

別添資料 3 技術協力作成資料

Activity 5 SOP およびマニュアル類以外

A5-a Asset Management for PPP Toll Roads in Indonesia
(Technical Report)

UPGRADING OF E-SPM

2022

DETAILED DESIGN

REPORT



Republic of Indonesia
Project for Strengthening Management Capacity of Toll Road Development



Preface

This seventh Monthly Report was prepared by PT Varian Global Perencana for the “**Upgrading of E-SPM**” project. This Monthly Report is provided to explain the technical approach and methodology, work plans, and work progress according to the time schedule.

On this occasion, we humbly as consultants express our gratitude and highest appreciation to PASCO Corporation for trusting us to cooperate in working on part of the “Project for Strengthening Management Capacity of Toll Road Development”. We hope this Report is acceptable to substance requirements in the Terms of Reference (TOR). Corrections and suggestions will be useful for us.

Thank you.

Jakarta, February 28, 2023

PT. Varian Global Perencana



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Introduction

Chapter

01



Based on the Regulation of the Minister of Public Works and Public Housing Number 43/PRT/M/2015 about Indonesian Toll Road Authority (ITRA; Badan Pengatur Jalan Tol (BPJT) in Bahasa), one of the tasks of ITRA is to monitor the implementation of planning and implementation of construction, operation and maintenance of toll roads by Toll Road Operators (TRO; Badan Usaha Jalan Tol (BUJT) in Bahasa). During the toll road operation, ITRA has the task of supervising the fulfillment of TROs obligations related to the operation and maintenance of toll roads, compliance with Toll Road Minimum Service Standards (Standar Pelayanan Minimal (SPM) in Bahasa), managing operation data and evaluating the implementation of toll road operations and maintenance carried out by TROs.

Minimum Service Standards or **SPM** is a measure of the type and quality of basic services that must be achieved in the implementation of TROs. Along with the growth of toll roads in Indonesia, ITRA has implemented a digital transformation to facilitate the function of monitoring and supervising the operation and maintenance activities of toll roads, which is called electronic SPM or E-SPM. E-SPM has been implemented since 2019, and continues to be developed, most recently in 2021. Functionally, the current function and capacity of E-SPM is not sufficient for effective and efficient toll road management for ITRA. E-SPM currently only accommodates SPM fulfillment by TROs, with analysis features related to it. Meanwhile, ITRA's task in monitoring and evaluating toll road operation and maintenance activities requires more than that. Additional features, advanced analysis, and technical ideas are needed to develop the current E-SPM.

1.1. The Purpose and Objectives

Refers to Term of Reference, the main objective of the Services is to develop additional functional modules to upgrade the current E-SPM so that E-SPM can also work as Asset Management System for ITRA. The Services shall also prepare relevant documents related to upgrading/development and operation of E-SPM such as updating detailed design, user manuals, conducting training and technical support after completion of the Project.

1.2. Scope of Work

Refers to Term of Reference, the scope of work is to carry out the following tasks but not limited to:

1. **Updating database design and detailed report design**

The Sub-Consultant shall update the database design (data model) and detailed design report incorporating the data and analysis modules to be supplemented in the current E-SPM. All feedbacks and comments to be provided by the Project and the users shall

incorporate in the upgraded database design and detailed design report. The updated database design and detailed design report shall submit together with the updated version of E-SPM.

2. Updating of database design

The Sub-Consultant shall update the database design incorporating additional data especially road inventory data. The additional data table etc. shall prepare to comply with the functional modules to be supplemented.

3. Upgrading of E-SPM

a. Overall structure of the upgraded E-SPM

The conceptual image of upgraded E-SPM structure is shown below. The Sub-Consultant shall prepare overall structure of the upgraded E-SPM by taking account of all changes made in this upgrading.

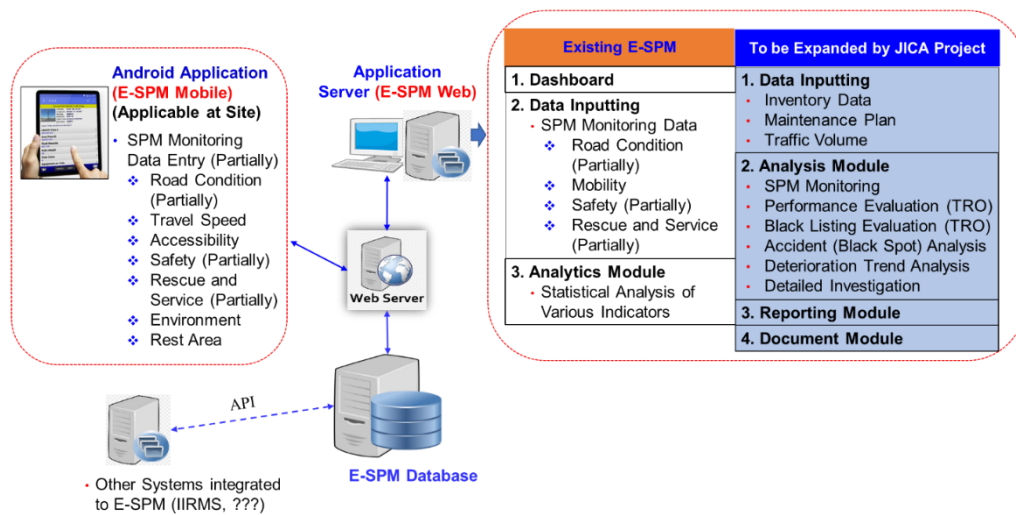


Figure 1.1 Overall structure of upgraded E-SPM

b. Design platform

E-SPMS shall upgraded with the same design platform as designed in for the current E-SPM. The upgraded E-SPM shall be bilingual (English and Bahasa).

c. Development of road inventory data inputting module

Toll Road Inventory Data

The Sub-Consultant shall develop a road inventory data inputting module for the following inventory data.



Table 1.1 Toll Road inventory data

SN	Data Items	Unit	Data Type	Data Definition
1.	Toll Road ID			
2.	Toll Road Holding Name			
3.	Toll Road Name			
4.	Year of Construction			
5.	Toll Road Section Name			
6.	Chainage (From)			
7.	Chainage (To)			
8.	Number of Lane			
9.	ROW			
10.	Inbound Carriageway Width			
11.	Outbound Carriageway Width			
12.	Inbound Pavement Type			
13.	Outbound Pavement Type			
14.	No. of Bridges			
15.	No. of Toll Gates			
16.	No. of Service Area			
17.	No. of Rescue Station			
18.				
19.				
20.				

Maintenance Plan

The Sub-Consultant shall develop an interface to input information related to maintenance plan formulated by each TRO.

Table 1.2 Maintenance plans of toll roads (1/2)

SN	Data Items	Unit	Data Type	Data Definition
1.	Toll Road ID			
2.	Toll Road Holding Name			
3.	Toll Road Name			
4.	Toll Road Section Name			
5.	Chainage (From)			
6.	Chainage (To)			
7.	Coordinate (Lat) From			

Table 1.3 Maintenance plans of toll roads (2/2)

SN	Data Items	Unit	Data Type	Data Definition
8.	Coordinate (Long) From			
9.	Coordinate (Lat) To			
10.	Coordinate (Long) To			
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				

Traffic Volume

The Sub-Consultant shall develop an interface to input information related to traffic volume.

Table 1.4 Traffic volume data

SN	Data Items	Unit	Data Type	Data Definition
1.	Toll Road ID			
2.	Toll Road Holding Name			
3.	Toll Road Name			
4.	Year of Construction			
5.	Toll Road Section Name			
6.	Traffic Counter Chainage			
7.	Coordinate of Counter (Lat)			
8.	Coordinate of Counter (Long)			
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				



d. **SPM monitoring module**

The Sub-Consultant shall develop a single interface to monitor SPM indicators recorded by TRO and ITRA Inspection Team on top of minimum indicator stipulated by regulation (No. 16/PRT/M/2014) as shown in **Figure 2**.

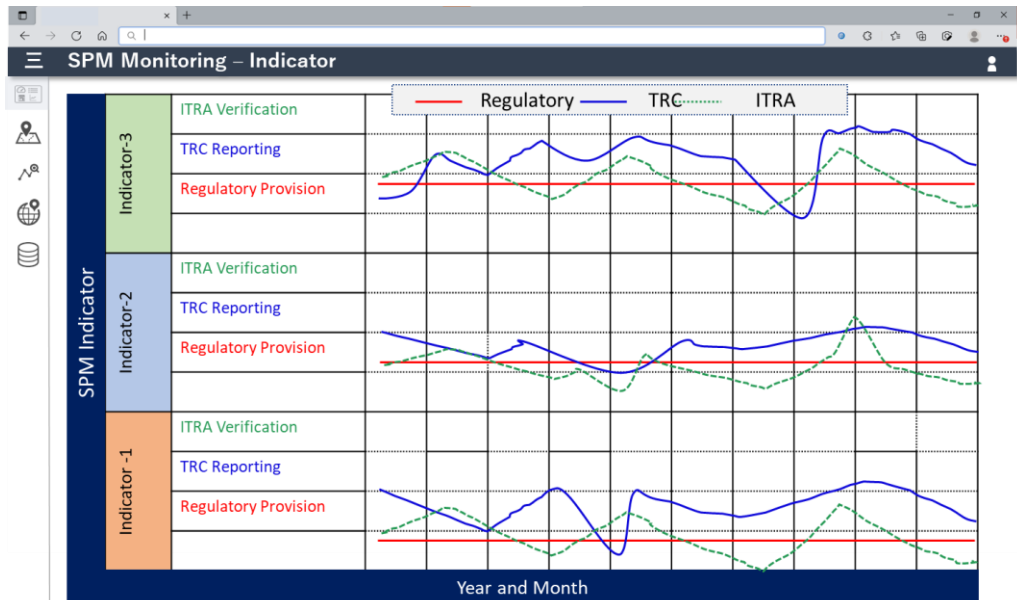


Figure 1.2 SPM monitoring (conceptual image only)

e. **Performance evaluation module**

The Sub-Consultant shall develop an analytical module to conduct performance evaluation of TROs using data collected for E-SPM. In the current version of E-SPM, there is a kind of performance evaluation but comparative evaluation is missing.

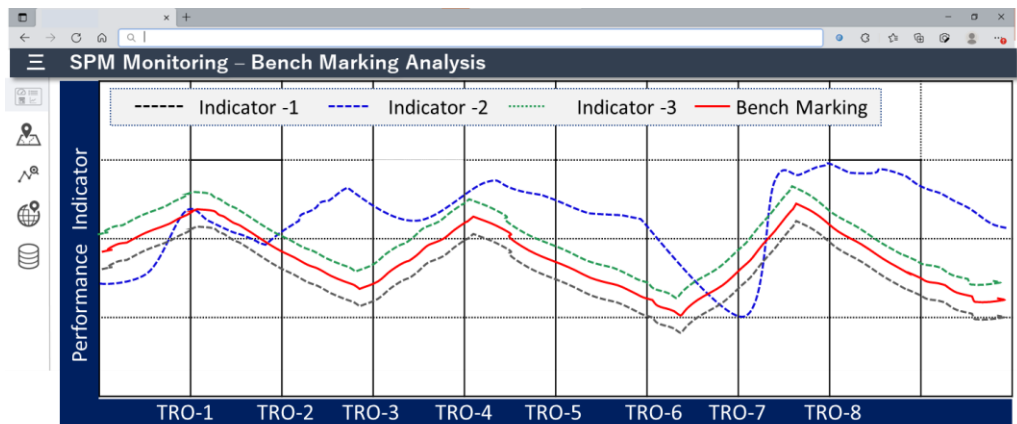


Figure 1.3 Performance evaluation of TROs (conceptual image only)

f. **Black listing module**

In the current version of E-SPMS, there is a tool to list the best 5 TROs which comply with SPM requirements. Also, there is a graphical presentation of number of detected defects and number of repair events as shown in **Figure 1.4**. However, there is no list of TROs which do not fulfill the requirements of SPM. Therefore, it is advised to create a list of black listed TROs who do not fulfill the requirements of SPM. The Sub-Consultant shall develop a tool to list up the TROs which do not fulfill the requirements of SPM.

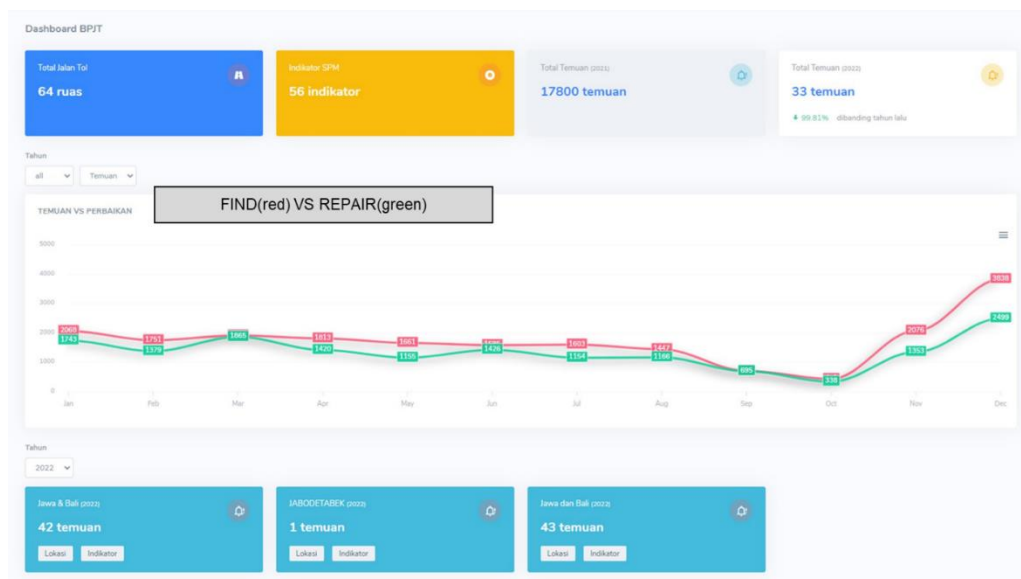


Figure 1.4 Comparison of number of detected defects and repair

g. **Accident data analysis (Black Spot Analysis) module**

The Sub-Consultant shall develop accident inputting and analysis module. The accident inputting interface shall include information as per Indonesian regulations. The black spot analysis module shall develop in such a way that the module can identify the black spots based on accident analysis. The module shall also be able to prepare accident and black spot maps. Since BINAMARGA has already Safety Analyst as a component of Agile Assets for national roads, it is advised to develop similar module from the consistency point of view also within MPWH.

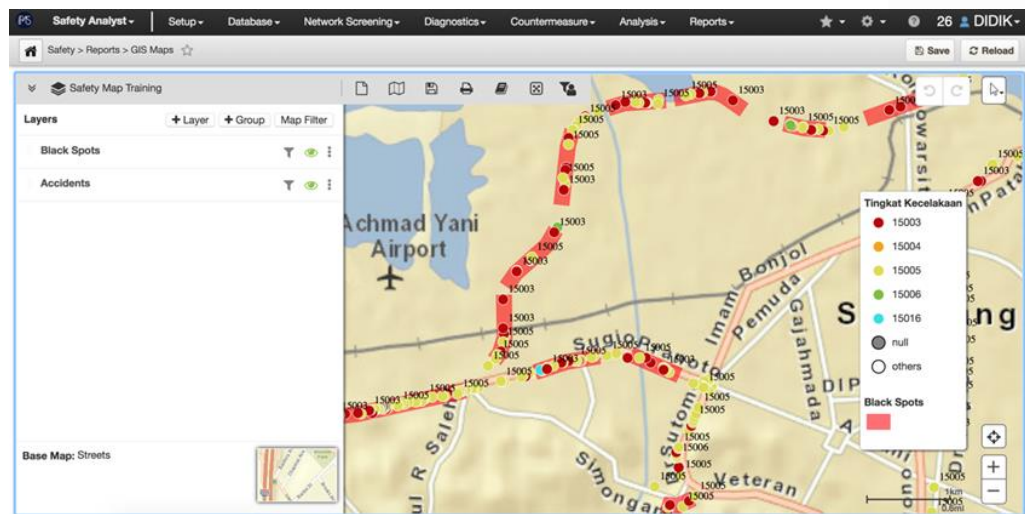
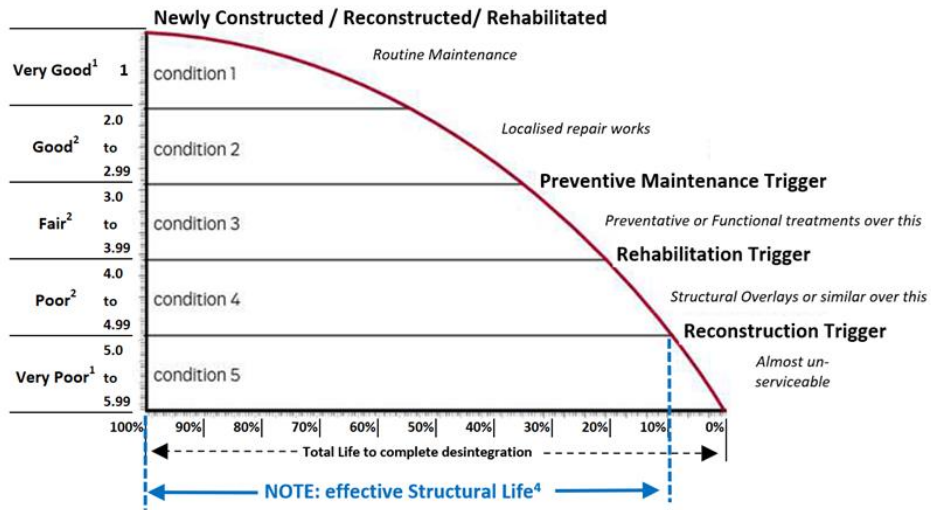


Figure 1.5 Accident and Black Spots mapping (source: AgileAssets)

h. **Deterioration trend analysis model (deterioration prediction)**

Since ITRA is not toll the road operator but regulator only, ITRA does not need to carry out deterioration prediction for maintenance planning. Deterioration prediction for ITRA is only to see the trend of deterioration in individual toll road and periodically check whether the maintenance works carried out by TROs are proper or not. Also, TROs report conditions of roads in terms of IRI and skid resistance twice a year as per regulation. Therefore, it is anticipated that the trend of deterioration can be observed just by analyzing those data collected biannually. Also, BINAMARGA and CFRI is developing a common deterioration prediction model. Therefore, it is recommended to develop a similar deterioration prediction model. In order to apply the same deterioration model, IRI data shall be categorized into 1-5 scale damage grading (1: No damage, 5: Heavily damage). The Project team and counterpart will inform in due course about the method of converting IRI data to damage severity rating in the scale of 1-5.

Typical Pavement Asset Degradation Curve



DETERIORATION FORECASTING MODEL (PAVEMENT)

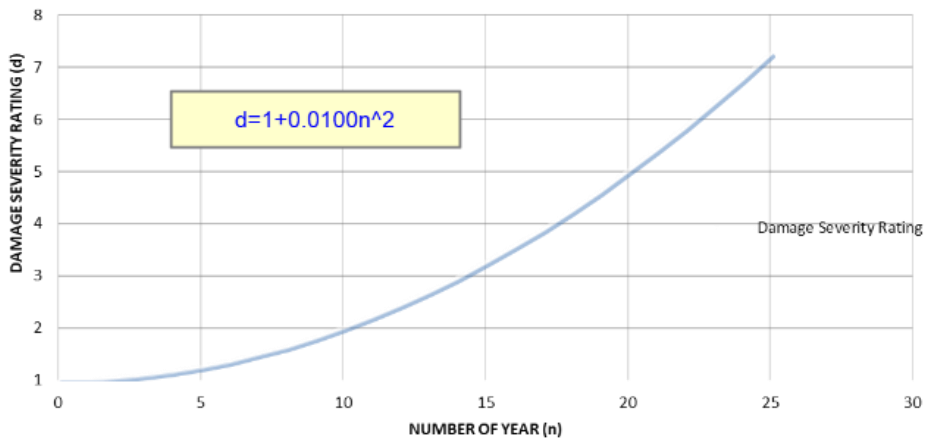


Figure 1.6 Deterioration prediction model being adopted for national and regional roads

i. **Detailed investigation module**

The Sub-Consultant shall develop an analytic interface to recommend for the detailed investigation by analyzing the historical damage detection in the same location. In the current version of E-SPM, only location is identified but any further analysis or measures are not recommended. The Sub-Consultant shall create a list with recommended detailed investigation based in the threshold of damages detected in the same location/area. The criteria for recommendation will be provided by the Project in due course. Also, upon double click of damage location point, the Sub-



Consultant shall develop a pop-up window to show details of damages including damage photos.

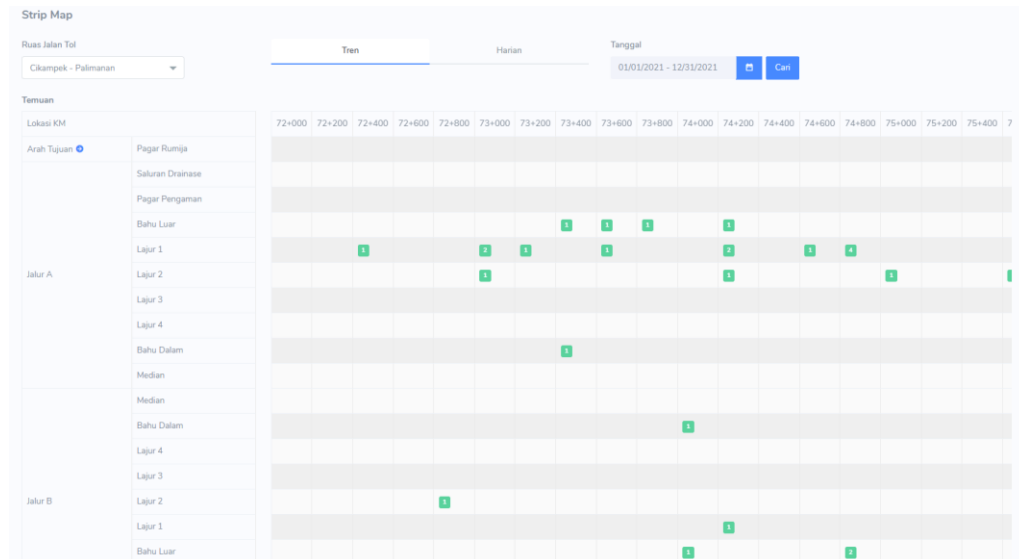


Figure 1.7 Damage detection and presented in the current version of E-SPM

j. Reporting module

The Sub-Consultant shall develop reporting tool to generate static (i.e., defined format) report and dynamic (i.e., user's selection). The format/template of static report will be provided by the Project in due course. The Sub-Consultant shall also develop analysis tool to generate the report in tabular, graphical, etc. format. Upon completion of this module, the SPM report submitted by each TRO currently in hard-copy shall be replaced by this system generated by the upgraded E-SPM.

k. Documentation module

The Sub-Consultant shall develop document module to store relevant documents such as user manual, road maintenance manual, norms and standards, and project related documents (As-built drawing, etc.) in PDF format.

4. Integration module (to integrate with other systems)

The Sub-Consultant shall develop integration tool to integrate E-SPM other system such as Bridge Management System, and IRMS (Indonesia Road Management System for National Roads). The Project will provide the details of the system and data to be integrated in due course. Therefore, the Sub-Consultant shall design and develop E-SPM considering relational database for possibility/needs of integration with other systems.

5. Prepare user manuals

The Sub-Consultant shall prepare system administration manual (for system updating and administration at back end) and user manuals (for ordinary users at front end). The user manual shall be user-friendly (i.e., simple and self-explanatory).

6. System trial run and testing

Upon completion of supplemented modules in E-SPM, the system shall put into trial operation. The Sub-Consultant shall closely monitor the trial operation, assist the user and take immediate action in the system revision if some critical system issues are observed/reported.

7. Conduct training

The Sub-Consultant shall support in conducting the training as per the training program to be developed by the Project. The training is basically conducted in Jakarta. Alternatively, considering the COVID-19 situation, the training may also conduct online as E-SPM will be fully web-based system. The Project may request the Sub-Consultant to make presentation in the Seminar/Workshop to be organized under the Project. The Sub-Consultant shall be responsible for the following but not limited:

- Prepare training materials related to E-SPM
- Provide speaker/trainer or any other assistants needed for the training including OJT

8. Revise incorporating feedbacks from the users

The Sub-Consultant shall work together with the Project to collect feedback from all level of E-SPM users in specified interval of trial period to be decided by the Project. The feedbacks shall carefully analyze, and all reasonable feedbacks shall discuss with the Project and all relevant feedbacks/comments shall incorporate in E-SPM as well as in relevant documents.

9. Handover CRMS and technical support

Upon successful completion of trial operation and testing, the Sub-Consultant shall handover the upgraded E-SPM together with all relevant documents such as upgraded database design, detailed design, and user manuals to ITRA. After handing over of upgraded E-SPM, the Sub-Consultant shall provide technical support to ITRA for one-year period starting from date of handing over of upgraded E-SPM. The technical support includes troubleshooting of any technical problem in the system, minor revision system if any of the functions or algorithms are not properly developed, etc.





Methodology

Chapter

02



2.1. E-SPM

E-SPM is an information system developed by ITRA with a client server base. The database and application server are ITRA's authority and full control rights, which are able to manage operation and maintenance activities on operating toll roads. Meanwhile, client applications accessed by TROs have limited control rights according to their designation. E-SPM currently also accommodates TRO holdings which can access SPM data on toll roads that are their subsidiaries (but only on web applications, not for mobile applications). Utilization of a mobile-based client application is used to collect data, such as: documentation, coordinates, real time information, etc. General overview of E-SPM architecture can be seen in the figure below:

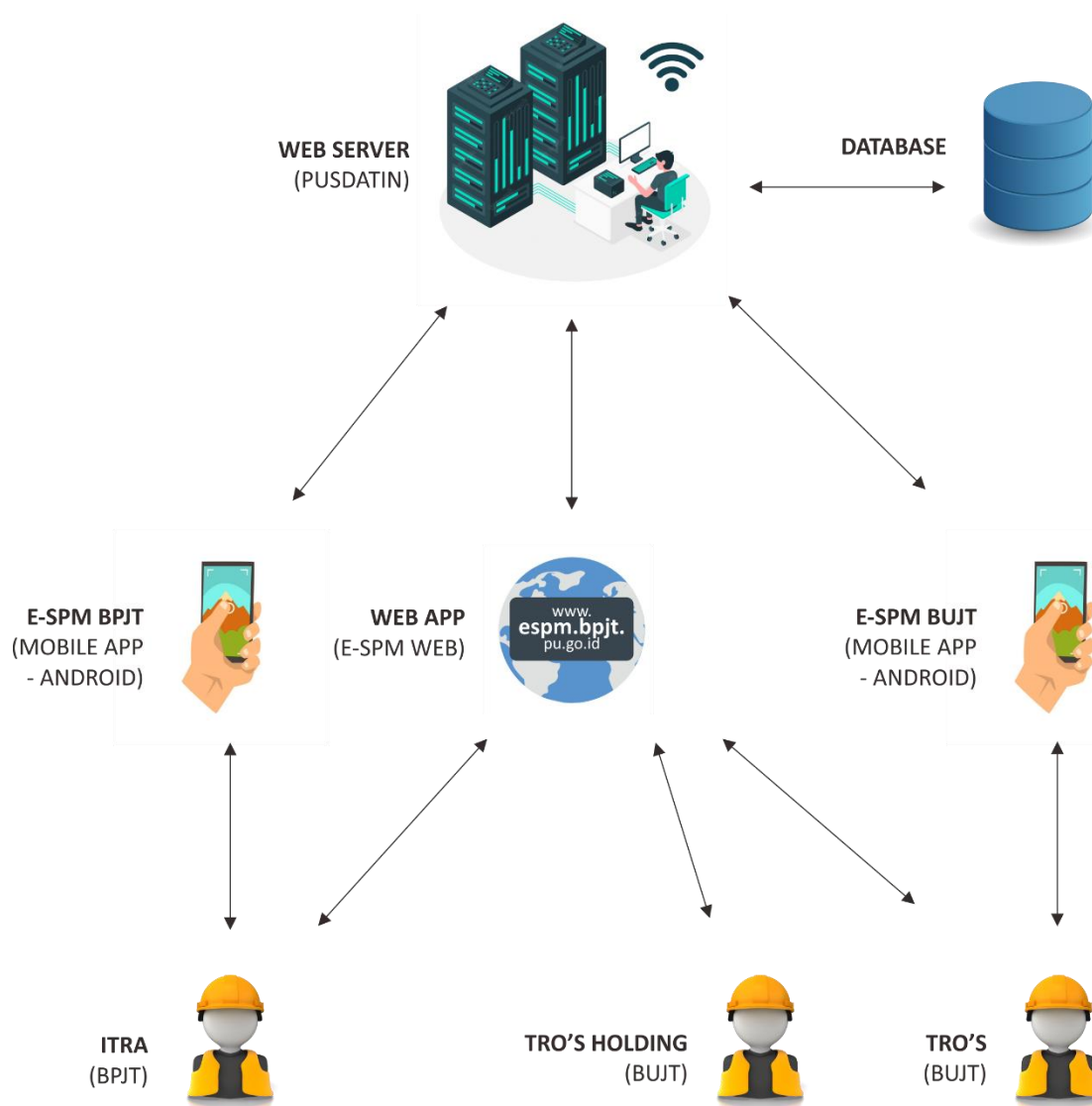


Figure 2.1 General overview of E-SPM architecture

The following is E-SPM technical information:

Table 2.1 E-SPM technical information

Items	Applied Information
Server	
Network	
• Server	PUSDATIN (Pusat Data dan Informasi in Bahasa)
• Server Name	espm.bjpt.pu.go.id
• IP Address	103.211.50.23
• Port Enable	22, 80, 443
Hardware	
• Processor	Intel(R) Xeon(R) CPU E7-8870 v2 @2.30GHz
• RAM	8 GB
• Storage	500 GB
Software	
• Operation System	Ubuntu Server 18.04 LTS
• Web Server	Apache 2 version 2.4.29
• PHP	PHP version 7.2
• Database Server	MySQL version 5.7
Web Application	
Framework	Laravel
CMS	October CMS
Server API	Google Cloud API
Mobile Application	
Framework	Flutter 2.5
Backend Services	Firebase, Playstore
Server API	Google Cloud API

2.2. Technical Approach

The technical approach used in the development of E-SPM, in stages:

1. Obtaining the functionality and architecture of E-SPM which is currently being applied;
2. Obtaining the technical requirements from ITRA through the JICA/PASCO Project Team as stated in the Term of Reference (TOR);
3. Analysis to accommodate ITRA requires. The analysis relates to the technical methods and current capabilities of E-SPM.



4. The results of the analysis are outlined in the design of information systems for additions, changes or adjustments to the database structure, application modules, or other required technical matters. The design will be prepared in "System Process Design", "Database Design" and "User Interface Design".
 - a. **System Process Design**
 - **Context Diagram**

Context diagram is a diagram that serves to map the environmental model which is represented by a single circle that represents the entire system. Context diagram is a diagram used to describe the relationship between the processes involved in the Information System.
 - **Use Case Diagram**

Use case is an activity or also a continuous interaction between actors (users) and Information Systems. Use case diagrams are used in the design of Information Systems in order to obtain an overview of the functionality expected by the system. The purposes for designing this diagram are:

 - Describe the behaviour of system to be developed;
 - Describe an interaction between one or more actors and the system to be developed;
 - Knowing the functions that exist in a system and who is authorized to use these functions. The emphasis in this diagram is "what" the system does, not "how";
 - Represents an interaction between actors (users or other systems) with the system;
 - Explain in simple terms the function of the system from the user's point of view.
 - b. **Database Design**

Database design is the process of determining the content and arrangement of the data needed to support various designs of Information Systems. This design is crucial in the development of an Information System, because it will directly affect the performance and sustainability of the system. System analysts must be able to translate user needs through data collection and analysis of activities that occur on the running system.
 - c. **User Interface Design**

User Interface (UI) is the visual elements of a product system including buttons, icons, images, text, screen designs, and other visual elements that bridge the application with the user. With the user interface, the user can interact with the application. Good interaction makes it easy for users to meet their needs and goals.
5. Development and upgrading of E-SPM in accordance with the scope of work and other technical requirements. Development work will be carried in separate environment (development server) and upgraded modules will integrate with existing E-SPM after

proper testing and verification. It's intended so that there should not be any interruption in the current E-SPM operation. The following technical information is used for E-SPM development:

Table 2.2 Technical information used for E-SPM development

Items	Applied Information
Server	
Network	
• Server	VM in Google Cloud Platform
• Server Name	espm.varianglobal.com
• IP Address	34.101.67.170
• Port Enable	80, 443
Hardware	
• Processor	2 Virtual Processor
• RAM	2 GB
• Storage	15 GB
Software	
• Operation System	Ubuntu Server 20.04.4 LTS
• Web Server	Apache 2.4
• PHP	PHP version 7.4
• Database Server	MySQL version 8
Web Application	
Framework	Laravel
CMS	October CMS
Server API	Google Cloud API
Mobile Application	
Framework	-
Backend Services	-
Server API	-

6. E-SPM trial process to determine application functionality, validation and reliability;
7. Implementation of e-SPM after the trial was carried out, including support the JICA/PASCO Project Team in the context of training and socialization to ITRA and TROs as users. The E-SPM user manual is submitted to the JICA/PASCO Project Team at this stage.



8. Operation and maintenance, including defect liability for application problems, corrections or additional requirements obtained during the E-SPM operation process. Specific application modules can also be integrated with related external systems as required.

Overview of the technical approach referred to above can be seen in the following figure:

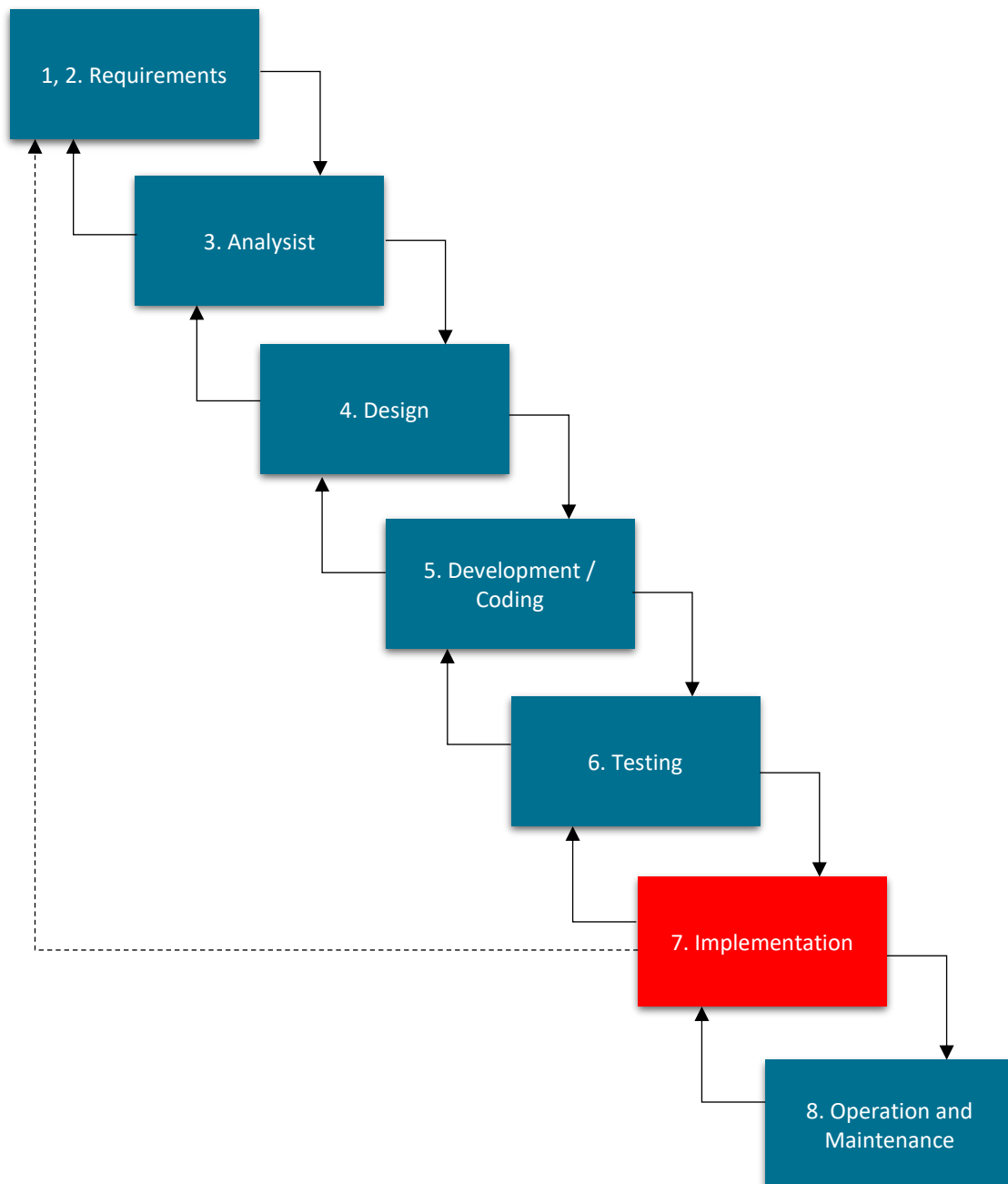


Figure 2.2 Technical approach for Information System development (waterfall scheme)

2.3. Methodology

The technical approach described above will be detailed in the form of a methodology to be understood in more detail.

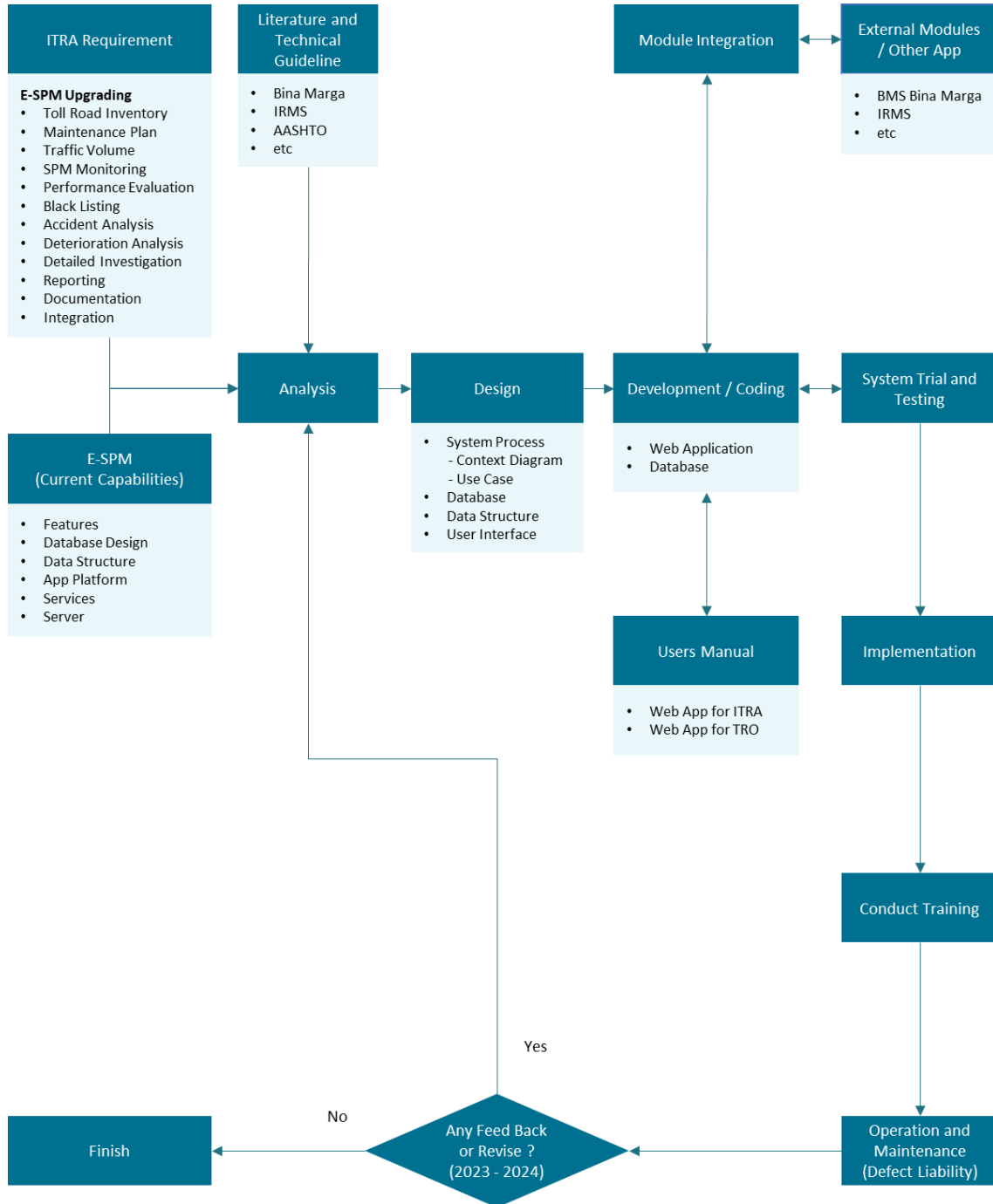


Figure 2.3 Detailed methodology





Data Inputting Module

Chapter

03



3.1. Inventory Data

Based on Term of Reference (TOR), inventory data is one of the targets of E-SPM upgrading in the form of data inputting. Investigation results of the existing data structure for the "Inventory Data" development plan can be seen in the following table:

Table 3.1 Investigation results of the existing data structure for the “Inventory Data” development plan (1/4)

SN	Data Items	Data Type	Description
1.	Toll Road ID	Integer	Already available in table “vgp_spm_highways”
2.	Toll Road Holding Name	String	Already available in table “vgp_spm_highways”, refers to table “vgp_spm_holdings”
3.	Toll Road Name	String	Already available in table “vgp_spm_highways”
4.	Year of Construction	Year	Field added in table “vgp_spm_highways”
5.	Toll Road Section Name	String	Refers to table “vgp_spm_highwaysegments”
6.	Chainage (From)	Decimal	Refers to table “vgp_spm_highwaysegments”
7.	Chainage (To)	Decimal	Refers to table “vgp_spm_highwaysegments”
8.	Number of Lane	Integer	Number of lanes determined by each segment (ramp to ramp), input details by adding fields in table “vgp_spm_highwaysegments”: Main Lane: mainroad_number_of_lane Start Ramp: Inbound: inbound_start_number_of_lane Outbound: outbound_start_number_of_lane End Ramp: Inbound: inbound_end_number_of_lane Outbound: outbound_end_number_of_lane
9.	ROW	Decimal	Right of Way (ROW) width determined by each segment (ramp to ramp) per-direction. Field added in table “vgp_spm_highwaysegments”
10.	Inbound Carriageway Width (Figure 3.1)	Decimal	Inbound Carriageway Width determined by each segment (ramp to ramp), input details by adding fields in table “vgp_spm_highwaysegments” refers to the Indonesian Highway Geometric Standard (2009):

Table 3.2 Investigation results of the existing data structure for the “Inventory Data” development plan (2/4)

SN	Data Items	Data Type	Description
10.	Inbound Carriageway Width (Figure 3.1)	Decimal	<p>Start Ramp: Outer Shoulder: inbound_start_os_width Main Lane: inbound_start_lane_width Inner Shoulder: inbound_start_is_width Motor Cycle: inbound_start_mc_width</p> <p>End Ramp: Outer Shoulder: inbound_end_os_width Main Lane: inbound_start_end_width Inner Shoulder: inbound_end_is_width Motor Cycle: inbound_end_mc_width</p>
11.	Outbound Carriageway Width (Figure 3.1)	Decimal	<p>Outbound Carriageway Width determined by each segment (ramp to ramp), input details by adding fields in table “vgp_spm_highwaysegments” refers to the Indonesian Highway Geometric Standard (2009):</p> <p>Start Ramp: Outer Shoulder: outbound_start_os_width Main Lane: outbound_start_lane_width Inner Shoulder: outbound_start_is_width Motor Cycle: outbound_start_mc_width</p> <p>End Ramp: Outer Shoulder: outbound_end_os_width Main Lane: outbound_end_lane_width Inner Shoulder: outbound_end_is_width Motor Cycle: outbound_end_mc_width</p>
12.	Inbound Pavement Type (Figure 3.1)	String	<p>Inbound Pavement Type determined by each segment (ramp to ramp), input details by adding fields in table “vgp_spm_highwaysegments”:</p> <p>Start Ramp: Outer Shoulder: inbound_start_os_pavement_type Main Lane: inbound_start_lane_pavement_type Inner Shoulder: inbound_start_is_pavement_type Motor Cycle: inbound_start_mc_pavement_type</p>



Table 3.3 Investigation results of the existing data structure for the “Inventory Data” development plan (3/4)

SN	Data Items	Data Type	Description
12.	Inbound Pavement Type (Figure 3.1)	String	End Ramp: Outer Shoulder: inbound_end_os_pavement_type Main Lane: inbound_end_lane_pavement_type Inner Shoulder: inbound_end_is_pavement_type Motor Cycle: inbound_end_mc_pavement_type
13.	Outbound Pavement Type (Figure 3.1)	String	Outbound Pavement Type determined by each segment (ramp to ramp), input details by adding fields in table “vgp_spm_highwaysegments”: Start Ramp: Outer Shoulder: outbound_start_os_pavement_type Main Lane: outbound_start_lane_pavement_type Inner Shoulder: outbound_start_is_pavement_type Motor Cycle: outbound_start_mc_pavement_type End Ramp: Outer Shoulder: outbound_end_os_pavement_type Main Lane: outbound_end_lane_pavement_type Inner Shoulder: outbound_end_is_pavement_type Motor Cycle: outbound_end_mc_pavement_type
14.	No. of Bridges	Integer	Detail table added, named “jica_spm_bridges”. This table refers to “vgp_spm_highways”
15.	No. of Toll Gates	Integer	Already available in table “vgp_spm_tollgates”, refers to table “vgp_spm_highways”
16.	No. of Service Area	Integer	Detail table added, named “jica_spm_restarea”. This table refers to “vgp_spm_highways”
17.	No. of Rescue Station	Integer	Detail table added, named “jica_spm_rescuestations”. This table refers to “vgp_spm_highways”
18.	Main Road Width	Decimal	Main Road Width determined by each segment (ramp to ramp), input details by adding fields in table “vgp_spm_highwaysegments” refers to the Indonesian Highway Geometric Standard (2009): Outer Shoulder: mainroad_os_width Main Lane: mainroad_lane_width Inner Shoulder: mainroad_is_width

Table 3.4 Investigation results of the existing data structure for the “Inventory Data” development plan (4/4)

SN	Data Items	Data Type	Description
18.	Main Road Width	Decimal	Motor Cycle: mainroad_mc_width
19.	Main Road Pavement Type	String	Main Road Pavement Type determined by each segment (ramp to ramp), input details by adding fields in table “vgp_spm_highwaysegments”: Outer Shoulder: mainroad_os_pavement_type Main Lane: mainroad_lane_pavement_type Inner Shoulder: mainroad_is_pavement_type Motor Cycle: mainroad_mc_pavement_type

Text: already available in the existing e-SPM database

Text: e-SPM database development

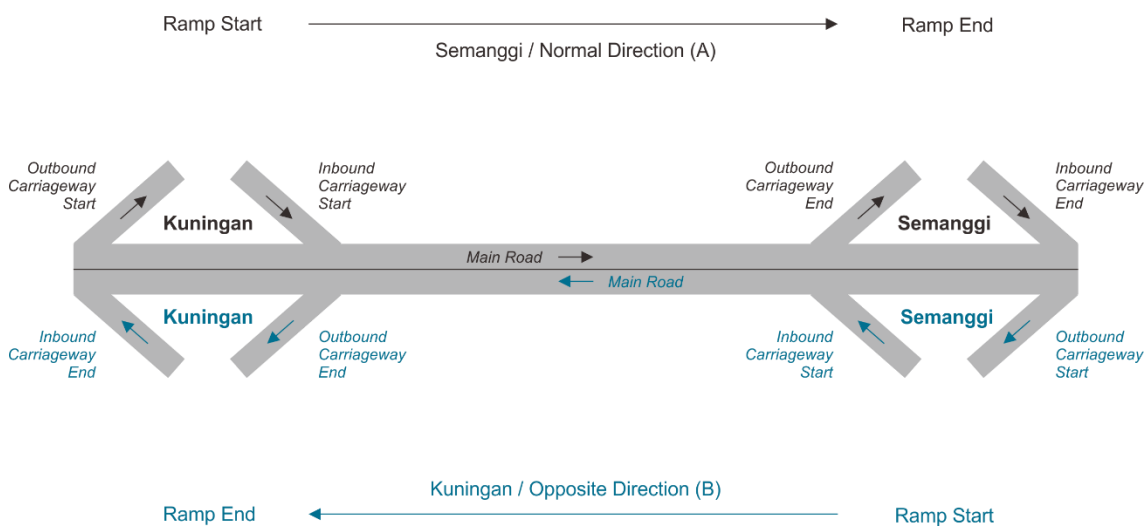


Figure 3.1 Explanation of "Inbound and Outbound Carriageway" by highway segment (ramp to ramp)



3.1.1. System Process Design

3.1.1.1. Context Diagram

The Context Diagram for "Inventory Data" can be seen in the image below:

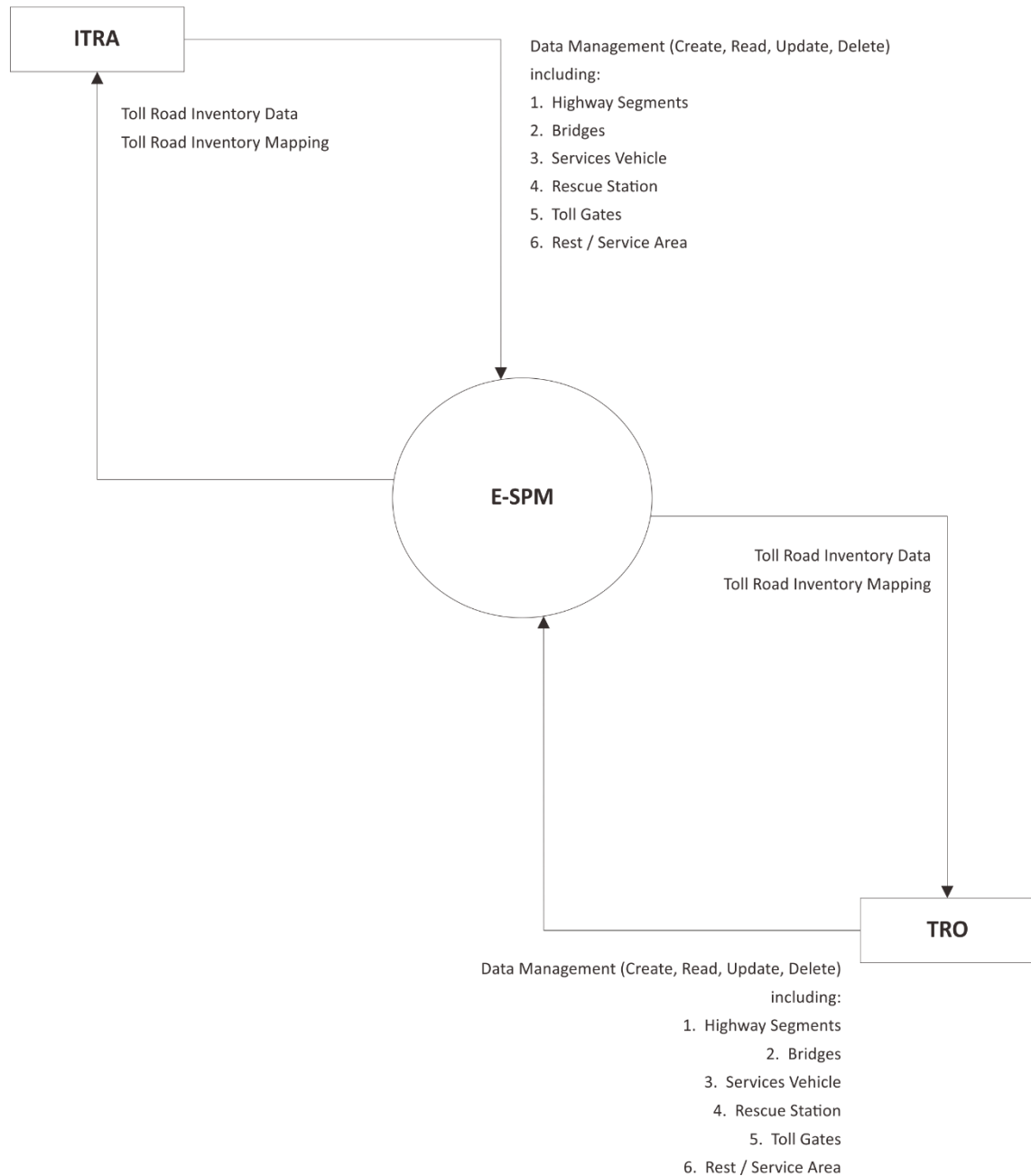


Figure 3.2 Context Diagram for "Inventory Data"

3.1.1.2. Use Case Diagram

The Use Case Diagram for "Inventory Data" can be seen in the image below:

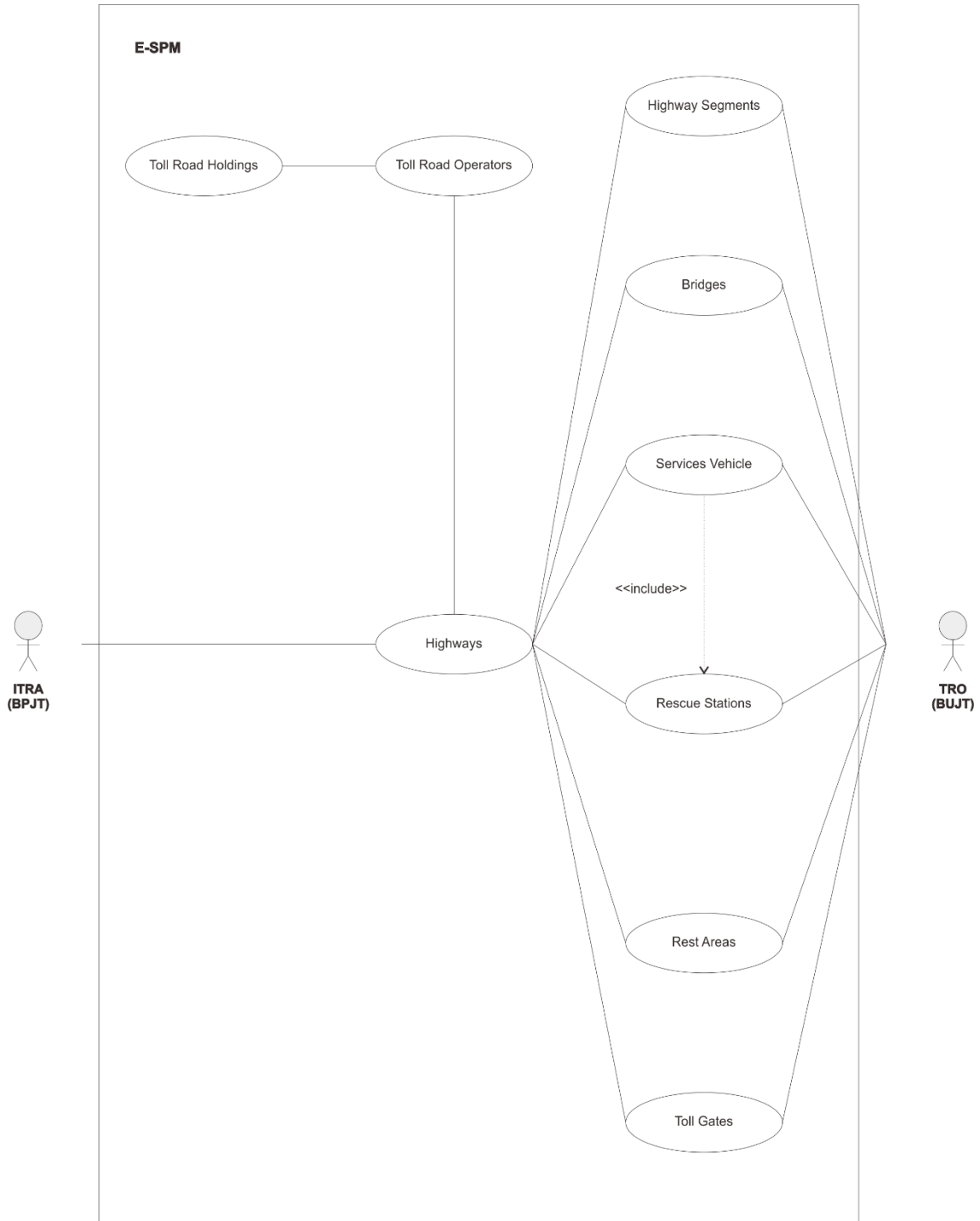


Figure 3.3 Use Case Diagram for "Inventory Data"



3.1.2. Database Design

Database Design for "Inventory Data" can be seen in the image below:

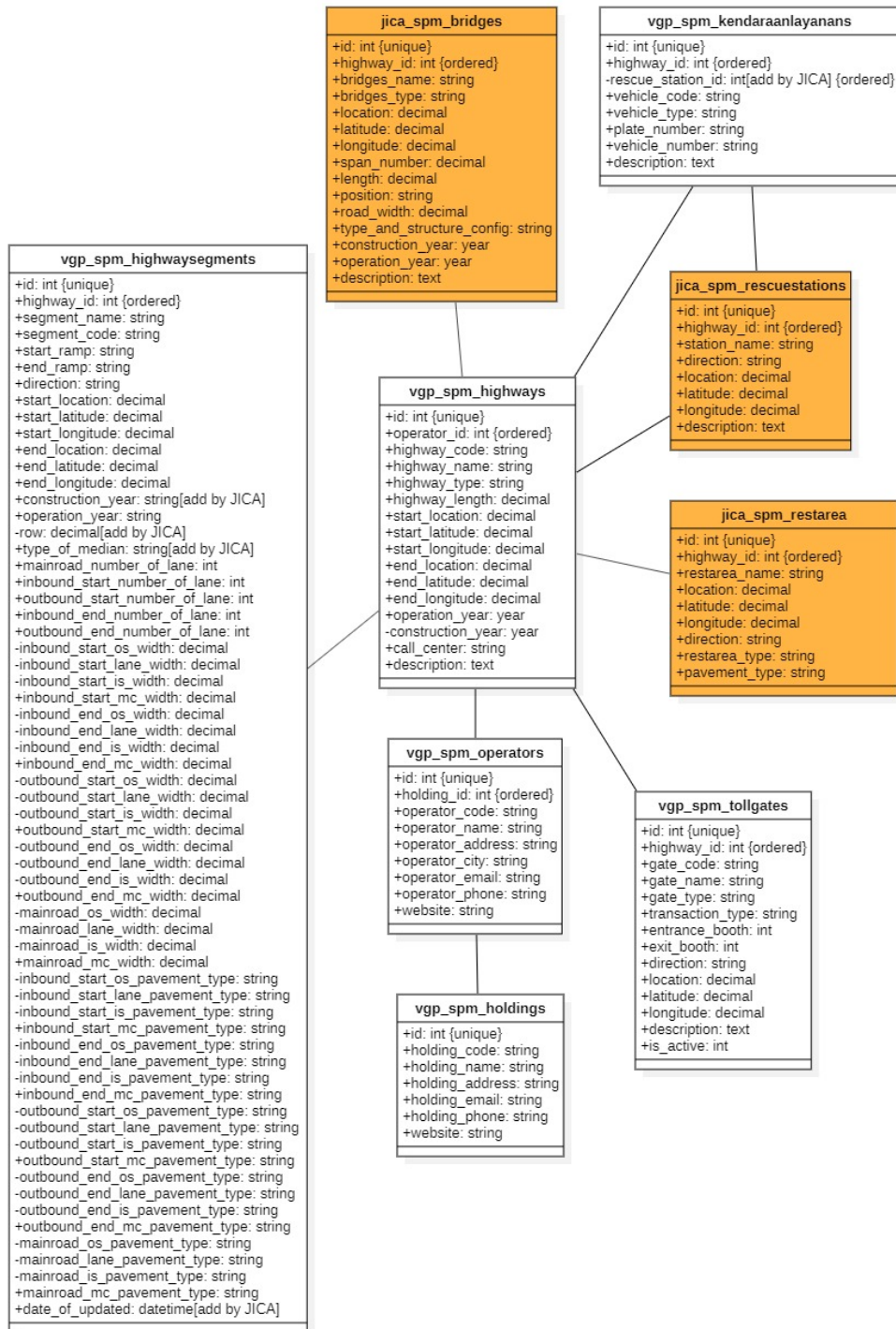


Figure 3.4 Database Design for "Inventory Data"

Based on the results of the meeting on September 16, 2022 at the JICA Project Office, it was agreed by BPJT that the data dictionary for database design for the Inventory Data module is as follows:

3.1.2.1. TROs Holding

Table Name : **vgp_spm_holdings**
 Table Relation : vgp_spm_operators
 Type of Table : Master
 Description : Holding company master data from TRO of each operating toll road
 Note : No changes in this table

Table 3.5 Data dictionary for “vgp_spm_holdings” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each TROs holding
2.		holding_code	Code	string	Specific code for holding, coded by ITRA
3.		holding_name	Name	string	Name of TROs holding
4.		holding_address	Address	string	Official Address of TROs holding
5.		holding_email	Email	string	Email of TROs holding
6.		holding_phone	Phone	string	Phone Number of TROs holding
7.		website	Website	string	Official Website of TROs holding

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.1.2.2. Toll Road Operator (TRO)

Table Name : **vgp_spm_operators**
 Table Relation : vgp_spm_holdings, vgp_spm_highways
 Type of Table : Master
 Description : TRO master of each operating toll road
 Note : No changes in this table



Table 3.6 Data dictionary for “vgp_spm_operators” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each TRO
2.	F	holding_id	Holding	integer	Refers to “vgp_spm_holdings” table
3.		operator_code	Code	string	Specific code for TRO, coded by ITRA
4.		operator_name	Name	string	Name of TRO
5.		operator_address	Address	string	Official Address of TRO
6.		operator_city	City	string	City of TRO (based on official address)
7.		operator_email	Email	string	Email of TRO
8.		operator_phone	Phone	string	Phone Number of TRO
9.		website	Website	string	Official Website of TRO

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.1.2.3. Highways

Table Name : **vgp_spm_highways**

Table Relation : vgp_spm_operators, vgp_spm_tollgates, jica_spm_rescuestations, vgp_spm_kendaraanlayanans, jica_spm_bridges, vgp_spm_highway_segments

Type of Table : Master

Description : Operation toll road master

Note : The "Construction Year" and "Operation Year" fields were moved to the "Highway Segment" table, considering the year of operation and year of construction which could be different for each segment.

Table 3.7 Data dictionary for “vgp_spm_highways” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each highway
2.	F	operator_id	Operator	integer	Refers to “vgp_spm_operators” table
3.		highway_code	Code	string	Specific code for highway, coded by ITRA
4.		highway_name	Name	string	Name of highway
5.		highway_type	Type	string	Type of highway (Inner City Highway or Intercity Highway)
6.		highway_length	Length (Km)	decimal	Length of highway

Table 3.8 Data dictionary for “vgp_spm_highways” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
7.		start_location	Start of Chainage	decimal	Chainage of start point of highway in KM.HM format
8.		start_latitude	Latitude	decimal	Latitude of start point of highway
9.		start_longitude	Longitude	decimal	Longitude of start point of highway
10.		end_location	End of Chainage	decimal	Chainage of end point of highway in KM.HM format
11.		end_latitude	Latitude	decimal	Latitude of end point of highway
12.		end_longitude	Longitude	decimal	Longitude of end point of highway
13.		call_center	Call Center	string	Number of call center
14.		description	Description	text	Description of highway

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.1.2.4. Toll Gates

Table Name : **vgp_spm_tollgates**

Table Relation : vgp_spm_highways

Type of Table : Master

Description : Toll gate master on each operating toll road

Note : No changes in this table

Table 3.9 Data dictionary for “vgp_spm_tollgates” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each toll gate
2.	F	highway_id	Highway	Integer	Refers to “vgp_spm_highways” table
3.		gate_code	Gate Code	string	Toll gate code, coded by TRO
4.		gate_name	Gate Name	string	Name of toll gate
5.		gate_type	Gate Type	string	Type of toll gate, based on location and function (Entrance Gate, Exit Gate, Main Gate (Entrance and Exit))
6.		transaction_type	Transaction Type	string	Transaction type of toll gate (Open System, Closed System, Integration System)



Table 3.10 Data dictionary for “vgp_spm_tollgates” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
7.		entrance_booth	Number of Entrance Booth	integer	Number of entrance booth
8.		exit_booth	Number of Exit Booth	integer	Number of exit booth
9.		direction	Direction	string	Type of direction (Normal Direction (A), Opposite Direction (B), Main Road (Both Direction))
10.		location	Chainage	decimal	Chainage of toll gate in KM.HM format
11.		latitude	Latitude	decimal	Latitude of toll gate
12.		longitude	Longitude	decimal	Longitude of toll gate
13.		description	Description	text	Description of toll gate

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.1.2.5. Rescue Stations

Table Name : **jica_spm_rescuestations**

Table Relation : vgp_spm_highways, vgp_spm_kendaraanlayanans

Type of Table : Master

Description : Rescue station master data of each operating toll road

Note : No changes in this table

Table 3.11 Data dictionary for “jica_spm_rescuestations” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each rescue station
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.		station_name	Station Name	string	Name of rescue station
4.		direction	Direction	string	Type of direction (Normal Direction (A) or Opposite Direction (B))
5.		location	Chainage	decimal	Chainage of rescue station in KM.HM format
6.		latitude	Latitude	decimal	Latitude of rescue station

Table 3.12 Data dictionary for “jica_spm_rescuestations” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
7.		longitude	Longitude	decimal	Longitude of rescue station
8.		description	Description	text	Description of rescue station

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.1.2.6. Services Vehicle

Table Name : **vgp_spm_kendaraanlayanans**

Table Relation : vgp_spm_highways, jica_spm_rescuestations

Type of Table : Master

Description : Services vehicle master data of each operating toll road

Note : No changes in this table

Table 3.13 Data dictionary for “vgp_spm_kendaraanlayanans” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	Id	ID	integer	ID assigned for each service vehicle
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.	F	rescue_station_id	Station	integer	Refers to “jica_spm_rescuestations” table
4.		vehicle_code	Vehicle Code	string	Vehicle code, usually coded by TRO
5.		vehicle_type	Vehicle Type	string	Type of vehicle (Ambulance, Tow Truck, Highway Police, Highway Patrol, or Rescue Car)
6.		plate_number	Plate Number	string	Vehicle Registration Plate
7.		vehicle_number	Vehicle Number	string	Vehicle number, usually numbered by TRO
8.		description	Description	text	Description of service vehicle

Text: already available in the existing e-SPM database

Text: e-SPM database development



3.1.2.7. Bridges

Table Name : **jica_spm_bridges**
 Table Relation : vgp_spm_highways
 Type of Table : Master
 Description : Bridge master data of each operating toll road
 Note : No changes in this table

Table 3.14 Data dictionary for “jica_spm_bridges” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each bridge
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.		bridge_name	Bridge Name	string	Name of bridge
4.		location	Chainage	decimal	Chainage of bridge in KM.HM format
5.		latitude	Latitude	decimal	Latitude of bridge
6.		longitude	Longitude	decimal	Longitude of bridge
7.		bridge_type	Bridge Type	string	Type of bridge (Under Bridge, Overpass, Underpass, Pedestrian Bridge, Other)
8.		position	Bridge Position	string	Position of bridge (Main Road, Interchange, On/Off Ramp, Access)
9.		road_width	Road Width	decimal	Road width effective (meters)
10.		length	Bridge Length (m)	decimal	Total length of the bridge, either parallel or cross (meters)
11.		span_number	Number of Span	integer	Number of span, for example: "PCI (16+30+30+16)" number of span = 4
12.		type_and_structure_config	Type and Structure Configuration	string	Type and span length (meters), for example: "PCI (16+30+30+16)" 4 PCI Girders with length of span 16m+30m+30m+16m
13.		construction_year	Construction Year	year	Year of bridge construction
14.		operation_year	Operation Year	year	Year of bridge operation
15.		description	Description	text	Description of bridge

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.1.2.8. Highway Segments

Table Name : **vgp_spm_highwaysegments**

Table Relation : vgp_spm_highways

Type of Table : Master

Description : Highway segment master data of each operating toll road

Note : Added "construction year" and "operation year" fields from the "Highway" table, considering the year of operation and year of construction which could be different for each segment.

Table 3.15 Data dictionary for “vgp_spm_highwaysegments” table (1/6)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	Id	ID	integer	ID assigned for each highway segment (ramp to ramp)
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.		segment_code	Segment Code	string	Specific code by TRO
4.		segment_name	Segment Name	string	Name of segment (ramp to ramp), “[Name of start ramp] - [Name of end ramp]” format as default
5.		start_ramp	Name of Start Ramp	string	Name of start ramp
6.		end_ramp	Name of End Ramp	string	Name of end ramp
7.		direction	Direction	string	Type of direction (Normal Direction (A) or Opposite Direction (B))
8.		start_location	Chainage of Start Ramp	decimal	Chainage of start point of ramp/segment in KM.HM format
9.		start_latitude	Latitude	decimal	Latitude of start point of ramp/segment
10.		start_longitude	Longitude	decimal	Longitude of start point of ramp/segment
11.		end_location	Chainage of End Ramp	decimal	Chainage of end point of ramp/segment in KM.HM format
12.		end_latitude	Latitude	decimal	Latitude of end point of ramp/segment
13.		end_longitude	Longitude	decimal	Longitude of end point of ramp/segment
14.		construction_year	Construction Year	year	Start construction year



Table 3.16 Data dictionary for “vgp_spm_highwaysegments” table (2/6)

SN	P/F	Data Items	Caption	Data Type	Definition
15.		operation_year	Operation Year	year	Construction completion/traffic opening year
16.		row	Right of Way Width	decimal	Width of Right of Way (meters)
17.		type_of_median	Type of Median	string	Median type by material/structure (Open Median (Land), Concrete Barrier, Wire Rope, Fence, or Other)
18.		mainroad_number_of_lane	Number of Lanes on Main Road	integer	Number of lanes on main road
19.		inbound_start_number_of_lane	Number of Lane on Inbound Carriageway (Start Ramp)	integer	Number of lanes on inbound direction (start ramp)
20.		outbound_start_number_of_lane	Number of Lane on Outbound Carriageway (Start Ramp)	integer	Number of lanes on outbound direction (start ramp)
21.		inbound_end_number_of_lane	Lane on Inbound Carriageway (End Ramp)	integer	Number of lanes in inbound direction (end ramp)
22.		outbound_end_number_of_lane	Number of Lane on Outbound Carriageway (End Ramp)	integer	Number of lanes in outbound direction (end ramp)
23.		inbound_start_os_width	Outer Shoulder Width (m) on Inbound Carriageway (Start Ramp)	decimal	Outer Shoulder width (meters) in inbound direction (start ramp)
24.		inbound_start_lane_width	Main Lane Width (m) on Inbound Carriageway (Start Ramp)	decimal	Main Lane width (meters) in inbound direction (start ramp)
25.		inbound_start_is_width	Inner Shoulder Width (m) on Inbound Carriageway (Start Ramp)	decimal	Inner Shoulder width (meters) in inbound direction (start ramp)
26.		inbound_start_mc_width	Motor Cycle Lane Width (m) on Inbound Carriageway (Start Ramp)	decimal	Motor Cycle lane width (meters) in inbound direction (start ramp)
27.		inbound_end_os_width	Outer Shoulder Width (m) on Inbound Carriageway (End Ramp)	decimal	Outer Shoulder width (meters) in inbound direction (end ramp)

Table 3.17 Data dictionary for “vgp_spm_highwaysegments” table (3/6)

SN	P/F	Data Items	Caption	Data Type	Definition
28.		inbound_end_lane_width	Main Lane Width (m) on Inbound Carriageway (End Ramp)	decimal	Main Lane width (meters) in inbound direction (end ramp)
29.		inbound_end_is_width	Inner Shoulder Width (m) on Inbound Carriageway (End Ramp)	decimal	Inner Shoulder width (meters) in inbound direction (end ramp)
30.		inbound_end_mc_width	Motor Cycle Lane Width (m) on Inbound Carriageway (End Ramp)	decimal	Motor Cycle lane width (meters) in inbound direction (end ramp)
31.		outbound_start_os_width	Outer Shoulder Width (m) on Outbound Carriageway (Start Ramp)	decimal	Outer Shoulder width (meters) in outbound direction (start ramp)
32.		outbound_start_lane_width	Main Lane Width (m) on Outbound Carriageway (Start Ramp)	decimal	Main Lane width (meters) in outbound direction (start ramp)
33.		outbound_start_is_width	Inner Shoulder Width (m) on Outbound Carriageway (Start Ramp)	decimal	Inner Shoulder width (meters) in outbound direction (start ramp)
34.		outbound_start_mc_width	Motor Cycle Lane Width (m) on Outbound Carriageway (Start Ramp)	decimal	Motor Cycle lane (meters) width in outbound direction (start ramp)
35.		outbound_end_os_width	Outer Shoulder Width (m) on Outbound Carriageway (End Ramp)	decimal	Outer Shoulder width (meters) in outbound direction (end ramp)
36.		outbound_end_lane_width	Main Lane Width (m) on Outbound Carriageway (End Ramp)	decimal	Main Lane width (meters) in outbound direction (end ramp)
37.		outbound_end_is_width	Inner Shoulder Width (m) on Outbound Carriageway (End Ramp)	decimal	Inner Shoulder width (meters) in outbound direction (end ramp)
38.		outbound_end_mc_width	Motor Cycle Lane Width (m) on Outbound Carriageway (End Ramp)	decimal	Motor Cycle lane width (meters) in outbound direction (end ramp)
39.		mainroad_os_width	Outer Shoulder Width (m) on Main Road	decimal	Outer Shoulder width (meters) in main road
40.		mainroad_lane_width	Main Lane Width (m) on Main Road	decimal	Main Lane width (meters) in main road



Table 3.18 Data dictionary for “vgp_spm_highwaysegments” table (4/6)

SN	P/F	Data Items	Caption	Data Type	Definition
41.		mainroad_ is_width	Inner Shoulder Width (m) on Main Road	decimal	Inner Shoulder (meters) width in main road
42.		mainroad_ mc_width	Motor Cycle Lane Width (m) on Main Road	decimal	Motor Cycle lane width (meters) in main road
43.		inbound_start_ os_pavement_ type	Pavement Type of Outer Shoulder on Inbound Carriageway (Start Ramp)	string	Outer Shoulder pavement type in inbound direction (start ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
44.		inbound_start_ lane_pavement_ type	Pavement Type of Main Lane on Inbound Carriageway (Start Ramp)	string	Main Lane pavement type in inbound direction (start ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
45.		inbound_start_ is_pavement_ type	Pavement Type of Inner Shoulder on Inbound Carriageway (Start Ramp)	string	Inner Shoulder pavement type in inbound direction (start ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
46.		inbound_start_ mc_pavement_ type	Pavement Type of Motor Cycle Lane on Inbound Carriageway (Start Ramp)	string	Motor Cycle lane pavement type in inbound direction (start ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
47.		inbound_end_ os_pavement_ type	Pavement Type of Outer Shoulder on Inbound Carriageway (End Ramp)	string	Outer Shoulder pavement type in inbound direction (end ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
48.		inbound_end_ lane_pavement_ type	Pavement Type of Main Lane on Inbound Carriageway (End Ramp)	string	Main Lane pavement type in inbound direction (end ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement

Table 3.19 Data dictionary for “vgp_spm_highwaysegments” table (5/6)

SN	P/F	Data Items	Caption	Data Type	Definition
49.		inbound_end_ is_pavement_ type	Pavement Type of Inner Shoulder on Inbound Carriageway (End Ramp)	string	Inner Shoulder pavement type in inbound direction (end ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
50.		inbound_end_ mc_pavement_ type	Pavement Type of Motor Cycle Lane on Inbound Carriageway (End Ramp)	string	Motor Cycle lane pavement type in inbound direction (end ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
51.		outbound_start_ os_pavement_ type	Pavement Type of Outer Shoulder on Outbound Carriageway (Start Ramp)	string	Outer Shoulder pavement type in outbound direction (start ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
52.		outbound_start_ lane_pavement_ type	Pavement Type of Main Lane on Outbound Carriageway (Start Ramp)	string	Main Lane pavement type in outbound direction (start ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
53.		outbound_start_ is_pavement_ type	Pavement Type of Inner Shoulder on Outbound Carriageway (Start Ramp)	string	Inner Shoulder pavement type in outbound direction (start ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
54.		outbound_start_ mc_pavement_ type	Pavement Type of Motor Cycle Lane on Outbound Carriageway (Start Ramp)	string	Motor Cycle lane pavement type in outbound direction (start ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
55.		outbound_end_ os_pavement_ type	Pavement Type of Outer Shoulder on Outbound Carriageway (End Ramp)	string	Outer Shoulder pavement type in outbound direction (end ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement



Table 3.20 Data dictionary for “vgp_spm_highwaysegments” table (6/6)

SN	P/F	Data Items	Caption	Data Type	Definition
56.		outbound_end_lane_pavement_type	Pavement Type of Main Lane on Outbound Carriageway (End Ramp)	string	Main Lane pavement type in outbound direction (end ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
57.		outbound_end_is_pavement_type	Pavement Type of Inner Shoulder on Outbound Carriageway (End Ramp)	string	Inner Shoulder pavement type in outbound direction (end ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
58.		outbound_end_mc_pavement_type	Pavement Type of Motor Cycle Lane on Outbound Carriageway (End Ramp)	string	Motor Cycle lane pavement type in outbound direction (end ramp): Rigid Pavement, Flexible Pavement, or Composite Pavement
59.		mainroad_os_pavement_type	Pavement Type of Outer Shoulder on Main Road	string	Outer Shoulder pavement type in main road (Rigid Pavement, Flexible Pavement, or Composite Pavement)
60.		mainroad_lane_pavement_type	Pavement Type of Main Lane on Main Road	string	Main Lane pavement type in main road (Rigid Pavement, Flexible Pavement, or Composite Pavement)
61.		mainroad_is_pavement_type	Pavement Type of Inner Shoulder on Main Road	string	Inner Shoulder pavement type in main road (Rigid Pavement, Flexible Pavement, or Composite Pavement)
62.		mainroad_mc_pavement_type	Pavement Type of Motor Cycle Lane on Main Road	string	Motor Cycle lane pavement type in main road (Rigid Pavement, Flexible Pavement, or Composite Pavement)

Text: already available in the existing e-SPM database

Text: e-SPM database development

Text: new update

3.1.2.9. Rest Area

Table Name : **jica_spm_restarea**

Table Relation : vgp_spm_highways, jica_spm_maintenance_restarea

Type of Table : Master

Description : Services/rest area master data of each operating toll road
Note : New table, previously forgot to accommodate

Table 3.21 Data dictionary for “jica_spm_restarea” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	Id	ID	integer	ID assigned for each Rest Area
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.		restarea_name	Rest Area Name	string	Name of service/rest area, “[Type of Rest Area] [Chainage of Rest Area (Kilometer)] [Direction : “A” for normal direction, “B” for opposite direction]” format as default
4.		location	Chainage of Rest Area	decimal	Chainage of Rest Area in KM.HM format
5.		latitude	Latitude	decimal	Latitude of Rest Area
6.		longitude	Longitude	decimal	Longitude of Rest Area
7.		direction	Direction	string	Type of direction (Normal Direction (A) or Opposite Direction (B))
8.		restarea_type	Type of Rest Area	string	Type of Rest Area based on Indonesian Regulation, TI (Tempat Istirahat in Bahasa) or TIP (Tempat Istirahat dan Pelayanan in Bahasa)
9.		pavement_type	Pavement Type	string	Pavement type in Rest Area: Rigid Pavement, Flexible Pavement, or Composite Pavement

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.1.3. User Interface Design

User Interface (UI) Design for "Inventory Data" can be seen in **Figure 3.5** to **Figure 3.16**:



PT JASA MARGA (PERSERO) TBK

NGAWI - KERTOSONO

Construction on 2001

580.000 - 672.000

2 Lane

Segment Bridge Tollgates Rescue Station Service Area

CARUBAN - NGANJUK JNK-005

580.000 - 672.000

Normal Direction (A)

ROW : 45.00 m

Number of Lane

Main road	2			
Inbound start	2	Inbound end	2	
Outbound start	2	Outbound end	2	

Inbound Carriage Width

Outer Shoulder Start	35.00 m	Outer Shoulder End	35.00 m
Lane Start	35.00 m	Lane End	35.00 m
Inner Shoulder Start	35.00 m	Inner Shoulder End	35.00 m
Motorcycle Lane Start	35.00 m	Motorcycle Lane End	35.00 m

Outbound Carriage Width

Outer Shoulder Start	35.00 m	Outer Shoulder End	35.00 m
Lane Start	35.00 m	Lane End	35.00 m
Inner Shoulder Start	35.00 m	Inner Shoulder End	35.00 m
Motorcycle Lane Start	35.00 m	Motorcycle Lane End	35.00 m

Mainroad Carriage Width

Outer Shoulder	35.00 m
Lane	35.00 m
Inner Shoulder	35.00 m
Motorcycle Lane	35.00 m

Inbound Pavement Type

Outer Shoulder Start	Rigid	Outer Shoulder End	Rigid
Lane Start	Rigid	Lane End	Rigid
Inner Shoulder Start	Rigid	Inner Shoulder End	Rigid
Motorcycle Lane Start	Rigid	Motorcycle Lane End	Rigid

Outbound Pavement Type

Outer Shoulder Start	Rigid	Outer Shoulder End	Rigid
Lane Start	Rigid	Lane End	Rigid
Inner Shoulder Start	Rigid	Inner Shoulder End	Rigid
Motorcycle Lane Start	Rigid	Motorcycle Lane End	Rigid

Mainroad Pavement Type

Outer Shoulder	Rigid
Lane	Rigid
Inner Shoulder	Rigid
Motorcycle Lane	Rigid

NGANJUK - CARUBAN JNK-005

580.000 - 672.000

Normal Direction (A)

ROW : 45.00 m

Number of Lane

Main road	2			
Inbound start	2	Inbound end	2	
Outbound start	2	Outbound end	2	

Inbound Carriage Width

Outer Shoulder Start	35.00 m	Outer Shoulder End	35.00 m
Lane Start	35.00 m	Lane End	35.00 m
Inner Shoulder Start	35.00 m	Inner Shoulder End	35.00 m
Motorcycle Lane Start	35.00 m	Motorcycle Lane End	35.00 m

Outbound Carriage Width

Outer Shoulder Start	35.00 m	Outer Shoulder End	35.00 m
Lane Start	35.00 m	Lane End	35.00 m
Inner Shoulder Start	35.00 m	Inner Shoulder End	35.00 m
Motorcycle Lane Start	35.00 m	Motorcycle Lane End	35.00 m

Mainroad Carriage Width

Outer Shoulder	35.00 m
Lane	35.00 m
Inner Shoulder	35.00 m
Motorcycle Lane	35.00 m

Inbound Pavement Type

Outer Shoulder Start	Rigid	Outer Shoulder End	Rigid
Lane Start	Rigid	Lane End	Rigid
Inner Shoulder Start	Rigid	Inner Shoulder End	Rigid
Motorcycle Lane Start	Rigid	Motorcycle Lane End	Rigid

Outbound Pavement Type

Outer Shoulder Start	Rigid	Outer Shoulder End	Rigid
Lane Start	Rigid	Lane End	Rigid
Inner Shoulder Start	Rigid	Inner Shoulder End	Rigid
Motorcycle Lane Start	Rigid	Motorcycle Lane End	Rigid

Mainroad Pavement Type

Outer Shoulder	Rigid
Lane	Rigid
Inner Shoulder	Rigid
Motorcycle Lane	Rigid

Figure 3.5 User Interface Design for "Highways" information

Add Holdings X

Holding Logo

Upload a file or drag and drop
png, jpg or gif up to 3mb

Holding Code

Holding Name

Holding Address

Holding Email

Holding Phone


Website

Figure 3.6 User Interface Design for “TROs Holding” data inputting



Add Operator X

Operator Logo



Upload a file or drag and drop
png, jpg or gif up to 3mb

Holding Id

PT Jasa Marga (Persero) Tbk▼

Operator Code **Operator Name**

OPRT-004

PT Jasa Marga (Persero)

Operator Address

Plaza Tol Ciililitan Jalan Ciililitan Besar Jakarta 13510

Operator City **Website**

Jakarta

www.jasamarga.com

Operator Email **Operator Phone**

ctc@jasamarga.co.id

+622180887227

Close Save

Figure 3.7 User Interface Design for “Toll Road Operator (TRO)” data inputting

Add Highway ✕

Image

Operator Id

Jasa Marga Ngawi - Kertosono ▾

Highway Code	Highway Name
JM001	Jakarta - Cikampek
Highway Type	Highway Length
Inner City ▾	76
Start Location	End Location
9.000	11.000
Start Latitude	End Latitude
0.00000000	0.00000000
Start Longitude	End Longitude (Input Biasa)
0.00000000	0.00000000
Call Center	
138593	
Description	
Type a description of Toll Road...	

Close Save

Figure 3.8 User Interface Design for “Highways” data inputting



Add Toll Gates ✕

Image

Upload a file or drag and drop
png, jpg or gif up to 3mb

Active

Highway

Cimanggis - Cibitung ▾

Gate Name

Airmadidi

Gate Code GATE-AIRMADIDI **Gate Type** Entrance Gate ▾

Transaction Type

Closed Transaction ▾

Entrance Booth 3 **Exit Booth** 3

Direction

Normal Direction (A) ▾

Location 0.000 **Latitude** 0.000000 **Longitude** 0.000000

Description

Type a description of Toll Road...

Close Save

Figure 3.9 User Interface Design for “Toll Gates” data inputting

Add Rescue Stations ×

Highway
Cimanggis - Cibitung ▾

Station Name
Pool 1

Direction
Normal Direction (A) ▾

Location	Latitude	Longitude
0.000	0.000000	0.000000

Description
Type a description of Toll Road...

Close Save

Figure 3.10 User Interface Design for “Rescue Stations” data inputting



Add Kendaraan Layanans ✕

Image

Upload a file or drag and drop
png, jpg or gif up to 3mb

Highway

Cimanggis - Cibitung ▼

Rescue Station

Pool 1 ▼

Vehicle Code	Vehicle Type
CC003	Ambulance ▼
Plate Number	Vehicle Number
B 1534 ZZ	003

Description

Type a description of Toll Road...

Close Save

Figure 3.11 User Interface Design for “Services Vehicle” data inputting

Add Bridges ✕

Image

Upload a file or drag and drop
png, jpg or gif up to 3mb

Highway

Cimanggis - Cibitung ▼

Bridges Name

Kalikuto

Bridges Type

Overpass ▼

Location **Latitude** **Longitude**

0.000 0.000000 0.000000

Position **Road Width**

50 ▼ 80 meter

Length **Span Number**

80 meter 80 meter

Type and Structure Config

Construction Year **Operation Year**

80 meter 80 meter

Description

Type a description of Toll Road...

Close Save

Figure 3.12 User Interface Design for “Bridges” data inputting



Add Highway Segments
✕

Highway

Cimanggis - Cibitung
▼

Segment Name

On Ramp Jatikarya - Cimanggis...
▼

Segment Code

Cimacibi-001
▼

Name Of Start Ramp

On Ramp Jatikarya
▼

Name Of End Ramp

Cimanggis Junction
▼

Direction

Opposite Direction (B)
▼

Start Location/Change

7.200
▼

Latitude

0.00000000
▼

Longitude

0.00000000
▼

End Location/Change

8.400
▼

Latitude

0.00000000
▼

Longitude

0.00000000
▼

Construction Year

2019
▼

Operation Year

2019
▼

Row Width (Meters)

25.00
▼

Type Of Median

Median Concrete Barrier
▼

Number Of Lanes

Main Road

Median
▼

Inbound Carriageway (Start Ramp)

▼

Inbound Carriageway (End Ramp)

▼

Outbound Carriageway (Start Ramp)

▼

Outbound Carriageway (End Ramp)

▼

Figure 3.13 User Interface Design for “Highway Segments” data inputting (1/3)

Lane Width (Meters)

Outer Shoulder on Inbound Carriageway (Start Ramp)	Outer Shoulder on Inbound Carriageway (End Ramp)
<input type="text"/>	<input type="text"/>
Main Lane on Inbound Carriageway (Start Ramp)	Main Lane on Inbound Carriageway (End Ramp)
<input type="text"/>	<input type="text"/>
Inner Shoulder on Inbound Carriageway (Start Ramp)	Inner Shoulder on Inbound Carriageway (End Ramp)
<input type="text"/>	<input type="text"/>
Motor Cycle Lane on Inbound Carriageway (Start Ramp)	Motor Cycle Lane on Inbound Carriageway (End Ramp)
<input type="text"/>	<input type="text"/>
Outer Shoulder on Outbound Carriageway (Start Ramp)	Outer Shoulder on Outbound Carriageway (End Ramp)
<input type="text"/>	<input type="text"/>
Main Lane on Outbound Carriageway (Start Ramp)	Main Lane on Outbound Carriageway (End Ramp)
<input type="text"/>	<input type="text"/>
Inner Shoulder on Outbound Carriageway (Start Ramp)	Inner Shoulder on Outbound Carriageway (End Ramp)
<input type="text"/>	<input type="text"/>
Motor Cycle Lane on Outbound Carriageway (Start Ramp)	Motor Cycle Lane on Outbound Carriageway (End Ramp)
<input type="text"/>	<input type="text"/>
Outer Shoulder on Main Road	
<input type="text"/>	
Main Lane on Main Road	
<input type="text" value="3.25"/>	
Inner Shoulder on Main Road	
<input type="text"/>	
Motor Cycle on Main Road	
<input type="text"/>	

Figure 3.14 User Interface Design for “Highway Segments” data inputting (2/3)



Pavement Type

Outer Shoulder on Inbound Carriageway (Start Ramp)	Outer Shoulder on Inbound Carriageway (End Ramp)
<input type="text" value="Perkerasan Kaku (Rigid)"/>	<input type="text" value="Perkerasan Kaku (Rigid)"/>
Main Lane on Inbound Carriageway (Start Ramp)	Main Lane on Inbound Carriageway (End Ramp)
<input type="text" value="Perkerasan Kaku (Rigid)"/>	<input type="text" value="Perkerasan Kaku (Rigid)"/>
Inner Shoulder on Inbound Carriageway (Start Ramp)	Inner Shoulder on Inbound Carriageway (End Ramp)
<input type="text" value="Perkerasan Kaku (Rigid)"/>	<input type="text" value="Perkerasan Kaku (Rigid)"/>
Motor Cycle Lane on Inbound Carriageway (Start Ramp)	Motor Cycle Lane on Inbound Carriageway (End Ramp)
<input type="text"/>	<input type="text"/>
Outer Shoulder on Outbound Carriageway (Start Ramp)	Outer Shoulder on Outbound Carriageway (End Ramp)
<input type="text" value="Perkerasan Kaku (Rigid)"/>	<input type="text" value="Perkerasan Kaku (Rigid)"/>
Main Lane on Outbound Carriageway (Start Ramp)	Main Lane on Outbound Carriageway (End Ramp)
<input type="text" value="Perkerasan Kaku (Rigid)"/>	<input type="text" value="Perkerasan Kaku (Rigid)"/>
Inner Shoulder on Outbound Carriageway (Start Ramp)	Inner Shoulder on Outbound Carriageway (End Ramp)
<input type="text" value="Perkerasan Kaku (Rigid)"/>	<input type="text" value="Perkerasan Kaku (Rigid)"/>
Motor Cycle Lane on Outbound Carriageway (Start Ramp)	Motor Cycle Lane on Outbound Carriageway (End Ramp)
<input type="text"/>	<input type="text"/>
Outer Shoulder on Main Road	
<input type="text" value="Perkerasan kaku (Rigid)"/>	
Main Lane on Main Road	
<input type="text" value="Perkerasan kaku (Rigid)"/>	
Inner Shoulder on Main Road	
<input type="text" value="Perkerasan kaku (Rigid)"/>	
Motor Cycle Lane on Main Road	
<input type="text"/>	

Figure 3.15 User Interface Design for “Highway Segments” data inputting (3/3)

Add Rest Area ×

Highway

Rest Area Name

Chainage of Rest Area Latitude Longitude

Direction

Type of Rest Area Pavement Type

Figure 3.16 User Interface Design for “Rest Area” data inputting



3.2. Maintenance Plan

Based on Term of Reference (TOR), maintenance plan is one of the targets of E-SPM upgrading in the form of data inputting. Investigation results of the existing data structure for the "Maintenance Plan" development plan can be seen in the following table:

Table 3.22 Investigation results of the existing data structure for the "Maintenance Plan" development plan (1/2)

SN	Data Items	Data Type	Description
1.	Toll Road ID	Integer	Already available in table "vgp_spm_highways"
2.	Toll Road Holding Name	String	Already available in table "vgp_spm_highways", refers to table "vgp_spm_holdings"
3.	Toll Road Name	String	Already available in table "vgp_spm_highways"
4.	Toll Road Section Name	String	Refers to table "vgp_spm_highwaysegments"
5.	Chainage (From)	Decimal	Refers to table "vgp_spm_highwaysegments"
6.	Chainage (To)	Decimal	Refers to table "vgp_spm_highwaysegments"
7.	Coordinate (Lat) From	Decimal	<p>Already available in "vgp_spm_operatormaints" table, but merged in operation and maintenance activities. Maintenance and operation tables will be separated.</p> <ul style="list-style-type: none"> • Maintenance activity added with name "jica_spm_maintenanceplan_head", "jica_spm_maintenanceplan_detail", "jica_spm_asset_category" • Operation activity added with name "jica_spm_operation"
8.	Coordinate (Long) From	Decimal	<p>Already available in "vgp_spm_operatormaints" table, but merged in operation and maintenance activities. Maintenance and operation tables will be separated.</p> <ul style="list-style-type: none"> • Maintenance activity added with name "jica_spm_maintenanceplan_head", "jica_spm_maintenanceplan_detail", "jica_spm_asset_category" • Operation activity added with name "jica_spm_operation"

Table 3.23 Investigation results of the existing data structure for the “Maintenance Plan” development plan (2/2)

SN	Data Items	Data Type	Description
9.	Coordinate (Lat) To	Decimal	<p>Already available in "vgp_spm_operatormaints" table, but merged in operation and maintenance activities. Maintenance and operation tables will be separated.</p> <ul style="list-style-type: none"> • Maintenance activity added with name "jica_spm_maintenanceplan_head", "jica_spm_maintenanceplan_detail", "jica_spm_asset_category" • Operation activity added with name "jica_spm_operation"
10.	Coordinate (Long) To	Decimal	<p>Already available in "vgp_spm_operatormaints" table, but merged in operation and maintenance activities. Maintenance and operation tables will be separated.</p> <ul style="list-style-type: none"> • Maintenance activity added with name "jica_spm_maintenanceplan_head", "jica_spm_maintenanceplan_detail", "jica_spm_asset_category" • Operation activity added with name "jica_spm_operation"

Text: already available in the existing e-SPM database

Text: e-SPM database development



3.2.1. System Process Design

3.2.1.1. Context Diagram

The Context Diagram for "Maintenance Plan" can be seen in the image below:

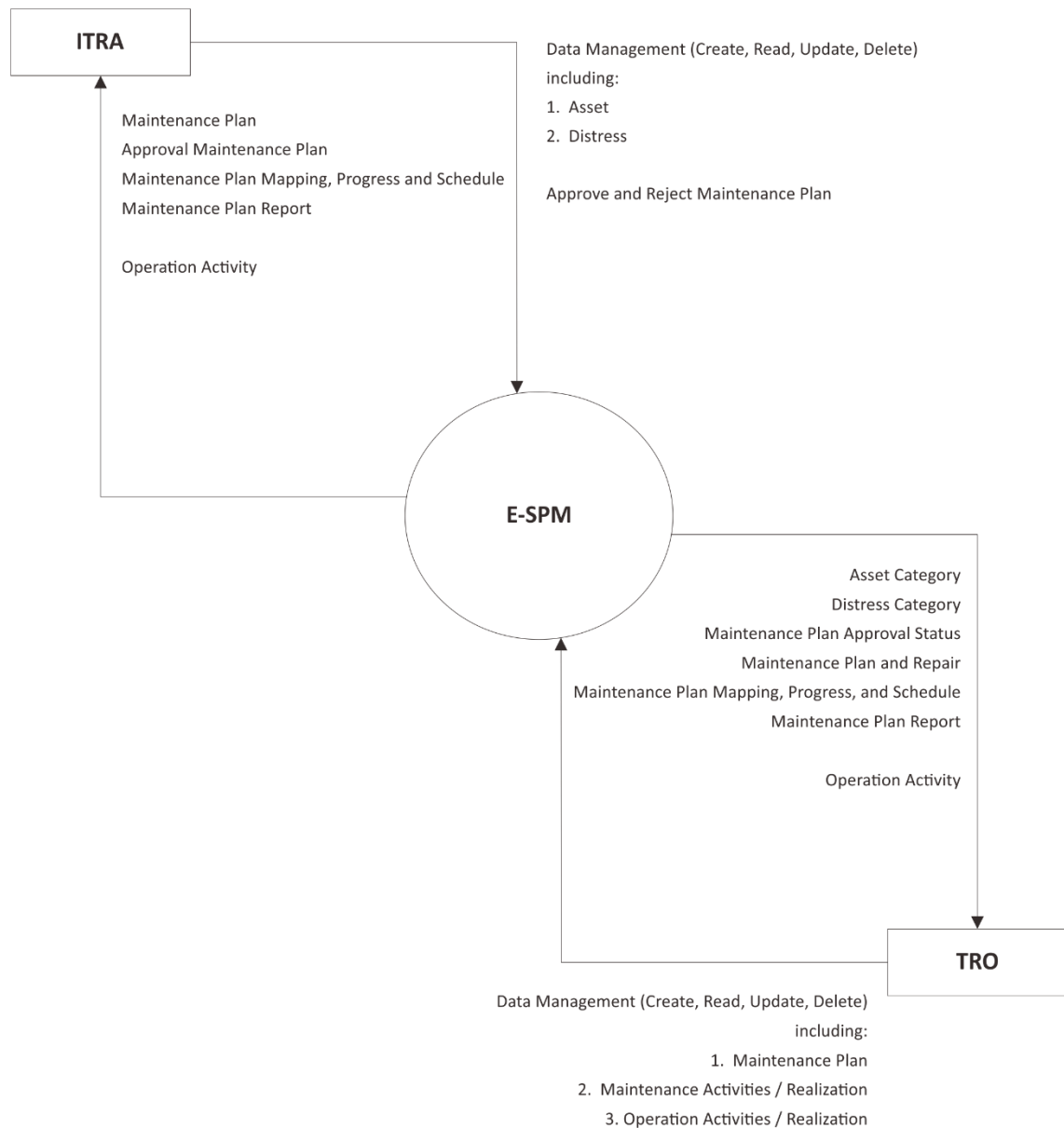


Figure 3.17 Context Diagram for "Maintenance Plan"

3.2.1.2. Use Case Diagram

The Use Case Diagram for "Maintenance Plan" can be seen in the image below:

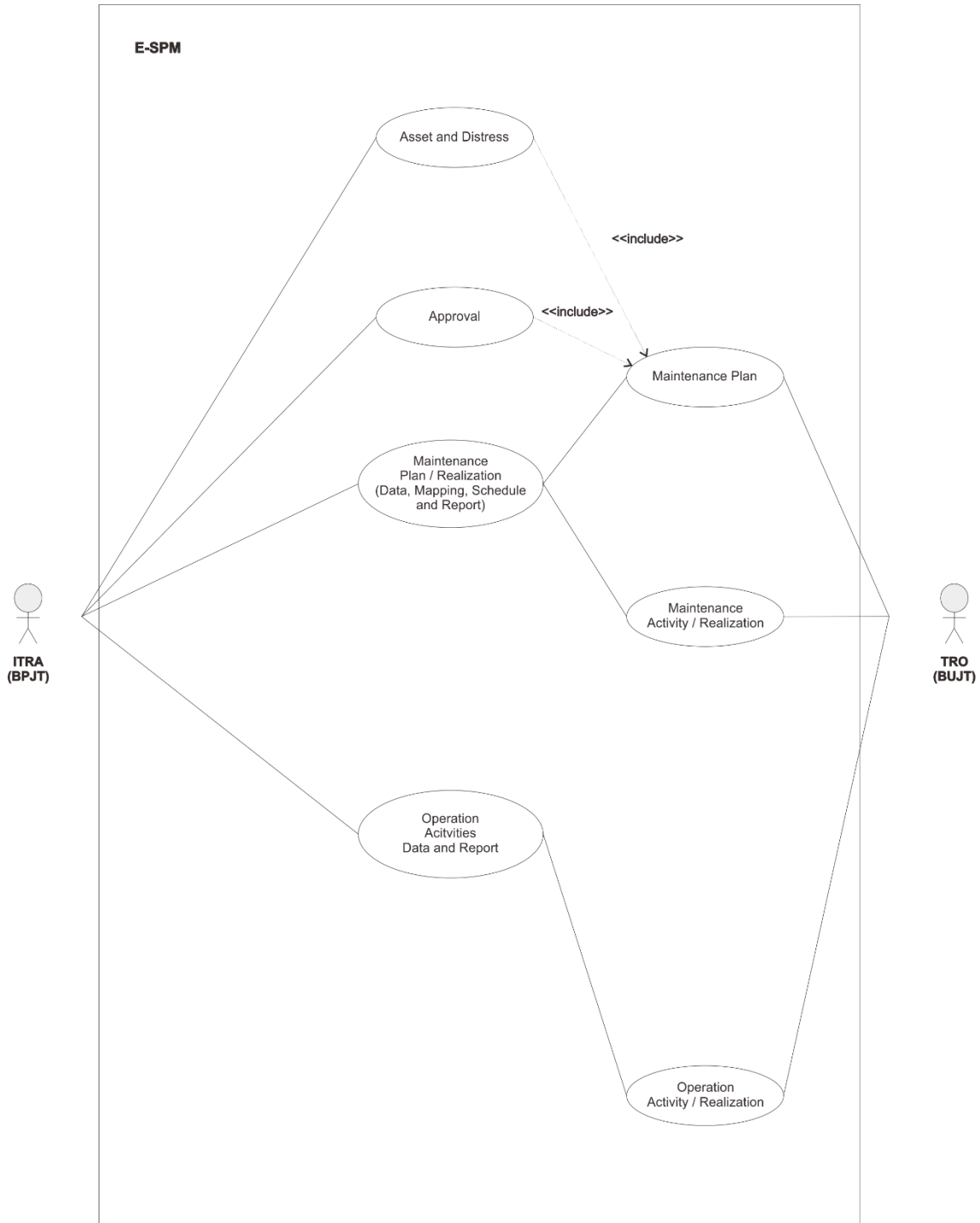


Figure 3.18 Use Case Diagram for "Maintenance Plan"



3.2.2. Database Design

Database Design for "Maintenance Plan" can be seen in the image below:

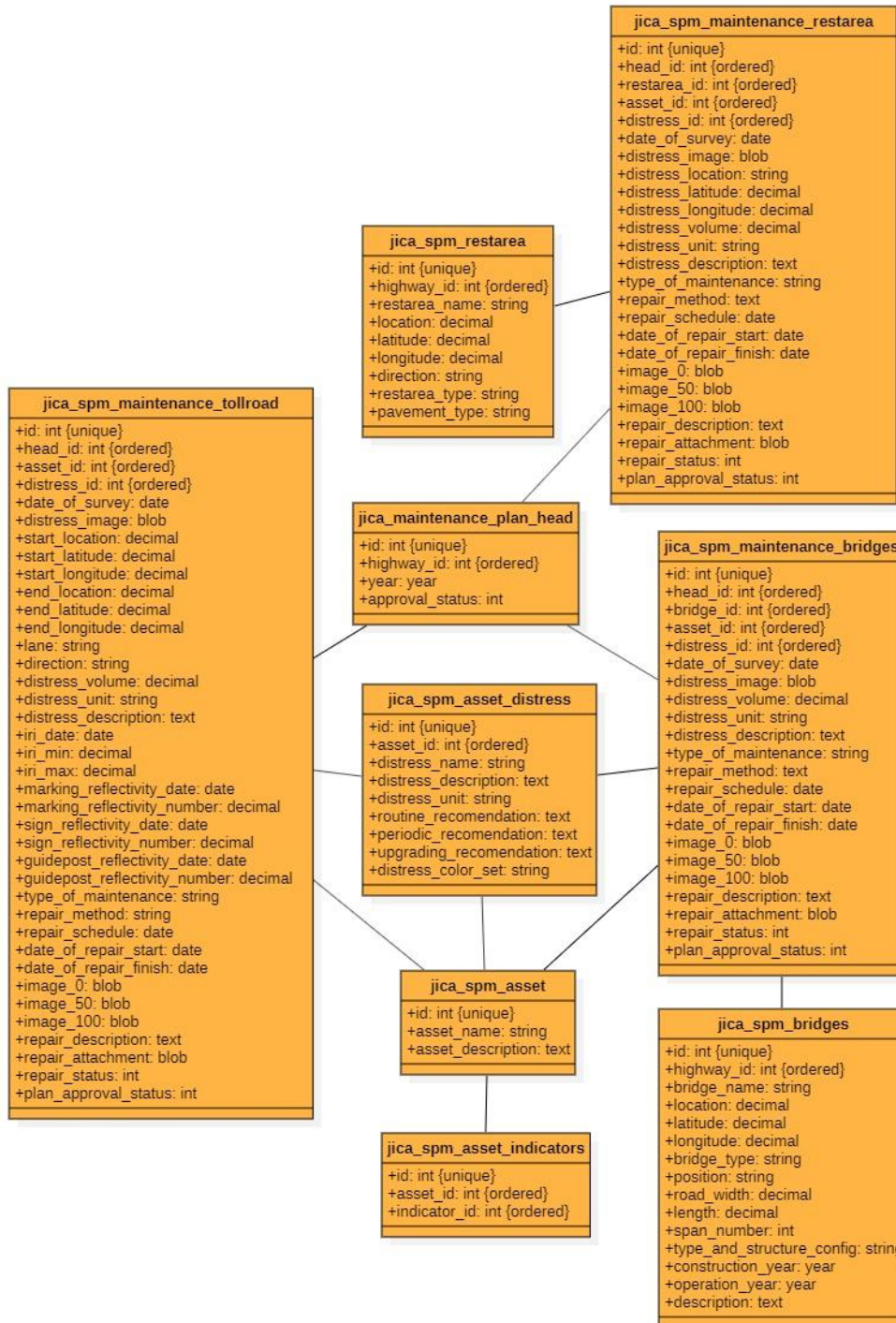


Figure 3.19 Database Design for "Maintenance Plan"

Based on the results of further discussion on October 5, 2022 at the "BPJT Office", several things have been adjusted to accommodate the module required by BPJT (Maintenance Modul Draft is attached). However, due to technical considerations, some formats and data structures have also been adjusted. Comparison of maintenance module draft and adjustments can be seen in the attachment of this report.

3.2.2.1. Maintenance Plan (Head)

Table Name : **jica_spm_maintenance_plan_head**
 Table Relation : vgp_spm_highways, jica_spm_maintenance_tollroad,
 jica_spm_maintenance_bridges, jica_spm_maintenance_restarea
 Type of Table : Transaction
 Description : Head of maintenance plan
 Note : All data structures changed

Table 3.24 Data dictionary for "jica_spm_maintenance_plan_head" table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each maintenance plan
2.	F	highway_id	Highway	integer	Refers to "vgp_spm_highways table"
3.		year	Year of Maintenance	year	Year of maintenance plan
4.		approval_status	Approval Status	string	Approval status for 1 year maintenance program

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.2.2.2. Maintenance Toll Road (Detail)

Table Name : **jica_spm_maintenance_tollroad**
 Table Relation : jica_spm_maintenance_plan_head, jica_spm_asset, jica_spm_asset_distress
 Type of Table : Transaction
 Description : Details of maintenance plan for toll road
 Note : New table



Table 3.25 Data dictionary for “jica_spm_maintenance_tollroad” table (1/3)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each detail maintenance
2.	F	head_id	Maintenance Plan/Head	integer	Refers to “jica_spm_maintenance_plan_head” table
3.	F	asset_id	Asset	integer	Refers to “jica_spm_asset” table
4.	F	distress_id	Distress	integer	Refers to “jica_spm_asset_distress” table
5.		date_of_survey	Date	datetime	Date of survey (distress found)
6.		distress_image	Image	blob	Distress image
7.		start_location	Start of Chainage	decimal	Chainage of start point of distress in KM.HM format
8.		start_latitude	Latitude	decimal	Latitude of start point of distress
9.		start_longitude	Longitude	decimal	Longitude of start point of distress
10.		end_location	End of Chainage	decimal	Chainage of end point of distress in KM.HM format
11.		end_latitude	Latitude	decimal	Latitude of end point of distress
12.		end_longitude	Longitude	decimal	Longitude of end point of distress
13.		lane	Lane	string	Lane position of distress (Outer Shoulder, Lane 1, Lane ... (Based on [lane_number] and [segment_id], Inner Shoulder, Out of Lane)
14.		direction	Direction	string	Direction of distress location (normal direction or opposite direction)
15.		distress_volume	Volume	decimal	Volume of distress
16.		distress_unit	Unit	string	Volume unit of distress (m, m ² , m ³ , etc.)
17.		distress_description	Description	string	Description of distress (if any)
18.		iri_date	IRI Testing Date	datetime	Refers to “vgp_spm_iriheads” table, based on the latest measurement date (according to distress location) Target Asset: Pavement
19.		iri_min	IRI Min (m/km)	decimal	Refers to “vgp_spm_iridetails” table, minimum IRI value based on the latest measurement date (according to distress location) Target Asset: Pavement

Table 3.26 Data dictionary for “jica_spm_maintenance_tollroad” table (2/3)

SN	P/F	Data Items	Caption	Data Type	Definition
20.		iri_max	IRI Max (m/km)	decimal	Refers to “vgp_spm_iridetails” table, maximum IRI value based on the latest measurement date (according to distress location) Target Asset: Pavement
21.		marking_reflectivity_date	Marking Reflectivity Testing Date	datetime	Refers to “vgp_spm_markingheads” table, based on the latest measurement date (according to distress location) Target Asset: Road Marking
22.		marking_reflectivity_number	Marking Reflectivity (%)	decimal	Refers to “vgp_spm_markingdetails” table, road marking reflectivity value based on the latest measurement date (according to distress location) Target Asset: Road Marking
23.		sign_reflectivity_date	Traffic Sign Reflectivity Testing Date	datetime	Refers to “vgp_spm_signheads” table, based on the latest measurement date (according to distress location) Target Asset: Traffic Sign
24.		sign_reflectivity_number	Traffic Sign Reflectivity (%)	decimal	Refers to “vgp_spm_signdetails” table, road marking reflectivity value based on the latest measurement date (according to distress location) Target Asset: Traffic Sign
25.		guidepost_reflectivity_date	Guide Post Reflectivity Testing Date	datetime	Refers to “vgp_spm_reflectorheads” table, based on the latest measurement date (according to distress location) Target Asset: Guide Post/Reflector
26.		guidepost_reflectivity_number	Guide Post Reflectivity (%)	decimal	Refers to “vgp_spm_reflectordetails” table, road marking reflectivity value based on the latest measurement date (according to distress location) Target Asset: Guide Post/Reflector
27.		type_of_maintenance	Type of Maintenance	string	Type of maintenance: Routine, Periodic or Upgrading
28.		repair_method	Repair Method	string	Repair of method
29.		repair_schedule	Repair Schedule	date	Date of repair schedule



Table 3.27 Data dictionary for “jica_spm_maintenance_tollroad” table (3/3)

SN	P/F	Data Items	Caption	Data Type	Definition
30.		date_of_repair_start	Date of Repair Start	datetime	Date and time of repair start
31.		date_of_repair_finish	Date of Repair Finish	datetime	Date and time of repair finish
32.		image_0	Image 0%	blob	Photo before repair (0%)
33.		image_50	Image 50%	blob	Photo during repair (50%)
34.		image_100	Image 100%	blob	Photo after repair (100%)
35.		repair_description	Description	string	Description of repair (if any)
36.		repair_attachment	Attachment	blob	Attachment of repair (if any)
37.		repair_status	Status	string	Repair Status (Planned, Ongoing, Finish)
38.		plan_approval_status	Plan Approval Status	string	Status of plan approval (approve or reject), before repair

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.2.2.3. Maintenance Bridges (Detail)

Table Name : **jica_spm_maintenance_bridges**

Table Relation : jica_spm_maintenance_plan_head, jica_spm_bridges, jica_spm_asset, jica_spm_asset_distress

Type of Table : Transaction

Description : Details of maintenance plan for bridges

Note : New table

Table 3.28 Data dictionary for “jica_spm_maintenance_bridges” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each detail maintenance
2.	F	head_id	Maintenance Plan/Head	integer	Refers to “jica_spm_maintenance_plan_head” table
3.	F	bridge_id	Bridge	integer	Refers to “jica_spm_bridges” table

Table 3.29 Data dictionary for “jica_spm_maintenance_bridges” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
4.	F	asset_id	Asset	integer	Refers to “jica_spm_asset” table
5.	F	distress_id	Distress	integer	Refers to “jica_spm_asset_distress” table
6.		date_of_survey	Date	datetime	Date of survey (distress found)
7.		distress_image	Image	blob	Distress image
8.		distress_volume	Volume	decimal	Volume of distress
9.		distress_unit	Unit	string	Volume unit of distress (m, m ² , m ³ , etc.)
10.		distress_description	Description	string	Description of distress (if any)
11.		type_of_maintenance	Type of Maintenance	string	Type of maintenance: Routine, Periodic or Upgrading
12.		repair_method	Repair Method	string	Repair of method
13.		repair_schedule	Repair Schedule	date	Date of repair schedule
14.		date_of_repair_start	Date of Repair Start	datetime	Date and time of repair start
15.		date_of_repair_finish	Date of Repair Finish	datetime	Date and time of repair finish
16.		image_0	Image 0%	blob	Photo before repair (0%)
17.		image_50	Image 50%	blob	Photo during repair (50%)
18.		image_100	Image 100%	blob	Photo after repair (100%)
19.		repair_description	Description	string	Description of repair (if any)
20.		repair_attachment	Attachment	blob	Attachment of repair (if any)
21.		repair_status	Status	string	Repair Status (Planned, Ongoing, Finish)
22.		plan_approval_status	Plan Approval Status	string	Status of plan approval (approve or reject), before repair

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.2.2.4. Maintenance Rest Area (Detail)

Table Name : **jica_spm_maintenance_restarea**



Table Relation : jica_spm_maintenance_plan_head, jica_spm_restarea, jica_spm_asset,
jica_spm_asset_distress

Type of Table : Transaction

Description : Details of maintenance plan for rest areas

Note : New table

Table 3.30 Data dictionary for “jica_spm_maintenance_restarea” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each detail maintenance
2.	F	head_id	Maintenance Plan/Head	integer	Refers to “jica_spm_maintenance_plan_head” table
3.	F	restarea_id	Bridge	integer	Refers to “jica_spm_restarea” table
4.	F	asset_id	Asset	integer	Refers to “jica_spm_asset” table
5.	F	distress_id	Distress	integer	Refers to “jica_spm_asset_distress” table
6.		date_of_survey	Date	datetime	Date of survey (distress found)
7.		distress_image	Image	blob	Distress image
8.		distress_location	Location	string	Distress location: On Ramp, Off Ramp, Passenger vehicle carriageway, Heavy vehicle carriageway, Parking, etc.
9.		distress_latitude	Latitude	decimal	Latitude of distress location
10.		distress_longitude	Longitude	decimal	Longitude of distress location
11.		distress_volume	Volume	decimal	Volume of distress
12.		distress_unit	Unit	string	Volume unit of distress (m, m ² , m ³ , etc.)
13.		distress_description	Description	string	Description of distress (if any)
14.		type_of_maintenance	Type of Maintenance	string	Type of maintenance: Routine, Periodic or Upgrading
15.		repair_method	Repair Method	string	Repair of method
16.		repair_schedule	Repair Schedule	date	Date of repair schedule
17.		date_of_repair_start	Date of Repair Start	datetime	Date and time of repair start
18.		date_of_repair_finish	Date of Repair Finish	datetime	Date and time of repair finish
19.		image_0	Image 0%	blob	Photo before repair (0%)
20.		image_50	Image 50%	blob	Photo during repair (50%)
21.		image_100	Image 100%	blob	Photo after repair (100%)

Table 3.31 Data dictionary for “jica_spm_maintenance_restarea” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
22.		repair_ description	Description	string	Description of repair (if any)
23.		repair_ attachment	Attachment	blob	Attachment of repair (if any)
24.		repair_status	Status	string	Repair Status (Planned, Ongoing, Finish)
25.		plan_approval_ status	Plan Approval Status	string	Status of plan approval (approve or reject), before repair

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.2.2.5. Asset

Table Name : **jica_spm_asset**

Table Relation : jica_spm_asset_indicators, jica_spm_asset_distress,
jica_spm_maintenance_tollroad, jica_spm_maintenance_bridges

Type of Table : Master

Description : Asset master (new table), for uniform definition of TRO

Table 3.32 Data dictionary for “jica_spm_asset” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each asset category
2.		asset_name	Asset Name	string	Name of asset
3.		asset_description	Description	string	Description of asset

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.2.2.6. Asset Indicators

Table Name : **jica_spm_asset_indicators**

Table Relation : jica_spm_asset, vgp_spm_indicators

Type of Table : Master



Description : Created to accommodate 1 asset that is part of ≥ 1 SPM indicators

Table 3.33 Data dictionary for “jica_spm_asset_indicators” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each asset category
2.	F	asset_id	Asset	integer	Refers to “jica_spm_asset” table
3.	F	Indicator_id	Indicator	integer	Refers to “vgp_spm_indicators” table

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.2.2.7. Asset Distress

Table Name : **jica_spm_asset_distress**

Table Relation : jica_spm_asset, jica_spm_maintenance_tollroad,
jica_spm_maintenance_bridges

Type of Table : Master

Description : Asset distress master (new table), for uniform definition of TRO

Table 3.34 Data dictionary for “jica_spm_asset_distress” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each asset category
2.	F	asset_id	Asset	integer	Refers to “jica_spm_asset” table
3.		distress_name	Distress Name	string	Name of distress
4.		distress_ description	Description	string	Description of distress
5.		distress_unit	Unit	string	Unit of distress (m, m ² , m ³ , etc.)
6.		routine_ recommendation	Routine Recommendation	string	Repair recommendation for Routine Maintenance
7.		periodic_ recommendation	Periodic Recommendation	string	Repair recommendation for Periodic Maintenance
8.		upgrading_ recommendation	Upgrading Recommendation	string	Repair recommendation for Upgrading Maintenance
9.		distress_color_set	Color Set	string	Color set for strip map features

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.2.2.8. Operation

Table Name : **jica_spm_operations**
 Table Relation : vgp_spm_highways
 Type of Table : Transaction
 Description : Operation activity data on toll roads

Table 3.35 Data dictionary for “jica_spm_operations” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each operation activities
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways table”
3.		operation_date	Date	datetime	Date and Time of operation activities
4.		operation_description	Description	string	Description of operation activities
5.		operation_location	Chainage	decimal	Chainage of operation activities in KM.HM format
6.		operation_latitude	Latitude	decimal	Latitude of operation activities
7.		operation_longitude	Longitude	decimal	Longitude of operation activities
8.		direction	Direction	string	Type of direction (Normal Direction (A), Opposite Direction (B), Both Direction)
9.		operation_attachment	Attachment	blob	Attachment of operation activities

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.2.3. User Interface Design

User Interface (UI) Design for "Maintenance Plan" can be seen in **Figure 3.20** to **Figure 3.25**:



Add Tollroad Maintenance Plan

Highway: Periode: Approve

[Jalan Aspal](#) [Jalan Beton](#) [Seluruh Tipe Drainase](#) [Kerb](#) [MCB](#) [Guardrail](#) [Wirerope](#) [Rounding](#) [Marka Jalan](#)

Jalan Aspal Add to List

Name Distress	Maintenance Type	Maintenance Schedule	Status Repair	Status	Comment	
Alur	Rutin	25 Oct 2022	FINISHED	Approve	-	
Alur	Rutin	25 Oct 2022	FINISHED	Approve	-	
Alur	Rutin	25 Oct 2022	UNFINISHED	Approve	-	
Alur	Rutin	25 Oct 2022	UNFINISHED	Unapprove	Lorem ipsum Lorem ipsum Lorem ipsum	

Save Cancel

Figure 3.20 User Interface Design for “Maintenance Toll Road” data inputting

Add Bridge Maintenance Plan

Highway: Bridge: Periode: Approve

[Bangunan Atas](#) [Bangunan Bawah](#) [Bangunan Pilar](#)

Jalan Aspal Add to List

Name Distress	Maintenance Type	Maintenance Schedule	Status Repair	Status	Comment	
Alur	Rutin	30 Oct 2022	FINISHED	Approve	-	
Alur	Rutin	30 Oct 2022	FINISHED	Approve	-	
Alur	Rutin	30 Oct 2022	UNFINISHED	Approve	-	
Alur	Rutin	30 Oct 2022	UNFINISHED	Unapprove	Lorem ipsum Lorem ipsum Lorem ipsum	

Save Cancel

Figure 3.21 User Interface Design for “Maintenance Bridges” data inputting

Add Rest Area Maintenance Plan

Highway: Semarang - Batang | Rest Area: TIP KM 360 B | Periode: 2022 ● Approve

[On Ramp](#) [Off Ramp](#) [Jalur Kendaraan Kecil](#) [Jalur Kendaraan Besar](#) [Parkir](#)

Jalan Aspal ➕ Add to List

List of Distress					
Name Distress	Maintenance Type	Maintenance Schedule	Status Repair	Status	Comment
Alur	Rutin	30 Oct 2022	FINISHED	● Approve	-
Alur	Rutin	30 Oct 2022	FINISHED	● Approve	-
Alur	Rutin	30 Oct 2022	UNFINISHED	● Approve	-
Alur	Rutin	30 Oct 2022	UNFINISHED	● Unapprove	Lorem ipsum Lorem ipsum Lorem ipsum

[Save](#) [Cancel](#)

Figure 3.22 User Interface Design for “Maintenance Rest Area” data inputting

Add Asset ×

Asset Name

Description

Indikator SPM

+

Daftar Indikator

Perkerasan Jalan Utama [Retak]	
Perkerasan Jalan Utama [Lubang]	

Figure 3.23 User Interface Design for “Asset” and “Asset Indicators” data inputting

Add Asset Distress ×

Asset Name

Indicator Name

Subtansi SPM

Distress Name

Description of Distress

Units of Distress

Repair Recommendation

Routine

Periodic

Upgrading


Color Reference
 

Figure 3.24 User Interface Design for “Asset Distress” data inputting

Add Operation ✕

Highway

Ngawi - Kertosono ▾

Date 📅 Select Date Location 0.000

Latitude 0.000000 Longitude 0.000000

Direction

Normal Direction (A) ▾

Description

Type a description of Operation....

Attachment

📁 Upload 🗑 Remove

Close Save

Figure 3.25 User Interface Design for “Operation” data inputting

3.3. Traffic Volume

Based on Term of Reference (TOR), traffic volume is one of the targets of E-SPM upgrading in the form of data inputting. Investigation results of the existing data structure for the "Traffic Volume" development plan can be seen in the following table:

Table 3.36 Investigation results of the existing data structure for the "Traffic Volume" development plan

SN	Data Items	Data Type	Description
1.	Toll Road ID	Integer	Already available in table "vgp_spm_highways"
2.	Toll Road Holding Name	String	Already available in table "vgp_spm_highways", refers to table "vgp_spm_holdings"
3.	Toll Road Name	String	Already available in table "vgp_spm_highways"
4.	Year of Construction	Year	Field added in table "vgp_spm_highways"
5.	Toll Road Section Name	String	Refers to table "vgp_spm_highwaysegments"
6.	Traffic Counter Chainage	Decimal	Field added in table "vgp_spm_trfvolegments"
7.	Coordinate of Counter (Lat)	Decimal	Field added in table "vgp_spm_trfvolegments"
8.	Coordinate of Counter (Long)	Decimal	Field added in table "vgp_spm_trfvolegments"
9.	Traffic Volume Class 1	Integer	Already available in table "vgp_spm_trfvolegments", divided into hourly
10.	Traffic Volume Class 2	Integer	Already available in table "vgp_spm_trfvolegments", divided into hourly
11.	Traffic Volume Class 3	Integer	Already available in table "vgp_spm_trfvolegments", divided into hourly
12.	Traffic Volume Class 4	Integer	Already available in table "vgp_spm_trfvolegments", divided into hourly
13.	Traffic Volume Class 5	Integer	Already available in table "vgp_spm_trfvolegments", divided into hourly



3.3.1. System Process Design

3.3.1.1. Context Diagram

The Context Diagram for "Traffic Volume" can be seen in the image below:

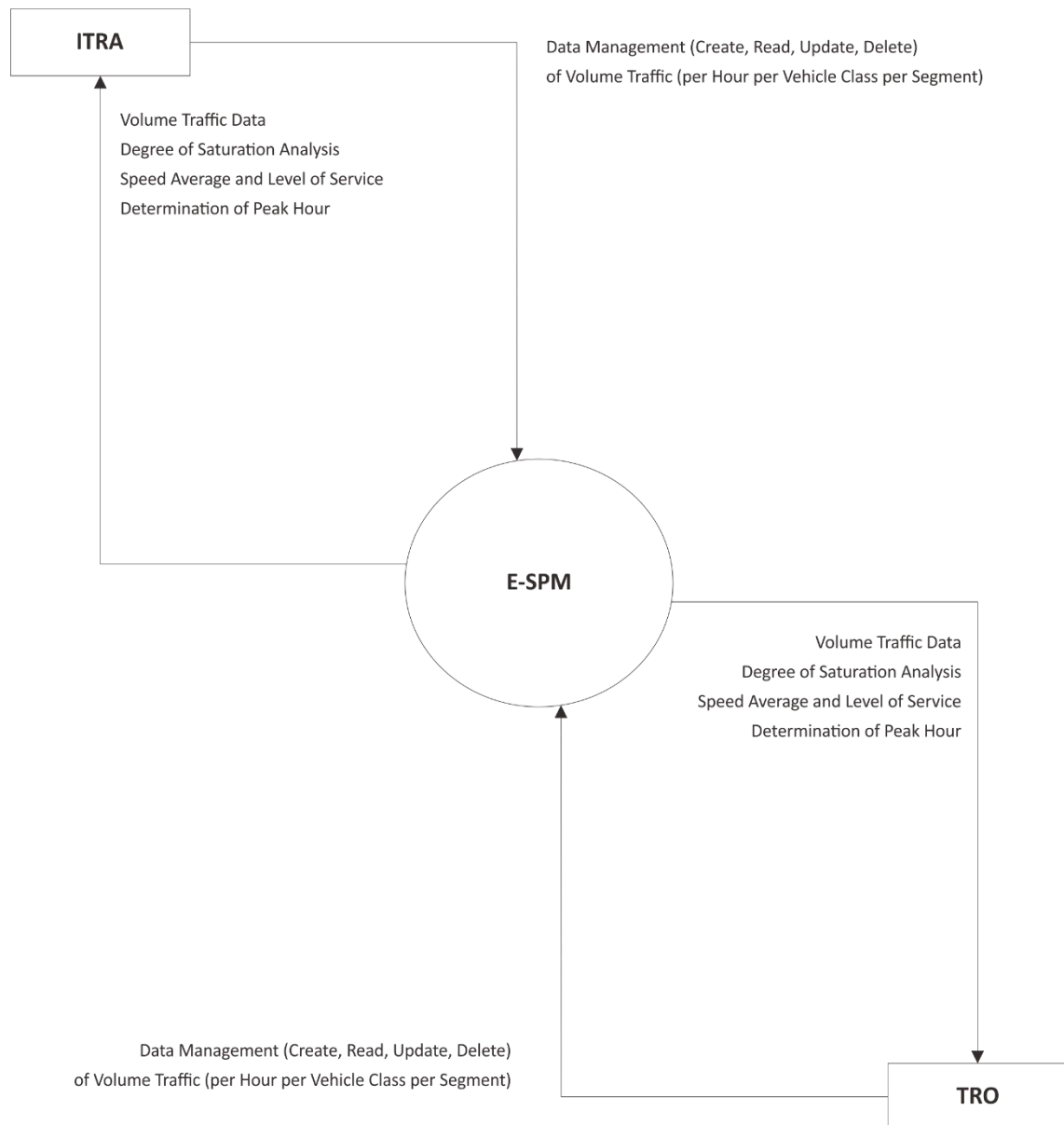


Figure 3.26 Context Diagram for "Traffic Volume"

3.3.1.2. Use Case Diagram

The Use Case Diagram for "Traffic Volume" can be seen in the image below:

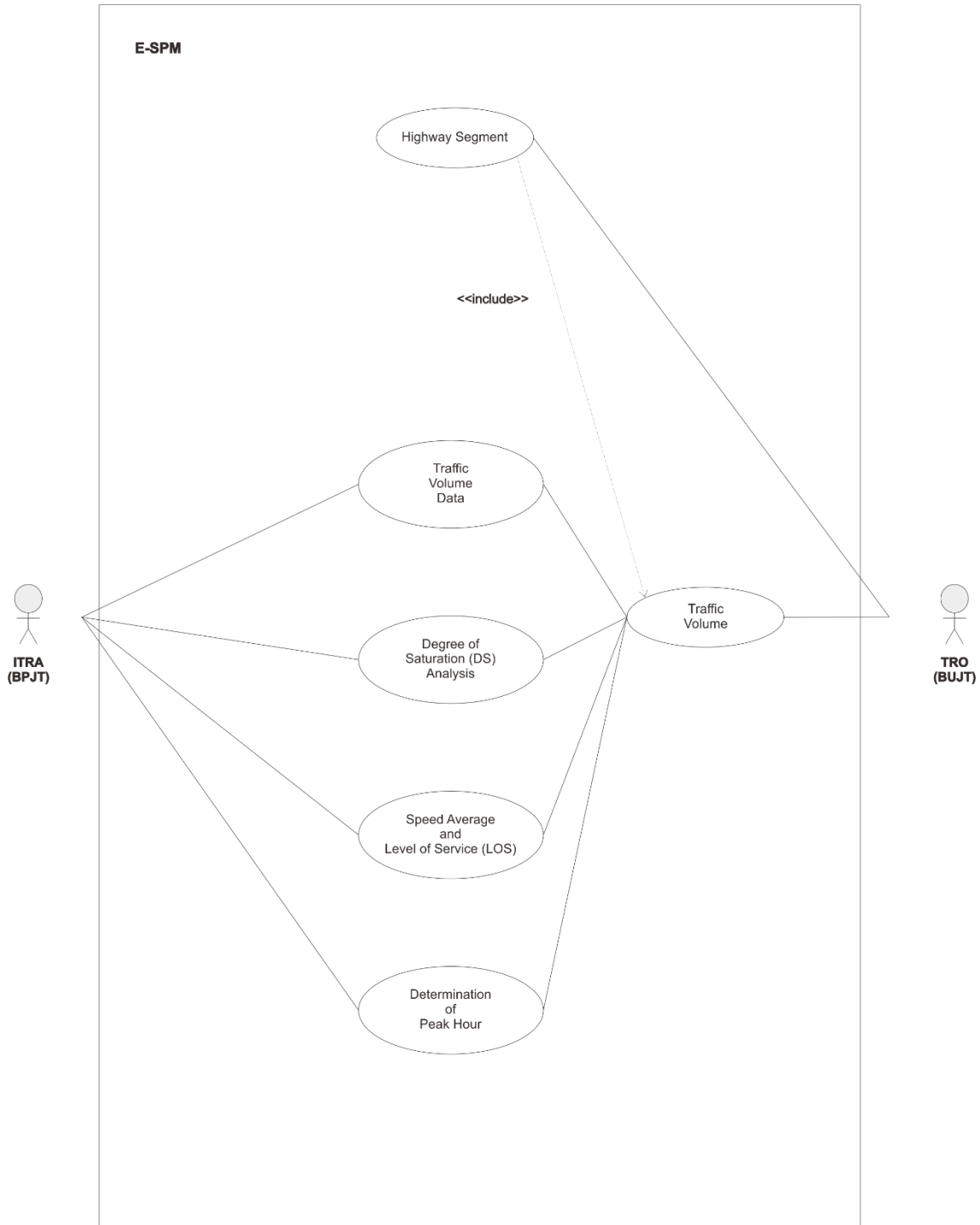


Figure 3.27 Use Case Diagram for "Traffic Volume"



3.3.2. Database Design

Database Design for "Traffic Volume" can be seen in the image below:

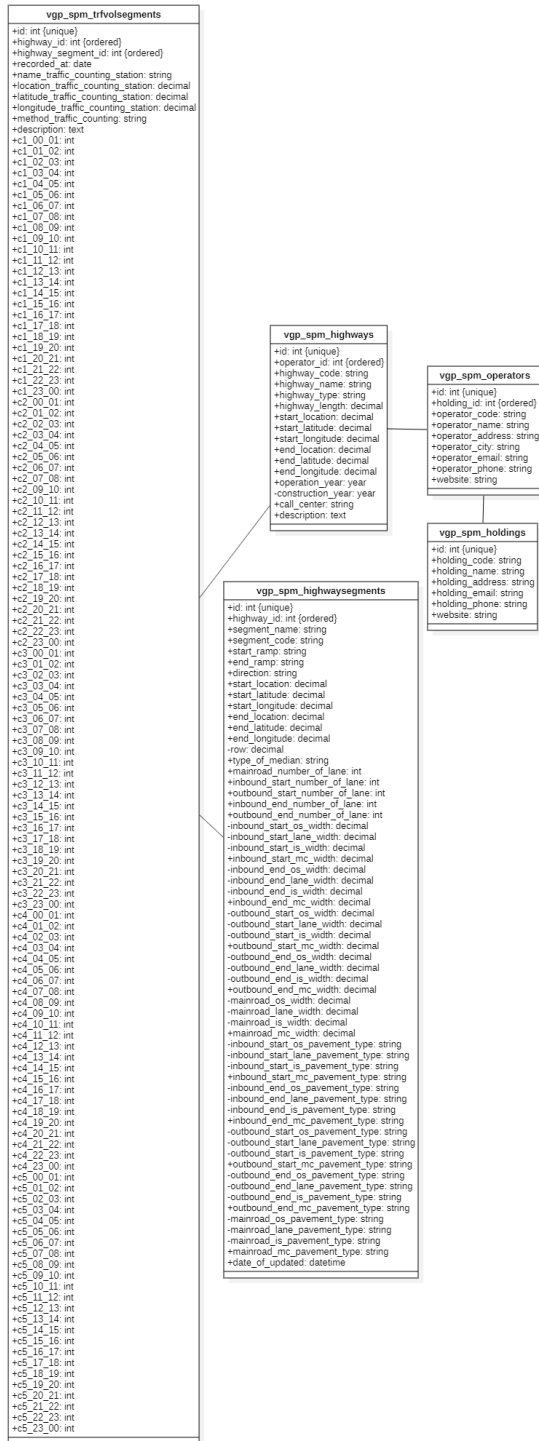


Figure 3.28 Database Design for "Traffic Volume"

Based on the results of the meeting on September 16, 2022 at the JICA Project Office, it was agreed by BPJT that the data dictionary for database design for the Traffic Volume module is as follows:

3.3.2.1. Traffic Volume (Segment)

Table Name : **vgp_spm_trfvolegments**
 Table Relation : vgp_spm_highways, vgp_spm_highwaysegments
 Type of Table : Transaction
 Description : Hourly traffic volume data required for degree of saturation analysis and determination of peak hours
 Note : No changes in this table

Table 3.37 Data dictionary for “vgp_spm_trfvolegments” table (1/5)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each segment traffic volume data
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.	F	highway_ segment_id	Segment	integer	Refers to “vgp_spm_highway_segments” table
4.		recorded_at	Traffic Date	date	Traffic counting date
5.		name_traffic_ counting_station	Name of TC Station	string	Name of traffic counting station
6.		location_traffic_ counting_station	Chainage of TC Station	decimal	Chainage of traffic counting point in KM.HM format
7.		latitude_traffic_ counting_station	Latitude of TC Station	decimal	Latitude of traffic counting point
8.		longitude_traffic_ counting_station	Longitude of TC Station	decimal	Longitude of traffic counting point
9.		method_traffic_ counting	TC Method	decimal	Method of traffic counting
10.		description	Description	Text	Description of traffic counting/traffic volume data
11.		c1_00_01	00-01 am	integer	Class 1 traffic volume at 00 - 01 am
12.		c1_01_02	01-02 am	integer	Class 1 traffic volume at 01 - 02 am
13.		c1_02_03	02-03 am	integer	Class 1 traffic volume at 02 - 03 am
14.		c1_03_04	03-04 am	integer	Class 1 traffic volume at 03 - 04 am
15.		c1_04_05	04-05 am	integer	Class 1 traffic volume at 04 - 05 am



Table 3.38 Data dictionary for “vgp_spm_trfvolesegments” table (2/5)

SN	P/F	Data Items	Caption	Data Type	Definition
16.		c1_05_06	05-06 am	integer	Class 1 traffic volume at 05 - 06 am
17.		c1_06_07	06-07 am	integer	Class 1 traffic volume at 06 - 07 am
18.		c1_07_08	07-08 am	integer	Class 1 traffic volume at 07 - 08 am
19.		c1_08_09	08-09 am	integer	Class 1 traffic volume at 08 - 09 am
20.		c1_09_10	09-10 am	integer	Class 1 traffic volume at 09 - 10 am
21.		c1_10_11	10-11 am	integer	Class 1 traffic volume at 10 - 11 am
22.		c1_11_12	11am-12pm	integer	Class 1 traffic volume at 11 am - 12 pm
23.		c1_12_13	12-01 pm	integer	Class 1 traffic volume at 12 - 01 pm
24.		c1_13_14	01-02 pm	integer	Class 1 traffic volume at 01 - 02 pm
25.		c1_14_15	02-03 pm	integer	Class 1 traffic volume at 02 - 03 pm
26.		c1_15_16	03-04 pm	integer	Class 1 traffic volume at 03 - 04 pm
27.		c1_16_17	04-05 pm	integer	Class 1 traffic volume at 04 - 05 pm
28.		c1_17_18	05-06 pm	integer	Class 1 traffic volume at 05 - 06 pm
29.		c1_18_19	06-07 pm	integer	Class 1 traffic volume at 06 - 07 pm
30.		c1_19_20	07-08 pm	integer	Class 1 traffic volume at 07 - 08 pm
31.		c1_20_21	08-09 pm	integer	Class 1 traffic volume at 08 - 09 pm
32.		c1_21_22	09-10 pm	integer	Class 1 traffic volume at 09 - 10 pm
33.		c1_22_23	10-11 pm	integer	Class 1 traffic volume at 10 - 11 pm
34.		c1_23_00	11pm-12am	integer	Class 1 traffic volume at 11 pm - 12 am
35.		c2_00_01	00-01 am	integer	Class 2 traffic volume at 00 - 01 am
36.		c2_01_02	01-02 am	integer	Class 2 traffic volume at 01 - 02 am
37.		c2_02_03	02-03 am	integer	Class 2 traffic volume at 02 - 03 am
38.		c2_03_04	03-04 am	integer	Class 2 traffic volume at 03 - 04 am
39.		c2_04_05	04-05 am	integer	Class 2 traffic volume at 04 - 05 am
40.		c2_05_06	05-06 am	integer	Class 2 traffic volume at 05 - 06 am
41.		c2_06_07	06-07 am	integer	Class 2 traffic volume at 06 - 07 am
42.		c2_07_08	07-08 am	integer	Class 2 traffic volume at 07 - 08 am
43.		c2_08_09	08-09 am	integer	Class 2 traffic volume at 08 - 09 am
44.		c2_09_10	09-10 am	integer	Class 2 traffic volume at 09 - 10 am
45.		c2_10_11	10-11 am	integer	Class 2 traffic volume at 10 - 11 am
46.		c2_11_12	11am-12pm	integer	Class 2 traffic volume at 11 am - 12 pm
47.		c2_12_13	12-01 pm	integer	Class 2 traffic volume at 12 - 01 pm
48.		c2_13_14	01-02 pm	integer	Class 2 traffic volume at 01 - 02 pm
49.		c2_14_15	02-03 pm	integer	Class 2 traffic volume at 02 - 03 pm
50.		c2_15_16	03-04 pm	integer	Class 2 traffic volume at 03 - 04 pm
51.		c2_16_17	04-05 pm	integer	Class 2 traffic volume at 04 - 05 pm
52.		c2_17_18	05-06 pm	integer	Class 2 traffic volume at 05 - 06 pm
53.		c2_18_19	06-07 pm	integer	Class 2 traffic volume at 06 - 07 pm

Table 3.39 Data dictionary for “vgp_spm_trfvolesegments” table (3/5)

SN	P/F	Data Items	Caption	Data Type	Definition
54.		c2_19_20	07-08 pm	integer	Class 2 traffic volume at 07 - 08 pm
55.		c2_20_21	08-09 pm	integer	Class 2 traffic volume at 08 - 09 pm
56.		c2_21_22	09-10 pm	integer	Class 2 traffic volume at 09 - 10 pm
57.		c2_22_23	10-11 pm	integer	Class 2 traffic volume at 10 - 11 pm
54.		c2_19_20	07-08 pm	integer	Class 2 traffic volume at 07 - 08 pm
55.		c2_20_21	08-09 pm	integer	Class 2 traffic volume at 08 - 09 pm
56.		c2_21_22	09-10 pm	integer	Class 2 traffic volume at 09 - 10 pm
57.		c2_22_23	10-11 pm	integer	Class 2 traffic volume at 10 - 11 pm
58.		c2_23_00	11pm-12am	integer	Class 2 traffic volume at 11 pm - 12 am
59.		c3_00_01	00-01 am	integer	Class 3 traffic volume at 00 - 01 am
60.		c3_01_02	01-02 am	integer	Class 3 traffic volume at 01 - 02 am
61.		c3_02_03	02-03 am	integer	Class 3 traffic volume at 02 - 03 am
62.		c3_03_04	03-04 am	integer	Class 3 traffic volume at 03 - 04 am
63.		c3_04_05	04-05 am	integer	Class 3 traffic volume at 04 - 05 am
64.		c3_05_06	05-06 am	integer	Class 3 traffic volume at 05 - 06 am
65.		c3_06_07	06-07 am	integer	Class 3 traffic volume at 06 - 07 am
66.		c3_07_08	07-08 am	integer	Class 3 traffic volume at 07 - 08 am
67.		c3_08_09	08-09 am	integer	Class 3 traffic volume at 08 - 09 am
68.		c3_09_10	09-10 am	integer	Class 3 traffic volume at 09 - 10 am
69.		c3_10_11	10-11 am	integer	Class 3 traffic volume at 10 - 11 am
70.		c3_11_12	11am-12pm	integer	Class 3 traffic volume at 11 am - 12 pm
71.		c3_12_13	12-01 pm	integer	Class 3 traffic volume at 12 - 01 pm
72.		c3_13_14	01-02 pm	integer	Class 3 traffic volume at 01 - 02 pm
73.		c3_14_15	02-03 pm	integer	Class 3 traffic volume at 02 - 03 pm
74.		c3_15_16	03-04 pm	integer	Class 3 traffic volume at 03 - 04 pm
75.		c3_16_17	04-05 pm	integer	Class 3 traffic volume at 04 - 05 pm
76.		c3_17_18	05-06 pm	integer	Class 3 traffic volume at 05 - 06 pm
77.		c3_18_19	06-07 pm	integer	Class 3 traffic volume at 06 - 07 pm
78.		c3_19_20	07-08 pm	integer	Class 3 traffic volume at 07 - 08 pm
79.		c3_20_21	08-09 pm	integer	Class 3 traffic volume at 08 - 09 pm
80.		c3_21_22	09-10 pm	integer	Class 3 traffic volume at 09 - 10 pm
81.		c3_22_23	10-11 pm	integer	Class 3 traffic volume at 10 - 11 pm
82.		c3_23_00	11pm-12am	integer	Class 3 traffic volume at 11 pm - 12 am
83.		c4_00_01	00-01 am	integer	Class 4 traffic volume at 00 - 01 am
84.		c4_01_02	01-02 am	integer	Class 4 traffic volume at 01 - 02 am
85.		c4_02_03	02-03 am	integer	Class 4 traffic volume at 02 - 03 am
86.		c4_03_04	03-04 am	integer	Class 4 traffic volume at 03 - 04 am
87.		c4_04_05	04-05 am	integer	Class 4 traffic volume at 04 - 05 am



Table 3.40 Data dictionary for “vgp_spm_trfvolesegments” table (4/5)

SN	P/F	Data Items	Caption	Data Type	Definition
88.		c4_05_06	05-06 am	integer	Class 4 traffic volume at 05 - 06 am
89.		c4_06_07	06-07 am	integer	Class 4 traffic volume at 06 - 07 am
90.		c4_07_08	07-08 am	integer	Class 4 traffic volume at 07 - 08 am
91.		c4_08_09	08-09 am	integer	Class 4 traffic volume at 08 - 09 am
92.		c4_09_10	09-10 am	integer	Class 4 traffic volume at 09 - 10 am
93.		c4_10_11	10-11 am	integer	Class 4 traffic volume at 10 - 11 am
94.		c4_11_12	11am-12pm	integer	Class 4 traffic volume at 11 am - 12 pm
95.		c4_12_13	12-01 pm	integer	Class 4 traffic volume at 12 - 01 pm
96.		c4_13_14	01-02 pm	integer	Class 4 traffic volume at 01 - 02 pm
97.		c4_14_15	02-03 pm	integer	Class 4 traffic volume at 02 - 03 pm
98.		c4_15_16	03-04 pm	integer	Class 4 traffic volume at 03 - 04 pm
99.		c4_16_17	04-05 pm	integer	Class 4 traffic volume at 04 - 05 pm
100.		c4_17_18	05-06 pm	integer	Class 4 traffic volume at 05 - 06 pm
101.		c4_18_19	06-07 pm	integer	Class 4 traffic volume at 06 - 07 pm
102.		c4_19_20	07-08 pm	integer	Class 4 traffic volume at 07 - 08 pm
103.		c4_20_21	08-09 pm	integer	Class 4 traffic volume at 08 - 09 pm
104.		c4_21_22	09-10 pm	integer	Class 4 traffic volume at 09 - 10 pm
105.		c4_22_23	10-11 pm	integer	Class 4 traffic volume at 10 - 11 pm
106.		c4_23_00	11pm-12am	integer	Class 4 traffic volume at 11 pm - 12 am
107.		c5_00_01	00-01 am	integer	Class 5 traffic volume at 00 - 01 am
108.		c5_01_02	01-02 am	integer	Class 5 traffic volume at 01 - 02 am
109.		c5_02_03	02-03 am	integer	Class 5 traffic volume at 02 - 03 am
110.		c5_03_04	03-04 am	integer	Class 5 traffic volume at 03 - 04 am
111.		c5_04_05	04-05 am	integer	Class 5 traffic volume at 04 - 05 am
112.		c5_05_06	05-06 am	integer	Class 5 traffic volume at 05 - 06 am
113.		c5_06_07	06-07 am	integer	Class 5 traffic volume at 06 - 07 am
114.		c5_07_08	07-08 am	integer	Class 5 traffic volume at 07 - 08 am
115.		c5_08_09	08-09 am	integer	Class 5 traffic volume at 08 - 09 am
116.		c5_09_10	09-10 am	integer	Class 5 traffic volume at 09 - 10 am
117.		c5_10_11	10-11 am	integer	Class 5 traffic volume at 10 - 11 am
118.		c5_11_12	11am-12pm	integer	Class 5 traffic volume at 11 am - 12 pm
119.		c5_12_13	12-01 pm	integer	Class 5 traffic volume at 12 - 01 pm
120.		c5_13_14	01-02 pm	integer	Class 5 traffic volume at 01 - 02 pm
121.		c5_14_15	02-03 pm	integer	Class 5 traffic volume at 02 - 03 pm
122.		c5_15_16	03-04 pm	integer	Class 5 traffic volume at 03 - 04 pm
123.		c5_16_17	04-05 pm	integer	Class 5 traffic volume at 04 - 05 pm
124.		c5_17_18	05-06 pm	integer	Class 5 traffic volume at 05 - 06 pm
125.		c5_18_19	06-07 pm	integer	Class 5 traffic volume at 06 - 07 pm

Table 3.41 Data dictionary for “vgp_spm_trfvolesegments” table (5/5)

SN	P/F	Data Items	Caption	Data Type	Definition
88.		c4_05_06	05-06 am	integer	Class 4 traffic volume at 05 - 06 am
89.		c4_06_07	06-07 am	integer	Class 4 traffic volume at 06 - 07 am
90.		c4_07_08	07-08 am	integer	Class 4 traffic volume at 07 - 08 am
91.		c4_08_09	08-09 am	integer	Class 4 traffic volume at 08 - 09 am
92.		c4_09_10	09-10 am	integer	Class 4 traffic volume at 09 - 10 am
93.		c4_10_11	10-11 am	integer	Class 4 traffic volume at 10 - 11 am
94.		c4_11_12	11am-12pm	integer	Class 4 traffic volume at 11 am - 12 pm
95.		c4_12_13	12-01 pm	integer	Class 4 traffic volume at 12 - 01 pm
96.		c4_13_14	01-02 pm	integer	Class 4 traffic volume at 01 - 02 pm
97.		c4_14_15	02-03 pm	integer	Class 4 traffic volume at 02 - 03 pm
98.		c4_15_16	03-04 pm	integer	Class 4 traffic volume at 03 - 04 pm
99.		c4_16_17	04-05 pm	integer	Class 4 traffic volume at 04 - 05 pm
100.		c4_17_18	05-06 pm	integer	Class 4 traffic volume at 05 - 06 pm
101.		c4_18_19	06-07 pm	integer	Class 4 traffic volume at 06 - 07 pm
102.		c4_19_20	07-08 pm	integer	Class 4 traffic volume at 07 - 08 pm
103.		c4_20_21	08-09 pm	integer	Class 4 traffic volume at 08 - 09 pm
104.		c4_21_22	09-10 pm	integer	Class 4 traffic volume at 09 - 10 pm
105.		c4_22_23	10-11 pm	integer	Class 4 traffic volume at 10 - 11 pm
106.		c4_23_00	11pm-12am	integer	Class 4 traffic volume at 11 pm - 12 am
107.		c5_00_01	00-01 am	integer	Class 5 traffic volume at 00 - 01 am
108.		c5_01_02	01-02 am	integer	Class 5 traffic volume at 01 - 02 am
109.		c5_02_03	02-03 am	integer	Class 5 traffic volume at 02 - 03 am
110.		c5_03_04	03-04 am	integer	Class 5 traffic volume at 03 - 04 am
111.		c5_04_05	04-05 am	integer	Class 5 traffic volume at 04 - 05 am
112.		c5_05_06	05-06 am	integer	Class 5 traffic volume at 05 - 06 am
113.		c5_06_07	06-07 am	integer	Class 5 traffic volume at 06 - 07 am
114.		c5_07_08	07-08 am	integer	Class 5 traffic volume at 07 - 08 am
115.		c5_08_09	08-09 am	integer	Class 5 traffic volume at 08 - 09 am
116.		c5_09_10	09-10 am	integer	Class 5 traffic volume at 09 - 10 am
117.		c5_10_11	10-11 am	integer	Class 5 traffic volume at 10 - 11 am
118.		c5_11_12	11am-12pm	integer	Class 5 traffic volume at 11 am - 12 pm
119.		c5_12_13	12-01 pm	integer	Class 5 traffic volume at 12 - 01 pm
120.		c5_13_14	01-02 pm	integer	Class 5 traffic volume at 01 - 02 pm
121.		c5_14_15	02-03 pm	integer	Class 5 traffic volume at 02 - 03 pm
122.		c5_15_16	03-04 pm	integer	Class 5 traffic volume at 03 - 04 pm
123.		c5_16_17	04-05 pm	integer	Class 5 traffic volume at 04 - 05 pm
124.		c5_17_18	05-06 pm	integer	Class 5 traffic volume at 05 - 06 pm
125.		c5_18_19	06-07 pm	integer	Class 5 traffic volume at 06 - 07 pm

126.	c5_19_20	07-08 pm	integer	Class 5 traffic volume at 07 - 08 pm
127.	c5_20_21	08-09 pm	integer	Class 5 traffic volume at 08 - 09 pm
128.	c5_21_22	09-10 pm	integer	Class 5 traffic volume at 09 - 10 pm
129.	c5_22_23	10-11 pm	integer	Class 5 traffic volume at 10 - 11 pm
130.	c5_23_00	11pm-12am	integer	Class 5 traffic volume at 11 pm - 12 am

Text: already available in the existing e-SPM database

Text: e-SPM database development

3.3.3. User Interface Design

User Interface (UI) Design for "Traffic Volume" can be seen in **Figure 3.26**:

Add Traffic Volume Segment
✕

Highway

Cimanggis - Cibitung
▼

Highway Segment

On Ramp Jatikarya - Cimanggis Junction
▼

Recorded At

📅 Select Date

Traffic Counting Station

Name

On Ramp Jatikarya - Cimanggis Junction

Location	Latitude	Longitude
0.000	0.000000	0.000000

Method

Counting

Description

Type a description of Traffic Counting...

Class I	Class II	Class III	Class IV	Class V
00:00 - 01:00	08:00 - 09:00	16:00 - 17:00		
- 0 +	- 0 +	- 0 +		
01:00 - 02:00	09:00 - 10:00	17:00 - 18:00		
- 0 +	- 0 +	- 0 +		
02:00 - 03:00	10:00 - 11:00	18:00 - 19:00		
- 0 +	- 0 +	- 0 +		
03:00 - 04:00	11:00 - 12:00	19:00 - 20:00		
- 0 +	- 0 +	- 0 +		
04:00 - 05:00	12:00 - 13:00	20:00 - 21:00		
- 0 +	- 0 +	- 0 +		
05:00 - 06:00	13:00 - 14:00	21:00 - 22:00		
- 0 +	- 0 +	- 0 +		
06:00 - 07:00	14:00 - 15:00	22:00 - 23:00		
- 0 +	- 0 +	- 0 +		
07:00 - 08:00	15:00 - 16:00	23:00 - 00:00		
- 0 +	- 0 +	- 0 +		

Close
Save

Figure 3.29 User Interface Design for “Traffic Volume” data inputting





Analysis Module

Chapter

04



4.1. SPM Monitoring

Based on Term of Reference (TOR), SPM monitoring is one of the targets of E-SPM upgrading in the form of analysis module. The Sub-Consultant shall develop a single interface to monitor SPM indicators recorded by TRO and ITRA Inspection Team on top of minimum indicator stipulated by regulation (No. 16/PRT/M/2014).

The analysis feature as referred to in **Figure 1.2** is to find out the comparison of SPM fulfilment by TRO, ITRA and regulatory provisions. The technical approach will be described through a sample case of SPM fulfilment.

Table 4.1 Sample case of SPM fulfilment (indicator: potholes)

ITRA Verification			TRO Reporting		
Damage Found (Date)	Repair Date	Repair Duration (Days)	Damage Found (Date)	Repair Date	Repair Duration (Days)
01/05/2022	06/05/2022	5	01/05/2022	07/05/2022	6
01/05/2022	06/05/2022	5	02/05/2022	07/05/2022	5
01/05/2022	09/05/2022	8	03/05/2022	07/05/2022	4
01/05/2022	09/05/2022	8	04/05/2022	09/05/2022	5
02/05/2022	09/05/2022	7	04/05/2022	09/05/2022	5
02/05/2022	10/05/2022	8	04/05/2022	09/05/2022	5
04/05/2022	10/05/2022	6	05/05/2022	09/05/2022	4
04/05/2022	10/05/2022	6	07/05/2022	10/05/2022	3
04/05/2022	10/05/2022	6	10/05/2022	11/05/2022	1
04/05/2022	12/05/2022	8	11/05/2022	13/05/2022	2
04/05/2022	12/05/2022	8	11/05/2022	13/05/2022	2

From the sample data above, the next step is to calculate the value of SPM fulfilment using the following equation:

$$SPM = \frac{\sum_1^n rd - df}{n}$$

..... **Equation 4.1**

- SPM* : SPM fulfilment (daily)
- n* : Amount of damage in 1 day
- rd* : Repair Date of each damage (datetime format)
- df* : Damage Found (datetime format)

The results of calculating the SPM fulfilment value based on the example in **Table 4.1** using **Equation 4.1** can be seen in the following table:

Table 4.2 The results of calculating the value of SPM fulfilment

Date of SPM Fulfilment	ITRA	TRO
01/05/2022	6,5	6
02/05/2022	7,5	5
03/05/2022	0	4
04/05/2022	6	5
05/05/2022	0	4
06/05/2022	0	0
07/05/2022	0	3
08/05/2022	0	0
09/05/2022	0	0
10/05/2022	0	1
11/05/2022	0	2

Table 4.2 above when converted into a comparison chart which can be seen in the image below:

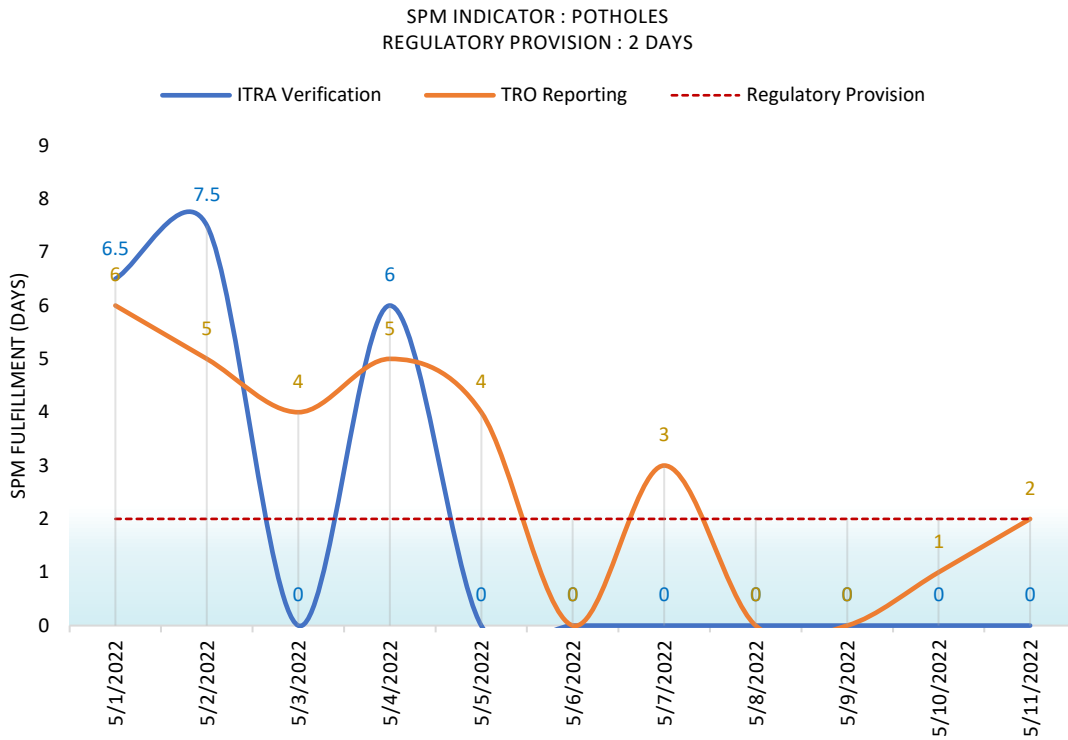


Figure 4.1 Comparison chart of SPM fulfilment



4.1.1. System Process Design

4.1.1.1. Context Diagram

The Context Diagram for "SPM Monitoring" analysis can be seen in the image below:

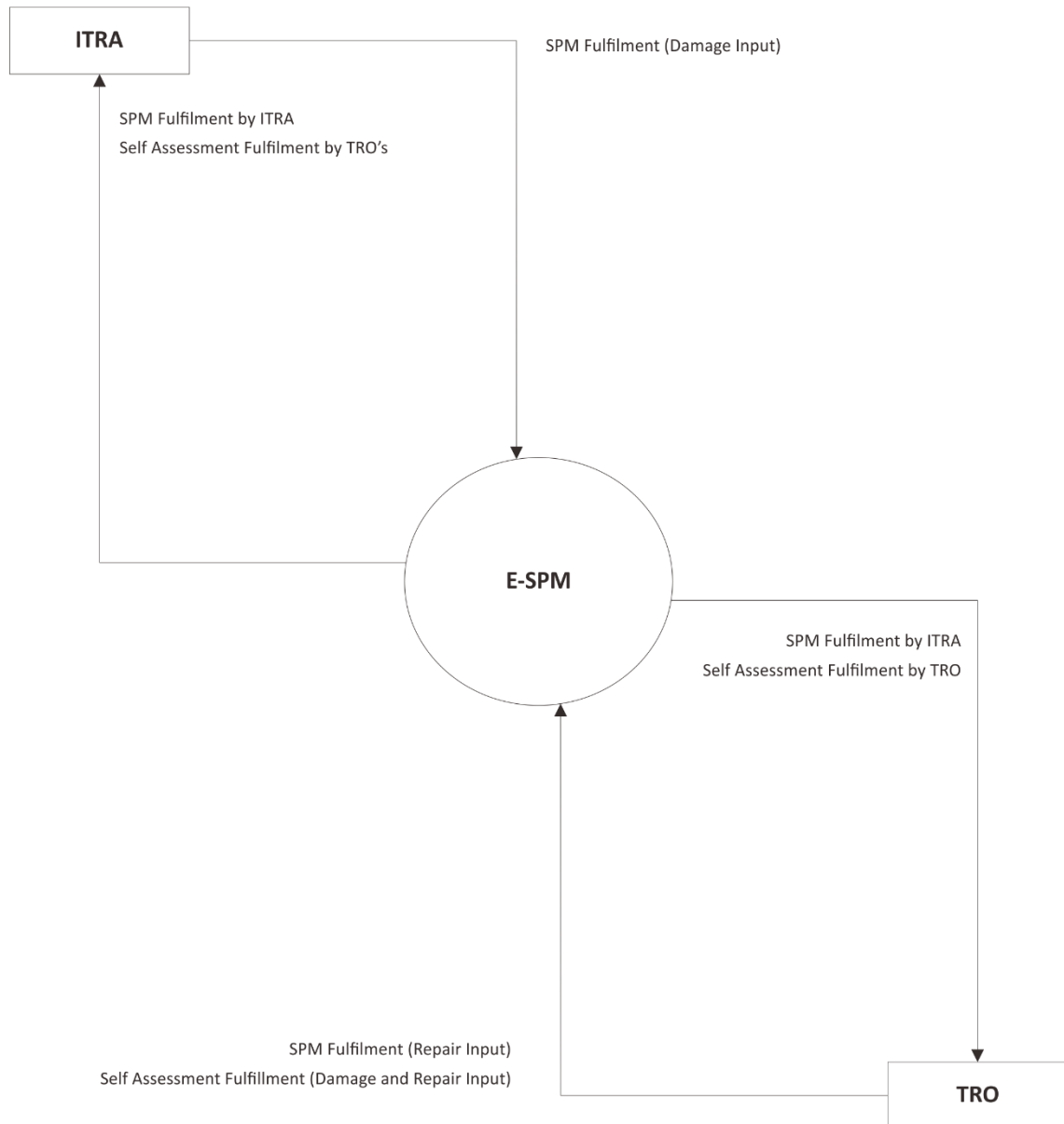


Figure 4.2 Context Diagram for "SPM Monitoring" analysis

4.1.1.2. Use Case Diagram

The Use Case Diagram for "SPM Monitoring" analysis can be seen in the image below:

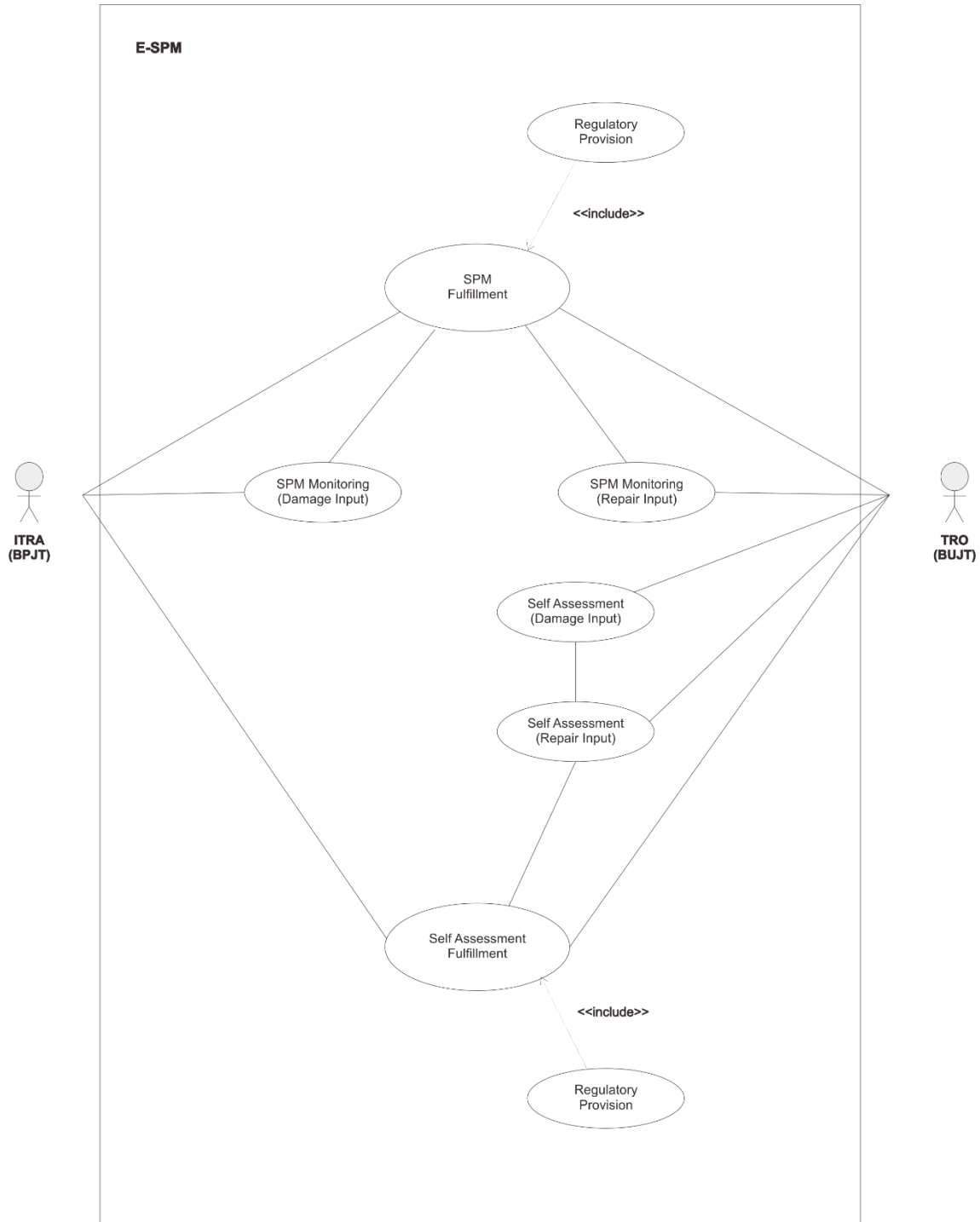


Figure 4.3 Use Case for "SPM Monitoring" analysis



4.1.2. Database Design

Database Design for "SPM Monitoring" analysis can be seen in the image below:

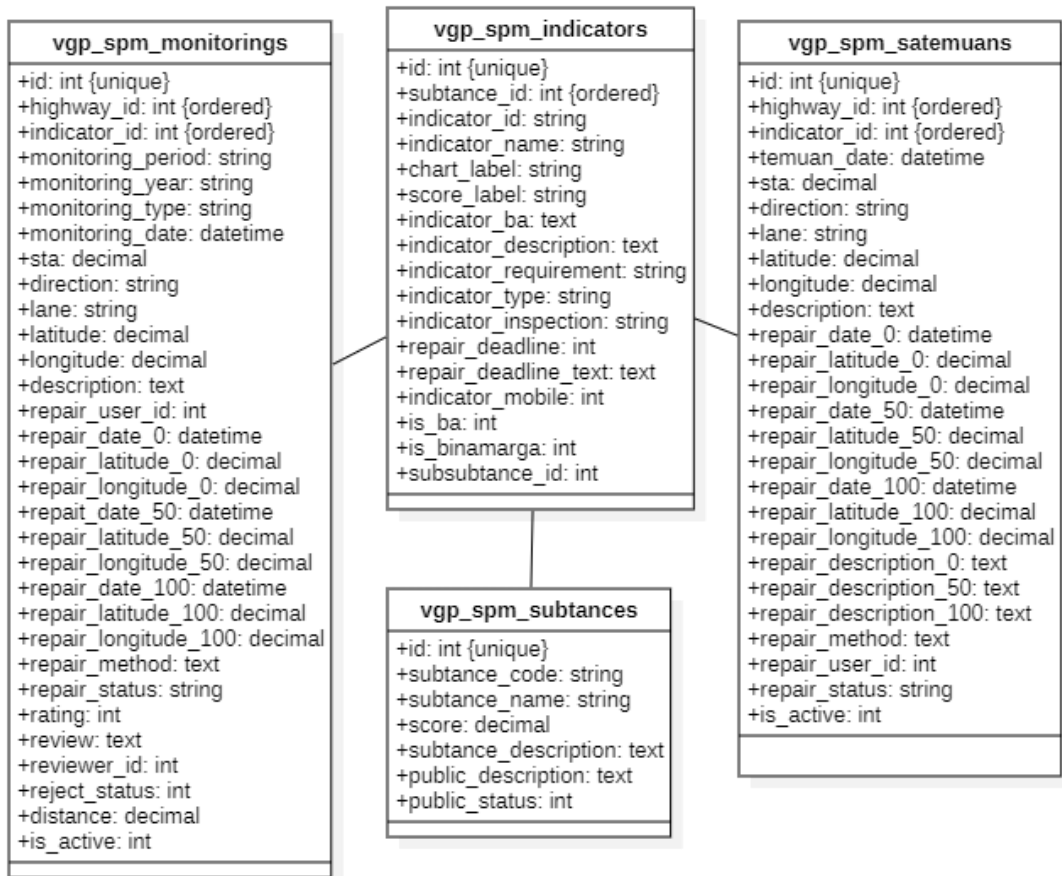


Figure 4.4 Database design for “SPM Monitoring” analysis

4.1.2.1. SPM Substances

Table Name : **vgp_spm_substances**

Table Relation : -

Type of Table : Master

Description : Substance master data of SPM fulfilment, referring to the Regulation of the Minister of Public Works no: 16/PRT/M/2014 about Minimum Standard of Service (Standar Pelayanan Minimum (SPM) in Bahasa) for toll roads

Table 4.3 Data dictionary for “vgp_spm_substances” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each substance
2.		substance_code	Code	string	Specific code for substance, coded by ITRA
3.		substance_name	Name	string	Name of substance
4.		score	-	decimal	For SPM competition calculation
5.		substance_description	Description	string	Description of substance
6.		public_description	-	string	For SPM competition label
7.		public_status	-	integer	For validation

Text: already available in the existing e-SPM database

Text: e-SPM database development

4.1.2.2. SPM Indicators

Table Name : **vgp_spm_indicators**

Table Relation : vgp_spm_substances

Type of Table : Master

Description : Indicator master data of SPM fulfilment, referring to the Regulation of the Minister of Public Works no: 16/PRT/M/2014 about Minimum Standard of Service (Standar Pelayanan Minimum (SPM) in Bahasa) for toll roads

Table 4.4 Data dictionary for “vgp_spm_indicators” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each indicator
2.	F	substance_id	Substance	integer	Refers to “vgp_spm_substances” table
3.		indicator_id	Code	string	Specific code for indicator, coded by ITRA
4.		indicator_name	Name	string	Name of indicator
5.		chart_label	-	string	Label for dashboard chart
6.		score_label	-	string	Label for dashboard score (competition)
7.		indicator_ba	-	string	Label for SPM report
8.		indicator_description	Description	string	Description of indicator



Table 4.5 Data dictionary for “vgp_spm_indicators” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
9.		indicator_ requirement	Requirement	string	Indicator requirement for SPM fulfilment
10.		indicator_type	-	string	For fulfilment requirement
11.		indicator_ inspection	-	string	For fulfilment requirement
12.		repair_deadline	Repair Deadline	integer	Repair deadline (in days)
13.		repair_deadline_ text	-	string	Label for SPM report
14.		indicator_mobile	-	integer	For validation mobile app
15.		is_ba	-	integer	For validation SPM report (on/off)
16.		is_binamarga	-	integer	For validation Bina Marga (on/off), request from ITRA

Text: already available in the existing e-SPM database

Text: e-SPM database development

4.1.2.3. SPM Monitoring

Table Name : **vgp_spm_monitorings**

Table Relation : vgp_spm_highways, vgp_spm_indicators, backend_users

Type of Table : Transaction

Description : Inspection/verification of SPM fulfilment by ITRA

Table 4.6 Data dictionary for “vgp_spm_monitorings” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each monitoring data
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.	F	indicator_id	Indicator	integer	Refers to “vgp_spm_indicators” table
4.		monitoring_period	Period	string	Period of SPM monitoring
5.		monitoring_year	Year	string	Year of SPM monitoring
6.		monitoring_type	Monitoring Type	string	Type of SPM monitoring, monthly or semester
7.		monitoring_date	Date	datetime	Date of SPM monitoring
8.		sta	Chainage	decimal	Chainage of damage/issue

Table 4.7 Data dictionary for “vgp_spm_monitorings” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
9.		direction	Direction	string	Direction of damage/issue location (normal direction or opposite direction)
10.		lane	Lane	string	Lane position of damage/issue
11.		latitude	Latitude	decimal	Latitude of damage/issue location
12.		longitude	Longitude	decimal	Longitude of damage/issue location
13.		description	Description	string	Description of damage/issue
14.	F	repair_user_id	User	integer	Refers to “backend_users” table (TRO)
15.		repair_date_0	0% Date	datetime	Date of repair 0% (before repair)
16.		repair_latitude_0	0% Latitude	decimal	Latitude of repair 0% (before repair)
17.		repair_longitude_0	0% Longitude	decimal	Longitude of repair 0% (before repair)
18.		repair_date_50	50% Date	datetime	Date of repair 50% (repair process)
19.		repair_latitude_50	50% Latitude	decimal	Latitude of repair 50% (repair process)
20.		repair_longitude_50	50% Longitude	decimal	Longitude of repair 50% (repair process)
21.		repair_date_100	100% Date	datetime	Date of repair 100% (after repair)
22.		repair_latitude_100	100% Latitude	decimal	Latitude of repair 100% (after repair)
23.		repair_longitude_100	100% Longitude	decimal	Longitude of repair 100% (after repair)
24.		repair_method	Repair Method	string	Repair method
25.		repair_status	Repair Status	string	Repair status: Finish/Unfinish
26.		rating	Rate	integer	Repair that has been completed will be rated by BPJT
27.		review	Review	string	Repair that has been completed will be reviewed by BPJT
28.	F	reviewer_id	Reviewer	integer	Refers to “backend_users” table (ITRA)
29.		reject_status	Approval Status	integer	After repairs are carried out, BPJT may reject/accept it
30.		distance	Distance (m)	decimal	For distance information between damage/issue and repair location

Text: already available in the existing e-SPM database

Text: e-SPM database development



In order to calculate SPM fulfilment by ITRA, the df variable in **Equation 4.1** is taken from the "monitoring_date" field (7) of this table. While the rd variable is taken from the "repair_date_100" field (21).

4.1.2.4. Self-Assessment

Table Name : **vgp_spm_satemuans**
 Table Relation : vgp_spm_highways, vgp_spm_indicators, backend_users
 Type of Table : Transaction
 Description : Self-Assessment (SA) of SPM fulfilment by TROs

Table 4.8 Data dictionary for "vgp_spm_satemuans" table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each SA data
2.	F	highway_id	Highway	integer	Refers to "vgp_spm_highways" table
3.	F	indicator_id	Indicator	integer	Refers to "vgp_spm_indicators" table
4.		temuan_date	Date	datetime	Date of damage/issue was found
5.		sta	Chainage	decimal	Chainage of damage/issue
6.		direction	Direction	string	Direction of damage/issue location (normal direction or opposite direction)
7.		lane	Lane	string	Lane position of damage/issue
8.		latitude	Latitude	decimal	Latitude of damage/issue location
9.		longitude	Longitude	decimal	Longitude of damage/issue location
10.		description	Description	string	Description of damage/issue
11.		repair_date_0	0% Date	datetime	Date of repair 0% (before repair)
12.		repair_latitude_0	0% Latitude	decimal	Latitude of repair 0% (before repair)
13.		repair_longitude_0	0% Longitude	decimal	Longitude of repair 0% (before repair)
14.		repair_date_50	50% Date	datetime	Date of repair 50% (repair process)
15.		repair_latitude_50	50% Latitude	decimal	Latitude of repair 50% (repair process)
16.		repair_longitude_50	50% Longitude	decimal	Longitude of repair 50% (repair process)
17.		repair_date_100	100% Date	datetime	Date of repair 100% (after repair)
18.		repair_latitude_100	100% Latitude	decimal	Latitude of repair 100% (after repair)

Table 4.9 Data dictionary for “vgp_spm_satemuans” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
19.		repair_ longitude_100	100% Longitude	decimal	Longitude of repair 100% (after repair)
20.		repair_method	Repair Method	string	Repair method
21.	F	repair_user_id	User	integer	Refers to “backend_users” table (TRO)
22.		repair_status	Repair Status	string	Repair status: Finish/Unfinish

Text: already available in the existing e-SPM database

Text: e-SPM database development

In order to calculate SPM fulfilment by TROs (Self-Assessment), the df variable in **Equation 4.1** is taken from the "temuan_date" field (4) of this table. While the rd variable is taken from the "repair_date_100" field (17).

4.1.3. User Interface Design

User Interface (UI) Design for "SPM Monitoring" analysis can be seen in **Figure 4.5**:



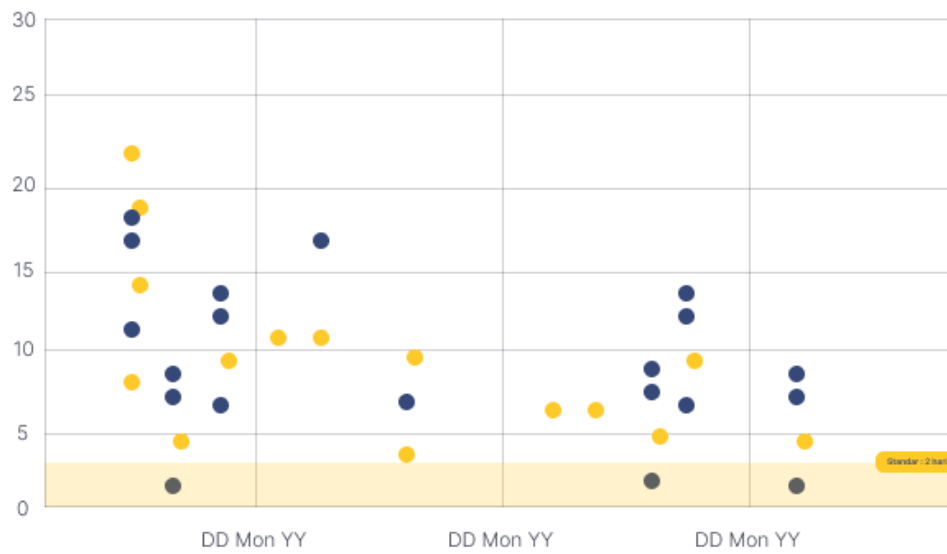
Indicator Fulfillment Chart

Indicator Fulfillment [Indicator Name]

DD/MM/YY - DD/MM/YY

● SPM ● Self Assessment

Tolerance Time (Day)



Indicator Fulfillment [Indicator Name]

DD/MM/YY - DD/MM/YY

● SPM ● Self Assessment

Tolerance Time (Day)

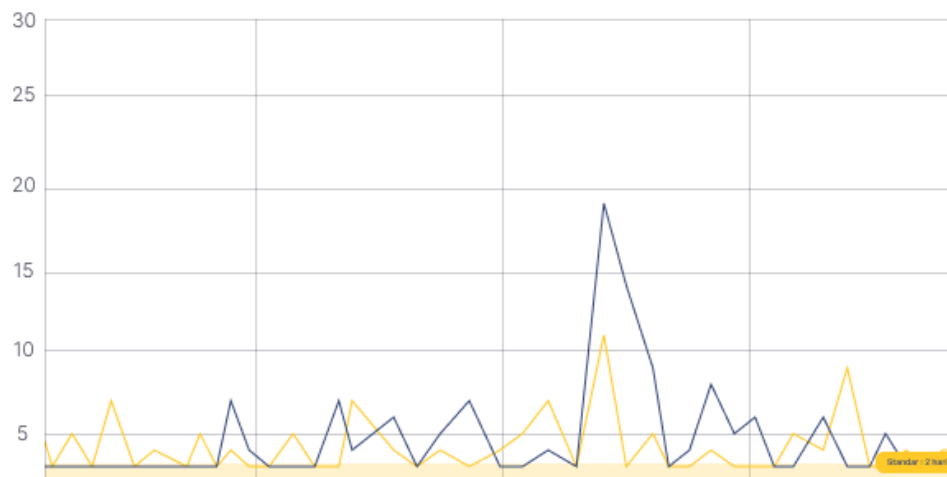


Figure 4.5 User Interface Design for “SPM Monitoring” analysis



4.2. TROs Performance Evaluation

Based on Term of Reference (TOR), TROs performance evaluation is one of the targets of E-SPM upgrading in the form of analysis module. The Sub-Consultant shall develop an analytical module to conduct performance evaluation of TROs using data collected for E-SPM. In the current version of E-SPM, there is a kind of performance evaluation but comparative evaluation is missing.

The analysis feature as referred to in **Figure 1.3** is to determine the comparison of SPM fulfilment based on indicators for each toll road. The technical approach will be described through a sample case of SPM fulfilment.

Table 4.10 Sample case of SPM fulfilment per-indicators

Indicator	SPM Fulfilment							
	TRO-1	TRO-2	TRO-3	TRO-4	TRO-5	TRO-6	TRO-7	TRO-8
Indicator-1	98,8	86,4	75,6	99,2	88,8	85,4	97,2	86,1
Indicator-2	98,7	98,0	100,0	98,2	100,0	90,0	92,2	94,0
Indicator-3	93,7	93,0	95,0	93,2	95,0	85,0	87,2	89,0
Indicator-4	96,7	96,0	98,0	96,2	98,0	88,0	90,2	92,0
Indicator-5	91,7	91,0	93,0	91,2	93,0	83,0	85,2	87,0
Indicator-6	94,7	88,0	90,0	88,2	90,0	80,0	82,2	84,0
Indicator-x	89,7	83,0	85,0	83,2	85,0	75,0	77,2	79,0
Indicator-54	92,7	86,0	88,0	86,2	88,0	78,0	80,2	82,0

From the sample data above, the next step is to calculate the value of SPM fulfilment using the following equation:

$$SPM_i = \frac{n_{finish}}{n} \times 100$$

..... Equation 4.2

- SPM_i : SPM fulfilment per-indicators
- n_{finish} : Amount of damage that has been repaired
- n : Amount of damage/issue

Table 4.10 above when converted into a comparison chart which can be seen in **Figure 4.6** below:

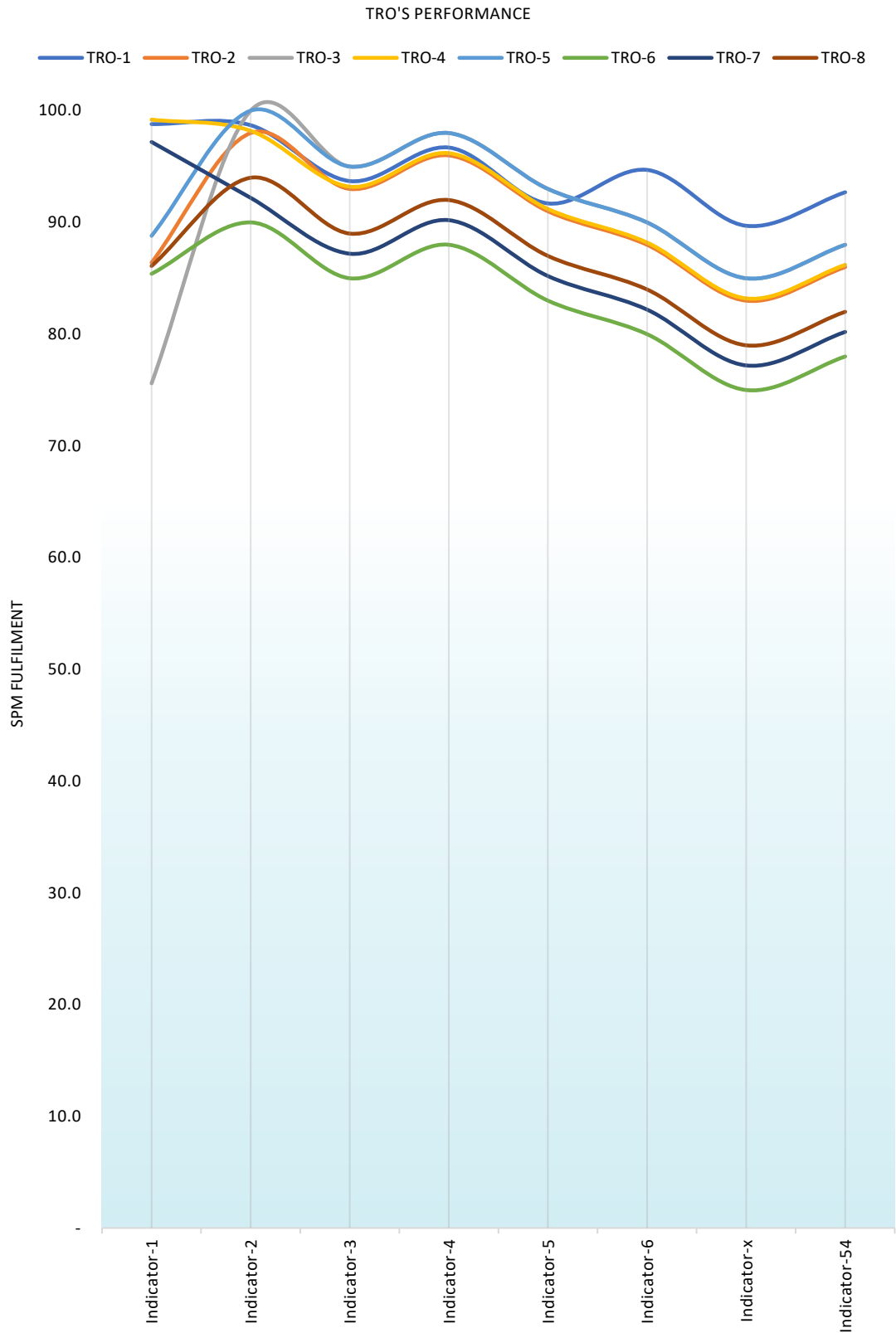


Figure 4.6 TROs performance in fulfilling SPM

4.2.1. System Process Design

4.2.1.1. Context Diagram

The Context Diagram for "TROs Performance" analysis can be seen in the image below:

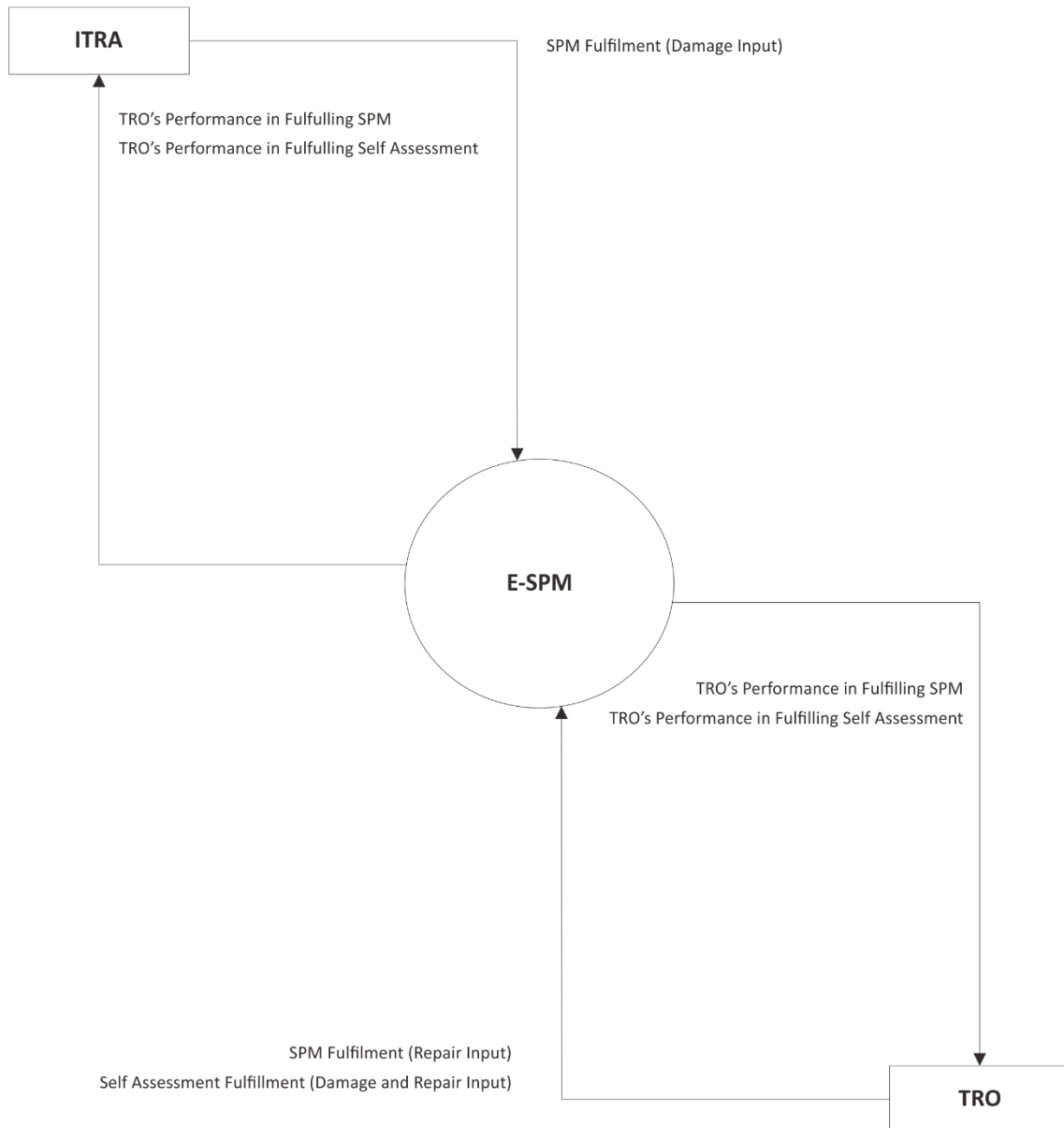


Figure 4.7 Context Diagram for "TROs performance" analysis



4.2.1.2. Use Case Diagram

The Use Case Diagram for "TROs Performance" analysis can be seen in the image below:



Figure 4.8 Use Case for "TROs Performance" analysis

4.2.2. Database Design

Database Design for "TROs Performance" analysis basically the same as "SPM Monitoring" analysis (**Figure 4.4**), which can also be seen in the image below:

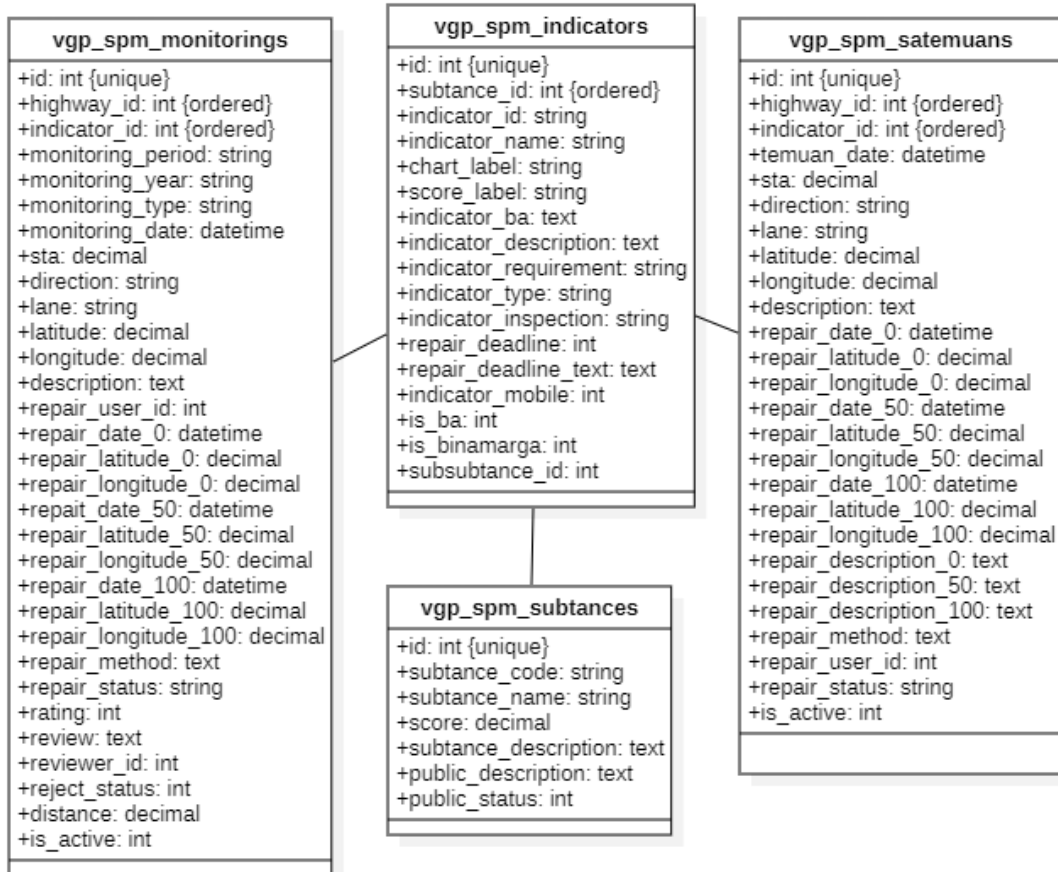


Figure 4.9 Database design for "TROs Performance" analysis

4.2.2.1. SPM Substances

Table Name : **vgp_spm_substances**

Table Relation : -

Type of Table : Master

Description : Substance master data of SPM fulfilment, referring to the Regulation of the Minister of Public Works no: 16/PRT/M/2014 about Minimum Standard of Service (Standar Pelayanan Minimum (SPM) in Bahasa) for toll roads

Note : Same as **Sub-Chapter 4.1.2.1**



Table 4.11 Data dictionary for “vgp_spm_substances” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each substance
2.		substance_code	Code	string	Specific code for substance, coded by ITRA
3.		substance_name	Name	string	Name of substance
4.		score	-	decimal	For SPM competition calculation
5.		substance_description	Description	string	Description of substance
6.		public_description	-	string	For SPM competition label
7.		public_status	-	integer	For validation

Text: already available in the existing e-SPM database

Text: e-SPM database development

4.2.2.2. SPM Indicators

Table Name : **vgp_spm_indicators**

Table Relation : vgp_spm_substances

Type of Table : Master

Description : Indicator master data of SPM fulfilment, referring to the Regulation of the Minister of Public Works no: 16/PRT/M/2014 about Minimum Standard of Service (Standar Pelayanan Minimum (SPM) in Bahasa) for toll roads

Note : Same as **Sub-Chapter 4.1.2.2**

Table 4.12 Data dictionary for “vgp_spm_indicators” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each indicator
2.	F	substance_id	Substance	integer	Refers to “vgp_spm_substances” table
3.		indicator_id	Code	string	Specific code for indicator, coded by ITRA
4.		indicator_name	Name	string	Name of indicator
5.		chart_label	-	string	Label for dashboard chart
6.		score_label	-	string	Label for dashboard score (competition)
7.		indicator_ba	-	string	Label for SPM report
8.		indicator_description	Description	string	Description of indicator

Table 4.13 Data dictionary for “vgp_spm_indicators” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
9.		indicator_ requirement	Requirement	string	Indicator requirement for SPM fulfilment
10.		indicator_type	-	string	For fulfilment requirement
11.		indicator_ inspection	-	string	For fulfilment requirement
12.		repair_deadline	Repair Deadline	integer	Repair deadline (in days)
13.		repair_deadline_ text	-	string	Label for SPM report
14.		indicator_mobile	-	integer	For validation mobile app
15.		is_ba	-	integer	For validation SPM report (on/off)
16.		is_binamarga	-	integer	For validation Bina Marga (on/off), request from ITRA

Text: already available in the existing e-SPM database

Text: e-SPM database development

4.2.2.3. SPM Monitoring

Table Name : **vgp_spm_monitorings**

Table Relation : vgp_spm_highways, vgp_spm_indicators, backend_users

Type of Table : Transaction

Description : Inspection/verification of SPM fulfilment by ITRA

Note : Same as **Sub-Chapter 4.1.2.3**

Table 4.14 Data dictionary for “vgp_spm_monitorings” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each monitoring data
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.	F	indicator_id	Indicator	integer	Refers to “vgp_spm_indicators” table
4.		monitoring_period	Period	string	Period of SPM monitoring
5.		monitoring_year	Year	string	Year of SPM monitoring
6.		monitoring_type	Monitoring Type	string	Type of SPM monitoring, monthly or semester
7.		monitoring_date	Date	datetime	Date of SPM monitoring



Table 4.15 Data dictionary for “vgp_spm_monitorings” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
8.		sta	Chainage	decimal	Chainage of damage/issue
9.		direction	Direction	string	Direction of damage/issue location (normal direction or opposite direction)
10.		lane	Lane	string	Lane position of damage/issue
11.		latitude	Latitude	decimal	Latitude of damage/issue location
12.		longitude	Longitude	decimal	Longitude of damage/issue location
13.		description	Description	string	Description of damage/issue
14.	F	repair_user_id	User	integer	Refers to “backend_users” table (TRO)
15.		repair_date_0	0% Date	datetime	Date of repair 0% (before repair)
16.		repair_latitude_0	0% Latitude	decimal	Latitude of repair 0% (before repair)
17.		repair_longitude_0	0% Longitude	decimal	Longitude of repair 0% (before repair)
18.		repair_date_50	50% Date	datetime	Date of repair 50% (repair process)
19.		repair_latitude_50	50% Latitude	decimal	Latitude of repair 50% (repair process)
20.		repair_longitude_50	50% Longitude	decimal	Longitude of repair 50% (repair process)
21.		repair_date_100	100% Date	datetime	Date of repair 100% (after repair)
22.		repair_latitude_100	100% Latitude	decimal	Latitude of repair 100% (after repair)
23.		repair_longitude_100	100% Longitude	decimal	Longitude of repair 100% (after repair)
24.		repair_method	Repair Method	string	Repair method
25.		repair_status	Repair Status	string	Repair status: Finish/Unfinish
26.		rating	Rate	integer	Repair that has been completed will be rated by BPJT
27.		review	Review	string	Repair that has been completed will be reviewed by BPJT
28.	F	reviewer_id	Reviewer	integer	Refers to “backend_users” table (ITRA)
29.		reject_status	Approval Status	integer	After repairs are carried out, BPJT may reject/accept it
30.		distance	Distance (m)	decimal	For distance information between damage/issue and repair location

Text: already available in the existing e-SPM database

Text: e-SPM database development

In order to calculate SPM fulfilment (per-indicator) by ITRA, the n_{finish} variable in **Equation 4.2** is taken from the "repair_status = 'Finish'" field (25) of this table. While the n variable is taken from the "count data based on highway_id" field (2).

4.2.2.4. Self-Assessment

Table Name : **vgp_spm_satemuans**
 Table Relation : vgp_spm_highways, vgp_spm_indicators, backend_users
 Type of Table : Transaction
 Description : Self-Assessment (SA) of SPM fulfilment by TROs
 Note : Same as **Sub-Chapter 4.1.2.4**

Table 4.16 Data dictionary for “vgp_spm_satemuans” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each SA data
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.	F	indicator_id	Indicator	integer	Refers to “vgp_spm_indicators” table
4.		temuan_date	Date	datetime	Date of damage/issue was found
5.		sta	Chainage	decimal	Chainage of damage/issue
6.		direction	Direction	string	Direction of damage/issue location (normal direction or opposite direction)
7.		lane	Lane	string	Lane position of damage/issue
8.		latitude	Latitude	decimal	Latitude of damage/issue location
9.		longitude	Longitude	decimal	Longitude of damage/issue location
10.		description	Description	string	Description of damage/issue
11.		repair_date_0	0% Date	datetime	Date of repair 0% (before repair)
12.		repair_latitude_0	0% Latitude	decimal	Latitude of repair 0% (before repair)
13.		repair_longitude_0	0% Longitude	decimal	Longitude of repair 0% (before repair)
14.		repair_date_50	50% Date	datetime	Date of repair 50% (repair process)
15.		repair_latitude_50	50% Latitude	decimal	Latitude of repair 50% (repair process)
16.		repair_longitude_50	50% Longitude	decimal	Longitude of repair 50% (repair process)
17.		repair_date_100	100% Date	datetime	Date of repair 100% (after repair)



Table 4.17 Data dictionary for “vgp_spm_satemuans” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
18.		repair_latitude_100	100% Latitude	decimal	Latitude of repair 100% (after repair)
19.		repair_longitude_100	100% Longitude	decimal	Longitude of repair 100% (after repair)
20.		repair_method	Repair Method	string	Repair method
21.	F	repair_user_id	User	integer	Refers to “backend_users” table (TRO)
22.		repair_status	Repair Status	string	Repair status: Finish/Unfinish

Text: already available in the existing e-SPM database

Text: e-SPM database development

In order to calculate Self-Assessment fulfilment (per-indicator) by TRO, the n_{finish} variable in **Equation 4.2** is taken from the "repair_status = 'Finish'" field (22) of this table. While the n variable is taken from the "count data based on highway_id" field (2).

4.2.3. User Interface Design

User Interface (UI) Design for "TROs Performance" analysis can be seen in **Figure 4.10**:

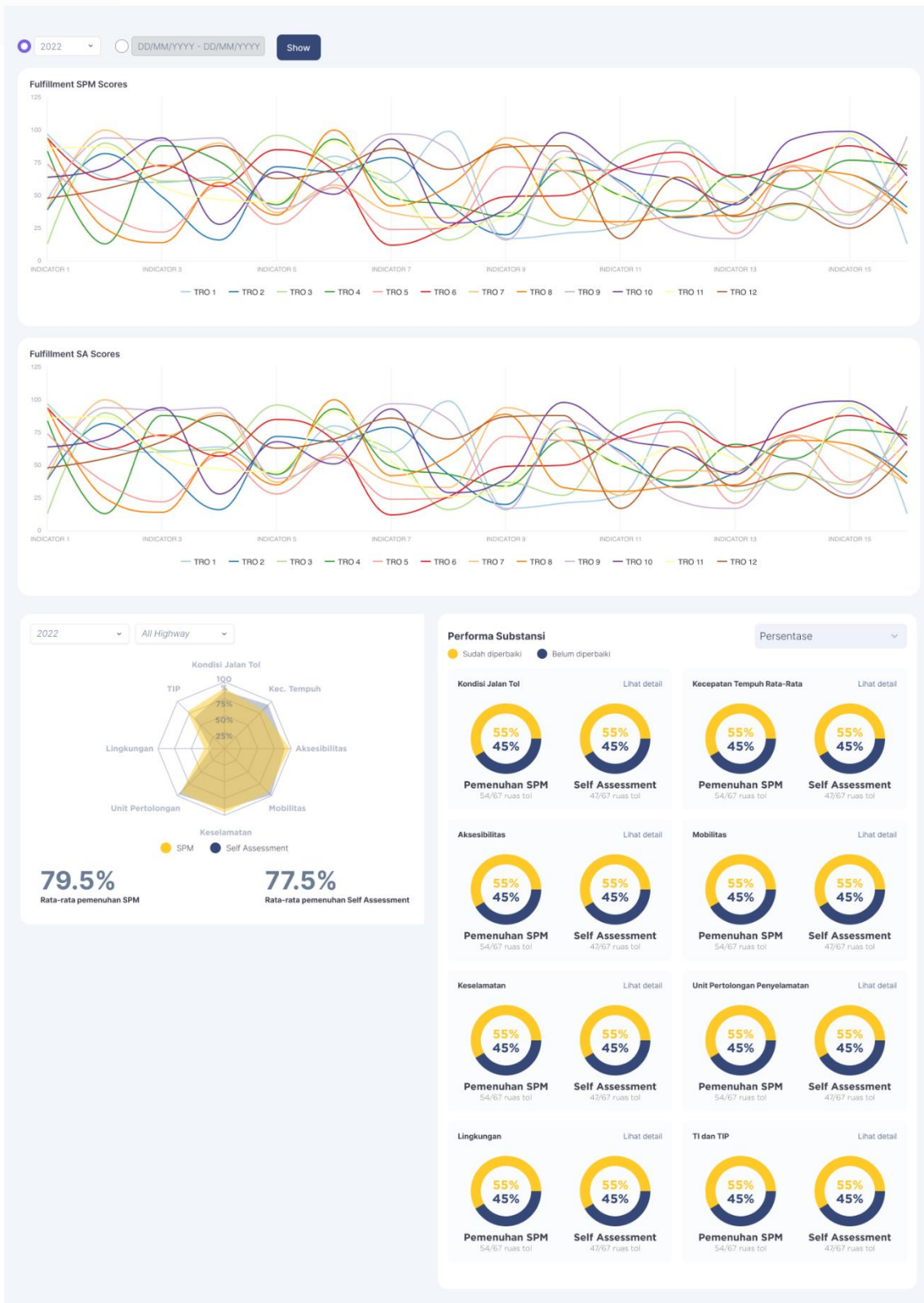


Figure 4.10 User Interface Design for “TROs Performance” analysis



4.3. TROs Blacklist Evaluation

Based on Term of Reference (TOR), TROs blacklist evaluation is one of the targets of E-SPM upgrading in the form of analysis module. In the current version of E-SPMS, there is a tool to list the best 5 TROs which comply with SPM requirements. Also, there is a graphical presentation of number of detected defects and number of repair events as shown in **Figure 1.4**. However, there is no list of TROs which do not fulfil the requirements of SPM. Therefore, it is advised to create a list of black listed TROs who do not fulfil the requirements of SPM. The Sub-Consultant shall develop a tool to list up the TROs which do not fulfil the requirements of SPM.

Actually, ITRA has developed an SPM competition system which is an assessment concept in order to create positive enthusiasm for each TRO to compete in providing the best service for road users. The system mechanism that is carried out is like a 'football league' competition, where after passing a period of time, the team with the highest points (win 3 points, draw 1 point, lose 0 points) will become the champion of the competition. If in football points are determined from the results of the match, the points earned in this SPM competition are determined based on the percentage and duration of repairs to damage referring to the tolerance time for repairs in accordance with Minister of Public Works Regulation Number No.16/PRT/M/2014 about Minimum Services Standard for Toll Road. Each indicator and substance are also given a calculation weight as a multiplier, was obtained from previous ITRA studies. The weighting of substance can be seen in **Table 4.18**.

Table 4.18 Weighting of Substance

No	Substances	Weight (%)
1	Toll Road Condition <i>Kondisi Jalan Tol</i>	25.62
2	Average Travel Speed <i>Kecepatan Tempuh Rata-Rata</i>	12.75
3	Accessibility <i>Aksesibilitas</i>	11.07
4	Mobility <i>Mobilitas</i>	9.00
5	Safety <i>Keselamatan</i>	23.02
6	Rescue Units and Service Assistance <i>Unit Pertolongan/Penyelamatan dan Bantuan Layanan</i>	10.47
7	Environment <i>Lingkungan</i>	3.40
8	Rest Area <i>Tempat Istirahat (TI) dan Tempat Istirahat dan Pelayanan (TIP)</i>	4.67
Total		100.00

Text: in Bahasa

The weighting of indicators can be seen in **Table 4.19** to **Table 4.28**.

Table 4.19 Weighting of Substance 1 - Toll Road Condition (25.62%)

Indicators	Sub-Indicators	Weight (%)	Weight (%)
Main Road Pavement <i>Perkerasan Jalan Utama</i>		47.42	
	Skid Resistance <i>Kekesatan</i>		10.00
	International Roughness Index (IRI) <i>Ketidakrataan</i>		10.00
	Potholes <i>Lubang</i>		30.00
	Rutting <i>Rutting</i>		25.00
	Crack <i>Retak</i>		25.00
Drainage <i>Drainase</i>		19.55	
	No Precipitate <i>Tidak Ada Endapan</i>		60.00
	Channel Cross Section <i>Penampang Saluran</i>		40.00
Median <i>Median</i>		14.12	
	Kerb <i>Kerb</i>		5.00
	Median Concrete Barrier <i>Median Concrete Barrier</i>		35.00
	Guard Rail <i>Guard Rail</i>		30.00
	Wire Rope <i>Wire Rope</i>		30.00
Shoulder Pavement <i>Bahu Jalan</i>		12.58	
	Potholes <i>Lubang</i>		40.00
	Rutting <i>Rutting</i>		30.00
	Crack <i>Retak</i>		30.00
Rounding <i>Rounding</i>		6.33	
Total		100	

Text: in Bahasa



Table 4.20 Weighting of Substance 2 - Average Travel Speed (12.75%)

Indicators	Sub-Indicators	Weight (%)	Weight (%)
Average Travel Speed		100	
	<i>Kecepatan Tempuh Rata-Rata</i>		
Total		100	

Text: in Bahasa

Table 4.21 Weighting of Substance 3 - Accessibility (11.07%)

Indicators	Sub-Indicators	Weight (%)	Weight (%)
Average Transaction Speed		77.34	
	<i>Kecepatan Transaksi Rata-Rata</i>		
Number of Vehicles Queue		22.66	
	<i>Jumlah Antrian Kendaraan</i>		
Total		100	

Text: in Bahasa

Table 4.22 Weighting of Substance 4 - Mobility (9.00%)

Indicators	Sub-Indicators	Weight (%)	Weight (%)
Speed of Handling Traffic Obstacles		62.62	
	<i>Kecepatan Penanganan Hambatan Lalu Lintas</i>		
	Observation Area/Patrol Observation		30.00
	<i>Wilayah Pengamatan/Observasi Patroli</i>		
	Starting from the Information Received to the Location		35.00
	<i>Mulai Informasi Diterima Sampai ke Lokasi</i>		
	Handling of Trouble Vehicles		35.00
	<i>Penanganan Kendaraan Mogok</i>		
	Wire Rope		30.00
	<i>Wire Rope</i>		
Speed of Police Handling		21.50	
	<i>Kecepatan Penanganan PJR</i>		
Speed of Towing Handling		15.88	
	<i>Kecepatan Penanganan Derek</i>		
Total		100	

Text: in Bahasa

Table 4.23 Weighting of Substance 5 - Safety (23.02%)

Indicators	Sub-Indicators	Weight (%)	Weight (%)
Road Guideline <i>Petunjuk Jalan</i>		42.60	
	Traffic Sign <i>Perambuan</i>		25.00
	Road Marking <i>Marka Jalan</i>		25.00
	Guide Post/Reflector <i>Guide Post/Reflektor</i>		25.00
	KM Sign <i>Patok Kilometer</i>		10.00
	HM Sign <i>Patok Hektometer</i>		15.00
Other Facility <i>Fasilitas Lainnya</i>		12.47	
	Street Lighting <i>Penerangan Jalan Umum (PJU)</i>		25.00
	Anti-Glare <i>Anti Silau</i>		5.00
	ROW Fence <i>Pagar Rumija</i>		25.00
	Safety Fence <i>Pagar Pengaman</i>		45.00
Accident Handling <i>Penanganan Kecelakaan</i>		32.87	
	Handling of Accident Victims <i>Penanganan Korban Kecelakaan</i>		55.00
	Handling of Accident Vehicles <i>Penanganan Kendaraan Kecelakaan</i>		45.00
Security and Law Enforcement <i>Pengamanan dan Penegakan Hukum</i>		12.06	
Total		100	

Text: in Bahasa

Table 4.24 Weighting of Substance 6 - Rescue Units and Service Assistance (10.47%) (1/2)

Indicators	Sub-Indicators	Weight (%)	Weight (%)
Ambulance <i>Petunjuk Jalan</i>		33.66	
Tow Truck <i>Kendaraan Derek</i>		17.35	
Police Car <i>Kendaraan PJR</i>		12.11	



Table 4.25 Weighting of Substance 6 - Rescue Units and Service Assistance (10.47%) (2/2)

Indicators	Sub-Indicators	Weight (%)	Weight (%)
Highway Patrol		14.56	
<i>Patroli Layanan Jalan Tol</i>			
Rescue Car		10.23	
<i>Kendaraan Rescue</i>			
Information System		12.09	
<i>Sistem Informasi</i>			
	Information and Communication of Traffic Condition		50.00
	<i>Informasi dan Komunikasi Kondisi Lalu Lintas</i>		
	Phone Number of Toll Info		50.00
	<i>Nomor Telepon Info Tol</i>		
Total		100	

Text: in Bahasa

Table 4.26 Weighting of Substance 7 - Environment (3.40%)

Indicators	Sub-Indicators	Weight (%)	Weight (%)
Cleanness		62.33	
<i>Kebersihan</i>			
	Right of Way		65.00
	<i>Dalam Rumija Tol</i>		
	Operation Office and Toll Booth		35.00
	<i>Kantor Operasi dan Gardu Tol</i>		
Plant		23.74	
<i>Tanaman</i>			
Grass		13.93	
<i>Rumput</i>			
Total		100	

Text: in Bahasa

Table 4.27 Weighting of Substance 8 - Rest Area (4.67%) (1/2)

Indicators	Sub-Indicators	Weight (%)	Weight (%)
Road Condition		25.19	
<i>Kondisi Jalan</i>			
On/Off Ramp		18.74	
<i>On/Off Ramp</i>			
Toilet		13.44	
<i>Toilet</i>			

Table 4.28 Weighting of Substance 8 - Rest Area (4.67%) (2/2)

Indicators	Sub-Indicators	Weight (%)	Weight (%)
Vehicle Parking	Parkir Kendaraan	11.01	
Lighting	Penerangan	10.63	
Gas Station	Stasiun Pengisian Bahan Bakar	10.05	
Workshop	Bengkel Umum	5.31	
Restaurant	Tempat Makan dan Minum	5.63	
Total		100	

Text: in Bahasa

After knowing the weighting of each substance and indicator, the next step is to calculate the value of each toll road through the following calculation stages:

- **Stage 1:** Calculate the value of each indicator

$$iv_a = \frac{\sum_1^n jptw}{n} \times iw_a \quad \text{..... Equation 4.3}$$

- iv* : Indicator Value
- a* : Indicator-a
- n* : Amount of damage/issue in 1 indicator
- jptw* : Number of repairs on time
- iw* : Indicator Weight

- **Stage 2:** Calculate the percentage value of each indicator

$$ipv_a = \frac{iv_a}{iw_a} \times 100 \quad \text{..... Equation 4.4}$$

- ipv* : Indicator Percentage Value (%)

- **Stage 3:** Calculate the value of each substance



$$sv_b = \sum_{a=1}^{54} iv_a \times sw_b$$

..... Equation 4.5

- sv* : Substance Value
- 54 : Total amount of indicators
- b* : Substance-b
- sw* : Substance Weight

- **Stage 4:** Calculate the percentage value of each substance

$$spv_b = \frac{sv_b}{sw_b} \times 100$$

..... Equation 4.6

- spv* : Substance Percentage Value (%)

- **Stage 5:** Calculate the final score

$$fs = \sum_{b=1}^8 spv_b$$

..... Equation 4.7

- fs* : Final Score
- 8 : Total amount of substances

The final result of the quantitative assessment will determine which TROs are blacklisted, before further evaluation by ITRA. For example, the minimum value set is 75:

Table 4.29 Example of SPM fulfilment final score (1/2)

No	TRO	Fulfilment Percentage by Substances								Final Score	Category
		Score Range: 0 - 100									
		Minimum Score: 75									
		S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8		
1	TRO-1	100	100	100	100	100	100	100	100	100	
2	TRO-2	100	100	100	100	100	100	98	100	99,93	
3	TRO-3	100	100	100	100	100	97	100	100	99,69	

Table 4.30 Example of SPM fulfilment final score (2/2)

No	TRO	Fulfilment Percentage by Substances								Final Score	Category
		Score Range: 0 - 100									
		Minimum Score: 75									
S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8				
4	TRO-4	99	100	100	98	100	96	100	100	99,15	
5	TRO-5	99	100	100	100	100	88	100	100	98,49	
6	TRO-6	98	100	100	98	100	96	100	89	98,38	
7	TRO-7	95	100	100	95	100	100	100	100	98,27	
8	TRO-8	99	100	100	96	100	98	100	80	98,24	
9	TRO-9	100	100	100	94	100	92	100	88	98,06	
10	TRO-10	95	100	100	90	100	96	100	100	97,40	
11	TRO-11	89	100	100	100	100	100	100	90	96,71	
12	TRO-12	89	100	100	88	100	100	94	85	95,20	
13	TRO-13	80	100	100	100	100	100	85	88	93,81	
14	TRO-14	85	100	100	100	90	100	100	75	92,69	
15	TRO-15	100	100	100	100	75	100	75	55	91,29	
16	TRO-16	75	100	100	100	82	100	100	90	88,98	
17	TRO-17	60	100	100	100	90	90	80	90	85,26	
18	TRO-18	100	100	100	100	50	50	100	100	83,26	
19	TRO-19	80	100	100	100	40	100	100	90	80,60	
20	TRO-20	70	100	100	100	60	70	100	100	79,97	
21	TRO-21	80	100	100	100	40	100	100	70	79,66	
22	TRO-22	100	100	100	100	20	100	100	55	79,48	
23	TRO-23	89	100	100	100	30	100	80	80	79,45	
24	TRO-24	85	100	100	100	50	80	100	20	78,82	
25	TRO-25	100	100	100	100	20	80	70	100	78,47	
26	TRO-26	90	100	100	100	50	20	100	90	77,09	
27	TRO-27	70	100	100	100	60	50	100	80	76,94	
28	TRO-28	88	100	100	100	20	100	40	100	76,47	
...	TRO-...	100	100	100	100	10	100	100	35	76,25	
...	TRO-...	50	100	100	100	50	100	100	90	75,21	
57	TRO-57	40	100	100	100	60	100	80	100	74,74	Blacklist
58	TRO-58	90	100	100	100	50	10	100	50	74,17	Blacklist
59	TRO-59	60	100	100	100	50	60	100	50	71,72	Blacklist
60	TRO-60	50	100	100	100	40	70	100	90	69,77	Blacklist
61	TRO-61	50	100	100	100	35	70	100	90	68,62	Blacklist
62	TRO-62	87	45	65	68	55	66	70	95	67,73	Blacklist
63	TRO-63	58	66	67	100	45	55	86	45	60,83	Blacklist

S: Substance



4.3.1. System Process Design

4.3.1.1. Context Diagram

The Context Diagram for "TROs Blacklist Evaluation" analysis can be seen in the image below:

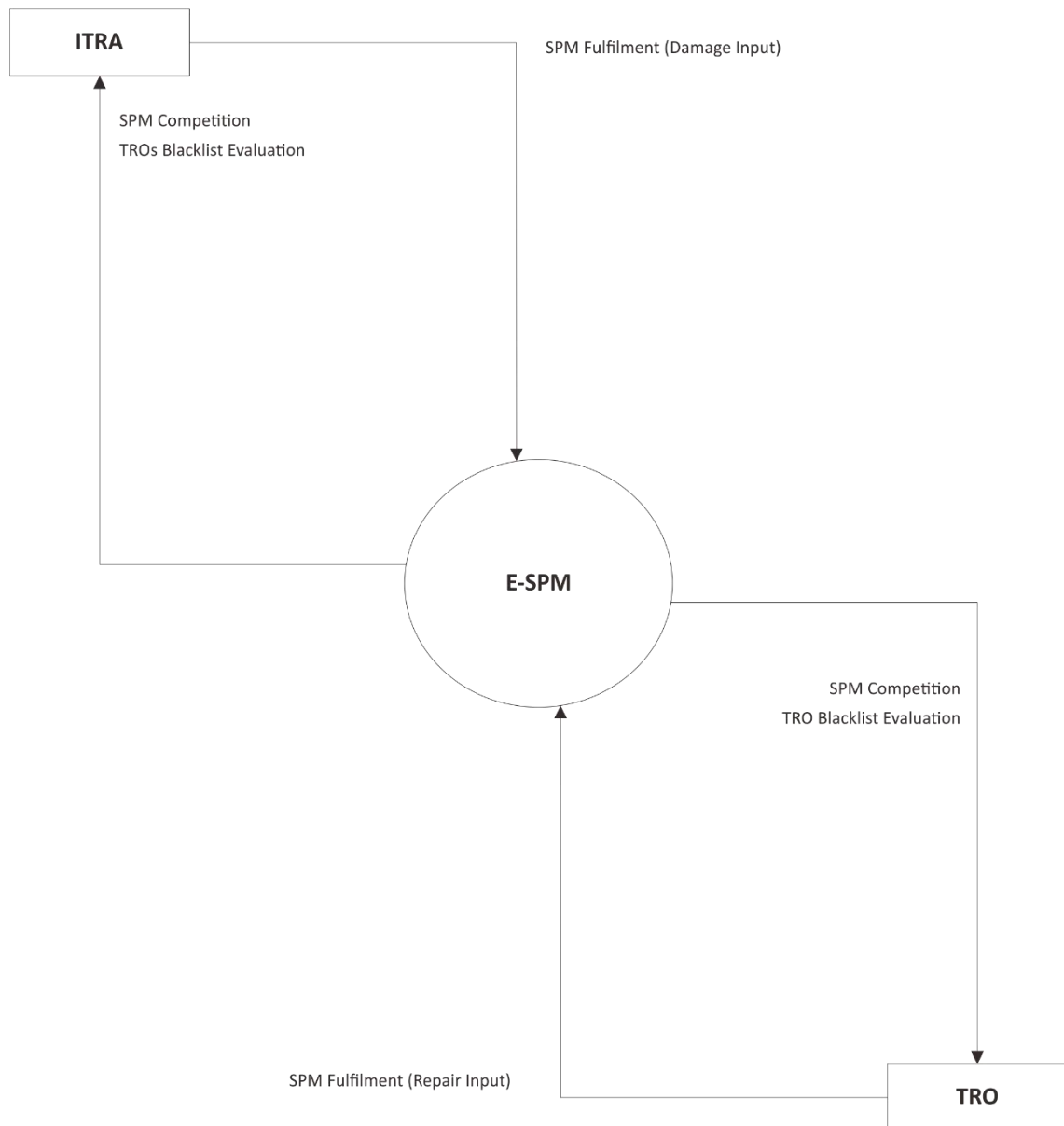


Figure 4.11 Context Diagram for "TROs Blacklist Evaluation" analysis

4.3.1.2. Use Case Diagram

The Use Case Diagram for "TROs Blacklist Evaluation" analysis can be seen in the image below:



Figure 4.12 Use Case for "TROs Blacklist Evaluation" analysis



4.3.2. Database Design

Database Design for "TROs Blacklist Evaluation" analysis can be seen in the image below:

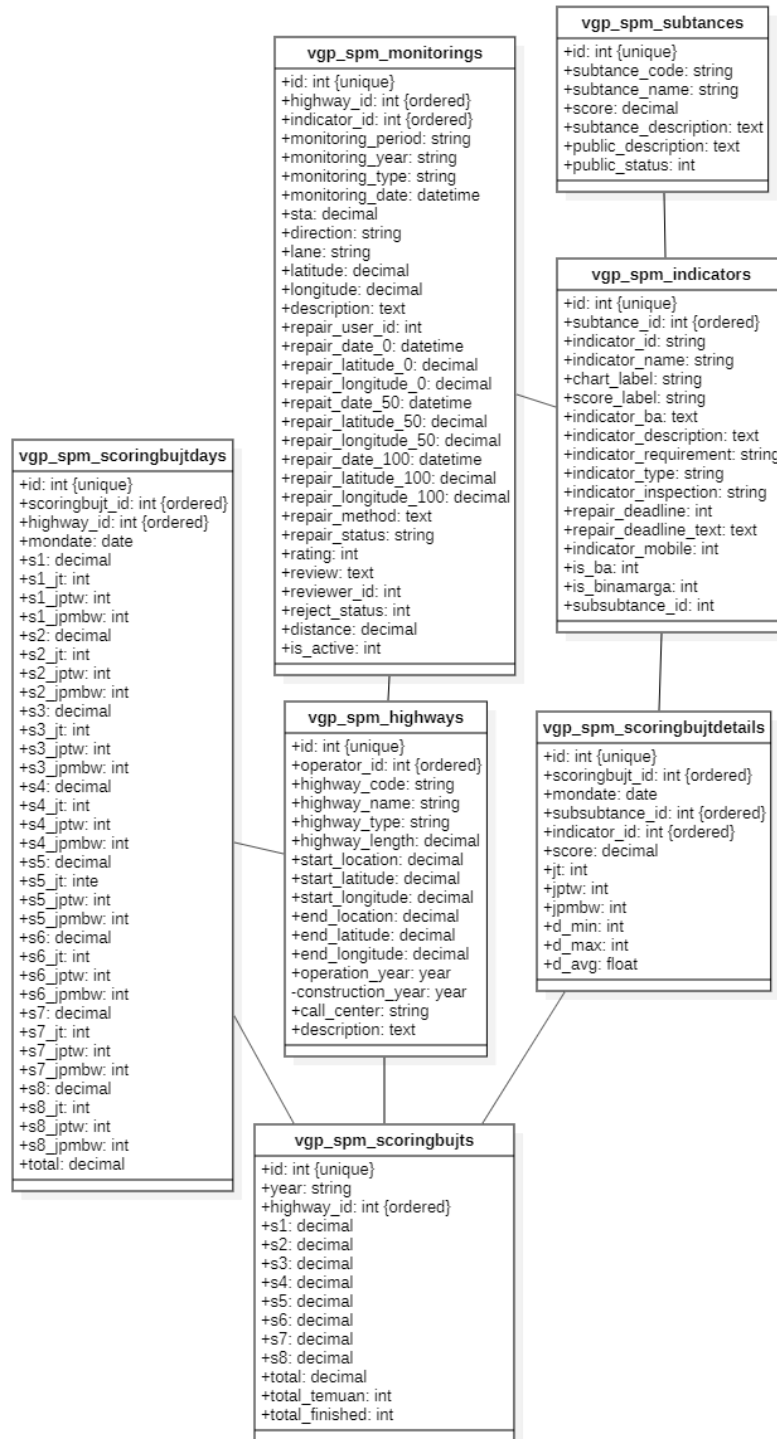


Figure 4.13 Database design for “TROs Blacklist Evaluation” analysis

4.3.2.1. Indicators Scoring

Table Name : **vgp_spm_scoringbujtdetails**

Table Relation : vgp_spm_scoringbujts, vgp_spm_substances, vgp_spm_indicators

Type of Table : Transaction

Description : Detailed indicators scoring for each damage/issue from SPM fulfilment by ITRA

Table 4.31 Data dictionary for “vgp_spm_scoringbujtdetails” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each indicator scoring
2.	F	scoringbujt_id	Scoring	integer	Refers to “vgp_spm_scoringbujts” table
3.		mondate	Date	date	Date of scoring, based on damage/issue was found
4.	F	subsubstance_id	Substance	integer	Refers to “vgp_spm_substances” table
5.	F	indicator_id	Indicator	integer	Refers to “vgp_spm_indicators” table
6.		score	Score	decimal	Indicator Percentage Value (<i>ipv</i>), refers to Equation 4.4
7.		jt	<i>jt</i>	integer	Amount of damage/issue in 1 indicator (<i>jt</i>), refers to Equation 4.3
8.		jptw	<i>jptw</i>	integer	Number of repairs on time (<i>jptw</i>), refers to Equation 4.3
9.		jpmbw	<i>jpmbw</i>	integer	The number of repairs exceeds the time limit ($jpmbw = jt - jptw$)
10.		d_min	-	integer	Dashboard information (old version)
11.		d_max	-	integer	Dashboard information (old version)
12.		d_avg	-	decimal	Dashboard information (old version)

Text: already available in the existing e-SPM database

Text: e-SPM database development

4.3.2.2. Substance Scoring (Daily)

Table Name : **vgp_spm_scoringbujtdays**

Table Relation : vgp_spm_highways, vgp_spm_scoringbujts

Type of Table : Transaction

Description : Detailed substances scoring (daily scoring)



Table 4.32 Data dictionary for “vgp_spm_scoringbujtdays” table (1/3)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each substance scoring
2.	F	scoringbujt_id	Scoring	integer	Refers to “vgp_spm_scoringbujts” table
3.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
4.		mondate	Date	date	Date of scoring
5.		indicator_id	Indicator	integer	Refers to “vgp_spm_indicators” table
6.		s1	Score for Substance-1	decimal	Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
7.		s1_jt	<i>jt</i> for Substance-1	integer	Amount of damage/issue of indicators that are part of Substance-1 (<i>jt</i>), refers to Equation 4.3
8.		s1_jptw	<i>jptw</i> for Substance-1	integer	Number of repairs on time of indicators that are part of Substance-1 (<i>jptw</i>), refers to Equation 4.3
9.		s1_jpmbw	<i>jpmbw</i> for Substance-1	integer	the number of repairs exceeds the time limit of indicators that are part of Substance-2 ($jpmbw = jt - jptw$)
10.		s2	Score for Substance-2	decimal	Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
11.		s2_jt	<i>jt</i> for Substance-2	integer	Amount of damage/issue of indicators that are part of Substance-2 (<i>jt</i>), refers to Equation 4.3
12.		s2_jptw	<i>jptw</i> for Substance-2	integer	Number of repairs on time of indicators that are part of Substance-2 (<i>jptw</i>), refers to Equation 4.3
13.		s2_jpmbw	<i>jpmbw</i> for Substance-2	integer	the number of repairs exceeds the time limit of indicators that are part of Substance-2 ($jpmbw = jt - jptw$)
14.		s3	Score for Substance-3	decimal	Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
15.		s3_jt	<i>jt</i> for Substance-3	integer	Amount of damage/issue of indicators that are part of Substance-3 (<i>jt</i>), refers to Equation 4.3
16.		s3_jptw	<i>jptw</i> for Substance-3	integer	Number of repairs on time of indicators that are part of Substance-3 (<i>jptw</i>), refers to Equation 4.3
17.		s3_jpmbw	<i>jpmbw</i> for Substance-3	integer	the number of repairs exceeds the time limit of indicators that are part of Substance-3 ($jpmbw = jt - jptw$)

Table 4.33 Data dictionary for “vgp_spm_scoringbujtdays” table (2/3)

SN	P/F	Data Items	Caption	Data Type	Definition
18.		s4	Score for Substance-4	decimal	Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
19.		s4_jt	<i>jt</i> for Substance-4	integer	Amount of damage/issue of indicators that are part of Substance-4 (<i>jt</i>), refers to Equation 4.3
20.		s4_jptw	<i>jptw</i> for Substance-4	integer	Number of repairs on time of indicators that are part of Substance-4 (<i>jptw</i>), refers to Equation 4.3
21.		s4_jpmbw	<i>jpmbw</i> for Substance-4	integer	the number of repairs exceeds the time limit of indicators that are part of Substance-4 ($jpmbw = jt - jptw$)
22.		s5	Score for Substance-5	decimal	Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
23.		s5_jt	<i>jt</i> for Substance-5	integer	Amount of damage/issue of indicators that are part of Substance-5 (<i>jt</i>), refers to Equation 4.3
24.		s5_jptw	<i>jptw</i> for Substance-5	integer	Number of repairs on time of indicators that are part of Substance-5 (<i>jptw</i>), refers to Equation 4.3
25.		s5_jpmbw	<i>jpmbw</i> for Substance-5	integer	the number of repairs exceeds the time limit of indicators that are part of Substance-5 ($jpmbw = jt - jptw$)
26.		s6	Score for Substance-6	decimal	Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
27.		s6_jt	<i>jt</i> for Substance-6	integer	Amount of damage/issue of indicators that are part of Substance-6 (<i>jt</i>), refers to Equation 4.3
28.		s6_jptw	<i>jptw</i> for Substance-6	integer	Number of repairs on time of indicators that are part of Substance-6 (<i>jptw</i>), refers to Equation 4.3
29.		s6_jpmbw	<i>jpmbw</i> for Substance-6	integer	the number of repairs exceeds the time limit of indicators that are part of Substance-6 ($jpmbw = jt - jptw$)
30.		s7	Score for Substance-7	decimal	Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
31.		s7_jt	<i>jt</i> for Substance-7	integer	Amount of damage/issue of indicators that are part of Substance-7 (<i>jt</i>), refers to Equation 4.3



Table 4.34 Data dictionary for “vgp_spm_scoringbujtdays” table (3/3)

SN	P/F	Data Items	Caption	Data Type	Definition
32.		s7_jptw	<i>jptw</i> for Substance-7	integer	Number of repairs on time of indicators that are part of Substance-7 (<i>jptw</i>), refers to Equation 4.3
33.		s7_jpmbw	<i>jpmbw</i> for Substance-7	integer	the number of repairs exceeds the time limit of indicators that are part of Substance-7 ($jpmbw = jt - jptw$)
34.		s8	Score for Substance-8	decimal	Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
35.		s8_jt	<i>jt</i> for Substance-8	integer	Amount of damage/issue of indicators that are part of Substance-8 (<i>jt</i>), refers to Equation 4.3
36.		s8_jptw	<i>jptw</i> for Substance-8	integer	Number of repairs on time of indicators that are part of Substance-8 (<i>jptw</i>), refers to Equation 4.3
37.		s8_jpmbw	<i>jpmbw</i> for Substance-8	integer	the number of repairs exceeds the time limit of indicators that are part of Substance-8 ($jpmbw = jt - jptw$)
38.		total	Final Score	decimal	Daily Final Score (<i>fs</i>), refers to Equation 4.7

Text: already available in the existing e-SPM database

Text: e-SPM database development

4.3.2.3. Substance Scoring (Annual)

Table Name : **vgp_spm_scoringbujts**

Table Relation : vgp_spm_highways

Type of Table : Transaction

Description : Detailed substances scoring (annual scoring)

Table 4.35 Data dictionary for “vgp_spm_scoringbujts” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each TRO scoring
2.		year	Year	string	Year/annual period of scoring
3.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table

Table 4.36 Data dictionary for “vgp_spm_scoringbujts” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
4.	s1		Final Score for Substance-1	decimal	Final score for Substance-1/Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
5.	s2		Final Score for Substance-2	decimal	Final score for Substance-2/Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
6.	s3		Final Score for Substance-3	decimal	Final score for Substance-3/Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
7.	s4		Final Score for Substance-4	decimal	Final score for Substance-4/Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
8.	s5		Final Score for Substance-5	decimal	Final score for Substance-5/Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
9.	s6		Final Score for Substance-6	decimal	Final score for Substance-6/Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
10.	s7		Final Score for Substance-7	decimal	Final score for Substance-7/Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
11.	s8		Final Score for Substance-8	decimal	Final score for Substance-8/Substance Percentage Value (<i>spv</i>), refers to Equation 4.6
12.	total		Final Score	decimal	Annual Final Score (<i>fs</i>), refers to Equation 4.7
13.	total_temuan		Total of <i>jt</i>	integer	Total amount of damage
14.	total_finished		Total of <i>jptw</i>	integer	Total amount of repairs on time

Text: already available in the existing e-SPM database

Text: e-SPM database development

4.2.3. User Interface Design

User Interface (UI) Design for "TROs Blacklist Evaluation" analysis can be seen in **Figure 4.14**:



Tollroads Performance Ranking

Year: Periode: [Download XLSX](#)

List Tollroads Ranking

TOLLROADS	SUBSTANCE 1	SUBSTANCE 2	SUBSTANCE 3	SUBSTANCE 4	SUBSTANCE 5	SUBSTANCE 6	SUBSTANCE 7	SUBSTANCE 8	FINAL SCORE	
1. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
2. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
3. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
4. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
5. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
6. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
7. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
8. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
9. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
10. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
11. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
12. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
13. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
14. TOLLROADS	100%	100%	100%	100%	100%	100%	100%	100%	100	☰
15. TOLLROADS	75%	75%	75%	75%	75%	75%	75%	75%	75	☰
16. TOLLROADS	75%	75%	75%	75%	75%	75%	75%	75%	75	☰

Figure 4.14 User Interface Design for “TROs Blacklist Evaluation” analysis

4.4. Accident (Black Spot) Analysis

Based on Term of Reference (TOR), traffic accident (blackspot analysis) is one of the targets of E-SPM upgrading in the form of analysis module. The Sub-Consultant shall develop accident inputting and analysis module. The accident inputting interface shall include information as per Indonesian regulations. The black spot analysis module shall develop in such a way that the module can identify the black spots based on accident analysis. The module shall also be able to prepare accident and black spot maps. Since BINAMARGA has already Safety Analyst as a component of Agile Assets for national roads, it is advised to develop similar module from the consistency point of view also within MPWH or any international practices such as International Road Assessment Program (iRAP).

The analysis feature as referred to in **Figure 1.5** is to identify blank spot locations on each toll road. The technical approach will start with an explanation of the method for determining the location of blank spots in accordance with existing regulations in Indonesia, before being further explained through an example of calculating accident data on one of Indonesia's toll roads.

Black spot is a point on a section prone to traffic accidents (0.03 kilo-meters to 1.0 kilo-meters). There are several definitions of black spot areas:

- **Department of Transport and Main Road - Queensland:** a black spot area is a location on a road, where the number of accidents that occur at this location is very high, usually can be solved technically.
- **Cambridge dictionary:** black spot area is a dangerous road because traffic accidents often occur.
- **Owards Safer Roads in Developing Countries: A Guide for Planners and Engineers, (1991):** black spot area is a grouping of locations where accidents often occur at a certain time, based on existing data and local information.
- **Guidelines for Handling Traffic Accident-Prone Locations in Indonesia (PdT-09-2004-B),** a location can be declared as a blank spot location if:
 - Has a high accident rate;
 - Locations of accidents are relatively stacked;
 - The accident location is in the form of an intersection, or a 100 - 300 m long road segment for urban roads, or a 1 km long road segment for inter-city roads;
 - Accidents occur in relatively the same location and span of time;
 - Having the cause of the accident with specific factors.

The accident rate weighting is a method used to calculate the accident index based on the characteristics of each accident. The weighting of the traffic accident rate in this activity is



carried out using the Accident Equivalence Rate (Angka Ekuivalen Kecelakaan (AEK) in Bahasa), based on the number of fatalities, serious injuries and minor injuries. The AEK calculation is tied to the accident fatality rate and the number of accident occurrences. AEK is calculated by adding up the accident incidents for each kilo-meter of road length, then multiplied by the weight value according to the fatality rate. The standard weight values used can be seen in the following table:

Table 4.37 Weighting by fatality rate

Fatality Rate	Weight
Deaths (Meninggal Dunia (<i>MD</i>) in Bahasa)	12
Serious Injuries (Luka Berat (<i>LB</i>) in Bahasa)	3
Minor Injuries (Luka Ringan (<i>LR</i>) in Bahasa)	3
Vehicles Involved (Kendaraan Terlibat (<i>K</i>) in Bahasa)	1

Source: Department of Settlement and Regional Infrastructure (Pd-T-09-2004-B)

AEK is calculated using the equation:

$$AEK = 12MD + 3LB + 3LR + 1K$$

..... Equation 4.8

- AEK* : Accident Equivalence Rate
- MD* : Number of died victims
- LB* : Number of serious injuries victims
- LR* : Number of minor injuries victims
- K* : Number of vehicles involved

Determination of the black spot location is based on the number of each kilo-meter of road that has an *AEK* weight value exceeding a certain limit. This limit value is calculated using the Upper Control Limit (Batas Kontrol Atas (*BKA*) in Bahasa) method (Bolla.M.E, et.all, 2013). The equation used to calculate the *BKA* value:

$$BKA = C + 3\sqrt{C}$$

..... Equation 4.9

- BKA* : Upper Control Limit
- C* : AEK Accident Rate

$$C = \frac{AEK}{Road\ Length}$$

..... Equation 4.10

The accident rate in each segment is shown in a diagram based on the accident rate that occurred. If the diagram of the accident rate for a segment exceeds the *BKA* line, then the location/segment is a Blackspot Area.

for further explanation, the following is an example of accident data on one of the toll roads in Indonesia:

Table 4.38 Traffic accident data on one of the toll roads in Indonesia

No	Year	Number of Accidents	Fatality Rate		
			Minor Injuries (<i>LR</i>)	Serious Injuries (<i>LB</i>)	Deaths (<i>MD</i>)
1	2019	390	796	243	93
2	2020	287	516	286	78
3	2021	174	373	133	32
Total		848	1.688	662	203

Data Source: ITRA

Calculation of the accident equivalent number (AEK) by multiplying the number of accident victims based on the victim criteria with the factors that can be seen in **Table 4.37**. AEK is a determinant of black spot locations.

Table 4.39 AEK calculation results (1/5)

Stationary (Start - Finish)		<i>LR</i>	<i>LB</i>	<i>MD</i>	<i>K</i>	3 × <i>LR</i>	3 × <i>LB</i>	12 × <i>MD</i>	1 × <i>K</i>	<i>AEK</i>
72+000	73+000	0	0	0	0	0	0	0	0	0
73+000	74+000	2	3	0	3	6	9	0	3	18
74+000	75+000	5	1	0	2	15	3	0	2	20
75+000	76+000	2	0	0	1	6	0	0	1	7
76+000	77+000	4	3	0	4	12	9	0	4	25
77+000	78+000	0	0	0	0	0	0	0	0	0
78+000	79+000	23	5	5	10	69	15	60	10	154
79+000	80+000	6	1	0	2	18	3	0	2	23
80+000	81+000	23	4	0	9	69	12	0	9	90



Table 4.40 AEK calculation results (2/5)

Stationary (Start - Finish)		<i>LR</i>	<i>LB</i>	<i>MD</i>	<i>K</i>	3 × <i>LR</i>	3 × <i>LB</i>	12 × <i>MD</i>	1 × <i>K</i>	<i>AEK</i>
81+000	82+000	1	1	0	4	3	3	0	4	10
82+000	83+000	4	0	0	6	12	0	0	6	18
83+000	84+000	6	2	0	8	18	6	0	8	32
84+000	85+000	9	2	1	5	27	6	12	5	50
85+000	86+000	5	0	0	4	15	0	0	4	19
86+000	87+000	7	0	0	3	21	0	0	3	24
87+000	88+000	9	5	2	9	27	15	24	9	75
88+000	89+000	7	4	5	2	21	12	60	2	95
89+000	90+000	11	7	1	10	33	21	12	10	76
90+000	91+000	7	0	0	3	21	0	0	3	24
91+000	92+000	3	0	0	1	9	0	0	1	10
92+000	93+000	6	1	1	6	18	3	12	6	39
93+000	94+000	9	0	0	3	27	0	0	3	30
94+000	95+000	2	0	0	1	6	0	0	1	7
95+000	96+000	7	0	0	5	21	0	0	5	26
96+000	97+000	3	0	0	4	9	0	0	4	13
97+000	98+000	5	3	0	4	15	9	0	4	28
98+000	99+000	0	0	1	3	0	0	12	3	15
99+000	100+000	5	4	0	10	15	12	0	10	37
100+000	101+000	4	3	0	7	12	9	0	7	28
101+000	102+000	6	8	0	10	18	24	0	10	52
102+000	103+000	3	0	0	4	9	0	0	4	13
103+000	104+000	4	1	1	4	12	3	12	4	31
104+000	105+000	5	0	1	3	15	0	12	3	30
105+000	106+000	2	1	0	4	6	3	0	4	13
106+000	107+000	20	6	0	9	60	18	0	9	87
107+000	108+000	11	1	0	9	33	3	0	9	45
108+000	109+000	0	0	0	0	0	0	0	0	0
109+000	110+000	3	0	0	2	9	0	0	2	11
110+000	111+000	5	2	1	5	15	6	12	5	38

Table 4.41 AEK calculation results (3/5)

Stationary (Start - Finish)		<i>LR</i>	<i>LB</i>	<i>MD</i>	<i>K</i>	3 × <i>LR</i>	3 × <i>LB</i>	12 × <i>MD</i>	1 × <i>K</i>	<i>AEK</i>
111+000	112+000	1	3	2	7	3	9	24	7	43
112+000	113+000	15	1	1	10	45	3	12	10	70
113+000	114+000	13	12	1	14	39	36	12	14	101
114+000	115+000	8	5	0	5	24	15	0	5	44
115+000	116+000	11	2	1	4	33	6	12	4	55
116+000	117+000	1	0	0	2	3	0	0	2	5
117+000	118+000	3	5	1	7	9	15	12	7	43
118+000	119+000	5	4	1	2	15	12	12	2	41
119+000	120+000	4	1	1	5	12	3	12	5	32
120+000	121+000	3	1	0	10	9	3	0	10	22
121+000	122+000	0	0	0	0	0	0	0	0	0
122+000	123+000	12	0	0	3	36	0	0	3	39
123+000	124+000	6	2	1	8	18	6	12	8	44
124+000	125+000	2	1	0	2	6	3	0	2	11
125+000	126+000	2	2	3	9	6	6	36	9	57
126+000	127+000	0	0	0	0	0	0	0	0	0
127+000	128+000	3	0	0	6	9	0	0	6	15
128+000	129+000	4	1	0	6	12	3	0	6	21
129+000	130+000	8	2	3	8	24	6	36	8	74
130+000	131+000	2	0	0	3	6	0	0	3	9
131+000	132+000	1	0	0	1	3	0	0	1	4
132+000	133+000	5	10	0	9	15	30	0	9	54
133+000	134+000	8	8	2	5	24	24	24	5	77
134+000	135+000	2	0	0	3	6	0	0	3	9
135+000	136+000	8	2	1	7	24	6	12	7	49
136+000	137+000	11	0	1	3	33	0	12	3	48
137+000	138+000	1	0	0	1	3	0	0	1	4
138+000	139+000	1	0	0	1	3	0	0	1	4
139+000	140+000	1	1	0	2	3	3	0	2	8
140+000	141+000	12	4	1	6	36	12	12	6	66



Table 4.42 AEK calculation results (4/5)

Stationary (Start - Finish)		<i>LR</i>	<i>LB</i>	<i>MD</i>	<i>K</i>	3 × <i>LR</i>	3 × <i>LB</i>	12 × <i>MD</i>	1 × <i>K</i>	<i>AEK</i>
141+000	142+000	8	2	0	9	24	6	0	9	39
142+000	143+000	7	6	0	9	21	18	0	9	48
143+000	144+000	10	5	1	9	30	15	12	9	66
144+000	145+000	2	0	0	1	6	0	0	1	7
145+000	146+000	2	0	0	1	6	0	0	1	7
146+000	147+000	8	0	1	7	24	0	12	7	43
147+000	148+000	2	0	1	4	6	0	12	4	22
148+000	149+000	4	2	0	5	12	6	0	5	23
149+000	150+000	4	0	1	2	12	0	12	2	26
150+000	151+000	9	7	4	8	27	21	48	8	104
151+000	152+000	4	0	1	4	12	0	12	4	28
152+000	153+000	7	9	0	8	21	27	0	8	56
153+000	154+000	9	0	0	3	27	0	0	3	30
154+000	155+000	6	5	5	5	18	15	60	5	98
155+000	156+000	5	0	0	8	15	0	0	8	23
156+000	157+000	2	1	0	4	6	3	0	4	13
157+000	158+000	4	0	0	2	12	0	0	2	14
158+000	159+000	7	2	0	4	21	6	0	4	31
159+000	160+000	7	6	1	5	21	18	12	5	56
160+000	161+000	2	0	0	7	6	0	0	7	13
161+000	162+000	8	2	2	12	24	6	24	12	66
162+000	163+000	4	0	1	3	12	0	12	3	27
163+000	164+000	1	2	1	5	3	6	12	5	26
164+000	165+000	11	3	0	9	33	9	0	9	51
165+000	166+000	12	2	2	8	36	6	24	8	74
166+000	167+000	5	1	0	7	15	3	0	7	25
167+000	168+000	5	4	0	7	15	12	0	7	34
168+000	169+000	6	4	0	3	18	12	0	3	33
169+000	170+000	0	1	1	4	0	3	12	4	19
170+000	171+000	11	4	0	4	33	12	0	4	49

Table 4.43 AEK calculation results (5/5)

Stationary (Start - Finish)		<i>LR</i>	<i>LB</i>	<i>MD</i>	<i>K</i>	3 × <i>LR</i>	3 × <i>LB</i>	12 × <i>MD</i>	1 × <i>K</i>	<i>AEK</i>
171+000	172+000	2	4	0	5	6	12	0	5	23
172+000	173+000	4	1	1	6	12	3	12	6	33
173+000	174+000	7	2	0	6	21	6	0	6	33
174+000	175+000	4	2	0	4	12	6	0	4	22
175+000	176+000	10	0	0	8	30	0	0	8	38
176+000	177+000	3	1	0	2	9	3	0	2	14
177+000	178+000	6	4	1	3	18	12	12	3	45
178+000	179+000	7	2	0	5	21	6	0	5	32
179+000	180+000	6	1	0	4	18	3	0	4	25
180+000	181+000	6	1	1	8	18	3	12	8	41
181+000	182+000	34	8	4	8	102	24	48	8	182
182+000	183+000	12	8	2	19	36	24	24	19	103
183+000	184+000	2	2	0	6	6	6	0	6	18
184+000	185+000	11	11	4	9	33	33	48	9	123
185+000	186+000	14	1	0	12	42	3	0	12	57
186+000	187+000	15	3	1	5	45	9	12	5	71
187+000	188+000	5	6	1	9	15	18	12	9	54
188+000	189+000	0	0	0	0	0	0	0	0	0
Total		70 7	26 0	76	614	2121	780	912	614	4427

Data Source: ITRA

The length of the toll road is 116.80 km, with a total *AEK* value obtained (one way) of 4427, so that the Upper Control Limit (*BKA*) value is **56,37 (Equation 4.9 and Equation 4.10)**. determining the location of black spots can be seen in the following graph:



BLANK SPOT LOCATION
ON THE ABC TOLL ROAD

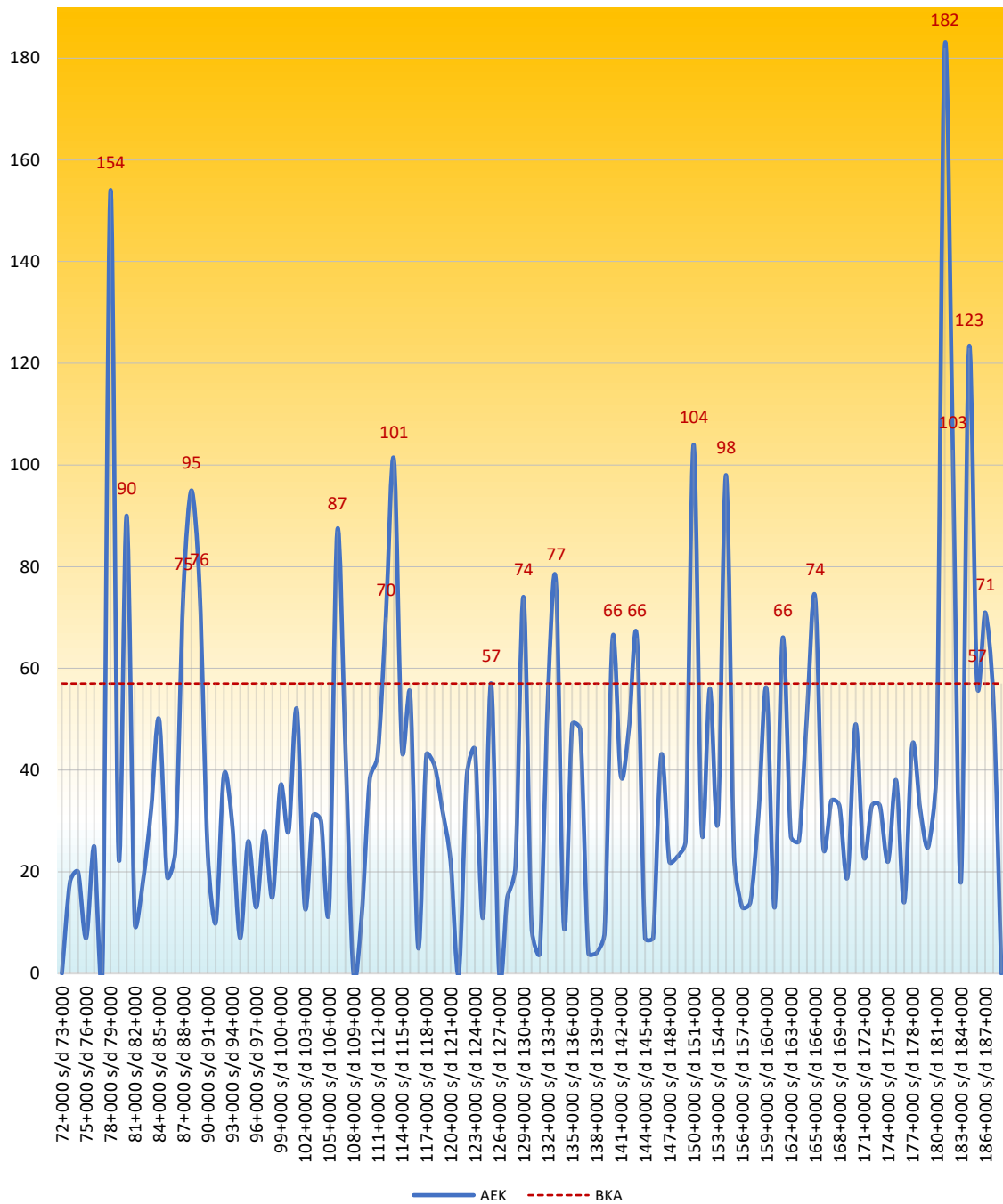


Figure 4.15 Black spot location determination (exceeding BKA)

The blank spot locations in the graph above will also be represented in the GIS in the form of a blackspot map.

4.4.1. System Process Design

4.4.1.1. Context Diagram

The Context Diagram for "Black Spot" analysis can be seen in the image below:

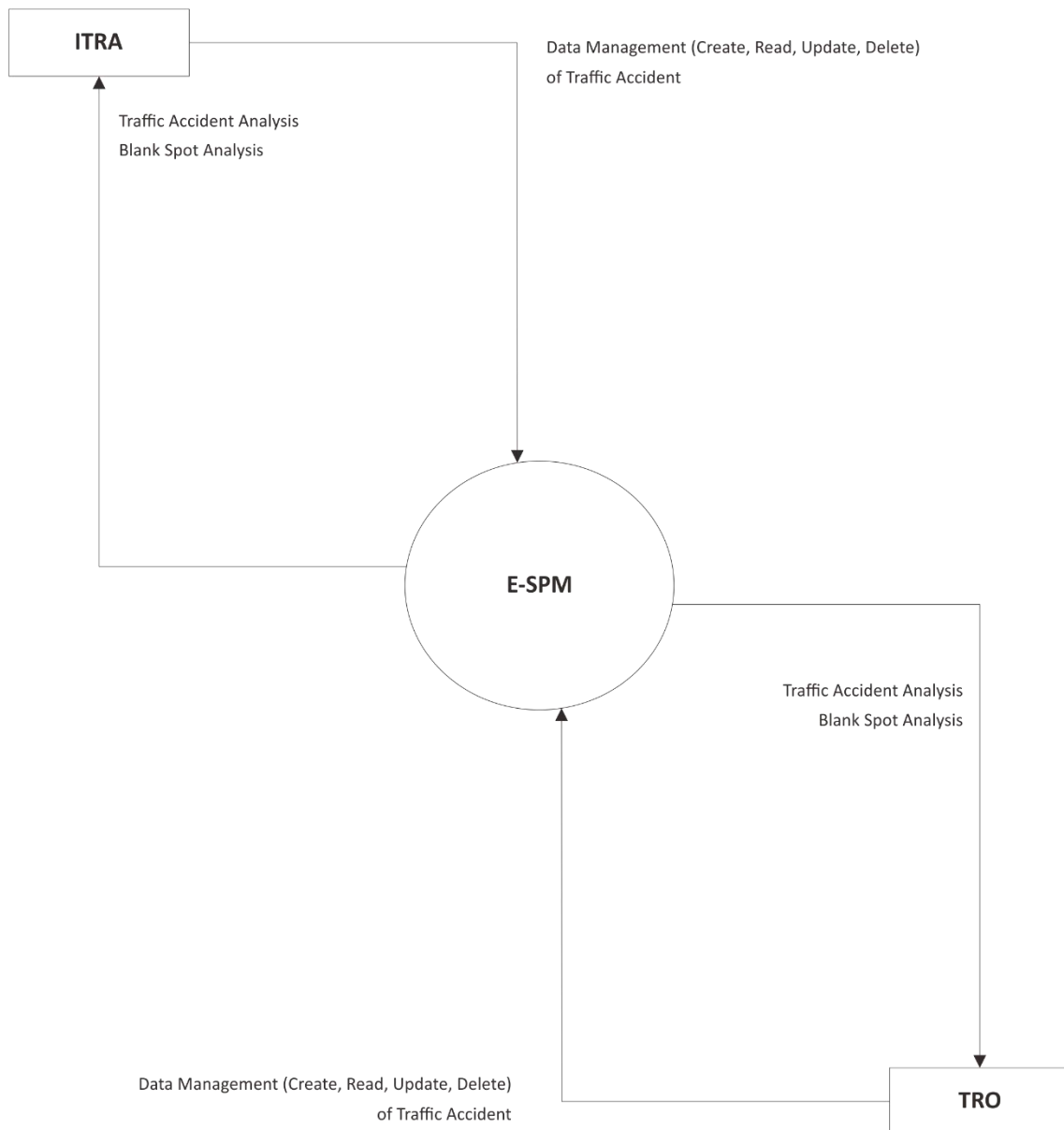


Figure 4.16 Context Diagram for "Black Spot" analysis



4.4.1.2. Use Case Diagram

The Use Case Diagram for "Black Spot" analysis can be seen in the image below:

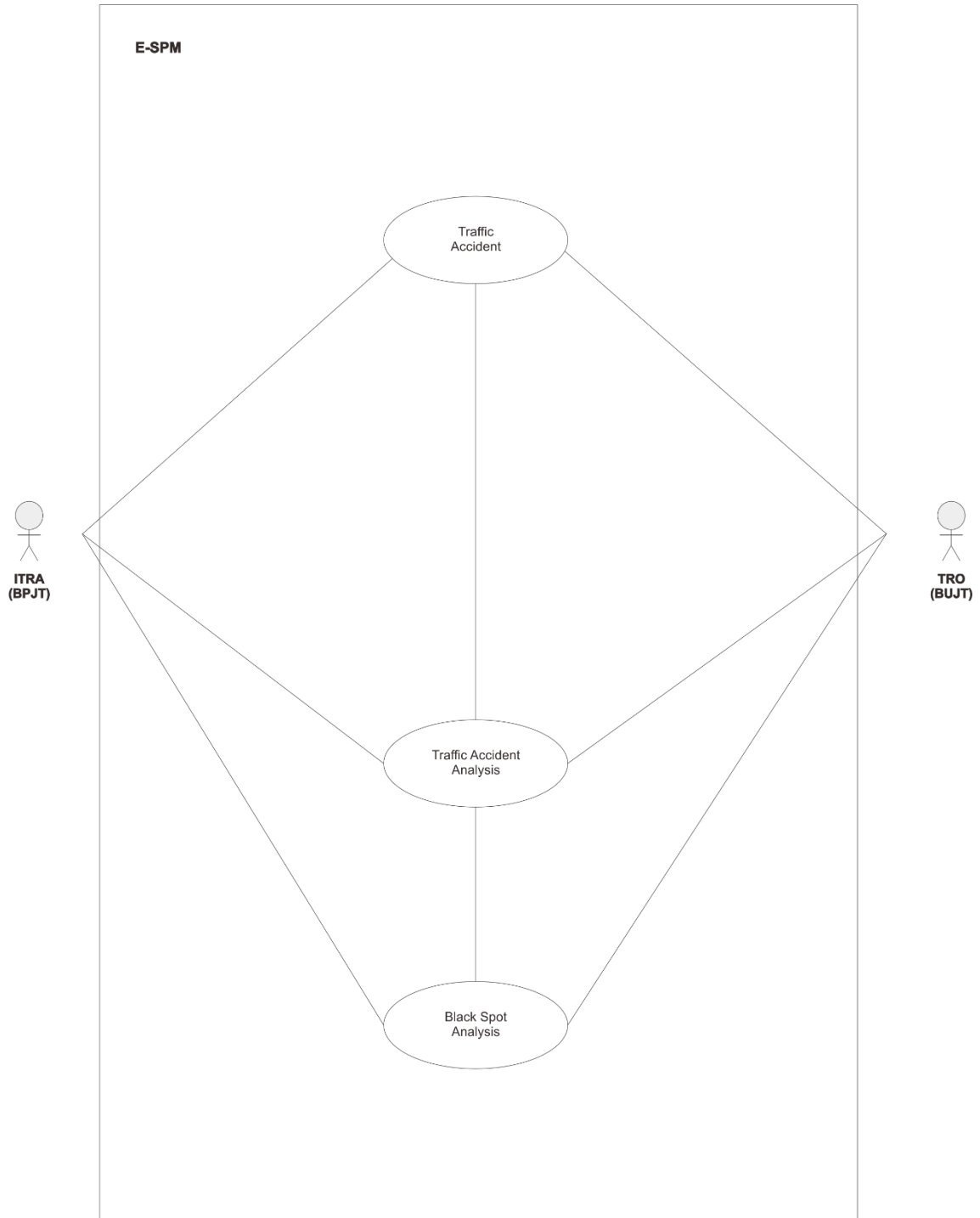


Figure 4.17 Use Case for "Black Spot" analysis

4.4.2. Database Design

Database Design for "Black Spot" analysis can be seen in the image below:

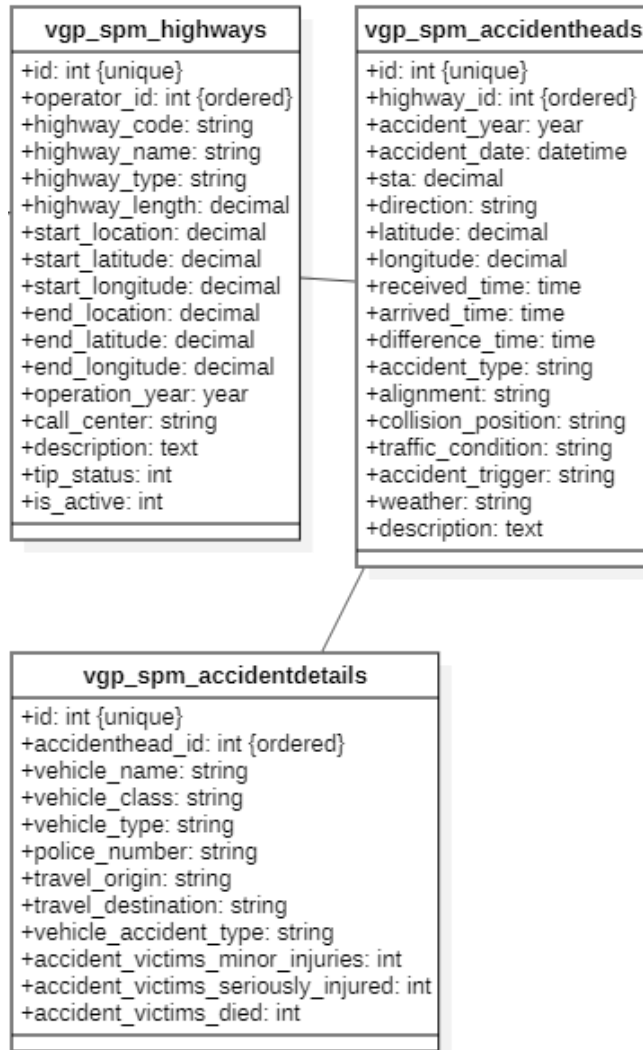


Figure 4.18 Database design for “Black Spot” analysis

4.4.2.1. Traffic Accident (Head)

Table Name : **vgp_spm_accidentheads**
 Table Relation : vgp_spm_highways
 Type of Table : Transaction
 Description : Head of traffic accident



Table 4.44 Data dictionary for “vgp_spm_accidentheads” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each traffic accident
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.		accident_year	Year	year	Year of traffic accident
4.		accident_date	Date	datetime	Date and time of traffic accident
5.		sta	Chainage	decimal	Chainage of traffic accident in KM.HM format
6.		direction	Direction	string	Direction of traffic accident location (normal direction or opposite direction)
7.		latitude	Latitude	decimal	Latitude of traffic accident location
8.		longitude	Longitude	decimal	Longitude of traffic accident location
9.		received_time	Information Received	time	To calculate the speed of arrival time at accident location
10.		arrived_time	Time of Arrival	time	To calculate the speed of arrival time at accident location
11.		difference_time	Arrival Time	time	Speed of arrival time
12.		accident_type	Type of Accident	string	Type of accident: Single accident, vehicle rollover, level crossing accident, etc.
13.		alignment	Type of Alignment	string	Type of alignment: Straight stretches, straight upward, straight downward, curve stretches, curve upward, curve downward, etc.
14.		collision_position	Collision Position	string	Collision position: Rear end collisions, side collisions, etc.
15.		traffic_condition	Traffic Condition	string	Traffic condition: Free flow, stop and go, congested, etc.
16.		accident_trigger	Accident Trigger	string	Accident trigger: Brake failure, distracted driving, road damage, drunk driving, animal crossing, etc.
17.		weather	Weather	string	Weather: Sunny, cloudy, rainy
18.		description	Description	string	Description of traffic accident

Text: already available in the existing e-SPM database

Text: e-SPM database development

4.4.2.1. Traffic Accident (Detail)

Table Name : **vgp_spm_accidentdetails**

Table Relation : vgp_spm_accidentheads

Type of Table : Transaction

Description : Detail of traffic accident (1 head for ≥ 1 detail/vehicles)

Table 4.45 Data dictionary for “vgp_spm_accidentdetails” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each detail accident
2.	F	accidenthead_id	Head	integer	Refers to “vgp_spm_accidentheads” table
3.		vehicle_name	Vehicle Name/Series	string	Name/series/brand of vehicle
4.		vehicle_class	Vehicle Class	string	Vehicle class: Class I, Class II, Class III, Class IV, or Class V
5.		vehicle_type	Vehicle Type	string	Type of Vehicle: Saloon car, minibus, bus, truck, container
6.		police_number	Police Number	string	Police number of vehicle
7.		travel_origin	Origin	string	Travel origin
8.		travel_destination	Destination	string	Travel destination
9.		vehicle_accident_type	Role in the Accident	string	Role in the accident: Main vehicle or vehicle involved
10.		accident_victims_minor_injuries	Victims - Minor Injuries	integer	Number of minor injuries
11.		accident_victims_seriously_injuries	Victims - Serious Injuries	integer	Number of serious injuries
12.		accident_victims_died	Victiems - Died	integer	Number of died victims

Text: already available in the existing e-SPM database

Text: e-SPM database development

In order to calculate *AEK*, each variable in determining the blank spot using **Equation 4.8** is taken from:



- MD* : vgp_spm_accidentdetails. accident_victims_died [12]
- LB* : vgp_spm_accidentdetails. accident_victims_seriously_injuries [11]
- LR* : vgp_spm_accidentdetails. accident_victims_minor_injuries [10]
- K* : count (vgp_spm_accidentdetails) where vgp_spm_accidentdetails.id = x

4.4.3. User Interface Design

User Interface (UI) Design for "Black Spot" analysis can be seen in **Figure 4.19** and **Figure 4.20**:

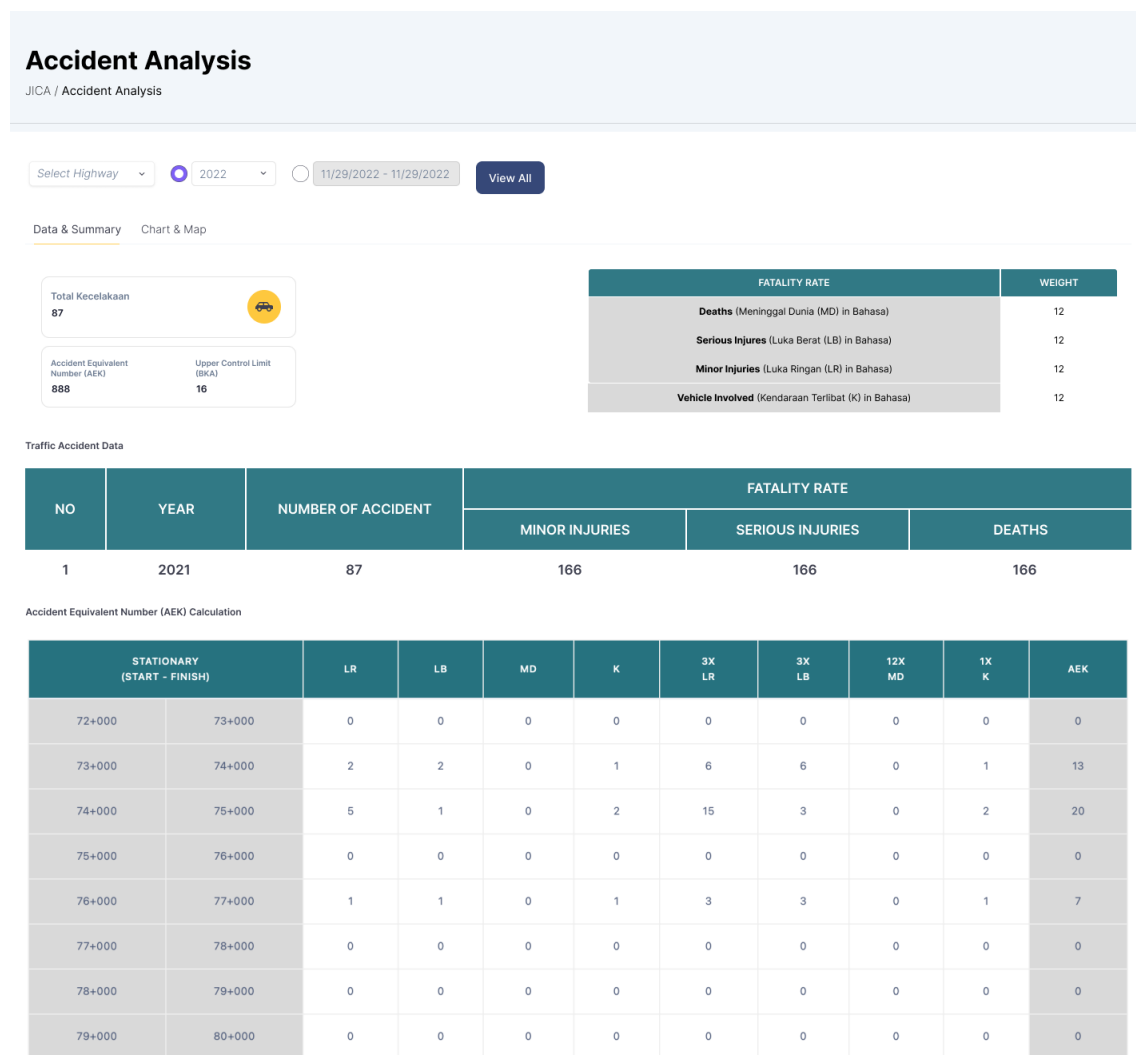


Figure 4.19 User Interface Design for "Black Spot" analysis (1/2)

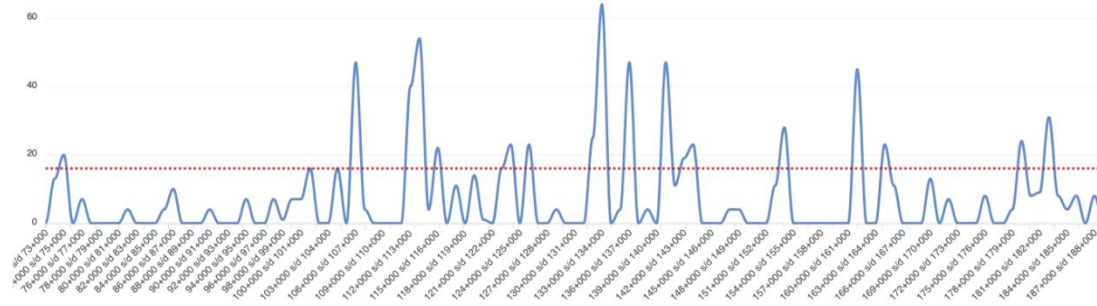
Accident Analysis

JICA / Accident Analysis

Select Highway 2022 11/29/2022 - 11/29/2022 [View All](#)

Data & Summary [Chart & Map](#)

Graph of AEK and BKA values per-kilometers



Accident Location Point

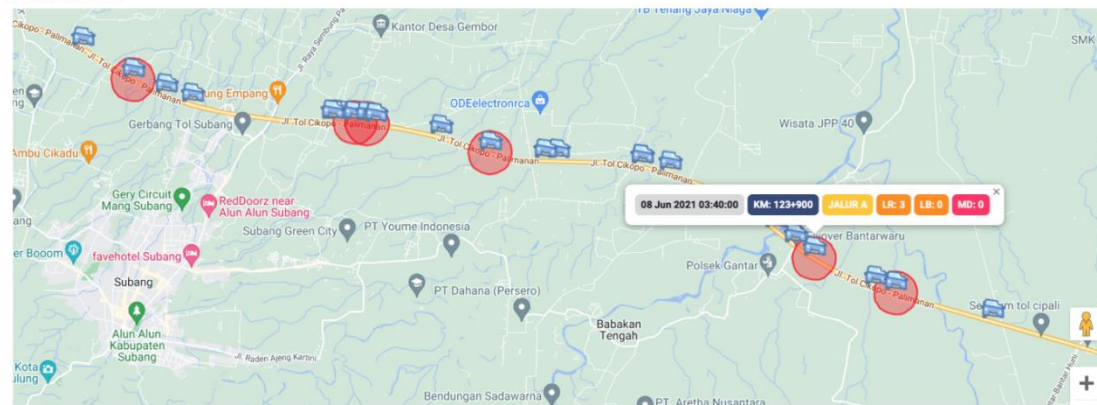


Figure 4.20 User Interface Design for “Black Spot” analysis (2/2)



4.5. Accident Rate Analysis

Based on the results of the virtual meeting on December 7, 2022, ITRA requested the addition of an accident analysis module in the form of accident rates for each toll road in Indonesia. The method used is also adopted from Guidelines for Handling Traffic Accident-Prone Locations in Indonesia No PdT-09-2004-B (same as guidelines for determining blackspot locations). The accident rate is calculated using the following equation:

$$T_k = \frac{F_k \times 100^8}{LHR_T \times n \times L \times 365} \dots\dots\dots \text{Equation 4.11}$$

- T_k : Accident Rate (100 JPKP)
- F_k : Frequency of traffic accidents for n-year data
- LHR_T : Annual average traffic volume
- n : Number of data years
- L : Road length (km)
- 100JPKP : Accident rate unit (accident/one hundred million vehicle trips per-kilometer)

For more details, the following is an example of calculating the accident rate on Indonesian toll roads, sorted by the highest accident rate:

Table 4.46 Accident Rate on Indonesian toll roads (example)

No	Highway	L (Km)	LHR _T	n	F _k	T _k	T _k (100JPKP)
1	Cikampek - Palimanan	116,75	20.231	1	390	4.523.738.616	45,24
2	Cikampek - Padalarang	58,00	60.432	1	500	3.908.248.581	39,08
3	Semarang - Batang	75,00	40.523	1	300	2.704.366.436	27,04
4	Semarang - Solo	72,95	40.982	1	250	2.291.019.043	22,91
5	Solo - Ngawi	90,12	30.324	1	210	2.105.323.117	21,05
6	Krian - Legundi - Manyar	29,00	20.376	1	44	2.040.059.726	20,40
7	Ciawi - Sukabumi	15,35	13.276	1	15	2.016.613.968	20,17
8	Jakarta - Bogor - Ciawi	59,00	110.231	1	458	1.929.375.923	19,29
9	Jakarta - Cikampek	52,33	80.234	1	289	1.885.800.730	18,86
10	Jalan Tol Layang MBZ	24,54	40.537	1	68	1.872.793.464	18,73
11	Surabaya - Gempol	46,32	53.029	1	167	1.862.694.441	18,63

4.5.1. System Process Design

4.5.1.1. Context Diagram

The Context Diagram for "Accident Rate" analysis can be seen in the image below:

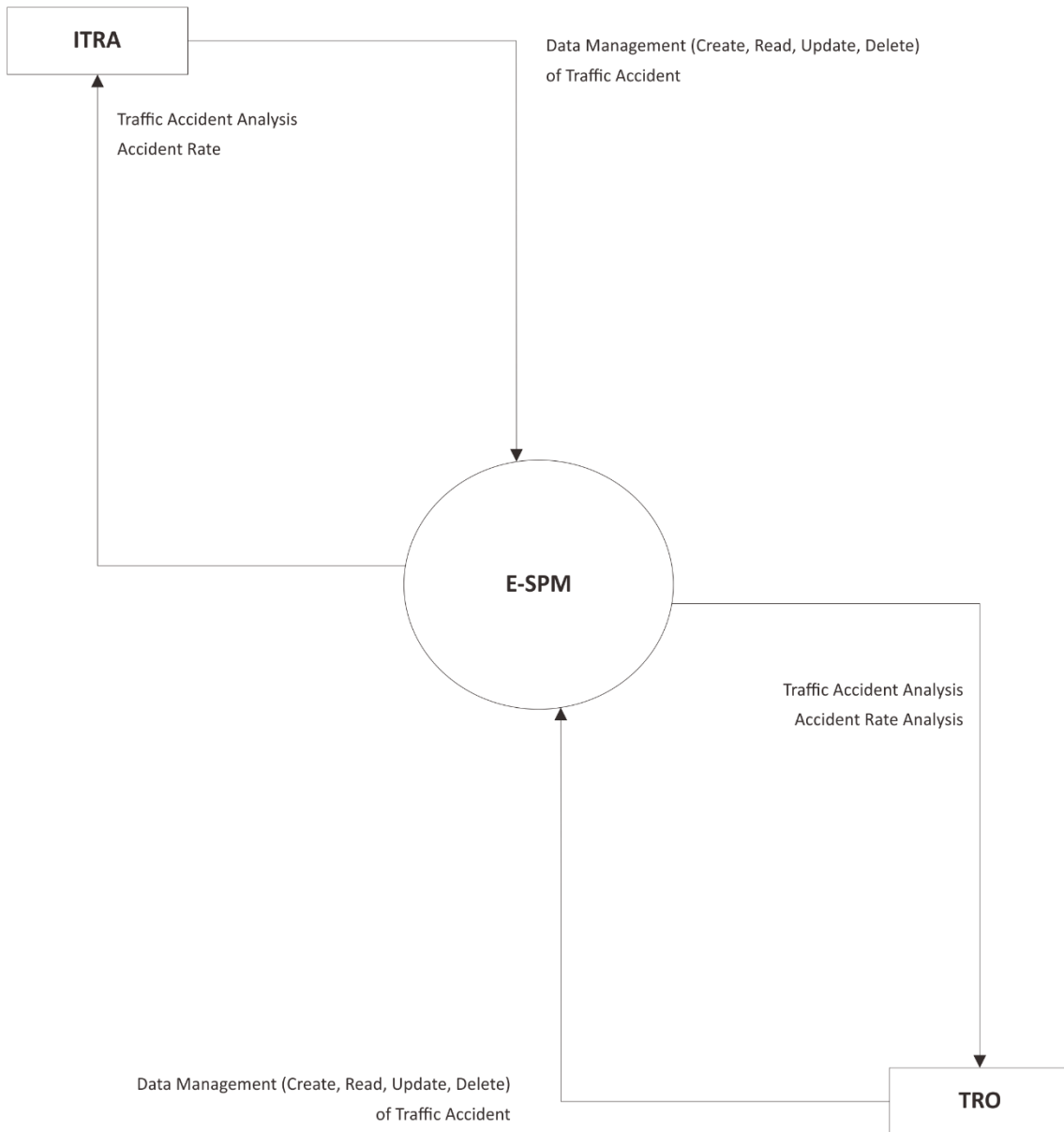


Figure 4.21 Context Diagram for "Accident Rate" analysis



4.5.1.2. Use Case Diagram

The Use Case Diagram for "Accident Rate" analysis can be seen in the image below:

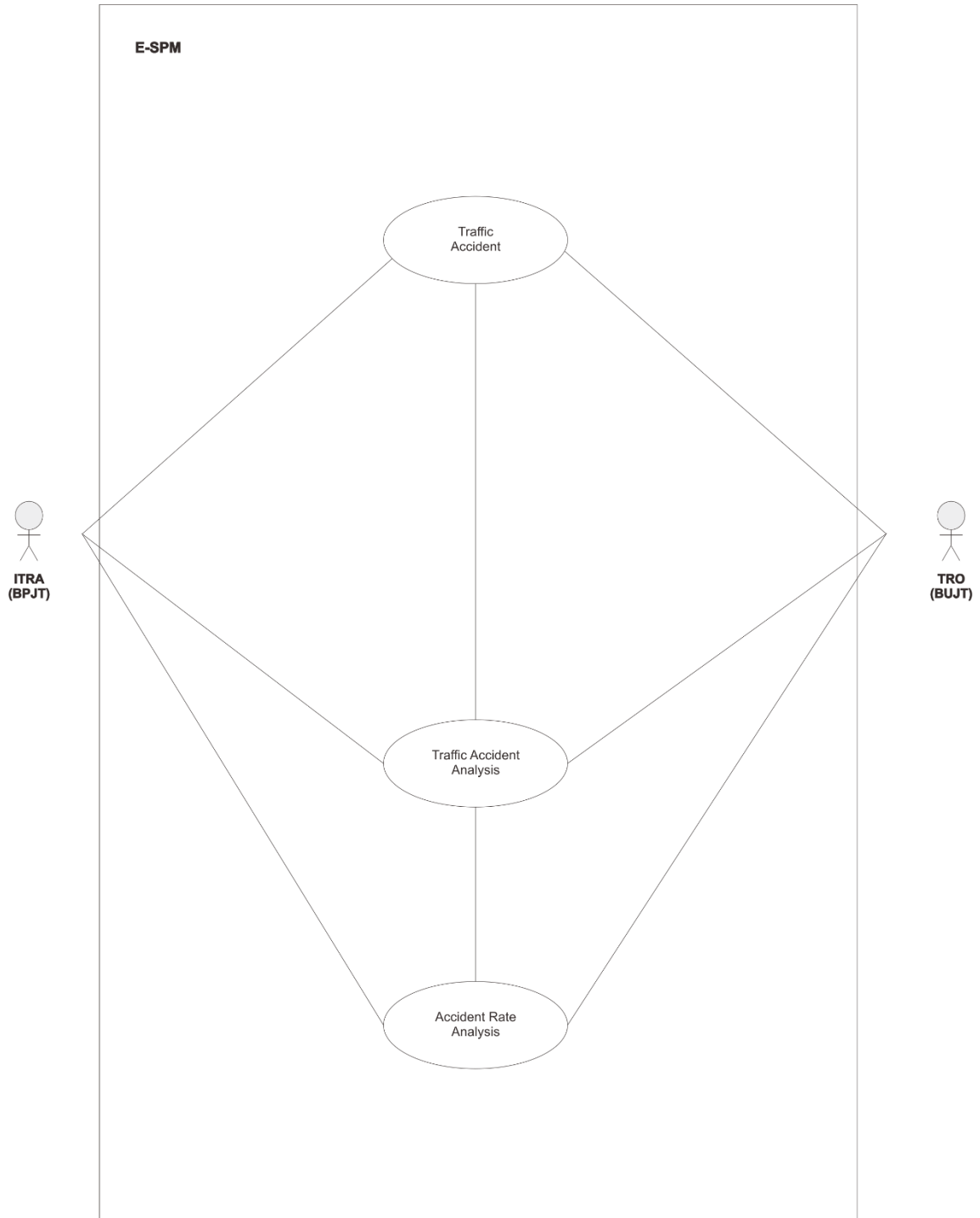


Figure 4.22 Use Case for "Accident Rate" analysis

4.5.2. Database Design

Database Design for "Accident Rate" analysis can be seen in the image below:

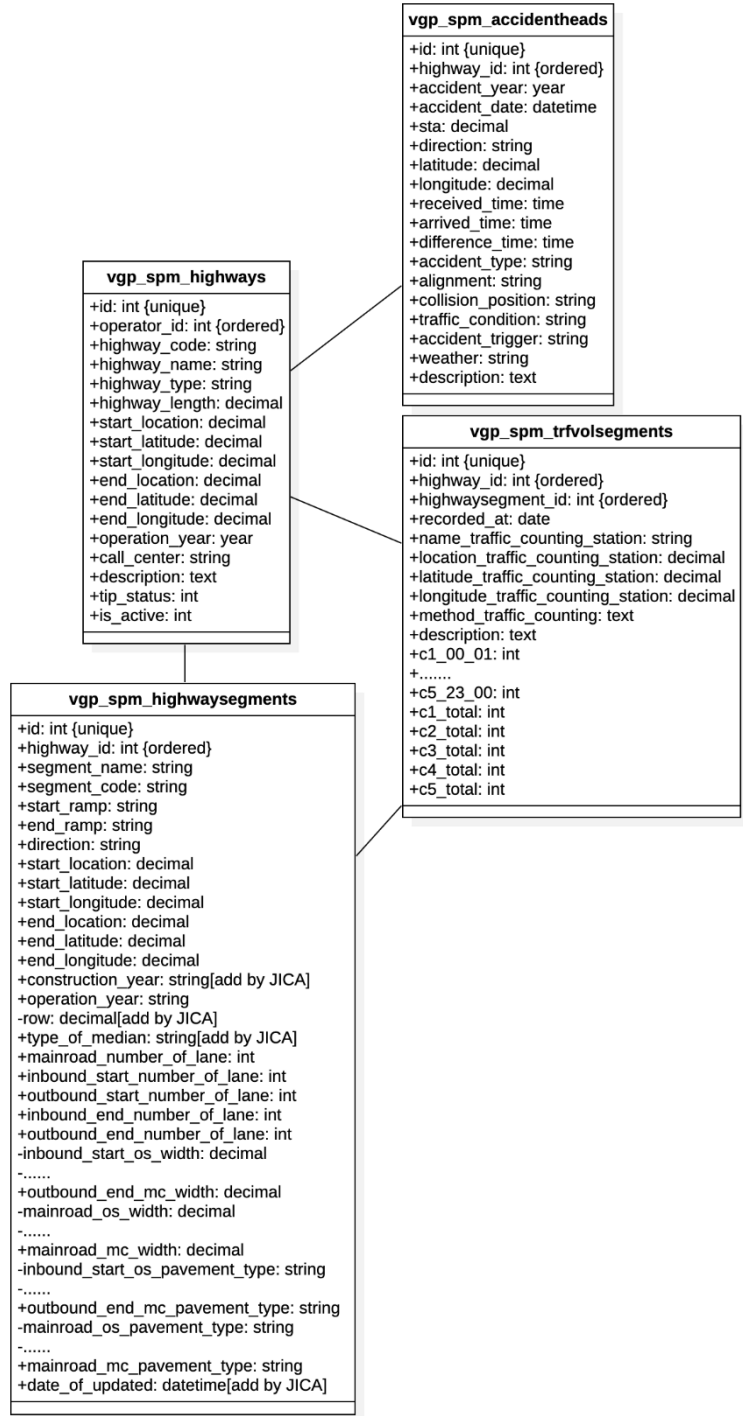


Figure 4.23 Database design for "Accident Rate" analysis



The data dictionary for the database design above can be seen in:

- **Sub-Chapter 3.1.2.3** : vgp_spm_highways
- **Sub-Chapter 3.1.2.8** : vgp_spm_highwaysegments
- **Sub-Chapter 3.3.2.1** : vgp_spm_trfvolsegments
- **Sub-Chapter 4.4.2.1** : vgp_spm_accidentheads

In order to calculate Accident Rate (T_k) using **Equation 4.11** is taken from:

- F_k : Count of vgp_spm_accidentheads. id [1] where vgp_spm_accidentheads. year [3] = x
- LHR_T : vgp_spm_trfvolsegments [sum of 11 - 130], with condition:
- Traffic volume data for each segment must be available. If the data is incomplete, accident rate (T_k) will be emptied;
 - If the traffic volume data for a segment is > 1 in the same year, the traffic volume will be averaged.
- n : 1 (calculated annually)
- L : vgp_spm_highways. highway_length [6]

4.5.3. User Interface Design

User Interface Design for "Accident Rate" analysis can be seen in **Figure 4.24** and **Figure 4.25**:

Accident Analysis Bina Marga
JICA / Accident Analysis Bina Marga

Year: 2022

$$T_k = \frac{F_k \times 100^8}{LHR_t \times n \times L \times 365}, (100JPKP)$$

dengan :

- Tk adalah Tingkat Kecelakaan, 100 JPKP
- Fk adalah Frekwensi Kecelakaan di ruas jalan untuk n tahun data
- LHRt adalah Volume Lalu lintas Rata-rata
- n adalah jumlah tahun data
- L adalah panjang ruas jalan, Km
- 100JPKP adalah satuan tingkat kecelakaan: kecelakaan / Seratus Juta Perjalanan Kendaraan Per-kilometer

NO	HIGHWAY	L (Km)	Jumlah Segmen	Jumlah Data (Segmen)	LHRt	n	Fk	Tk	Tk (100JPKP)
1	Cikampek - Palimanan	116.75	6	6	20.231	1	390	4.523.738.616	45,24
2	Cikampek - Purwakarta - Padalarang	58.00	4	4	60.432	1	500	3.908.248.581	39,08
3	Semarang - Batang	75.00	8	8	40.523	1	300	2.704.366.436	27,04
4	Semarang - Solo	72.95	4	4	40.982	1	250	2.291.019.043	22,91
5	Solo - Ngawi	90.12	2	2	30.324	1	210	2.105.323.117	21,05
6	Kiran - Legundi - Bunder Manyar	29.00	6	6	20.376	1	44	2.040.059.726	20,40
7	Ciawi - Sukabumi	15.35	8	8	13.276	1	15	2.016.613.968	20,17
8	Jakarta - Bogor - Ciawi	59.00	4	4	110.231	1	458	1.929.375.923	19,29
9	Jakarta - Cikampek	52.33	2	2	80.234	1	289	1.885.800.730	18,86
10	Jalan Tol Layang MBZ	24.54	4	4	40.537	1	68	1.872.793.464	18,73
11	Surabaya - Gempol	46.32	2	2	53.029	1	167	1.862.694.441	18,63
12	Gempol - Pasuruan	98.43	6	4	25.322	1	0	0	0
13	Pasuruan Probolinggo	23.44	4	3	14.736	1	0	0	0
14	Akses Tanjung Priok	56.33	6	2	12.382	1	0	0	0
15	Balikpapan - Samarinda	25.87	4	1	8.032	1	0	0	0
16	Bekasi - Cawang - Kampung Melayu	12.32	6	2	6.392	1	0	0	0
17	Binjai - Langsa	34.56	4	1	3.273	1	0	0	0
18	Bogor Ring Road Seksi I-III A	78.43	4	3	18.293	1	0	0	0
19	Cawang - Tomang - Pluit	25.48	4	2	60.493	1	0	0	0
20	Cibitung - Cilincing	15.42	6	4	20.392	1	0	0	0
21	Cileunyi - Sumedang - Dawuan	23.54	8	6	20.482	1	0	0	0
22	Cinere - Jagorawi	10.23	8	7	42.282	1	0	0	0
23	Gempol - Pandaan	9.32	4	3	12.986	1	0	0	0

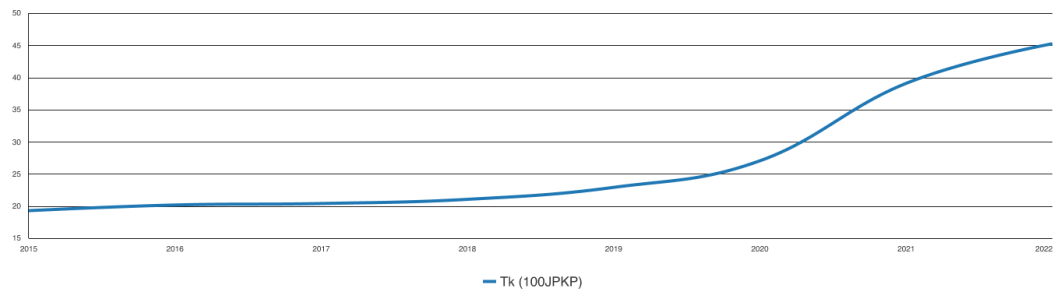
Figure 4.24 User Interface Design for "Accident Rate" analysis (1/2)

Accident Analysis Bina Marga

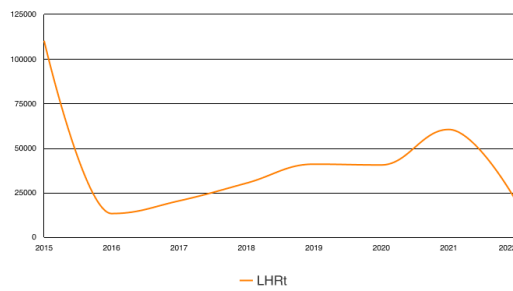
JICA / Accident Analysis Bina Marga

Cikampek - Palimanan

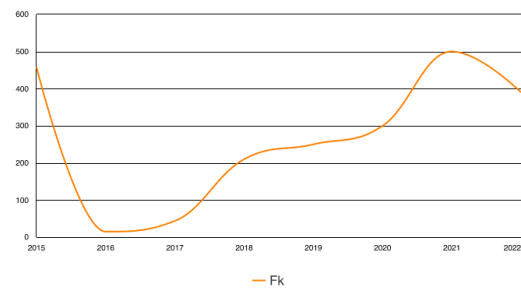
Tk (100JKPK) Grafik



LHRt Grafik



Fk Grafik



NO	YEAR	L (Km)	Jumlah Segmen	Jumlah Data (Segmen)	LHRt	n	Fk	Tk	Tk (100JKPK)
1	2022	116.75	6	6	20.231	1	390	4.523.738.616	45,24
2	2021	58.00	4	4	60.432	1	500	3.908.248.581	39,08
3	2020	75.00	8	8	40.523	1	300	2.704.366.436	27,04
4	2019	72.95	4	4	40.982	1	250	2.291.019.043	22,91
5	2018	90.12	2	2	30.324	1	210	2.105.323.117	21,05
6	2017	29.00	6	6	20.376	1	44	2.040.059.726	20,40
7	2016	15.35	8	8	13.276	1	15	2.016.613.968	20,17
8	2015	59.00	4	4	110.231	1	458	1.929.375.923	19,29

Figure 4.25 User Interface Design for “Accident Rate” analysis (2/2)

4.6. Fatality Rate Analysis

Based on the results of meeting on January 27, 2023, ITRA asked to add “fatality rate” calculation to the “accident rate” analysis module. The method used is also adopted from Guidelines for Handling Traffic Accident-Prone Locations in Indonesia No PdT-09-2004-B (same as guidelines for determining blackspot locations). The accident rate is calculated using the following equation:

$$T_f = \frac{F_k \times 10^8}{LHR_T \times n \times L \times 365}$$

..... **Equation 4.12**

- T_f : Fatality Rate (100 JPKP)
- F_k : Frequency of traffic accidents for n-year data
- LHR_T : Annual average traffic volume
- n : Number of data years
- L : Road length (km)
- 100JPKP : Accident rate unit (accident/one hundred million vehicle trips per-kilometer)

ITRA also asked to change the annual calculation to a monthly calculation using the equation:

$$T_k = \frac{F_k \times 10^6}{LHR_T \times n \times L \times 30}$$

..... **Equation 4.13**

- T_k : Accident Rate (100 JPKP)
- F_k : Frequency of traffic accidents for n-month data
- n : Number of data months

$$T_f = \frac{F_k \times 10^8}{LHR_T \times n \times L \times 30}$$

..... **Equation 4.14**

- T_f : Fatality Rate (100 JPKP)
- F_k : Frequency of traffic accidents for n-month data
- n : Number of data months

This ITRA request has been accommodated with an interface that can be seen in the following figure:



Figure 4.26 User Interface Design for "Accident Rate" and "Fatality Rate" analysis

While the system process design and database design are the same as in the "Accident Rate" analysis (Sub-Chapter 4.5).

4.7. Deterioration Trend Analysis

Based on Term of Reference (TOR), deterioration trend analysis is one of the targets of E-SPM upgrading in the form of analysis module. Since ITRA is not toll the road operator but regulator only, ITRA does not need to carry out deterioration prediction for maintenance planning. Deterioration prediction for ITRA is only to see the trend of deterioration in individual toll road and periodically check whether the maintenance works carried out by TROs are proper or not.

Deterioration of road conditions is a process of decreasing the performance of pavement in the form of a graphic using certain parameters. The deterioration model that will be used in the development of e-SPM through this project is by utilizing the International Roughness Index (IRI) parameter, which refers to the SPM regulations, each TRO is required to measure the IRI annually and report it to ITRA using the e-SPM.

International Roughness Index (IRI) or road surface roughness developed by the World Bank in the 1980s. IRI is used to describe a longitudinal profile of a road and is used as a standard for road surface roughness. The commonly recommended units are meters per-kilometre (m/km) or millimetre per-meter (mm/m). IRI is an index parameter which is calculated from the cumulative amount of surface up and down for the longitudinal profile direction divided by the distance/length of the measured surface. The Determination of Road Conditions Based on IRI Value can be seen in the table below:

Table 4.47 Determination of road conditions based on IRI

IRI (m/km)	Road Condition
$IRI \leq 4$	Good
$IRI > 4 \ \& \ IRI \leq 8$	Fair
$IRI > 8 \ \& \ IRI \leq 12$	Lightly Damaged
$IRI > 12$	Heavy Damage

Source: Routine maintenance for roads and bridges, Bina Marga

Meanwhile, the requirements for roughness (IRI) values for flexible and rigid pavements are in accordance with the Regulation of (The) Minister of Public Works of The Republic of Indonesia Number 16/ PRT/M/2014 of 2014 on Minimum Service Standards for Toll Roads is a **maximum of 4 m/km for per-km measurement, each lane is not average.**

IRI deterioration modelling for e-SPM adopts the HDM-III (Highway Design and Maintenance) model simplification method - Patterson & Attoh (1992) through the equation:



$$IRI_n = 1.04e^{0.023n} [IRI_0 + 263(1 + SNC)^{-5} \times CSA_n]$$

..... Equation 4.15

- IRI_n : Road roughness of the road in the n^{th} year (m/km)
- IRI_0 : Road roughness of the road in the base year (m/km)
- SNC : Structure number of pavement strength (**Equation 4.13**)
- CSA_n : Cumulative standard axle year-n (million ESA/lane) (**Equation 4.15**)

$$SNC = \{0.04 \times \sum (a_i \times h_i)\} + SN_{sg}$$

..... Equation 4.16

- a_i : Material and layer strength coefficient (**Table 4.48**)
- h_i : Layer thickness (mm)
- SN_{sg} : Subgrade contribution calculated by the formula Hodges et al, 1975 (**Equation 4.17**)

$$SN_{sg} = 3.51 \log CBR - 0.86(\log CBR)^2 - 1.43$$

..... Equation 4.17

- CBR : In situ California Bearing Ratio of subgrade (%)

$$CSA_n = \sum_1^N W_{18}$$

..... Equation 4.18

- N : Year
- W_{18} : Equivalent Single Axle Load (ESAL) (**Equation 4.19**)

$$W_{18} = \sum LHR \times VDF \times D_D \times D_L$$

..... Equation 4.19

- LHR : Annual Average Daily Traffic (AADT)
- VDF : Vehicle Damage Factor/Truck Factor (**Equation 4.17**)
- D_D : Direction distribution factor
- D_L : Lane distribution factor = 0,8 - 1,0 (PtT-01-2002-B Bina Marga)

$$VDF = \left(\frac{P}{k}\right)^4$$

Equation 4.20

- P : Axle load (ton)
 k : Axle factor/configuration (Table 4.49)


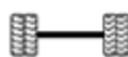
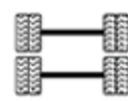
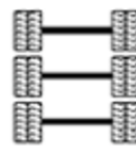
Table 4.48 Material and layer strength coefficient (a)

Layer Type	a
Surface/Intermediate Course	
Hot Mix Asphalt with Type A Aggregate	0,44
Hot Mix Asphalt with Type B Aggregate	0,40
Base Course	
Type B Hot Mix Asphalt	0,40
Asphalt Treated Base Class I	0,34
Bituminous Treated Aggregate Base	0,23
Asphalt Treated Base Class II	0,26
Cold-Laid Bituminous Concrete Base	0,23
Cement Treated Granular (Aggregate) Base	0,20
Soil-Cement Base	0,15
Crushed (Graded) Stone Base	0,14
Macadam Stone Base	0,12
Portland Cement Concrete Base (New) <i>Concrete k-400 / Rigid Pavement using this parameter *</i>	0,50
Old Portland Cement Concrete <i>Concrete k-125 / Lean Concrete using this parameter *</i>	0,40
Crack and Seated PCC	0,25 - 0,30
Rubblized PCC	0,20
Cold in Place Recycled	0,22 - 0,27
Subbase Course	
Soil-Cement Subbase	0,10
Soil-Lime Subbase	0,10
Granular Subbase	0,10
Soil-Aggregate Subbase	0,05

Source: AASHTO 1993 | (*) *Technical Approach*



Table 4.49 Axle load configuration (k)

Type of Vehicle Axle			
STRT	STRG	SDRG	STrG
Single Axle Single Wheel	Single Axle Double Wheel	Double Wheel Tandem Axle	Double Wheel Triple Axle
			
$k = 5,40$	$k = 8,16$	$k = 13,76$	$k = 18,45$

Source: Characteristics of vehicle loads on the national road sections of the Java Pantura and Jalintim - Indonesia, 2009

Referring to the technical requirements, Indonesian toll roads have 2 different loading standards (due to regulatory changes), the heaviest axle load is 8 tons (MST-8TON, Muatan Sumbu Terberat 8 Ton in Bahasa) and the heaviest axle load is 10 tons (MST-10TON, Muatan Sumbu Terberat 10 Ton in Bahasa). The calculation of the VDF value for each loading standard can be seen in **Table 4.50** and **Table 4.51**.

Table 4.50 VDF for the heaviest axle load is 8 tons (MST-8TON)











Vehicle Class	Class I	Class II	Class III	Class IV	Class V
					
Vehicle Type	Passenger Car	2-Axle Truck	3-Axle Truck	4-Axle Truck	5 Axle Truck
Axle	1.1	1.2	1.22	1.2-22	1.22-22
Load Axle-1 (Ton)	1,00	6,00	6,00	6,00	6,00
Load Axle-2 (Ton)	1,00	8,00	16,00	8,00	16,00
Load Axle-3 (Ton)				16,00	16,00
Load Axle-4 (Ton)					
VDF Axle-1	0,0012	1,5242	1,5242	1,5242	1,5242
VDF Axle-2	0,0012	0,9238	1,8281	0,9238	1,8281
VDF Axle-3				1,8281	1,8281
VDF Axle-4					
VDF	0,0024	2,4480	3,3523	4,2761	5,1804

Table 4.51 *VDF* for the heaviest axle load is 10 tons (MST-10TON)

Vehicle Class	Class I	Class II	Class III	Class IV	Class V
					
Vehicle Type	Passenger Car	2-Axle Truck	3-Axle Truck	4-Axle Truck	5 Axle Truck
Axle	1.1	1.2	1.22	1.2-22	1.22-22
Load Axle-1 (Ton)	1,00	6,00	6,00	6,00	6,00
Load Axle-2 (Ton)	1,00	10,00	20,00	10,00	20,00
Load Axle-3 (Ton)				20,00	20,00
Load Axle-4 (Ton)					
<i>VDF</i> Axle-1	0,0012	1,5242	1,5242	1,5242	1,5242
<i>VDF</i> Axle-2	0,0012	2,2555	4,4632	2,2555	4,4632
<i>VDF</i> Axle-3				4,4632	4,4632
<i>VDF</i> Axle-4					
<i>VDF</i>	0,0024	3,7796	5,9874	8,2428	10,4506

Technically, the calculation would be more precise if each TRO had recorded data for each vehicle load. But e-SPM currently does not provide a feature for TRO to report vehicle load data, so the *VDF* calculation uses the standard load used for each toll road.



4.6.1. System Process Design

4.7.1.1. Context Diagram

The Context Diagram for "IRI Deterioration" analysis can be seen in the image below:

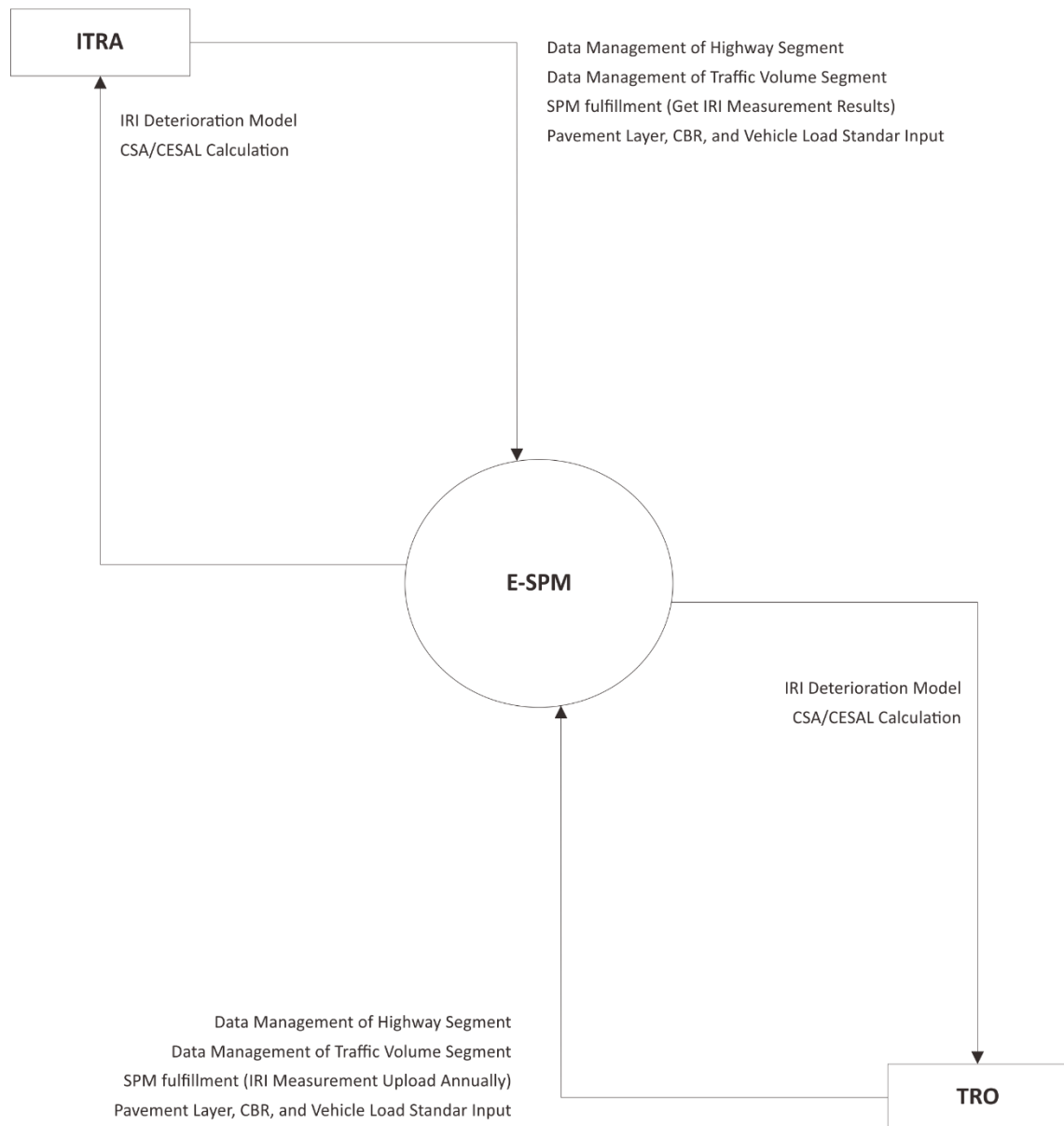


Figure 4.27 Context Diagram for "IRI Deterioration" analysis

4.7.1.2. Use Case Diagram

The Use Case Diagram for "IRI Deterioration" analysis can be seen in the image below:

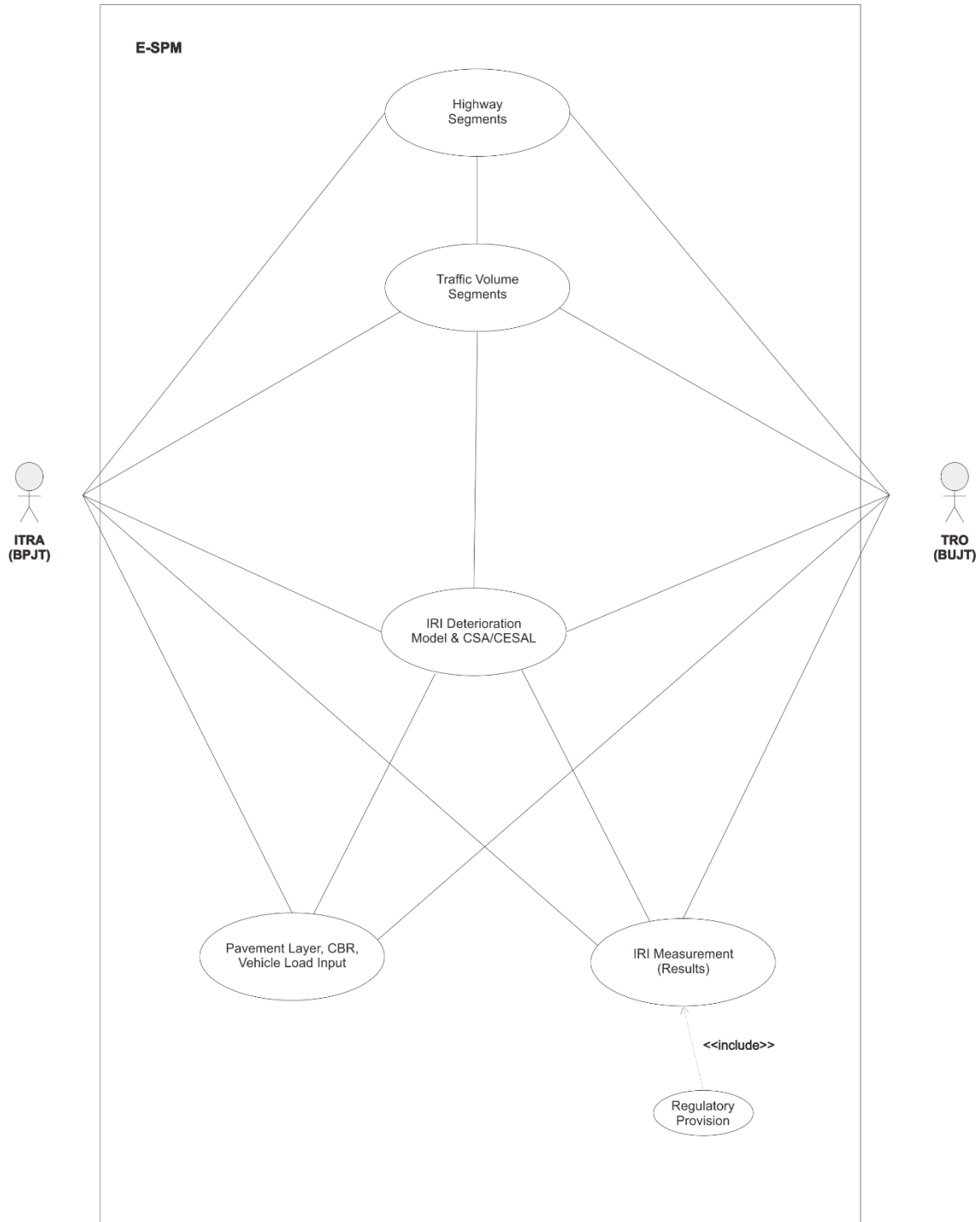


Figure 4.28 Use Case for "IRI Deterioration" analysis



4.6.2. Database Design

Database Design for "IRI Deterioration" analysis can be seen in the image below:

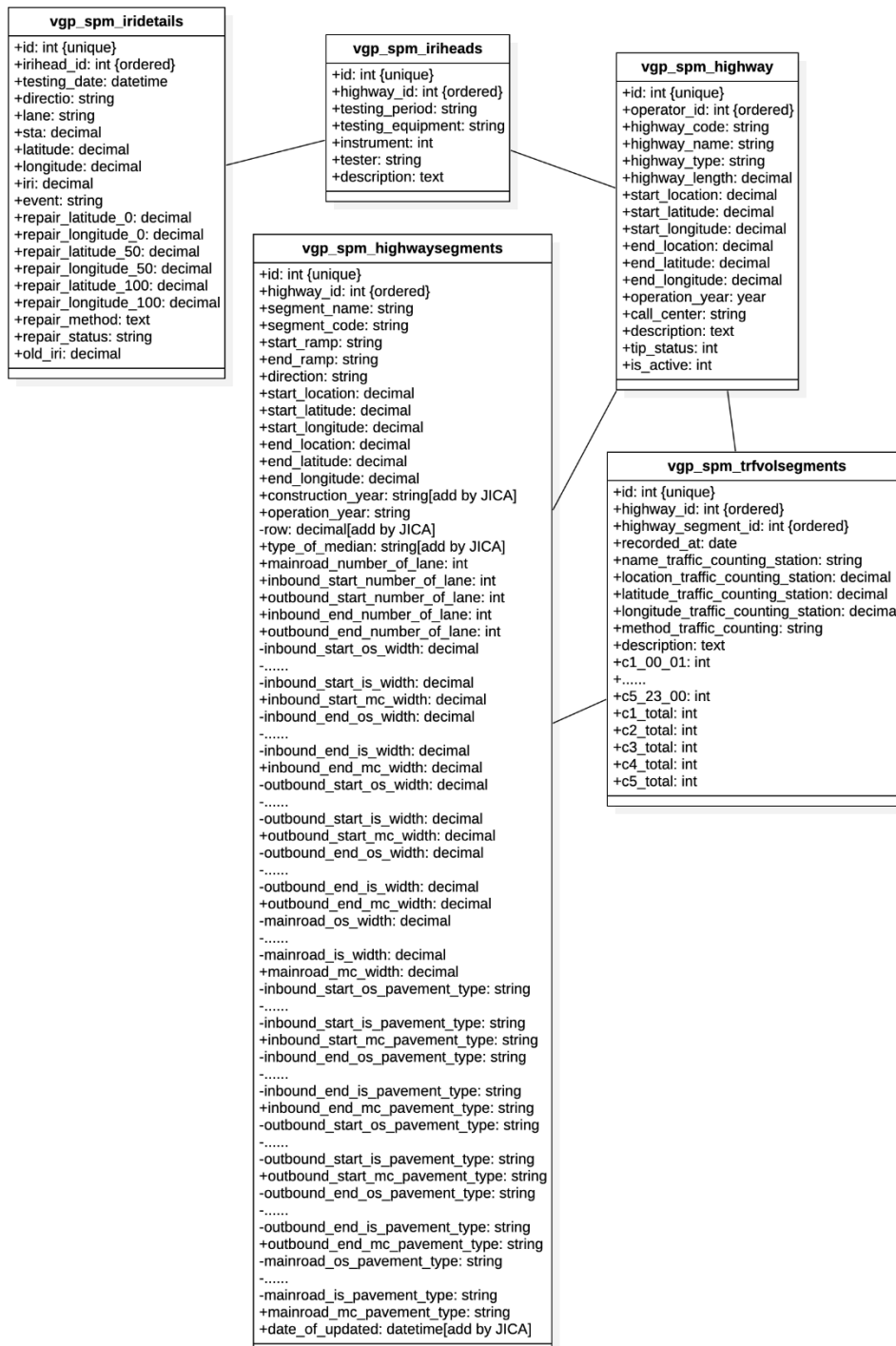


Figure 4.29 Database design for "IRI Deterioration" analysis

4.6.2.1. IRI (Head)

Table Name : **vgp_spm_iriheads**
 Table Relation : vgp_spm_highways, vgp_spm_irietails
 Type of Table : Transaction
 Description : Head of IRI measurement results

Table 4.52 Data dictionary for “vgp_spm_iriheads” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each IRI measurement
2.	F	highway_id	Highway	integer	Refers to “vgp_spm_highways” table
3.		testing_period	Period	year	Period of IRI measurement (annually)
4.		testing_equipment	Equipment	string	Testing equipment
5.		instrument	Measurement Interval	integer	Measurement interval per-lane: 100m, 1.000m, etc.
6.		tester	Tester	string	Tester
7.		description	Description	string	Description of IRI measurement

Text: already available in the existing e-SPM database

Text: e-SPM database development

4.6.2.1. IRI (Detail)

Table Name : **vgp_spm_irietails**
 Table Relation : vgp_spm_highways, vgp_spm_iriheads
 Type of Table : Transaction
 Description : Detail of IRI measurement results

Table 4.53 Data dictionary for “vgp_spm_irietails” table (1/2)

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	id	ID	integer	ID assigned for each IRI measurement
2.	F	irihead_id	Testing ID	integer	Refers to “vgp_spm_iriheads” table
3.		testing_date	Date	datetime	Date of measurement
4.		direction	Direction	string	Direction of distress location (normal direction or opposite direction)



Table 4.54 Data dictionary for “vgp_spm_irdetails” table (2/2)

SN	P/F	Data Items	Caption	Data Type	Definition
5.		lane	Lane	string	Lane position of measurement (main lane only)
6.		sta	Chainage	decimal	Tester
7.		latitude	Latitude	decimal	Description of IRI measurement
8.		longitude	Longitude	decimal	Chainage of point measurement
9.		iri	IRI (m/km)	decimal	IRI value (m/km)
10.		event	Event	string	Event of measurement, example: toll gate, rumble strip, etc.
11.		repair_latitude_0	Latitude - Repair 0%	decimal	Latitude of before repair (0%)
12.		repair_longitude_0	Longitude - Repair 0%	decimal	Longitude of before repair (0%)
13.		repair_latitude_50	Latitude - Repair 50%	decimal	Latitude of during repair (50%)
14.		repair_longitude_50	Longitude - Repair 50%	decimal	Longitude of during repair (50%)
15.		repair_latitude_100	Latitude - Repair 100%	decimal	Latitude of after repair (100%)
16.		repair_longitude_100	Longitude - Repair 100%	decimal	Longitude of after repair (100%)
17.		repair_method	Repair Method	string	Repair method (for IRI > 4 m/km)
18.		repair_status	Repair Status	string	Repair status: Finish or Unfinish (for IRI > 4 m/km)
19.		old_iri	Previous IRI Value (m/km)	decimal	Previous IRI value, before repair (for IRI > 4 m/km)

Text: already available in the existing e-SPM database

Text: e-SPM database development

The data dictionary for other tables has been described in:

- **Sub-Chapter 3.1.2.3** : vgp_spm_highways
- **Sub-Chapter 3.1.2.8** : vgp_spm_highwaysegments
- **Sub-Chapter 3.3.2.1** : vgp_spm_trfvolegments

In order to calculate IRI deterioration using **Equation 4.15 - Equation 4.20** is taken from:

- IRI_0 : vgp_spm_iridetails. iri [9]
 a_i : Select (refers to **Table 4.48**)
 h_i : Input (mm)
 CBR : Input (%), default 6%
 LHR : vgp_spm_trfvsegments [sum of 11 - 130], with condition:
- Traffic volume data for each segment must be available. If the data is incomplete, accident rate (T_k) will be emptied;
 - If the traffic volume data for a segment is > 1 in the same year, the traffic volume will be averaged.
 - Traffic volume data from the beginning of operations/previous years will be reduced by 3% annually (from the latest data)
- VDF : Select (refers to **Table 4.50** or **Table 4.51**)



4.6.3. User Interface Design

User Interface Design for "IRI Deterioration" analysis can be seen in **Figure 4.30 - Figure 4.32:**

IRI Detoration

JICA / Detoration IRI

Highway
Direction
Lane

Pavement Type

Layer Type	Coefficient
Base Course	
Type B Hot Mix Asphalt	0.40
Asphalt Treated Base Class I	0.34
Bituminous Treated Aggregate Base	0.23
Asphalt Treated Base Class II	0.26
Cold-Laid Bituminous Concrete Base	0.23
Cement Treated Granular (Aggregate) Base	0.20
Soil-Cement Base	0.15
Crushed (Graded) Stone Base	0.14
Macadam Stone Base	0.12
Portland Cement Concrete Base (New)	0.50
Old Portland Cement Concrete	0.40
Crack and Seated PCC	0.25 - 0.30
Rubblize PCC	0.20
Cold in Place Recycled	0.22 - 0.27

Layer Type	Coefficient
Surface/Intermediate Course	
Hot Mix Asphalt with Type A Aggregate	0.44
Hot Mix Asphalt with Type B Aggregate	0.40
Subbase Course	
Soil-Cement Subbase	0.10
Soil-Lime Subbase	0.10
Granular Subbase	0.10
Soil-Aggregate Subbase	0.05

Filled from the top layer of pavement (Based on type layer guideline)

Layer 1 Layer Type Koefisien thickness (mm)

Layer 2 Layer Type Koefisien thickness (mm)

[+ Add Layer](#)

California Bearing Ratio % *Based on pavement design manual

$$SN_{sp} = 3.51 \log CBR - 0.86(\log CBR)^2 - 1.43$$

Where:
 SN_g : Subgrade contribution, calculated by the formula Hodges et al, 1975
 CBR : In situ California Bearing Ratio of Subgrade (%) // Kolom D

SN_g

$$SNC = \left[0.04 \sum_{i=1}^n \frac{h_i}{a_i} \right] + SN_{sp}$$

Where:
 SNC : Structure value of pavement strength
 a : Material and Layer Strength coefficient // koefisien pada list kombinasi kolom C
 h : Layer thickness (mm) // input ketebalan pada kolom C
 SN_g : Subgrade contribution, calculated by the formula Hodges et al, 1975 // Hasil perhitungan kolom E

SNC

Select Loading Scenario (Heaviest Axle Load) **

Loading Scenario	Description
MST-8 TON	Heaviest Axle Load (MST) = 8 Tons
MST-10 TON	Heaviest Axle Load (MST) = 10 Tons

$$IRI_n = 1.04e^{0.022n} [IRI_0 + 263(1 + SNC)^{-5} \times CSA_n]$$

Where:
 IRI_n : IRI value in year-n (m/km) // Output akhir perhitungan pada tahun ke-n
 IRI₀ : IRI value in base year (m/km) // Nilai IRI per-Sta [vgl. spm_inidetails.in]
 SNC : Structure value of pavement strength // Hasil perhitungan kolom G
 CSA_n : Cumulative Standard Axle year-n (million ESA per-lane) // Sheet CSA-8 dan CSA-10

[Generate CSA and Detoration](#)

Figure 4.30 User Interface Design for "IRI Deterioration" analysis (1/3)

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CSA IRI Deterioration

TRUCK FACTOR / VEHICLE DAMAGE FACTOR (VDF)

Vehicle Class	Class I	Class II	Class III	Class IV	Class V
Vehicle Type	Pass. Car	2-axle Truck	3-axle Truck	4-axle Truck	5-axle Truck
Axle	1,1	1,2	1,2,2	1,2-2,2	1,2,2-2,2
Load Axle-1 (ton)	1,0000	6,0000	6,0000	6,0000	6,0000
Load Axle-2 (ton)	1,0000	8,0000	16,0000	8,0000	16,0000
Load Axle-3 (ton)				16,0000	16,0000
Load Axle-4 (ton)					
EF Axle-1	0,0012	1,5242	1,5242	1,5242	1,5242
EF Axle-2	0,0012	0,9238	1,8281	0,9238	1,8281
EF Axle-3				1,8281	1,8281
EF Axle-4					
Truck Factor	0,0024	2,4480	3,3523	4,2761	5,1804

CUMMULATIVE EQUIVALENT STANDARD AXLE LOAD (CESAL)

ESAL=traffic volume × Truck Factor × Direction Distribution × Lane Distribution × 365

Year	AADT (per-day)	Class I	Class II	Class III	Class IV	Class V	ESAL Class I	ESAL Class II	ESAL Class III	ESAL Class IV	ESAL Class V	Total ESAL (t/d)	ESAL (t/d)
2022	12.384	8.675	2.272	872	303	261	0,0060	1,6244	0,8534	0,3788	0,3953	3,2579	3,2579
2023	13.343	9.347	2.448	939	327	282	0,0064	1,7502	0,9195	0,4082	0,4259	3,5102	6,7680
2024	14.302	10.019	2.624	1.007	350	302	0,0069	1,8760	0,9856	0,4375	0,4565	3,7624	10,5305
2025	15.262	10.691	2.801	1.074	374	322	0,0073	2,0019	1,0517	0,4669	0,4871	4,0150	14,5455
2026	16.157	11.318	2.965	1.137	396	341	0,0078	2,1193	1,1134	0,4943	0,5157	4,2504	18,7959
2027	17.052	11.945	3.129	1.200	418	360	0,0082	2,2367	1,1751	0,5216	0,5443	4,4859	23,2818
2028	17.947	12.572	3.293	1.263	440	379	0,0086	2,3541	1,2368	0,5490	0,5728	4,7213	28,0031
2029	18.842	13.199	3.458	1.326	462	398	0,0091	2,4715	1,2984	0,5764	0,6014	4,9568	32,9599
2030	19.739	14.659	3.622	1.390	484	416	0,0095	2,5891	1,3603	0,6038	0,6300	5,1928	38,1527
2031	20.927	14.659	3.840	1.473	513	442	0,0101	2,7450	1,4421	0,6402	0,6679	5,5053	43,6580
2032	22.115	15.492	4.058	1.557	542	467	0,0106	2,9008	1,5240	0,6765	0,7059	5,8178	49,4758

CESAL Tollroad
..... Segment

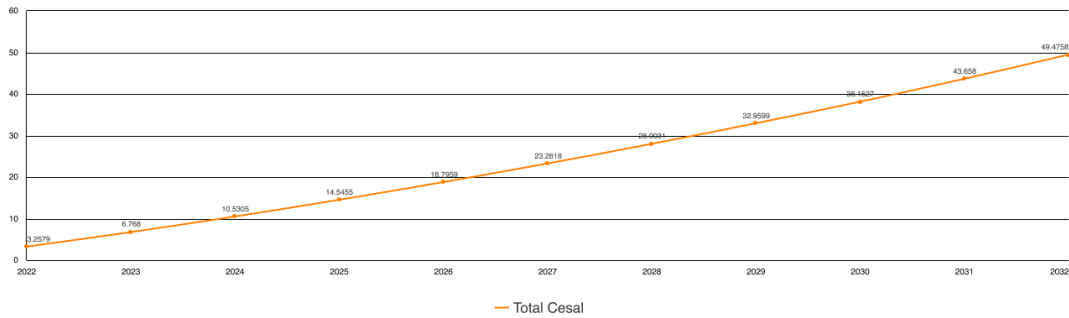
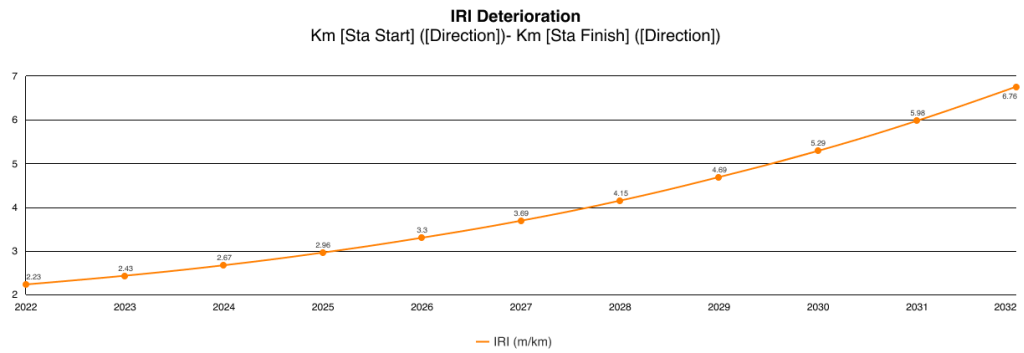


Figure 4.31 User Interface Design for “IRI Deterioration” analysis (2/3)



CSA IRI Deterioration



Export Xlsx

IRI (m/Km)	Road Condition
IRI <= 4	Good
IRI > 4 & IRI <= 8	Fair
IRI > 8 & IRI <= 12	Lightly Damaged
IRI > 12	Heavy Damage

Stationary Start	Stationary Finish	Section	Pavement Type	CBR rep. (%)	SNsg	SNC	IRI (m/km)											
							2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
6.800	6.900	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	2.23	2.43	2.67	2.96	3.30	3.69	4.15	4.69	5.29	5.98	6.76	dl
6.900	7.000	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	2.99	3.24	3.53	3.87	4.27	4.73	5.26	5.86	6.54	7.31	8.18	dl
7.000	7.100	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	2.19	2.38	2.62	2.91	3.24	3.64	4.10	4.62	5.23	5.91	6.69	dl
7.100	7.200	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	2.08	2.27	2.50	2.77	3.10	3.49	3.94	4.45	5.04	5.72	6.48	dl
7.200	7.300	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	1.93	2.11	2.33	2.59	2.91	3.28	3.72	4.22	4.80	5.46	6.20	dl
7.300	7.400	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	2.28	2.48	2.72	3.02	3.36	3.76	4.23	4.76	5.37	6.07	6.85	dl
7.400	7.500	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	2.33	2.53	2.78	3.08	3.42	3.83	4.30	4.84	5.46	6.16	6.95	dl
7.500	7.600	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	1.76	1.93	2.14	2.39	2.69	3.05	3.47	3.96	4.52	5.16	5.89	dl
7.600	7.700	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	1.63	1.79	1.99	2.23	2.53	2.87	3.28	3.76	4.30	4.93	5.64	dl
7.700	7.800	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	2.04	2.23	2.45	2.73	3.05	3.43	3.88	4.39	4.98	5.65	6.41	dl
7.800	7.900	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	2.41	2.62	2.87	3.17	3.53	3.94	4.42	4.96	5.59	6.30	7.10	dl
7.900	8.000	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	2.45	2.66	2.92	3.22	3.58	3.99	4.47	5.03	5.65	6.37	7.17	dl
8.000	8.100	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	1.30	1.44	1.61	1.83	2.10	2.42	2.80	3.25	3.76	4.35	5.03	dl
8.100	8.200	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	1.39	1.53	1.72	1.94	2.22	2.55	2.93	3.39	3.91	4.51	5.20	dl
8.200	8.300	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	1.51	1.66	1.85	2.09	2.37	2.71	3.11	3.57	4.11	4.72	5.42	dl
8.300	8.400	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	1.24	1.37	1.55	1.76	2.03	2.34	2.72	3.15	3.66	4.25	4.92	dl
8.400	8.500	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	1.95	2.13	2.35	2.62	2.94	3.31	3.75	4.25	4.83	5.49	6.24	dl
8.500	8.600	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	1.61	1.77	1.97	2.21	2.50	2.85	3.25	3.73	4.27	4.90	5.61	dl
8.600	8.700	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	7.22	7.74	8.32	8.97	9.70	10.50	11.40	12.40	13.50	14.72	16.06	dl
8.700	8.800	Pondok Aren - Pamulang	Rigid	6.00	0.78	8.02	8.16	8.74	9.38	10.10	10.90	11.79	12.77	13.85	15.05	16.36	17.81	dl

Figure 4.32 User Interface Design for “IRI Deterioration” analysis (3/3)

4.8. Deterioration Trend Analysis (Additional)

Based on the results of meeting on January 27, 2023, JICA Project Team asked for additional deterioration modules as stated in the TOR. However, the deterioration model in **Sub-Chapter 4.7** still exists. Referring to the TOR, currently Bina Marga and CFRI are developing a general deterioration forecasting model using the regression method. The technical approach used is to determine road pavement conditions based on years of operation to obtain an estimate of the remaining service life. Road conditions are determined in the "Damage Severity Rating (d)" variable using a scale of 1-5 (1: Very Good, 2: Good, 3: Fair, 4: Poor, 5: Very Poor).

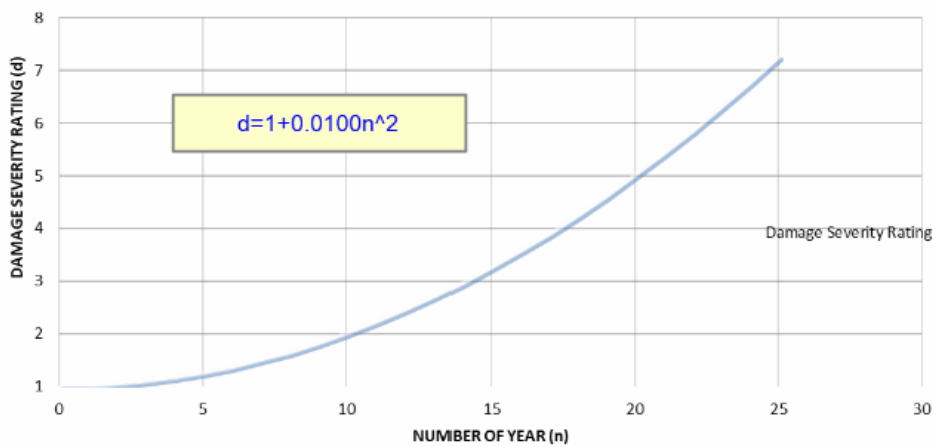


Figure 4.33 Deterioration forecasting model (pavement) using regression method

From the regression d above, we can find out the estimation of remaining service life.

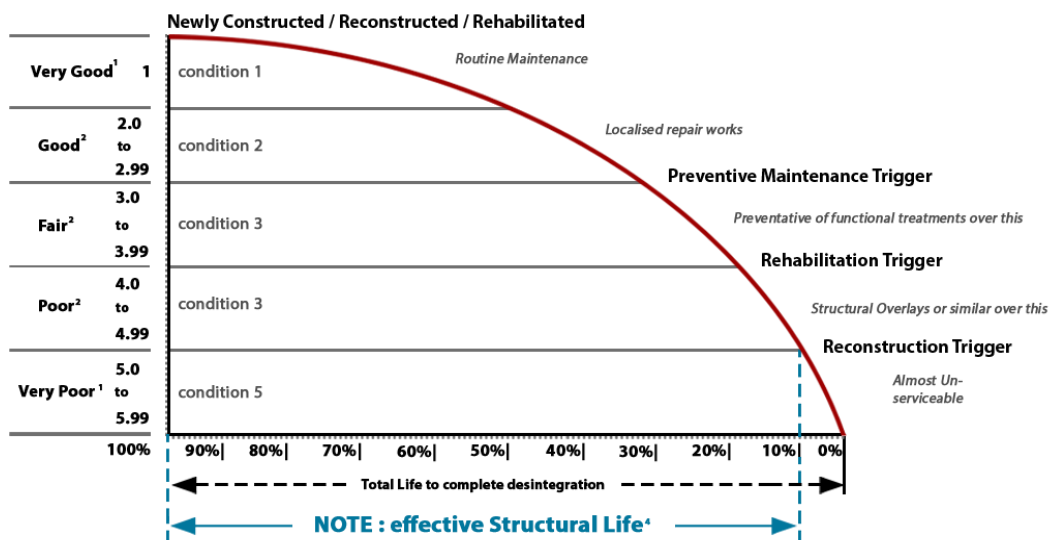


Figure 4.34 Typical pavement asset degradation curve



The following is the result of the calculation of the deterioration forecasting model using the example of operating toll road in 2022, forecasted for the next 30 years.

Table 4.55 Sample case of deterioration using the example of operating toll road in 2022

Year	<i>n</i>	<i>d</i>	Year	<i>n</i>	<i>d</i>
2022	0	1,00	2038	16	3,56
2023	1	1,01	2039	17	3,89
2024	2	1,04	2040	18	4,24
2025	3	1,09	2041	19	4,61
2026	4	1,16	2042	20	5,00
2027	5	1,25	2043	21	5,41
2028	6	1,36	2044	22	5,84
2029	7	1,49	2045	23	6,29
2030	8	1,64	2046	24	6,76
2031	9	1,81	2047	25	7,25
2032	10	2,00	2048	26	7,76
2033	11	2,21	2049	27	8,29
2034	12	2,44	2050	28	8,84
2035	13	2,69	2051	29	9,41
2036	14	2,96	2052	30	10,00
2037	15	3,25			

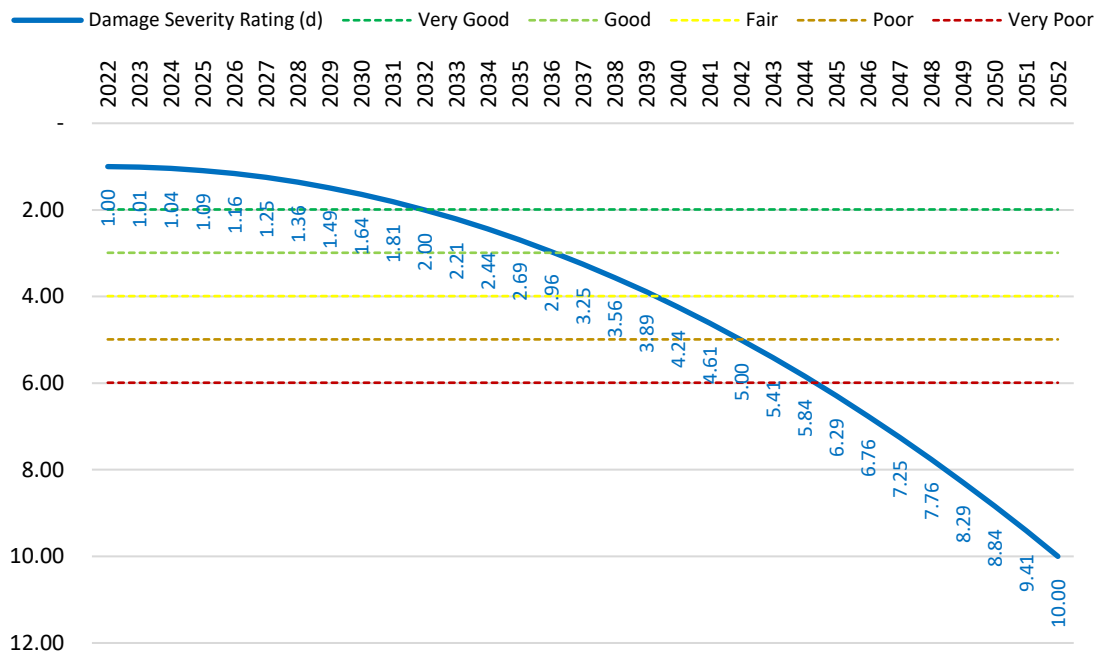


Figure 4.35 Degradation curve results

This module has been accommodated with an interface that can be seen in the following figure:

Deterioration Forecasting Model

Highway	Operation Year	damage severity rating (d)	Status
Akses Tanjung Priok	2017	1.36	Very Good
Bakauheni - Terbanggi Besar	2019	1.16	Very Good
Balikpapan - Samarinda	2019	1.16	Very Good
Bekasi - Cawang - Kampung Melayu	2017	1.36	Very Good
Belawan - Medan - Tanjung Morawa	1989	12.56	effective structural life < 0%
Binjai - Langsa	2022	1.01	Very Good
Bogor Ring Road Seksi I-III A	2009	2.96	Good
Cawang - Tomang - Pluit	1987	13.96	effective structural life < 0%
Cengkareng - Batu Ceper - Kunciran	2021	1.04	Very Good
Ciawi - Sukabumi	2018	1.25	Very Good
Cibitung - Cilincing	2021	1.04	Very Good
Cikampek - Palimanan	2015	1.64	Very Good
Cikampek - Purwakarta - Padalarang	2005	4.24	Poor
Cileunyi - Sumedang - Dawuan	2022	1.01	Very Good
Cimanggis - Cibitung	2020	1.09	Very Good
Cinere - Jagorawi	2012	2.21	Good
Depok - Antasari	2018	1.25	Very Good
Gempol - Pandaan	2015	1.64	Very Good
Gempol - Pasuruan	2017	1.36	Very Good
Jakarta - Bogor - Ciawi	1978	21.25	effective structural life < 0%
Jakarta - Cikampek	1988	13.25	effective structural life < 0%

Figure 4.36 User Interface Design for “Deterioration Forecasting Model” analysis (1/2)



Damage Severity Rating (d) Curve

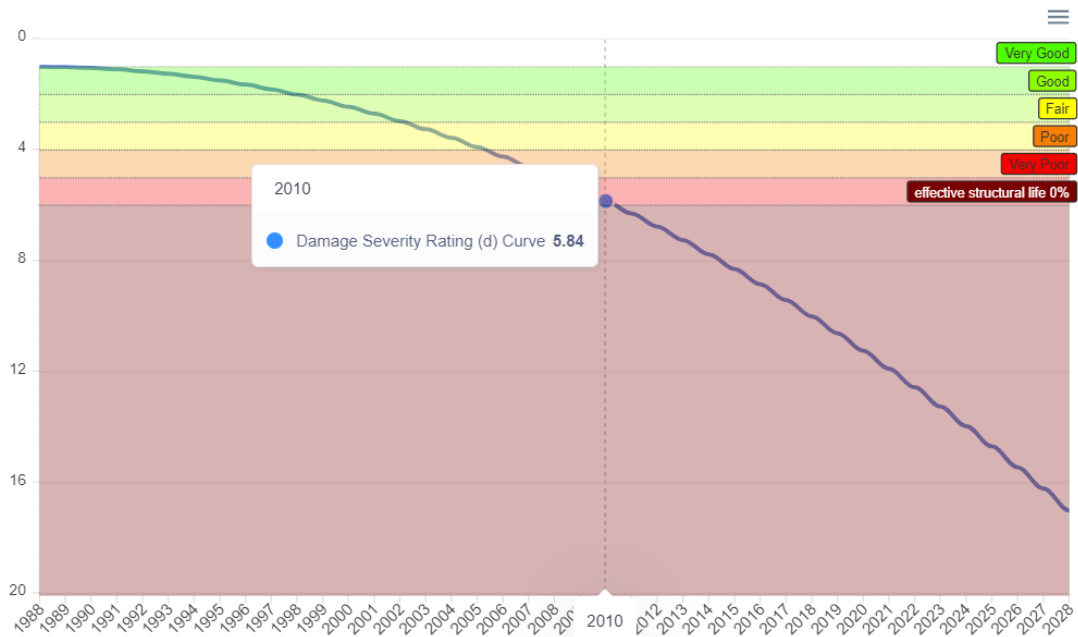


Figure 4.37 User Interface Design for “Deterioration Forecasting Model” analysis (2/2)

While the system process design and database design are not required, because the calculation process only requires the operating year parameter obtained from the "vgp_spm_highwaysegments" table.

4.9. Detailed Investigation

Based on Term of Reference (TOR), detailed investigation is one of the targets of E-SPM upgrading in the form of analysis module. The Sub-Consultant shall develop an analytic interface to recommend for the detailed investigation by analyzing the historical damage detection in the same location. In the current version of E-SPM, only location is identified but any further analysis or measures are not recommended. The Sub-Consultant shall create a list with recommended detailed investigation based in the threshold of damages detected in the same location/area. The criteria for recommendation will be provided by the Project in due course. Also, upon double click of damage location point, the Sub-Consultant shall develop a pop-up window to show details of damages including damage photos. The interface developed to accommodate this feature is in the form of a strip map with 200m intervals, which can be seen in **Table 4.56** below:

Table 4.56 Detailed investigation strip map

Chainage (Km)		0+000	0+200	0+400	0+600	0+800	...	
Direction →	ROW Fence							
	Drainage			2				
	Safety Fence							
	Outer Shoulder							
	Lane 1							
	Lane 2							
	Lane 3				3			
	Lane 4							
	Inner Shoulder							
	Median							
	Inner Shoulder							
	Lane 4							
	Lane 3							
	Lane 2							
	Lane 1						12	
	Outer Shoulder		8					
	Safety Fence							
	Drainage							
	← Direction	ROW Fence						
	Chainage (Km)		0+000	0+200	0+400	0+600	0+800	...

number of issues = 1-5;
 number of issues = 5-10;
 number of issues : > 10
● unrepair issue/damage



However, not all indicators can be included in this strip map feature, the details can be seen in the table below:

Table 4.57 SPM indicator classification for the strip map feature (1/2)

Substance	Indicator	Strip Map
Toll Road Condition	Main Road (Skid Resistance)	No
	Main Road (International Roughness Index/IRI)	No
	Main Road (Potholes)	Yes
	Main Road (Rutting)	Yes
	Main Road (Cracks)	Yes
	Drainage (Sediment)	Yes
	Drainage	Yes
	Median (Kerb)	Yes
	Median (Median Concrete Barrier/MCB)	Yes
	Median (Guard Rail)	Yes
	Median (Wire Rope)	Yes
	Potholes (Shoulder)	Yes
	Rutting (Shoulder)	Yes
	Cracks (Shoulder)	Yes
Rounding	No	
Average Travel Speed	Travel Speed at Normal Condition	No
Accessibility	Average Transaction Speed	No
	Amount of Vehicle Queues	No
Mobility	Patrol Observation Area	No
	From The Information Received to Incident Location	No
	Problem Vehicles Handling	No
	Police Handling Speed	No
	Tow Handling Speed	No
Safety	Traffic Sign (Quantity and Reflectivity)	No
	Road Marking (Quantity and Reflectivity)	Yes
	Guide Post/Reflector (Quantity and Reflectivity)	No
	Kilometre Sign (Quantity and Reflectivity)	No
	Hectometre Sign (Quantity and Reflectivity)	No
	Street Lighting	No

Table 4.58 SPM indicator classification for the strip map feature (2/2)

Substance	Indicator	Strip Map
Safety (Continue)	Anti-Glare	No
	ROW Fence	Yes
	Safety Fence	Yes
	Accident Handling (Accident Victims)	No
	Accident Handling (Accident Vehicles)	No
	Security and Law Enforcement	No
Rescue Unit, Service Assistance	Ambulance	No
	Tow (Truck)	No
	Police	No
	Toll Road Patrol (Operator)	No
	Rescue	No
	Traffic Information and Communication	No
	Phone Number for Toll Road Info	No
Environment	ROW Cleanness	No
	Operation and Toll Gate Cleanness	No
	ROW Plants	No
	ROW Grass	No
Rest Area	Road Condition	No
	On/Off Ramp	No
	Toilet	No
	Parking	No
	Lighting	No
	Gas Station	No
	Garage	No
Restaurants	No	

Source: Indonesian Minister of Public Works Regulation No: 16/PRT/M/2014



4.7.1. System Process Design

4.9.1.1. Context Diagram

The Context Diagram for "Detailed Investigation" analysis can be seen in the image below:

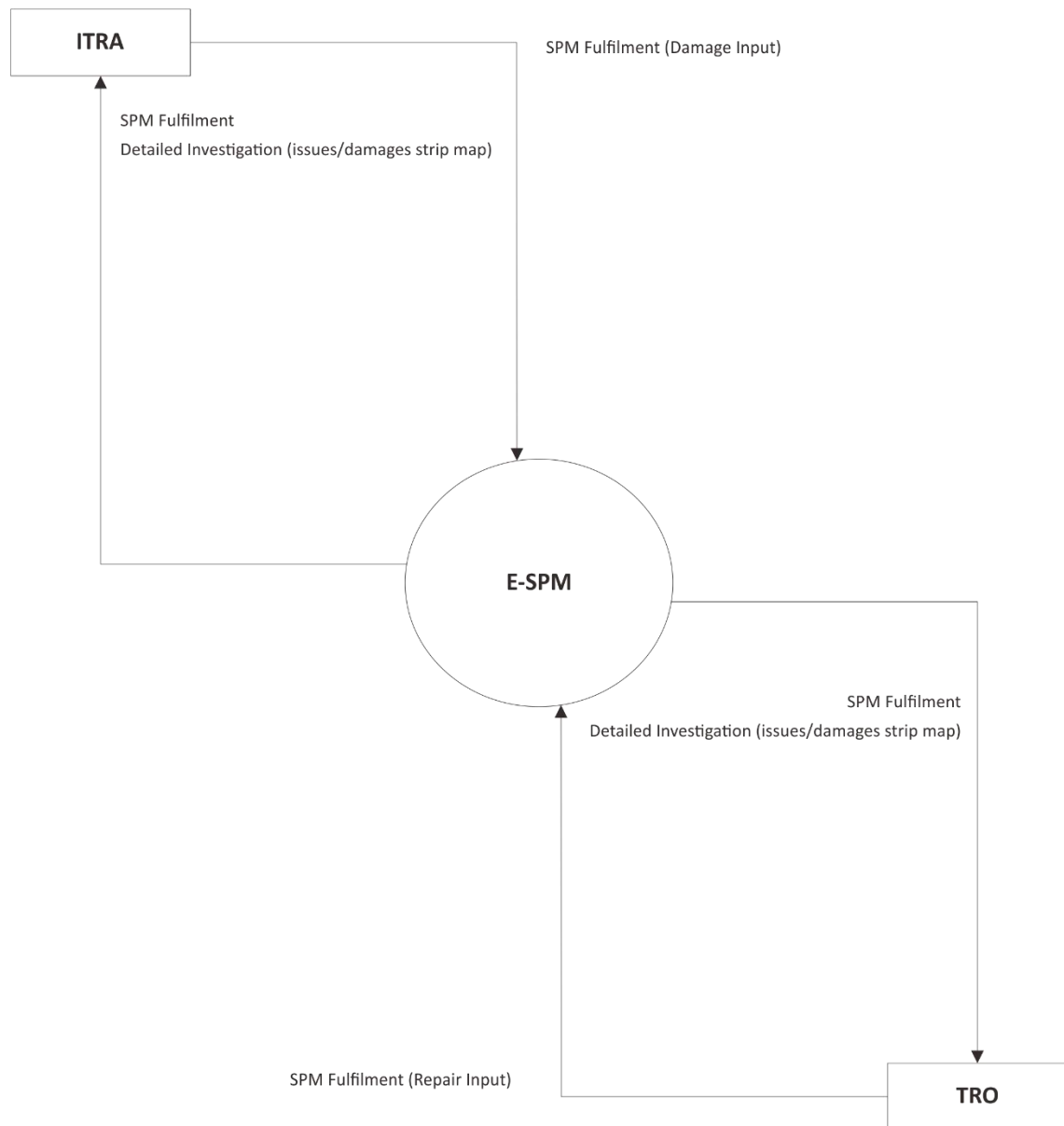


Figure 4.38 Context Diagram for "Detailed Investigation" analysis

4.9.1.2. Use Case Diagram

The Use Case Diagram for "Detailed Investigation" analysis can be seen in the image below:

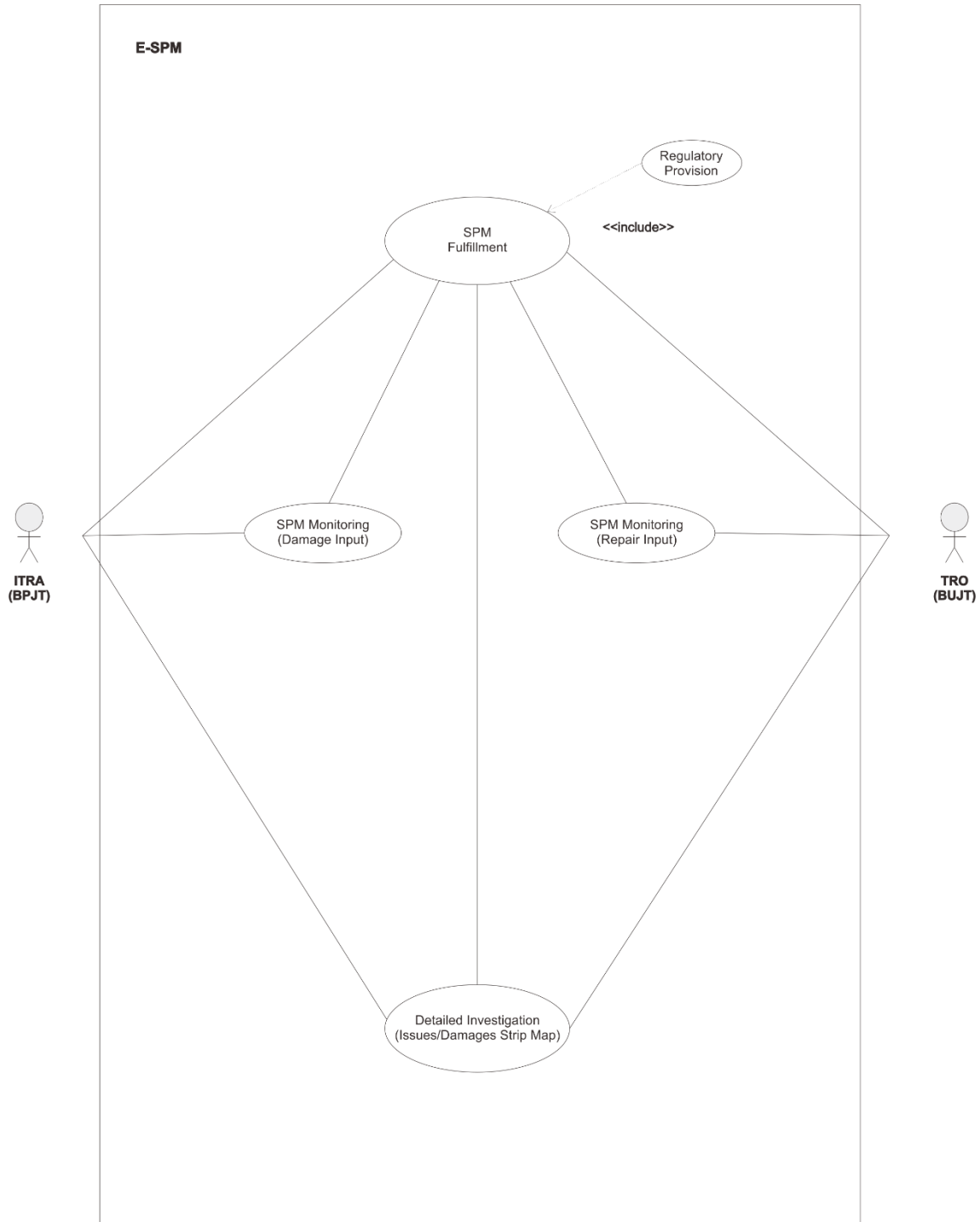


Figure 4.39 Use Case for "Detailed Investigation" analysis



4.7.2. Database Design

Database Design for "Detailed Investigation" analysis can be seen in the image below:

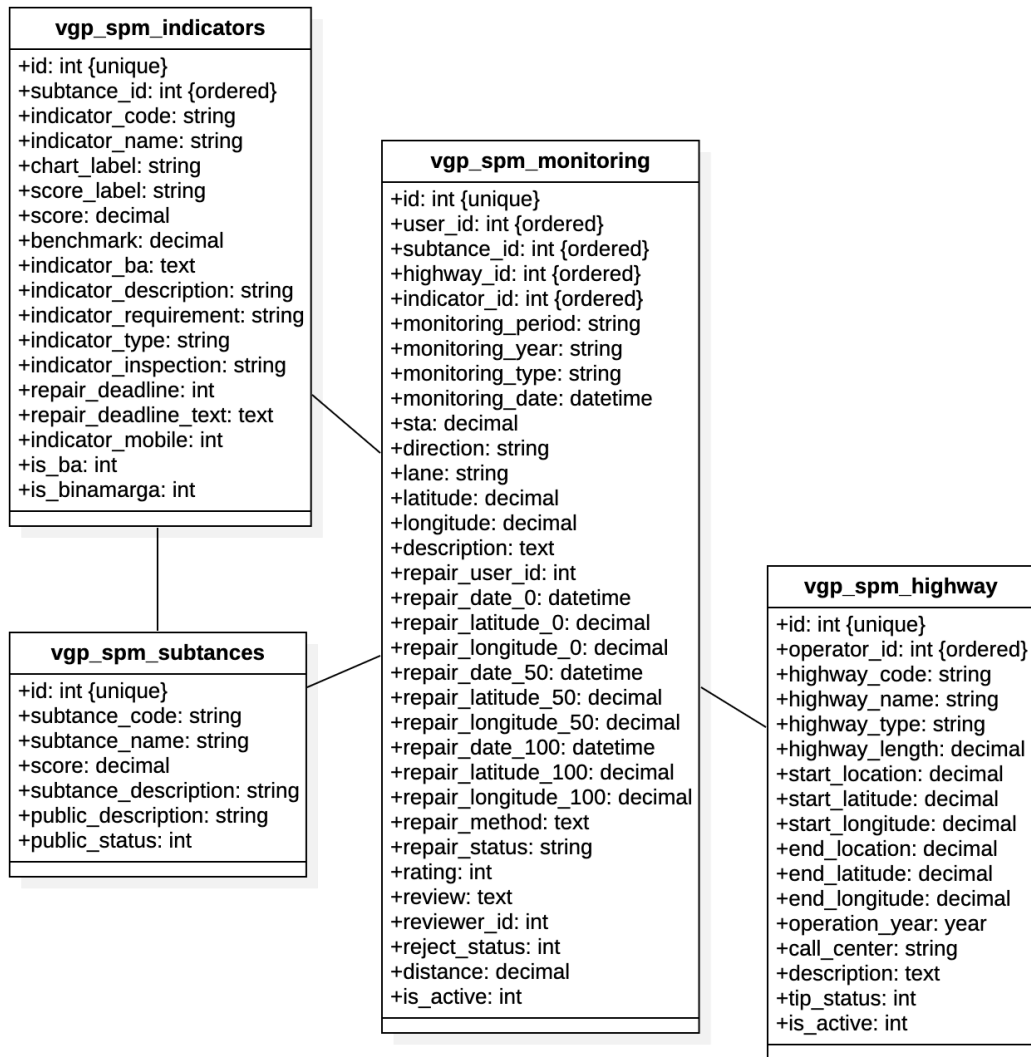


Figure 4.40 Database design for "Detailed Investigation" analysis

The data dictionary for the database design above can be seen in:

- **Sub-Chapter 3.1.2.3** : vgp_spm_highways
- **Sub-Chapter 4.2.2.1** : vgp_spm_substances
- **Sub-Chapter 4.2.2.2** : vgp_spm_indicators
- **Sub-Chapter 4.2.2.3** : vgp_spm_monitorings

4.7.3. User Interface Design

User Interface Design for "Detailed Investigation" analysis can be seen in **Figure 4.41** and **Figure 4.42**:

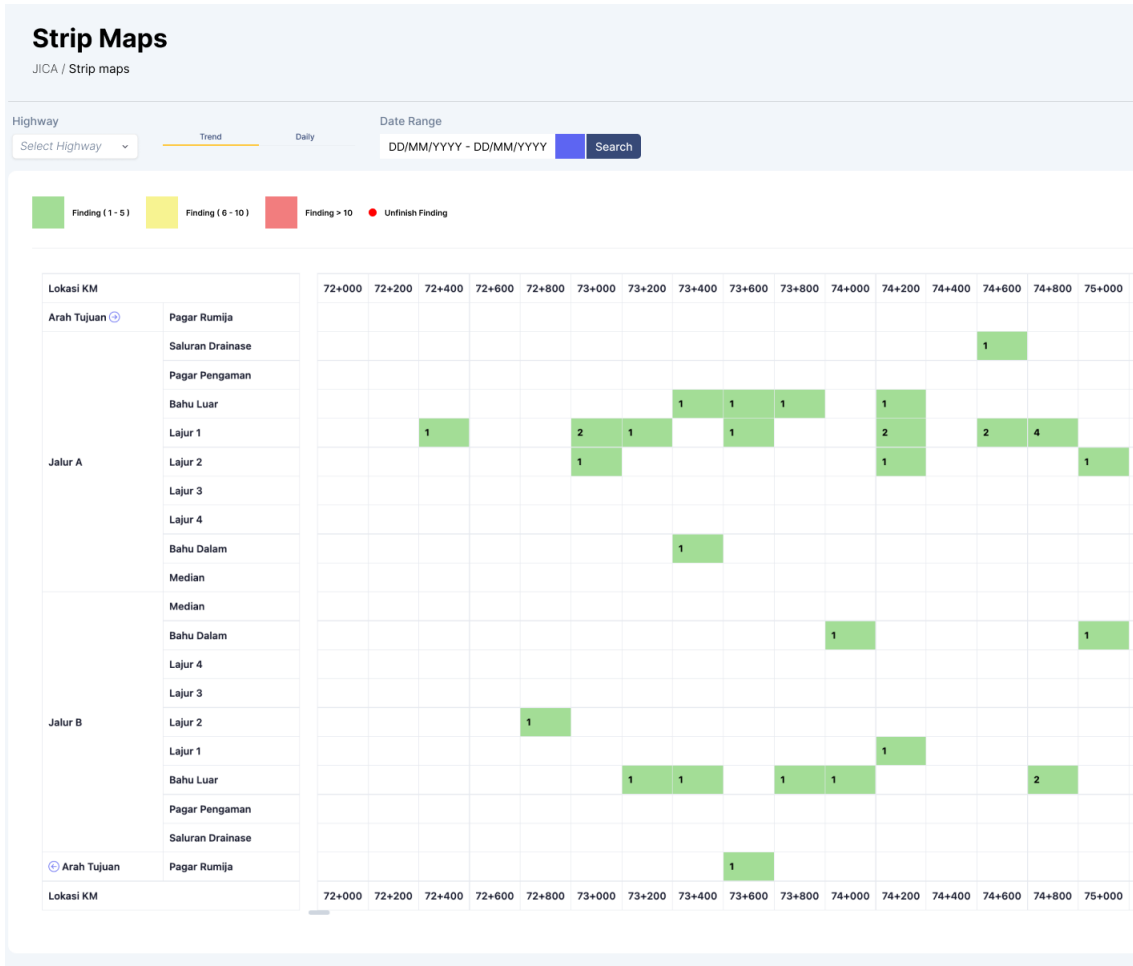


Figure 4.41 User Interface Design for “Detailed Investigation” analysis (1/2)

Each cell with a number can be clicked to display a pop-up window to show damage information, photos and coordinates, which can be seen in the image below:



Monitoring Data

Monitoring Data

Cikampek - Palimanan

Cikampek - Palimanan

Perkerasan Jalan Utama [Lubang]
ID 2440
12 Jul 2021 10:07:30
NORMAL DIRECTION (A) LANE 1 STA 72.500 ✓
Description:
Jalan Berlubang
Repair:
12 Jul 2021 10:07:30

Image Maps Location

Perkerasan Jalan Utama [Lubang]
ID 2440
12 Jul 2021 10:07:30
NORMAL DIRECTION (A) LANE 1 STA 72.500 ✓
Description:
Jalan Berlubang
Repair:
12 Jul 2021 10:07:30

Image Maps Location

Tutup

Tutup

Figure 4.42 User Interface Design for “Detailed Investigation” analysis (2/2)



Reporting & Doc Module

Chapter

05



5.1. Reporting

Based on Term of Reference (TOR), The Sub-Consultant shall develop reporting tool to generate static (i.e., defined format) report and dynamic (i.e., user’s selection). The format/template of static report will be provided by the Project in due course. The Sub-Consultant shall also develop analysis tool to generate the report in tabular, graphical, etc. format. Upon completion of this module, the SPM report submitted by each TRO currently in hard-copy shall be replaced by this system generated by the upgraded E-SPM.

Based on the results of discussions with ITRA, the required report is a “Toll Road Operation and Maintenance Report” referring to the hardcopy report format that is currently applied. The report design is presented separately in the attachment of this report (**Chapter 7**). The data presented in the report will be filtered in the desired date range, with a user interface that can be seen in the following image:

The screenshot displays a web interface for generating a report. At the top, it is titled 'Self Assessment Report' with a subtitle 'JICA / Self Assessment Report'. Below the title, there is a search bar containing a dropdown menu with the text 'Cikampek - Palimanan', a date range input field with the text '01/01/2023 - 01/31/2023', and a dark blue 'Submit' button. Underneath the search bar, there are two 'Download' buttons: one in blue and one in red, both with a document icon.

Figure 5.1 User Interface Design for generate report

5.2. Documentation

Based on Term of Reference (TOR), The Sub-Consultant shall develop document module to store relevant documents such as user manual, road maintenance manual, norms and standards, and project related documents (As-built drawing, etc.) in PDF format.

5.2.1. System Process Design

5.2.1.1. Context Diagram

The Context Diagram for "Documentation" module can be seen in the image below:

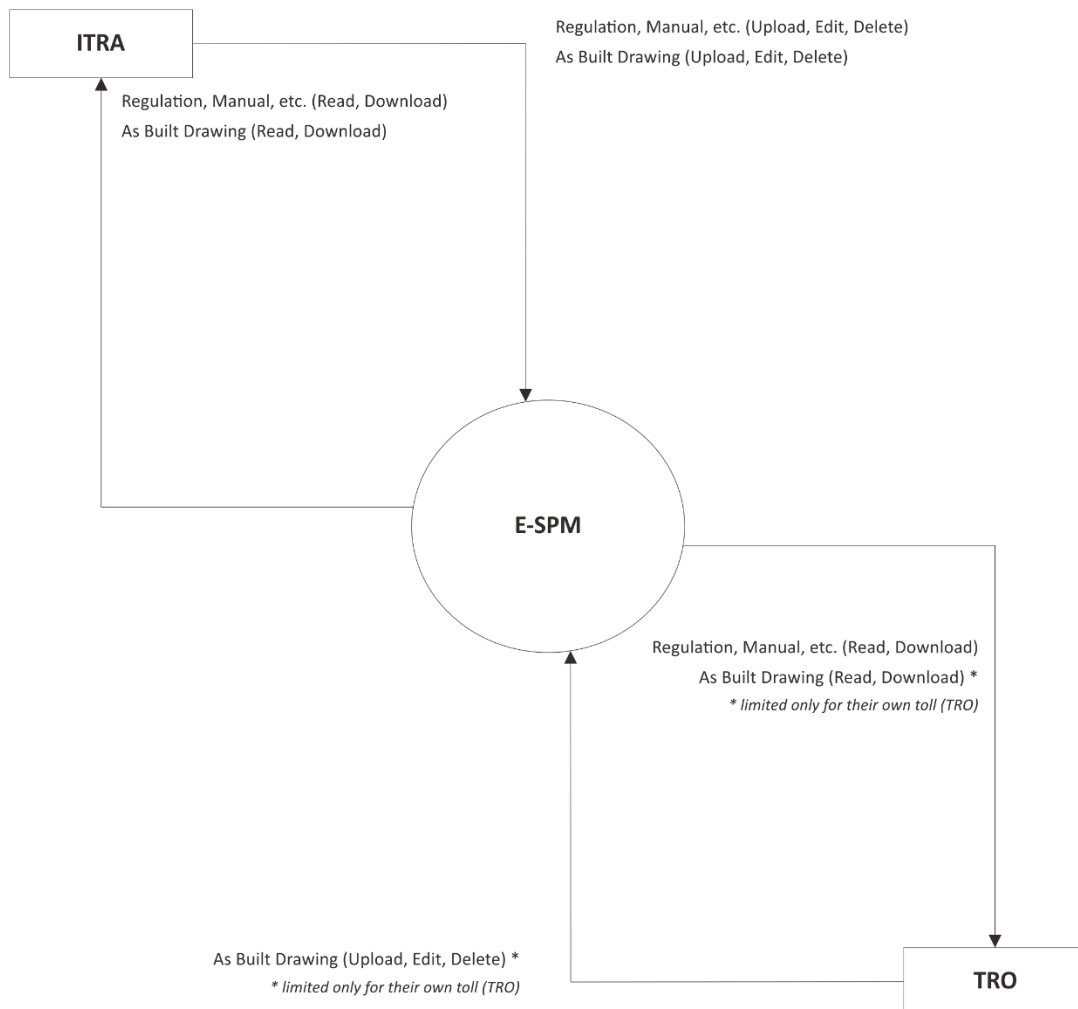


Figure 5.2 Context Diagram for "Documentation" module



5.2.1.2. Use Case Diagram

The Use Case Diagram for "Documentation" module can be seen in the image below:

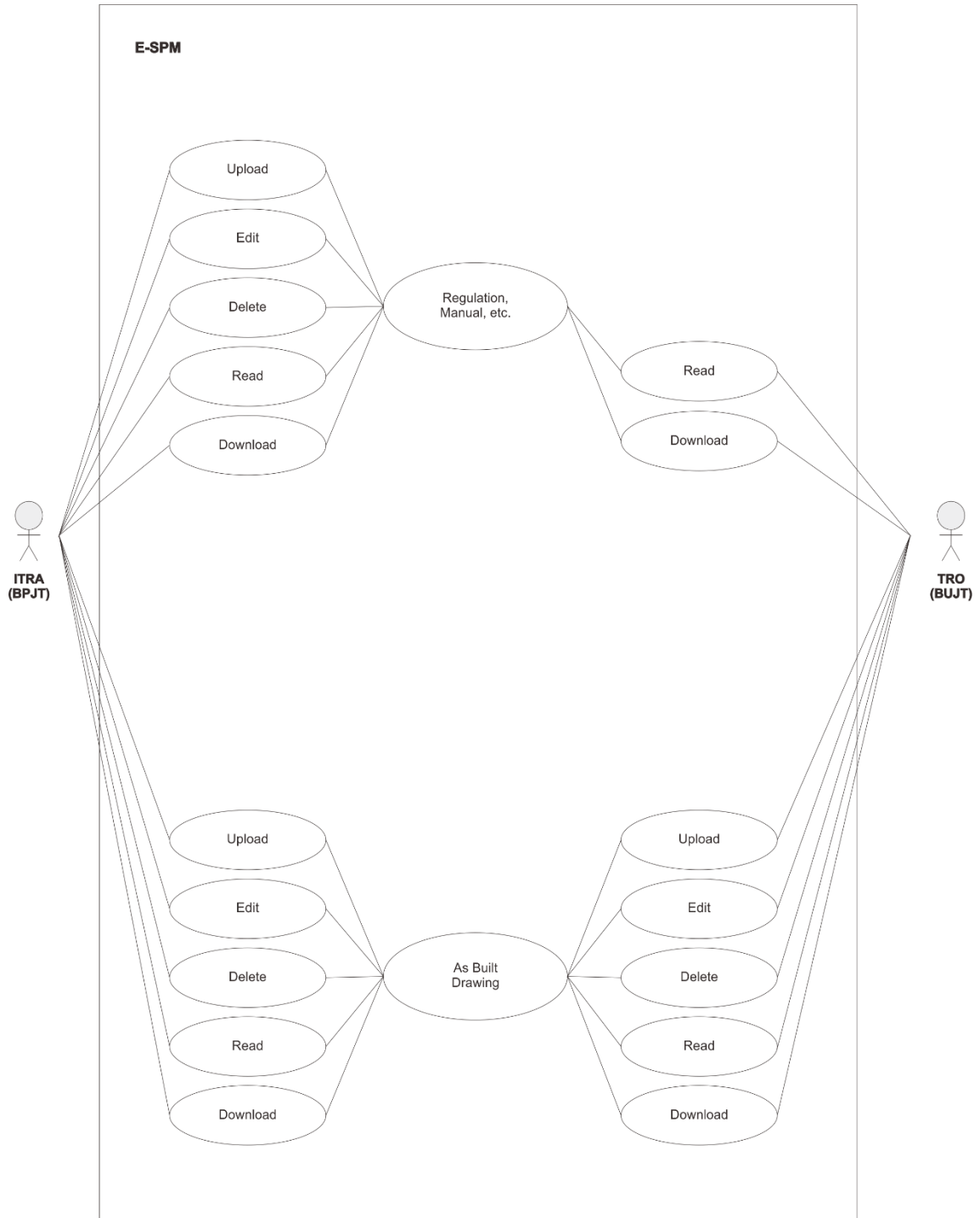


Figure 5.3 Use Case for "Documentation" module

5.2.2. Database Design

Database Design for "Documentation" module can be seen in the image below:

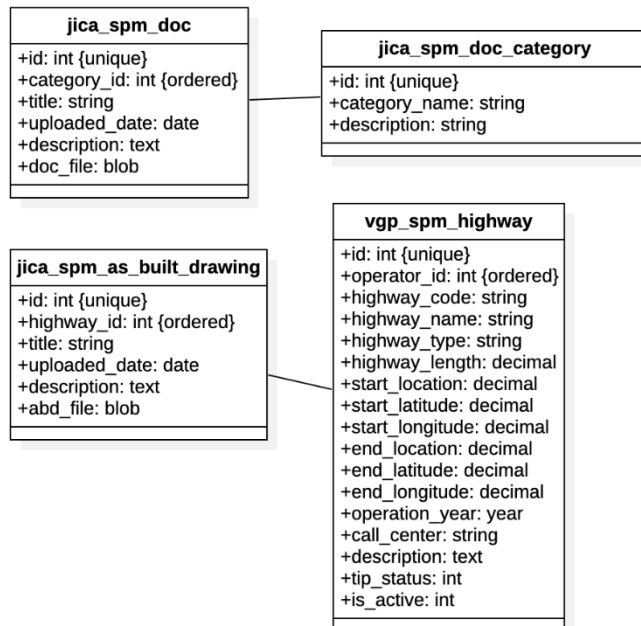


Figure 5.4 Database design for “Documentation” module

5.2.2.1. Documentation Category

Table Name : **jica_spm_doc_category**

Table Relation : jica_spm_doc

Type of Table : Master

Description : Category master for grouping non-as built drawing documents, such as regulations, manuals, etc.

Table 5.1 Data dictionary for “jica_spm_doc_category” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	Id	ID	integer	ID assigned for category
2.		category_name	Category Name	string	Name of document category
3.		description	Description	string	Description of document category

Text: already available in the existing e-SPM database

Text: e-SPM database development



5.2.2.2. Documentation

Table Name : **jica_spm_doc**

Table Relation : jica_spm_doc_category

Type of Table : Master

Description : Documentation master or master data for non-as built drawing documents, such as regulations, manuals, etc.

Table 5.2 Data dictionary for “jica_spm_doc” table

SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	Id	ID	integer	ID assigned for documentation file
2.	F	category_id	Category Name	integer	Refers to jica_spm_doc_category
3.		title	Title	string	Title of documentation file
4.		uploaded_date	Uploaded Date	date	Date of documentation uploaded
5.		description	Description	string	Description of documentation file
6.		doc_file	File	blob	Documentation file

Text: already available in the existing e-SPM database

Text: e-SPM database development

5.2.2.3. As Built Drawing

Table Name : **jica_spm_as_built_drawing**

Table Relation : vgp_spm_highways

Type of Table : Master

Description : Documentation master or master data for as built drawing documents

Table 5.3 Data dictionary for “jica_spm_as_built_drawing” table

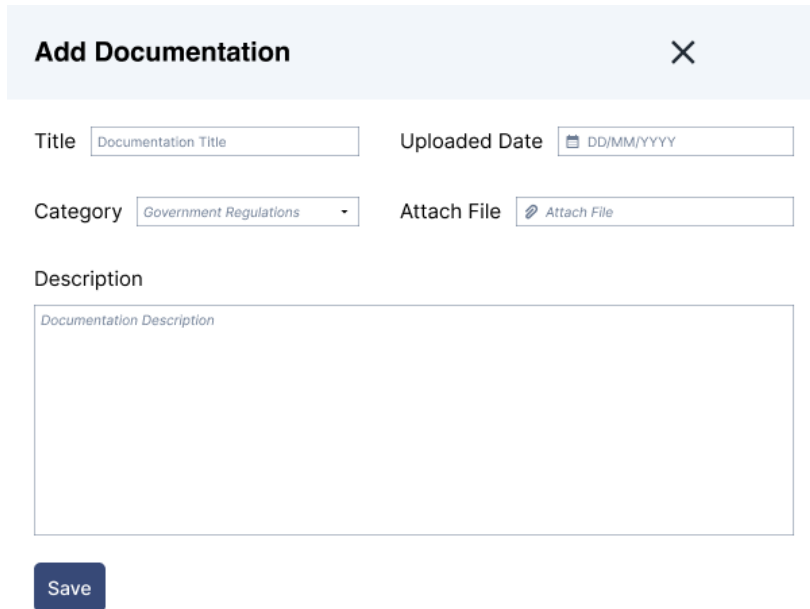
SN	P/F	Data Items	Caption	Data Type	Definition
1.	P	Id	ID	integer	ID assigned for documentation file
2.	F	highway_id	Highway	integer	Refers to vgp_spm_highways
3.		title	Title	string	Title of documentation file
4.		uploaded_date	Uploaded Date	date	Date of documentation uploaded
5.		description	Description	string	Description of documentation file
6.		doc_file	File	blob	Documentation file

Text: already available in the existing e-SPM database

Text: e-SPM database development

5.2.3. User Interface Design

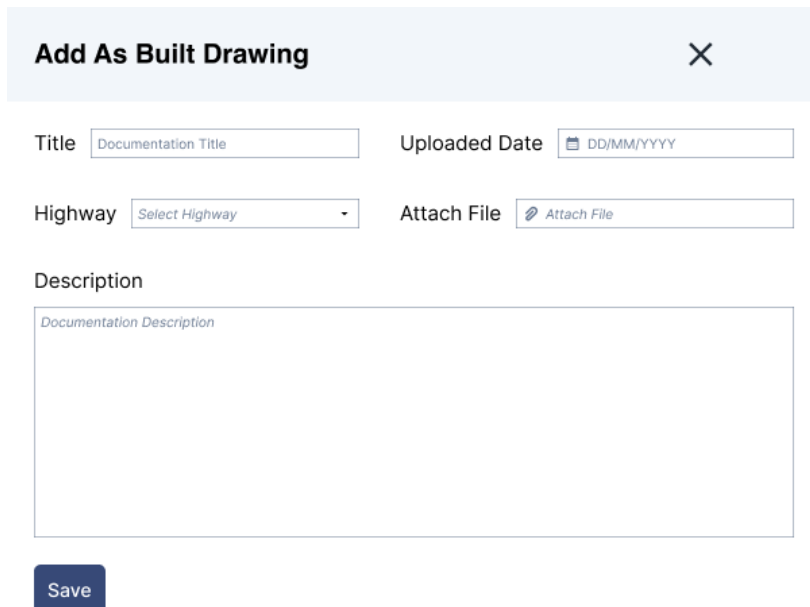
User Interface Design for "Documentation" module can be seen in **Figure 5.5 - Figure 5.8:**



The image shows a modal window titled "Add Documentation" with a close button (X) in the top right corner. The form contains the following fields:

- Title:** A text input field with the placeholder text "Documentation Title".
- Uploaded Date:** A date picker field with the format "DD/MM/YYYY".
- Category:** A dropdown menu with "Government Regulations" selected.
- Attach File:** A file upload button with a paperclip icon and the text "Attach File".
- Description:** A large text area with the placeholder text "Documentation Description".
- Save:** A dark blue button with the text "Save".

Figure 5.5 User Interface Design for "Documentation" module (1/4)



The image shows a modal window titled "Add As Built Drawing" with a close button (X) in the top right corner. The form contains the following fields:

- Title:** A text input field with the placeholder text "Documentation Title".
- Uploaded Date:** A date picker field with the format "DD/MM/YYYY".
- Highway:** A dropdown menu with "Select Highway" selected.
- Attach File:** A file upload button with a paperclip icon and the text "Attach File".
- Description:** A large text area with the placeholder text "Documentation Description".
- Save:** A dark blue button with the text "Save".

Figure 5.6 User Interface Design for "Documentation" module (2/4)

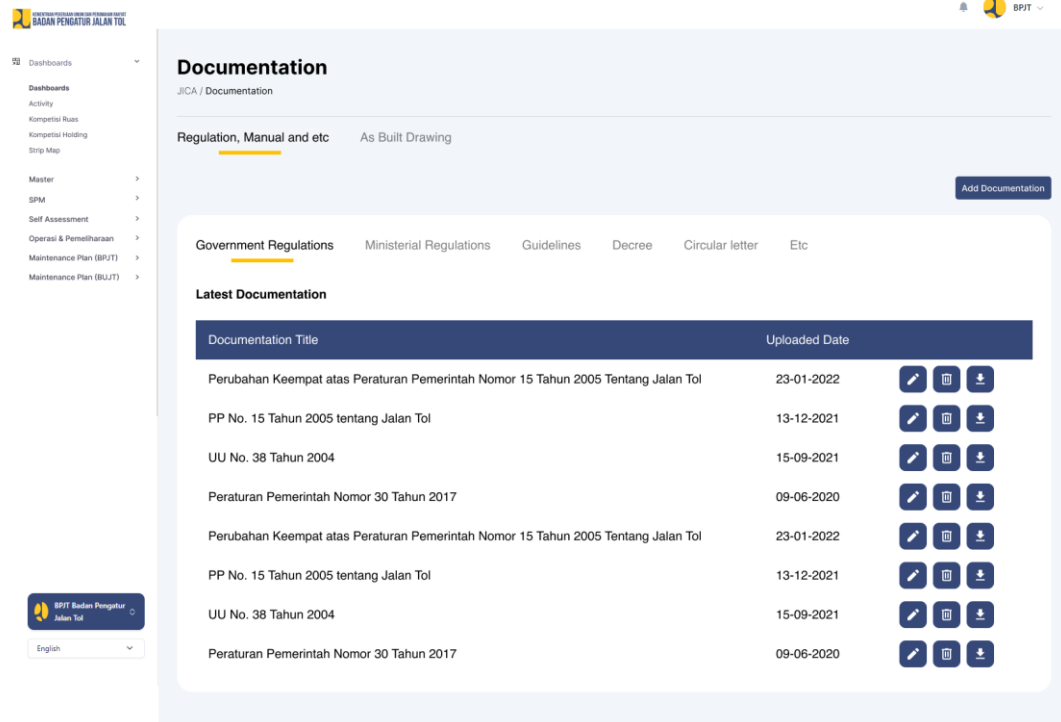


Figure 5.7 User Interface Design for “Documentation” module (3/4)

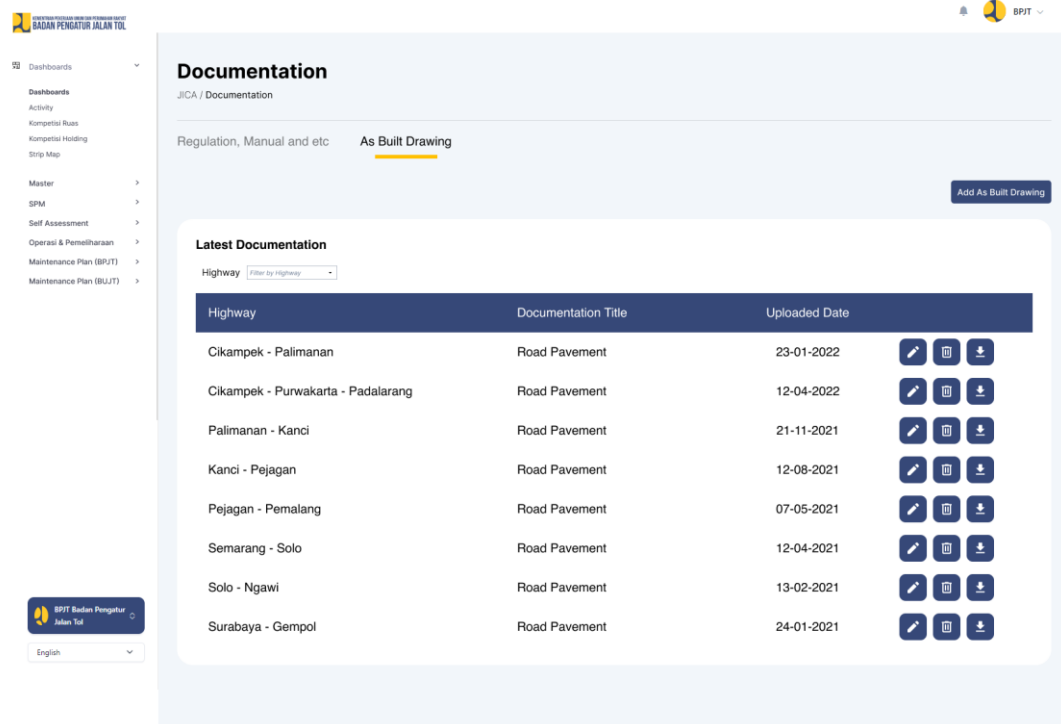


Figure 5.8 User Interface Design for “Documentation” module (4/4)

5.3. Integration

Based on Term of Reference (TOR), The Sub-Consultant shall develop integration tool to integrate E-SPM other system such as Bridge Management System, and IRMS (Indonesia Road Management System for National Roads). The Project will provide the details of the system and data to be integrated in due course. Therefore, the Sub-Consultant shall design and develop E-SPM considering relational database for possibility/needs of integration with other systems.

Based on the results of discussions with ITRA, the most possible integration for now is with the "Tol Kita" application. "Tol Kita" is a mobile application developed by ITRA for toll road users. This application contains information about toll road maps, toll prices, rest areas, CCTV access, call centre, complaints, weather and user satisfaction questionnaires. This application also contains the latest news related to toll roads and live updates on toll road operations.

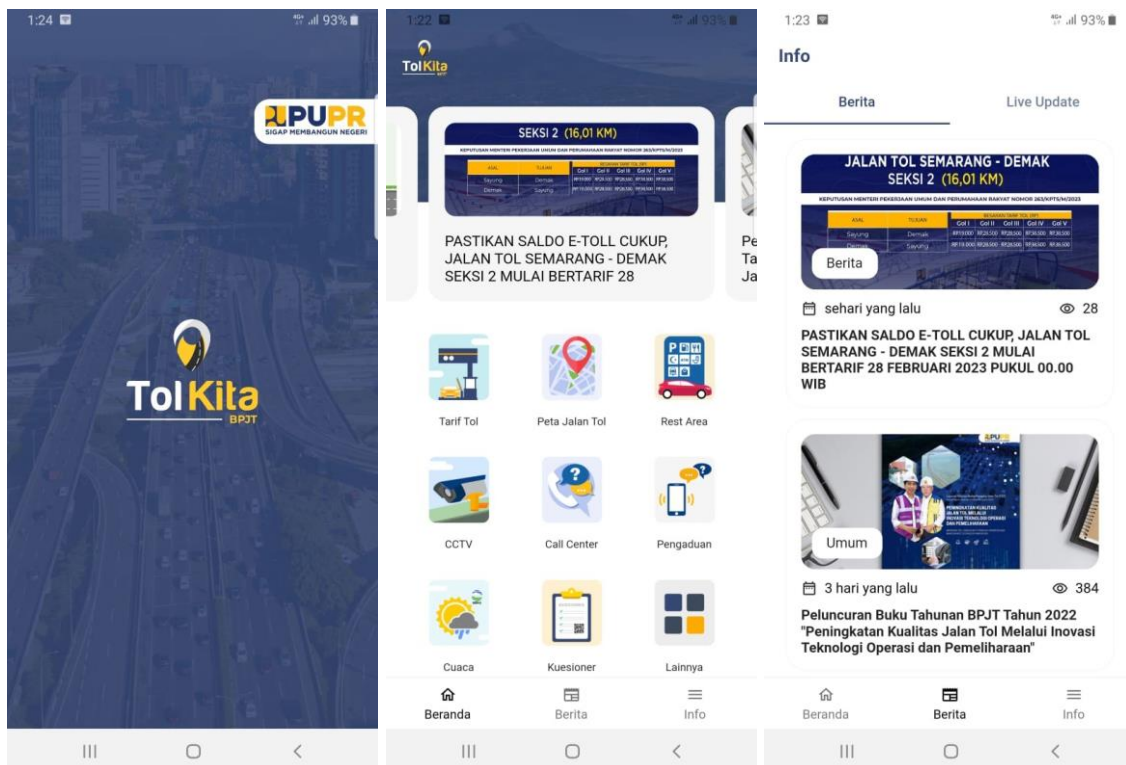


Figure 5.9 "Tol Kita" app (android version)

The integration required by ITRA is the provision of information on a summary of SPM fulfilment in substance for each toll road. The method applied in calculating SPM fulfilment in substance can be seen in the following equation:



$$SF = \sum_1^n \frac{n_{issue}}{n_{repair}} \times 100$$

..... Equation 5.1

- SF* : SPM Fulfilment per substance
- n* : Indicator-n
- n_{issue}* : Number of issue
- n_{repair}* : Number of issue that has been repaired

The technical approach will be described through a sample case of SPM fulfilment.

Table 5.4 Sample case of SPM fulfilment per-substances

Substance	Number of Issue	Number of Repair	SPM fulfilment
Substance-1	94	80	85,1 %
Substance-2	-	-	100,0 %
Substance-3	-	-	100,0 %
Substance-4	1	1	100,0 %
Substance-5	71	44	62,0 %
Substance-6	-	-	100,0 %
Substance-7	14	11	78,6 %
Substance-8	2	1	50,0 %

If the table above is converted to a graph of the percentage of SPM fulfilment, it can be seen in the following figure:

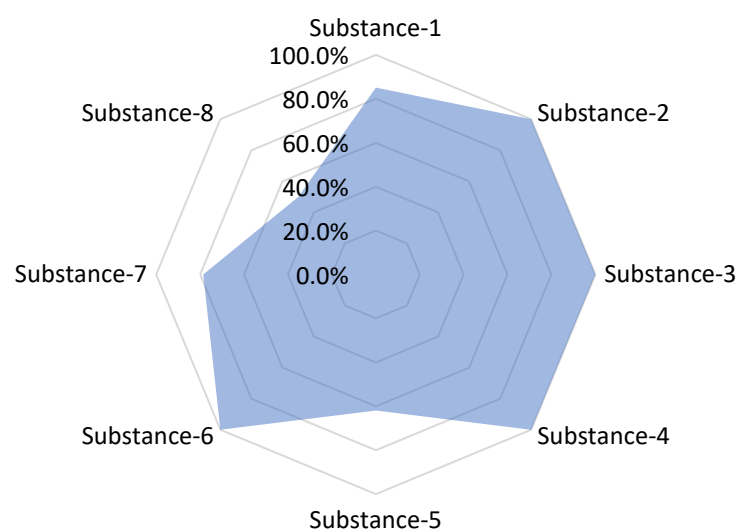


Figure 5.10 SPM fulfilment summary chart

The results and user interface of e-SPM integration with the "Tol Kita" app can be seen in the following figure:

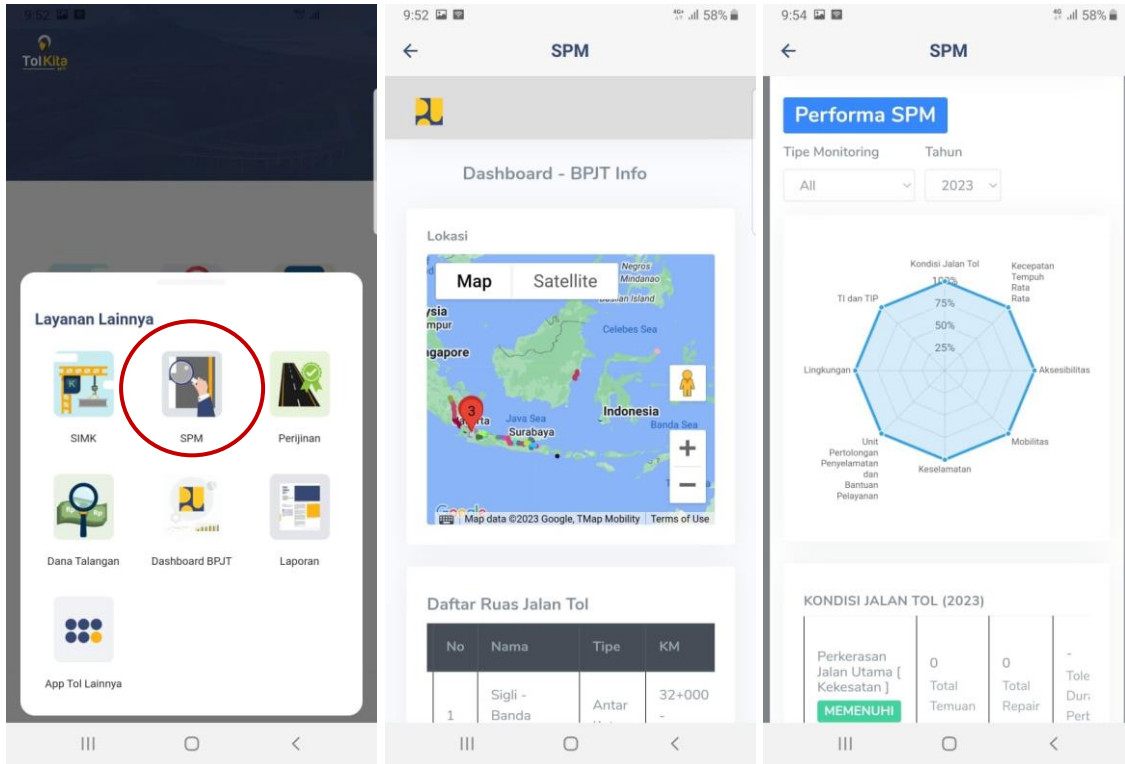


Figure 5.11 Toll roads information and SPM fulfilment on the "Tol Kita" app (android version)





Work Plan & Progress

Chapter

06



6.1. Work Plan

Refers to Term of Reference, time schedule for upgrading of E-SPM are divided in to two stages as below:

1. **Stage 1** - System Upgrading and Trial Operation
Time schedule for the system upgrading and trial operation is 24 months
2. **Stage 2** - Defects Liability and Technical Support Period

Table 6.1 Implementation schedule of E-SPM upgrading (Stage-1 and Stage-2)

Work Items	Month	2022					2023				2024			2025	
		8	9	10	11	12	1	2	3	12	1	8	9	1	8
								-				-			
								11			7		12		7
Stage-1: System Upgrading and Trial Operation															
1. System Upgrading Work Plan															
2. System Upgrading															
3. E-SPM User Manual															
4. E-SPM Administration Manual															
5. Trial Operation															
6. System Hand-Over															
7. Conduct Training															
Stage-2: Defects Liability and Technical Support Period															
8. Defects Liability Period															

Source: Term of Reference

Based on the timeline above, the duration requirements for each stage are:

1. Time schedule for the system upgrading and trial operation (**Stage-1**) is **24 months**;
2. Time schedule for defects liability and technical support (**Stage-2**) is **12 months**.

Refers to the project implementation schedule above, also as stated in the Term of Reference, the Sub-Consultant shall submit the following deliverables as specified in **Table 6.2** below:

Table 6.2 Deliverable of services

	Deliverables	Quantity (set) and Languages		Completed before Month
		English	Bahasa	
Deliverable 1	System Upgrading Work Plan	1	1	1
Deliverable 2	Draft Upgraded E-SPM System		1	7
Deliverable 3	E-SPM User's Manual (Draft/Final)	1	1	7/24
Deliverable 4	E-SPM Administration Manual (Draft/Final)	1	1	7/24
Deliverable 5	Upgraded Database Design and Detailed Design	1	1	24
Deliverable 6	Upgraded E-SPM System	-	1	24

Source: Term of Reference

6.2. Staffing

The Sub-Consultant have established an efficient Project Organization to successfully implement the consulting services in close working and coordination with the users taking into consideration the following:

1. To successfully carry out all deliverable services align with the purpose and scope of work in the most efficient manner;
2. To establish a systematic working relationship.

The Sub-Consultant will maintain multi-disciplined staffs in order to keep the best quality, timeliness, comprehensiveness and accuracy in the delivery of the consulting services. The Sub-Consultant's simple and straight forward type of organization, is shown in **Figure 6.1**.

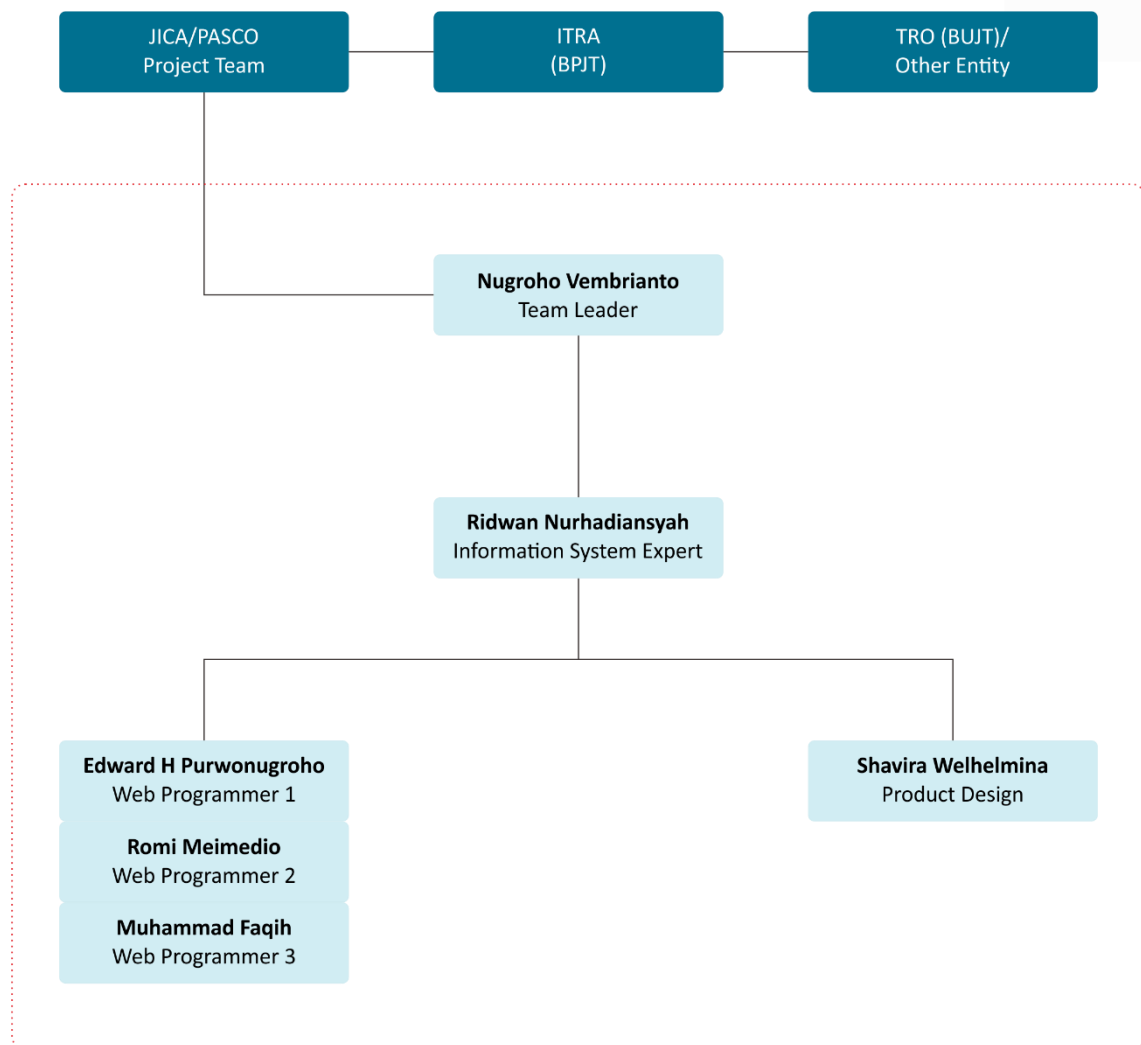


Figure 6.1 Project organization structure

Qualifications, duties and responsibilities of each position are not limited to:

1. **Team Leader**

- Experienced and in-depth understanding of SPM and toll road asset management;
- Responsible for the control, coordination, and sustainability of the project from the Sub-Consultant and technical side;
- Ensure the project is running on time, align with schedule, and all deliverable services are achieved;
- Supervision and control of overall project activities;
- Evaluate and recommend the upgrading of E-SPM to achieve project objectives;
- Determine the technical methods required for analysis and development;
- Prepare the project report, in particular: final reports and monthly reports;

- Establish a good communication and relationship among all parties involved in the Project;
- Conduct and/or attend meetings with parties involved in the Project as needed;
- As a training presenter.

2. Information System Expert

- Experienced and understanding of SPM and toll road asset management;
- Have an understanding of the design, infrastructure, and functionality of the existing E-SPM;
- As a system analyst who is able to translate technical requirements and user requirements to be accommodated in system design;
- Responsible for the control, coordination, and sustainability of the project from the technical and information system side;
- Ensure the development of E-SPM according to the technical needs of users;
- Determine the technical methods required for analysis and development;
- Designing information systems according to technical criteria;
- Prepare the project report, including:
 - Monthly Report and Final Report
 - E-SPM User Manual and
 - E-SPM Administration Manual
- Coordinate with external parties in the context of system integration;
- Conduct and/or attend meetings with parties involved in the Project as needed;
- As a training presenter.

3. Web Programmer

- As a programmer in order to develop E-SPM web applications;
- As a database administrator in order to develop the E-SPM database;
- Understand the design of information systems to be applied in coding;
- Expert in web programming, PHP language, October CMS, API and MySQL;
- Coordinate with external parties in the context of system integration;
- Technical responsibilities in the operation and maintenance of E-SPM, especially web-based;
- As a problem solver when technical problems occur during the project;
- As a technical trainer in seminars and defects liability period (during retention period).

4. Product Design

- Designing user interfaces for E-SPM web application;
- Designing E-SPM user manual;
- Coordinate with programmers in determining the design;



6.3. Progress

Based on the implementation schedule in **Table 6.1**, each work item is weighted to get the s curve of achievement progress. The weighting can be seen in **Table 6.3** below:

Table 6.3 Weighting based on work items

Work Items	Duration (Month)	Weight
Stage-1: System Upgrading and Trial Operation		
1. System Upgrading Work Plan	1	60%
2. System Upgrading	6	
3. E-SPM User Manual	2	10%
4. E-SPM Administration Manual	1	
5. Trial Operation	18	20%
6. System Hand-Over	-	-
7. Conduct Training	-	-
Stage-2: Defects Liability and Technical Support Period		
8. Defects Liability Period	12	10%
Total		100%

While the details of the weighting can be seen in **Table 6.4** to **Table 6.6**.

Table 6.4 Weighting details based on work items (1/3)

Work Items	Month P / A	2022					2023					2024			2025	
		8	9	10	11	12	1	2	3	12	1	8	9	1	8	
1. System Upgrading Work Plan	P	2.7														
	A	0.9	0.5	0.9	0.5											
2. System Upgrading																
2.1. Data Inputting Module																
- Toll Road Inventory																
Design (Process, Database, UI)	P		2.7													
	A	2.7														
Development/Coding	P		2.7													
	A	2.4	0.3													
- Traffic Volume																
Design (Process, Database, UI)	P		2.7													
	A	2.7														

Table 6.5 Weighting details based on work items (2/3)

Work Items	Month P / A	2022					2023					2024			2025	
		8	9	10	11	12	1	2	3	12	1	8	9	1	8	
- Traffic Volume																
Development/ Coding	P		2.7													
	A		2.7													
- Maintenance Plan																
Design (Process, Database, UI)	P			2.7												
	A	2.7														
Development/ Coding	P			2.7												
	A	1.4		1.4												
2.2. Analysis Module																
- SPM Monitoring																
Design (Process, Database, UI)	P				2.7											
	A				2.7											
Development/ Coding	P				2.7											
	A				2.0	0.7										
- Performance Evaluation																
Design (Process, Database, UI)	P				2.7											
	A				2.7											
Development/ Coding	P				2.7											
	A				2.0	0.7										
- Black Listing																
Design (Process, Database, UI)	P				2.7											
	A				2.7											
Development/ Coding	P				2.7											
	A				2.0	0.7										
- Accident (Black Spot)																
Design (Process, Database, UI)	P						2.7									
	A					2.7										
Development/ Coding	P						2.7									
	A					2.0	0.7									
- Deterioration Model																
Design (Process, Database, UI)	P							2.7								
	A							2.7								
Development/ Coding	P							2.7								
	A							2.0	0.7							
- Detailed Investigation																
Design (Process, Database, UI)	P							2.7								
	A							2.7								
Development/ Coding	P							2.7								
	A							2.7								



Table 6.6 Weighting details based on work items (3/3)

Work Items	Month P / A	2022					2023					2024		2025	
		8	9	10	11	12	1	2	3	12	1	8	9	1	8
2.3. Reporting and Documentation Module															
- Reporting	P							2.7							
	A			0.5			1.1	1.1							
- Documentation	P							2.7							
	A					2.7									
- Integration	P								2.7						
	A						1.4	1.4							
3. E-SPM User Manual															
3.1. Web Application for ITRA	P							1.7	1.7						
	A							2.2	1.1						
3.2. Web Application for TRO	P							1.7	1.7						
	A							2.2	1.1						
4. E-SPM Administration Manual	P								3.3						
	A								3.3						
5. Trial Operation	P									10	1.1	7.8	1.1		
	A														
6. System Hand-Over															
7. Conduct Training															
8. Defects Liability Period	P												3.3	5.8	0.8
	A														
Progress	P	2.7%	13.6%	19.1%	35.5%	51.8%	60.6%	70.0%	80.0%	81.1%	88.9%	90.0%	93.3%	99.2%	100%
	A	12.8%	15.9%	18.3%	37.4%	53.8%	61.3%	70.0%							

P: Planned Progress

A: Actual Progress

The S-Curve of progress achievement results can be seen in **Figure 6.2**.

7th Monthly Progress
(February 28, 2022)

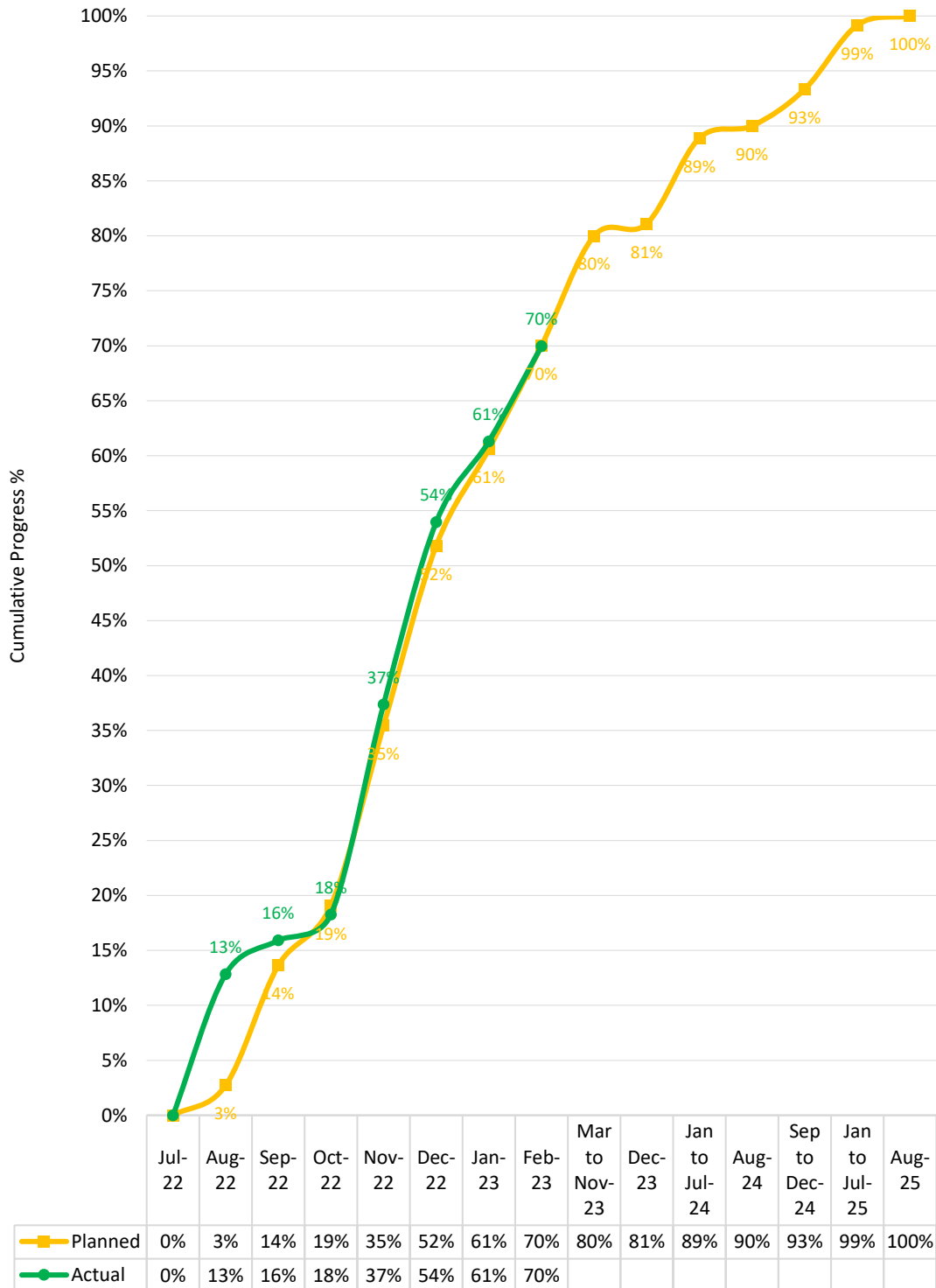


Figure 6.2 S-Curve of progress achievement results





Attachment

Chapter

07

[vgp_spm_operators.logo]

[date_range input]

REPORT

OPERATION MAINTENANCE

[vgp_spm_highways.highway_name] Toll Road

Toll Road Operator

[vgp_spm_operators.operator_name]

[vgp_spm_operators.operator_address] //limit 60 char

[vgp_spm_operators.operator_city] //limit 60 char

[vgp_spm_operators.operator_phone]

[vgp_spm_operators.operator_email]

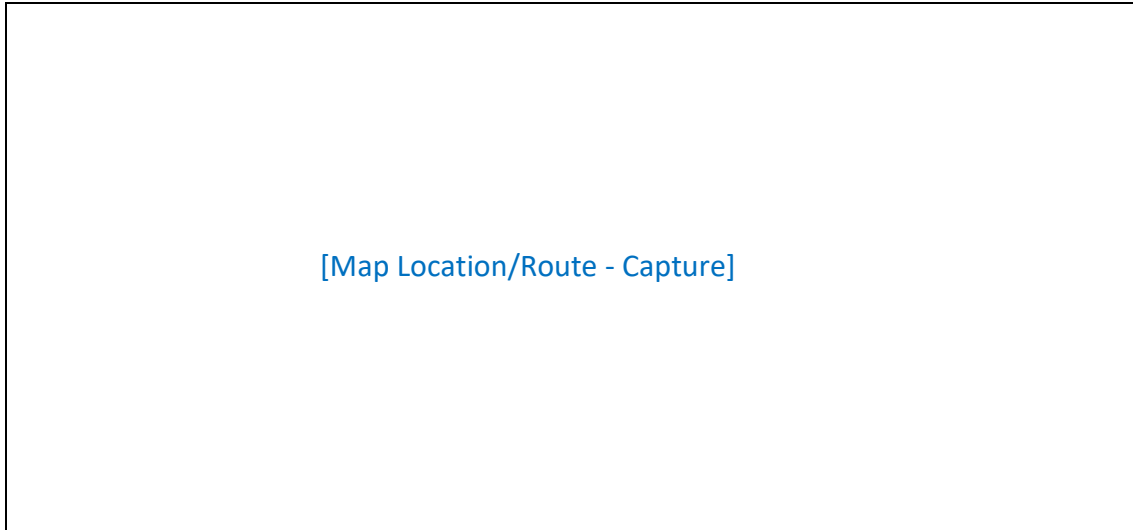
[vgp_spm_operators.website]

Automatic Reports Generated by E-SPM Indonesian Toll Road Authority

<https://esmbpjt.pu.go.id>

1. GENERAL DATA

1.1. TOLL ROAD LAYOUT



1.2. GENERAL DATA OF TOLL ROAD

No	Substance	Description
1	Road Length (Km)	[vgp_spm_highways.highway_length]
	▪ Start Location/Chainage	[vgp_spm_highways.start_location]
	▪ End Location/Chainage	[vgp_spm_highways.end_location]
2	Type of Toll Road	[vgp_spm_highways.highway_type]
3	Operation Year	[vgp_spm_highways.operation_year]
4	Call Centre	[vgp_spm_highways.call_center]
5	Number of Segments	Count of [vgp_spm_highwaysegments]
	▪ Normal Direction (A)	Where [direction] = "Normal"
	▪ Opposite Direction (B)	Where [direction] = "Opposite"
6	Number of Bridges	Count of [jica_spm_bridges]
	▪ Interchange	Where [bridge_type] = "Interchange"
	▪ Overpass	Where [bridge_type] = "Overpass"
	▪ Underpass	Where [bridge_type] = "Underpass"
	▪ Under Bridge	Where [bridge_type] = "Under Bridge"
	▪ Pedestrian Bridge	Where [bridge_type] = "Pedestrian Bridge"
7	Number of Rest Area	Count of [jica_spm_restarea]
	Type A (Rest and Services Area)	Where [restarea_type] = "Tipe A (.. Pelayanan)"
	Type B (Rest Area)	Where [restarea_type] = "Tipe B (..... Istirahat)"
	Type C	Where [restarea_type] = "Tipe C"
	Parking Bay	Where [restarea_type] = "Parking Bay"



1.3. SEGMENTS OF TOLL ROAD

[vgp_spm_highway_segments]

No	Direction	Substance	Description
1	[Direction]	Name of Segment	[segment_name]
		Location/Chainage	[start_location] & “-“ & [end_location]
		Length (Km)	[end_location] - [start_location]
		Construction Year	[construction_year]
		Operation Year	[operation_year]
		Number of Lanes	[mainroad_number_of_lane]
		Lane Width (m)	
		▪ Main Lane	[mainroad_lane_width]
		▪ Outer Shoulder	[os_width]
		▪ Inner Shoulder	[is_width]
		▪ Motorcycle Lane	[mc_width]
		Pavement Type	
		▪ Main Lane	[mainroad_lane_pavement_type]
		▪ Outer Shoulder	[mainroad_os_pavement_type]
		▪ Inner Shoulder	[mainroad_is_pavement_type]
		▪ Motorcycle Lane	[mainroad_mc_pavement_type]
2	[Direction-n]	Name of Segment	[segment_name] n
		Location/Chainage	[start_location] & “-“ & [end_location] n
		Length (Km)	[end_location] - [start_location] n
		Construction Year	[construction_year] n
		Operation Year	[operation_year] n
		Number of Lanes	[mainroad_number_of_lane] n
		Lane Width (m)	
		▪ Main Lane	[mainroad_lane_width] n
		▪ Outer Shoulder	[os_width] n
		▪ Inner Shoulder	[is_width] n
		▪ Motorcycle Lane	[mc_width] n
		Pavement Type	
		▪ Main Lane	[mainroad_lane_pavement_type] n
		▪ Outer Shoulder	[mainroad_os_pavement_type] n
		▪ Inner Shoulder	[mainroad_is_pavement_type] n
		▪ Motorcycle Lane	[mainroad_mc_pavement_type] n
...
...
...
...
...
...



1.4. INTERCHANGE AND BRIDGES

1.4.1. INTERCHANGE

[jica_spm_bridges] where [bridge_type] = "Interchange"

No	Name	Location	Length (m)	Span Number	Configuration	Operation Year
1	[bridge_name]	[location]	[length]	[span_number]	[type_...config]	[op..year]
2	[bridge_name]	[location]	[length]	[span_number]	[type_...config]	[op..year]
...
...
...

1.4.2. OVERPASS

[jica_spm_bridges] where [bridge_type] = "Overpass"

No	Name	Location	Length (m)	Span Number	Configuration	Operation Year
1	[bridge_name]	[location]	[length]	[span_number]	[type_...config]	[op..year]
2	[bridge_name]	[location]	[length]	[span_number]	[type_...config]	[op..year]
...
...
...

1.4.3. UNDERPASS

[jica_spm_bridges] where [bridge_type] = "Underpass"

No	Name	Location	Length (m)	Span Number	Configuration	Operation Year
1	[bridge_name]	[location]	[length]	[span_number]	[type_...config]	[op..year]
2	[bridge_name]	[location]	[length]	[span_number]	[type_...config]	[op..year]
...
...
...

1.4.4. UNDER BRIDGE

[jica_spm_bridges] where [bridge_type] = "Under Bridge"

No	Name	Location	Length (m)	Span Number	Configuration	Operation Year
1	[bridge_name]	[location]	[length]	[span_number]	[type_...config]	[op..year]
2	[bridge_name]	[location]	[length]	[span_number]	[type_...config]	[op..year]
...
...

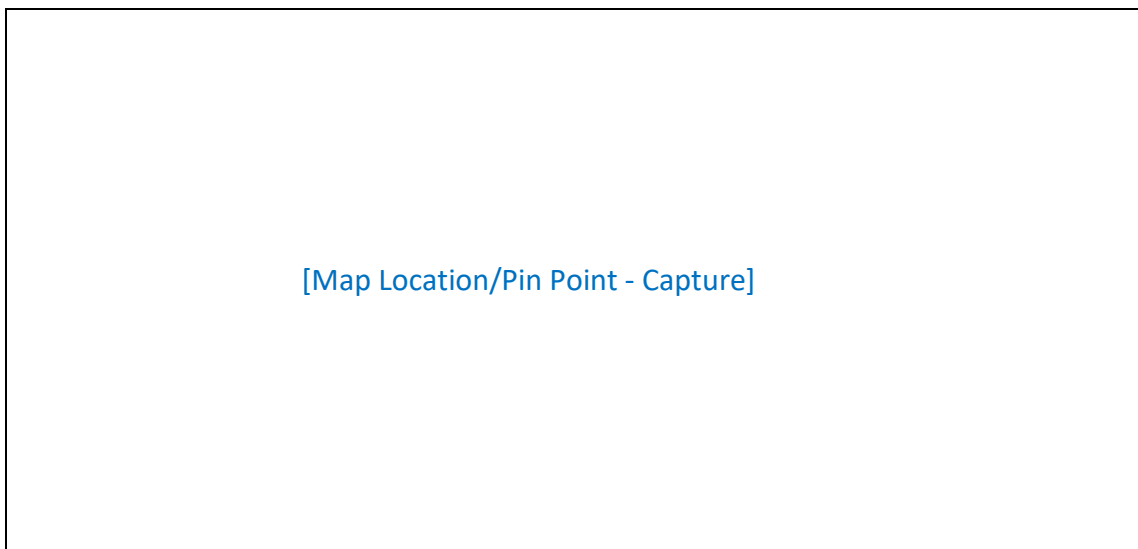


1.4.5. PEDESTRIAN BRIDGE

[jica_spm_bridges] where [bridge_type] = "Pedestrian Bridge"

No	Name	Location	Length (m)	Span Number	Configuration	Operation Year
1	[bridge_name]	[location]	[length]	[span_number]	[type_...config]	[op..year]
2	[bridge_name]	[location]	[length]	[span_number]	[type_...config]	[op..year]
...
...
...

1.5. REST AREA



[Map Location/Pin Point - Capture]

1.5.1. TYPE A (REST AND SERVICES AREA)

[jica_spm_restarea] where [restarea_type] = "Tipe A (Tempat Istirahat dan Pelayanan)"

No	Rest Area Name	Location	Direction	Pavement Type
1	[restarea_name]	[location]	[direction]	[pavement_type]
2	[restarea_name]	[location]	[direction]	[pavement_type]
...

1.5.2. TYPE B (REST AREA)

[jica_spm_restarea] where [restarea_type] = "Tipe B (Tempat Istirahat)"

No	Rest Area Name	Location	Direction	Pavement Type
1	[restarea_name]	[location]	[direction]	[pavement_type]
2	[restarea_name]	[location]	[direction]	[pavement_type]
...

1.5.3. TYPE C

[jica_spm_restarea] where [restarea_type] = "Type C"

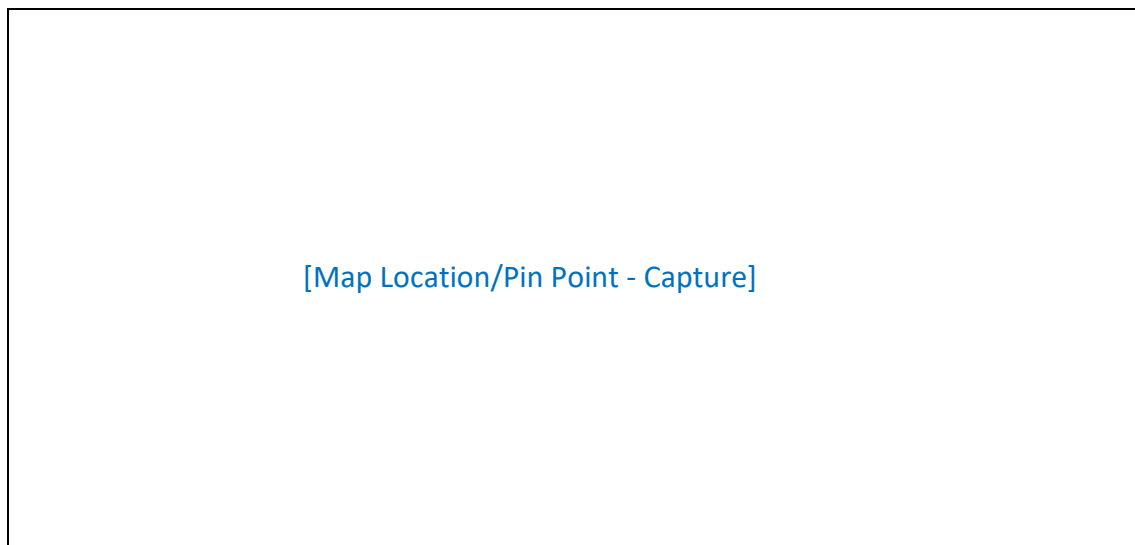
No	Rest Area Name	Location	Direction	Pavement Type
1	[restarea_name]	[location]	[direction]	[pavement_type]
2	[restarea_name]	[location]	[direction]	[pavement_type]
...

1.5.4. PARKING BAY

[jica_spm_restarea] where [restarea_type] = "Parking Bay"

No	Rest Area Name	Location	Direction	Pavement Type
1	[restarea_name]	[location]	[direction]	[pavement_type]
2	[restarea_name]	[location]	[direction]	[pavement_type]
...

1.6. TOLL GATES

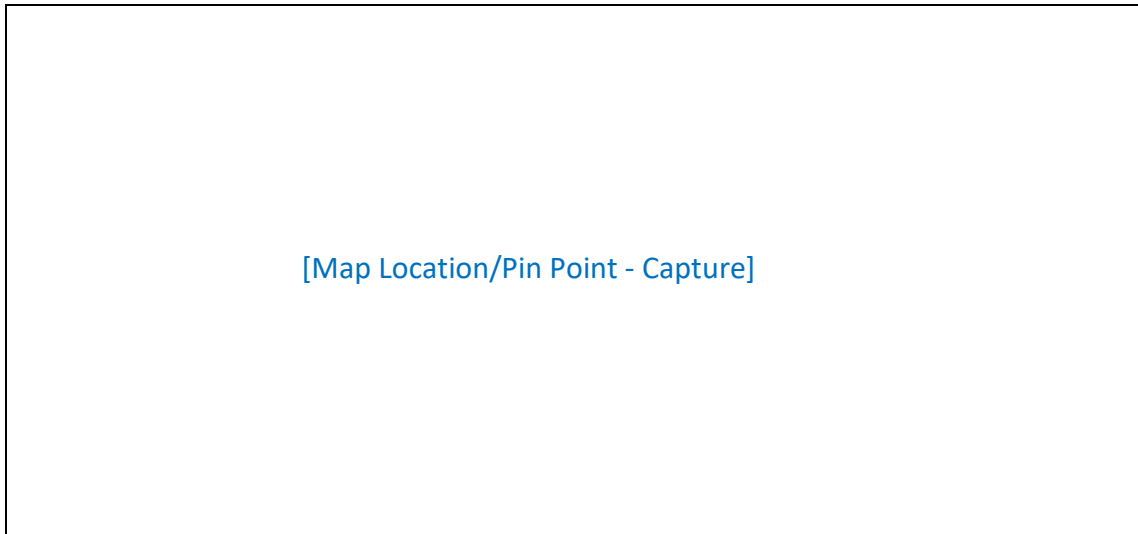


[Map Location/Pin Point - Capture]

[vgp_spm_tollgates]

No	Gate Name	Location	Type of Gate	Transaction System	Entry Booth	Exit Booth
1	[gate_name]	[location]	[gate_type]	[trans..._type]	[ent..._booth]	[exit_booth]
2	[gate_name]	[location]	[gate_type]	[trans..._type]	[ent..._booth]	[exit_booth]
...
...
...
...
...

1.7. RESCUE STATION



[Map Location/Pin Point - Capture]

[jica_spm_rescuestations] sort ASC by [location]

No	Station Name	Location	Direction	Description
1	[station_name]	[location]	[direction]	[description]
2	[station_name]	[location]	[direction]	[description]
...
...
...

1.8. SERVICES VEHICLE

[vgp_spm_kendaraanlayanans] sort ASC by [vehicle_type]

No	Vehicle Type	Vehicle Code	Plate Number	Station Location
1	[vehicle_type]	[vehicle_code]	[plate_number]	[jica_..cuestations.station_name]
2	[vehicle_type]	[vehicle_code]	[plate_number]	[jica_..cuestations.station_name]
3	[vehicle_type]	[vehicle_code]	[plate_number]	[jica_..cuestations.station_name]
4	[vehicle_type]	[vehicle_code]	[plate_number]	[jica_..cuestations.station_name]
5	[vehicle_type]	[vehicle_code]	[plate_number]	[jica_..cuestations.station_name]
6	[vehicle_type]	[vehicle_code]	[plate_number]	[jica_..cuestations.station_name]
...
...
...
...
...
...
...

2. TOLL ROAD OPERATION

2.1. TRAFFIC VOLUME (TOLL GATE TRANSACTION)

[LHRT Chart Title]

[LHRT Chart]

[vgp_spm_trfolgates] sort ASC by [min vgp_spm_highwaysegments.operation_year]

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n</i>
Year	Class I	Class II	Class III	Class IV	Class V	I (%)	II (%)	III (%)	IV (%)	V (%)	Total	LHRT	Growth (%)
[op..year]	[entrance_n] + [exit_n] per vehicle class (n) per year					b / l	c / l	d / l	e / l	f / l	a + b + c + d + e	* l / 365	
...	[entrance_n] + [exit_n] per vehicle class (n) per year					b / l	c / l	d / l	e / l	f / l	a + b + c + d + e	** l / 365	(** - *) / *x100
[year]	[entrance_n] + [exit_n] per vehicle class (n) per year					b / l	c / l	d / l	e / l	f / l	a + b + c + d + e	*** l / 365	(** - *) / *x100



Annual Traffic Volume

min vgp_.segments.op._year

[vgp_spm_trfvolgates] [vgp_spm_tollgates] sort ASC by vgp_spm_tollgates.gate_name

Toll Gate	Booth	Class	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
[gate_name] 1	Entrance	I	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[Jan-Des]	
		II	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[Jan-Des]
		III	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[Jan-Des]
		IV	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[Jan-Des]
		V	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[Jan-Des]
	Exit	I	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[Jan-Des]
		II	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[Jan-Des]
		III	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[Jan-Des]
		IV	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[Jan-Des]
		V	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[Jan-Des]
[gate_name] n	Entrance	I	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[entr.._1]	[Jan-Des]	
		II	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[entr.._2]	[Jan-Des]	
		III	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[entr.._3]	[Jan-Des]	
		IV	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[entr.._4]	[Jan-Des]	
		V	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[entr.._5]	[Jan-Des]	
	Exit	I	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[exit_1]	[Jan-Des]
		II	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[exit_2]	[Jan-Des]
		III	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[exit_3]	[Jan-Des]
		IV	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[exit_4]	[Jan-Des]
		V	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[exit_5]	[Jan-Des]
Total		SUM ↑	SUM ↑	SUM ↑	SUM ↑	SUM ↑	SUM ↑	SUM ↑	SUM ↑	SUM ↑	SUM ↑	SUM ↑	SUM ↑	SUM ↑	SUM ↑	
Average		SUM / 31	SUM / 28	SUM / 31	SUM / 30	SUM / 31	SUM / 30	SUM / 31	SUM / 31	SUM / 31	SUM / 30	SUM / 31	SUM / 30	SUM / 31	SUM / 365	

2.2. TRAFFIC ACCIDENT

Number of traffic accident based on location

[vgp_spm_accidentheads]

No	Segment	Location (Km)	A Direction	B Direction	Total
1	[vgp...segment.segment_name]	[start] - [end]	count A	count B	[A]+[B]
2	[vgp...segment.segment_name]	[start] - [end]	count A	count B	[A]+[B]
3	[vgp...segment.segment_name]	[start] - [end]	count A	count B	[A]+[B]
4	[vgp...segment.segment_name]	[start] - [end]	count A	count B	[A]+[B]
5	[vgp...segment.segment_name]	[start] - [end]	count A	count B	[A]+[B]
Total			[Total A]	[Total B]	[Total]

Number of traffic accident based on accident triggers

[vgp_spm_accidentdetails]

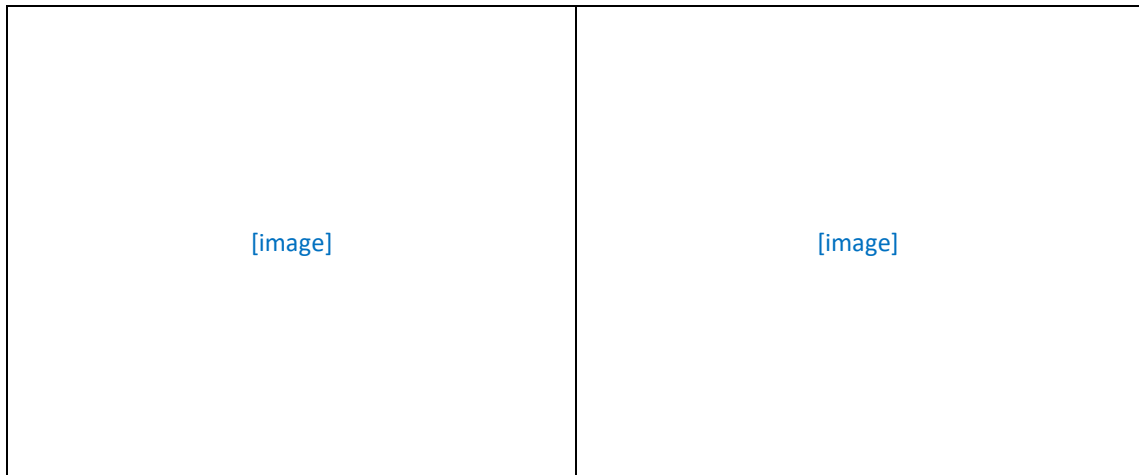
No	Accident Trigger	A Direction	B Direction	Total
1	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
2	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
3	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
4	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
5	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
6	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
7	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
8	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
9	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
10	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
11	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
12	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
13	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
14	[accident_trigger] list	count [dir=A]	count [dir=B]	[A]+[B]
Total		[Total]	[Total]	[Total]

2.3. OPERATION ACTIVITY

[vgp_spm_operatormaints] where [operatormaints_task] = "OPERATION"



[vgp_spm_highways.highway_name]



[operatormaints_date]

KM [sta]

[operatormaints_date]

KM [sta]

Activity:

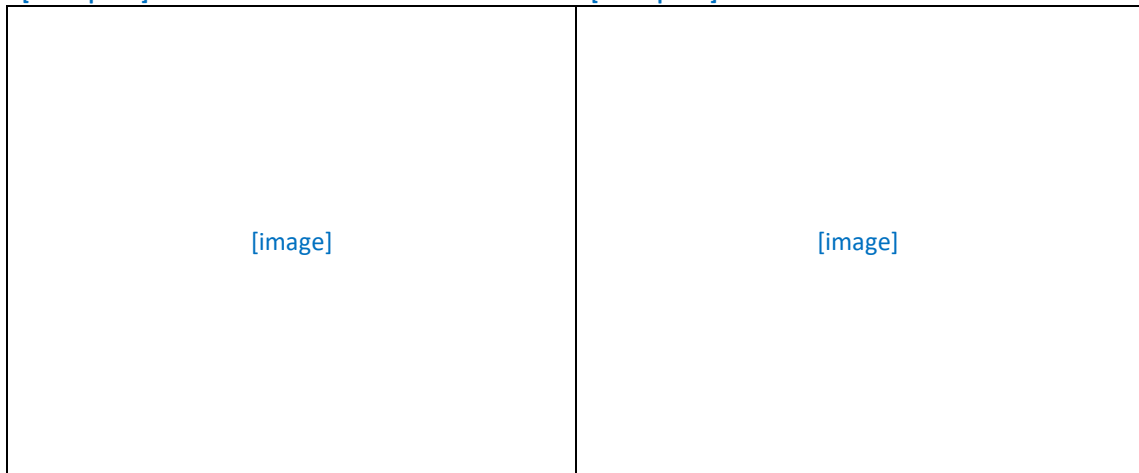
[direction] | [lane]

Activity:

[direction] | [lane]

[description]

[description]



[operatormaints_date]

KM [sta]

[operatormaints_date]

KM [sta]

Activity:

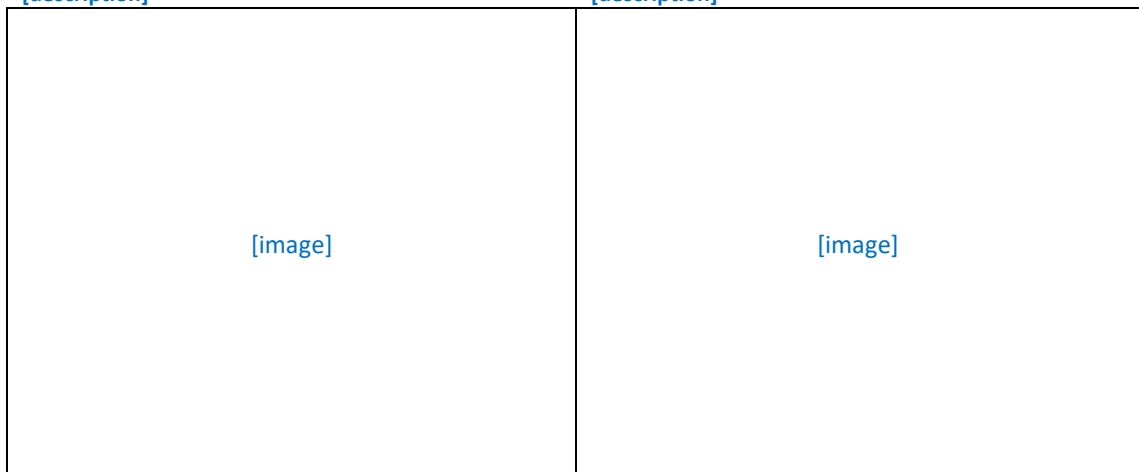
[direction] | [lane]

Activity:

[direction] | [lane]

[description]

[description]



[operatormaints_date]

KM [sta]

[operatormaints_date]

KM [sta]

Activity:

[direction] | [lane]

Activity:

[direction] | [lane]

[description]

[description]



3. TOLL ROAD MAINTENANCE

3.1. RESULTS OF LATEST SKID RESISTANCE MEASUREMENT

Testing Date : [vgp_spm_srdetails.testing_date]
 Tester : [vgp_spm_srheads.tester]
 Testing Equipment : [vgp_spm_srheads.testing_equipment]
 Measurement Interval (m) : [vgp_spm_srheads.instrument]
 Summary of Results :

Direction	Lane	Min (μm)	Max (μm)	Average (μm)
Normal Direction (A)	Lane 1	[vg..details.sr]	[vg..details.sr]	[vg..details.sr]
Normal Direction (A)	Lane 2	[vg..details.sr]	[vg..details.sr]	[vg..details.sr]
Normal Direction (A)	Lane 3	[vg..details.sr]	[vg..details.sr]	[vg..details.sr]
Normal Direction (A)	Lane 4	[vg..details.sr]	[vg..details.sr]	[vg..details.sr]
Opposite Direction (B)	Lane 1	[vg..details.sr]	[vg..details.sr]	[vg..details.sr]
Opposite Direction (B)	Lane 2	[vg..details.sr]	[vg..details.sr]	[vg..details.sr]
Opposite Direction (B)	Lane 3	[vg..details.sr]	[vg..details.sr]	[vg..details.sr]
Opposite Direction (B)	Lane 4	[vg..details.sr]	[vg..details.sr]	[vg..details.sr]
		[SR Min]	[SR Max]	[SR Avg]

3.2. RESULTS OF LATEST INTERNATIONAL ROUGHNESS INDEX (IRI) MEASUREMENT

Testing Date : [vgp_spm_iridetails.testing_date]
 Tester : [vgp_spm_iriheads.tester]
 Testing Equipment : [vgp_spm_iriheads.testing_equipment]
 Measurement Interval (m) : [vgp_spm_iriheads.instrument]
 Summary of Results :

Direction	Lane	Min (m/km)	Max (/km)	Average (m/km)
Normal Direction (A)	Lane 1	[vg..details.iri]	[vg..details.iri]	[vg..details.iri]
Normal Direction (A)	Lane 2	[vg..details.iri]	[vg..details.iri]	[vg..details.iri]
Normal Direction (A)	Lane 3	[vg..details.iri]	[vg..details.iri]	[vg..details.iri]
Normal Direction (A)	Lane 4	[vg..details.iri]	[vg..details.iri]	[vg..details.iri]
Opposite Direction (B)	Lane 1	[vg..details.iri]	[vg..details.iri]	[vg..details.iri]
Opposite Direction (B)	Lane 2	[vg..details.iri]	[vg..details.iri]	[vg..details.iri]
Opposite Direction (B)	Lane 3	[vg..details.iri]	[vg..details.iri]	[vg..details.iri]
Opposite Direction (B)	Lane 4	[vg..details.iri]	[vg..details.iri]	[vg..details.iri]
		[IRI Min]	[IRI Max]	[IRI Avg]



3.3. RESULTS OF LATEST ROAD MARKING REFLECTIVITY MEASUREMENT

Testing Date : [vgp_spm_markingdetails.testing_date]
 Tester : [vgp_spm_markingheads.tester]
 Testing Equipment : [vgp_spm_markingheads.testing_equipment]
[vgp_spm_markingdetails]

Type of Marking	Color	Age	RL	QD	RL (%)	QD (%)	Average
Solid	White	[age]	[rl_val]	[qd_val]	[rl_per]	[qd_per]	[ref_avg]
Solid	Yellow	[age]	[rl_val]	[qd_val]	[rl_per]	[qd_per]	[ref_avg]
Dashed	White	[age]	[rl_val]	[qd_val]	[rl_per]	[qd_per]	[ref_avg]
Dashed	Yellow	[age]	[rl_val]	[qd_val]	[rl_per]	[qd_per]	[ref_avg]
Chevron	White	[age]	[rl_val]	[qd_val]	[rl_per]	[qd_per]	[ref_avg]
Chevron	Yellow	[age]	[rl_val]	[qd_val]	[rl_per]	[qd_per]	[ref_avg]
							[avg]

3.4. RESULTS OF LATEST TRAFFIC SIGN REFLECTIVITY MEASUREMENT

Testing Date : [vgp_spm_signndetails.testing_date]
 Tester : [vgp_spm_signnheads.tester]
 Testing Equipment : [vgp_spm_signnheads.testing_equipment]
[vgp_spm_signndetails]

Type of Sign	Angle 0.1 (%)	Angle 0.2 (%)	Angle 0.5 (%)	Angle 1.0 (%)	Average
Warning	[v01_percent]	[v02_percent]	[v05_percent]	[v10_percent]	[avg]
Prohibiton	[v01_percent]	[v02_percent]	[v05_percent]	[v10_percent]	[avg]
Guide Sign	[v01_percent]	[v02_percent]	[v05_percent]	[v10_percent]	[avg]
Mandatory	[v01_percent]	[v02_percent]	[v05_percent]	[v10_percent]	[avg]
					[avg]

3.5. RESULTS OF LATEST REFLECTOR REFLECTIVITY MEASUREMENT

Testing Date : [vgp_spm_reflectordetails.testing_date]
 Tester : [vgp_spm_reflectorheads.tester]
 Testing Equipment : [vgp_spm_reflectorheads.testing_equipment]
[vgp_spm_reflectordetails]

Color	Angle 0.1 (%)	Angle 0.2 (%)	Angle 0.5 (%)	Angle 1.0 (%)	Average
White	[v01_percent]	[v02_percent]	[v05_percent]	[v10_percent]	[ref_avg]
Red	[v01_percent]	[v02_percent]	[v05_percent]	[v10_percent]	[ref_avg]
					[avg]

3.6. MAINTENANCE ACTIVITY

[vgp_spm_operatormaints] where [operatormaints_task] = "MAINTENANCE"

[image]	[image]
[operatormaints_date] KM [sta] Activity: [direction] [lane] [description]	[operatormaints_date] KM [sta] Activity: [direction] [lane] [description]
[image]	[image]
[operatormaints_date] KM [sta] Activity: [direction] [lane] [description]	[operatormaints_date] KM [sta] Activity: [direction] [lane] [description]
[image]	[image]
[operatormaints_date] KM [sta] Activity: [direction] [lane] [description]	[operatormaints_date] KM [sta] Activity: [direction] [lane] [description]

[Date_Range Input]

 [vgp_spm_highways.highway_name]



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Upgrading of E-SPM

Republic of Indonesia
Project for Strengthening Management Capacity of Toll Road Development



E-SPM WORKSHOP

Using the E-SPM Application
and Its Development

2024

Activity
REPORT



Republic of Indonesia
Project for Strengthening Management Capacity of Toll Road Development

Preface

We are pleased to present the resume of the Using the E-SPM Application and Its Development Workshop. Throughout the workshop, participants engaged in fruitful discussions, offering valuable insights and feedback on the E-SPM application. The outcomes of the workshop will inform future development initiatives, guiding efforts to optimize the E-SPM application for the benefit of all stakeholders involved in toll road infrastructure management.

We express our gratitude to ITRA, JICA, and all Toll Road Operators (TRO) for their contribution to the success of this workshop. This resume provides a concise overview of the workshop proceedings, highlighting key discussions, insights, and recommendations. We trust it will serve as a valuable resource for ongoing efforts to advance toll road infrastructure management in Indonesia.

Thank you for your attention and continued support.

Jakarta, May 27th, 2024
PT Varian Global Perencana

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GGUNAAN
DAN



1. Introduction

The “Using E-SPM Application and Its Development” Workshop was held in six major cities in Indonesia, including Jakarta, Medan, Bandung, Semarang, Surabaya, and Bali. This section discusses the purpose and objectives, date and location, personnel composition, and list of Toll Road Operators (TRO).

”

1.1. Purpose and Objectives

This workshop is part of the “Strengthening Management Capacity of Toll Road Development” project, a collaboration between the Japan International Cooperation Agency (JICA) and the Ministry of Public Works and Public Housing (PUPR). The primary focus of this workshop is to explore the details of the upgraded E-SPM application. Specifically, we aim to provide participants with a thorough understanding of the enhanced features and functionalities integrated into the application. Additionally, we discussed the strategic framework of Asset Management, especially in the context of PPP toll road projects.

Participants will participate in hands-on sessions and interactive demonstrations to become familiar with the user interface and features of the upgraded E-SPM application (available for both mobile and web platforms). Through collaborative engagement and sharing of knowledge, we aim to address the needs and challenges faced by users in maximizing the potential of the e-SPM application.

1.2. Date and Locations

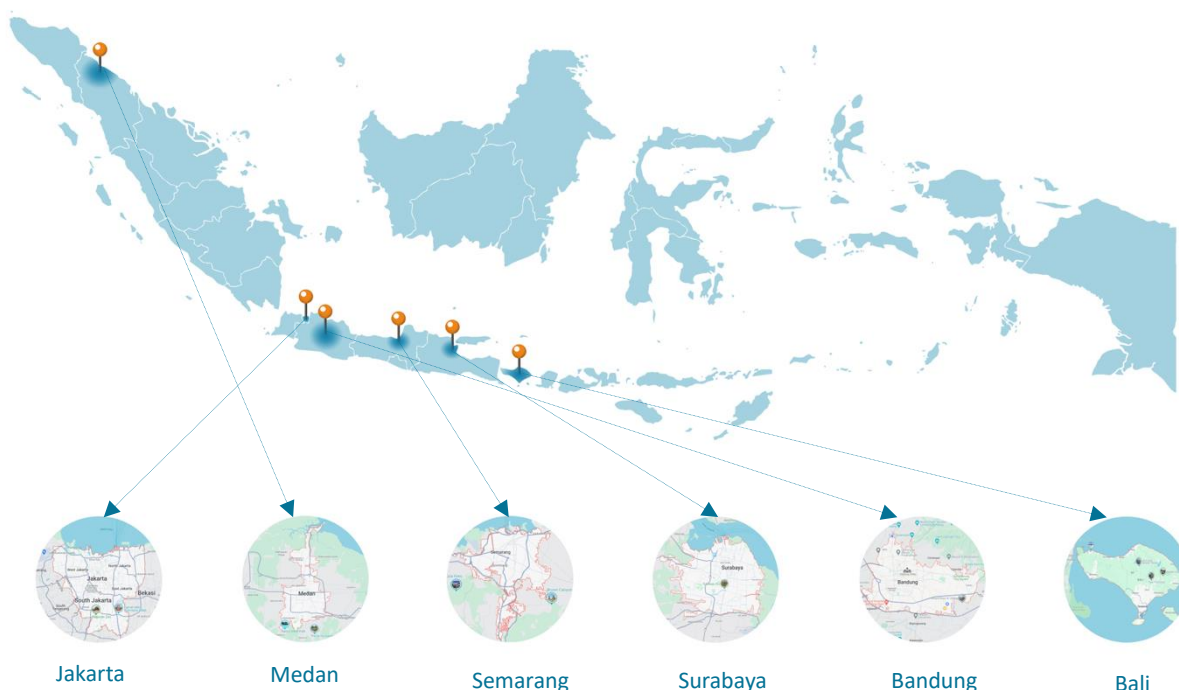


Figure 1.1 Workshop Locations

Workshops are held in six major cities in Indonesia: Jakarta, Medan, Bandung, Semarang, Surabaya, and Denpasar Bali. The schedule for the workshops can be viewed in the table below.

Table 1.1 Workshop Locations and Date

No	Location	Date
1.	Jakarta Day 1	April 25 th , 2024
2.	Jakarta Day 2	April 26 th , 2024
3.	Medan, North Sumatra	May 3 rd , 2024
4.	Bandung, West Java	May 8 th , 2024
5.	Semarang, Central Java	May 14 th , 2024
6.	Surabaya, East Java	May 15 th , 2024
7.	Denpasar, Bali	May 20 th , 2024

List of Cities	April, 2024						May, 2024																				
	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Jakarta (Team 1)	■																										
Jakarta (Team 2)		■																									
Medan									■																		
Bandung														■													
Semarang																				■							
Surabaya																					■						
Bali																										■	

Figure 1.2 Workshop Date and Locations

1.3. List of Toll Road Operators (TRO)

The following tables containing data on toll roads operational total in Indonesia that are invited to participate in the workshop.

Table 1.2 Total of Toll Road Operators List

No	Location	Toll Road Operators (TRO) Total	Region
1.	Jakarta Day 1	13 TRO	Banten – Jabodetabek
2.	Jakarta Day 2	14 TRO	Banten – Jabodetabek
3.	Medan	14 TRO	Trans Sumatra
4.	Bandung	8 TRO	West Java
5.	Semarang	8 TRO	Central Java
6.	Surabaya	8 TRO	East Java
7.	Bali	8 TRO	Sulawesi, Bali, and Kalimantan

1.4. Personnel Composition

The following is the composition of personnel who participated in the implementation of the workshop.

a. Speakers

- Representative of Toll Road Service Information System field from ITRA (BPJT): Mr. Galuh, Ms. Mitha, Ms. Aska, and SILJT BPJT representative.
- Japan International Cooperation Agency (JICA): Dr. Aoki and Dr. Pantha.
- PT Varian Global Perencana: Mr. Ridwan and Mr. Romi.

b. Moderator:

- PT Varian Global Perencana: Ms. Yola Widi.

c. Participants:

- Representatives from various Toll Road Operators (TRO) in Indonesia, especially those who are assigned to input operational data and manage assets in E-SPM application.

d. Organizers:

- Coordination team from the Indonesia Toll Road Authority (ITRA/BPJT), JICA Project Team and PT Varian Global Perencana (IT vendor for developing E-SPM).
- Administrative staff responsible for logistical arrangements and documentation: Ms. Sekar and PT Varian Global Perencana team.

1.5. Workshop Agenda Schedule

Workshop agenda schedule can be viewed in the following table.

Table 1.3 Workshop Agenda Schedule

No	Activities	Person In Charge (PIC)
1.	Participants Registration	
2.	Opening	Moderator (PT Varian Global Perencana)
3.	Greetings and Directions	SILJT (ITRA)
4.	Using The E-SPM Application and Its Development Presentation	JICA's Team with PT Varian Global Perencana
5.	E-SPM Web Application Simulation	PT Varian Global Perencana
6.	Break	
7.	E-SPM Mobile Application Simulation	PT Varian Global Perencana
8.	QnA Session	SILJT and JICA's Team with PT Varian Global Perencana

2. Jakarta Day 1

In this section, we'll cover the venue details, the list of invited TRO participants, Q&A discussions, and the summary of the 1st workshop which has successfully held at Amos Cozy Hotel, South Jakarta, Jakarta with participants included PT Marga Mandalasakti, PT Wijaya Karya Serang Panimbang, PT Jasa Marga (Persero), PT Jasamarga Kunciran Cengkareng, PT Marga Trans Nusantara, PT Cinere Serpong Jaya, PT Translingkar Kita Jaya, PT Hutama Karya (Persero), PT Bintaro Serpong Damai, PT Marga Sarana Jabar, and PT Jakarta Tollroad Development Jaya Pratama. Overall, the workshop provided a platform for fruitful exchanges, highlighting the importance of integrating suggestions into ongoing system development.

”

2.1. Date and Location



Figure 2.1 Detail Location of Jakarta Day 1 Workshop

The workshop was held at Florence Ballroom, Amos Cozy Hotel & Convention Hall Jakarta, Jl. Melawai Raya No. 83 – 85 Blok M, South Jakarta on Thursday, 25th April 2024 09.30 – 15.00 WIB.

2.2. Participants

The participants comprised several Toll Road Operators (TRO) located in Jakarta and its surrounding areas. The attendees were designated representatives tasked with providing input data on operations and asset management within the E-SPM application. The following table represents the list of TRO participants who have been invited to attend.

Table 2.1 Toll Road Operators (TRO) Participants in Jakarta Day 1

No	Toll Road Sections	Toll Road Operators
1.	Tangerang – Merak	PT Marga Mandalasakti
2.	Serang – Panimbang	PT Wijaya Karya Serang Panimbang
3.	Jakarta – Tangerang	PT Jasa Marga (Persero) Tbk.
4.	Cengkareng – Batu Ceper – Kuncir	PT Jasamarga Kunciran Cengkareng
5.	Kunciran – Serpong	PT Marga Trans Nusantara
6.	Serpong – Cinere	PT Cinere Serpong Jaya
7.	Cinere – Jagorawi	PT Translingkar Kita Jaya
8.	JORR S	PT Hutama Karya (Persero)
9.	JORR Non S	PT Jasa Marga (Persero) Tbk.
10.	Pondok Aren – Serpong	PT Bintaro Serpong Damai
11.	Jakarta – Bogor – Ciawi	PT Jasa Marga (Persero) Tbk.
12.	Bogor Ring Road	PT Marga Sarana Jabar
13.	6 Ruas dalam Kota Jakarta (Kelapa Gading – Pulo Gebang)	PT Jakarta Tollroad Development Jaya Pratama

2.3. Discussion

Below is the discussion from the Jakarta Day 1 workshop. It encompasses a range of topics and insights shared by participants, including both policy and technical discussions. This dialogue will serve as a valuable resource for future workshops and collaborative efforts.

Table 2.2 Discussion of Policy on Jakarta Day 1 Workshop - 1/2

POLICY QUESTIONS		
TRO and Name	Questions	Answer
Jasamarga Kunciran Cengkareng Mr. Karim	Should each street lamp detail be specified one by one? Is it necessary to provide IDs and other details individually?	That is indeed our goal. However, at the moment, we are still in the initial stage, and what needs to be inventoried are bridges, vehicle service pools, and other assets that we have already added in the current E-SPM menu.
Jasa Marga Jagorawi Mr. Irawan	In relation to the IRI assessment, if it is filled out late, the data will appear in red. How long is the tolerance given for this filling?	From the system, there is already a notification feature regarding this matter. When it is approaching its expiration date, an automatic notification will appear.
Jasa Marga Jagorawi Mr. Irawan	We often receive complaints from ITRA about capturing conditions at 100% during the daytime. Taking photos during the daytime is highly impractical and unsafe.	From ITRA perspective, if TRO can convince us that the environment remains the same, then it's not an issue.
Jasa Marga Jagorawi Mr. Irawan	Suggestion When rutting is detected, the repair duration in the SPM must be completed within 2x24 hours. However, we find that completing repairs within this timeframe for rutting issues is quite difficult, as the repair process entails a length procedure.	The issue is being addressed in the drafting of the new SPM regulation, where rutting indicators are under discussion. Your input will be reviewed in this context.
PT Hutama Karya Mr. Andika	Regarding the asset inventory that was previously discussed, we certainly need time for data input. When will this feature start to be used, and are there any predetermined deadlines?	Indeed, there is no deadline for data input, but the sooner, the better.
PT Hutama Karya Mr. Andika	Will SPM scores and the blacklist be made public? Because the blacklist is quite a sensitive matter.	No, the system will not be open to the general public, but it can still be accessed through the provided website.
PT WSP – Serang Panimbang Mr. Arash	On our toll road, we found that the streetlights were not working, and we need to purchase spare parts first, with an order lead time of one month. When I have submitted a request for additional time, what form of confirmation will indicate whether this extension is approved or not? Then, will there be an update on the status of the finding indicating the time that needs to be fulfilled? Does this additional time affect our score value?	If we fail to approve the extension request by the specified deadline, it will auto-approve. The confirmation will not indicate any lateness. However, the repair time will still be displayed based on the initially designated timeframe (e.g., four days). Regarding the score, we'll try to check what the algorithm looks like.

Table 2.3 Discussion of Policy on Jakarta Day 1 Workshop - 2/2

POLICY QUESTIONS		
TRO and Name	Questions	Answer
PT WSP – Serang Panimbang Mr. Arash	Regarding the noted findings, is there a time limit that must be met?	There isn't a specific time limit. However, we will follow up on these notes and also request updates.
PT WSP – Serang Panimbang Mr. Arash	Can discovery photo uploads be revised (in order to correct mistakes)? Currently, there's no option for revisions in the system, leading to upload errors.	Revisions aren't allowed presently to prevent manipulation. However, if an upload error happens, please contact us for rectification. We encourage self-correction before assessment; double-check uploads and notify us directly of any errors.
PT Hutama Karya Mr. Fitriandri	What is the explanation regarding the statuses 'Approved', 'Partially Approved', and 'Not Approved' in the maintenance plan feature?	The 'Approved' status means that everything submitted has been reviewed and approved by BPJT. 'Partially Approved' status indicates that there are some aspects that are still pending approval (such as needing further review or correction).

Table 2.4 Technical Discussions on Jakarta Day 1 Workshop - 1/2

TECHNICAL QUESTIONS		
TRO and Name	Questions	Answer
PT Hutama Karya Mr. Andika	We couldn't find a feature to add maintenance plans.	Maintenance plans can be added by selecting one of those groups and clicking on the "add maintenance plan" button. Perhaps, this could be a suggestion for us to add a button with a clearer label.
PT Hutama Karya Mr. Andika	Regarding maintenance plans, when there are conditions that don't match what has been planned, can the changes be accommodated on this website?	Until now, indeed there hasn't been any. However, we will try to discuss it.
PT Hutama Karya Mr. Fitriandri	Suggestion: Concerning vehicle units, we don't always use the same units due to replacements or recycling. I suggest ensuring that unused vehicles aren't accumulated and still listed on the website in the future.	ITRA could consider deleting units during replacements, but this might be regrettable. An alternative suggestion is to introduce active and inactive statuses to prevent the loss of vehicle unit history.
Jasa Marga Jagorawi Mr. Irawan	Will the red indication for time extension requests exceeding 2 days affect other aspects?	System-wise, it won't turn red. The red indication will only appear on the summary of all findings when the extension exceeds 2 days.
PT JTD Mr. Fuad	Is there an Excel format available for inputting daily traffic volume data per hour on the E-SPM website? Entering data individually on the website might be cumbersome.	Actually, we are in the process of preparing an upload template form for traffic volume to make it more convenient.

Table 2.5 Technical Discussions on Jakarta Day 1 Workshop - 2/2

TECHNICAL QUESTIONS		
TRO and Name	Questions	Answer
Jasa Marga Pusat Mr. Alif	Is it possible to import follow-up action findings data in Excel format?	Actually, it's very possible, but the documentation files won't be included.
PT WSP – Serang Panimbang Mr. Fahri	Is it possible to add a special account for vendors in E-SPM? Can its authorization and access be limited only to SPM?	Regarding that matter, we don't have an issue with it. We'll arrange it accordingly. However, our management's expectation yesterday was for one person to use one user account.
PT WSP – Serang Panimbang Mr. Fahri	Considering all the data we report is similar to what we usually report through TW/quarterly reports, it would be better if the data we've inputted can be generated into a TW report.	This feature already exists. As long as the data is in the system, you don't really need to report it back to us in physical form.
PT WSP – Serang Panimbang Mr. Fahri	Yesterday, during an SPM finding, we faced challenges with coordinate points. Despite taking data at the same location and angle, the coordinates were significantly inaccurate. This experience can provide valuable feedback for improvement. In the future, inaccurate locations could be confirmed with TRO before rejection.	GPS accuracy issues are often beyond our control, influenced by devices, weather, and other factors. Our recommendation is to refrain from saving data immediately if the accuracy remains significantly off.
PT CSJ – Serpong Cinere Mr. Achir	Data uploaded to the application sometimes disappears, such as travel time observations from January to March. What could be causing this issue?	So far, there have been no reports of server disruptions. However, if you experience such issues, please contact us directly for assistance.

2.4. Summary

During the workshop on the "Using E-SPM Application and Its Development," various concerns and suggestions were raised by participants from different TRO. These included queries about street lamp specifications, IRI assessment, rutting repair durations, maintenance plans, and the public accessibility of SPM scores. Additionally, participants sought clarification on extension requests, upload revisions, and data disappearance issues. The responses highlighted on-going system improvements and considerations for future enhancements. Here are the highlighted summary of the suggestions made in the form of points:

1. **Mr. Andika from PT Hutama Karya:**
 - Proposed adding a clearer label for adding maintenance plans.
 - Suggested considering making maintenance plans editable to accommodate changes.
 - Discussed the possibility of making changes to the SPM regulation regarding rutting indicators.
2. **Mr Fitriandri from PT Hutama Karya:**
 - Proposed considering deleting unused vehicle units during replacements or introducing active and inactive statuses to prevent accumulation.
3. **Mr. Fuad from PT JTD:**
 - Suggested creating an Excel upload template for daily traffic volume data entry to simplify the process.

4. **Mr. Fahri from PT WSP – Serang Panimbang:**

- Recommended adding a special account for vendors with limited access to SPM data.
- Suggested generating TW/quarterly reports directly from the inputted data in the E-SPM system.
- Addressed challenges with GPS accuracy and suggested coordination with TRO for confirmation of location before rejection.

WORKSHOP

PENGGUNAAN APLIKASI E-SPM DAN PENGERTIANNYA

THE PROJECT FOR STRENGTHENING
CAPACITY OF TOLL ROAD

SURABAYA, 15 MEI 2018



PT
VARIAN
GLOBAL
PERENCANA

3. Jakarta Day 2

In this section, we'll cover the venue details, the list of invited TRO participants, Q&A discussions, and the summary of the 2nd workshop which has successfully held at Amos Cozy Hotel, South Jakarta, Jakarta with participants included PT Cimanggis Cibitung Tollways, PT Cibitung Tanjung Priok Port Tollways, PT Trans Bumi Serbaraja, PT Citra Waspphutowa, PT Jakarta Lingkar Baratsatu, PT Marga Lingkar Jakarta, PT Jasa Marga (Persero) Tbk, PT Utama Karya, PT Citra Marga Nusaphala Persada, PT Kresna Kusuma Dyandra Marga, and PT Trans Jabar Tol. Overall, the workshop provided a platform for fruitful exchanges, highlighting the importance of integrating suggestions into ongoing system development.

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3.1. Location



Figure 3.1 Detail Location of Jakarta Day 2 Workshop

The workshop was held at Florence Ballroom, Amos Cozy Hotel & Convention Hall Jakarta, Jl. Melawai Raya No. 83 – 85 Blok M, South Jakarta on Thursday, 26th April 2024 09.30 – 15.30 WIB.

3.2. Participants

The participants comprised several Toll Road Operators (TRO) located in Jakarta and its surrounding areas. The attendees were designated representatives tasked with providing input data on operations and asset management within the E-SPM application. The following table represents the list of TRO participants who have been invited to attend.

Table 3.1 Toll Road Operators (TRO) Participants in Jakarta Day 2

No	Toll Road Sections	Toll Road Operators
1.	Cimanggis – Cibitung	PT Cimanggis Cibitung Tollways
2.	Cibitung – Cilincing	PT Cibitung Tanjung Priok Port Tollways
3.	Serpong – Balaraja	PT Trans Bumi Serbaraja
4.	Depok – Antasari	PT Citra Waspputowa
5.	JORR W1	PT Jakarta Lingkar Baratsatu
6.	JORR W2 Utara	PT Marga Lingkar Jakarta
7.	Pondok Aren – Bintaro Viaduct – Ulujami	PT Jasa Marga (Persero) Tbk.
8.	Akses Tanjung Priok	PT Hutama Karya (Persero)
9.	Prof. Dr. Ir. Soedijatmo	PT Jasa Marga (Persero) Tbk.
10.	Cawang – Tomang – Pluit (CTC)	PT Jasa Marga (Persero) Tbk.
11.	Cawang – Tj Priok – Ancol Timur – Jembatan Tiga/Pluit	PT Citra Marga Nusaphala Persada, Tbk
12.	Bekasi – Cawang – Kampung Melayu	PT Kresna Kusuma Dyandra Marga
13.	Ciawi – Sukabumi	PT Trans Jabar Tol

3.3. Discussion

Below is the discussion from the Jakarta Day 2 workshop. It encompasses a range of topics and insights shared by participants, including both policy and technical discussions. This dialogue will serve as a valuable resource for future workshops and collaborative efforts.

Table 3.2 Discussion of Policy on Jakarta Day 2 Workshop - 1/2

POLICY QUESTIONS		
TRO and Name	Questions	Answer
PT CMNP – Cawang Pluit Mr. Gunarto	In the self-assessment menu for gate transaction speed, it's stated in the application that SA is inputted monthly, while observations of vehicle queues are inputted per period or semester. When I checked the reference material, it stated that observations of vehicle queues are reported monthly. Regarding vehicle queues, should they be reported monthly or per semester?	Referring to the Regulation, compliance should occur monthly for operators or every six months for ITRA. An error seems to exist in the application, as the period for TRO should indeed be monthly.
PT CMNP – Cawang Pluit Mr. Gunarto	Regarding the input of asset inventory data on the E-SPM website, should we be responsible for inputting it? Because so far, we have only filled out the Self-Assessment for TRO (IRI, SR, etc.).	We hope that TRO will handle the input of this data. If there are any difficulties in the process, you can contact us.
PT BSD Mr. Akbar	Regarding the periodic routine in self-assessment, should operational vehicles be reported only when there is damage at a specific location, or is it simply a report that there is a rescue unit here?	As for the number of vehicles, it's actually an inventory figure. You don't need to update it every day, but only when there is a replacement or addition of vehicles. Concerning observation or handling, the data inputted is their response time.
PT MLJ – JORR W2 Pak Hendri	Suggestion: Due to the existence of scoreboards, we have been challenged by the management to be among the top 5 groups. Previously, assessment relied solely on response time. Now, there are multiple indicators. We propose that the length of the road and the type of road segment (old and new) be separated.	The scoring formula is still in trial mode and not fully launched. However, agreement from Bina Marga or TRO is necessary for our proposals. We'll gather opinions from both sides and discuss further.
PT MMS Mr. Rommy	Previously, maintenance plans were submitted via email on January 20th with general locations and costs. How will submission through the website be done, similar to what was done before or differently? Should STA data be inputted individually? How should latitude and longitude be filled?	Maintenance plans are still submitted following PPJT guidelines. Scattered locations can be combined if close, otherwise input individually. Alternatively, categorize based on work duration.

Table 3.3 Discussion of Policy on Jakarta Day 2 Workshop - 2/2

POLICY QUESTIONS		
TRO and Name	Questions	Answer
PT CTP Mr. Riyatno	When is the plan for developing E-SPM for asset management systems?	We're currently conducting this socialization to encourage TRO to complete their asset data. There's no set deadline yet, but the sooner it's inputted, the better.
PT CTP Mr. Riyatno	Will asset IDs be determined individually by TRO or standardized? Can a template be provided as mentioned before?	Currently, asset IDs are left to TRO discretion. There are no specific regulations from our end. Any future regulations will be communicated, and existing codifications will be retained.

Table 3.4 Technical Discussion on Jakarta Day 2 Workshop

TECHNICAL QUESTIONS		
TRO and Name	Questions	Answer
PT KKDM - Becakayu Mr. Erry	When I input the discovery and repair times, the duration does not appear. Even if it does appear, the duration is incorrect (more than 1 hour). We input through the website. We usually only use the mobile application for maintenance.	We'll investigate the issue further. Tasks intended for mobile input should be uploaded through mobile. There was a slight oversight as the feature should have been closed on the E-SPM website.
PT CMNP – Cawang Pluit Pak Joesoep	Can a template be provided for data input in the operations menu (traffic accidents) and self-assessment (handling of stalled vehicles, response time, etc.)?	Yes, this feature has already been included in our plans for additional features. So, you won't need to input the data one by one in the future.
PT MMS Mr. Wahid	Should traffic volume data be inputted daily, during peak hours, or monthly? Is there a system for direct upload if done daily? Should traffic data per segment be inputted hourly?	We prepare the gate traffic data format per day and will provide a template for easier input. Segment volume per segment cannot be specified only for peak hours due to varying peak times. Therefore, we create a format per hour for precision during peak hours. We are awaiting guidance from ITRA on this matter.
PT MMS Mr. Rommy	Yesterday, we received information regarding quarterly reporting, SPM reporting, etc., along with a checklist consisting of SIMK, E-SPM, and email. Will all of these migrate to E-SPM or still be used as per the current table?	We're developing a system integrating all toll road processes, including SIMK and E-SPM features. We anticipate its launch next year.
PT KKDM – Becakayu Pak Erry	Regarding the input of asset inventory data, all of our sections are bridges. Should we input all these bridges or how should it be done?	There's no need for input for toll roads with elevated constructions; detailing will be handled later.

3.4. Summary

During the workshop on the "Using E-SPM Application and Its Development," various concerns and suggestions were raised by participants from different TRO. Concerns included clarification on monthly reporting for vehicle queues, responsibility for asset inventory input, and the reporting process for operational vehicles. Additionally, participants proposed adjustments to the scoring formula and requested templates for data input. Clarifications were provided regarding maintenance plan submission, traffic volume data input, and asset inventory input processes. Plans for E-SPM development, including integration with other reporting systems, were also discussed. Here are the highlighted summary of the suggestions made in the form of points:

1. **Mr. Erry from PT KKDM – Becakayu:**
 - Reported issues with duration display during data input and suggested investigation.
2. **Mr Henri from PT MLJ – JORR W2:**
 - Proposed refining the scoring formula by separating road length and type for more accurate assessment.
3. **Mr. Joesoep from PT CMNP:**
 - Requested templates for easier data input in the operations menu (traffic accidents) and self-assessment (handling of stalled vehicles, response time, etc.).
4. **Mr. Riyatno from PT CTP:**
 - Asset Ids currently determined by TRO; future standardization and templates to be provided.
5. **Mr. Rommy from PT MMS:**
 - Anticipation of integrating all toll road processes into a single system, including SIMK and E-SPM, expected next year.

4. Medan, North Sumatra

In this section, we'll cover the venue details, the list of invited TRO participants, Q&A discussions, and the summary of the 3rd workshop which has successfully held at Grand Mercure Medan Angkasa Hotel, Medan, South Sumatra with participants included PT Hutama Karya (Persero), PT Hutama Karya Waskita, PT Jasa Marga Kualanam, and PT Waskita Sriwijaya Tol. Overall, the workshop provided a platform for fruitful exchanges, highlighting the importance of integrating suggestions into ongoing system development.

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4.1. Location



Figure 4.1 Detail Location of Medan Workshop

The workshop was held at Jasmine III – IV Ballroom, Grand Mercure Medan Angkasa Hotel, Jl. Sutomo No. 1, Perintis, Kec. Medan Tim., Medan City, North Sumatra on Friday, 3rd May 2024 09.30 – 15.30 WIB.

4.2. Participants

The participants comprised several Toll Road Operators (TRO) located in Medan and its surrounding areas in Sumatra. The attendees were designated representatives tasked with providing input data on operations and asset management within the E-SPM application. The following table represents the list of TRO participants who have been invited to attend.

Table 4.1 Toll Road Operators (TRO) Participants in Medan

No	Toll Road Sections	Toll Road Operators
1.	Sigli – Banda Aceh	PT Utama Karya (Persero)
2.	Binjai – Langsa	PT Utama Karya (Persero)
3.	Medan - Binjai	PT Utama Karya (Persero)
4.	Indrapura – Kisaran	PT Utama Karya (Persero)
5.	Kuala Tanjung – Tebing Tinggi – Parapat	PT Utama Marga Waskita
6.	Belawan – Medan – Tanjung Morawa	PT Jasa Marga (Persero) Tbk.
7.	Medan – Kualanamu – Tebingtinggi	PT Jasa Marga Kualanamu Tol
8.	Pekanbaru – Dumai	PT Utama Karya (Persero)
9.	Pekanbaru – Bangkinang	PT Utama Karya (Persero)
10.	Lubuklinggau – Curup – Bengkulu	PT Utama Karya (Persero)
11.	Kayuagung – Palembang – Betung	PT Waskita Sriwijaya Tol
12.	Palembang – Indralaya	PT Utama Karya (Persero)
13.	Terbanggi Besar – Pamatang Panggang – Kayu Agung	PT Utama Karya (Persero)
14.	Bakauheni – Terbanggi Besar	PT Utama Karya (Persero)

4.3. Discussion

Below is the discussion from the Medan workshop. It encompasses a range of topics and insights shared by participants, including both policy and technical discussions. This dialogue will serve as a valuable resource for future workshops and collaborative efforts.

Table 4.2 Discussion of Policy on Medan Workshop - 1/2

POLICY QUESTIONS		
TRO and Name	Questions	Answer
<p>PT Hutama Karya – Medan Binjai Mr. Rizki</p>	<p>After checking, we found that we haven't input much of the required data for our section. Will this affect our E-SPM ranking?</p>	<p>The current system accommodates only the SPM TRO requirements. The principle is to address all findings immediately, with deductions for unresolved or late fixes. The system provides information on the weighting and calculation mechanism. Uninputted asset data does not yet affect the SPM score, as the weighting formula is still being refined to accommodate all conditions across toll road sections.</p>
<p>PT Hutama Karya – Medan Binjai Mr. Nyno</p>	<p>In this application, we can report incidents that occur on our toll road sections. When there is an accident, is there a time limit for reporting it? When can the accident report be closed? Because this concerns the performance of the Toll Road Operator (TRO).</p>	<p>Accident data in the E-SPM application is not public and accessible only to TRO and ITRA. Reporting accidents is part of TRO's quarterly reporting obligation, and the focus is on submitting the report rather than closing the issue. The purpose is to identify trends in the reported data for evaluation and recommendations to reduce traffic accidents and fatalities. The data will also be refined for use by KNKT to provide concrete recommendations.</p>
<p>PT Hutama Marga Waskita – Kutepat Mr. Wisnu</p>	<p>Suggestion: On slide 23, there are eight substantive items along with weighting percentages. Of these weightings, the most influential is item number one, which is the condition of the toll road with a weighting percentage of 25,62%. In my opinion, for the toll road condition, the weighting should be 30%, because the condition of the toll road is crucial. If the toll road condition is poor, it will affect other substances, including performance.</p>	<p>ITRA hasn't conducted a specific study on this. The weighting is based on research from a TRO thesis, particularly from their maintenance department. There have been many inputs from TRO. If a similar method is to be used, it needs updating. Efforts are being made to incorporate this quantitative approach into regulations.</p>
<p>PT Hutama Karya – Bakauheni Terbanggi Besar Mr. Fahmi</p>	<p>Suggestion: I am from Bakauheni – Terbanggi Besar, which is a long section. We have been diligent in inputting data into E-SPM, but our ranking is still at 49. My suggestion is to separate the rankings between short and long sections.</p>	<p>We have received many suggestions regarding the length of sections. Each toll road section has different characteristics (types of vehicles, traffic, etc.). We will facilitate scoring weightings that can encompass all existing conditions.</p>

Table 4.3 Discussion of Policy on Medan Workshop - 2/2

POLICY QUESTIONS		
TRO and Name	Questions	Answer
PT Hutama Karya – Palembang Indralaya Mr. William	Suggestion: E-SPM has many updates. My suggestion is to provide a dedicated PIC from the consultant or ITRA who can oversee and guide the progress of data input.	For the PIC, you can contact Ms. Mitha, Mr. Dinal, or Mr. Galuh. I will share their contact information.

Table 4.4 Technical Discussion on Medan Workshop

TECHNICAL QUESTIONS		
TRO and Name	Questions	Answer
PT Hutama Karya – Medan Binjai Mr. Rizki	There are discrepancies in GPS coordinates (latitude and longitude) when uploading progress on SPM findings at 0%, 50%, and 100%. For example, a point that should be at the toll gate is incorrectly placed far away after closing the application. Does this impact the assessment?	This is a technical issue influenced by GPS accuracy, which depends on the device used and weather conditions. Using a GPS device with connections to multiple satellites and considering weather conditions can enhance accuracy. If the documentation matches the location of the findings (including the surroundings), then we have no issues.

4.4. Summary

During the workshop on the "Using E-SPM Application and Its Development," various concerns and suggestions were raised by participants from different TRO. Here are the highlighted summary of the suggestions made in the form of points:

1. **Mr. Rizki from PT Hutama Karya Medan – Binjai:**
 - Raised concerns about discrepancies in GPS coordinates during SPM progress uploads, which was attributed to technical issues influenced by GPS accuracy. No impact on assessment if documentation matches findings' location.
 - Queried the impact of incomplete data input on E-SPM ranking. It was clarified that uninputted asset data does not currently affect the score, as the system is still refining its weighting formula.
2. **Mr. Nyno from PT Hutama Karya Medan – Binjai:**
 - Inquired about reporting accidents and their time limits. It was clarified that accident data is accessible only to TRO and ITRA, with a focus on submission for trend analysis rather than immediate closure.
3. **Mr. Wisnu from PT Hutama Marga Waskita Kutepat:**
 - Suggested adjusting the weighting for toll road condition based on its significance. This was acknowledged, with efforts underway to incorporate a quantitative approach into regulations.
4. **Mr. Fahmi from PT Hutama Karya Bakauheni – Terbanggi Besar:**
 - Proposed separate rankings for short and long toll road sections. It was noted that each section's characteristics would be considered to facilitate scoring weightings.
5. **Mr. William from PT Hutama Karya Palembang – Indralaya:**
 - Suggested appointing a dedicated PIC to oversee E-SPM updates. Contact information for potential PICs was provided in response.

WORKSHOP PENGGUNAAN APLIKASI E-SPM DAN PENGEMBANGANNYA

The Project for Strengthening Management Capacity of Toll Road Development

5. Bandung, West Java

In this section, we'll cover the venue details, the list of invited TRO participants, Q&A discussions, and the summary of the 4th workshop which has successfully held at Grand Aquila Hotel, Bandung, West Java with participants included PT Jasamarga Transjawa Tol, PT Jasamarga Jalanlayang Cikampek, PT Jasa Marga (Persero), PT Citra Karya Jabar Tol, PT Citra Marga Lintas Jabar, PT Lintas Marga Sedaya, and PT Jasamarga Transjawa Tol. Overall, the workshop provided a platform for fruitful exchanges, highlighting the importance of integrating suggestions into ongoing system development.

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5.1. Location



Figure 5.1 Detail Location of Bandung Workshop

The workshop was held at Maluku Meeting Ballroom, Grand Aquila Hotel, Jl. Dr. Djundjunaan 116, Bandung, West Java on Wednesday, 8th May 2024 09.30 – 15.00 WIB.

5.2. Participants

The participants comprised several Toll Road Operators (TRO) located in Bandung and its surrounding areas in West Java. The attendees were designated representatives tasked with providing input data on operations and asset management within the E-SPM application. The following table represents the list of TRO participants who have been invited to attend.

Table 5.1 Toll Road Operators (TRO) Participants in Bandung

No	Toll Road Sections	Toll Road Operators
1.	Jakarta – Cikampek	PT Jasamarga Transjawa Tol
2.	Jalan Layang MBZ Sheikh Mohamed Bin Zayed	PT Jasamarga Jalanlayang Cikampek
3.	Cikampek – Padalarang	PT Jasa Marga (Persero) Tbk.
4.	Padalarang – Cileunyi	PT Jasa Marga (Persero) Tbk.
5.	Cileunyi – Sumedang – Dawuan Seksi 1 – 3	PT Citra Karya Jabar Tol
6.	Soreang Pasir Koja	PT Citra Marga Lintas Jabar
7.	Cikampek Palimanan	PT Lintas Marga Sedaya
8.	Palimanan – Kanci	PT Jasamarga Transjawa Tol

5.3. Discussion

Below is the discussion from the Bandung workshop. It encompasses a range of topics and insights shared by participants, including both policy and technical discussions. This dialogue will serve as a valuable resource for future workshops and collaborative efforts.

Table 5.2 Discussion of Policy on Bandung Workshop

POLICY QUESTIONS		
TRO and Name	Questions	Answer
PT JTT – Palimanan Kanci Mr. Ade	Regarding the testing of the reflectivity of markings and signs, does it need to be accompanied by BPTD, or is it allowed for the operator to do it alone? And is a report still necessary?	It does not need to be accompanied (self-testing by the operator is permitted). This is based on a letter we previously sent. There is no need to include a report.
PT JJC – MBZ Toll Road Mr. Andri	Is it possible for the longitude and latitude in this application to be unlocked? Field operators might forget to upload this data, so we could correct it.	Technically, we can unlock the longitude and latitude features. However, we lock these features to prevent manipulation (such as using Fake GPS). The request to unlock latitude and longitude cannot be fulfilled at this time.

Table 5.3 Technical Discussion on Bandung Workshop - 1/2

TECHNICAL QUESTIONS		
TRO and Name	Questions	Answer
RO 3 Mr. Iwan	Suggestion: Can a feature be added to the mobile version of E-SPM that allows field colleagues to navigate to the nearest location? Perhaps adding an additional button for navigation (e.g., Google Maps).	Regarding that, we can accommodate it.
PT JTT – Japek Mr. Amri	Regarding maintenance plans, what is the procedure after they're uploaded? Will there be a response from ITRA first? When can TRO implement the uploaded maintenance plans?	The maintenance plan feature is still in the early stages. Plans for the future regarding its mechanism are still under discussion (along with the formation of its SOP). Typically, evaluation of technical and cost aspects occurs jointly before ITRA approval.
PT JJC – MBZ Toll Road Mr. Fieter	When we are at the location of a finding, we sometimes lose signal due to the presence of the LRT and KCIC, which prevents us from uploading data. What is the solution for this issue?	Acknowledging the signal disruptions near KCIC, LRT, and Halim, the solution offered is the mobile app's offline feature. This allows data entry without internet access, ensuring all data is captured. Despite internet connectivity issues, coordinate accuracy depends on the device and weather conditions. Once connectivity is restored, the data can be uploaded. Users have the option to upload all offline data or select specific entries. Notifications to ITRA reflect upload time, while data timestamps remain original.
PT JJC – MBZ Toll Road Mr. Fieter	There is a finding at kilometer 101, located in Purbaleunyi, but it's logged under MBZ toll SPM. Additionally, there is a guardrail finding at kilometer 54 (dated May 6, 2024), which isn't on the MBZ section. What is the solution to this?	Regarding this issue, we will investigate it.

Table 5.4 Technical Discussion on Bandung Workshop - 2/2

TECHNICAL QUESTIONS		
TRO and Name	Questions	Answer
PT JMTM – Purbaleunyi Ms. Febi	We conducted the SPM yesterday. We received findings from the BPJT consultant on the Padaleunyi section on May 6, but the notification on our application was received only on May 7, 2024 (not in real time). However, the time allocated for addressing these SPM findings is only 2 days. While this incident doesn't always occur, it happens occasionally. If the notification of these findings is not real-time, it could hinder our response. Is there a reason for this delay?	Regarding this issue, we will investigate it.
PT JTT Mr. Purwo	In the E-SPM application, is it possible to add usernames for sub-holdings like Trans Java? What are the plans for this?	Currently, our application only accommodates holdings and branches. Technically, we can accommodate this request. It's valuable input, and we can facilitate it. However, internal discussions are needed before proceeding with this.
PT JTT – Japek Mr. Eko	When will the E-SPM application be available for iOS?	Progress is ongoing, but strict security measures on iPhones make it challenging. Despite rejections of multiple submission attempts, plans are in place to launch the iOS version soon.

5.4. Summary

During the workshop on the "Using E-SPM Application and Its Development," various concerns and suggestions were raised by participants from different TRO. Here are the highlighted summary of the suggestions made in the form of points:

- 1. Mr. Andri from PT JJC:**
 - Inquired about unlocking the longitude and latitude features in the application to rectify data upload errors, which was technically feasible but not permitted due to security concerns.
- 2. Ms. Febi from PT JMTM Purbaleunyi:**
 - Raised concerns about delayed notifications of findings, hindering prompt responses. Investigation into the cause of these delays was proposed to enhance real-time notifications.
- 3. Mr. Purwo from PT JTT Jakarta – Cikampek:**
 - Proposed adding usernames for sub-holdings like Trans Java in the E-SPM application, which was deemed technically possible pending internal discussions.
- 4. Mr. Eko from PT JTT Jakarta – Cikampek:**
 - Inquired about the availability of the E-SPM application for iOS.
- 5. Mr. Iwan from RO 3:**
 - Suggested adding a navigation feature to the mobile version of E-SPM to help field colleagues navigate to the nearest locations, which was deemed feasible and accepted for accommodation.

6. Semarang, Central Java

In this section, we'll cover the venue details, the list of invited TRO participants, Q&A discussions, and the summary of the 4th workshop which has successfully held at Ciputra Semarang Hotel, Semarang, Central Java with participants included PT Semesta Marga Jaya, PT Pejagan Pemalang Toll Road, PT Jasamarga Semarang Batang, PT Jasamarga Transjawa Tol, PT Trans Marga Jateng, PT Jasamarga Solo Ngawi, and PT PP Semarang Demak. Overall, the workshop provided a platform for fruitful exchanges, highlighting the importance of integrating suggestions into ongoing system development.

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6.1. Location



Figure 6.1 Detail Location of Semarang Workshop

The workshop was held at Puri Ballroom, Ciputra Semarang Hotel, Jl. Simpang Lima No. 1, Pekunden, Kec. Central Semarang, Semarang City, Central Java on Wednesday, 14th May 2024 09.30 – 15.00 WIB.

6.2. Participants

The participants comprised several Toll Road Operators (TRO) located in Bandung and its surrounding areas in West Java. The attendees were designated representatives tasked with providing input data on operations and asset management within the E-SPM application. The following table represents the list of TRO participants who have been invited to attend.

Table 6.1 Toll Road Operators (TRO) Participants in Semarang

No	Toll Road Sections	Toll Road Operators
1.	Kanci – Pejagan	PT Semesta Marga Jaya
2.	Pejagan – Pemalang	PT Pejagan Pemalang Toll Road
3.	Pemalang – Batang	PT Pemalang Batang Toll Road
4.	Semarang – Batang	PT Jasamarga Semarang Batang
5.	Semarang Seksi A, B, C	PT Jasamarga Transjawa Tol
6.	Semarang – Solo	PT Trans Marga Jateng
7.	Solo – Ngawi	PT Jasamarga Solo Ngawi
8.	Semarang – Demak Seksi 2	PT PP Semarang Demak

6.3. Discussion

Below is the discussion from the Semarang workshop. It encompasses a range of topics and insights shared by participants, including both policy and technical discussions. This dialogue will serve as a valuable resource for future workshops and collaborative efforts.

Table 6.2 Discussion of Policy on Semarang Workshop

POLICY QUESTIONS		
TRO and Name	Questions	Answer
AIS – Semarang Solo Mr. Ervan	Concerning the inspections carried out during tariff adjustments, JBH doesn't use E-SPM at all when conducting inspections. What will be ITRA's policy regarding this? In my opinion, it would be better if this application becomes a platform for TRO, ITRA, and JBH.	The response acknowledges discussions between BPJT and JBH regarding the use of E-SPM. It expresses the intention to make E-SPM a collaborative tool for monitoring. Regarding inspections, it clarifies that JBH is now responsible for SPM inspections, including tariff adjustments, while ITRA's role is limited to validating self-assessment reports submitted by TRO.
PT PPTR – Pejagan Pematang Mr. Roffian	Regarding the SPM ranking, is it updated monthly, yearly, or per period?	Our SPM ranking is updated daily (calculated) at 2 AM. The maximum update frequency is once every 24 hours.
PT PPTR – Pejagan Pematang Mr. Roffian	Repair time is included in the SPM assessment. In some cases, we need more than 7 x 24 hours for repairs. There are findings that require special handling, causing us to exceed the specified time limit (late). Is the delay time calculated from start to finish or updated per period?	Yes, repair time is factored into the SPM assessment. We've included a feature in the E-SPM application for extending repair time, where clear reasons for the extension should be provided. For urgent cases like potholes, temporary fixes are required while informing us for permanent repairs.
PT PBTR – Pematang Batang Mr. Indra	Regarding the SPM ranking, our board of directors has made it a Key Performance Indicator (KPI). Can self-assessment be included as one of the parameters to improve the ranking?	Currently, self-assessment is not included as an assessment component in the SPM ranking. However, we are in discussions regarding the latest SPM regulations. In these new regulations, we are also discussing the weighting of assessments for the SPM ranking. We will provide further details on this weighting.
PT JM – Semarang ABC Mr. Dian	JBH and BPJT/ITRA suggested reconstruction for repairing crack findings, although they weren't severe. We used sealant for a temporary fix. Can you explain this, considering reconstruction takes time?	Temporary repairs are acceptable to comply with SPM regulations. However, if permanent reconstruction is needed, it should be undertaken. Please inform ITRA when planning permanent repairs.

Table 6.3 Technical Discussion on Semarang Workshop - 1/2

TECHNICAL QUESTIONS		
TRO and Name	Questions	Answer
PT PPSD – Semarang Demak Mr. Aji	What is the difference between “self-assessment” and the “operation and maintenance” features in the E-SPM application?	Self-assessment involves routine reporting where BUJT conducts inspections in its segment, photographs any findings, and submits reports. On the other hand, the operation and maintenance feature entails significant (permanent) maintenance activities.
PT PPSD – Semarang Demak Mr. Aji	What data needs to be entered for the maintenance plan feature in this application?	The maintenance feature is primarily for reporting actions during field tasks. Maintenance planning, reported annually on January 20th, includes all planned maintenance activities for the year, such as SFO or reconstruction, along with budget input per handling.
PT JSB – Semarang Batang Mr. Yogi	Could you explain the offline mode in the E-SPM mobile application? How does it relate to the coordinates?	The offline mode in the E-SPM application is intended for areas with poor signal reception. Despite lacking a signal, coordinates can still be saved as the connection is directly to satellites. Later, this data can be stored and uploaded when there's an available connection. The upload timing adjusts based on when offline data input occurs, and this data appears automatically when internet connection is absent. Input process remains the same, with only the need to upload inputted data after offline input. GPS data remains accessible even in offline mode.
AIS – Semarang Solo Mr. Ervan	Is the mobile E-SPM application available for iOS? Currently, to address the absence of an iOS version, we utilize the web-based platform. However, when using the web-based platform, we are only able to delete findings and cannot input new data.	Currently, the E-SPM application is only available for Android. The iOS version of the application is still in development. We are working diligently to release the iOS version as soon as possible.
PT PBTR – Pemalang Batang Mr. Indra	We have been actively using this E-SPM since last year and find that E-SPM website very helpful. However, when we input self-assessment data on website, the fulfillment time shows zero (0). For example, when we input a one-hour difference, the fulfillment duration remains zero (0). Could you explain this issue?	Input via the website is not allowed. It was opened yesterday only in emergencies. Self-assessment input is designed for mobile use only. Last year, it was opened for website input due to server issues. However, data input remains through the mobile E-SPM. The reason for the unreadable duration is because of its rapidity. The focus of the self-assessment is not its speed but rather fulfilling the indicators. Meeting them within two days is considered satisfactory.

Table 6.4 Technical Discussion at Semarang Workshop - 2/2

TECHNICAL QUESTIONS		
TRO and Name	Questions	Answer
PT PPSD – Semarang Demak Ms. Heni	Is there a video tutorial available for using the E-SPM application? Considering we are a new section.	So far, there isn't a video tutorial available. However, we have provided a user manual that can be downloaded from the E-SPM website.
PT PPSD – Semarang Demak Ms. Heni	What data needs to be entered for the traffic volume at the toll gate on the provided template?	Regarding that, we will update the user manual to provide information on which data needs to be entered.
PT PPSD – Semarang Demak Ms. Heni	My suggestion is to prepare a template for this segment's traffic volume data to facilitate our input process.	We will accommodate your suggestion regarding the template.
PT SMR – Kanci Pejagan Mr. Ilham	Based on our experience, when we upload photos for 100% completion with the same point and angle, the distance exceeds 200 m. We've also marked to ensure the photo angles are the same. What's the explanation for this?	GPS accuracy can be affected by device quality and weather conditions. Using updated devices and considering weather factors can help improve accuracy. ITRA are flexible when it comes to discrepancies in coordinates. We review uploaded photos along with the surrounding environment. If the documentation aligns, there's no problem. However, if there are discrepancies in documentation or findings, indicating possible manipulation, we will evaluate them.
PT JM – Semarang ABC Mr. Dian	I encountered an issue where data wasn't saved after inputting it into the application. Is there a requirement for specific device specifications to use the app?	Continuous updates are needed for the operating system. We'll include the minimum specifications required for using the application in the user manual.

6.4. Summary

During the workshop on the "Using E-SPM Application and Its Development," various concerns and suggestions were raised by participants from different TRO. Here are the highlighted summary of the suggestions made in the form of points:

- 1. Ms. Heni from PT PPSD:**
 - Inquired about video tutorial availability and suggested preparing a template for traffic volume data input. It was confirmed that no video tutorial is available, but a user manual can be downloaded. The template suggestion was noted for accommodation.
- 2. Mr. Ervan from AIS:**
 - Inquired about the availability of the E-SPM app for iOS. It was confirmed to be under development, currently available only for Android.
- 3. Mr. Indra from PT PBTR – Pemalang Batang:**
 - Suggestion for ITRA to include self-assessment as one of the parameters for improving the ranking.

4. Mr. Dian PT JM Semarang ABC:

- Encountered data-saving issues and inquired about device specifications. The response highlighted the need for continuous OS updates and promised to include minimum specifications in the user manual.



7. Surabaya, East Java

In this section, we'll cover the venue details, the list of invited TRO participants, Q&A discussions, and the summary of the 7th workshop which has successfully held at Aston Inn Jemursari Hotel, Surabaya, East Java, with participants included PT Jasamarga Transjawa Tol (Surabaya – Gempol), PT Jasamarga Pandaan Tol, PT Jasamarga Surabaya Mojokerto, PT Jasamarga Ngawi Kertosono, PT Marga Bumi Matra Raya (Surabaya – Gresik), PT Marga Hanjaya Infrastruktur, PT Waskita Bumi Wira (KLBW), PT Citra Margautama Surabaya, and PT Jasamarga Surabaya Gempol. Overall, the workshop provided a platform for fruitful exchanges, highlighting the importance of integrating suggestions into ongoing system development.

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7.1. Location



Figure 7.1 Detail Location of Surabaya Workshop

The workshop was held at Freesia Ballroom, Aston Inn Jemursari, Jl. Sidosermo II No. 70a, Sidosermo, Kec. Wonocolo, Surabaya, East Java on Thursday, 15th May 2024 09.30 – 15.00 WIB.

7.2. Participants

The participants comprised several Toll Road Operators (TRO) located in Surabaya and its surrounding areas in East Java. The attendees were designated representatives tasked with providing input data on operations and asset management within the E-SPM application. The following table represents the list of TRO participants who have been invited to attend.

Table 7.1 Toll Road Operators (TRO) Participants in Surabaya

No	Toll Road Sections	Toll Road Operators
1.	Ngawi – Kertosono	PT Jasamarga Ngawi Kertosono
2.	Jombang – Mojokerto	PT Marga Hanjaya Infrastruktur
3.	Surabaya – Mojokerto	PT Jasamarga Surabaya Mojokerto
4.	Surabaya – Gempol	PT Jasamarga Transjawa Tol
5.	Surabaya – Gresik	PT Marga Bumi Matra Raya
6.	Waru – Juanda Airport Intersection	PT Citra Margatama Surabaya
7.	Krian – Legundi – Bunder – Manyar	PT Waskita Bumi Wira
8.	Gempol – Pandaan	PT Jasamarga Pandaan Tol

7.3. Discussion

Below is the discussion from the Surabaya workshop. It encompasses a range of topics and insights shared by participants, including both policy and technical discussions. This dialogue will serve as a valuable resource for future workshops and collaborative efforts.

Table 7.2 Discussion of Policy on Surabaya Workshop - 1/2

POLICY QUESTIONS		
TRO and Name	Questions	Answer
PT Waskita Bumi Wira Mr. Brian	Is it possible to differentiate the scoring calculations between short-span and long-span toll road sections?	Our goal in conducting this scoring and ranking is to encourage TROs to improve their self-assessment reporting routine. Currently, the score calculation method is based on the fulfillment duration time. However, comparing a section that has a distance of 5 km with 5 findings to a section that has a distance of 100 km with 100 findings does not seem fair. Therefore, we are working on establishing a fair weighting system for scores across all TROs, and this process is still under discussion.
PT Waskita Bumi Wira Mr. Brian	Regarding data input, we sometimes receive instructions to enter data via Google Forms or other formats as directed by BPJT through the existing WhatsApp group. However, we already have the E-SPM system designed for data entry. Is there a policy or direction from BPJT on this matter?	On January 9th, 2023, a circulated letter informed all TROs about the use of E-SPM, both web and mobile-based, for daily self-assessment reporting, monitoring, and improvement, so TRO doesn't have to report again back to ITRA physically and/or by email. Accident and traffic data are still requested via a link due to the limited routine use of E-SPM by TROs. The goal is to enhance awareness and compliance with E-SPM usage. Additionally, on March 14th, 2024, another letter specified the reports to be submitted via E-SPM. On March 14 th , 2024, we also circulated a letter regarding what reports need to be submitted via E-SPM.
PT Jasamarga Pandaan Tol Mr. Kuku	If all the data in the E-SPM has been filled in, do we still need to report quarterly reports?	If all the data has been entered regularly, there is no need to report the TW/quarterly report to us (ITRA).
PT Jasamarga Pandaan Tol Mr. Kuku	Regarding the maintenance plan, it was mentioned that only non-routine tasks need to be reported. How is the explanation if there are only routine tasks and no permanent tasks on a specific section?	For maintenance plans, we refer to the maintenance plan reporting obligations stated in the Toll Road Concession Agreement. We facilitate TRO in fulfilling this obligation. This maintenance plan must still be reported through E-SPM, even though there is no permanent work.
PT Waskita Bumi Wira Mr. Rhyan	For SPM findings on mobile, for example for pavement distress (potholes), it would be better if they could be classified individually (between asphalt and expansion joints).	Regarding indicators, we currently refer to the 2014 SPM Ministerial Regulation No. 16. As for your suggestion, it can be forwarded to the Toll Road Association (ATI) for further consideration and facilitation.
PT Citra Margatama Surabaya Mr. Grandis	If our maintenance plan that has been submitted is not approved yet, can we still do the maintenance or should we keep waiting for the approval?	Actually, the maintenance plan feature is still new, and we still learn about this feature. We will inform the standard operating procedure once it's finalized.

Table 7.3 Discussion of Policy on Surabaya Workshop - 2/2

POLICY DISCUSSIONS		
TRO and Name	Questions	Answer
<p>PT Jasamarga Transjawa Tol (Surabaya – Gempol) Mr. Heri</p>	<p>Regarding the OM report that has to be submitted on the E-SPM, is there any uniformity in the data that should be uploaded? What kind of format that should be used?</p>	<p>As for the transaction volume, it is per gate, per day and per group. For TROs, there is no difference, everything is the same. We will also make the segment volumes similar. Regarding quarterly reports, the report design that we have provided in this application is still in draft form. We are still waiting for the format. After this workshop, we hope that TROs can input all the data which we will later evaluate and list what data needs to be displayed in the report.</p>

Table 7.4 Technical Discussion on Surabaya Workshop - 1/2

TECHNICAL DISCUSSIONS		
TRO and Name	Questions	Answer
<p>PT Jasamarga Transjawa Tol (Surabaya – Gempol) Mr. Heri</p>	<p>Is it possible in our section to add sub-holding users? For example, in our section we added under sub-holdings with users in the maintenance area (JMTRM), rest area (JMTRB) and operations (JMTRT). If it can be added, who is the PIC I can contact regarding user addition?</p>	<p>Regarding adding users, you just have to assign each of the areas (maintenance, rest area, and operation) to input the data aligned with their responsibility. In the future, we have a plan to register each person who can access the system. Therefore, if there's any mistake, the toll road will not take the responsibility, but the user in person. For adding users, we will provide a form later.</p>
<p>PT Jasamarga Transjawa Tol Mr. Maulana</p>	<p>Regarding E-SPM monitoring, is it possible for us as a holding company to directly view all of our segments without entering the username and password for each section? This is to ensure that if any oversights occur in the application, we can promptly remind the relevant toll road sections.</p>	<p>We will try to update the list of the holding and inform the username so you can monitor all of the toll road segments under PT JTT.</p>
<p>PT Waskita Bumi Wira Mr. Brian</p>	<p>Suggestion: We truly appreciate the existence of the E-SPM application. However, it would be great if the E-SPM application could be integrated with other previous systems. Previously, TRO had already entered asset-related data into the previous systems (webgis, SIMKA, etc.), which now needs to be re-entered into the E-SPM system.</p>	<p>Regarding data integration, we already have plans to build an application system that can facilitate all toll road business processes, including preparation phase until evaluation phase. This year, we have started the process of integrating existing systems. We will integrate all data in SIMKA, E-SPM, etc. into one. For now, we will socialize E-SPM first as we migrate data from the previous system.</p>
<p>PT Marga Harjaya Infrastruktur Mr. Feri</p>	<p>Suggestion: It would be better if there's an excel template to input segment volume data through E-SPM application.</p>	<p>We already have received similar suggestions regarding template for segment volume data. We will accommodate that immediately.</p>

Table 7.5 Technical Discussion on Surabaya Workshop – 2/2

TECHNICAL QUESTIONS		
TRO and Name	Questions	Answer
PT Marga Harjaya Infrastruktur Mr. Yudistiro	Our colleagues in the field experienced problems when uploading SA findings. They cannot upload the findings documentation. We can upload 0% condition, but we cannot upload 50% and 100% conditions, even though the connection is online. A pop-up message appears that the uploaded data failed to save. If something like this happens, what should we do? We already have changed three different devices, but it still won't work.	We have conducted simulations for uploading the documentation of findings and no issues were encountered. Perhaps this is also related to the minimum specifications of the device used. We will immediately share updates regarding the minimum specifications of devices used. If anyone here experiences the same problem as the Jombang – Mojokerto section, then you can contact our team so we can see what kind of problem it is. We need to see the log or list of what errors occurred.
PT Citra Margatama Surabaya Mr. Grandis	Actually, we also experienced the same issue regarding the documentation upload on the application. Would it be acceptable to upload only 100% documentation due to the issues we're encountering?	For self-assessment, it should not be a problem. However, that could be the last option if the documentation of 50% condition cannot be uploaded.
PT Citra Margatama Surabaya Mr. Grandis	Our data on the E-SPM website and mobile platforms has not been integrated yet. For example, we have inputted the tollgates data on the website, but it doesn't appear on the mobile platform. How is the explanation regarding this issue?	Try to update or reinstall the application first. Even though there are no additional features, there's always an update on the playstore.

7.4. Summary

During the workshop on the "Using E-SPM Application and Its Development", various concerns and suggestions were raised by participants from different TRO. Here are the highlighted summary of the suggestions made in the form of points:

- 1. Mr. Brian from PT WBW - Krian – Legundi – Bunder – Manyar:**
 - Suggestion for ITRA to integrate the data of E-SPM application and previous system that has been used (SIMKA, webgis, etc.).
 - Suggestion for ITRA to differentiate the scoring calculations between short-span and long-span toll road section.
- 2. Mr. Feri from PT MHI - Jombang – Mojokerto:**
 - Suggestion for consultant to provide an excel template to input and upload segment volume data through E-SPM application.
- 3. Mr. Heri from PT Jasa Marga (Surabaya – Gempol):**
 - Suggestion for ITRA to add user under sub-holding of Surabaya – Gempol toll road.

8. Denpasar, Bali

In this section, we'll cover the venue details, the list of invited TRO participants, Q&A discussions, and the summary of the 8th workshop which has successfully held at Aston Denpasar Hotel, Denpasar, Bali, with participants included PT Makassar Metro Network, PT Jalan Tol Seksi Empat, PT Jasamarga Manado Bitung, PT Jasamarga Bali Tol, PT Jasamarga Balikpapan Samarinda, PT Transjawa Paspro Jalan Tol, PT Jasamarga Pandaan Malang, and PT Jasamarga Gempol Pasuruan. Overall, the workshop provided a platform for fruitful exchanges, highlighting the importance of integrating suggestions into ongoing system development.

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8.1 Location



Figure 8.1 Detail Location of Surabaya Workshop

The workshop was held at Agung Ballroom, Aston Denpasar Hotel & Convention Center, Jl. Gatot Subroto Barat No. 283, Denpasar City, Bali on Monday, 20th May 2024 09.30 – 15.00 WIB.

8.2 Participants

The participants comprised several Toll Road Operators (TRO) located in Denpasar and its surrounding areas in Bali. The attendees were designated representatives tasked with providing input data on operations and asset management within the E-SPM application. The following table represents the list of TRO participants who have been invited to attend.

Table 8.1 Toll Road Operators (TRO) Participants in Denpasar

No	Toll Road Sections	Toll Road Operators
1.	Ujung Pandang Section 1 – 3	PT Makassar Metro Network
2.	Makassar Section IV	PT Jalan Tol Seksi Empat
3.	Manado – Bitung	PT Jasamarga Manado Bitung
4.	Bali Mandara	PT Jasamarga Bali Tol
5.	Balikpapan – Samarinda	PT Jasamarga Balikpapan Samarinda
6.	Pasuruan – Probolinggo	PT Trans Jawa Paspro Jalan Tol
7.	Pandaan – Malang	PT Jasamarga Pandaan Malang
8.	Gempol – Pasuruan	PT Jasamarga Gempol Pasuruan

8.3 Discussion

Below is the discussion from the Bali workshop. It encompasses a range of topics and insights shared by participants, including both policy and technical discussions. This dialogue will serve as a valuable resource for future workshops and collaborative efforts.

Table 8.2 Discussion of Policy on Denpasar Workshop

POLICY QUESTIONS		
TRO and Name	Questions	Answer
PT Jasamarga Manado Bitung Mr. Fander	When a hole is found on the pavement, we usually do the temporary maintenance first, with sweep the hole or patching method. However, we already have plans to conduct an SFO. When we have reported the findings by uploading conditions of 0%, 50% and 100%, will the quality of maintenance using this patching method be approved? Or is there a possibility that we have to carry out an SFO based on the ITRA evaluation? And how do we replace documentation of these findings when there is an option to treat the findings with permanent repairs?	If a hole is found and a temporary maintenance is carried out using the patching method, there is actually no problem with it. From there, ITRA will see how the quality is like. As long as the work is properly done, we will not reject it. However, if the maintenance work is not proper, then we will still reject the quality. We still note that your section has already taken action to deal with the findings of the hole before the specified time limit. When there is a permanent repair, the details of the work can be reported in the maintenance report.
PT Jasamarga Manado Bitung Mr. Fander	Regarding asset management, is there any dashboard provided in the E-SPM application for inputting the public street lighting and other assets data?	We have prepared regarding this matter. However, we have not launched and opened the feature yet with considerations regarding the readiness of TRO. When we consider that TROs are ready, we will launch the features and the data can be inputted directly.
PT Jasamarga Manado Bitung Mr. Fander	If we are late in handling the findings (especially for rutting), will it be affecting our performance score? Because we always handled findings based on priority (P1, P2, so on).	Actually, the handling time in the Ministerial Regulation is two days, but many TROs handle rutting for more than two days because the process is quite long (including mobilization of equipment). For this, TRO could try submitting a request for an extension of handling time. TRO also can state the considerations regarding the condition so that we can approve it. We still discussed internally whether we should extend the repair time for rutting findings or not.
PT Jasamarga Manado Bitung Mr. Fander	Based on a letter from the Head of ITRA which was circulated in February, it was stated that TRO was asked to submit a maintenance plan. Is the maintenance plan still should be reported based on the guidelines or is it enough to just report it through E-SPM application?	Because we haven't socialized about this matter yet, for now TRO can just follow what is in the guidelines first and report the hardcopy to us (ITRA). However, in the future (estimated for next year), TRO will be able to submit the report by using the E-SPM application.
PT Jasamarga Bali Tol Mr. Tole	Every quarter, we always submit quarterly reports to ITRA. If E-SPM is fully operated, does the quarterly report still need to be reported?	When TRO has completed to input all the data in E-SPM, TRO will be able to generate quarterly reports automatically from E-SPM. We also hope that this entire process will be managed solely through E-SPM and TRO doesn't have to send reports back to us (ITRA).

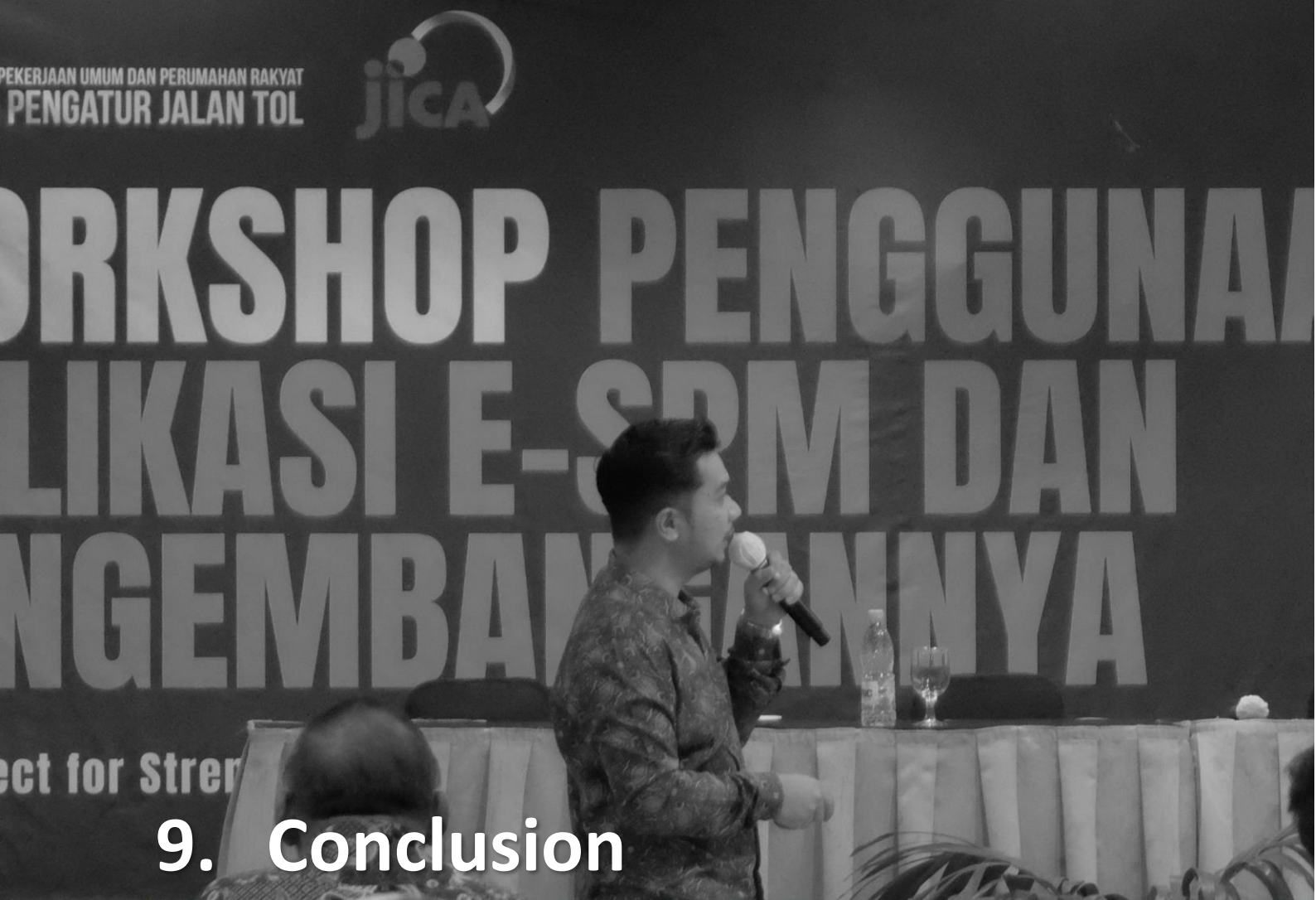
Table 8.3 Technical Discussion on Denpasar Workshop

TECHNICAL QUESTIONS		
TRO and Name	Questions	Answer
PT Jasamarga Bali Tol Mr. Tole	Suggestion: Considering that in our section there is a motorcycle lane, we hope that the consultant can add the 'Class VI' in the upload template that has been provided. Apart from that, we also hope that the motorcycle lane can be added on the lane selection.	We will accommodate the suggestion immediately.
PT Trans Jawa Paspro Jalan Tol Mrs. Eli	What data do we need to input in the excel template to upload traffic volume data?	In the excel template that we have provided, there are date, descriptions, and traffic volume for each vehicle classes. The column called 'Entrance 1, 2, 3, and so on' can be filled with amount of vehicle based on the vehicle class in the entrance gate, while 'Exit 1, 2, 3, and so on' can be filled with amount of vehicle based on the vehicle class in the exit gate. If there is only entry gate data, then the data in the exit column does not need to be filled in. The description column is also not required to be filled in. We will add additional information on what to fill in each column.

8.4 Summary

During the workshop on the "Using E-SPM Application and Its Development", various concerns and suggestions were raised by participants from different TRO. Here is the highlighted summary of the suggestions made in the form of points:

1. **Mr. Tole from PT JBT - Bali – Mandara:**
 - Suggestion for consultant to add the 'Class VI' in the upload template that has been provided and add the motorcycle lane on the lane selection in the E-SPM application.



9. Conclusion

This section includes conclusions regarding the workshop. It will be segmented into two parts: conclusions and suggestions. Within the suggestions segment, suggestions will be further categorized into two sections: suggestions for ITRA and suggestions for consultants.

”

9.1 Conclusion

The workshop on "Using E-SPM Application and Its Development" served as a vital platform for stakeholders from various Toll Road Operators (TRO) across Indonesia to voice concerns, offer suggestions, and engage in constructive dialogue regarding the refinement and enhancement of the E-SPM application. Participants raised pertinent issues ranging from system functionality to data accuracy and accessibility. These discussions underscored the commitment to improving the E-SPM application to better meet the evolving needs of toll road management. Key suggestions, such as clearer labeling for maintenance plans, refining scoring formulas, and addressing technical challenges, were thoroughly discussed. The active participation and collaboration observed throughout the workshops to advancing toll road infrastructure management in Indonesia.

9.2 Suggestions

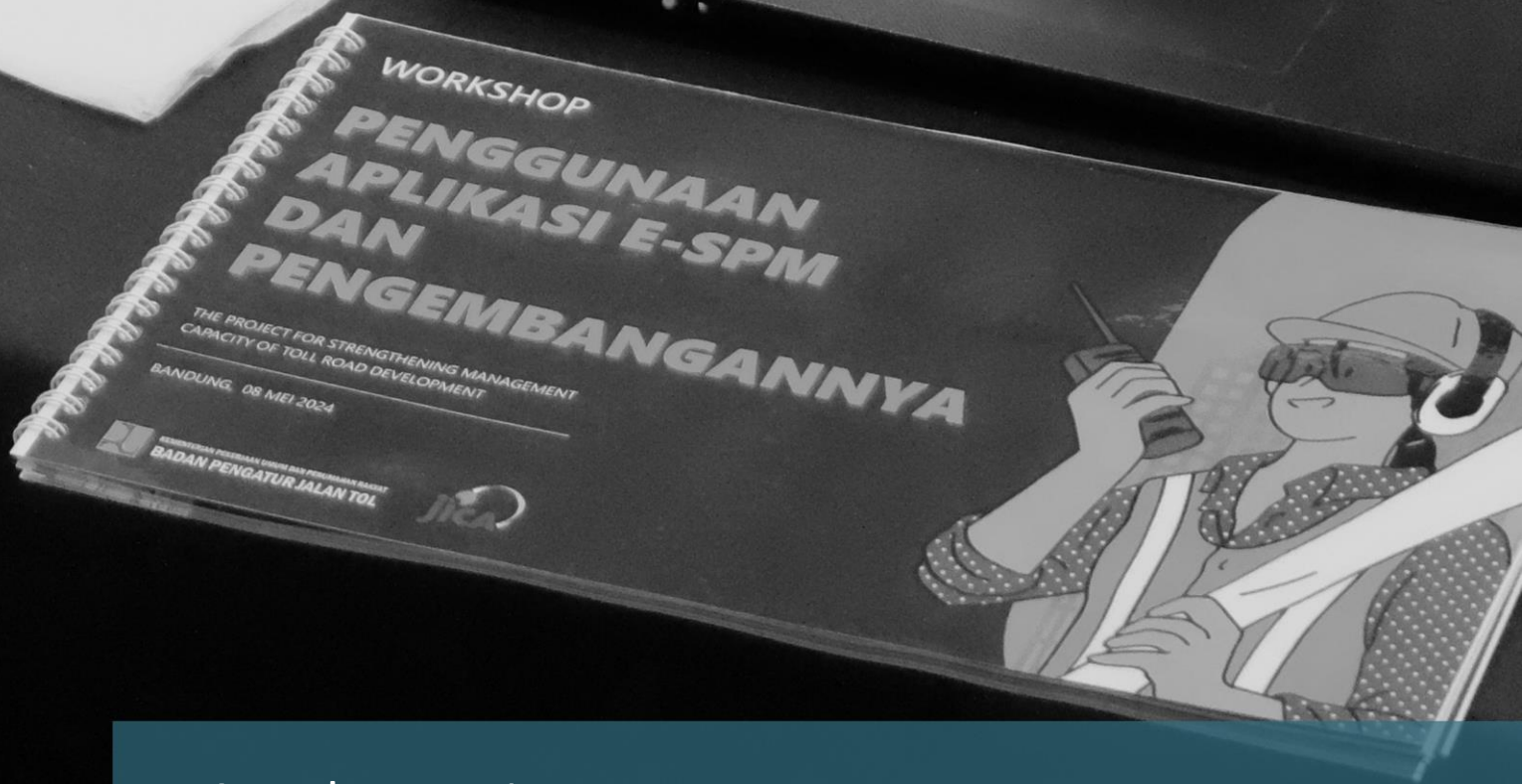
Here are the suggestions and inputs provided by Toll Road Operators (TRO) during the workshop. Suggestions and inputs are categorized into two types: recommendations given to ITRA (in the form of policy suggestions) and technical suggestions for consultants.

1. Policy Recommendations for ITRA

- Consider adjustments to the SPM regulation concerning rutting indicators.
- Proposed refining the scoring formula by separating road length and type for more accurate assessment (separated rankings for short and long toll road sections) and address the significance of toll road condition in weighting calculations.
- Include self-assessment as one of the parameters for improving the ranking.
- Appoint dedicated personnel (PIC) to oversee E-SPM updates.
- Proposed adding usernames for sub-holdings like JTT, JMTM, JMTO, JM RB, etc. in the E-SPM application.

2. Technical Recommendations for Consultants

- Provide a clearer label for adding maintenance plans.
- Proposed considering deleting unused vehicle units during replacements or introducing active and inactive statuses to prevent accumulation.
- Recommended adding a special account for vendors with limited access to SPM data.
- Requested templates (Excel) for easier data input in the operations menu (traffic accidents) and self-assessment (handling of stalled vehicles, response time, etc.).
- Develop an Excel upload template for daily traffic volume segment data through E-SPM application.
- Integrate data from SIMK, webgis, etc. into the E-SPM application.
- Generate quarterly (TW) reports directly from inputted data in the E-SPM system.
- Proposed E-SPM application for iOS.
- Provide a navigation feature (like google maps) to the mobile version of E-SPM to help field colleagues navigate to the nearest locations.
- One of the TRO inquired about video tutorial availability.
- Add the 'Class VI' option in the upload template and include the motorcycle lane in lane selection within the E-SPM application.
- Suggest adding information about the need for continuous OS updates and include minimum specifications for E-SPM applications.



Attachment 1

Documentation

”

Attachment 1.1. Jakarta Day 1 Documentations

Here are the documentation of the workshop "Using E-SPM Application and Its Development" that has been conducted in Florence Ballroom, Amos Cozy Hotel & Convention Hall Jakarta, Jakarta City Day 1.



Jakarta Day 1 Participants Documentation



Personnel of PT Varian Global Perencana on Jakarta Day 1 Workshop



Attachment 1.2. Jakarta Day 2 Documentations

Here are the documentation of the workshop "Using E-SPM Application and Its Development" that has been conducted in Florence Ballroom, Amos Cozy Hotel & Convention Hall Jakarta, Jakarta City Day 2.



Jakarta Day 2 Participants



Personnel of PT Varian Global Perencana on Jakarta Day 2 Workshop



Attachment 1.3. Medan Documentations

Here are the documentation of the workshop "Using E-SPM Application and Its Development" that has been conducted in Jasmine III – IV Ballroom, Grand Mercure Medan Angkasa Hotel, Medan.



Medan Participants



Personnel of PT Varian Global Perencana on Medan Workshop



Attachment 1.4. Bandung Documentations

Here are the documentation of the workshop "Using E-SPM Application and Its Development" that has been conducted in Maluku Ballroom, Grand Aquila Hotel, Bandung.



Bandung Participants



Personnel of PT Varian Global Perencana on Bandung Workshop



Attachment 1.5. Semarang Documentations

Here are the documentation of the workshop "Using E-SPM Application and Its Development" that has been conducted in Puri Ballroom, Ciputra Semarang Hotel, Semarang.



Semarang Participants



Personnel of PT Varian Global Perencana on Semarang Workshop



Attachment 1.6. Surabaya Documentations

Here are the documentation of the workshop "Using E-SPM Application and Its Development" that has been conducted in Freesia Ballroom, Aston Inn Jemursari, Surabaya.



Surabaya Participants



Personnel of PT Varian Global Perencana on Surabaya Workshop



Attachment 1.6. Bali Documentations

Here are the documentation of the workshop "Using E-SPM Application and Its Development" that has been conducted in Agung Ballroom, Aston Denpasar Hotel and Convention, Bali.

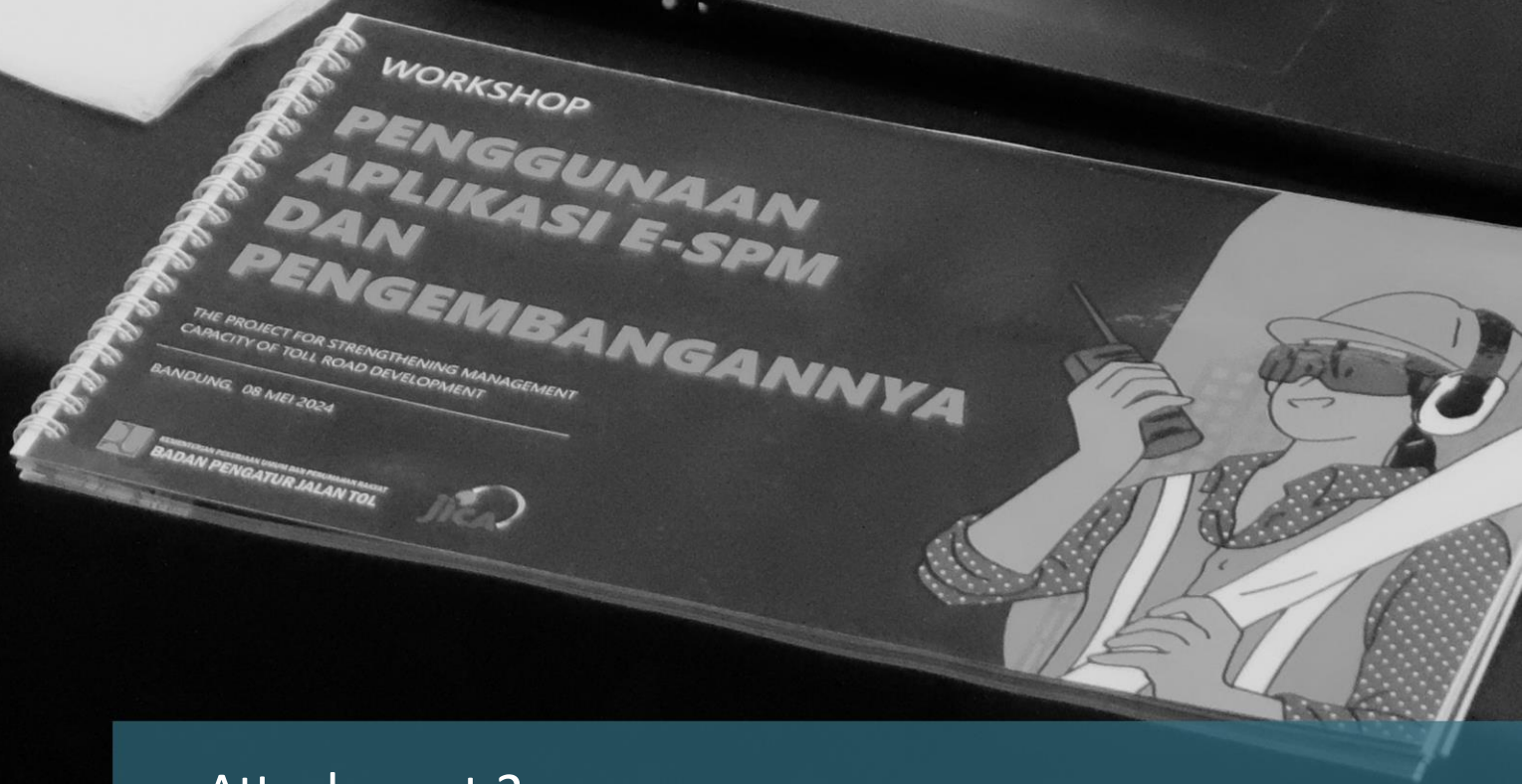


Bali Participants



Personnel of PT Varian Global Perencana on Bali Workshop

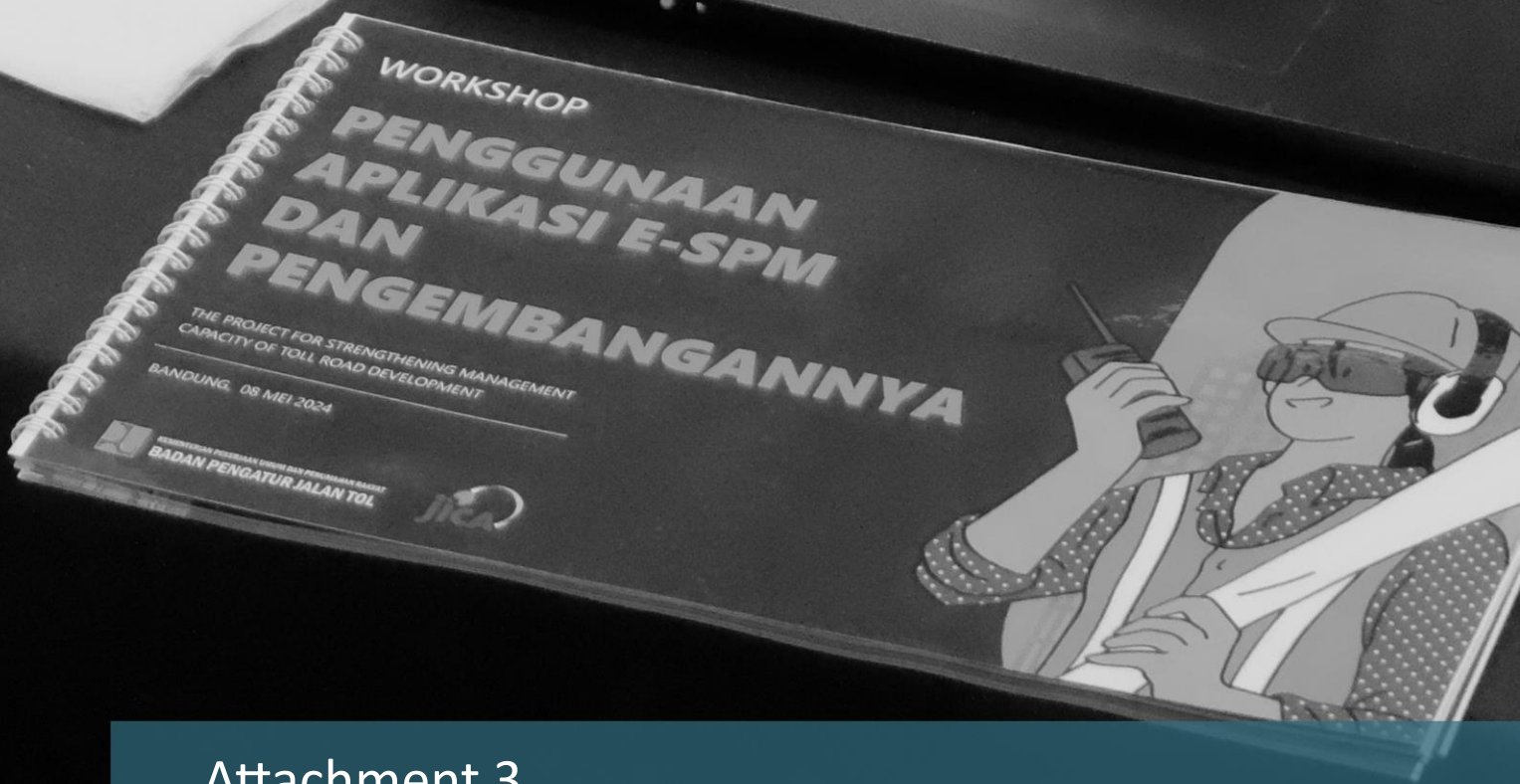




Attachment 2

Attendance Sheet

”



Attachment 3 Materials

”

WORKSHOP

USING THE E-SPM APPLICATION AND ITS DEVELOPMENT

THE PROJECT FOR STRENGTHENING MANAGEMENT CAPACITY OF TOLL ROAD DEVELOPMENT

JAKARTA, APRIL 25 - 26, 2024



 **KEMENTERIAN PEKERJAAN UMUM DAN PERUMAHAN RAKYAT**
BADAN PENGATUR JALAN TOL

 **jica**

ASSET MANAGEMENT OR MANAGING ASSETS

Asset Management and Managing Assets are not alternatives.

Asset Management = Strategies and plans of the organization to derive value from those assets

- The purpose of your organization and what assets does it need – and why
- Value, purpose and long-term outcomes
- Risk and context e.g., markets / climate / regulation or what
- Holistic approach to different funding streams e.g., CAPEX and OPEX?
- Collaborative behaviors - breaking down silos both internal and supply chain?
- How assets contribute to organizational value




Then, what is the Role of PUPR/BPJT/DGH in regard to toll road ?

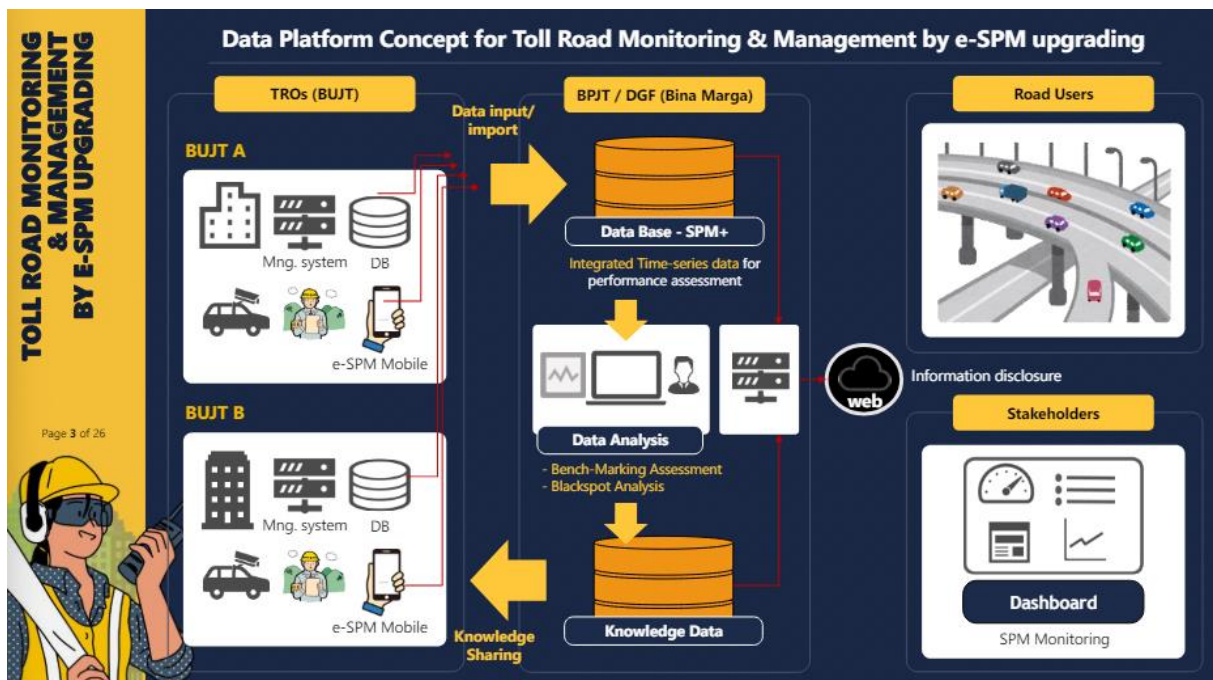
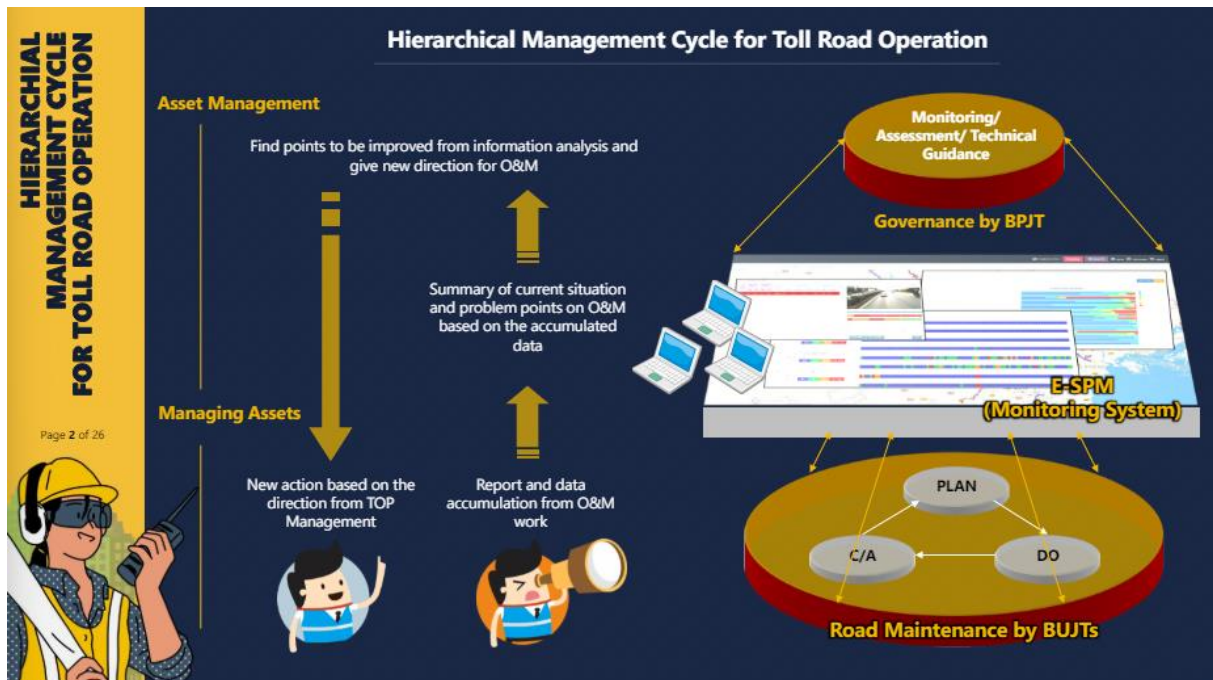
Managing Assets = Activities performed directly on the assets

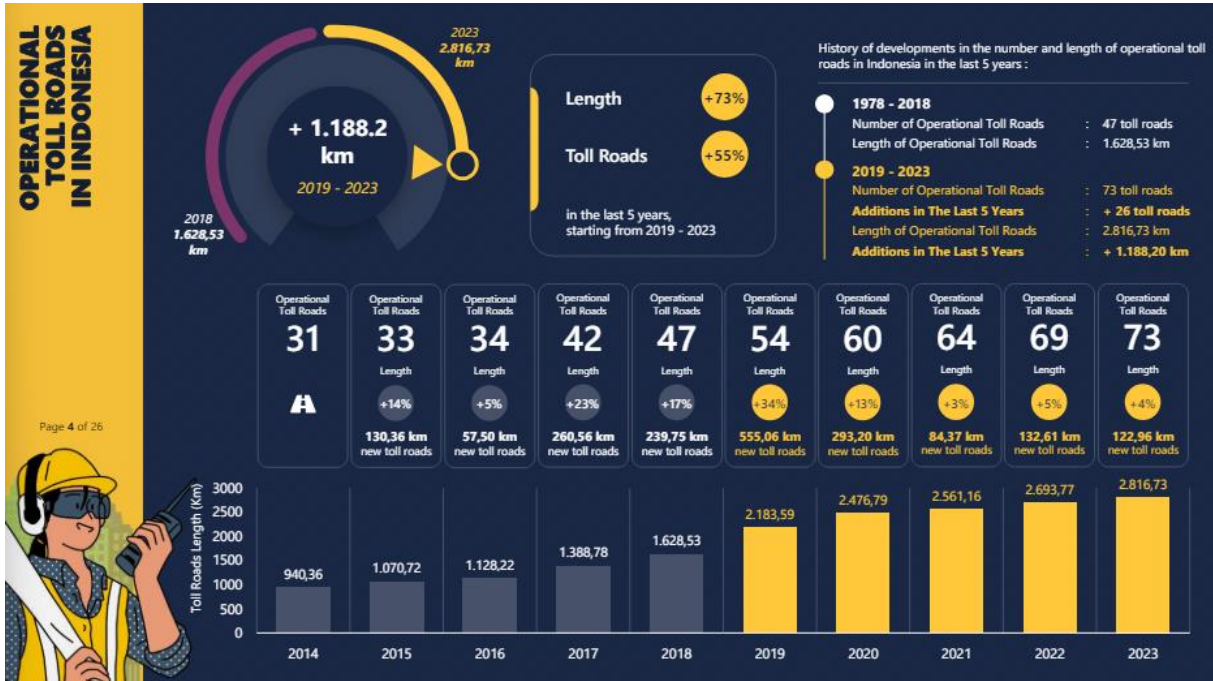
- Lifecycle activities and asset care - availability, reliability, dependability and safety
- Asset location, condition, life extension and/or interventions
- Asset databases, systems (and IT) and performance
- People, skills and work management
- Budgets and key performance indicators (KPIs) / cost of maintenance and current performance

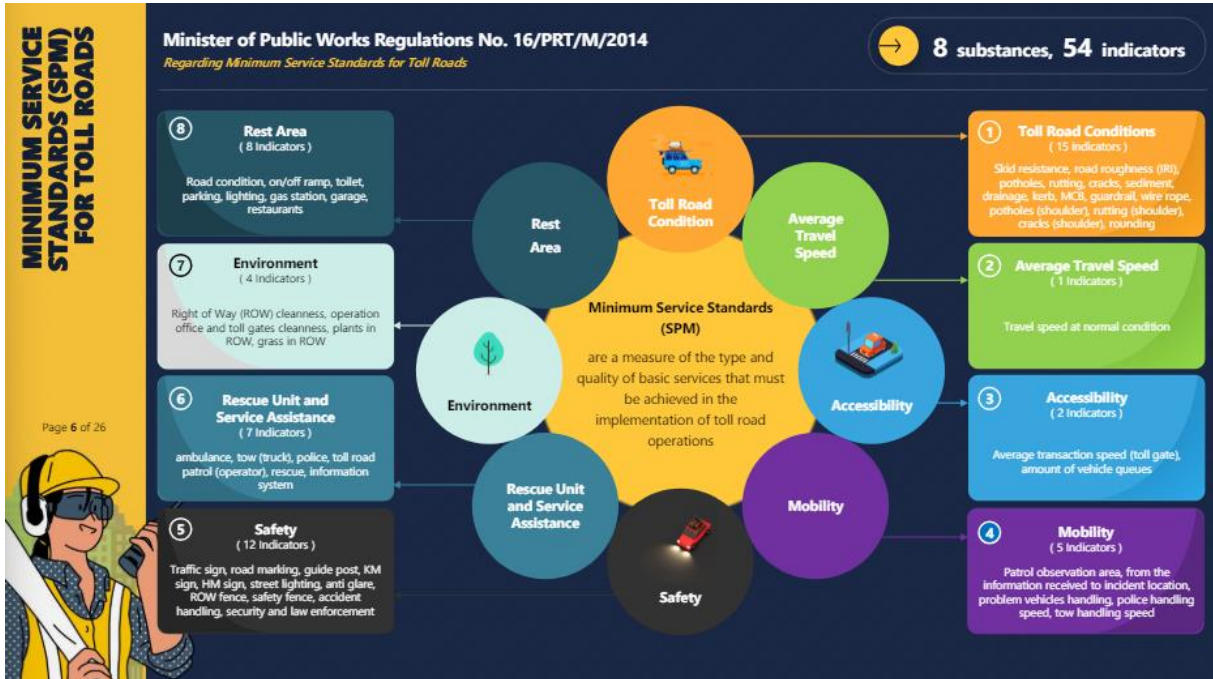
What is Role of BUJT ?

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MINIMUM SERVICE STANDARDS (SPM) FOR TOLL ROADS

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Toll Road Condition		Average Travel Speed		Environment	
1	Skid Resistance (Main Road)	Annually	1	Travel Speed (Normal Condition)	Monthly
2	Road Roughness (Main Road)	Annually			
3	Potholes (Main Road)	Daily			
4	Rutting (Main Road)	Daily			
5	Cracks (Main Road)	Daily			
6	Drainage	Daily			
7	Sediment	Daily			
8	Kerb (Median)	Daily			
9	Median Concrete Barrier	Daily			
10	Guardrail (Median)	Daily			
11	Wire Rope (Median)	Daily			
12	Potholes (Shoulder)	Daily			
13	Rutting (Shoulder)	Daily			
14	Cracks (Shoulder)	Daily			
15	Rounding	Daily			

Safety		Rest Area			
1	Traffic Sign	3 Months	1	Road Condition	Daily
2	Road Marking	3 Months	2	On/Off Ramp	Daily
3	Guide Post / Reflector	3 Months	3	Toilet	Daily
4	Kilometer Sign	3 Months	4	Parking	Monthly
5	Hectometer Sign	3 Months	5	Lighting	Monthly
6	Street Lighting	Daily	6	Gas Station	Monthly
7	Anti Glare	Daily	7	Garage	Monthly
8	ROW Fence	Daily	8	Restaurants	Monthly
9	Safety Fence	Monthly			
10	Accident Victims	Monthly			
11	Accident Vehicles	Monthly			
12	Security and Law Enforcement	Monthly			

Mobility		Rescue Unit, Service Assistance			
1	Patrol Observation Area	Monthly	1	Ambulance	Monthly
2	From Information Received ...	Monthly	2	Tow Truck	Monthly
3	Problem Vehicle Handling	Monthly	3	Police	Monthly
4	Police Handling Speed	Monthly	4	Toll Road Patrol (Operator)	Monthly
5	Tow Handling Speed	Monthly	5	Rescue	Monthly
			6	Traffic Info and Communication	Monthly
			7	Phone Number for Toll Info	Monthly

Accessibility		
1	Average Transaction Speed	Monthly
2	Amount of Vehicle Queues	Monthly

frequency

- daily (20 indicators) 37%
- monthly (25 indicators) 46%
- quarterly annually (7 indicators) 13%
- annually (2 indicators) 4%

MINIMUM SERVICE STANDARDS (SPM) FULFILLMENT

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Conventional SPM Fulfillment

SPM Fulfillment Monitoring

- Issues were recorded manually using a survey form
- Recording of issues includes: issues indicators, location of issues (stationary, direction, lane), documentation / photo number, notes / description

Minutes / Reports of Monitoring Results

- Minutes / Monitoring Result Reports are created manually after site monitoring are completed

Repair by TRO

- The Minutes/reports are used as a reference by TRO in order to repair activities, repair duration is calculated after the Minutes are published
- Repair reports are prepared manually by TRO, and sent to ITRA when repairs have been completed
- Opportunities for manipulation of duration, location, quantity, and/match between issues and repair

Evaluation and Minutes of Repair / SPM Report

- After the repair report by TRO was received by ITRA
- Repairs by TRO can only be rejected at this stage, if site review is not carried out
- Analysis is carried out as requirement by manually and separately

SPM Fulfillment Using e-SPM

SPM Fulfillment Monitoring

- Issues were recorded using the e-SPM application (Android based)
- Recording of issues includes everything in conventional methods and is equipped with automatic location coordinates and accuracy features
- On site mode and driving mode are available

Minutes / Reports of Monitoring Results

- Minutes / Fulfillment Reports can be generated automatically using the e-SPM application

Repair by TRO

- Every Issue is recorded in real time by e-SPM application, the repair duration is calculated automatically based on the time the issues data was collected
- Repairs can be reported using e-SPM and can be accessed by TRO and ITRA at any time without having to wait for repairs to be completed
- Minimize manipulation of duration, location, quantity, and/match between issues and repair

Evaluation and Minutes of Repair / SPM Report

- Can be generated at any time according to requirement
- Repairs by TRO can be immediately rejected by ITRA. Review and comment features are available
- Several analysis features are available

IMPLEMENTATION OF E-SPM APPLICATION

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Website

Web-based application developed to manage SPM fulfillment activities comprehensively. Intended for data processing, analysis and reporting.
User: ITRA/BM, TRO and TRO's Holding

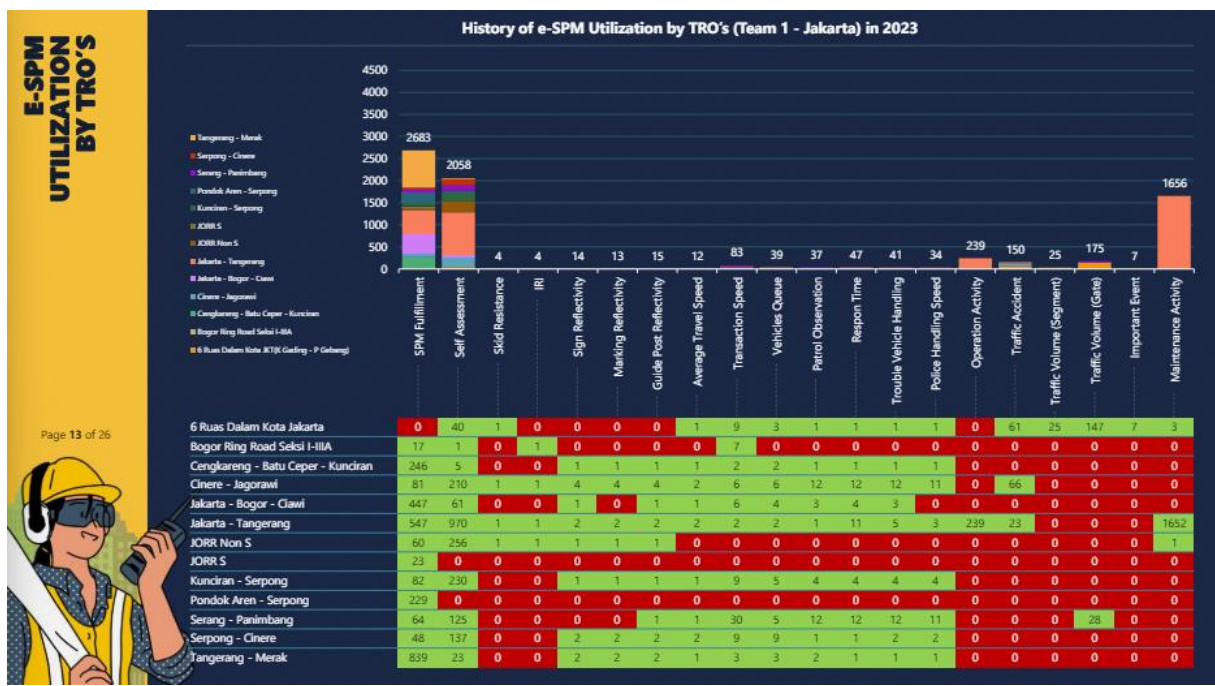
Mobile App

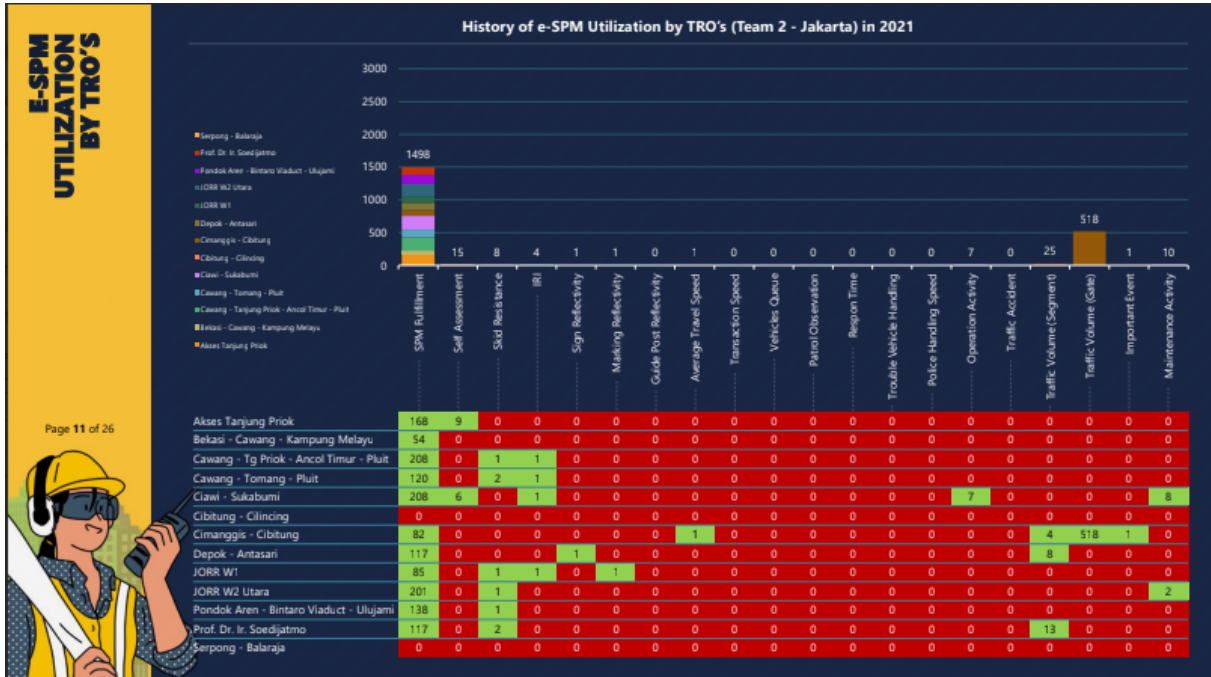
Mobile-based application (currently Android) developed to collect data on the site.
User: Consultant or ITRA/BM Team, TRO Operation/Maintenance Team

Server

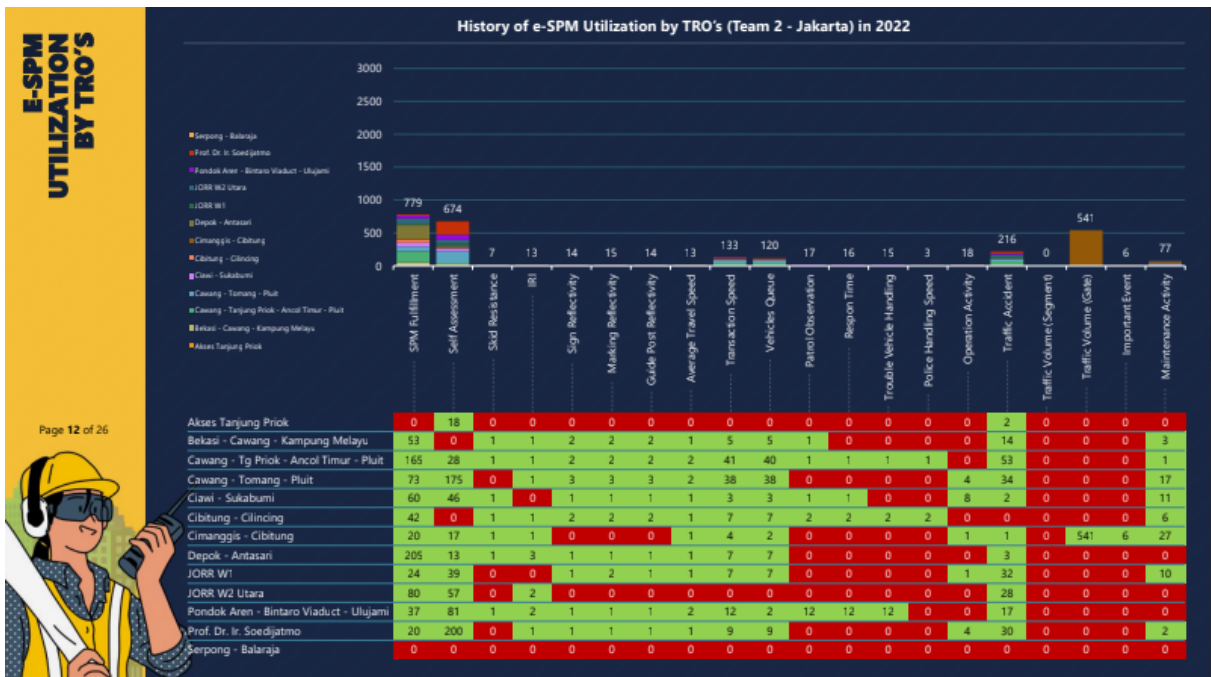
The e-SPM server is managed by PUSDATIN PUPR.
User: ITRA





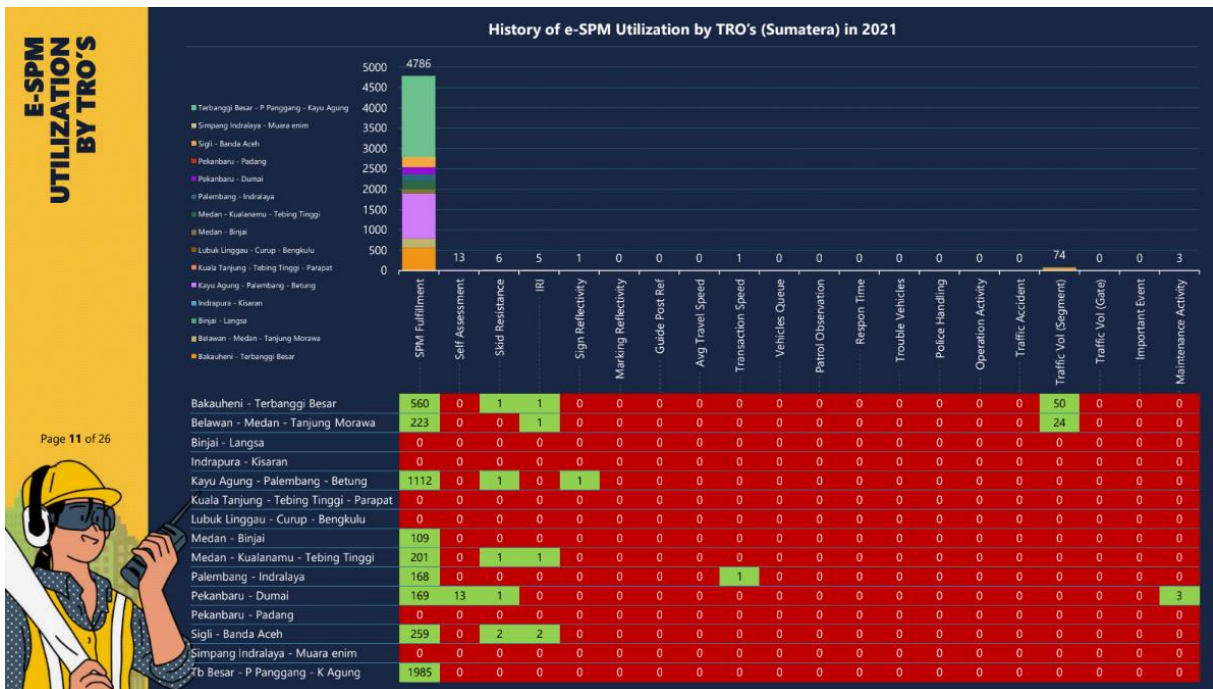
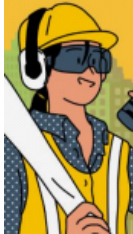
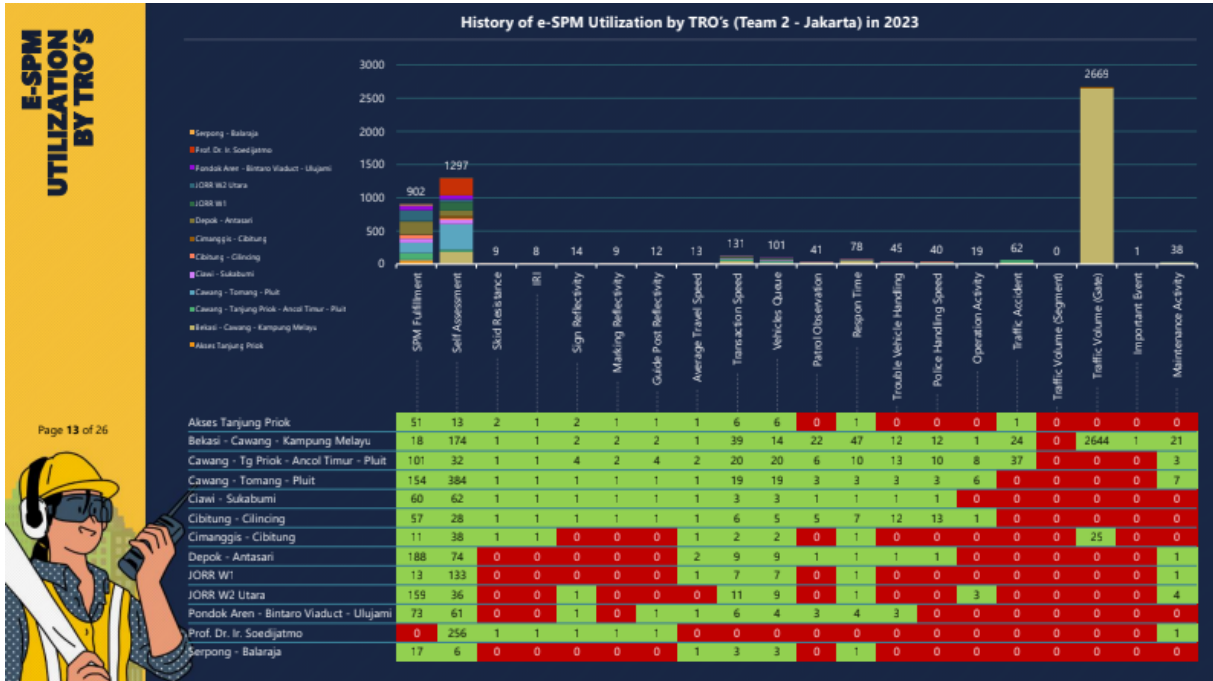


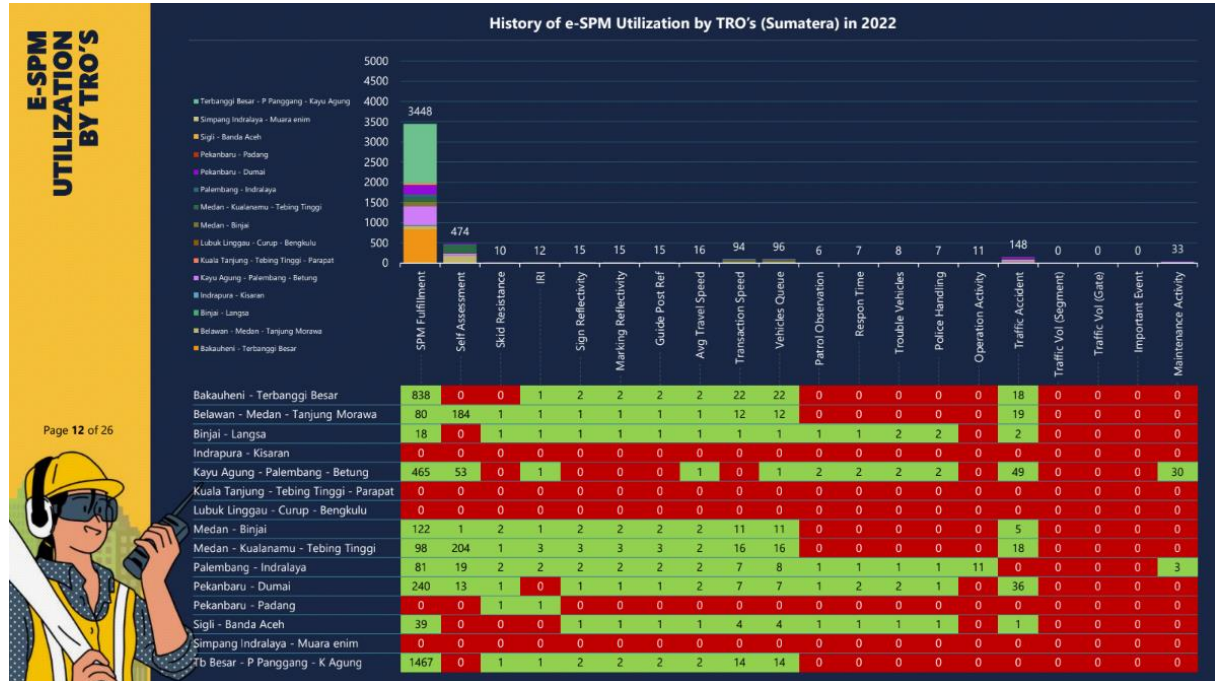
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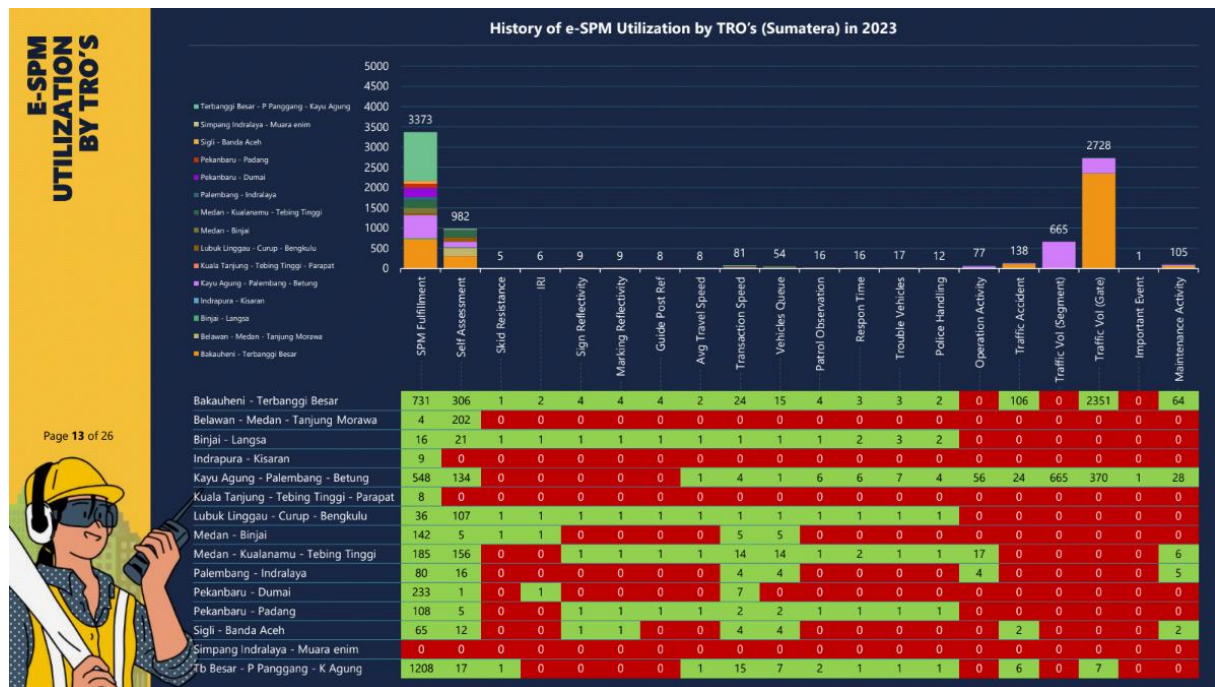
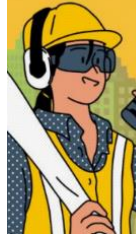
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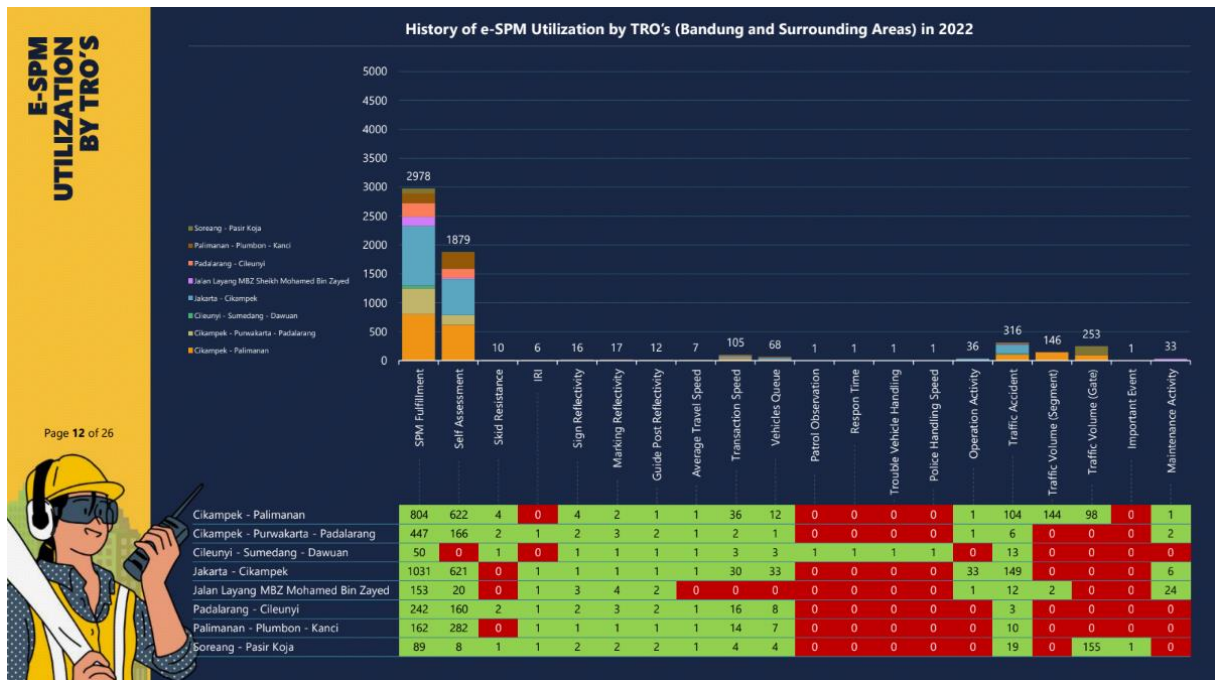
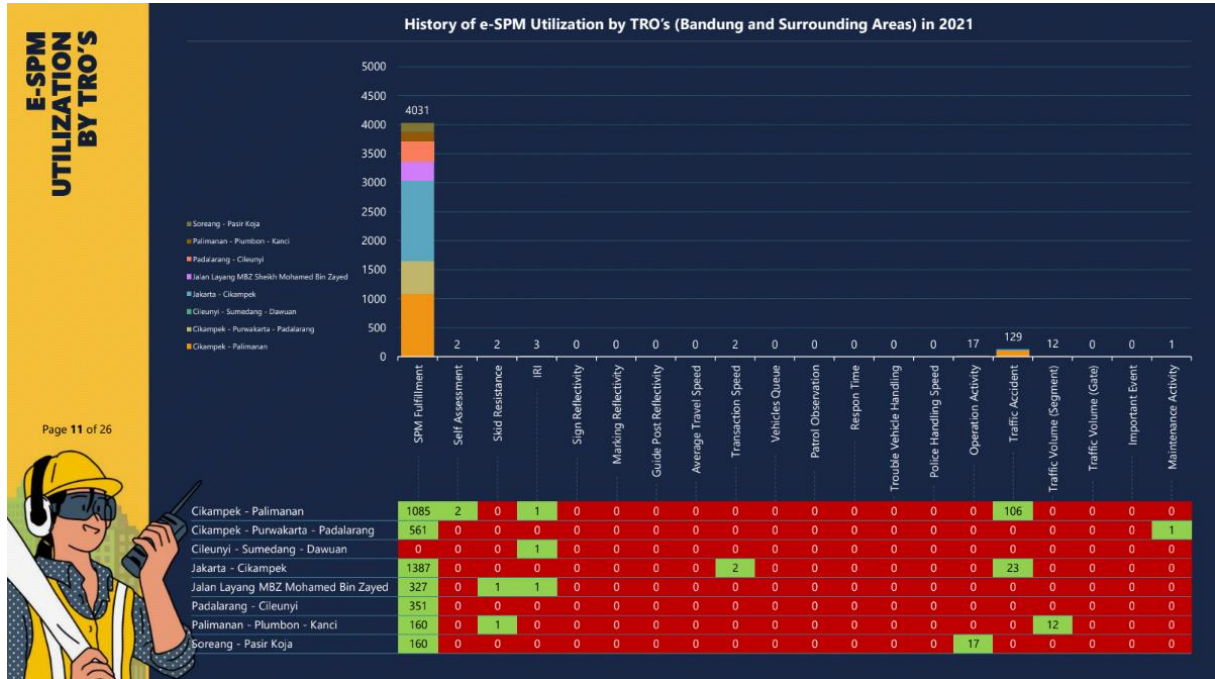


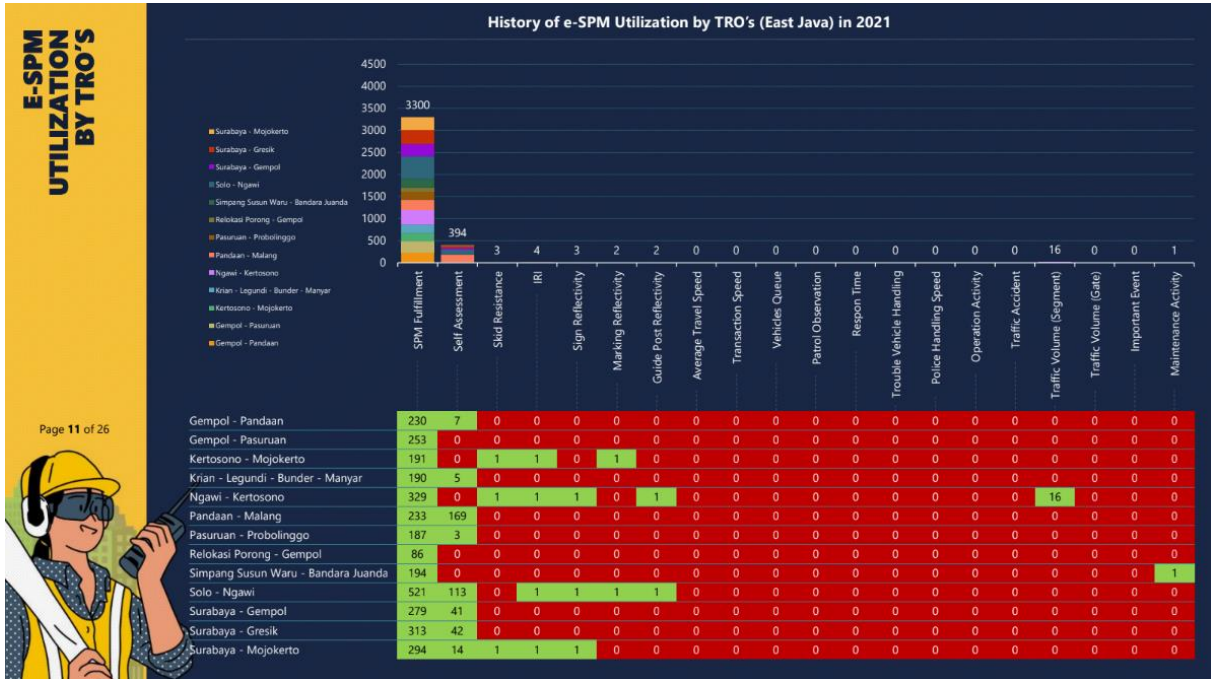
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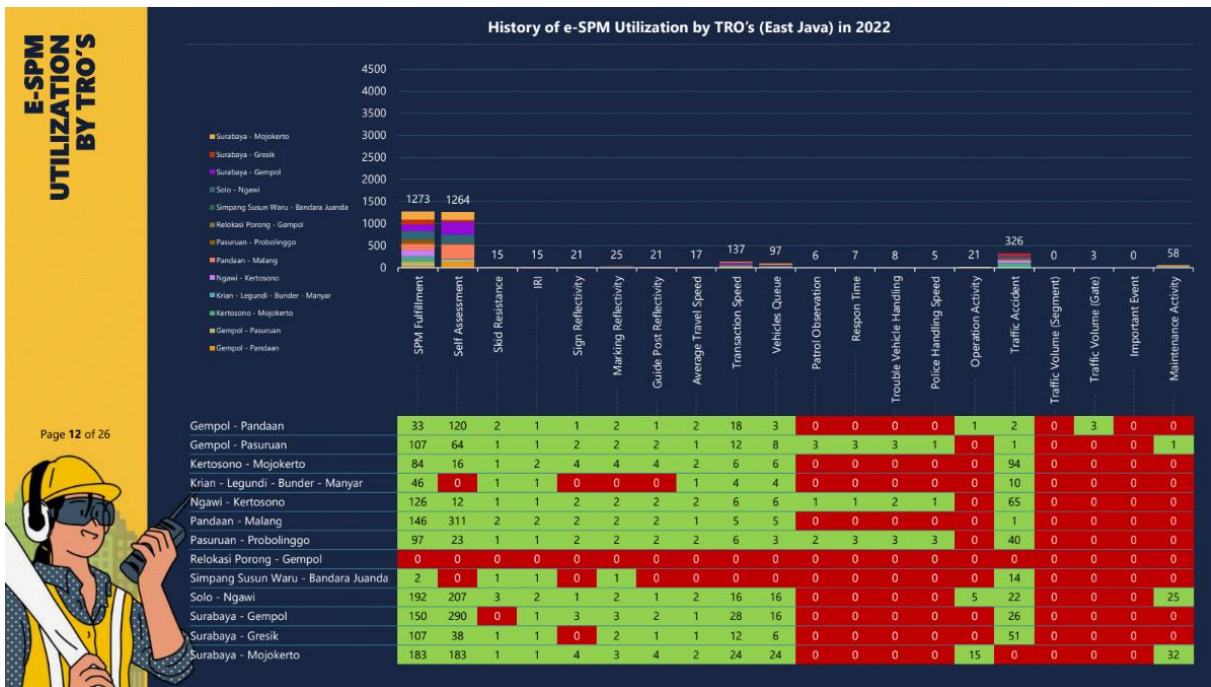
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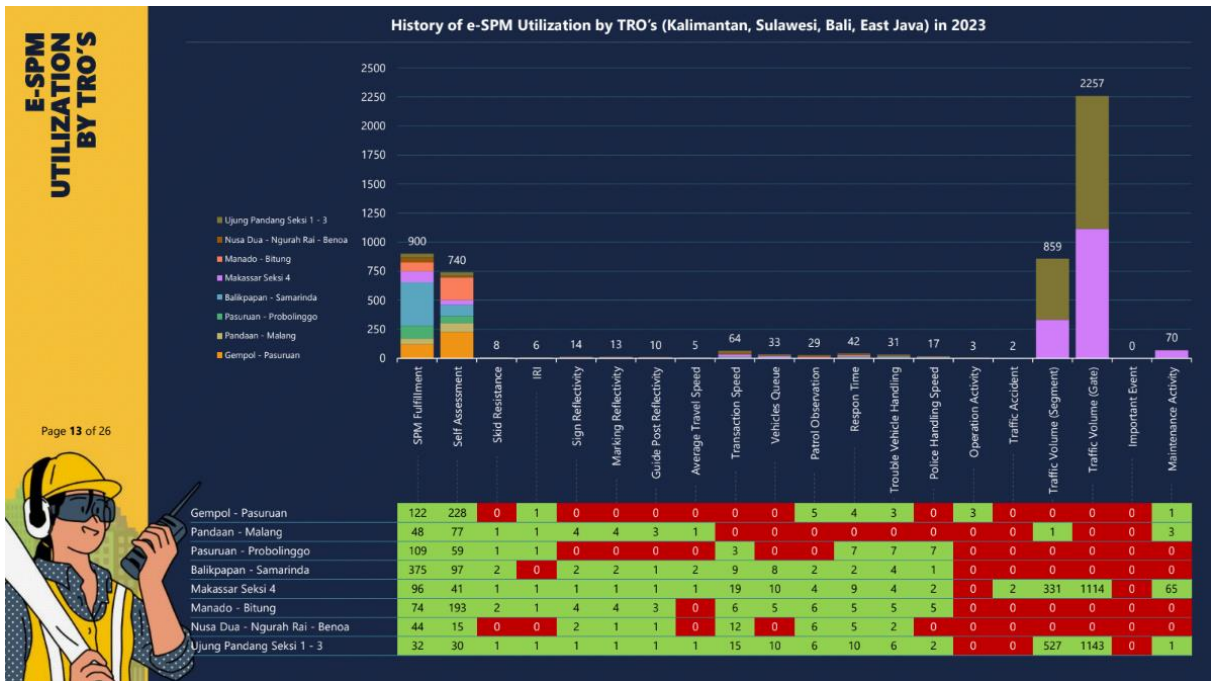
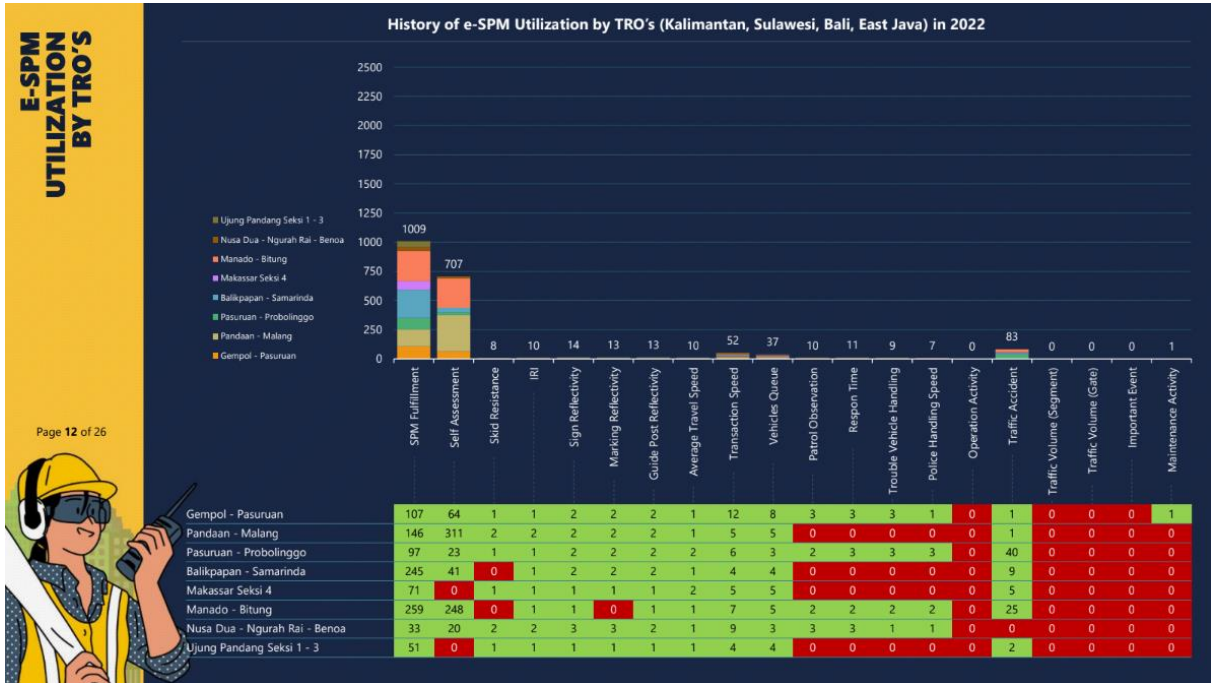


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E-SPM DEVELOPMENT PLAN




E-SPM (Stand Alone)

e-SPM is currently applied and stands alone, not integrated with any system or application



Asset Management System (AMS)

e-SPM will be part of the toll road Asset Management System, integrated with each other and cannot stand alone



Item	E-SPM Existing	E-SPM (Part of AMS)
Orientation	<p>SPM Fulfillment (Ministry Regulation)</p> <p>Developed and implemented in accordance with procedures for fulfilling SPM based on ministry regulations</p>	<p>Toll Road Asset</p> <p>Developed to be oriented towards "Asset Inventory" on the toll roads</p>
Object (Example)	<p>Indicator, Location (KM, Location, Coordinate)</p> <p>Issues in fulfilling SPM are identified based on attributes: issue indicators and location details.</p> <p>Example: Issue on Road Sign/Street Lighting</p> <p>Indicator : Road Sign/Street Lighting KM : 05+200 [input] Lane : Non-Lane [input] Direction : A Direction [input] Latitude (Deg) : -6.12345678 [automatic] * Longitude (Deg) : 120.12345678 [automatic] *</p> <p><small>* according to the data collection location</small></p>	<p>Indicator, Asset ID</p> <p>Issues in fulfilling SPM are identified based on asset data that has been inventoried and stored in the database</p> <p>Example: Issue on Road Sign/ Street Lighting</p> <p>Indicator : Road Sign/Street Lighting Asset ID : TS-262626 [select/search]</p> <p>Asset Information (Automatically according to inventory data)</p> <p>↓</p> <p>KM : 05+200 [automatic] Lane : Non-Lane [automatic] Direction : A Direction [automatic] Latitude (Deg) : -6.12345678 [automatic] Longitude (Deg) : 120.12345678 [automatic]</p>
History, Trend (Example)	<p>Depending on Location</p> <p>History of issues, repairs depending on location. For the same object, data collection errors may occur.</p>	<p>Right on Target</p> <p>History of issues and repairs is recorded precisely, minimizing errors because it is specifically based on inventory data</p>

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IMPROVEMENT OF E-SPM FEATURES

Previous Version of e-SPM

- Master Data**
 - Toll Roads
 - Toll Road Operators (TRO) and Holding
 - Toll Road Groups
 - Toll Road Segments
 - Toll Gates
 - Substance and Indicators of Minimum Service Standard
- Data Inputting**
 - Services Vehicles
 - Traffic Volume (Segment and Gate)
 - Traffic Accident
 - Maintenance Activity
 - Operation Activity
- Analysis**
 - Minimum Service Standard (SPM) Summary
 - Self Assessment by TRO's Summary
 - SPM Competition
 - Traffic Accident Summary
- Reporting**
 - Minutes of SPM Fulfillment and Repair

Expanded by JICA Project

- Asset Master
- Asset Category
- Asset Distress
- Document Category (Regulation, Technical Guidelines, etc)
- Asset Inventory - Rescue Station and Services Vehicles
- Asset Inventory - Rest Area
- Asset Inventory - Bridges
- Maintenance Plan
- Document
- Performance Evaluation of SPM Fulfillment by ITRA and TRO's
- Blacklisting Evaluation
- Blackspot Location (Traffic Accident Analysis)
- Deterioration Trend Analysis
- Detailed Investigation
- Report of SPM Fulfillment



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IMPROVEMENT OF E-SPM INFRASTRUCTURE

e-SPM Infrastructure Development

Category	Component	e-SPM 2019	e-SPM 2021	e-SPM 2023/2024
Network	Server	Cloud Server (Google)	Server PUSDATIN PUPR	Server PUSDATIN PUPR
Network	Domain	www.espmweb.varianglobal.tech	www.espmbjit-pu.go.id	www.espm-bjpt-pu.go.id
Network	IP Server	auth-db364.hostinger.com	103.211.50.23	103.8.238.226
Network	API Server	Google Cloud API & Playstore	Google Cloud API & Playstore	Google Cloud API & Playstore
Hardware	Processor	VCPU 2 Core	Intel(R) Xeon(R) CPU E7-8870 v2	Intel(R) Xeon(R) Gold 6330H
Hardware	RAM	4 GB	8 GB	8 GB
Hardware	Storage	200 GB	500 GB	1.500 GB
Software	Operation System	Ubuntu Server 18.04 LTS	Ubuntu Server 18.04 LTS	Ubuntu Server 21.04 LTS
Software	Web Server	Apache 2 versi 2.4.29	Apache 2 versi 2.4.29	Apache 2 versi 2.4.46
Software	PHP	PHP 7.2	PHP 7.2	PHP 7.4
Software	DBMS	MySQL 5.7	MySQL 5.7	MySQL 8
Web Application	Framework	Laravel	Laravel	Laravel
Web Application	CMS	October CMS	October CMS	October CMS
Mobile Application	Framework	Native Android	Flutter 2.5	Flutter 3.7.9
Mobile Application	Backend Service	-	Firebase	Firebase
UI / UX Design	Tools	Corel Draw GraphicSuite 2020	Figma	Figma


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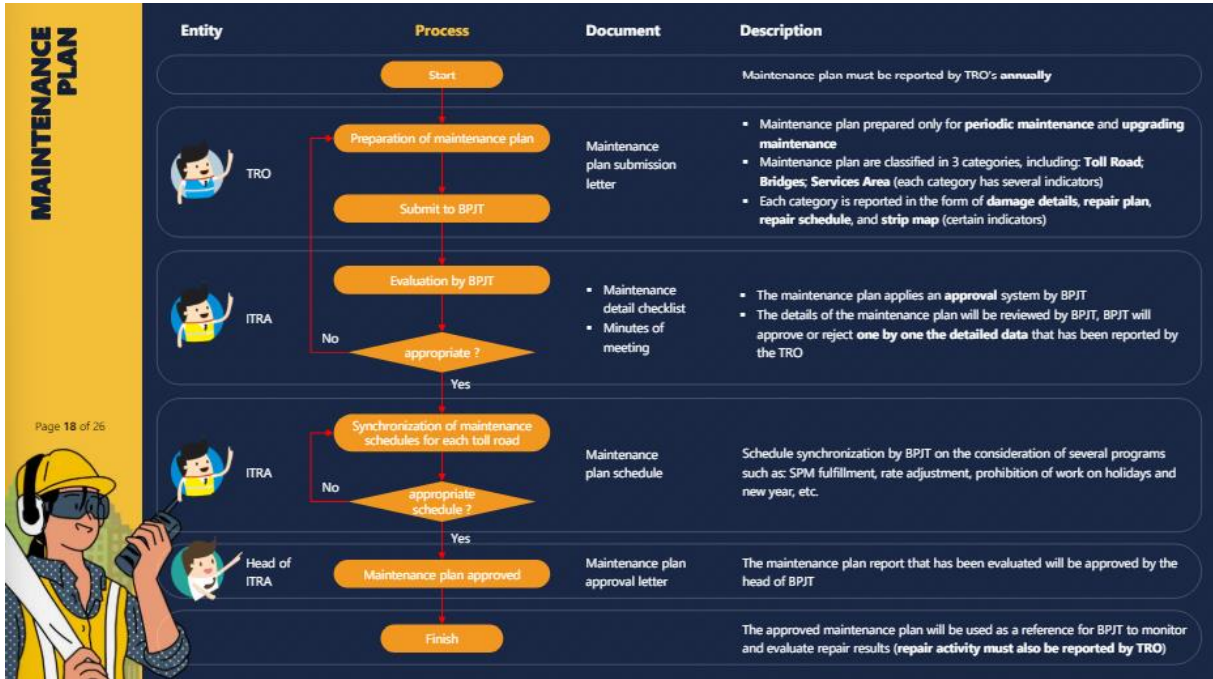


INVENTORY DATA INPUTTING FEATURES

No	Inventory Data/ Data Inputting	Module Link	Data Attributes
1	Highway Segments	https://espm.bjpt-pu.go.id/v1-highwaysegment	<ul style="list-style-type: none"> ▪ ID ▪ Highway ID ▪ Segment Code ▪ Segment Name ▪ Name of Start Ramp ▪ Name of End Ramp ▪ Direction ▪ Chainage of Start ▪ Latitude ▪ Longitude
2	Toll Gates	https://espm.bjpt-pu.go.id/v1-tollgate	<ul style="list-style-type: none"> ▪ ID ▪ Highway ID ▪ Gate Code ▪ Gate Name ▪ Gate Type ▪ Transaction Type ▪ Entrance Booth ▪ Exit Booth ▪ Direction ▪ Chainage (Km) ▪ Latitude (Deg) ▪ Longitude (Deg) ▪ Description
3	Rescue Stations	https://espm.bjpt-pu.go.id/inventory-servicevehicle-dashboard	<ul style="list-style-type: none"> ▪ ID ▪ Highway ID ▪ Station Name ▪ Direction ▪ Chainage (Km) ▪ Latitude (Deg) ▪ Longitude (Deg) ▪ Description
4	Services Vehicle	https://espm.bjpt-pu.go.id/inventory-servicevehicle-dashboard	<ul style="list-style-type: none"> ▪ ID ▪ Highway ID ▪ Rescue Station ID ▪ Vehicle Code ▪ Vehicle Type ▪ Police Number ▪ Vehicle Number ▪ Description
5	Bridges	https://espm.bjpt-pu.go.id/inventory-bridge-dashboard	<ul style="list-style-type: none"> ▪ ID ▪ Highway ID ▪ Bridge Name ▪ Chainage (Km) ▪ Latitude (Deg) ▪ Longitude (Deg) ▪ Bridge Type ▪ Bridge Position ▪ Road Width ▪ Bridge Length (m) ▪ Number of Span ▪ Type and Structure Configuration ▪ Construction Year ▪ Operation Year ▪ Description
6	Services Area	https://espm.bjpt-pu.go.id/inventory-restarea-dashboard	<ul style="list-style-type: none"> ▪ ID ▪ Highway ID ▪ Rest Area Name ▪ Chainage (Km) ▪ Latitude (Deg) ▪ Longitude (Deg) ▪ Direction ▪ Rest Area Type ▪ Pavement Type

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MAINTENANCE PLAN

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Maintenance Plan List

Toll Road	Period	Total Cost	Submitted Status	Approval Status
Akses Tanjung Priok	2024	IDR. 100.000.000.000,-	Submitted	Approved
Bakauheni - Terbanggi Besar	2024	IDR. 375.000.000.000,-	Submitted	Partial Approved
Balikpapan - Samarinda	2024	IDR. 150.000.000.000,-	Submitted	Waiting Approval
Bekasi - Cawang - Kampung Melayu	2024	IDR. 0,-	Not Submitted	-

Maintenance Plan Details

Toll Road	Period	Road Pavement	Drainage	Rounding	Road Sign	Guardrail	Landscape	Others
Akses Tanjung Priok	2024	3	2	2	2	2	5	3
Bakauheni - Terbanggi Besar	2024	3 1 1	2		4 2	2 4	2	1 2
Balikpapan - Samarinda	2024	8	4	2	2	7		2
Bekasi - Cawang - Kampung Melayu	2024							

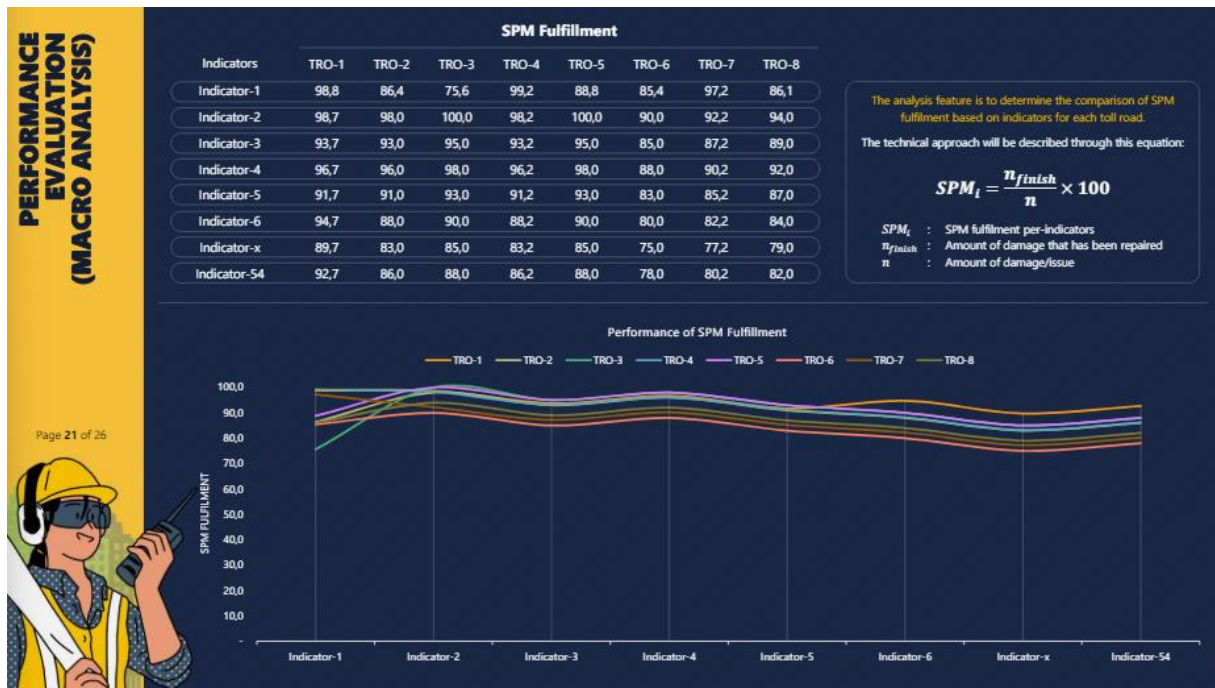
● Has been reviewed and approved by ITRA
 ● Not yet reviewed by ITRA
 ● Rejected by ITRA

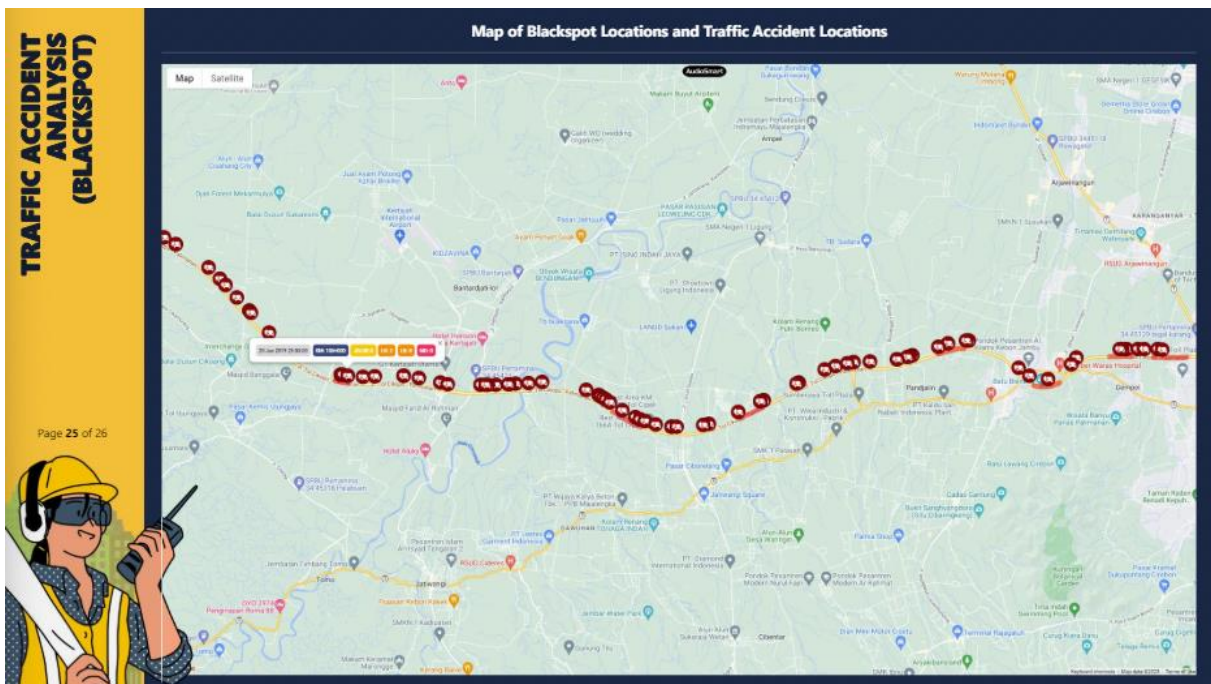
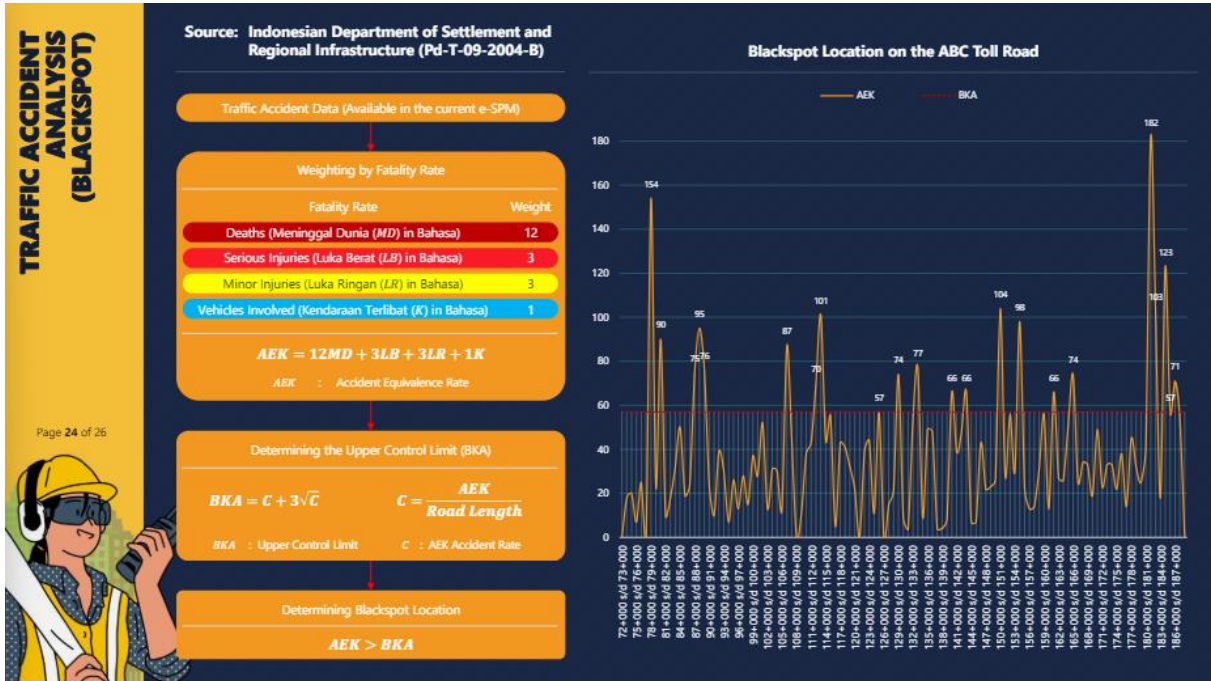
Convert to Schedule / Calendar

Jan Feb Mar Apr **May** Jun Jul Aug Sep Oct Nov Dec

All Toll Road 2024

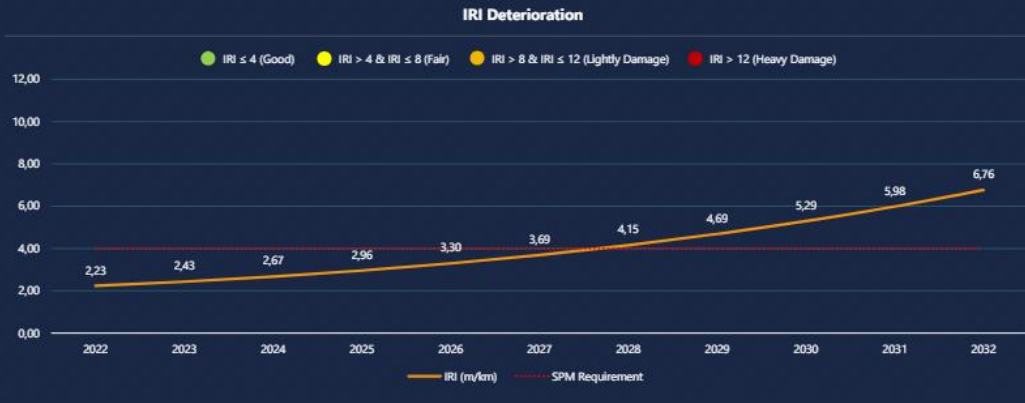
Toll Road	Category	Asset Name	Distress Type	Location (Km)	Direction	Lajur	Jadwal
Akses Tanjung Priok	Toll Road	Pavement	Rutting	10.000 - 11.200	A	Lane 1	May 2024, 22 View Details
Akses Tanjung Priok	Toll Road	Pavement	Rutting	08.400 - 09.800	B	Lane 1	May 2024, 10 View Details
Akses Tanjung Priok	Toll Road	Guardrail	Beam Damage	11.200 - 11.250	A	Non Lane	May 2024, 11 View Details
Bakauheni - Terbanggi Besar	Toll Road	Pavement	Divided Slab	03.100 - 03.110	A	Lane 1	May 2024, 20 View Details
Bakauheni - Terbanggi Besar	Toll Road	Rounding	Drop Off	24.100 - 24.150	B	Non Lane	May 2024, 25 View Details





**IRI
DETERIORATION
(MICRO ANALYSIS)**

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Stationary Start	Stationary Finish	Section	Pavement Type	CBR rep. (%)	SNsg	SNC	IRI (m/km)										
							2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
7,400	7,500	Pondok Aren - Pamulang	Rigid	6,00	0,78	8,02	2,33	2,53	2,78	3,08	3,42	3,83	4,30	4,84	5,46	6,16	6,95
7,500	7,600	Pondok Aren - Pamulang	Rigid	6,00	0,78	8,02	1,51	1,66	1,85	2,09	2,37	2,71	3,11	3,57	4,11	4,72	5,42
7,600	7,700	Pondok Aren - Pamulang	Rigid	6,00	0,78	8,02	1,24	1,37	1,55	1,76	2,03	2,34	2,72	3,15	3,66	4,25	4,92
7,700	7,800	Pondok Aren - Pamulang	Rigid	6,00	0,78	8,02	1,95	2,13	2,35	2,62	2,94	3,31	3,75	4,25	4,83	5,49	6,24
7,800	7,900	Pondok Aren - Pamulang	Rigid	6,00	0,78	8,02	1,61	1,77	1,97	2,21	2,50	2,85	3,25	3,73	4,27	4,90	5,61
7,900	8,000	Pondok Aren - Pamulang	Rigid	6,00	0,78	8,02	7,22	7,74	8,32	8,97	9,70	10,50	11,40	12,40	13,50	14,72	16,06
8,000	8,100	Pondok Aren - Pamulang	Rigid	6,00	0,78	8,02	8,16	8,74	9,38	10,10	10,90	11,79	12,77	13,85	15,05	16,36	17,81



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2024

E-SPM WORKSHOP

Using the E-SPM Application
and Its Development

Upgrading of E-SPM

Republic of Indonesia
Project for Strengthening Management Capacity of Toll Road Development
