DESIGN OF INVESTIGATION SUPPORT SYSTEM PROTOTYPE

A Case Study in Train Accident Investigation at DAOP 4 Semarang

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***Abstract*— Investigation can be a complex task without any supporting system that provides a necessary data or relevant information. Such as investigation of the PT Kereta Api Indonesia (KAI) in analyzing a train accident due to human error is limited. Analysis conducted by KAI only focuses on individuals who are related and have not been able to analyze the error causes in detail because of lack of data. This research tried to design investigation support system prototype to facilitate all of the processes needed in analysis a train accident. The processes started with the interview process using Critical Decision Method (CDM) and inferred using the Emergent Themes Analysis (ETA). Then a systematic method of Human Factors Analysis Classification System Indonesian Railroad (HFACS-IR) used to analyze human error especially for train accidents occurred in Indonesia. At last, accident scenarios constructed by the Linking Causal Factor. The result shows that investigation process suggested able to give more effective recommendation and the prototype design make these processes easier.**

Keywords: train accident investigation, human error, support system prototype

I. INTRODUCTION

The published data from the Department of Transportation regarding the number of train accidents, in the last five years (2006-2011) show that 535 train accidents occurred. Among them are 20 cases of train accidents by rail, 116 cases of train accidents by public transportation, dropped 366 cases, and 33 cases overturned train.

Based on the results of the Ministry of Transportation records DGR years 2009 - 2011 outside the external factors, the factors causing the train crash to human error is dominated by the operator with a percentage of 25% followed by 24 % means factors, infrastructure, 15%, and 7% natural. Human error in train accident are often considered only error machinist course, but need more in-depth investigation because of human error that occurs is the contribution of the other aspects (management, systems, etc.).

To reduce the occurrence of human error in train accident required methods Human Factors Analysis and Classification System (HFACS), which is one method of analysis of human error with a systematic approach to determine the main cause of the accident. During its development, there are modifications HFACS analysis to optimize its application in the railway industry that generates methods Human Factors Analysis and Classification System Rail Road (Reinach & Viale, 2005). Application of HFACS - RR can not be directly applied in Indonesia, Adjustment HFACS - RR method that can be applied to the condition of railways in Indonesia has been developed previously by Budiawan in 2011 and generating method – HFACS-IR (Human Factors Analysis and Classification System Indonesian Railroad) [1].

In the previous study entitled Development of Investigation Application of Human Error on Railway Accidents [2], the main purpose of application is focused only on crash between trains. There is a need to further development of this application to include more kind of train accident cases. In the PP 72 of 2009 section 110 subsection (3) states that a collision between a train and public transport is not an accident railways [3]. Then the design of investigation support system leads to the case of a train accident that is recognized by the PT Kereta Api Indonesia (KAI), that is an accident between trains, fell, and rolled.

II. OBJECTIVE

General purpose: "Designing support system with the accident investigation HFACS-IR method and CDM to analyze human error which occurred on train crash in Indonesia"

Specific objectives:

1. Completing the data collection techniques in the analysis of a train wreck.
2. Designing support system with the railway accident investigation more complete coverage of the case.
3. To test the use of the application to the company concerned at KAI.

III. LITERATURE

A. HFACS - IR

Budiawan (2011) developed the method into HFACS - IR methods that have been adapted to the unique situation in Indonesia railways. HFACS - IR method categorizes errors into five categories, each category of mutual influence. Distribution of the five categories, namely misconduct crew (crew acts), the trigger of crew misconduct (preconditions for crew acts), less supervision supervisor (supervisory

factors), factor organization (organizational factors), and external factors that influence (outside factors) [2]. Here is an explanation of each category mistake HFACS - IR.

a. Crew acts: the fault of the crew due to the failure of the condition of his own crew (errors) or a violation of the rules (contravention).
b. Precondition for crew acts: a trigger condition crew acts. Errors in this condition can be triggered by itself crews conditions (conditions of crews) or conditions on the ground implementation (practices of crews).
c. Supervisory factors: the cause of the preconditions for the crew acts due to lack of supervision on the resource. This can be caused by the inability of supervisors or no periodic checks, a plan that does not match the target, the supervisor failed to correct the error, and one supervisor to comply with procedures and regulations.
d. Organizational factors: a failure to identify the company or organization related. At this stage it is usually difficult because of the scope of problems that are too broad.
e. Outside factors: an error occurs due to two external factors, ie factors regulatory environment and economic / political / social / legal environment.

B. Linking Causal Factor

There are terms genotype and phenotype in an error in the method of linking causal factor. Genotype is the process of detecting the cause of an error that does not appear physically, in the form of mental processes, and is the cause of the phenotype. The phenotype itself is known as the process of diagnosing physical error and can be measured. When simplified, the differences in genotype and phenotype of an error, the same as the concept of cause and effect [2].

C. Critical Decision Method (CDM)

Critical Decision Method (CDM) is a structured interview process that can be used to obtain information and knowledge from experienced operators about their decision-making, understanding and problem solving processes during critical non - routine incidents [4].

D. Emergence Theme Analysis Approach (ETA)

Emergent Themes Analysis (ETA) is a technique for analyzing the data obtained with the CDM interview from a different perspective. ETA in this study is used to discuss more in depth the most complex problems known from the results of the data analysis method structured CDM.

ETA analysis methods combine or filter the different concepts of the various methods of interviews in order to collect the required information in a systematic way [5].

IV. SYSTEM DESIGN

A. Procedure

Initial procedure in the event of an accident this app is filled with detailed data crash data entry and data events involved trains. Then fill in the data investigator, investigator here is the people or the authorities to investigate train accidents that occurred. After saving the data the investigator, then entering the crew involved in the accident.

Then interviews conducted to train crew using CDM method through several stages. The first stage is a brief description of train accident suffered by the train crew. For the second stage is a detailed description of the incident and to provide detailed identification of the accident timeline. The third stage is a more detailed interview to the train crew, this detailed interview consisted of a few questions related to train accidents. Then the last stage is the comparison of the expert with beginners, so it can be seen where the train crew who have expert and which are still beginners.

The next procedure is to perform an analysis of prior CDM stage using ETA. The first stage is the preparation of a great theme to collect the same information from each train crew involved in the accident. Then the next stage is the analysis of similarity occurrence specific that have been collected at this stage of events in common transcript.

Having analyzed using ETA, followed by human error analysis method HFACS - IR. In HFACS analysis - there are 5 levels of IR. Level 1 is the train crew actions are directly related to train accidents. Then at level 2 to level 5 is an analysis that identifies the cause of a train crews action that have been identified at level 1.

After the data collection and analysis procedure is completed, the next procedure is then carried out recommendations for improvement. Recommendations are made concerning the analysis that has been done before. For the last procedure of this investigation is the application of the results of the accident investigation report that displays detailed data accident, investigators of data, the data train crew involved, human error analysis, and recommendations for improvement are given. The accident investigation procedure can be seen in Figure 1:

B. Database Design

Designing the database is done in order to avoid accumulation and duplication of data. This investigation used a database to store a variety of required data. The data stored in the database are:

- The history data of train wrecks,
- Train crew interview data,
- Analysis of train crew interviews,
- The causal factors linking scenario/ relationship among the factors that have been defined,
- Analysis of human error in train accidents.

C. Prototype Design

The investigation support system designed by prototyping method to have the user or decision maker involvement. The prototype includes designing interface and basic function of the investigation process. These are:

- Detail Accident Input
  The following page is used to input the details of train accidents that occurred.
- Investigator Input

This page serves to provide data input investigator who is investigating a train accident.

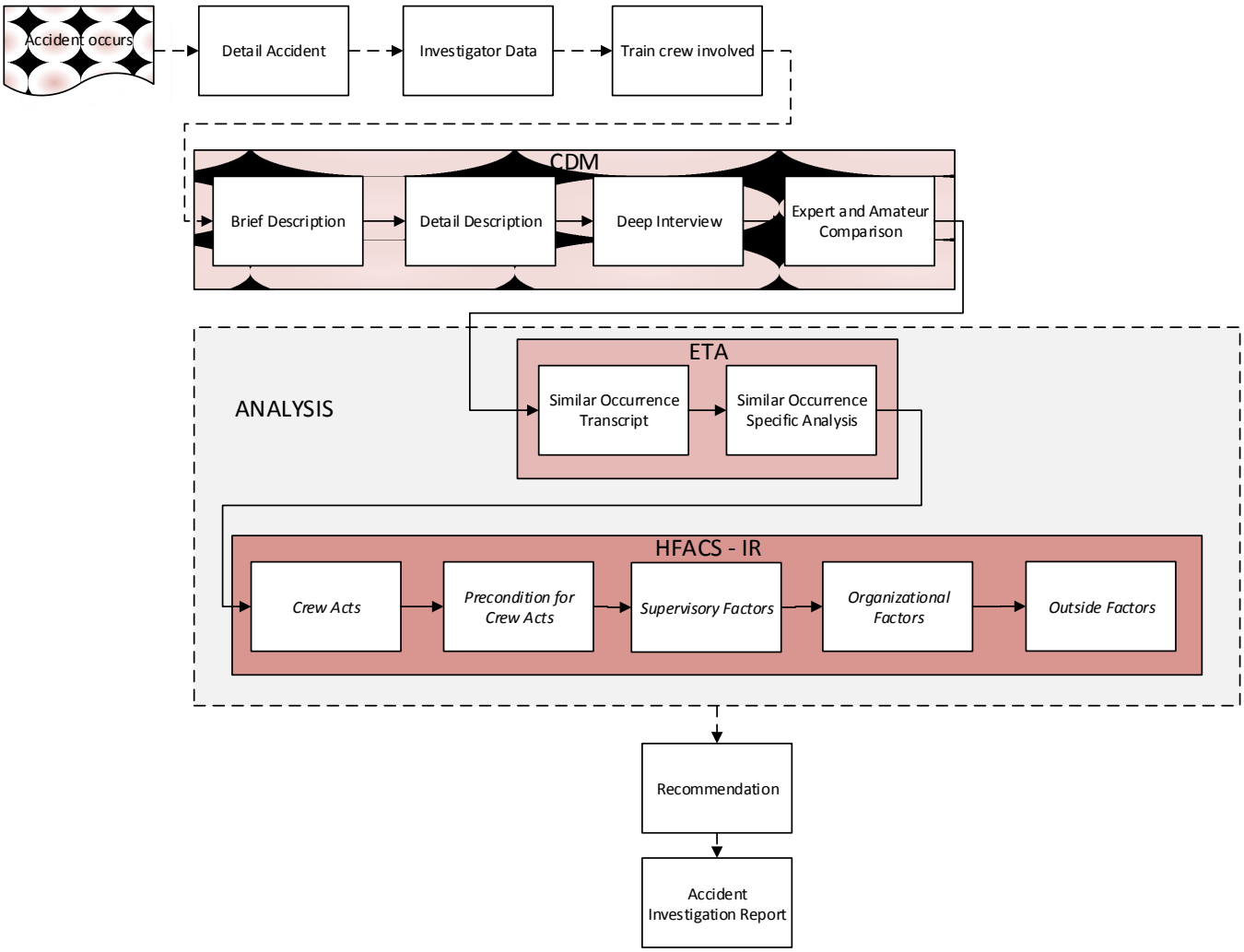

Figure 1. Overview of the procedure for accident investigation [6].

- Personnel Data Input
  Data entered on this page train crew involved a train wreck and their principal - the principal recognition that lists questions CDM.
- Chronological Data Input
  On the chronological page described the cause of the incident, due to the events, and the estimated loss due to train accidents.
- Analysis Data Input
  Page analysis functions to analyze the incidence of train accidents that occurred. There is analysis of ETA and HFACS - IR on this page also the recommendations on strategic decision-making of railway accidents from happening again in the future.
- Investigation Results
  Investigation results page containing the results of data collection and their recap the analysis has been done before.

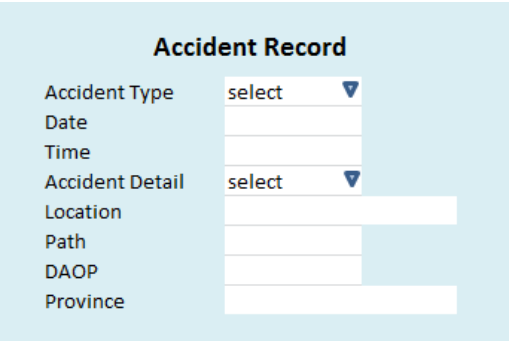

Figure 2. Detail Accident Input

Figure 3. Investigator Input.

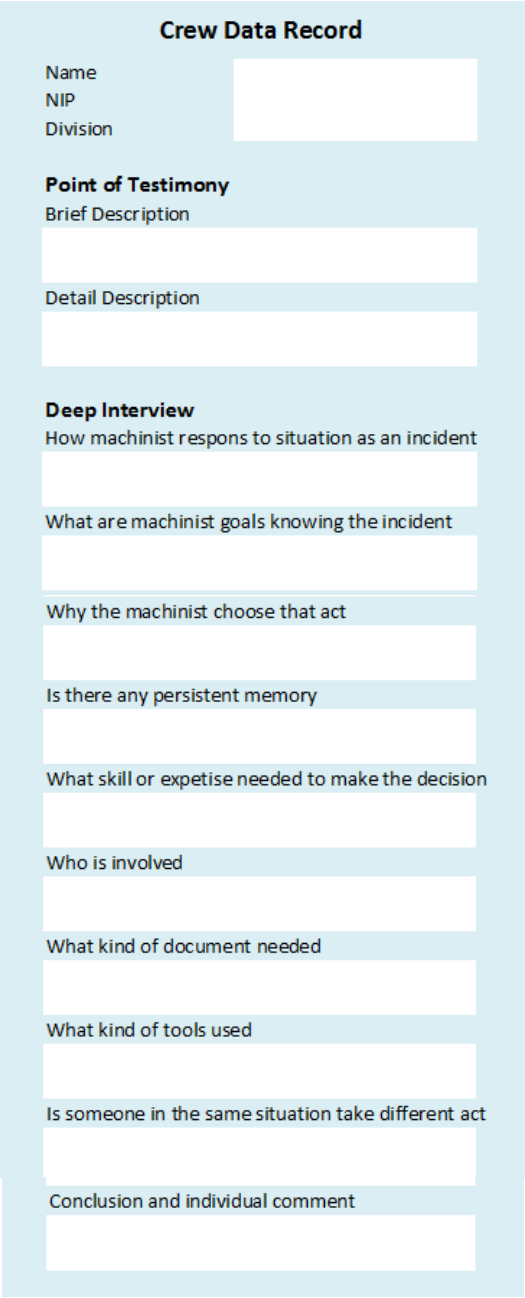

Figure 4. Personnel Data Input

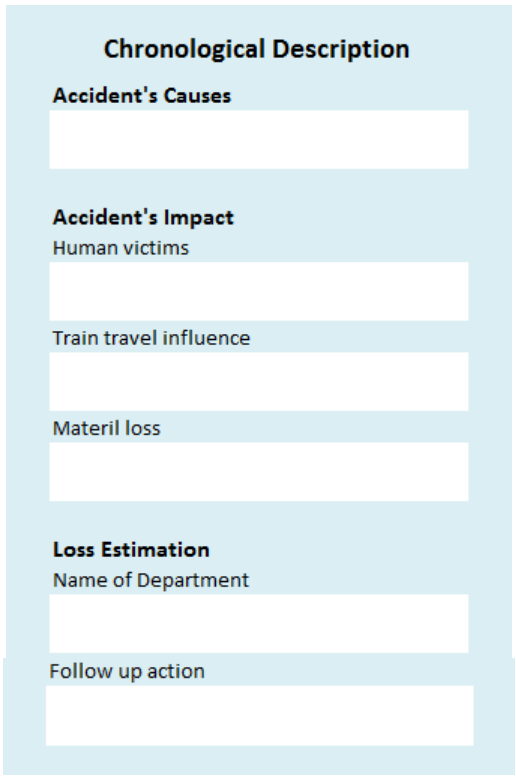

Figure 5. Chronological Data Input.

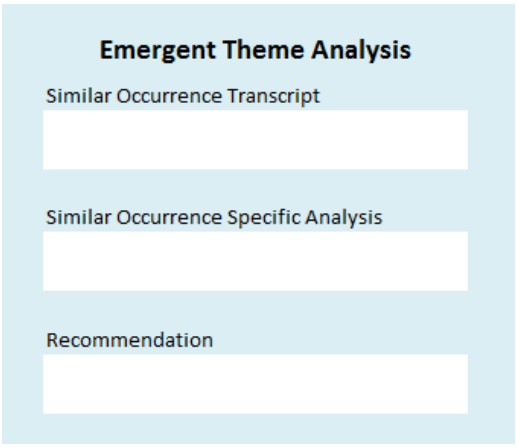

Figure 6. Analysis Data Input.

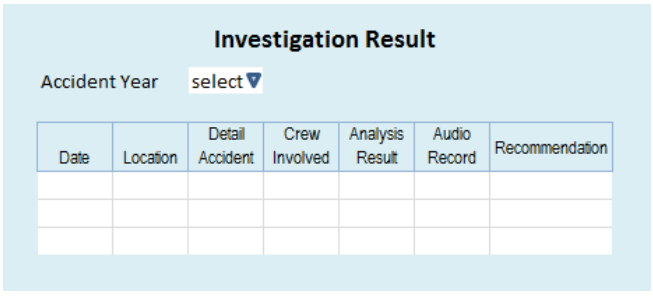

Figure 7. Investigation Results.

V. CONCLUSION

Based on the research's result, it can be concluded as follows:

1. The investigation support system prototype is designed to help KAI by providing relevant data needed in investigating train accident.
2. The use of Critical Decision Method followed by Emergence Theme Analysis approach help the rail accident investigation process has better focus.
3. This support system is designed to record all data in railway accident one single database to make the investigation process easier.

ACKNOWLEDGMENT

This research funded by the Directorate of Research and Community Service Directorate General of Higher Education, The Ministry of Education and Culture of the Republic of Indonesia.

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