



# **RESPOND-OR**

## **Decision Support System (DSS)**

### **User Manual**

Prof. Heru Suhartanto  
Dr. Toto Haryanto  
Muhamad Fathurahman  
Aby Salim

Universitas Indonesia

## Contents

---

List of tables.....	3
List of figures .....	4
Executive Summary .....	6
1 Sign-in and User Navigation.....	8
1.1 Menu Item: Disaster .....	9
1.2 Menu Item: Master Data .....	9
1.2.1 Insert Depots, Shelters and Zones .....	10
1.3 Menu Item: Network Generation.....	12
1.4 Menu Item: Evacuation Plan .....	12
1.5 Menu Item: Personnel Routing & Scheduling .....	12
1.6 Menu Items: Settings and Logout.....	12
2 Network Generation (Risk Calculation) .....	13
2.1 Create Network Data .....	13
2.2 Video Tutorial .....	20
3 Assisted Evacuation Planning .....	21
3.1 Input Preparation and Running AEP Module .....	22
3.2 Video Tutorial .....	31
4. Personnel Routing and Scheduling: .....	32
4.1 Input Preparation and Running PRS Module.....	32
4.2 Video Tutorial .....	42
Concluding Remarks .....	43
References .....	44

## List of tables

---

Table 1-1. Input Categories of the Master Data .....	9
Table 2-1 List of Inputs for Network Risk Calculation .....	14
Table 3-1. Input Categories of PRS Module.....	32

## List of figures

Figure 0-1 General steps of the Decision Support System .....	6
Figure 0-2 Login	6
Figure 0-3 General steps of the Decision Support System .....	6
Figure 1-1 Login .....	8
Figure 1-2 Menu Item: Disaster .....	9
Figure 1-3. Master Data: Depots .....	10
Figure 1-4 Master Data: Insert Depot.....	10
Figure 1-5 Master Data: Insert Shelters .....	11
Figure 1-6 Master Data Insert Zones .....	11
Figure 1-7. Network generation main page. ....	12
Figure 2-1 List of current network data.....	13
Figure 2-2 Upload file input data for network generation .....	13
Figure 2-3 Sample of Inarisk file of city of Lombok .....	14
Figure 2-4 Sample of Risk Layer of City of Lombok .....	15
Figure 2-5. Network Generation – Input Location .....	15
Figure 2-6 Network generation: selecting depots .....	16
Figure 2-7 Network generation: selection shelters .....	16
Figure 2-8. Network generation: selecting village or zones .....	17
Figure 2-9. Network generation: Pixel To Coordinate Pairs and input files directory in json format .....	17
Figure 2-10 Network generation: Status of input file.....	18
Figure 2-11 Network generation: running process .....	18
Figure 2-12. Network generation: execution complete .....	19
Figure 2-13. Network generation: Visualization of network data .....	19
Figure 3-1. Assisted Evacuation Planning Flow .....	21
Figure 3-2. Create new disaster instance .....	22
Figure 3-3 Evacuation Planning main page. ....	23
Figure 3-4. Configuration of AEP module .....	23
Figure 3-5. Vehicle type.....	24
Figure 3-6. Add new type of vehicle. ....	24
Figure 3-7. List of vehicles for each depots. ....	25
Figure 3-8. Adding new vehicle at specific depot.....	25
Figure 3-9. Input Preparation before running AEP module.....	26
Figure 3-10. List of AEP solutions .....	26
Figure 3-11. AEP value-path .....	27
Figure 3-12. List of AEP solution sorted by Max Evacuation Time. ....	28
Figure 3-13 More detail AEP solution.....	28
Figure 3-14. AEP- Evacuation dispatch .....	29
Figure 3-15. AEP- Evac Open Shelter .....	29
Figure 3-16. AEP- Evacuation Path .....	30
Figure 3-17. AEP- Evacuation routes .....	30
Figure 4-1. Current List of PRS solutions. ....	32
Figure 4-2. Create new PRS solutions.....	33
Figure 4-3. Input data preparation for PRS module .....	33
Figure 4-4. Services Input data .....	34

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

Figure 4-5. Adding PRS setting.....	34
Figure 4-6. Setting for the service .....	35
Figure 4-7 List of selected depots.....	35
Figure 4-8. List of selected Demand Points .....	35
Figure 4-9. List of selected Resting Point .....	36
Figure 4-10. Generate alpha network values for PRS.....	36
Figure 4-11 List of demand of services.....	37
Figure 4-12. Sample input of personnel / teams.....	37
Figure 4-13. Executing PRS module .....	38
Figure 4-14. PRS Solutions .....	38
Figure 4-15. PRS value-path.....	39
Figure 4-16. PRS detail percentages of value-path .....	39
Figure 4-17. Summary of the PRS solutions .....	40
Figure 4-18. Detail of a PRS solution across the planning horizon.....	40
Figure 4-19. Personnel schedule on a given day .....	41
Figure 4-20. Personnel routing map on a given day.....	41

## Executive Summary

The RESPOND-OR Decision Support System (DSS) aims to assist the disaster response agencies in Indonesia - the National Board for Disaster Management (BNPB), Regional Disaster Management (BPBD) and non-government organizations (NGOs) - in making two disaster response decisions: i) assisted evacuation, and ii) personnel routing and scheduling. Accordingly, the DSS has two main modules: i) Assisted Evacuation Planning (AEP), and ii) Personnel Routing and Scheduling (PRS). AEP and PRS modules will utilize the network data generated by the system to solutions/recommendations for a defined disaster location. The AEP and PRS modules of the RESPOND-OR were developed by the RESPOND-OR Lancaster University research team (Prof. Konstantinos G. Zografos, Prof. Juliana Sutanto, Dr. Ahmed Kheiri, Dr. Aleksandr Pirogov, Dr. Istenc Tarhan). The description of the mathematical models and algorithms of the AEP module are provided in (Pirogov, et al., 2022); while the description of the PRS model and algorithm can be found in (Tarhan, et al., 2022a, and Tarhan et al., 2022b).

The figure below illustrates the general steps of using the DSS.

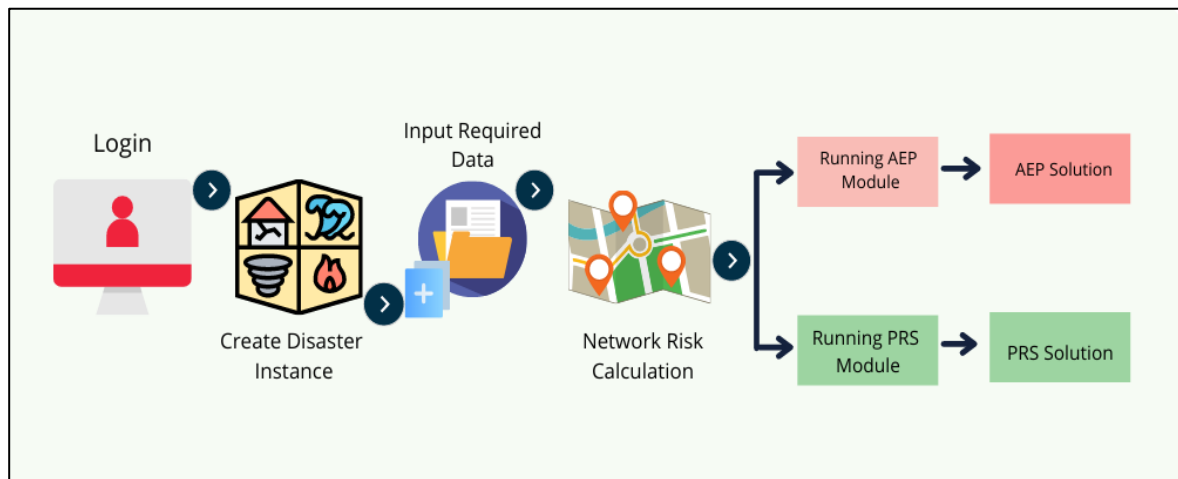


Figure 0-1 General steps of the Decision Support System

To access the DSS, the user needs to sign-in with an authorized account. After signing in, the user must firstly create a disaster instance that corresponds to the area that has been affected by the disaster under consideration. The User can then insert all the necessary input data such as the location of the centroid of the zones comprising the affected areas, the location of the shelters, the location of the depots of the vehicles that will be used for the evacuation, the location of the origin of the personnel that will be dispatched to provide emergency response services, the location of the candidate resting points of the disaster response personnel, the capacities and speeds of the evacuation vehicles, and the available capacity of the candidate shelter facilities for people and livestock (when applicable). Next, the data describing the underlying network of the disaster affected area that contains the risk values, the travel times of the underlying roadway network, and the points of interests (POIs), e.g., zones, shelters, depots, need to be generated. The network generation procedure developed by the RESPOND-OR Universitas Indonesia research team (Gultom et al. 2021) will generate a graph that connects all POIs, along with the risk and travel time associated with its links. The risk value is computed based on BNPB inaRISK data (<https://inarisk.bnpb.go.id:6443/arcgis/rest/services/inaRISK/>). The output file of the network risk

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

calculation will be used as an input to both the AEP and PRS modules. After the network risk calculation is completed, the user can begin running the AEP or PRS module. The AEP module will provide alternative solutions for assisted evacuation, whereas the PRS module will provide alternative solutions for personnel routing and scheduling in a disaster instance.

This manual will assist user in using the DSS, including accessing the DSS, storing data, preparing for network risk calculation, running the AEP and PRS modules, and interpreting the outputs of the AEP and PRS modules for a small disaster instance of earthquake disaster in Lombok City at Nusa Tenggara Barat province, Indonesia. The input data for this disaster instance was collected by the RESPOND-OR Universitas Indonesia research team.

### Disclaimer

The RESPOND-OR DSS provides recommendations for assisted evacuation planning and personnel routing and scheduling. The users are responsible for the validation of the data input and the decisions made. The RESPOND-OR team is not liable for i) the data validation process, ii) any decisions made resulting from the use of the DSS, and iii) the misuse of the DSS.

## 1 Sign-in and User Navigation

The DSS can be accessed via a web browser<sup>1</sup> on these addresses: <https://dss-respondor.cs.ui.ac.id> (primary server) or <http://101.50.3.107/respondorv2/> (secondary server, only for testing purposes)<sup>2</sup>. You should first log in with a valid username and password<sup>3</sup>, and a correct captcha code. Figure 1-1 shows the DSS login page as it appears in a web browser.

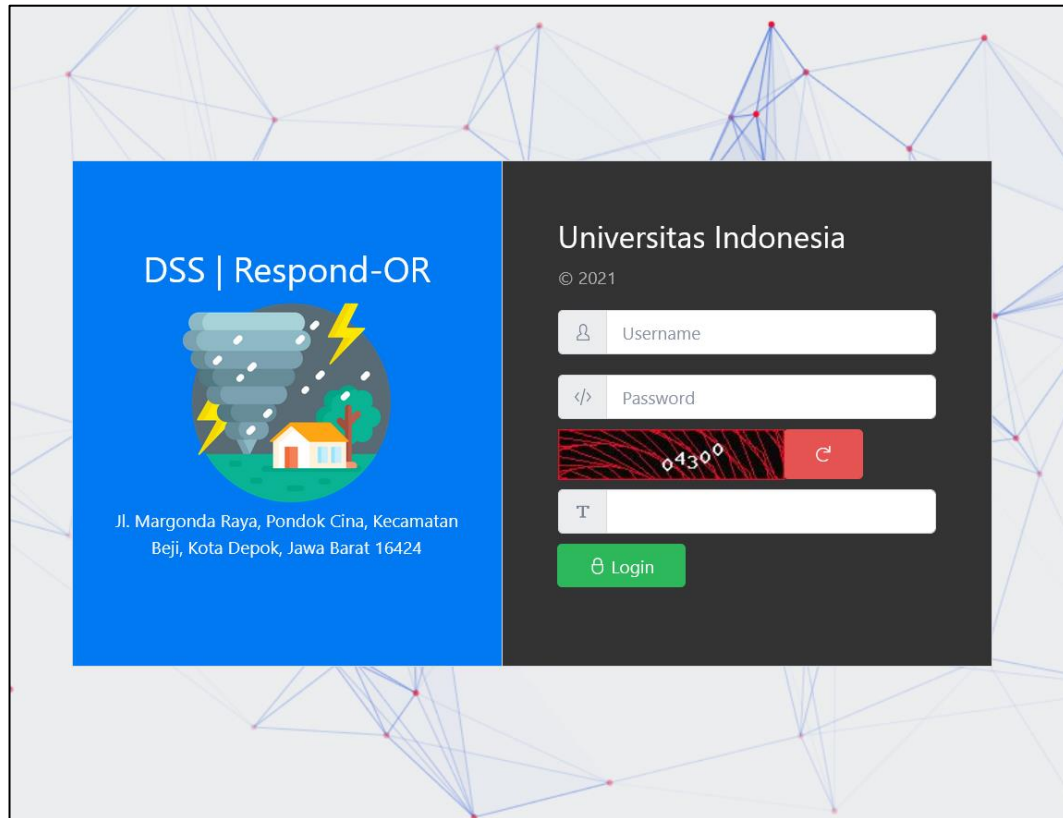


Figure 1-1 Login

After successfully signing-in, the system will redirect the user to the Dashboard page. This page will inform the user about the last disaster impacted areas, the total number of the disaster cases that have been added to the system, the total number of input data that have been added to the system, and the total number of assisted evacuation planning and personnel routing and scheduling instances that have been added to the system. The User can find the menu items on the left-hand side of the DSS, which include: Disaster, Master Data, Network Generation, Evacuation Plan, Routing & Scheduling, Settings, and Logout.

<sup>1</sup> We recommend to use the latest version of chrome or mozilla firefox.

<sup>2</sup> As we are improving the DSS, it is recommended to access the DSS from the secondary server. A new link of the secondary server will be provided for the new version of the DSS.

<sup>3</sup> type "admin" for username and password for testing account.



### 1.1 Menu Item: Disaster

'Disaster' menu provides the list of disaster instances that were created. Each disaster instance consists of disaster's location and date. User can add, remove, or modify a disaster instance. Adding a new disaster instance is the first step before running the AEP and PRS module. Each disaster instance will have its own AEP and PRS solutions.

No.		Name	Date	Location Name	Coordinate		Action
					Latitude	Longitude	
1	<input type="checkbox"/>	TL8LOMBOK	2022-02-16	LOMBOK	-8.5647	116.3398	<a href="#">view</a> <a href="#">update</a>
2	<input type="checkbox"/>	TL6 LOMBOK	2022-02-15	LOMBOK	-8.6218	116.2958	<a href="#">view</a> <a href="#">update</a>
3	<input type="checkbox"/>	TL5LOMBOK	2022-02-15	LOMBOK	-8.6353	116.2135	<a href="#">view</a> <a href="#">update</a>
4	<input type="checkbox"/>	TL2LOMBOK	2022-02-15	LOMBOK	-8.5905	116.3246	<a href="#">view</a> <a href="#">update</a>
5	<input type="checkbox"/>	TL4LOMBOK	2022-02-15	LOMBOK	-8.5810	116.3343	<a href="#">view</a> <a href="#">update</a>

Figure 1-2 Menu Item: Disaster

### 1.2 Menu Item: Master Data

'Master Data' menu enables user to add, remove, or modify the input data for network risk calculation, AEP and PRS modules. The input data categories of the Master Data are listed in Table 1-1. These data can be reused if the same disaster strikes the same location, with the same attributes of the data.

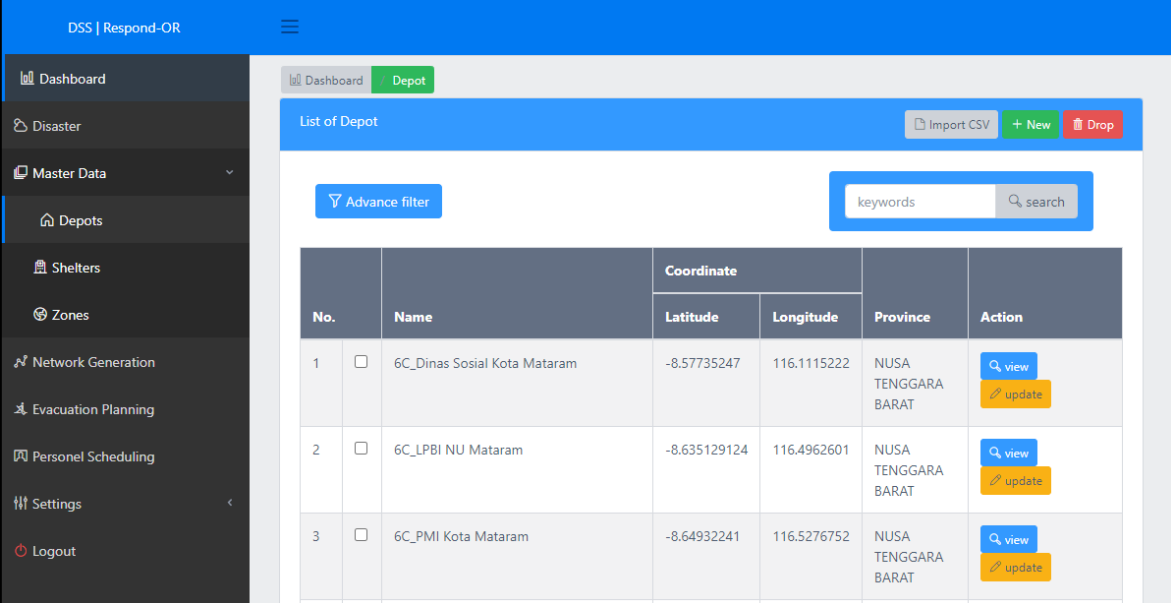
Table 1-1. Input Categories of the Master Data

Input Category	Description
Depots	Locations of the evacuation vehicles
Shelters	Evacuation points. Each shelter contains information related to the capacity of people and livestock
Zone	The disaster-affected area. Each zone data includes the number of people and livestock that need assisted evacuation and the zone's coordinates.

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

### 1.2.1 Insert Depots, Shelters and Zones

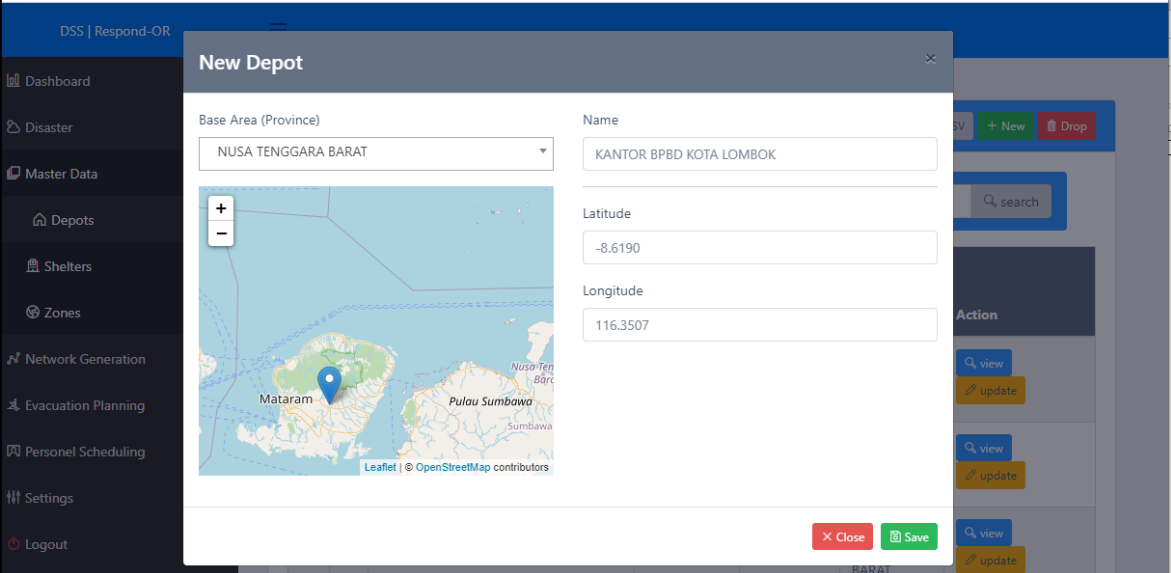
To insert Depots, Shelters and Zones data, user may go to the Master Data menu item and select one of input data categories e.g Depots, Shelters and Zones as shown in Figure 1-3.



No.	Name	Coordinate		Province	Action
		Latitude	Longitude		
1	6C_Dinas Sosial Kota Mataram	-8.57735247	116.1115222	NUSA TENGGA BARAT	<a href="#">view</a> <a href="#">update</a>
2	6C_LPBI NU Mataram	-8.635129124	116.4962601	NUSA TENGGA BARAT	<a href="#">view</a> <a href="#">update</a>
3	6C_PMI Kota Mataram	-8.64932241	116.5276752	NUSA TENGGA BARAT	<a href="#">view</a> <a href="#">update</a>

Figure 1-3. Master Data: Depots

To insert a new depot, click New (green button) at the top-right of the page and fill the corresponding information for the depots including the name of the depot, province and the coordinates which represented by the latitude and longitude. See Figure 1-4



**New Depot**

Base Area (Province): NUSA TENGGA BARAT

Name: KANTOR BPBD KOTA LOMBOK

Latitude: -8.6190

Longitude: 116.3507

Buttons: Close, Save

Figure 1-4 Master Data: Insert Depot

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

To insert a new shelter, at the Shelters page, click New at the top-right of the page and fill the corresponding information for the shelter including base area province, the name of the shelters, capacity of people, capacity of livestock and its coordinates. See Figure 1-5.

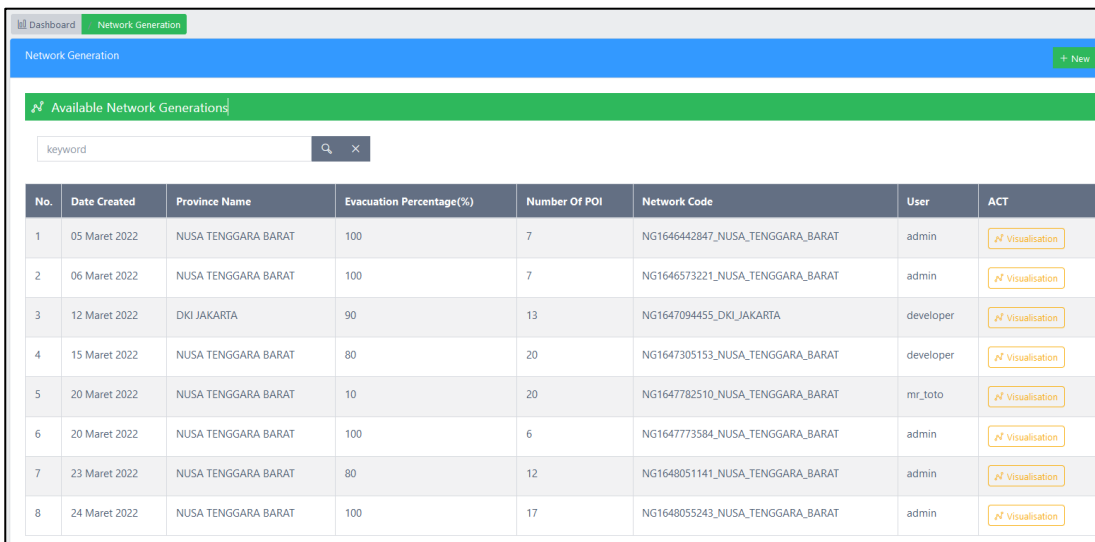
Figure 1-5 Master Data: Insert Shelters

To insert a new zone, at the Zones page, click New at the top-right of the page and fill the corresponding information for the zone including base area province, the name of the zone, number of population of people, capacity of livestock to be evacuated and its coordinates. See Figure 1-6.

Figure 1-6 Master Data Insert Zones

### 1.3 Menu Item: Network Generation

'Network Generation' menu enables the user to create the network data around point of interests (POIs) such as shelter, disaster zone, resting point, and depot. The detailed steps of network generation are presented on section 2 of this user manual document. The output is a network/graph that connects all POIs such that there can be multiple paths between the POIs. Each path between two POIs represents a distinct trade-off between the transportation risks and the travel times among the paths between the relevant POIs. In other words, none of the paths between two given POIs can outperform any of the remaining paths between these POIs in terms of both its travel time and transportation risk. The transportation risk value is computed based on BNPB inaRISK data (<https://inarisk.bnpb.go.id:6443/arcgis/rest/services/inaRISK/>). The output file will be automatically integrated as an input to the AEP and PRS modules.



No.	Date Created	Province Name	Evacuation Percentage(%)	Number Of POI	Network Code	User	ACT
1	05 Maret 2022	NUSA TENGGARA BARAT	100	7	NG1646442847_NUSA_TENGGARA_BARAT	admin	<a href="#">Visualisation</a>
2	06 Maret 2022	NUSA TENGGARA BARAT	100	7	NG1646573221_NUSA_TENGGARA_BARAT	admin	<a href="#">Visualisation</a>
3	12 Maret 2022	DKI JAKARTA	90	13	NG1647094455_DKI_JAKARTA	developer	<a href="#">Visualisation</a>
4	15 Maret 2022	NUSA TENGGARA BARAT	80	20	NG1647305153_NUSA_TENGGARA_BARAT	developer	<a href="#">Visualisation</a>
5	20 Maret 2022	NUSA TENGGARA BARAT	10	20	NG1647782510_NUSA_TENGGARA_BARAT	mr_toto	<a href="#">Visualisation</a>
6	20 Maret 2022	NUSA TENGGARA BARAT	100	6	NG1647773584_NUSA_TENGGARA_BARAT	admin	<a href="#">Visualisation</a>
7	23 Maret 2022	NUSA TENGGARA BARAT	80	12	NG1648051141_NUSA_TENGGARA_BARAT	admin	<a href="#">Visualisation</a>
8	24 Maret 2022	NUSA TENGGARA BARAT	100	17	NG1648055243_NUSA_TENGGARA_BARAT	admin	<a href="#">Visualisation</a>

Figure 1-7. Network generation main page.

### 1.4 Menu Item: Evacuation Plan

'Evacuation Plan' menu allows the user to run the AEP module and see the recommended solutions for assisted evacuation in a selected disaster instance. The details are explained in section 3.

### 1.5 Menu Item: Personnel Routing & Scheduling

'Personnel Routing & Scheduling' menu allows user to run the PRS module and see the recommended solutions for personnel routing and scheduling in a selected disaster instance. The details are explained in section 4.

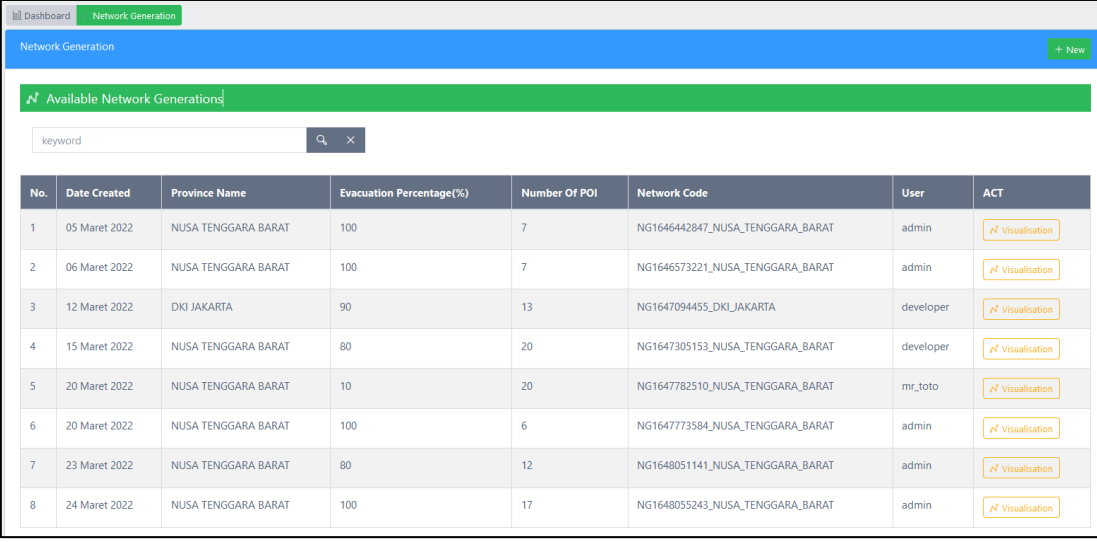
### 1.6 Menu Items: Settings and Logout

'Settings' menu allows user to manage user account and general setting of the DSS including DSS name, description, and user-list. 'Logout' menu terminates a usage session.

## 2 Network Generation (Risk Calculation)

### 2.1 Create Network Data

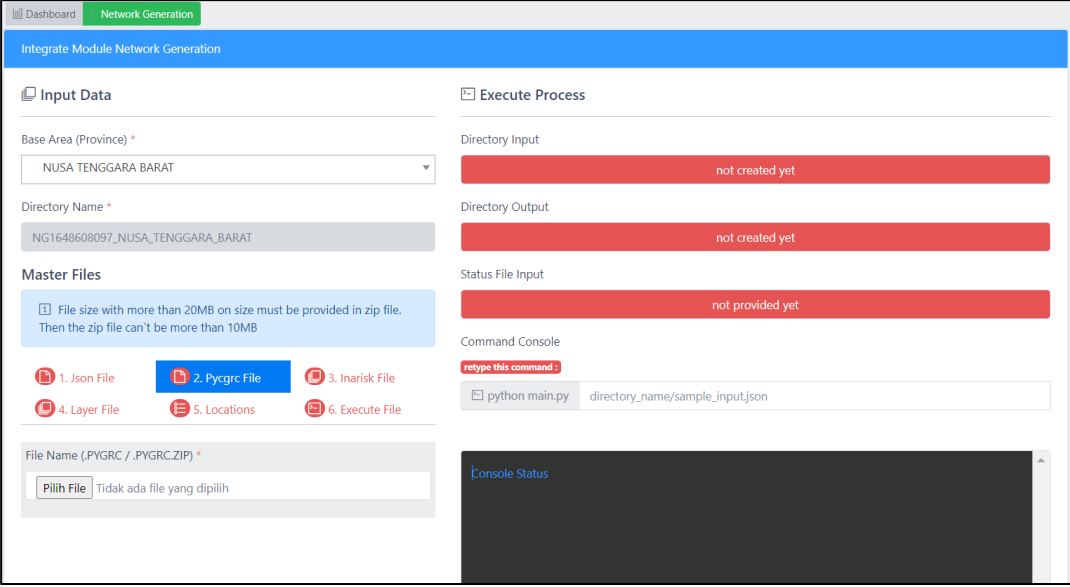
This section will demonstrate how to create a network data that can be used for AEP and PRS module. The user may go straight to the Network Generation menu item in the first step, then the system will display the list of current network data as depicted in the Figure 2-1.



The screenshot shows the 'Network Generation' menu item selected in the top navigation bar. Below it, there is a section titled 'Available Network Generations' with a search bar. The main content is a table listing 8 network generations.

No.	Date Created	Province Name	Evacuation Percentage(%)	Number Of POI	Network Code	User	ACT
1	05 Maret 2022	NUSA TENGGARA BARAT	100	7	NG1646442847_NUSA_TENGGARA_BARAT	admin	<a href="#">Visualisation</a>
2	06 Maret 2022	NUSA TENGGARA BARAT	100	7	NG1646573221_NUSA_TENGGARA_BARAT	admin	<a href="#">Visualisation</a>
3	12 Maret 2022	DKI JAKARTA	90	13	NG1647094455_DKI_JAKARTA	developer	<a href="#">Visualisation</a>
4	15 Maret 2022	NUSA TENGGARA BARAT	80	20	NG1647305153_NUSA_TENGGARA_BARAT	developer	<a href="#">Visualisation</a>
5	20 Maret 2022	NUSA TENGGARA BARAT	10	20	NG1647782510_NUSA_TENGGARA_BARAT	mr_toto	<a href="#">Visualisation</a>
6	20 Maret 2022	NUSA TENGGARA BARAT	100	6	NG1647773584_NUSA_TENGGARA_BARAT	admin	<a href="#">Visualisation</a>
7	23 Maret 2022	NUSA TENGGARA BARAT	80	12	NG1648051141_NUSA_TENGGARA_BARAT	admin	<a href="#">Visualisation</a>
8	24 Maret 2022	NUSA TENGGARA BARAT	100	17	NG1648055243_NUSA_TENGGARA_BARAT	admin	<a href="#">Visualisation</a>

Figure 2-1 List of current network data



The screenshot shows the 'Integrate Module Network Generation' interface. It is divided into two main sections: 'Input Data' and 'Execute Process'.

**Input Data:**

- Base Area (Province):** A dropdown menu with 'NUSA TENGGARA BARAT' selected.
- Directory Name:** A text field containing 'NG1648608097\_NUSA\_TENGGARA\_BARAT'.
- Master Files:** A section with a warning: 'File size with more than 20MB on size must be provided in zip file. Then the zip file can't be more than 10MB'. Below this are six numbered steps: 1. Json File, 2. Pycgrc File, 3. Inarisk File, 4. Layer File, 5. Locations, and 6. Execute File. Step 2 is highlighted with a blue button.
- File Name (.PYGRC / .PYGRC.ZIP):** A text field with a 'Pilih File' button and the text 'Tidak ada file yang dipilih'.

**Execute Process:**

- Directory Input:** A red bar indicating 'not created yet'.
- Directory Output:** A red bar indicating 'not created yet'.
- Status File Input:** A red bar indicating 'not provided yet'.
- Command Console:** A section with a 'retype this command' button and a text area containing 'python main.py directory\_name/sample\_input.json'.
- Console Status:** A dark area for displaying the command output.

Figure 2-2 Upload file input data for network generation

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

To create new network data user should click New button at the top-right of the page, the system will redirect the user to upload the necessary input data for network generation as shown in Figure 2-2.

At the upload page, user may select the Base Area (Province) and upload necessary input data namely Master Files. The Base Area (Province) refers to the Province in which a disaster might occur. In this case, we select Nusa Tenggara Barat as the Base Area (Province). The Master Files include several input data as describe in the Table 2-1.

### Table 2-1 List of Inputs for Network Risk Calculation

Supporting files	Description
(1) Json File and (2) Pygrc File - Open street digital map	A digital map of the disaster area. If a disaster occurs in Lombok area, then a digital map of Lombok area with *.osm or *.pbf format will be used. Before uploading to the DSS, the digital map should be converted to *.pycgrc and *_contracted.json format using the open source software osmconvert64 & OsmToRoadGraph <sup>4</sup> .
(3) Inarisk File and (4) Layer File in image format	Inarisk File is an image of a map of a disaster location in *.png format (see Figure 2-3). Layer File is an image of a risk map of a disaster location (see Figure 2-4). These images can be accessed through InaRisk web services <sup>5</sup>
(5) Locations	User select number of depots, shelters, and villages (zones) from the database to be include as the point of interests. (see Figure 2-5, 2-6, 2-7, 2-8). User may also specify the Evacuation Percentage value. This value represents the percentage how many people in the zone should be evacuated. By specifying the evacuation percentage into 100% the algorithm will accomodate to evacuate all people in selected villages or zones
(6) Execute File	A *.json file that contains the directory addresses of all supporting files and Pixel To Coordinate Pairs (see Figure 2-5).

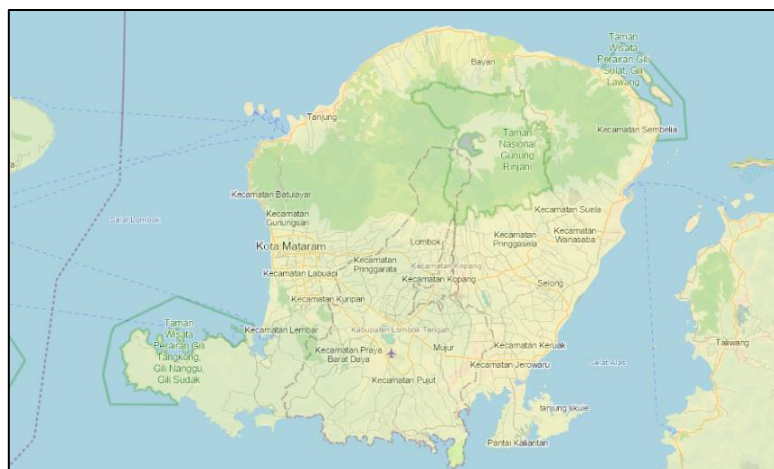


Figure 2-3 Sample of Inarisk file of city of Lombok

<sup>4</sup> [H0https://github.com/AndGem/OsmToRoadGraph](https://github.com/AndGem/OsmToRoadGraph)

<sup>5</sup> <https://inarisk.bnpb.go.id:6443/arctis/rest/services/inaRISK/>

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

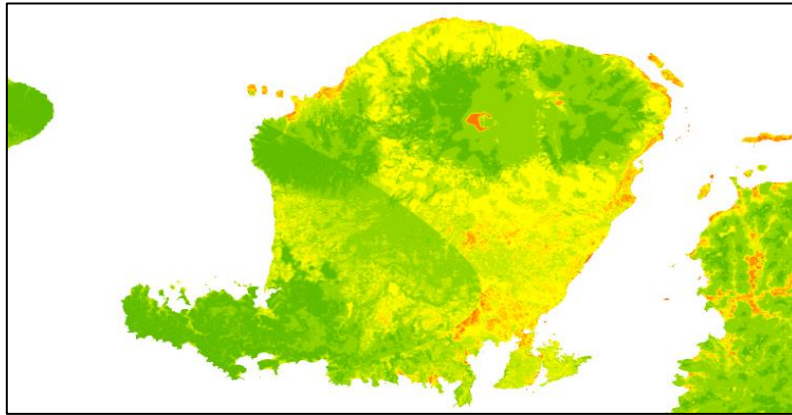


Figure 2-4 Sample of Risk Layer of City of Lombok

Dashboard Network Generation

Integrate Module Network Generation

**Input Data**

Base Area (Province) \*  
NUSA TENGGARA BARAT

Directory Name \*  
NG1648608097\_NUSA\_TENGGARA\_BARAT

**Master Files**

File size with more than 20MB on size must be provided in zip file. Then the zip file can't be more than 10MB

1. Json File 2. Pycgrc File 3. Inarisk File  
4. Layer File 5. Locations 6. Execute File

Master Locations (Point Of Interest) \*  
View Input

**Execute Process**

Directory Input  
not created yet

Directory Output  
not created yet

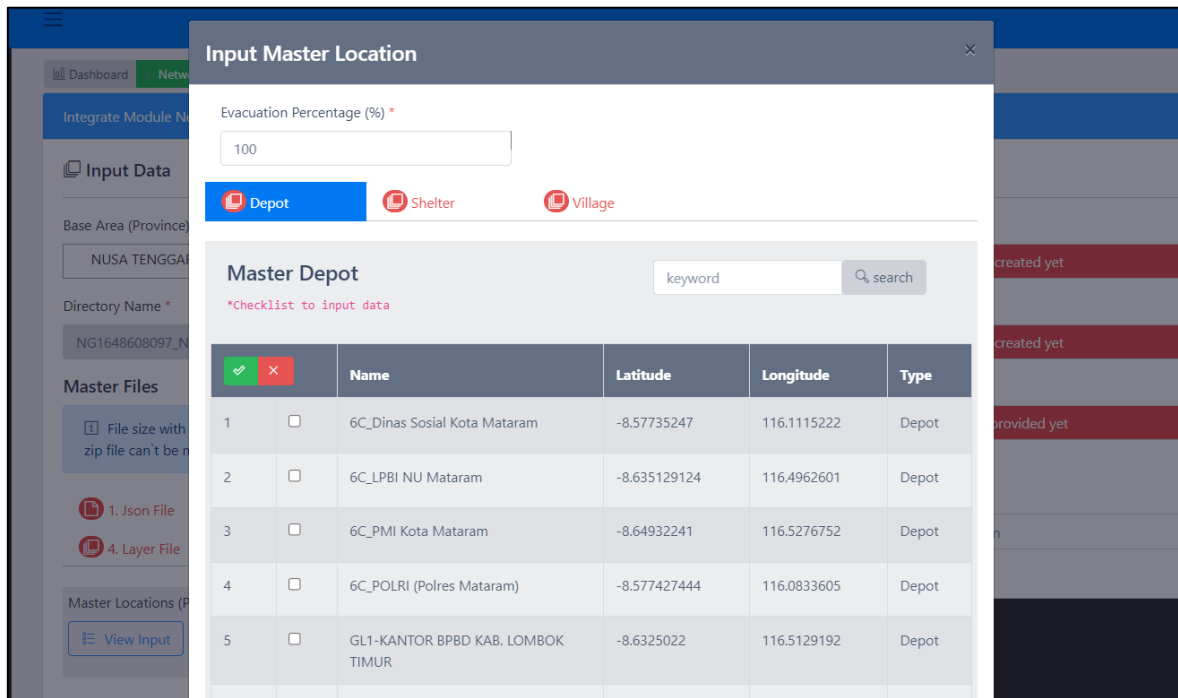
Status File Input  
not provided yet

Command Console  
retype this command :  
python main.py directory\_name/sample\_input.json

Console Status

Figure 2-5. Network Generation – Input Location

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)



**Input Master Location**

Evacuation Percentage (%) \*

100

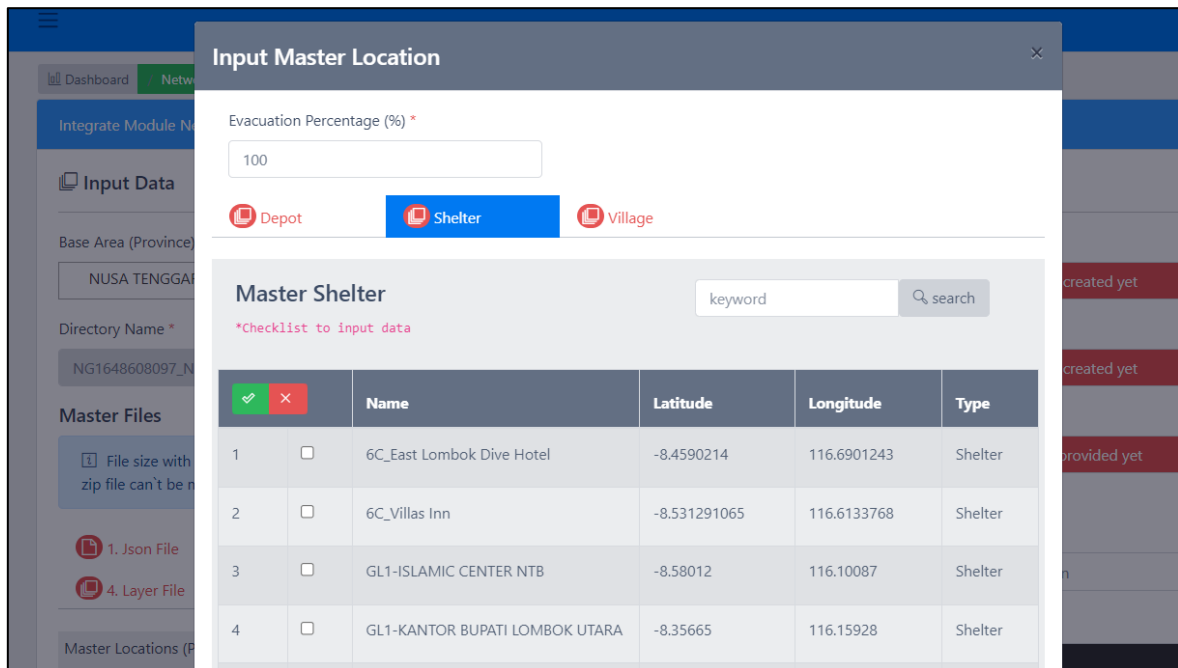
**Depot** **Shelter** **Village**

**Master Depot**

\*Checklist to input data

	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Name	Latitude	Longitude	Type
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6C_Dinas Sosial Kota Mataram	-8.57735247	116.1115222	Depot
2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6C_LPBI NU Mataram	-8.635129124	116.4962601	Depot
3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6C_PMI Kota Mataram	-8.64932241	116.5276752	Depot
4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6C_POLRI (Polres Mataram)	-8.577427444	116.0833605	Depot
5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	GL1-KANTOR BPBD KAB. LOMBOK TIMUR	-8.6325022	116.5129192	Depot

Figure 2-6 Network generation: selecting depots



**Input Master Location**

Evacuation Percentage (%) \*

100

**Depot** **Shelter** **Village**

**Master Shelter**

\*Checklist to input data

	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Name	Latitude	Longitude	Type
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6C_East Lombok Dive Hotel	-8.4590214	116.6901243	Shelter
2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6C_Villas Inn	-8.531291065	116.6133768	Shelter
3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	GL1-ISLAMIC CENTER NTB	-8.58012	116.10087	Shelter
4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	GL1-KANTOR BUPATI LOMBOK UTARA	-8.35665	116.15928	Shelter

Figure 2-7 Network generation: selection shelters



**Input Master Location**

Evacuation Percentage (%) \*

100

Depot Shelter **Village**

**Master Village** keyword search

\*Checklist to input data

		Name	Latitude	Longitude	Type
1	<input type="checkbox"/>	6C_Darakunci	-8.312128891	116.6634475	Village
2	<input type="checkbox"/>	6C_Kantor Camat	-8.350814451	116.5439054	Village
3	<input type="checkbox"/>	6C_Lapangan	-8.358901133	116.5301424	Village
4	<input type="checkbox"/>	6C_Lapangan pegading	-8.574387346	116.6218082	Village
5	<input type="checkbox"/>	6C_Lap Sugian	-8.619134086	116.4802546	Village

Figure 2-8. Network generation: selecting village or zones

```
{
  "name": "NG1648608097_NUSA_TENGGARA_BARAT",|
  "output_dir":
"/var/www/html/respondorv2/network_generation/execute/NG1648608097_NUSA_TENGGARA_BARAT
/output/",
  "network_pycgr_file":
"/var/www/html/respondorv2/network_generation/execute/NG1648608097_NUSA_TENGGARA_BARAT
/lombok.pycgrc",
  "poi_file":
"/var/www/html/respondorv2/network_generation/execute/NG1648608097_NUSA_TENGGARA_BARAT
/master_locations.csv",
  "network_json_file":
"/var/www/html/respondorv2/network_generation/execute/NG1648608097_NUSA_TENGGARA_BARAT
/lombok_contracted.json",

  "risk_layer_file": "/var/www/html/respondorv2/network_generation/execute/NG1648608097_N
USA_TENGGARA_BARAT/lombok_earthquake_risk_layer_inarisk.png",
  "risk_coordinates_samples": [
    [[355, 129], [-8.360141, 116.123455]],
    [[788, 148], [-8.388333, 116.71706]],
    [[465, 424], [-8.761341, 116.274014]]
  ]
}
```

Figure 2-9. Network generation: Pixel To Coordinate Pairs and input files directory in json format

Figure 2-9 shows the content of input.json. basically this file contains the name of the network id, output directory, all input file directories where input file are stored on the server. There are risk coordinates samples at the end of the file to indicate pixel-to-coordinate pairs. To avoid exceptions, make sure you type this file accurately.

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

Once all the necessary inputs are selected and ready to be upload, user may go to 6. Execute tab and select the json file that contain directory address of input files then click upload and wait until Status input file complete (the color of the status change to green) as depicted in Figure 2-10

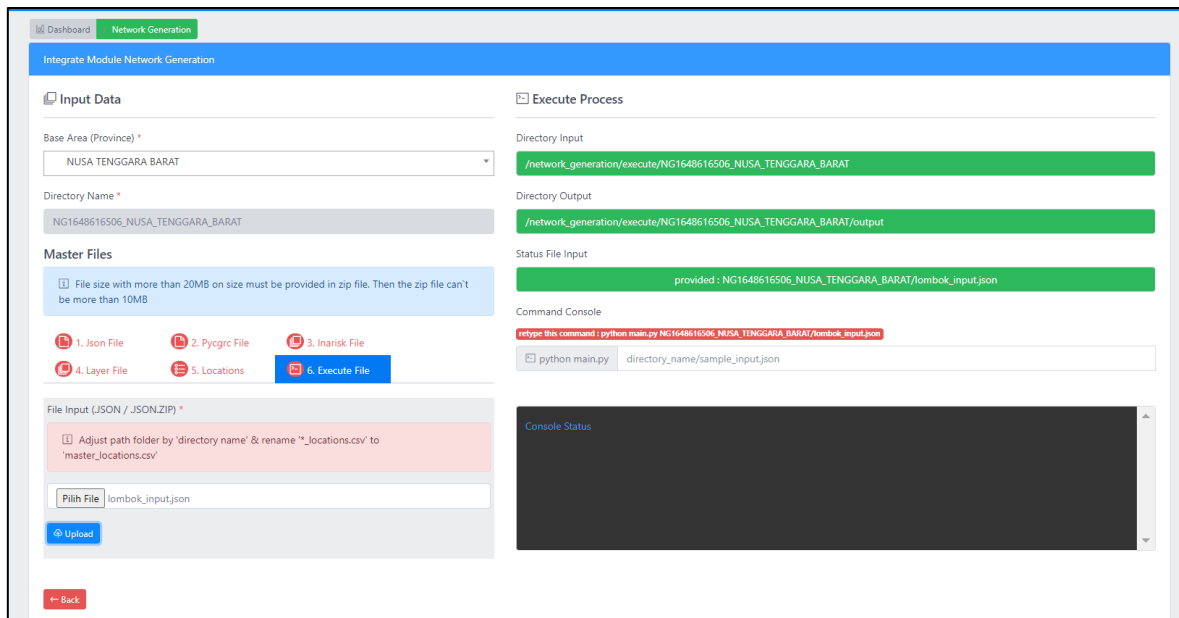


Figure 2-10 Network generation: Status of input file

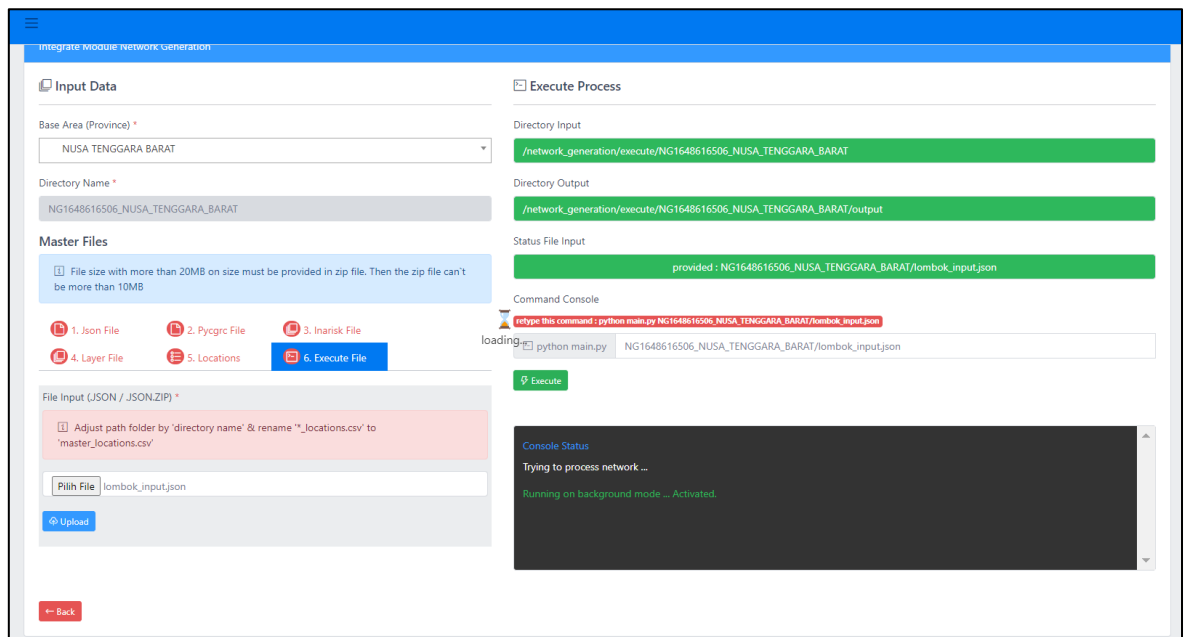


Figure 2-11 Network generation: running process

To execute network generation, user must retype the directoryname/input\_name.json and click Execute then wait until the execution process complete, see Figure 2-11 and Figure 2-12

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

The screenshot displays the 'Integrate Moodle Network Generation' web application. The interface is divided into two main sections: 'Input Data' and 'Execute Process'.

**Input Data Section:**

- Base Area (Province):** A dropdown menu showing 'NUSA TENGGARA BARAT'.
- Directory Name:** A text input field containing 'NG1648616506\_NUSA\_TENGGARA\_BARAT'.
- Master Files:** A section with a note: 'File size with more than 20MB on size must be provided in zip file. Then the zip file can't be more than 10MB'. Below this are six file upload buttons: '1. Json File', '2. Pygnc File', '3. Inarisk File', '4. Layer File', '5. Locations', and '6. Execute File'.
- File Input (JSON / JSON.ZIP):** A section with a note: 'Adjust path folder by 'directory name' & rename "locations.csv" to "master\_locations.csv"'. Below this is a 'Pick File' button and a text input field containing 'lombok\_input.json', followed by an 'Upload' button.

**Execute Process Section:**

- Directory Input:** A green bar showing the path '/network\_generation/execute/NG1648616506\_NUSA\_TENGGARA\_BARAT'.
- Directory Output:** A green bar showing the path '/network\_generation/execute/NG1648616506\_NUSA\_TENGGARA\_BARAT/output'.
- Status File Input:** A green bar showing the path 'provided : NG1648616506\_NUSA\_TENGGARA\_BARAT/lombok\_input.json'.
- Command Console:** A section with a red warning message: 'retype this command : python main.py NG1648616506\_NUSA\_TENGGARA\_BARAT/lombok\_input.json'. Below this is a text input field containing 'python main.py NG1648616506\_NUSA\_TENGGARA\_BARAT/lombok\_input.json' and an 'Execute' button.
- Message:** A black box with white text showing the command execution output: 'Message : unusual: 8 LAPANGAN SAMBELIA -8.308117 116.70546:reading /var/www/html/respondor2/network\_generation/execute/NG1648616506\_NUSA\_TENGGARA\_BARAT/lombok\_input.json All Done'.

At the bottom left, there is a 'Back' button.

Figure 2-12. Network generation: execution complete

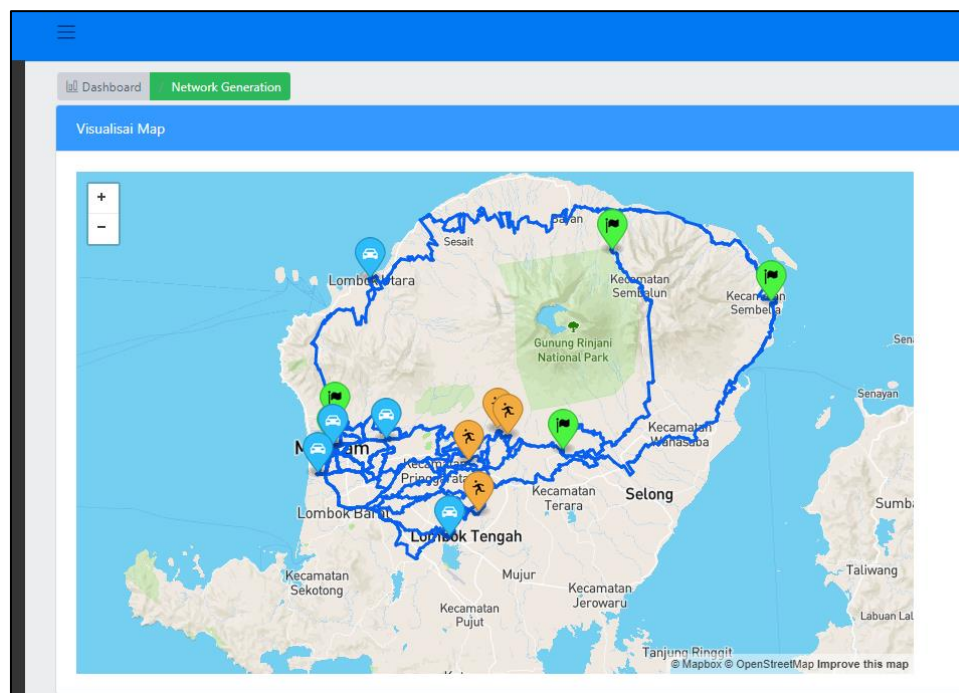


Figure 2-13. Network generation: Visualization of network data

Once the execution complete, the network generation output will appear at the front of network generation page. The network also can be visualized as shown in Figure 2-13.

## 2.2 Video Tutorial

In the following link, we provide a video tutorial on how to create network data : [Video Demo of the Network Generation](#)<sup>6</sup> . The sample input for network data can be access through this following link: [Network data sample](#)<sup>7</sup>

---

<sup>6</sup> [https://drive.google.com/file/d/1nc0L-MDX5dU3KfWSH6o-ab7c\\_ksJnHVP/view?usp=sharing](https://drive.google.com/file/d/1nc0L-MDX5dU3KfWSH6o-ab7c_ksJnHVP/view?usp=sharing)

<sup>7</sup> <https://drive.google.com/drive/folders/1XgAV4vZ7pbwPZdOGMqnUgYGIBSau4s-u?usp=sharing>

### 3 Assisted Evacuation Planning<sup>7</sup>

The Assisted Evacuation Planning (AEP) module provides solutions for assisted evacuation by minimizing the number of opened shelters, minimizing the maximum evacuation time (hour), minimizing the evacuation risks, and minimizing the total travel time (hour). To run the AEP module, user should perform the following steps. In explaining the steps below, we will use a small disaster instance of earthquake disaster in Lombok City at Nusa Tenggara Barat province, Indonesia.

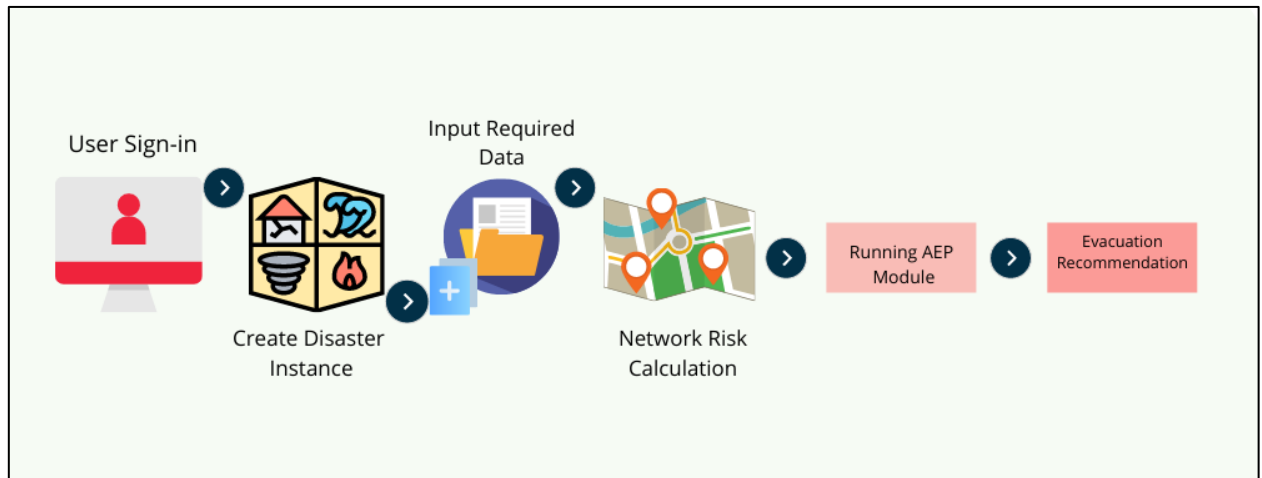
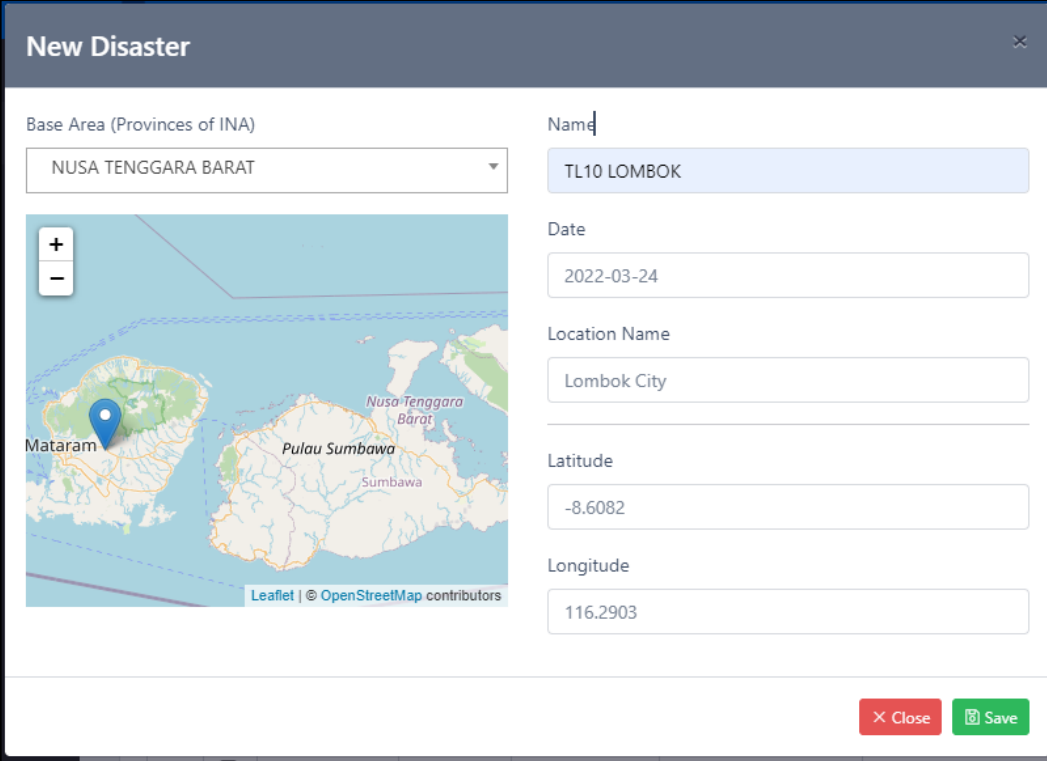


Figure 3-1. Assisted Evacuation Planning Flow

<sup>7</sup> Pirogov, A., Zografos, K. G., Sutanto, J., Kheiri, A., Suhartanto, H., Haryanto, T., Fathurahman, M., Sopha, B. M., Arini, H. M., Sakti, S., Abushama, H., Ali, H. H. S. M., Elbadawi, K. RESPOND-OR: Modelling and Solving the Assisted Evacuation Problem for Natural Disasters: A Multi-objective Programming Approach. 2022. *Technical report*

### 3.1 Input Preparation and Running AEP Module

1. Click on 'Disaster' menu to create a new disaster instance. Fill in the disasters's name, date, and location. To fill in the coordinate of the disaster's location, drag the location icon on the map to Lombok City; the latitude and longitude will be filled in automatically, as shown in Figure 3-2.



The screenshot shows a 'New Disaster' form with the following fields and values:

Field	Value
Base Area (Provinces of INA)	NUSA TENGGARA BARAT
Name	TL10 LOMBOK
Date	2022-03-24
Location Name	Lombok City
Latitude	-8.6082
Longitude	116.2903

The map on the left shows the location of Lombok City on the island of Lombok, with a blue pin indicating the selected location. The map also shows the surrounding islands of Mataram, Pulau Sumbawa, and Sumbawa.

Figure 3-2. Create new disaster instance

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

- After creating a new disaster instance, user should proceed to Evacuation Planning menu. At the beginning, user might see the current list of the AEP solutions as shown in Figure 3-3.

No.	Date Created	Disaster	Alpha	Speed	AEP Code	User	ACT
1	06 Maret 2022	Lombok	0.00	60	NG1646442847_NUSA_TENGGARA_BARAT_10_0.00	admin	<a href="#">Visualisation</a> <a href="#">Download Archives</a> <a href="#">Drop</a>
2	06 Maret 2022	Lombok	0.25	60	NG1646573221_NUSA_TENGGARA_BARAT_10_0.25	admin	<a href="#">Visualisation</a> <a href="#">Download Archives</a> <a href="#">Drop</a>

Figure 3-3 Evacuation Planning main page.

To create new AEP solutions, click New button at the top-left of the page, then the system will redirect user to specify the parameters for AEP module as depicted in Figure 3-4.

**Integrate Module Assisted Evacuation**

**Input Data**

Network \*  
 NG1648055243\_NUSA\_TENGGARA\_BARAT

Disaster \*  
 TL10 LOMBOK

**Parameters**

0 (fx) Alpha  
 60 (fx) Speed

**Master Files**

Please provide the vehicles data.

1. Vehicle Types 2. Vehicles  
 3. Execute

[View Input](#) Its general for all process \*

[Back](#)

**Execute Process**

Status File Input  
 not provided yet

Command Console  
 retype this command :  
 python main.py sample\_input.xlsx

Console Status

Figure 3-4. Configuration of AEP module

Before executing the AEP module, Firstly, user should select the Network Data and Disaster Instance. Network data already associated with the shelters, depots and zones. If user may have a new point of shelters, depots or zones, the user should create a new disaster data. Secondly, user should specify the parameters of the AEP module including the value of Alpha and Speed. Alpha value indicates risk. The higher the value of alpha, the less risky but longer the route is for the evacuation. The Speed value indicate the average speed at the route. Master Files allow user to

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

specify the type of vehicle and the total number of vehicle availability in each depot for evacuation. To insert new type of vehicle, user may select vehicle type and click View Input as depicted in Figure 3-5

No.		Type Name	Max Speed	Cap People	Cap Livestock	Cost	Action
1	<input type="checkbox"/>	Diesel Truck	120	26	0	250000	<a href="#">view</a> <a href="#">update</a>
2	<input type="checkbox"/>	Military Truck	80	50	0	500000	<a href="#">view</a> <a href="#">update</a>
3	<input type="checkbox"/>	Pickup Truck	80	10	0	100000	<a href="#">view</a> <a href="#">update</a>
4	<input type="checkbox"/>	Regular Car	100	6	0	100000	<a href="#">view</a> <a href="#">update</a>
5	<input type="checkbox"/>	Rescue Car	80	30	0	100000	<a href="#">view</a> <a href="#">update</a>

Load More

Total Data : 5  
Current Data : 5

Figure 3-5. Vehicle type

To add new type of vehicle, user should click New button at the top-right of the page, then user will redirect to insert new type of vehicle as shown in Figure 3-6.

**New Vehicle**

Type Name  
Rescue Car II

Max Speed  
100

Capacity People  
35

Capacity Livestock  
0

Cost  
150000

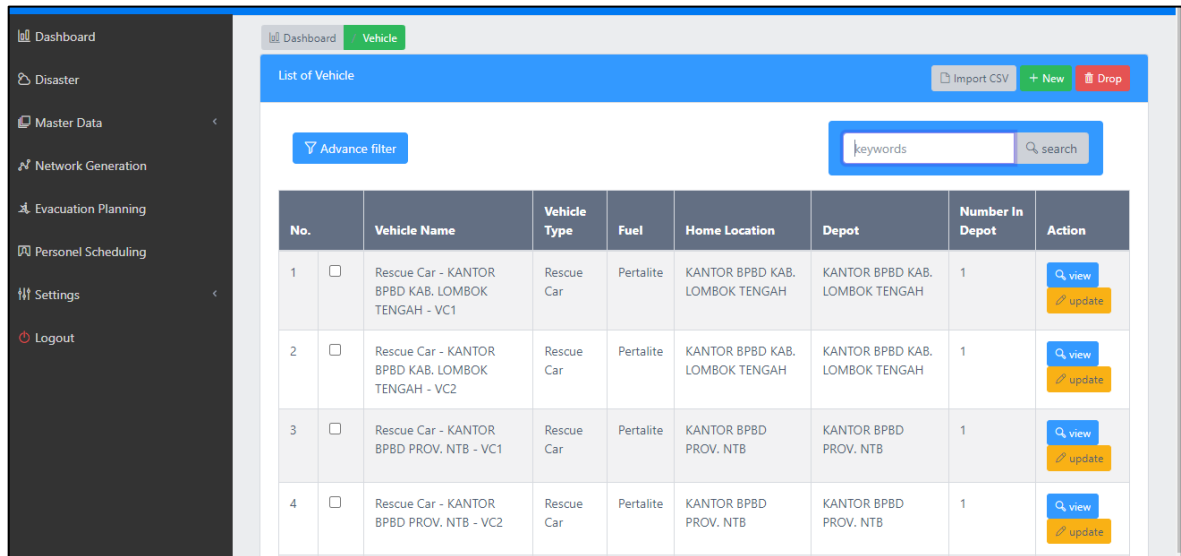
[Close](#) [Save](#)

Figure 3-6. Add new type of vehicle.



## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

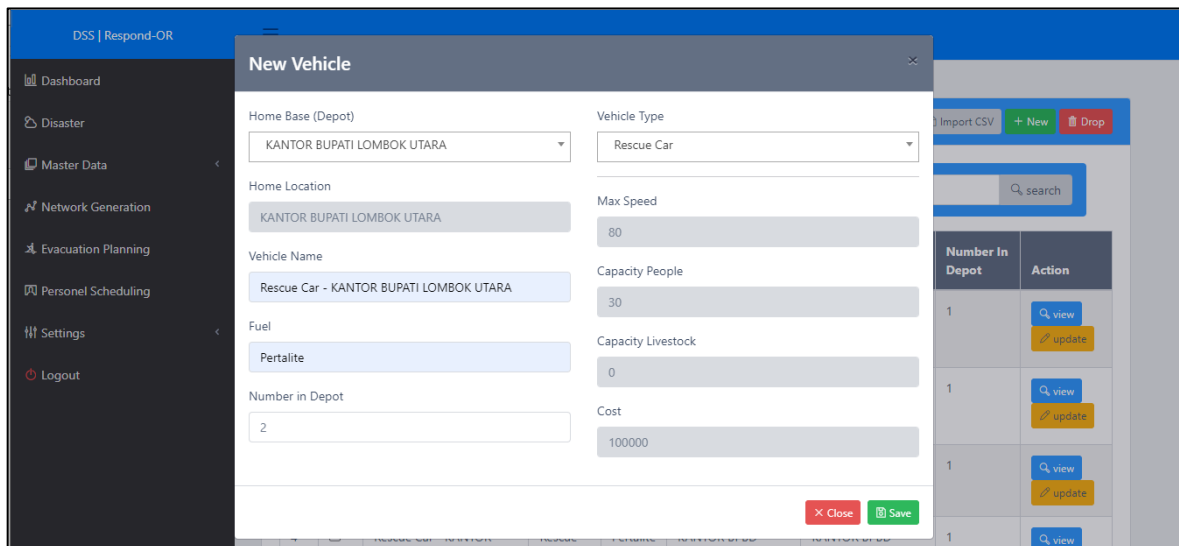
To specify the total number of vehicle for each depots that ready for evacuation, user should select Vehicles and click View Input as depicted in Figure 3-7. The system will display all the vehicle list that associated with the depots.



No.	Vehicle Name	Vehicle Type	Fuel	Home Location	Depot	Number In Depot	Action
1	Rescue Car - KANTOR BPBD KAB. LOMBOK TENGAH - VC1	Rescue Car	Pertalite	KANTOR BPBD KAB. LOMBOK TENGAH	KANTOR BPBD KAB. LOMBOK TENGAH	1	<a href="#">view</a> <a href="#">update</a>
2	Rescue Car - KANTOR BPBD KAB. LOMBOK TENGAH - VC2	Rescue Car	Pertalite	KANTOR BPBD KAB. LOMBOK TENGAH	KANTOR BPBD KAB. LOMBOK TENGAH	1	<a href="#">view</a> <a href="#">update</a>
3	Rescue Car - KANTOR BPBD PROV. NTB - VC1	Rescue Car	Pertalite	KANTOR BPBD PROV. NTB	KANTOR BPBD PROV. NTB	1	<a href="#">view</a> <a href="#">update</a>
4	Rescue Car - KANTOR BPBD PROV. NTB - VC2	Rescue Car	Pertalite	KANTOR BPBD PROV. NTB	KANTOR BPBD PROV. NTB	1	<a href="#">view</a> <a href="#">update</a>

Figure 3-7. List of vehicles for each depots.

To add new vehicle at specific depots, user should click New button at the top-right of the page then fill or choose the corresponding attributes including Home (Depot), Vehicle name, type of Fuel, and total number in depot as shows in Figure 3-8.



DSS | Respond-OR

Dashboard

Disaster

Master Data

Network Generation

Evacuation Planning

Personel Scheduling

Settings

Logout

Dashboard

Vehicle

List of Vehicle

Import CSV

+ New

Drop

Advance filter

search

No.	Vehicle Name	Vehicle Type	Fuel	Home Location	Depot	Number In Depot	Action
1	Rescue Car - KANTOR BPBD KAB. LOMBOK TENGAH - VC1	Rescue Car	Pertalite	KANTOR BPBD KAB. LOMBOK TENGAH	KANTOR BPBD KAB. LOMBOK TENGAH	1	<a href="#">view</a> <a href="#">update</a>
2	Rescue Car - KANTOR BPBD KAB. LOMBOK TENGAH - VC2	Rescue Car	Pertalite	KANTOR BPBD KAB. LOMBOK TENGAH	KANTOR BPBD KAB. LOMBOK TENGAH	1	<a href="#">view</a> <a href="#">update</a>
3	Rescue Car - KANTOR BPBD PROV. NTB - VC1	Rescue Car	Pertalite	KANTOR BPBD PROV. NTB	KANTOR BPBD PROV. NTB	1	<a href="#">view</a> <a href="#">update</a>
4	Rescue Car - KANTOR BPBD PROV. NTB - VC2	Rescue Car	Pertalite	KANTOR BPBD PROV. NTB	KANTOR BPBD PROV. NTB	1	<a href="#">view</a> <a href="#">update</a>

Figure 3-8. Adding new vehicle at specific depot

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

After specifying the availability of vehicle in each depot, user may select Execute tab and Click 'Generate' button, then wait until Status file Input changes into green-colour, as shown in Figure 3-9.

Figure 3-9. Input Preparation before running AEP module

Once the status file input complete, then AEP module is ready to execute. User should retype the directory input file that show in the status file input to the command console then click **Execute**. please wait until the process is completed. After the execution of AEP module complete, user should refresh the 'Evacuation Planning' page to see the solutions as shown in Figure 3-10.

Evacuation Planning								Drop
Personel Scheduling	10	23 Maret 2022	TL10 LOMBOK	0.00	60	NG1648051141_NUSA_TENGGARA_BARAT_33_0.00	admin	Visualisation Download Archives Drop
Settings	11	23 Maret 2022	TL9 LOMBOK	0.50	100	NG1647773584_NUSA_TENGGARA_BARAT_31_0.50	admin	Visualisation Download Archives Drop
Logout	12	30 Maret 2022	TL10 LOMBOK	0.00	60	NG1648055243_NUSA_TENGGARA_BARAT_33_0.00	admin	Visualisation Download Archives Drop

Figure 3-10. List of AEP solutions

The new generated solution will be displayed at the end of the list. In this case, the new solution refers to the TL 10 LOMBOK. There are three Buttons which are Visualization, Download Archive and Drop. Visualization will display the detail of the solution, Download Archive will allow user to download input and output of the AEP module in csv format for further analysis, Drop button will remove the AEP solution.

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

3. AEP Solutions: Select 'Visualisation' button to view the detail solution. User will see solution value path and solution table. The y-axis of the value path provides user with information about the percentage deviation of the solutions to the optimal one (see Figure 3-11). In the example above, the optimal solution is the 'Obj Order 1243' represented by Solution ID number 2 (see No. 2 at the solution table). The solution table provides list of all the AEP solutions (see Figure 3-12). Please note that in this example, the solution for 'Obj Order 1342' is the quite similar with the solution for 'Obj Order 4123'. When two or more objectives-orders ('Obj Order') have the same solution, the value path only shows one of them; whereas the solution table shows all solutions.

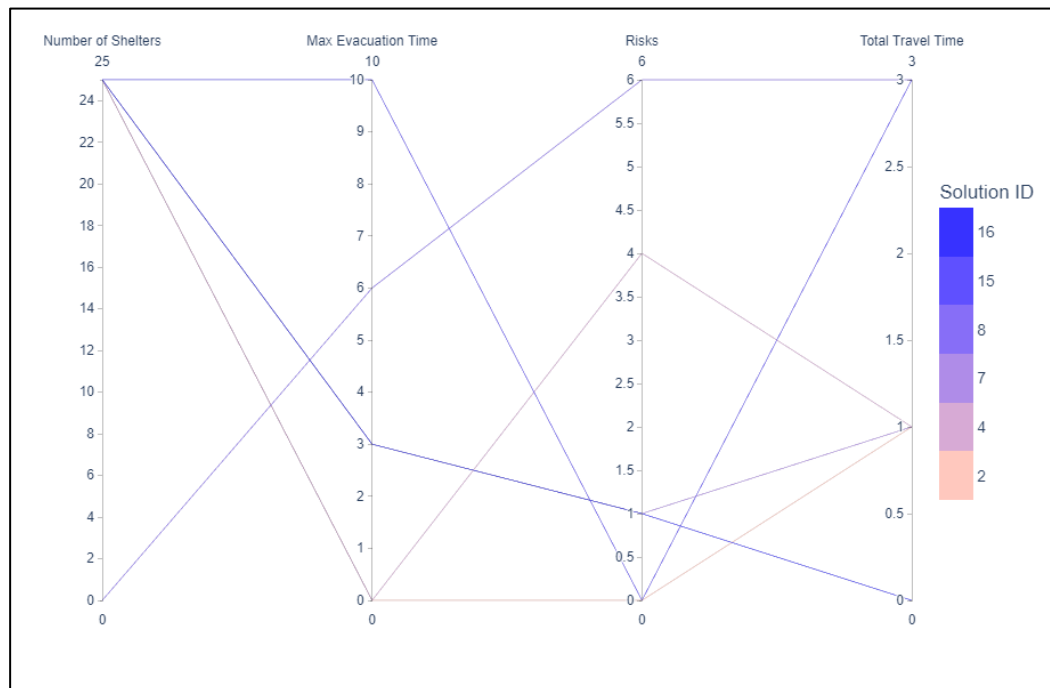


Figure 3-11. AEP value-path

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

No.	Problem Type	Obj Order	Number Of Shelter	Max Evacuation Time (hr)	Risk	Total Time Travel (hr)	Fleet Cost	Action
2	FSC	1243	5	5.88	1512.4	35.45	800000.0	<a href="#">Detail</a>
4	FSC	1342	5	5.88	1561.71	35.14	800000.0	<a href="#">Detail</a>
19	FSC	4123	5	5.89	1555.79	36.61	800000.0	<a href="#">Detail</a>
6	FSC	1432	5	5.95	1557.63	36.13	800000.0	<a href="#">Detail</a>
23	FSC	4312	5	5.95	1584.14	35.82	800000.0	<a href="#">Detail</a>
13	FSC	3124	5	5.99	1522.94	36.84	800000.0	<a href="#">Detail</a>
20	FSC	4132	5	5.99	1515.26	35.52	800000.0	<a href="#">Detail</a>
1	FSC	1234	5	6.05	1623.76	38.05	800000.0	<a href="#">Detail</a>
5	FSC	1423	5	6.05	1542.54	36.96	800000.0	<a href="#">Detail</a>
16	FSC	3241	5	6.05	1524.7	34.95	800000.0	<a href="#">Detail</a>

Showing 1 to 10 of 24 entries

Previous **1** 2 3 Next

Figure 3-12. List of AEP solution sorted by Max Evacuation Time.

Click 'Detail' button next to a solution to see the more details (see Figure 3-13).

<a href="#">Advance filter</a>								
No.	Problem Type	Obj Order	Number Of Shelter	Max Evacuation Time (hr)	Risk	Total Time Travel (hr)	Fleet Cost	Action
2	FSC	1243	5	5.88	1512.4	35.45	800000.0	<a href="#">Detail</a>
4	FSC	1342	5	5.88	1561.71	35.14	800000.0	Evac Dispatch Evac Open Shelter Evac Path
19	FSC	4123	5	5.89	1555.79	36.61	800000.0	
6	FSC	1432	5	5.95	1557.63	36.13	800000.0	

Figure 3-13 More detail AEP solution

Vehicle dispatch ('Evac Dispatch') informs user which vehicle should be dispatched to a specific zone for assisted evacuation (see Figure 3-14). The opened shelters ('Evac Open Shelter') informs user which shelters should be used (see Figure 3-15)

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

Evac Dispatch				
No.	Obj Order	Vehicle Id	Type Id	Dispatched To
1	1243	Rescue Car - KANTOR BPBD KAB. LOMBOK TENGAH - VC1	Rescue Car	ABIAN TUBUH
2	1243	Rescue Car - KANTOR BPBD KAB. LOMBOK TENGAH - VC2	Rescue Car	ABIAN TUBUH
3	1243	Rescue Car - KANTOR KECAMATAN LINGSAR - VC1	Rescue Car	AIK BERIK
4	1243	Rescue Car - KANTOR KECAMATAN LINGSAR - VC2	Rescue Car	AIK BERIK
5	1243	Rescue Car - KANTOR BPBD PROV. NTB - VC1	Rescue Car	AIK BERIK
6	1243	Rescue Car - KANTOR BPBD PROV. NTB - VC2	Rescue Car	ABIAN TUBUH
7	1243	Rescue Car - KANTOR BUPATI LOMBOK UTARA - VC1	Rescue Car	AIK BERIK
8	1243	Rescue Car - KANTOR BUPATI LOMBOK UTARA - VC2	Rescue Car	AIK DAREK
				Close

Figure 3-14. AEP- Evacuation dispatch

Evac Open Shelter		
No.	Shelter Id	Shelter
1	0	MASJID KARIMAH MUHAMMAD ALI
2	1	KANTOR YSLPP
3	2	LAPANGAN RINJANI
4	5	LAPANGAN UMUM MATARAM
5	6	LAP SUELA
		Close

Figure 3-15. AEP- Evac Open Shelter

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)


Evac Path				
No.	Type Id	Time (hr)	Trips	Map
1	Rescue Car	5.5892	ABIAN TUBUH -> LAPANGAN RINJANI ( P = 30 : L = 0 )   AIK BERIK -> KANTOR YSLPP ( P = 30 : L = 0 )   AIK BERIK -> LAPANGAN UMUM MATARAM ( P = 30 : L = 0 )	
2	Rescue Car	5.8564	ABIAN TUBUH -> LAPANGAN RINJANI ( P = 30 : L = 0 )   AIK BUKAQ -> LAPANGAN RINJANI ( P = 30 : L = 0 )   AIK BERIK -> LAP SUELA ( P = 30 : L = 0 )   AIKMEL UTARA -> MASJID KARIMAH MUHAMMAD ALI ( P = 30 : L = 0 )   AIKMEL UTARA -> MASJID KARIMAH MUHAMMAD ALI ( P = 30 : L = 0 )	
3	Rescue Car	5.5752	AIK BERIK -> LAPANGAN RINJANI ( P = 30 : L = 0 )   AIK BERIK -> KANTOR YSLPP ( P = 30 : L = 0 )   AIK DAREK -> LAPANGAN UMUM MATARAM ( P = 30 : L = 0 )	
4	Rescue Car	5.7183	AIK BERIK -> LAP SUELA ( P = 30 : L = 0 )   AIKMEL UTARA -> LAP SUELA ( P = 30 : L = 0 )   AIKMEL UTARA -> LAP SUELA ( P = 30 : L = 0 )   AIKMEL UTARA -> LAP SUELA ( P = 30 : L = 0 )   AIKMEL UTARA -> MASJID KARIMAH MUHAMMAD ALI ( P = 30 : L = 0 )	
5	Rescue Car	5.827	AIK BERIK -> LAPANGAN RINJANI ( P = 30 : L = 0 )   AIK BUKAQ -> KANTOR YSLPP ( P = 30 : L = 0 )   AIK DAREK -> KANTOR YSLPP ( P = 30 : L = 0 )	
6	Rescue Car	4.9283	ABIAN TUBUH -> KANTOR YSLPP ( P = 30 : L = 0 )   AIK DAREK -> LAPANGAN UMUM MATARAM ( P = 30 : L = 0 )	
7	Rescue Car	5.3678	AIK BERIK -> LAPANGAN RINJANI ( P = 20 : L = 0 )   AIK BUKAQ -> LAP SUELA ( P = 30 : L = 0 )   AIKMEL UTARA -> LAP SUELA ( P = 20 : L = 0 )	
8	Rescue Car	5.8802	AIK DAREK -> LAPANGAN RINJANI ( P = 20 : L = 0 )   AIK BUKAQ -> LAPANGAN RINJANI ( P = 10 : L = 0 )   ABIAN TUBUH -> KANTOR YSLPP ( P = 30 : L = 0 )	
				

Figure 3-16. AEP- Evacuation Path

Evacuation path informs user the evacuation route from zone to shelter (see Figure 3-16). Click 'map view' button to view the evacuation route on the map (see Figure 3-17).

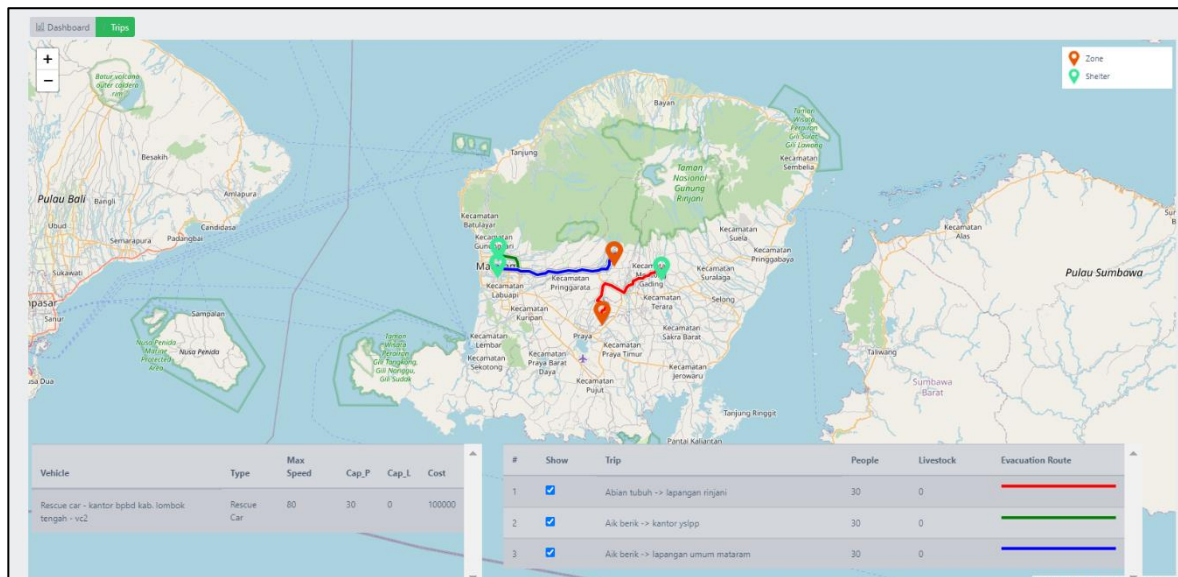


Figure 3-17. AEP- Evacuation routes

## 3.2 Video Tutorial

In the following link, we provide a video tutorial on how to run the AEP module: [Video Demo of the AEP Module](https://drive.google.com/file/d/152rPdxxAbVXkoc6UNF7hZwz7fWMqdjD0/view?usp=sharing)<sup>8</sup>

---

<sup>8</sup> <https://drive.google.com/file/d/152rPdxxAbVXkoc6UNF7hZwz7fWMqdjD0/view?usp=sharing>

## 4. Personnel Routing and Scheduling<sup>9,10</sup>

The Personnel Routing and Scheduling (PRS) module provides solutions for personnel routing and scheduling by minimizing i) the unmet demand, ii) the average completion time of the services, iii) the gap between different locations in terms of the amount of services they are provided, and iv) the total transportation risk. To run the PRS module, user should perform the following steps. In explaining the steps below, we will use a small disaster instance of earthquake disaster in Lombok City that is located in Nusa Tenggara Barat province in Indonesia. The input categories of the PRS module is shown in Table 3-1.

Table 4-1. Input Categories of PRS Module

Input category	Description
Services	Disaster response services, such as evacuation and medical services
Demand Points	The locations that require the services under consideration
Demands	The attributes of the services required at demand points
Resting Points	The locations where the personnel can rest
Depots	The locations where the personnel start working
Network Data	The network represented as a multi-graph connecting all points of interest (POIs) as described in Section 1.3
Personnel	Personnel teams who provide specific services. The minimum number of personnel in a team is one (1).
Settings	The parameters to set the specifics of the module implementation

### 4.1 Input Preparation and Running PRS Module

Click 'Routing & Scheduling' menu. The page will display all the PRS solutions for each disaster instance. To run new PRS solution, click 'New' button at the top-right of the page to prepare the following input data for the disaster instance (see Figure 4-1):

No.	Date Created	Disaster Name	PRS Code	User	ACT
1	12 Maret 2022	JKT_Banjir	NG1647094455_DKI_JAKARTA_7	developer	Visualisation Download Archives Drop
2	12 Maret 2022	Lombok	NG1646442847_NUSA_TENGGERA_BARAT_10	developer	Visualisation Download Archives Drop

Figure 4-1. Current List of PRS solutions.

<sup>9</sup> Tarhan, İ., Zografos, K. G., Sutanto, J., Kheiri, A. and Suhartanto, H. 2022a. A multi-objective rolling horizon personnel routing and scheduling model for large-scale natural disasters, *Technical Report*.

<sup>10</sup> Tarhan, İ., Zografos, K. G., Sutanto, J. and Kheiri, A. 2022b. Dynamic personnel routing and scheduling, *Technical Report*.



## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

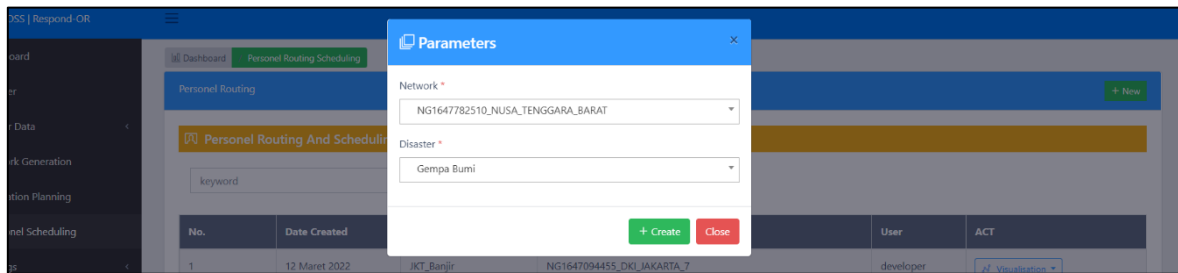


Figure 4-2. Create new PRS solutions

After user click New button, user should specify the network data and disaster instance, then click Create. User will automatically redirect to insert several type of input data see Figure (4-3).

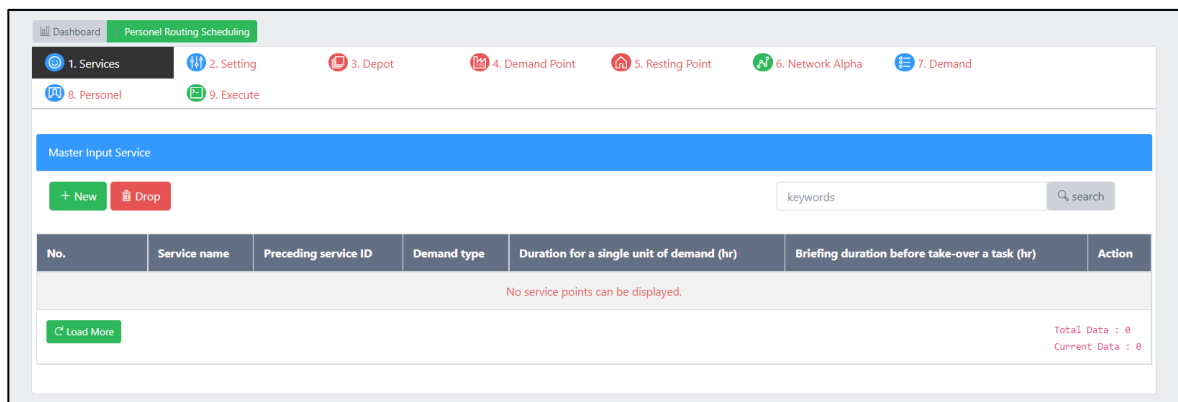
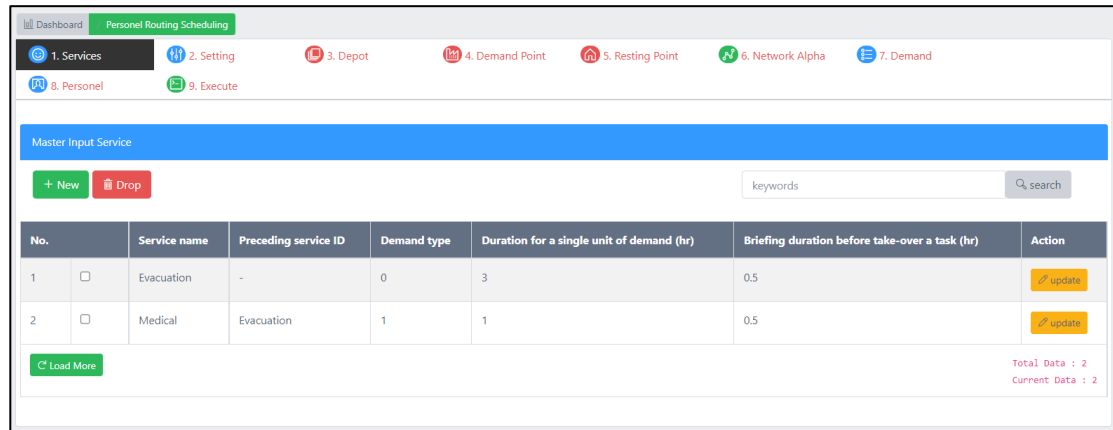


Figure 4-3. Input data preparation for PRS module

- a) **Services:** What services that will be performed on the affected areas. Click the 'Services' tab, and then click 'New' button to input the services. For instance, in Figure 4-4, user inputted two services, which are Evacuation and Medical. The 'Preceding service ID' indicates the sequential dependency of the services. In this example, the evacuation service precedes the medical service. Demand type column shows whether the type of the demand for the relevant service is discrete or continuous. Demand type's being equal to zero (one) corresponds to a discrete (continuous) demand. Evacuation service has discrete demand as it is defined by the number of tents to set-up at demand points. On the other hand, medical service has continuous demand as it is defined by the duration of the medical services to be provided at demand points. 'Duration for a single unit of demand' is the time duration (in hour) of a single service, e.g., setting a single tent for the evacuation service. 'Briefing duration before take-over a task' is the time duration (in hour) of a briefing session among the personnel handing-over an ongoing service

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)



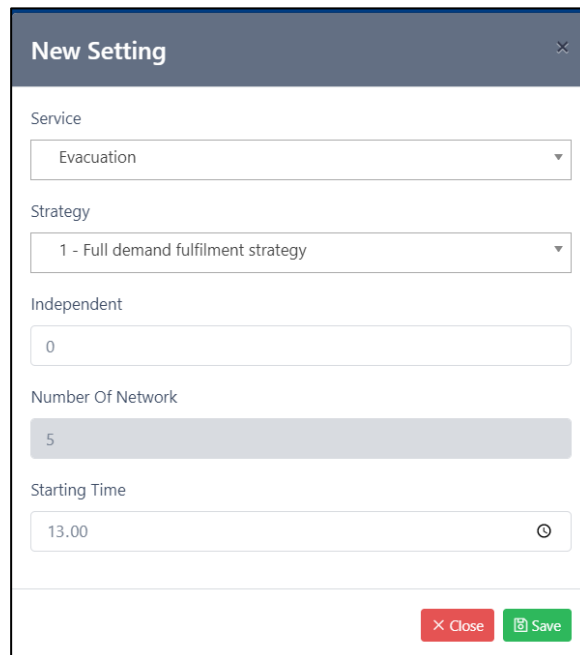
The screenshot shows a web application interface for 'Master Input Service'. At the top, there is a navigation bar with tabs: 1. Services, 2. Setting, 3. Depot, 4. Demand Point, 5. Resting Point, 6. Network Alpha, 7. Demand, 8. Personnel, and 9. Execute. Below the navigation bar, there is a 'Master Input Service' section with a '+ New' button, a 'Drop' button, and a search bar labeled 'keywords'. Below this is a table with the following data:

No.	Service name	Preceding service ID	Demand type	Duration for a single unit of demand (hr)	Briefing duration before take-over a task (hr)	Action
1	Evacuation	-	0	3	0.5	<a href="#">update</a>
2	Medical	Evacuation	1	1	0.5	<a href="#">update</a>

Below the table, there is a 'Load More' button and a status bar indicating 'Total Data : 2' and 'Current Data : 2'.

Figure 4-4. Services Input data

- b. **Setting:** The configuration of each service includes the strategy, number of networks, and starting time (see Figure 4-5). Click 'Setting' tab, and then click 'Add' button (see Figure 4-5). In this example, the strategy of the evacuation service is a full demand strategy ('Strategy' = 1). In this strategy, there is no restriction on the number of tents that can be set at a demand points whereas it is restricted in the partial demand fulfilment strategy ('Strategy' = 0). Details of the relevant strategies can be found in Tarhan et al. (2022a). "Starting time" is used to set the time at which the services under consideration can start. By default, it can be set to "0:00". User can update the setting configuration by clicking on the 'update' button (see Figure 4-5).



The 'New Setting' dialog box contains the following fields:

- Service:** A dropdown menu with 'Evacuation' selected.
- Strategy:** A dropdown menu with '1 - Full demand fulfilment strategy' selected.
- Independent:** A text input field with the value '0'.
- Number Of Network:** A text input field with the value '5'.
- Starting Time:** A text input field with the value '13.00' and a clock icon for time selection.

At the bottom right, there are two buttons: 'Close' (red) and 'Save' (green).

Figure 4-5. Adding PRS setting

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

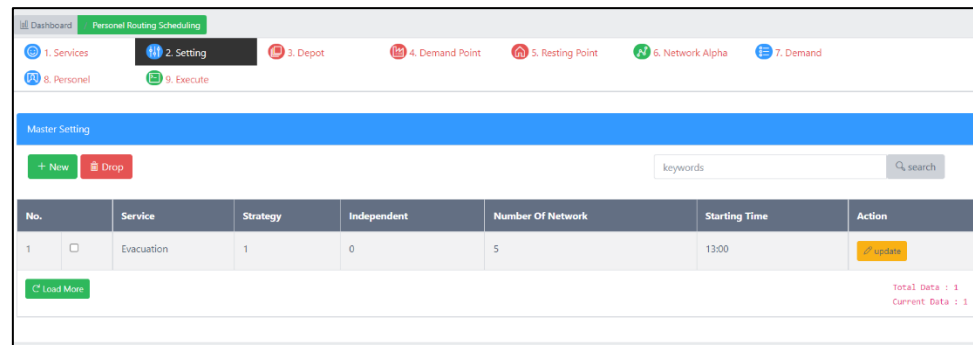


Figure 4-6. Setting for the service

- c. Depot, Demand Point, and Resting Point are the locations where the personnels start working, the locations of the services, and the locations where the personnel will take a rest. To add these data, Click the respective 'Depot', 'Demand Point', and 'Resting Point' tabs, and Click 'New' (see Figure 4-7, 4-8, and 4-9).

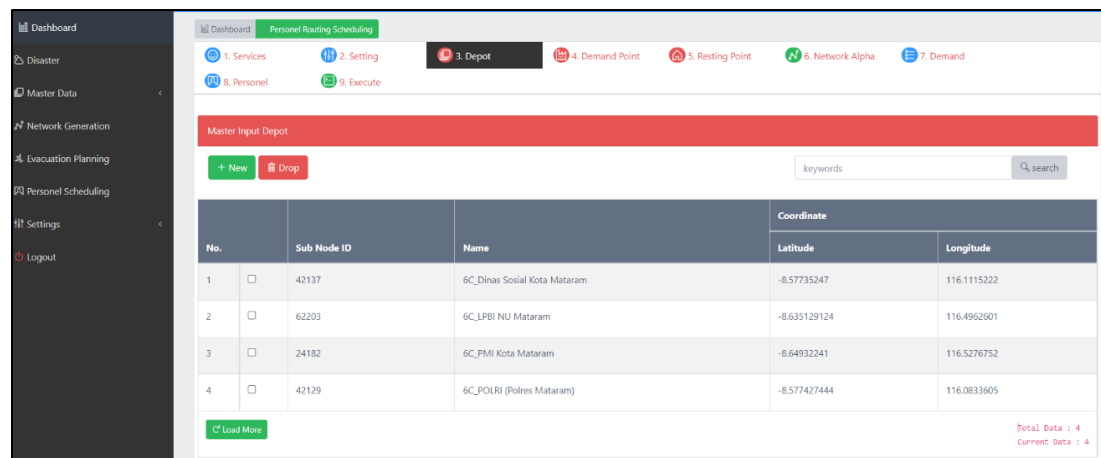


Figure 4-7 List of selected depots

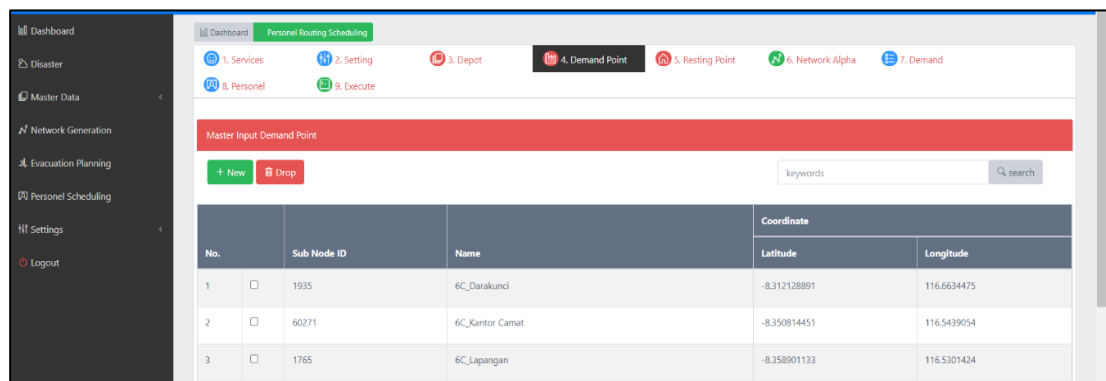


Figure 4-8. List of selected Demand Points

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

Dashboard

Disaster

Master Data

Network Generation

Evacuation Planning

Personnel Scheduling

HI Settings

Logout

Dashboard

Personnel Routing Scheduling

1. Services

2. Setting

3. Depot

4. Demand Point

5. Resting Point

6. Network Alpha

7. Demand

8. Personnel

9. Execute

Master Input Resting Point

+ New

Drop

keywords

search

No.		Sub Node ID	Name	Coordinate	
				Latitude	Longitude
1	<input type="checkbox"/>	83637	6C_East Lombok Dive Hotel	-8.4590214	116.6901243
2	<input type="checkbox"/>	66216	6C_Villas Inn	-8.531291065	116.6133768

Load More

Total Data : 2  
Current Data : 2

Figure 4-9. List of selected Resting Point

- d) Network Alpha: Click 'Generate File Input', retype the command shown under the 'Command Console', and then click 'Execute'. As shown in Figure 4-10, it generates five networks with different alpha values each of which represents a different trade-off level between the travel time and transportation risk (the higher the value of alpha, the less risky yet longer paths between the POIs). These networks construct all together the multi-graph described in Section 1.3.

File Input provided

Input/NG1647782510\_NUSA\_TENGGARA\_BARAT\_3

File Input (CSV)

Generate File Input

Command Console

retype this command : Input/NG1647782510\_NUSA\_TENGGARA\_BARAT\_3

Execute

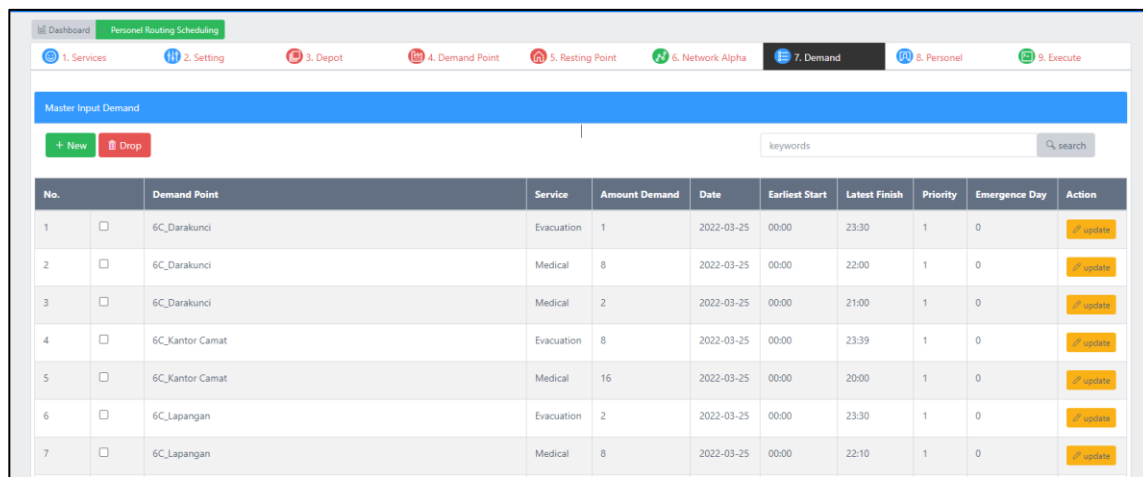
Console Status

Results Detail

Figure 4-10. Generate alpha network values for PRS

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

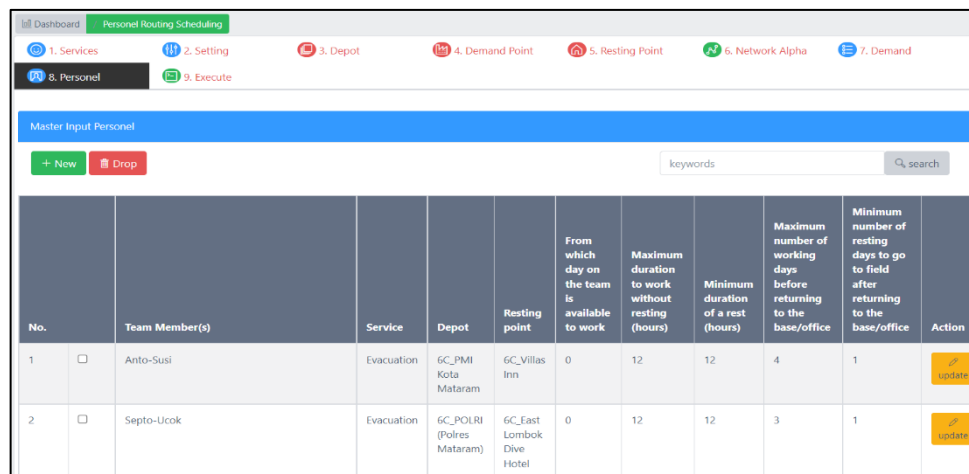
- e) Demand: Click 'Demand' tab, and then click 'New' to input the amount of service demanded, its date and time, its earliest start and latest finish time during the day, its priority (the higher the priority, the more urgent the relevant demand) and its emergence day (e.g., emergence day of zero means that the relevant demand emerged/arised at the beginning of the planning horizon) for every service in every demand point (see Figure 4-11).



No.	Demand Point	Service	Amount Demand	Date	Earliest Start	Latest Finish	Priority	Emergence Day	Action
1	6C_Darakunci	Evacuation	1	2022-03-25	00:00	23:30	1	0	update
2	6C_Darakunci	Medical	8	2022-03-25	00:00	22:00	1	0	update
3	6C_Darakunci	Medical	2	2022-03-25	00:00	21:00	1	0	update
4	6C_Kantor Camat	Evacuation	8	2022-03-25	00:00	23:39	1	0	update
5	6C_Kantor Camat	Medical	16	2022-03-25	00:00	20:00	1	0	update
6	6C_Lapangan	Evacuation	2	2022-03-25	00:00	23:30	1	0	update
7	6C_Lapangan	Medical	8	2022-03-25	00:00	22:10	1	0	update

Figure 4-11 List of demand of services

- f) Personnel: Click 'Personnel' tab, and then click 'New' to input the information related to the personnels who perform the service, including the name of the personnel/team members, what service they provide, which day they can start the service, the maximum duration of working without resting (hour), the minimum duration of resting (hour), the maximum number of continuous working days, and the minimum resting days to go the field again after returning to the base/office. The sample input of the personnels/teams for evacuation service is shown in Figure 4-12.



No.	Team Member(s)	Service	Depot	Resting point	From which day on the team is available to work	Maximum duration to work without resting (hours)	Minimum duration of a rest (hours)	Maximum number of working days before returning to the base/office	Minimum number of resting days to go to field after returning to the base/office	Action
1	Anto-Susi	Evacuation	6C_PMI Kota Mataram	6C_Villas Inn	0	12	12	4	1	update
2	Septo-Ucok	Evacuation	6C_POLRI (Polres Mataram)	6C_East Lombok Dive Hotel	0	12	12	3	1	update

Figure 4-12. Sample input of personnel / teams

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

Once all the inputs required for the PRS module are entered, it can be executed as follows.

- g) Execute: Click first the 'Execute' tab and then the 'Generate' button to prepare the input files. The file input is complete when it turns into green-colour. After the file input is complete, retype the name of the disaster instance under the 'Console Command' and click 'Execute' to run the PRS module, as shown in Figure 4-13

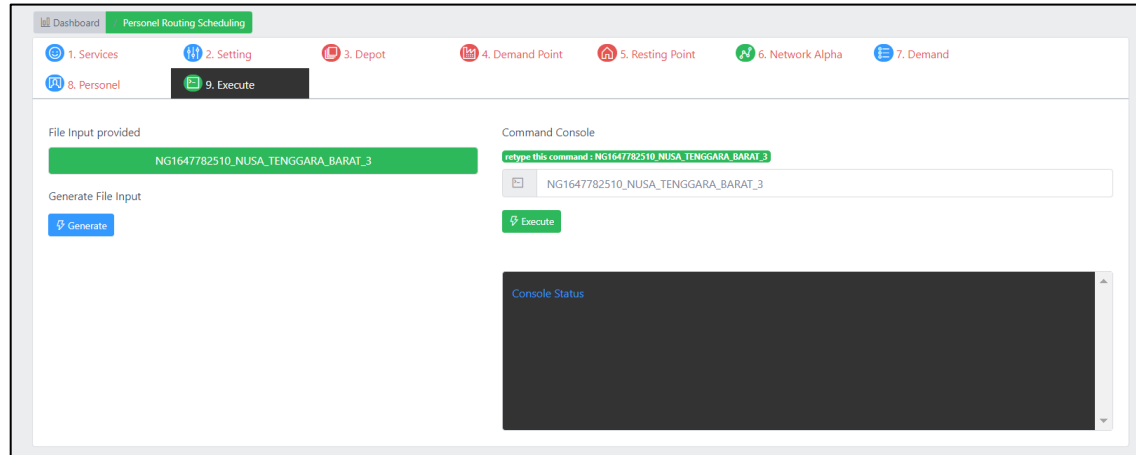


Figure 4-13. Executing PRS module

After the the process is completed, return to the 'Routing & Scheduling' page, and see the solutions by clicking the 'Visualization' button next to the disaster instance (see Figure 4-14).

5	27 Maret 2022	Gempa Bumi	NG1647782510_NUSA_TENGGARA_BARAT_3	mr_toto	<a href="#">Visualisation</a> <a href="#">Download Archives</a> <a href="#">Drop</a>
---	---------------	------------	------------------------------------	---------	--

Figure 4-14. PRS Solutions

- h. Solutions: After clicking the 'Visualisation' button, user will see all PRS solutions. The y-axis of the value-path plot shows how much each solution deviates from the optimal values for the objectives under consideration over the planning horizon (see Figure 4-15). The x-axis shows the objective functions: UD = Unsatisfied Demand, ACT = Average demand completion time, F= Fairness, and TR = Transportation Risk. In this example, the value-path plot shows that the evacuation services will be completed in 10 days. Below the value-path plot is a table showing the detail percentages of the value-path (see Figure 4-16) and summary table of the solutions (see Figure 4-17). In this example, there are ~13 solutions for the evacuation services. Click 'Detail' button to see the detail of each solution. For example, Figure 4-18 shows the detail of the first solution (solution id = 1).

# RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

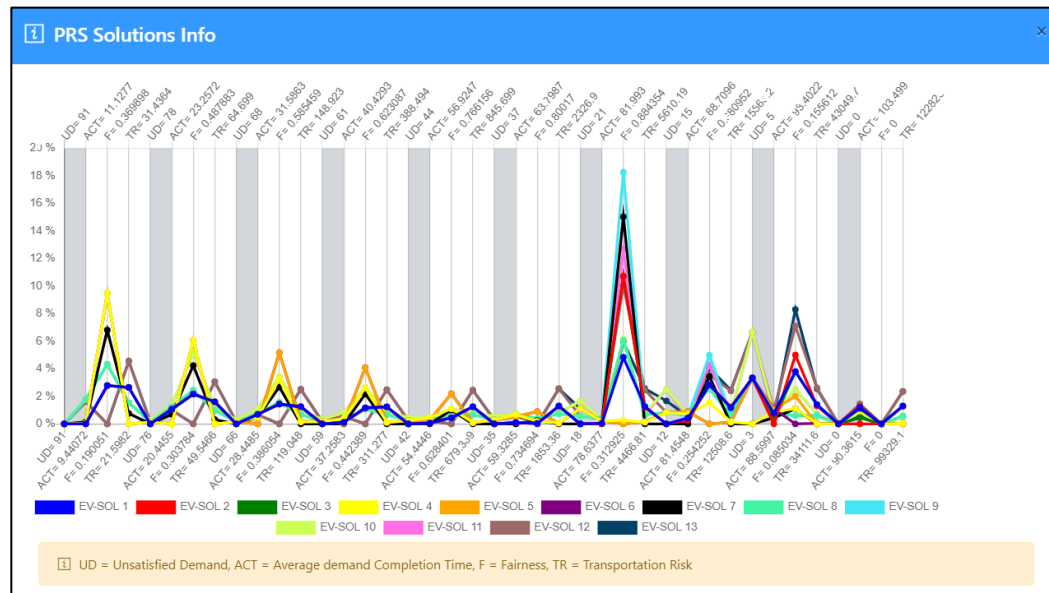


Figure 4-15. PRS value-path

UD = Unsatisfied Demand, ACT = Average demand Completion Time, F = Fairness, TR = Transportation Risk

Label	UD	ACT	F	TR	UD	ACT	F	TR	UD	ACT	F	TR
EV-SOL 1	0	0	0.278523	0.264575	0	0.10639	0.216235	0.16008	0	0.0690241	0.143722	0.124607
EV-SOL 2	0	0	0.278523	0.264575	0	0.10639	0.216235	0.16008	0	0.0690241	0.143722	0.124607
EV-SOL 3	0	0	0.278523	0.264575	0	0.10639	0.216235	0.16008	0	0.0690241	0.143722	0.124607
EV-SOL 4	0	0.00434046	0.946309	0	0.0131579	0	0.606018	0	0.0151515	0.0473327	0.32489	0.0146684
EV-SOL 5	0	0.00434046	0.946309	0	0.0131579	0	0.606018	0	0.0151515	0	0.51652	0.0167367

Figure 4-16. PRS detail percentages of value-path

## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

Solution_id	Service Name	Planning Horizon Length	Average Demand Completion Time (hr)	Transportation Risk	Action
0	evacuation	227.137	100.471	112152	<a href="#">Detail</a>
1	evacuation	228.022	90.3615	112220	<a href="#">Detail</a>
2	evacuation	225.94	94.6381	112205	<a href="#">Detail</a>
3	evacuation	225.522	98.2491	99695.7	<a href="#">Detail</a>
4	evacuation	225.522	99.4716	99329.1	<a href="#">Detail</a>
5	evacuation	226.224	101.719	99341	<a href="#">Detail</a>
6	evacuation	222.94	94.5305	99706.6	<a href="#">Detail</a>
7	evacuation	225.874	97.6739	105038	<a href="#">Detail</a>
8	evacuation	225.874	97.8102	105065	<a href="#">Detail</a>
9	evacuation	226.49	99.7739	104123	<a href="#">Detail</a>

Showing 1 to 10 of 13 entries

Previous [1](#) [2](#) Next

Figure 4-17. Summary of the PRS solutions

Solution_id	Service Name	Period	Unsatisfied Demand	Average Demand Completion Time (hr)	Fairness	Transportation Risk	Detail
1	evacuation	0	91	9.44072	0.242985	27.3125	<a href="#">Detail</a>
1	evacuation	1	76	22.6207	0.369473	57.478	<a href="#">Detail</a>
1	evacuation	2	66	30.4121	0.441539	133.882	<a href="#">Detail</a>
1	evacuation	3	59	37.669	0.494048	349.759	<a href="#">Detail</a>
1	evacuation	4	42	54.7325	0.655825	763.787	<a href="#">Detail</a>
1	evacuation	5	35	59.8766	0.737245	2093.77	<a href="#">Detail</a>
1	evacuation	6	18	78.6377	0.647959	5006.39	<a href="#">Detail</a>
1	evacuation	7	12	83.5293	0.326531	14033.1	<a href="#">Detail</a>
1	evacuation	8	4	88.5997	0.127551	38568.6	<a href="#">Detail</a>
1	evacuation	9	0	90.3615	0	112220	<a href="#">Detail</a>

Figure 4-18. Detail of a PRS solution across the planning horizon

In the solution detail (Figure 4-18), ‘Period’ refers to the days of the planning horizon. In this example, the planning horizon consists of 10 days as aforementioned. Click ‘Detail’ button (see Figure 4-18) to see the detail information of the personnel schedule on a given day, as shown in Figure 4-19. Click ‘Detail’ button to see the map view of the personnel routes on a given day, as shown in Figure 4-20.



## RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR)

Dashboard Personnel Routings Cheduling

List of Personel Status Solution

keyword

Solution_id	Service Name	Period	Personnel_id	Team Member	Work Status	Resting Start Time	Working Start Time	Resting Finish Time	working Finish Time	Starting Location	Final Location	Detail
1	evacuation	0	0	Suci-ilham	1	12 : 54	00 : 00	00 : 54	12 : 00	6C_PMI Kota Mataram	6C_Villas Inn	<a href="#">Detail</a>
1	evacuation	0	1	Anto-Susi	1	21 : 14	09 : 06	09 : 14	21 : 06	6C_POLRI (Polres Mataram)	6C_East Lombok Dive Hotel	<a href="#">Detail</a>
1	evacuation	0	2	Agus	1	15 : 31	00 : 00	03 : 31	12 : 00	6C_POLRI (Polres Mataram)	6C_Villas Inn	<a href="#">Detail</a>
1	evacuation	0	3	Suci-ilham	1	12 : 42	00 : 00	00 : 42	12 : 00	6C_POLRI (Polres Mataram)	6C_Villas Inn	<a href="#">Detail</a>
1	evacuation	0	4	Anto-Susi	1	13 : 38	00 : 00	01 : 38	12 : 00	6C_POLRI (Polres Mataram)	6C_East Lombok Dive Hotel	<a href="#">Detail</a>

Figure 4-19. Personnel schedule on a given day

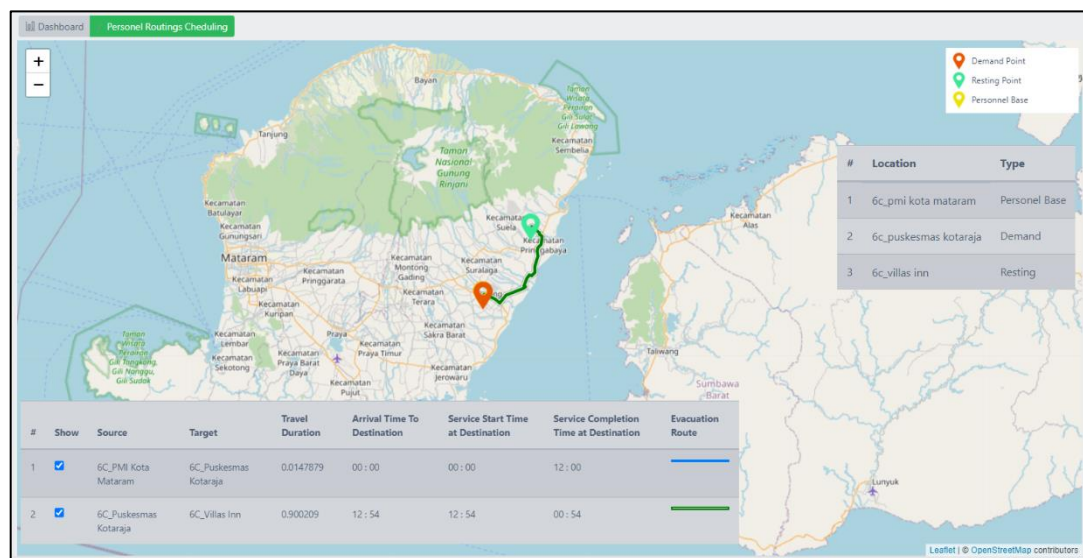


Figure 4-20. Personnel routing map on a given day

## 4.2 Video Tutorial

In the following link, we provide a video tutorial on how to run the PRS module: [Video Demo of the PRS Module](https://drive.google.com/file/d/1BxCjw9Imp4U5D1FaAO7zG8yF21fe6CFY/view?usp=sharing) <sup>11</sup>

---

<sup>11</sup> <https://drive.google.com/file/d/1BxCjw9Imp4U5D1FaAO7zG8yF21fe6CFY/view?usp=sharing>

## Concluding Remarks

---

The RESPOND-OR Decision Support System (DSS) provides two main modules for disaster response: i) Assisted Evacuation Planning (AEP), and ii) Personnel Routing and Scheduling (PRS) modules. The AEP module assists the disaster response agencies by providing recommendations for assisted evacuations based on four objectives, namely minimizing the number of opened shelters, minimizing the maximum evacuation time (hour), minimizing the evacuation risks, and minimizing the total travel time (hour). The PRS module assists the disaster response agencies by providing recommendations for personnel routing and scheduling for a single or multiple services in a disaster area based on four objectives, namely minimizing the number of unmet demand, minimizing the average completion time of the services, minimizing the gap between different locations in terms of the amount of services provided, and minimizing the transportation risk. A step-by-step guide and a video tutorial link on how to run each module is provided in this manual.

### Disclaimer

The RESPOND-OR DSS provides recommendations for assisted evacuation planning and personnel routing and scheduling. The users are responsible for the validation of the data input and the decisions made. The RESPOND-OR team is not liable for i) the data validation process, ii) any decisions made resulting from the use of the DSS, and iii) the misuse of the DSS.

## References

---

Gultom, Y., Haryanto, T., and Suhartanto, H. 2021. Route Subnetwork Generation using OpenStreetMap Data for Emergency Response Problem Modeling in Indonesia, *Proceedings of the International Conference on Advanced Computer Science and Information Systems (ICACSIS)*, 2021, pp. 1-6, doi: 10.1109/ICACSIS53237.2021.9631340.

Pirogov, A., Zografos, K. G., Sutanto, J., Kheiri, A., Suhartanto, H., Haryanto, T., Fathurahman, M., Sopha, B. M., Arini, H. M., Sakti, S., Abushama, H., Ali, H. H. S. M., Elbadawi, K.. RESPOND-OR: Modelling and Solving the Assisted Evacuation Problem for Natural Disasters: A Multi-objective Programming Approach. 2022. *Technical report*

Tarhan, İ., Zografos, K. G., Sutanto, J., Kheiri, A. and Suhartanto, H. 2022a. A multi-objective rolling horizon personnel routing and scheduling model for large-scale natural disasters, *Technical Report*.

Tarhan, İ., Zografos, K. G., Sutanto, J. and Kheiri, A. 2022b. Dynamic personnel routing and scheduling, *Technical Report*.

## Credits and Acknowledgments

### RESPOND-OR Academic Partners

Centre for Transportation  
and Logistics (CENTRAL)



Lancaster University  
Management School



### RESPOND-OR Stakeholders and Advisors



RESPOND-OR is funded by the UK's Engineering and Physical Sciences  
Research Council (EPSRC). Project Grant EP/T003979/1

