transactions. [7] The rail transportation in Malaysia started as a commodity transporter and later developed into an intercity train service. However, the rapid development of Kuala Lumpur as the capital city of Malaysia has also an adverse impact on traffic movements which became a public concern especially to residents and business community. Thus, initiatives such as introducing better and wider road networks, bus lanes, and better road signalling and monitoring systems were introduced by the Kuala Lumpur City Hall (DBKL). However, urban road congestions still continues and this triggered the government to explore other alternatives which will be discussed later in this paper.

## History of World Railway Transportation

The world railway transportation system started in the western countries whereby the transportation technology was needed to assist the industrial revolution. [12] The coal and steam powered train and vehicles were developed in Great Britain in 17<sup>th</sup> century. With this technology, the horse and human powered vehicles became light transportation system whereas steam vehicles became the mass transportation system. However, in early 17s, the introduction of diesel powered train and vehicles took over with better and efficient mechanical technology. This technology has been introduced in long distance and heavy duty industries including the mobility of important cargoes during the World War 1 and 2. Modernisation of the transportation industry came into place in 1863 when electrical power was introduced as a power source for transportation vehicles. It started with the first electrified trains open in Germany, 1881. This evolution happened due to the needs to reduce pollution in air and enhance the health among the population. Vehicles that have experienced this evolution are trains as engineers can easily adopt electric power into the train network system. In Malaysia, the first railway line was constructed between Taiping and Port Weld during the Malaya era in 1885. In 1886, it expanded to Kuala Lumpur and Klang and later a new line was constructed between Seremban and Port Dickson (1891).

Currently, new inventions and innovations in train system are continuously carried-out by engineers and scientist to enhance the effectiveness and efficiency of the electrified train system. The introduction of new breed of trains and vehicles which are electric powered such as light rail transit (LRT), mass rapid transit (MRT), monorail, commuter rail, sky train, high speed trains and bus rapid transit (BRT) has enhance city mobility and reduce city congestion. Many modern and big cities in the world such as Tokyo, London, Seoul, Paris, New York and Shanghai have adopted to train transit as its main urban transportation system apart from the existing bus and taxi system. [3] The introduction of a more efficient and effective urban public transportation mode was seen as important initiative to ensure the sustainability of public transportation in urban areas for better mobility.

### **Malaysian Rail History, Policy and Standards**

Malaysian transportation system has evolved traditional transportation modes to a better and modern image system. This happened not only for urban transportation systems but also for rural systems. In Malaysia, rail transportation system is now categorised into urban, sub-urban and rural. Urban rail transportation system is initially designed to reduce congestion in cities by enhancing mobility among city-lites. The rail system will be constructed to increase connectivity between different place of interest in the city centers for commuters and visitors. The introduction of rail network in cities is considered as a property-value price (PVP) catalyst. This will also attracts investors and visitors to increase the economic activities in a city.

Rail transportation as sub-urban system, is introduced in Malaysia because many Malaysians preferred to stay at the outskirts or perimeters of city centers. They chose to live in sub-urban as to avoid the hecticness and busy city-life. With the needs to travel to the city, sub-urban train system will not only reduce traffic congestion on roads but also reduce stresses among the commuters. As for rural train transportation system, it is also commonly known as intercity train system. The main reason for the introduction of this system is to enhance better communication between cities and regions. It is also aimed to become an integration agent by providing reliable, fast, easy and cheaper transportation system if compared to air, road and water transportation system. [9] However, currently operators are planning their best to provide and enhance their train services to meet passengers' requirements and satisfaction. The introduction of new technologies in train transportation has been able to attract more public commuters to use train services than private vehicles and buses as train transportation are proving reliable and more punctual services.

In ensuring that Malaysian train services are operated in accordance to the desired standards, the Malaysian government has introduced several initiatives such as establishing new structure for train operating framework, agencies for planning, integration and monitoring purposes. The establishment of PRASARANA in 1998 has been able to integrate the land transportation systems

in Kuala Lumpur city centre including the urban rail transportation. LRT STAR, LRT PUTRA and MONOREL systems were integrated under the subsidiary company of PRASARANA, RAPIDKL. The bus system were also integrated and rebranded as RAPIDBUS and PRASARANA has successfully coordinated these integration initiatives in phases. Currently, RAPIDKL is conducting the rail expansion project to enhance its rail connectivity and networks. With this project, it is expected that more city-lites will be using rail services as their first choice public transportation. The latest urban rail transit project, the Mass Rapid Transit (MRT), is expected to complement existing urban rail transit network and increase the rail commuters' satisfaction. In this [1] and [2] research has found that the Kuala Lumpur urban rail transit commuters were mostly satisfied with the rail network but suggested more points of interest are included in the connectivity projects such as Puchong, Shah Alam, part of Kajang regions and Selayang. However, these areas are being considered in the expansion projects by PRASARANA and MRT. It is desired that the urban rail transit system will be the best public transportation alternative for Kuala Lumpur city-lites.

The history of Malaysian train system starts way back in 1885 as mentioned in section 1 of this paper. The expansion projects conducted by the British at that time continued from 1885 to 1931 with railway lines being constructed in states such as Perak, Selangor, Negeri Sembilan, Penang, Johor, Singapore and Kelantan. After Malaysia achieved its independence, the railway lines were continuously lengthened and more funds were injected by the government to enhance the train services especially for intercity services. In 1995, the first commuter train service was introduced by KTMB to connect Kuala Lumpur and Rawang and Kuala Lumpur Seremban. The evolution of train services has currently continued quite rapidly with the introduction of the Express Rail Link service (ERL) between Kuala Lumpur and KLIA which is also known as KLIA Ekspres. This is considered as Malaysia's first high-speed train system as it is reported to operate at a speed of more than 150 km/hr. In the pipeline, Malaysia is currently planning to construct a high-speed train system and service between Kuala Lumpur and Singapore which will operate at a maximum speed of 300 km/hr and stops at least at 4 stations for a journey of around 400km. This plan is yet to be finalised by the Malaysian government through its transportation planning agency, SPAD (Suruhanjaya Pengangkutan Awam Darat).

### **Importance of Rail Services And Safety**

In discussing about rail services and safety, the most important element is how to avoid accidents from happening and providing enough information to the targeted audience. In Malaysia, there have been several instances whereby rail services experiences problems and accidents occurred. Some factors that contributed towards these instances in Malaysia are Structural, Operation, Passengers & Strangers and Right of Way. [8] When safety is concerned, it is always related to community safety and security. In India for instance, campaign were started to alert passengers so that they are aware of their lives and future of their well-being. Thus, safety and the community are closely linked as the levels of safety among community members are dependent on their awareness and exposure to prioritizing safety in their lives.

According to the United Nations Development Program (UNDP), Community Safety or Community Security (CS) is a concept that seeks to operate human security, human development and state-building paradigms at the local level. The contemporary concept of community security are narrowly defined which includes both group and personal security. The approach focuses on ensuring that communities and their members are 'free from fear'. Yet a broader contemporary definition also includes action on a wider range of social issues to ensure 'freedom from want'. Like community safety and citizen security, it promotes a multi-stakeholder approach that is driven by an analysis of local needs. By emphasizing the 'community' aspect the concept seeks to embrace both cultures and contexts that are 'individual-oriented', including many in Latin America, and cultures and contexts that are 'group oriented', as are many in Africa and South Asia.

However, 'Community' does not just refer to individual community members, but refers to all actors, groups and institutions within the specific geographic space. It is therefore will also

include civil society organizations, the police and the local authorities that are responsible for delivering security and other services in that area. Thus when discussing on railway safety, it will not only covers the mechanical safety or physical safety but also intangible matters such as awareness, education including establishment of rules and laws followed with procedures and guidelines for preventive purposes.

Safety rules and standards, such as operating rules, signalling rules, requirements on staff and technical requirements applicable to rolling stock have been devise. These national safety rules should gradually be replaced by rules based on common standards, established by technical specifications for interoperability (TSIs). In the United Kingdom, the Commission has the power to suspend the implementation of a national safety rule for a maximum of six months. Malaysia, likewise, depends on the SPAD (Suruhanjaya Pengangkutan Awam Darat) and the relevant train operators to be the enforcer of rules and regulations being set-up to ensure safety of trains in service. The elements being highlighted by UK are:

(a) Safety certification

The safety certificate must be renewed upon application by the railway undertaking at intervals not exceeding five years. It must be wholly or partly updated whenever the type or extent of the operation is substantially altered. A railway undertaking applying for authorisation to place rolling stock in service in another Member State will submit a technical file concerning the rolling stock or type of rolling stock to the relevant safety authority, indicating its intended use on the network. In addition to the safety requirements laid down in the certificate, licensed railway undertakings must comply with national requirements, compatible with European law and applied in a non-discriminatory manner, relating to health, safety and social conditions, including legal provisions relating to driving time, and the rights of workers and consumers.

(b) Maintenance of vehicles

Before it is placed in service or used on the network, each vehicle is assigned a maintenance entity. The entity ensures the working order of vehicles by introducing a system of maintenance in accordance with the vehicle's maintenance book and the applicable safety requirements.

(c) National safety authority

Each Member State must establish a safety authority which is independent from railway undertakings, infrastructure managers, applicants for certificates and procurement entities. It will respond promptly to requests and application, communicate its requests for information without delay and adopt all its decisions within four months after all requested information has been provided. The safety authority will carry out all inspections and investigations that are needed for the accomplishment of its tasks and be granted access to all relevant documents and to premises, installations and equipment of infrastructure managers and railway undertakings.

(d) Accident and incident investigations

Serious train accidents, such as derailments and collisions with fatal consequences, occur rarely, but when they do they attract public interest and the interest of safety professionals all over Europe. Criteria governing the independence of the investigating body are strictly defined so that this body has no link with the various actors of the sector.

However, a Disaster Risk Reduction (DRR) framework was initially established by the Red Cross Association in the UK and USA whenever there are any accidents including railways. This DRR is applied by more than 70 national red-cross or emergency societies all over the world including Malaysia. Thus, the framework for community safety and resilience is concerned with what contributions the Red Cross and Red Crescent can make in building community safety and resilience through a focus on disaster risk and its reduction. This framework has emerged from a widespread consultative process. At the National Society level, the framework was presented at five

regional meetings for review and feedback. These regional meetings were held in Johannesburg, Katmandu, Penang, Panama and Rabat and were attended by over 70 National Societies.

FRA's Office of Railroad Safety (USA, 2013) promotes and regulates safety throughout the Nation's railroad industry. It is regulatory and conducts inspection responsibilities through a diverse staff of railroad safety experts. [10]The staffs include 400 Federal safety inspectors who operate out of eight regional offices as stated in its website. Each regional administrator is supported by two deputy regional administrators, chief inspectors, supervisory specialists, grade crossing safety managers and safety inspectors for five of the safety disciplines focusing on compliance and enforcement in hazardous materials, motive power and equipment, operating practices, signal, train control and track. Other functions of the FRA include the followings:

- Conducts railroad safety and customer training (including State Safety Inspectors)
- Conducts accident and employee fatality investigations and reporting
- Promotes partnerships between labour, management, and the agency that address systemic initiatives
- Establish the development and implementation of safety rules and standards

### **Factors Affecting Railway Safety**

There are several factors affecting railway safety. In the literature scouted by the author, safety may be influenced by management, infrastructure, operation standards, rule and regulations, safety measures, passengers and behaviour, train system and also the train movements along the network. However, in this section, the author will only briefly explain the factors directly related to railway safety and will elaborate when relating with the case studies analysed in section 3 and so forth [11].

#### **Infrastructure**

There are many components of infrastructures necessary to complete a rail transportation system. Rail transport itself is a means of conveyance of passengers and goods, by way of wheeled vehicles running on rail tracks. It is also commonly referred to as train transport. Track usually consists of steel rails installed on sleepers/ties and ballast, on which the rolling stock, usually fitted with metal wheels, moves. However, other variations are also possible, such as slab track where the rails are fastened to a concrete foundation resting on a prepared subsurface. Rolling stock in railway transport systems generally has lower frictional resistance when compared with highway vehicles and the passenger and freight cars (carriages and wagons) can be coupled into longer trains. Railways are a safe land transport system when compared to other forms of transport. Railway transport is capable of high levels of passenger and cargo utilization and energy efficiency, but is often less flexible and more capital-intensive than highway transport is, when lower traffic levels are considered.

#### **Train Speed**

Train speed is a significant element or factor to railway safety. The operators have to monitor and conducts frequent inspections to trains as to ensure that speed compliance are being followed. For instance, rolling stock and traction faulty may lead to speed violation and results in railway accidents through varieties of reasons such as overshooting during stops, skidding, collision and overturning of trains.

#### **Passengers and Strangers**

In developing countries and highly populated areas, the situation is undesired but uncontrollable. In India for instance, train accidents is considered common news but when it killed many passengers, it may be considered a tragic situation. It is common for city trains in Indian cities. The application of safety rules and regulations were ignored due to the out of control situation. However, the Indian government has been putting its effort continuously to improve the situation so that passengers will experience a safe and comfortable train services.

### **Train-Crossing system**

The importance of a properly designed train crossing system will ensure the safety of the trains or rolling stocks crossing a road or vice versa. This will also have an impact on the pedestrians when a rail track is within the city compound. Figure 1 shows a rail crossing system and its appropriate signalling components.

### **Signalling system**

Signalling system is another factor installed for the reason to enhance safety among operators and passengers. It will be able to avoid train collisions, track accidents due to unidentified objects and any unexpected faulty or defects to the tracks during train operations. Usual signalling systems installed are light signals, axle counters and CCTV. However, these days, with the ICT in place, many train signalling systems are centrally controlled via a state of the art computer based train control center.

### **On-board equipment**

The operation of a train depends on the driver. This is a typical system especially when it involves long distant travelling trains. Thus, an appropriate on-board set of equipment must be provided for the drivers to operate especially during emergencies. It will not only smoothen the journey taken but also enhance the safety features of a train or rolling stock. However, today's technology in train control system has moved to a new dimension whereby the establishment of a control center system has not only enhanced safety but also creates avenue for real-time monitoring and data transmission system.

### **Lining-up at stations**

A systematic method but yet simple to guide passengers at platforms are lines and signage. These lines are important to follow as they will act as a guide to passengers on the danger zones while at platforms. Figure 2 show a yellow line as a guide so that passengers will stand behind them while waiting for a train to arrive.



Figure 1: A car waiting at train crossing junction



Figure 2: Yellow line – Safety Guide

### **Spacing or gap between train and platforms**

According to a report by Queensland Rail, Australia, disabled, mothers with prams and aged individuals are possible victims to unexpected spacing or gap between trains and platforms. It was reported that an elderly woman needed a hip replacement after she fell when her suitcase got caught in the door of a train which then left the station in one of almost 1000 Queensland Rail safety incidents in the past year show in Figure 3.

In Malaysia, this issue is not critical as the design of train platforms in Malaysia are conducted in accordance to the specifications required by the train authorities and SPAD. Thus, spacing and gaps between train coaches and platforms are not critical unless it is for old trains and platforms which are still not upgraded to the new specifications.

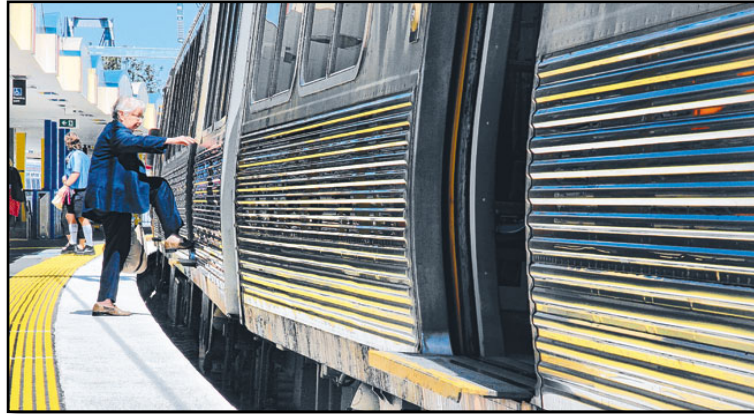


Figure 3: An elderly attempting to climb a train coach with wide gap.

### **Rail Services and Safety In Malaysia – Analysis Of Accidents**

The rail services in Malaysia have been growing quite rapidly in the last 10 years. The introduction of new technology based train services has made the transportation services more competitive and vibrant. It is without doubt that Malaysian rail industry has grown with the rest of the world. Thus, rail services and safety is considered as important and needs protection in order to uplift its service reputation. Despite of efforts were conducted to ensure the passenger's safety, accidents still happened as discussed in the followings.

#### **Case Study 1 – The Kuala Lumpur Light Rail Transit, Malaysia Train Accident**

This case study is a simple train accident but yet due to negligence and failure of control system, the train accident occurred. The train accident involves an LRT or Light Rail Transit in Kuala Lumpur. This urban train transit accident occurred on 28<sup>th</sup> October 2006. The light rail transit train overshot the end of its tracks and ended up dangling about 25m above the ground near the Sentul Timur station here (See Figure 4). [5] The train, belonging to the Ampang Line (formerly known as Star-LRT) was empty and it was fortunate for the driver who was saved after the incident which occurred at 7.11am early morning.

#### **Case Study 2 – The Bukit Mertajam, Malaysia Train Accident**

KTMB train derailment at Bukit Mertajam happened at 2.45pm carrying more than 150 passengers (See Figure 5) in 2013. [6] The incident has caused the train engine to catch fire. However, in the incident, none were injured and the train service was not disrupted.



Figure 4: LRT coach hanging at end of track



Figure 5: The KL-bound KTM trailed that derailed near Bukit Mertajam

### **Case Study 3 – The Sungai Petani, Malaysia Train Accident**

This case study is about a cargo train accident with an illegal; pedestrian crossing the rail tracks. It happened on 8<sup>th</sup> February 2013 in Sungai Petani, Kedah, Malaysia. An 18-year-old girl was killed while her elder sister is fighting for her life after the siblings were hit by a Butterworth-bound cargo train along the tracks at Jalan Kuala Ketil about 1am. The sisters had tried to illegally cross the tracks on their motorcycle when the train, which had earlier left Bangkok, Thailand, rammed into them. It is believed that the sisters, D. Nalinidevi, 18, and Rani, 20, who was riding pillion, had sneaked through the rail gates, which had already been closed to allow the cargo train to pass.

Nalinidevi was crushed by the speeding train, which only managed to stop about 500m away from the scene. Rani was thrown about 50m from the scene and suffered serious injuries, including numerous broken bones. She is admitted at Sultan Abdul Hamid Hospital's intensive care unit. The sisters were said to be on their way home from a nearby temple after helping out preparations for a special prayer function the next day. Witnesses said the girls had illegally entered the track area as the rail gates located behind an old police station in town were already closed to traffic at the time. The train driver lodged a report at the Kuala Muda district police headquarters because of the incident.

### **Summary and Analysis Cases**

Case study 1 showed that negligence lead to accident and devising a contingency measure may be able to avoid further disastrous incident. In case study 2, the incident happened because the engine has caught fire due to negligence during maintenance works. This then lead to derailment and created delays in the service. However, fortunately there was no injuries and fatality involved. Case study 3 resulted from interference by passenger by which was not supposed to happen. The authorities and operators have put up appropriate warning and countermeasure for safety but, due to violation of these countermeasures the accidents happened.

### **Concluding Remarks**

Rail transit development in Malaysia has started on a busier approach whereby it was meant to transport tin ores and raw commodities. However, it has recently established itself as an important transporter for human and city carriers. Thus, it can be concluded that from the above literatures and case studies, train are important and train accidents may be categorised into four that is structural, operation, ROW (right of way) passengers and strangers. The causes of train accidents or crashes may also be the result of human error due to incompetency and callousness. However, these can be improved with the implementation of high technology equipment or facilities installed to assist operators by giving early warnings. The Malaysian authorities such as KTMB and PRASARANA have made numerous efforts to ensure safety at site as a priority. Nevertheless, the safety of train operation is dependent of sufficient skilled human resources, frequent rolling stock maintenance and appropriate facilities installed as monitoring assistance. Our modern, technology-driven world has constantly introduces fresh challenges for rail safety advocates. From teens walking with headphones to distracted drivers approaching highway-rail grade crossings, it's vitally important to look and listen near tracks or railroad property and stay alert to stay alive. Through the 3 E's approach that is Education, Enforcement and Engineering, we can successfully join other rail safety partners to address these challenges, making communities with tracks and railroad property safer, reducing collision incidents and decreasing the likelihood of injuries and fatalities. Finally, this review has been able to enlighten three (3) main elements including rail service, enforcement and safety. These elements are important in order to enhance quality of train services and safety by using current state of the art technology.

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