# AN INSIGHT REVIEW OF INDONESIA RAILWAY ACCIDENTS

Preliminary Study on Indonesia Railways Datamining

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***Abstract*— The number of railway accidents in the last decade in Indonesia has reached its critical condition. Data of railway accidents from General Directorate of Railway System showed 150 accidents in 2005, 115 accidents in 2006, 147 accidents in 2007, 131 fatal accidents in 2008, 118 accidents in 2009. Those accidents were caused by human error (35%), external aspects (20%), utility factors (2%), and infrastructure factors (18%). Human error, influenced with other factors, is the major cause of accidents and become a major concern of railway accidents studies. The objective of this study is to determine a breadth and depth of the railway accidents problem in Indonesia. It will be achieved by studying secondary data (archives) and analysis from literature study. Source of data for this study are from short reports and investigation reports by PT Kereta Api Indonesia (PT KAI) and National Transportation Safety Committee (NTSC) in the last five years. Each data is analyzed based on accident and major cause. Statistical method is used to process the data, such as descriptive statistic. The results of this study accident's cause was 62.07% Pure Human Error, including violating signal or standard operating procedures..**

***Keywords: railway accident, railway system, human error, transportation safety, statistical method***

## I. INTRODUCTION

Transportation safety is one of issues that has been studied in recent decades, both in Indonesia and abroad. This issue is getting major attention and is considered very important, particularly because of the big negative impacts resulting from transportation accidents. These impacts include property losses, damages of facilities, infrastructures, and transportation equipment, which, in other words, economical losses. In addition, a transport accident may also have an invaluable impact, such as human injuries even causing a human death.

When a railroad accident occurs, we can be sure that there will be many severe damages. Furthermore, fatal accident will bring an extremely undesirable consequence, that is human death. For example, the most recent accident, the collisions between Prambanan Ekspres railways with a bus in Klaten, Central Java, which put 15 bus passengers to death and 8 other people to injury (Kompas, 2007).

Based on this background, the main issue in this study was how much the breadth and depth of railway safety problems, whether manifested in the form of near miss, incident, and also fatal accident (Peristiwa Luar Biasa Hebat/PLH). Information about the breadth and depth is very relevant and may show how significance and crucial of the problem faced. This information will also provide how important to analyze a human error carefully, structured, and systematically, moreover, the importance of designing an appropriate intervention strategies. The appropriate strategies can prevent accidents to occur and reduce the negative impact of railway accident.

The objective of this study was to determine a scope (breadth and depth) of the railway accidents problem in category of near miss, incident, or fatal accident in Indonesia. Relatively complete information of the railway accidents statistics in Indonesia would be available to PT Kereta Api Indonesia (PT KAI), government, community, and other stakeholders. This information should motivate the stakeholders how important to improve the safety of this transportation mode.

## II. METHODS

In this study, the problem of railway accident caused by human error of railway operation was analyzed with regard to each type of incident. As a tool in problem solving, literature studies related to the problem will be discussed. Human error literature, fault tree analysis, rate of accidents, and statistical method were used to obtain the suitable results. Accident investigation data were referred to PT KAI and National Transportation Safety Committee (NTSC) then those data were identified which aspect would potentially caused by an error. The description of an incident and its cause was categorized based on cause of error.

## III. RESULTS AND DISCUSSIONS

Railway accidents were categorized in fatal accident if the incident in operation of railway causes human death, severe damages (loss of materials), and disruption of railway travel. Fatal accident was considered as extraordinary accident when the incident involved human death; or serious injury; or great case when there were:

a. Damage to the railroad so could not be used for at least 24 hours or severe material damages;
b. A part or a whole of the railway derailed or crashed;

c. Other objects (railway, carriage, wagon, etc.) was seriously damaged because of railway or railway collision;
d. All of hazards was caused by employees negligence or operational;
e. Attempted sabotage.

Malfunction recording data or fatal accident and the analysis was not only as a tool for getting information regarding railway accidents, but also as a significant information to generate root causes of the malfunction.

Fatal accident data collected from railway accident reports [1] is given in Figure 1.

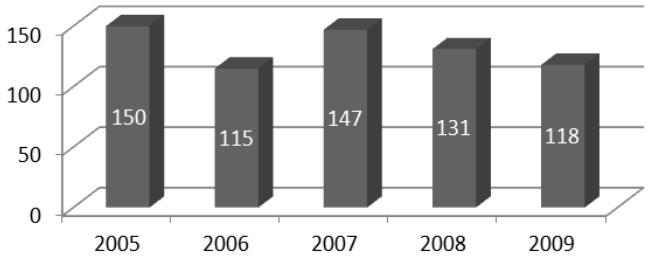


Figure 1. Fatal Accident in 2005-2009 (Source: General Directorate of Railway System)

Moreover, the detailed data were shown in Table I.

TABLE I. COMULATIVE OF RAIWAYS ACCIDENTS IN 2008-2009 (SOURCE: GENERAL DIRECTORATE OF RAILWAY SYSTEM)

| DAOP/ DIVRE | CATEGORY | | | | | TOTAL |
|---|---|---|---|---|---|---|
| | TRAIN VS TRAIN | TRAIN VS VEHICLE | TUMBLE | FLOOD | OTHER | |
| 1 Jak | 4 | 7 | 27 | 3 | 1 | 42 |
| 2 Bd | 0 | 0 | 19 | 3 | 0 | 22 |
| 3 Cn | 0 | 6 | 8 | 0 | 0 | 14 |
| 4 Sm | 0 | 4 | 20 | 5 | 0 | 29 |
| 5 Pw | 0 | 2 | 9 | 0 | 0 | 11 |
| 6 Yk | 0 | 3 | 3 | 1 | 0 | 7 |
| 7 Mn | 1 | 3 | 6 | 0 | 0 | 10 |
| 8 Sb | 2 | 3 | 21 | 1 | 2 | 29 |
| 9 Jr | 0 | 1 | 7 | 2 | 1 | 11 |
| DIV I | 0 | 1 | 12 | 0 | 0 | 13 |
| DIV II | 0 | 0 | 2 | 0 | 0 | 2 |
| DIV III | 4 | 4 | 50 | 1 | 1 | 60 |

The impact of the accident that occurred between the year 2008-2009 can be seen from the Table II below.

TABLE II. COMULATIVE OF RAIWAYS ACCIDENTS IN 2008-2009 (SOURCE: GENERAL DIRECTORATE OF RAILWAY SYSTEM)

| DAOP/ DIVRE | CATEGORY | | | | | TOTAL |
|---|---|---|---|---|---|---|
| | DELAY | NON DELAY | DIE | MAJOR | MINOR | |
| 1 Jak | 36 | 5 | 11 | 5 | 47 | 63 |
| 2 Bd | 21 | 1 | 0 | 2 | 0 | 2 |
| 3 Cn | 10 | 4 | 10 | 6 | 1 | 17 |
| 4 Sm | 26 | 3 | 5 | 7 | 2 | 14 |
| 5 Pw | 10 | 1 | 2 | 0 | 0 | 2 |
| 6 Yk | 5 | 2 | 16 | 12 | 0 | 28 |
| 7 Mn | 8 | 2 | 14 | 25 | 3 | 42 |
| 8 Sb | 23 | 3 | 7 | 39 | 14 | 60 |
| 9 Jr | 10 | 1 | 1 | 4 | 21 | 26 |
| DIVR I | 14 | 0 | 0 | 0 | 4 | 4 |
| DIVR II | 1 | 1 | 0 | 0 | 0 | 0 |
| DIVR III | 55 | 3 | 8 | 10 | 46 | 64 |

From Table I and Table II show that the greatest number of PLH is DIVRE III. In addition, the number of casualties resulting from this accident is too many. This may be related to the number of critical points that exist at that location.

TABLE III. NUMBER OF CRITICAL POINTS IN RAILWAY LOCATION (SOURCE: GENERAL DIRECTORATE OF RAILWAY SYSTEM)

| DAOP/ DIVRE | SLIDE | FLOOD | MIRE | MUD | TOTAL |
|---|---|---|---|---|---|
| 1 Jak | 4 | 3 | 0 | 0 | 7 |
| 2 Bd | 8 | 1 | 3 | 0 | 12 |
| 3 Cn | 0 | 0 | 2 | 0 | 2 |
| 4 Sm | 19 | 22 | 0 | 0 | 41 |
| 5 Pw | 4 | 7 | 10 | 0 | 21 |
| 6 Yk | 5 | 6 | 7 | 0 | 18 |
| 7 Mn | 12 | 1 | 12 | 0 | 25 |
| 8 Sb | 14 | 14 | 8 | 1 | 37 |
| 9 Jr | 3 | 3 | 0 | 0 | 6 |
| DIV I | 17 | 8 | 0 | 0 | 25 |
| DIV II | 7 | 7 | 0 | 0 | 14 |
| DIV III | 12 | 10 | 7 | 0 | 29 |

Data obtained from the General Directorate of Railway System also concluded that 35% of accidents were caused by the aspects of human resources (operators). The contribution from the external aspect was 20%. Twenty three percent and 18% of those railway accidents were caused by facilities factor and infrastructure factor, respectively (Figure 2).

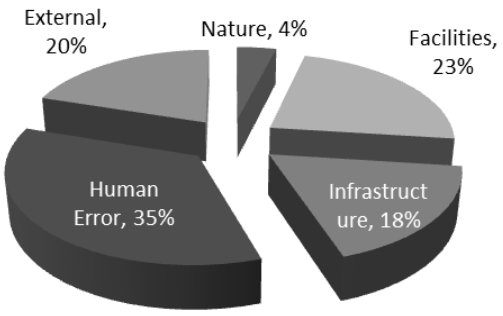


Figure 2. Percentage of The Cause of Accident in 2008
(Source: General Directorate of Railway System)

In early 1960s, Payne and Altman [2] stated that human error was a failure in the context of human information processing, which the error was divided into input, process, and output, also focusing in the context of unsuccessful of system design [3]. Hagen and Mays [4] defined human error as human failure (operator) on doing any action, which was measured by criteria such as accuracy and timeline of the accident.

Depiction of the influence of human error is called a representative system. Fault tree (Henley and Kumamoto in Kirwan [5]) can be used to describe the pattern of occurrence of system failure, which might consist of human error itself (Pure Human Error), or a mixture of human and hardware (Design induced error), and / or events in the environment depends on the scenario (System Induced Error).

Fault Tree is technique provides a systematic explanation of a combination of events that may be in the system that caused the damage. Basically, the fault tree is a logic diagram in which the logic gates used to determine the relationship between the events entered and issued by events. Fault-Tree Analysis using Boolean algebra in logic analysis and the possibility of damage is calculated for each event.

Furthermore analysis with fault tree was referred to NTSC investigation reports because it has been known what the cause of an event. Totally, there were 16 reports (2.29%) investigation from 698 accident reports. From those 16 investigation reports, it is found that 62.07% of the cause was Pure Human Error (Table IV)

TABLE IV. FAULT TREE CATEGORY

| Fault Tree Category | % |
|---|---|
| Pure Human Error | 62.07 |
| Design Induced Error | 24.14 |
| System Induced Error | 10.34 |
| Others | 3.45 |

Results from an investigation conducted by a team PT KAI by investigation team on Fatal Accident in 2005-2009, which was then classified based on description of the cause of human resources error:

1. Violating signal
2. Braking
3. Leaving locomotive
4. Sleepy and daydreaming
5. Violating the speed limit

The results show that fatal accident could be caused by lack of documentation and near miss handling and violation of standard operating procedure. This documentation can be conducted by interview method or check sheet. Interview method which could be used is unstructured interview method so the respondent did not feel investigated. One of this method is Critical Decision Method (CDM). Knowing near miss earlier, we could prevent the bigger incident that cause more casualties and losses.

## IV. CONCLUSION

The result of investigation reports analysis of accident's cause was 62.07% Pure Human Error, including violating signal or standard operating procedures. These results can be used for further research on developing data warehouse, and conducting classification with data mining to deeply accidents analysis.

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