

Analysis of The Causes of Train Accidents to Support Railway Safety

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Abstract

The aim of railway safety is to reach the highest safety standard, which is zero tolerance to all possible risks. But in reality, there are lots of inevitable accidents and disturbance. There for this research's aim is to find out railway accident cases and to determine the main factor of such accidents, especially on railway operational area with the most occurring accident which are investigated by KNTK in Jakarta. This research is using descriptive explorative method with the help of secondary data which obtained from Railway Company in Jakarta and also from research literature. This research is focus on derailment. to find out the cause of the highest train accident by using *root cause analysis* data and interview with KNKT (National Transportation Safety Committee) investigator in Jakarta. Research shows that there are some main factors on railway accidents, which are facility, infrastructure and human resource. From the research also shows that human resource is the main cause of railway accident. The factors are inspection personnel, also facility and infrastructure maintenance personnel who are incompetence and unprofessional with their job.

Keywords: railway accident, safety, derailment, KNKT

Introduction

Transportation has an important role in society life. All society members are using the means of transportation for their daily commute, especially land transportation mainly train. Railway is known as the safest mass transportation because of its certain characteristics. Therefore the safety on railway is always placed as the key factor (Hidayat, 2011).

Safety standard on railway is written on PM 24, 2015. Safety standard on railway consists of facility, infrastructure and human resource safety. But in railway reality the disturbance and accidents are inevitable (Menteri Perhubungan Republik Indonesia, 2015)

Related factors of accident in railway system are facility, infrastructure and human resource factors. Therefore this research aims to find out the main factor which causes breakdown. This research is devoted on train operational region which has the most accident case. According to KNKT the region is in Jakarta. Therefore the result from this study is expected to give an insight to prevent accidents happen from those factors.

Train accident is also known as extraordinary event case. This is a intentionally or unintentionally incident which disturbs railway system. Accident, especially on railway that occur on train track covers train collusion, train with public transportation crash, derailment, tumble down, flood/land eruption etc (Siti Malkhamah Dkk, 2014).

Derailment is a case in which a train is out of its rail (KNKT, 2016). Derailment can be caused by facility, infrastructure and human resource factors.

Some action is needed to lessen the train accident, which includes a better train maintenance (especially superstructure and train track). Developing training and knowledge to railway system is necessary for human resources in order to make them more responsible in giving the service. This also requires better and more frequent of inspection and testing of facility and infrastructure (Miloš & Kosijer, 2014).

Safety on railway system are effected by some factors, namely internal and external factors. Internal factors that effect the railway safety are facility, infrastructure and human resource. Internal standard factor on railway system is regulated on PM 24, 2015.

It is stated in railway infrastructure safety standard that train track should have technical term, which include the term of train track system and term of train track component. Rail way system and component include free space, build space, geometry, axle load and frequency. Rail way system should be equipped with safety facility which include forced rail and protective line (catch track and slide track). Rail way components which include rail, switch, which must not more than level of wear, mooring, bearing. These must be placed entirely, on certain

occasion two bearing must not be placed in a row, no mooring on the same side, ballast, sub ballast and subgrade (Menteri Perhubungan Republik Indonesia, 2015).

Based on railway Rules and Regulation, it is stated that each railway infrastructure must do inspection on operated infrastructure to know the condition and function of railway infrastructure. Railway infrastructure inspection is one of activity to check railway infrastructure's condition and function (Kementerian Perhubungan Indonesia, 2007).

Inspection on rail way consists of routine/daily check, Scheduled/monthly inspection. Unscheduled inspection will be conducted if something blocks the way when there are heavy rain, earth quake or land slide or natural climate change that can endanger the railway operation safety.

Railway facility safety standard division that consists of locomotive and train must have safety standard term. Locomotive should at least equipped with safety equipment, such as communication devices between machinist and travel controller officer or vice versa. Functional glass wiper, main head light, small fire distinguisher, pipe, speedometer, deadman device serve as warning devices for machinist in operating the locomotive which is its working sytem related with breaking activation. This must also equipped with cabin light, wheel holder, emergency break and data recorder (event recorder or data logger).

Safety regulation in passenger train should at least equipped with safety device equipment, which include small fire distinguisher at least one tube on each train, at least four unit of glass breaker hammer (two on left side and two on right side) closely placed near the emergency window which cannot be open or close. At least each train should have four blocks of wheel holder, and emergency break at least two lever on each train. Safety procedure instruction must be displayed on certain places which can be easily seen by the passenger. It contains information on safety related procedure such as evacuation way, small fire distinguisher, window breaker hammer location and emergency situation regulation.

To make sure the railway is functioning well, testing and inspection are needed. Railway infrastructure inspection is conducted regularly as scheduled. It can be done daily, monthly, semester, or yearly. The facility is testing through trial testing and periodically testing.

Human resources on railway must have competence certificate. As a sign that they already qualified on competence, expertise and proficiency. To get the certificate, railway infrastructure staff must take training and education first, and also fulfill health requirement that is proved by attaching health verification certificate from doctor (Peraturan Pemerintah, 2017)

Railway infrastructure operator must check the railway infrastructure crew before operating the train. The check at least consists of blood pressure check, drug and alcohol abuse. Routine annual inspection at least consists of mental check, physical check and health check, also issuing assignment letter (Menteri Perhubungan Republik Indonesia, 2015).

National Transportation Safety Committee (KNKT) is a non-structural organization in Ministry of Transportation to make investigation on transportation accident, which under the supervision of Minister of Transportation. Investigation task by KNKT is a series of way from Ministry of Transportation to increase the transportation safety.

The idea of investigation conducted by KNKT is to know how and why the accident occurs by identifying weakness on safety system to prevent similar accident in the future. Investigation is not based on putting someone else's fault or charging at individual or a group of individual on a matter or any other weakness that is identified on the investigation.

Not every train accident will be investigated by KNKT, only for those that are accepted as an extraordinary event case. It includes any accident that causes casualty, badly wounded or massive destruction. Also KNKT can investigate recurring accident at the same spot or with the same facility and infrastructure.

While for investigation and research, one level crossing is conducted and coordinated by Street Transportation Accident. The investigation result is made

from safety recommendation which must be followed up by the government, railway infrastructure operator. Railway facility operator also will announce to public (KNKT, n.d.).

Method

This research is using explorative descriptive methodology. The object of this research is all over Jakarta region. Data collecting method is using interview technique. The secondary data are collected from companies that operate railway transportation in Jakarta and also from KNKT (National Transportation Safety Committee) to be analyzed. Data analysis technique is using *root cause analysis* (RCA) with two steps, *five why analysis* and *Fishbone analysis*.

Discussion and Result

A. Analysis of railway accident in Jakarta

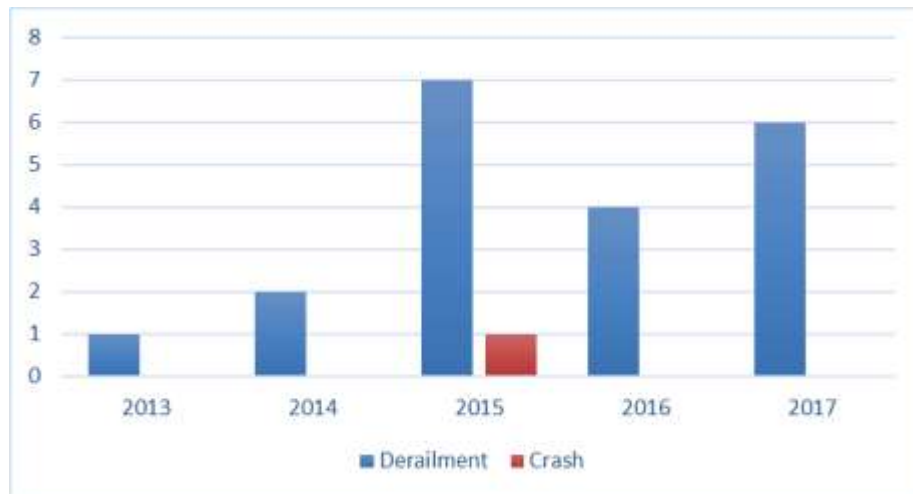


Figure 1. Railway Accident Data in Jakarta Region (2013-2017)

Based on railway accident data in Jakarta on 2013, train accident derailment case happened once. The derailment happened on June 23rd at 03:35 o'clock in Emplasmen Rangkasbitung.

In 2014 train derailment case in Jakarta happened twice more than in 2013.. It shows that there was an increase of 50% derailment in Jakarta in 2014. The first derailment was on March 23rd at 09:19 o'clock at Emplasmen Station Karangatu. The second derailment was on Mei 5th at 08:30 o'clock at Manggarai Station.

In 2015 train derailment happened 7 times with train collision happened once, five times more than in 2014. This shows that derailment in 2015 increased by 71,4% and collision between train happened for the first time on May 3 at 5:10 PM at Emplasement Juanda Station. The second derailment happened on June 18 at 11:03 AM between Kebayoran and Pondokranji. The third derailment happened on July 8 between Karangatu Station. The fourth derailment was on August 19 at 2:35 PM at Manggarai Station. The fifth derailment was on October 27 at 09:00 AM at Emplasemen Manggarai. The sixth derailment was on November 8 at 08:30 AM at petak jalan Bogor. The seventh derailment was on December 20 at 06:20 PM at Emplasemen Tanah Abang.

In 2016 derailment case happened four times, three times less than in 2015. This shows that train derailment in Jakarta region decreases as much as 75%. The first derailment was on April 6 at 03:16 PM at Manggarai Station. The second derailment was on May 18 at 06:25 AM at intersection between Manggarai Station and Sudirman Station. The third derailment was on May 21 at 05:40 AM at Emplasemen Cilandak Station. The fourth derailment was on December 8 at 02:58 PM at Pondok Jati Station.

In 2017 derailment case happened six times, two times more than 2016. This shows that derailment in Jakarta increases 33,3%. The first derailment was on September 14 at 09:45 AM at Emplasemen Jakarta Kota. The second derailment was on September 24 at 05:22 at Cigobog Station. The third derailment was on October 3 at 07:57 at Emplasemen Manggarai. The fourth derailment was on October 24 at 02:55 AM at Emplasemen Pasar Senen Station. The fifth derailment was on October 30 at 11:09 AM at Jatinegara

Station. The sixth derailment was on December 24 at 02:01 AM at Batu Ceper Station.

According to diagram above, derailment accident is the most frequent train accident occur in Jakarta region. The lowest derailment happened once in 2013. The highest derailment happened seven times in 2015 with the increase of 71,4% from the previous year. The most frequent area for having derailment was Emplasemen Manggarai Station. The average of train derailment at Jakarta from 2013 to 2017 was four times in a year.

B. Analysis of Derailment Cause at Jakarta

According to data investigation by KNKT, there were seven cases of train derailment in Jakarta from 2008 until March 2017. The seven cases were the derailment case that fits the criteria which cause six hours of roadblock and casualties (Government Regulation Republik of Indonesia). The number of derailment in 2017 happened once. There are three factors which caused the train derailment, they are infrastructure factor, facility factor and human resource factor.

The following discussion is factor analysis on train derailment from 2008 until 2017 based on KNKT investigation data:

On Juni 26, 2008, at Emplasemen Kebayoran South Jakarta, there was a derailment on KA PLB 8601 (BB). The derailment happened because the train were crossing the rail which had a wessel problem.

In 2010 there were derailment twice. The first case was KRL 620a on Mei 6 at Emplasemen Manggarai Station. It happened because there was a double track problem. The second case happened with KA Agrobomo Anggrek on July 30 at Emplasemen Manggarai Station. It happened because of stiffness on bogie and also there was a hard shaking on bogie and the train body.

In 2012 there was a derailment case on KRL 435 on October 4 at Emplasemen Cilebut Station – Bogor Station. It happened because the wheel ware and the bogie chassis was leaping.

In 2016 there were two derailment cases. The first was KRL 2473 on April 6 2016 at Emplasemen Manggari Station. The cause was double track. The second derailment was KRL 1517 on May 18 2016 at Lengkung km 5+500/400 Manggarai Station – Sudirman Station, the cause was rail worn out and over limit skilu.

In 2017 there was a derailment KRL 1479 A on March 15 2017 at Lengkung Emplasemen Jatinegara caused by 16 mm skilu.

C. Analysis of Derailment Cause Factor at Jakarta

KA PLB 8601 derailment happened on June 26, 2008 at Emplasemen Kebayoran South Jakarta. There were few findings that caused the derailment. The cause was because of small gravel between the tip of wessel and the rail piston. It made the tip of the wessel couldn't close perfectly. Therefore PPKA propped wessel with stone, because there were no emergency equipment for the wessel. Based on the interview with KNKT investigator, this kind of case is rare, therefore it is the one and only case. Its because this kind of case should be handled by Signal and Telecommunication division (SINTEL) and Street and Bridge (JJ).

KRL 620a derailment occured on May 6 2010 at Emplasemen Manggarai Station. There can be found some causes of the derailment. It happened because of double track. This caused by the wessel tounge was changing it course. The tongue of the wessel was hit by gearbox hanger. The gearbox hanger fell because the nut bolt and split pen was not functioning well. The cause of it was inaccurate of semester inspection on infrastructure.

The second case was KA Agrobromo Anggrek on July 30, 2010 at Emplasemen Manggarai Station. The finding was the derailment caused by stiffness on the bogie and hard shaking on bogie and body train. The shaking was because there was an empty air on one of the air spring side. It happened because the orrvice hole was clog because the levelling pipe was dirty. It can

be concluded that the final problem is because the bogie inspection was not optimal. Based on the interview with KNKT investigator, the train that used air spring system was no longer exist, because the use of air spring had lots of disadvantages.

KRL 435 derailment on October, 2012 occurred at Emplasemen Cilebut Station-Bogor Station. It was discovered several findings that cause the derailment. It because of the wheel ware and bogie chassis was leaping. It happened because the train had a lump at size of 16,7 mm. The lump at the rail connection was caused by lack of bolt on connector plate (fishplate). The lump was also caused by crack on plate connector without tidied up the surface from the previous broke spot. This thing happened because there was lack of monitor and evaluation after the restoration of the rail track.

KRL 2473 derailment on April, 2016 occurred at Emplasement Manggarai Station. It was discovered several findings that caused the derailment. The derailment was caused by double spur which happened because of the wessel movement. It moved because the wessel did not lock properly as the motor ware of the wessel's performance decreased. This case was the third times happened. According to KNKT investigator, the problem was because there were no thorough maintenance before.

The second derailment was KRL 1517 on May 18, 2016 at Lengkung km 5+500/40 Manggarai Station –Sudirman Station. The finding shown that skilu and TAN was worn-out over the limit. Skilu is a height rail way gap on two spot of three meters measurement in distance practice between six bearings from one axis to another (60 cm between bearing axis in a row). It happened because there were no lubrication or lack of maintenance on curve way. From the interview of KNKT investigator, this thing happened before the maintenance three month maintenance period came. It can be concluded that therewere lack of more intense maintenance initiative because of the three month period maintenance schedule.

KRL 1479 breakdown occurred on March 15, 2017 at Lengkung emplasemen Jatinegara. The breakdown was caused by 16 mm skilu. This is beyond standard measurement. Skilu is a declining rail way so the rail way is not balance. If the train passes that particular rail, there will be a hanging side which can make bogie twisted because it is too light. According to KNKT investigator, maintenance had been done on the rail track curve as scheduled. The derailment happened just before the next maintenance came. This was caused by lack of initiative to check and maintain the area that resulted the breakdown.

Conclusion

From accident analysis research in Jakarta, it can be concluded that the highest train accident within the last five years was derailment with average of four times occurrence within a year. Based on the result of the investigation, the cause factors of the derailment are wessel disturbance, rail lump or rail brake and not properly connected plate. The facility factor was caused by lack of maintenance and inspection on the train resulting in some loose part such as gearbox hanger tied ware and lack of maintenance on train that use air spring system. Human resource factor was the inspection and maintenance personnel that lack of initiative to check the area that have accidental history.

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