THE DEVELOPMENT OF MALAYSIAN HIGHWAY – RAIL LEVEL CROSSING SAFETY SYSTEMS: A PROPOSED RESEARCH FRAMEWORK

Siti Zaharah Ishak

Transport System Centre, School of Natural & Built Environments, University Of South Australia, GPO Box 2471, Adelaide 5001 SA

Tel: 08-83021778
Fax: 08-83021880
Email: ishsz001@students.unisa.edu.au

ABSTRACT

Safety levels at highway – rail level crossing locations continue to be a major concern at most of developing countries. Basically more than half of these accidents occur at public crossings, where active warning devices are in place and functioning properly. In most cases, accidents occurred when road users ignored the gates and passed through them or if they stopped on the tracks before the gates are lowered. This phenomenon speaks directly to the need to re-examine both safety evaluation and design practices at highway-rail level crossing. Therefore the primary aims of this research project are: (a) To identify the factors contributing to the highway rail accidents at level crossing in Malaysia; (b) To develop highway rail accident empirical model; (c) To establish the optimum sight distance at interference of highway – rail level crossing and (d) To identify the road user perception and attitude towards traffic signals or stop signs at highway-rail level crossing.

To achieve the objectives, research work is divided into two major scopes which include both qualitative and quantitative elements. Data sources can be from secondary data collection and primary data collection. Secondary data collection will be from Keretapi Tanah Melayu Berhad (KTMB), Ministry of Transport (MOT) and Royal Malaysian Police databases. Primary data collection will be from field study and qualitative assessment. Field study will cover on site survey of the highway-rail geometric design, sight distance and breaking distance at highway rail-grade crossing critical spot location. Questionnaires will be distributed to gather the information on the road user’s perception and attitude towards traffic signals or stop signs at highway - rail level crossings. The result of the study will feed into the development of Malaysian highway-rail level crossing safety systems.

Keywords: Highway – rail level crossing; safety system; empirical model
1. Introduction

The paper describes the proposed research framework entitled ‘The Development of Malaysian Highway-Rail Level Crossing Safety Systems’. This paper begins with a brief introduction of the proposed research framework, research background and the significant of studies. Next, the proposed research objectives and the research methodology are outlined. Finally, the summary highlighted on the overall ideas of the proposed research framework.

2. Research Background

The term highway - rail level crossing is a crossing located on one level or at grade. It is also used to describe the crossing of a railway line by a road, path or other railroad. It also called as railway level crossing or level crossing in other countries such as Canada, Australia and the United Kingdom.

Safety levels at highway – rail level crossing continue to be a major concern at most of the countries. In Malaysia, accident involving trains are one of the most serious safety issued faced by rail systems and it is largely beyond the control of rail organization. One of the large rail organizations in Malaysia is Keretapi Tanah Melayu (KTMB). Currently there are 151 locations of highway-rail level crossing that are covered by KTMB. From the total locations, 30 of the highway-rail level crossings are located at private properties (private crossing) and other 121 are in the government properties (public crossing).

Table 1 shows the accident statistics involving train for year 1999 to 2004. From the total numbers of accidents, approximately 30% of accidents involving train occurred at highway-rail level crossing followed by 28% knocked trespassers and 42% knocked animals. The trend of accidents is fluctuated from year 1999 to 2004 by different types of incidents.

Table 1: Train Accident statistics from 1999 to 2004

<table>
<thead>
<tr>
<th>Incident</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accident at highway – rail level crossing</td>
<td>57</td>
<td>73</td>
<td>66</td>
<td>55</td>
<td>53</td>
<td>51</td>
<td>30</td>
</tr>
<tr>
<td>Knocked Trespassers</td>
<td>70</td>
<td>46</td>
<td>49</td>
<td>47</td>
<td>74</td>
<td>50</td>
<td>28</td>
</tr>
<tr>
<td>Knocked Animals</td>
<td>96</td>
<td>83</td>
<td>67</td>
<td>88</td>
<td>89</td>
<td>80</td>
<td>42</td>
</tr>
</tbody>
</table>

Source: Keretapi Tanah Melayu, KTMB, 2005)
Figure 1 shows the type of vehicle involved in the accident at highway-rail level crossing in Malaysia from 2000 to 2004. Lorry is a main contributor of a highway rail level crossing accident in Malaysia with 35%, followed by motorcycle with 29%. Third main contributor of a crossing accident is a car with 20% of cases reported. Van, bus, train and tractor/trailer comprised 10% of total accident and remain 2% for other vehicles. In comparison with Australia, figure 2 shows the large percentage of the fatal accident at highway-rail level crossing contributed from pedestrian followed by occupants of cars and motorcycle riders (Australian Transport Council, 2003). From both figures, it shows that accident cases vary according to countries.

Figure 2: Railway level crossing crash fatalities by mode of transport in Australia from 1997-2000.
Source: Australian Transport Council (2003)
Based on discussions with General Manager of Safety, Health and Environmental Department KTMB, accidents between motor vehicles and trains has been the major contributor of injuries and fatalities in the railroad industry. Most of the accidents cases have been solved as an isolated or ad-hoc cases. There is no proper system being adopted or developed to suit the Malaysian environment and considered as non- systematic application.

Responsibilities for crossing safety rest with a number of parties including roadways, road authorities and the users of the crossings. A safety system for highway – rail level crossing is also influence by factors such as Engineering, Enforcement, Education and Encouragement (4 E’s).

This research will focus on the elements of Engineering and Education systems. Hopefully the later stages of the Enforcement and Encouragement can help in reducing the numbers of accidents at highway – rail level crossing.

3. Problem Statement

Highway-rail level crossing is a special type of intersection. The fact that train runs on a fixed guide way and cannot avoid collision. In most cases, trains are not expected to stop and yield to motorists and some trains would require several kilometers to stop. Some train speeds can be considerably higher than normal road speeds. Currently, trains in Malaysia operate at speed up to 120 km/hr.

In Malaysia, many studies have been conducted regarding highway traffic safety but there has been no proper study involving motor vehicles – train accident. Even though an accident involving motor vehicles and trains is not a great concern at present, but it is important to remember that when there is an accident involved motor vehicle and train, rate of severity and the cost involved can give greater impact to the country since it resulted in property damages and lost of lives.

As highlighted by Australian Transport Council (2003) in the National Railway Level Crossing Safety Strategy Report, accident at railway level crossing giving a greater impact to everyone involved especially when it is involved with fatality. It will result in incalculable pain and suffering for families and others associated with victims as well as any operator staff involved in the crash. Direct financial costs in term of medical and repair costs, loss of personal income and loss of business and consequential financial loss were also the result of the incidents.

Due to these facts, the strategy for improving highway – rail level crossing in Malaysia will be dealing with the improvements of road aspects particularly in designing better road design including visibility – ability to see a train and judge a safe gap to cross. However, this research will also study on the road user’s behaviour. Therefore, with the evidence and supportive data available a good system can be established. Currently, KTMB has no proper system to remedy or mitigate accident rate at highway-rail level crossing in Malaysia.
4. Literature Review

Australian Transport Council (2003) in the National Railway Level Crossing Safety Strategy reported that accident between motor vehicle and trains are amongst the most severe type of accident when compared with the other type of road crashes in Australia. There are about 8% from approximately 100 crashes happened resulted in death every year. It is estimated that the financial cost of the crashes involved is $32M per year excluding rail operators and infrastructure losses.

Meeker, F. et. al (1997) studied the driver behaviour at a highway – rail level crossing as trains approached. Drivers crossing around barrier gates tended to stop or slow down on approach significantly less than those crossing with flasher only. It was suggested that the gates themselves provided an impediment to crossing which forced drivers to have inclination to cross into making a hurried and sometimes perilous decision. Their behaviour was seen as explaining the surprisingly high numbers of accidents that occur at barrier gates crossings.

The most disturbing characteristic of highway-rail level crossing accidents was reported to be over 50% occurred at public crossings, where active warning devices such as gates, flashing lights, bells, etc were in placed and functioned properly (Wanat, 1998). This phenomenon speaks directly to the need to re-examine both safety evaluation (i.e. accident prediction) methods and design practices at highway—rail level crossings.

Austin R. (2002) reported that three earlier developed accident prediction models were Peabody Dimmick Formula, New Hampshire Index, National Cooperative Highway Research Program (NCHRP) Hazard Index and United State Department of Transportation (US DOT) Accident Prediction Formula. Each of the accident prediction models has its own unique assumption, limitation, advantages and disadvantages.

The research conducted by Federal Railroad Administration (1996) shows that there is 64% reduction in the number of rail-road crossing accidents in the duration of 1978 to 1993 after a multidisciplinary safety improvement efforts sponsored and performed by them.

The weight of evidence in previous literature would suggest that the importance of studies at highway-rail level crossing. A comprehensive study is needed in order to improve the national highway-rail level crossing in Malaysia. Therefore based on the data available and the issues identified, improvements to highway – rail level crossings safety are most likely to be achieved through the development of proper safety systems.
5. Objectives

The objectives of the research are divided into two parts: Primary objective and secondary objectives.

Primary objectives are as follows:
   i) To identify the factors contributing to the highway – rail accident at level crossing in Malaysia
   ii) To developed highway-rail accident empirical model

The data is needed in order to identify the factors contributing to the accident as well as to determine the critical spot locations. Thus, the secondary objectives are very useful to understand the problems at the critical spot locations.

Secondary objectives are as follows:
   iii) To establish the clearing sight distance at interference of highway –rail level crossing (critical spot) location suite with Malaysian condition
   iv) To identify the road user’s perception and attitude towards traffic signal or stop sign at highway – rail level crossing

Perhaps in final stages, any possible safety treatments and countermeasures can help in safety improvements. The result of the analysis will feed into the development of Malaysian highway-rail level crossing safety systems.

6. Methodology

Research work is divided into two (2) major scopes which include both qualitative and quantitative elements.

6.1 Data Sources

   6.1.1 Secondary data collection

With a good collaboration with KTMB, accident data at highway- rail level crossing can be collected. Additionally, the data also can be collected from Ministry of Transport (MOT), Royal Malaysian Police and Public Works Department of Malaysia (PWD). The parameter will be selected in order to suite the development of highway-rail accident empirical model. The model is very useful in explaining the relationship between vehicle-train accidents at level crossing and geometric design of the road.

   6.1.2 Primary Data Collection

Field Study
Field studies include speed studies and other studies associated with geometric design will be conducted at the highway – rail level crossing (critical spot)
location. It is very important to improve and to propose proper designs of highway – rail level crossing safety systems.

**Qualitative assessment**
Questionnaires will be distributed to gather information on the road user’s perception and attitude towards traffic signal or stop sign at highway-rail level crossing. The feedbacks will be important in order to design road user’s education systems.

From the established data, available systems can be adopted but all the systems will be tailored to MOT requirements.

7. **Summary**

This paper presents the proposed research framework on the development of Malaysian highway-rail level crossing safety systems. Past researchers had explored the relationship on the highway-rail interfaces, in considering various parameter suits with their countries. Thus, in order to understand the reasons of the accidents involving train and motor vehicle accident at highway-rail level crossing in Malaysia, the appropriate parameter need to be determined and tested. Meanwhile, the objectives were outlined in considering various aspects including the evaluation of engineering design and road user’s behaviour. Perhaps, good result will be achieved with the outlined of the proposed research framework.

8. **References**


www.path.berkeley.edu/~lep/TTM/High_Rail_Intersect/index.html.