CHAPTER 1: INTRODUCTION

1.1.WHAT IS MOBILISE PLATFORM?

The MOBILISE platform is a data-sharing platform among various stakeholders that maintains data security with the host agencies. Also, the system provides a space for collaborative decision-making among the stakeholders using multiple research tools.

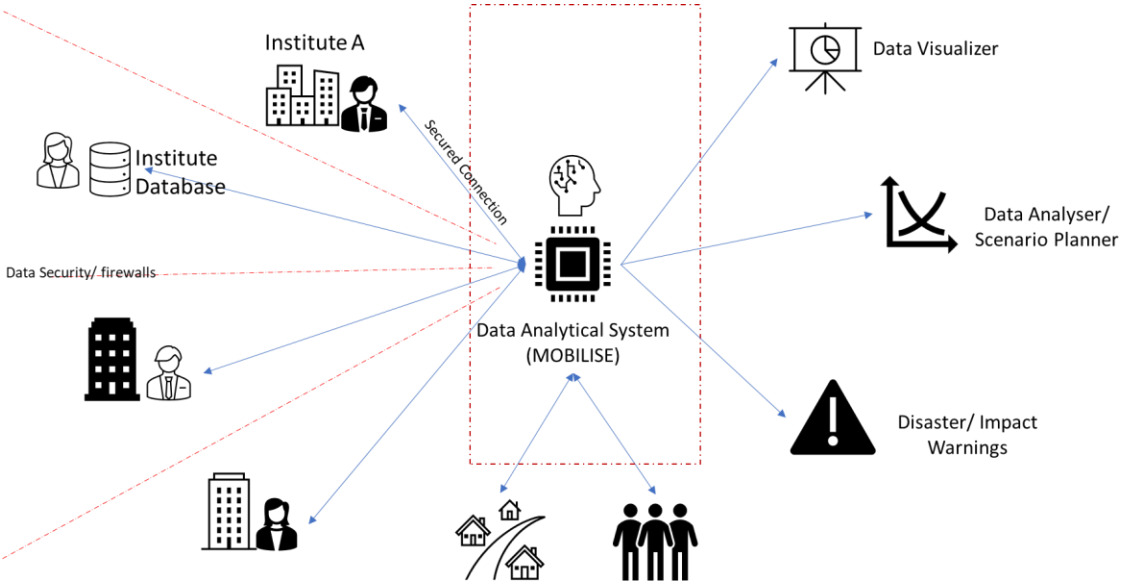
"The MOBILISE platform provides us with many increased capabilities for proactively managing our disaster risk reduction strategies. Disaster management is a long journey, and we must strengthen our institutional capacity. By using the MOBILISE platform, we're able to link our responsibilities and create a more systematic chain thanks to the technical data inputs."

Eng (Dr) Asiri Karunawardena -Director General

National Building Research Organisatioin- Sri Lanka

Kalutara LIVING-lab

Several studies have proven that data redundancy was practised in many organisations while conducting project activities, resulting in resource waste. Therefore, many isolated networks have much information needed for other organisations. Organizations are reluctant to share the data with other organizations due to misuse of the information.



MOBILISE 3.0 provides secure data sharing between the organisations. The data is stored in the Microsoft Azure cloud, which maintains a world-class data-securing system. The data is accessed through the Post SQL system, which manages the user credentials to access the information.

2. BENEFITS AND LIMITATIONS

The MOBILISE 3.0 provides various benefits to users. The benefits and its' limitations can be listed in the following boxes.

Benefits of MOBILISE 3.0

- Easy way to data sharing
- System Customised for decision makers
- Web based system
- No GIS (Geographic Information Systems) knowledge is needed for operation
- Password protected user logins
- Visualise data attributes
- Customised data visualisation
- Simple data interactions
- Simple data cleaning process
- Mata data management mechanism
- Availability of data filtering options
- Availability of preview of the data
- Facilitate customised scenario development
- Integration of sensor networks
- Access to disaster early warning dashboards

Limitation of MOBILISE 3.0

- Data sharing capacity per account – unlimited – limit with a license to 10 Gb
- Number of administrative logins – 1 number
- Number of user accounts – unlimited. (But in the future, this will depend on the license agreement)
- Centralised user login management
- No user activity recording system
- Basic GIS knowledge is required for data uploading
- Single data visualisation platform
- Vector data-based scenario builder
- Centralised sensor network management
- Internet connection required- Not tested on low-band widths
- Admins can delete the data

3. BASIC FEATURES OF THE SYSTEM

The following feature is integrated into the MOBILISE 3.0 system, and researchers are developing many tools in line with future developments.

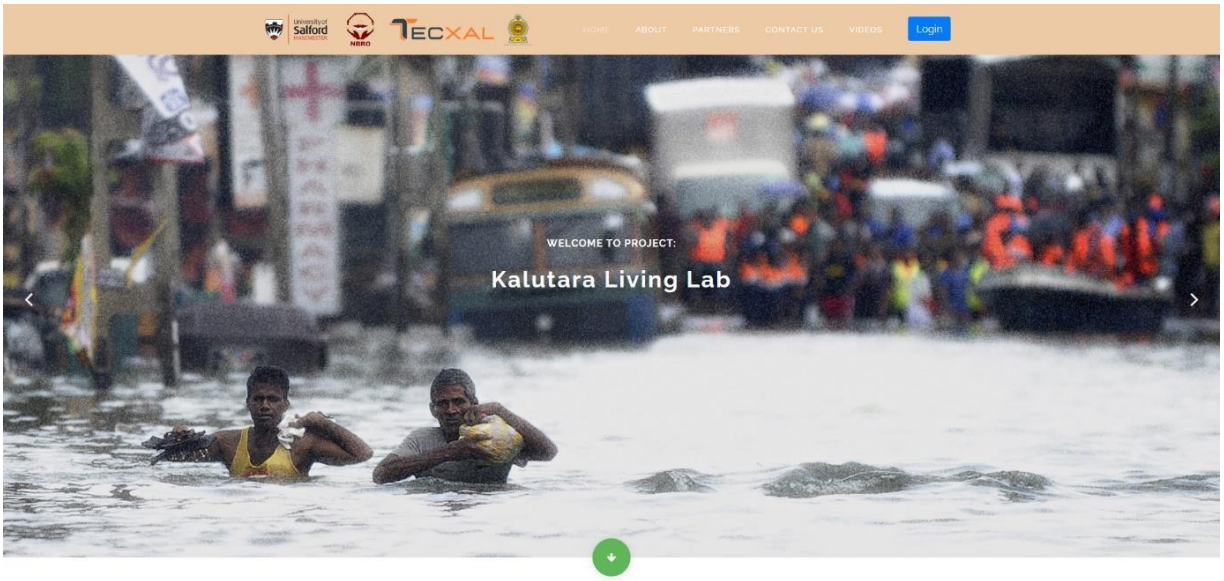
1. Data Engine
2. Data Visualiser
3. Scenario Builder
4. IoT (Internet of Things) Sensor Network

5. Early Warning
6. Drone Simulations

CURRENT USERS AND CASE STUDIES

The MOBILISE project was conducted in three main countries: Pakistan, Malaysia, and Sri Lanka. A living lab was established in each country, engaging with many stakeholders during the project implementation. The following section discusses each Living-Labs and the application of the MOBILISE platform.

LIVING-LAB@KALUTARA- SRI LANKA



Kalutara Living Labs offers a positive open innovation environment for government organisations, private organisations, academic institutions, and users (e.g., communities) to come together to build a common understanding of their problems and to co-create solutions that can solve their problems. Kalutara Living Lab has been set up to refine and confirm the MOBILISE digital solutions developed by the THINKlab at the University of Salford in UK, in collaboration with NBRO (National Building Research Organisation) and District Secretary of Kalutara, to support disaster risk reduction and climate change adaptation activities. The user can investigate the Kalutara living lab through the following URL: https://kalutara.mobilise-srilanka.org/

Project Partners

University of Salford MANCHESTER

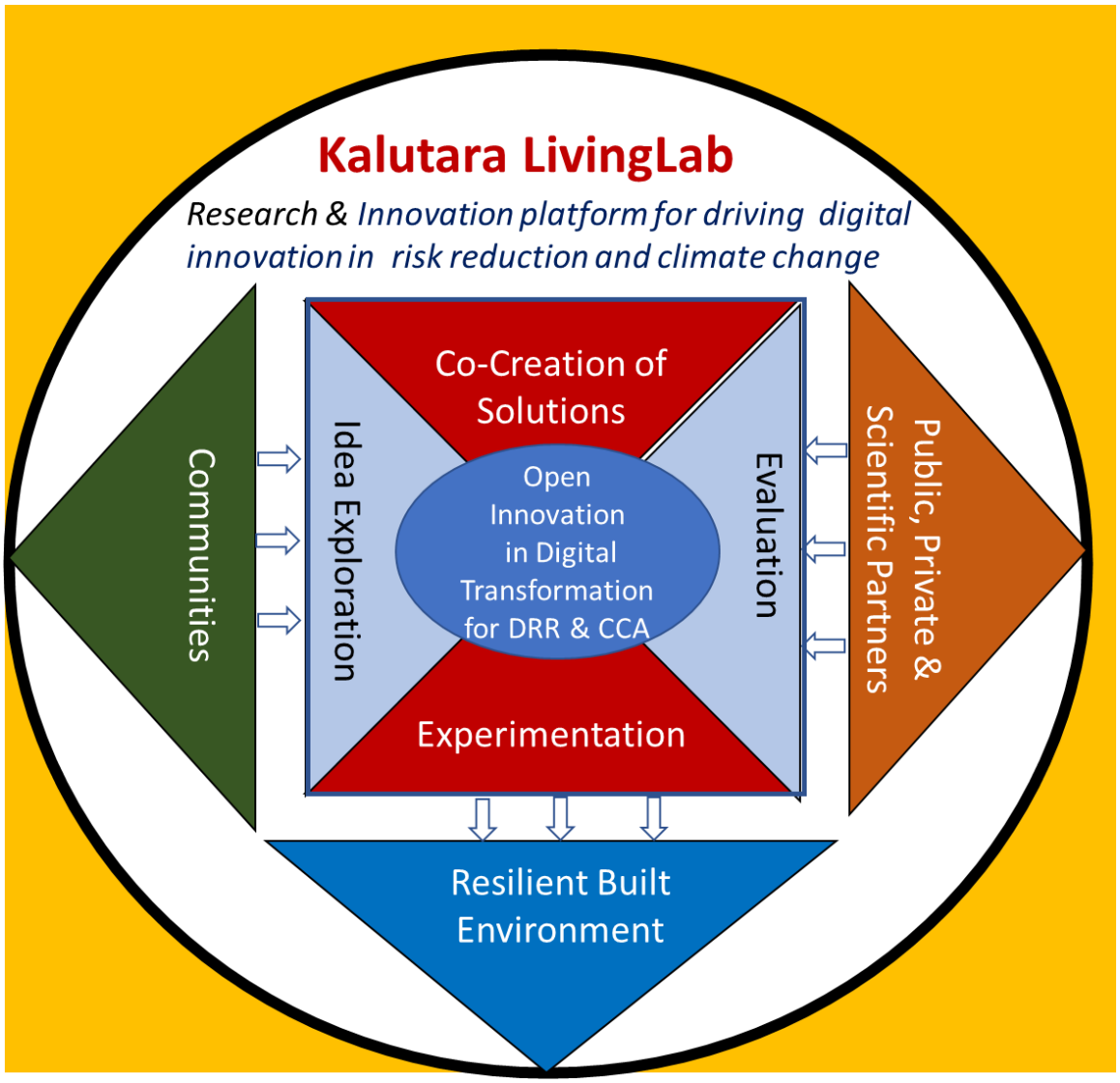
District Secretariat Kalutara

NBRO

Stakeholders

Land Use Policy Planning Department | Department of Meteorology | Irrigation Department | Urban Development Authority | National Disaster Relief and Services Centre

The concept behind the Kalutara LIVING lab is to create co-creation of solutions for the problems faced by the stakeholders, provide innovative technology for idea exploration from the community, and enhance the evaluation of public-private scientific partnership outputs. This unit aims to promote a 'Resilient Built Environment' in Kalutara.

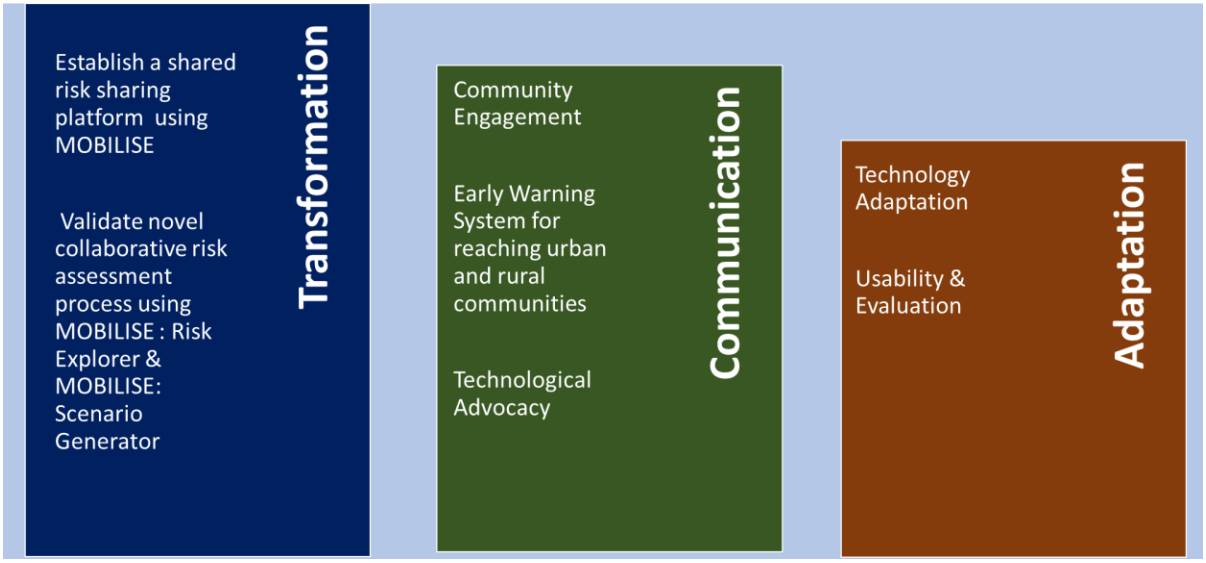


Within the Kalutara Living lab Context, the project team plans to refine, develop and evaluate the following digital solutions provided by the MOBILISE digital platform.

- ***Shared data*** *-sharing platform among stakeholders to establish a rich picture of the local risks.*

- ***Digital solutions*** *- to support collaborative risk assessment involving relevant stakeholders*
- ***Engaging with the community for disaster risk reduction activities****.*
- ***Early warning system*** *for reaching the community in both urban and digitally excluded rural areas.*

These research and innovation activities will be conducted under three themes: transformation, communication, and adaptation. Under transformation, innovation activities will be carried out to strengthen our data sharing and collaborative risk governance capabilities.



Under communication, technical and non-technical solutions will be tested to strengthen our communication with the community at risk and explore mechanisms for issuing early warnings to reach a wider community living in urban and rural settings. Technological adaptation and system usability will be tested under the adaptation category. The project milestones have been identified for continuing the activities.

CASE STUDIES AND EVALUATION METHODOLOGY

The purpose of the evaluation at this initial stage was to investigate the user satisfaction of the MOBILISE platforms in terms of:

- Does the system offer functions they want and need?
- Does the system offer the information that they want and need?
- Is the system easy to understand and use?

The outcome of this initial evaluation was then used to guide the further technical development of the MOBILISE platform to ensure users can use the platform to fulfill the intended tasks such as understanding local risks, risk assessment, risk communication, responding to early warning etc.

The following section provides such need assessment using two main application scenarios.

EVALUATION OF APPLICATION SCENARIO 1: ABILITY OF MOBILISE PLATFORM TO COLLABORATE IN IDENTIFYING COMMUNITIES AT HIGH RISK

This scenario aimed to demonstrate and evaluate how the MOBILISE platform can be used to integrate various data sources to establish a common understanding of local risks and identify the communities at risk due to landslides. The following process was deployed to develop a complete local risk view and identify the communities at risk, which led to the establishment of 30 community-based programmes to work with the communities to build their resilience.

Step 1: The following data was collected from various agencies and uploaded to the MOBILISE Data Engine to explore local risks.

Data Layers	Data Owner
Landslide Hazard maps	National Building Research Organisation
Landslide symptoms	National Building Research Organisation
Land use data	Land Use Policy and Planning Department
Building and Roads	Survey Department

Step 2 : Visualisation of the Hazard and Exposure Layers for identifying pockets of risks

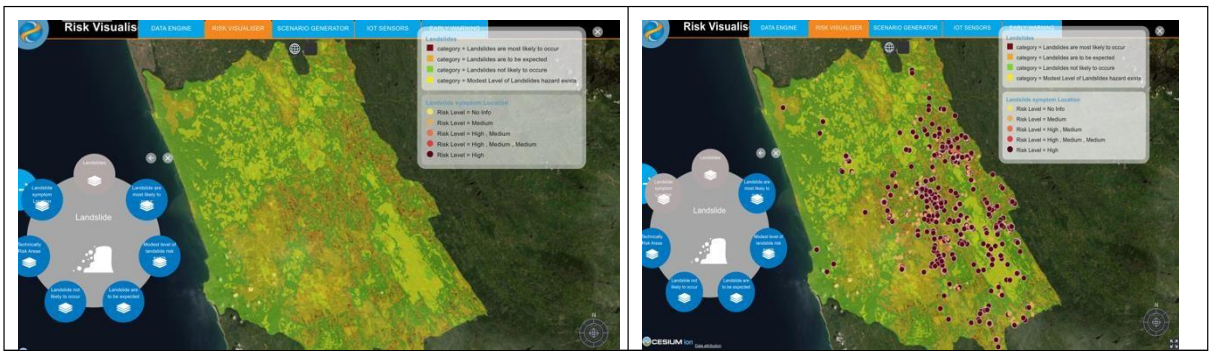


Figure 4a: Landslide Hazard Layer: The layer shows the landslide probability in four different classes as classified by the NBRO.

Figure 4b: Landslide Symptoms Layer: This layer shows the recent landslide symptoms identified by communities & NBRO officers. The map shows the overlay between the landslide hazard and symptom layers.

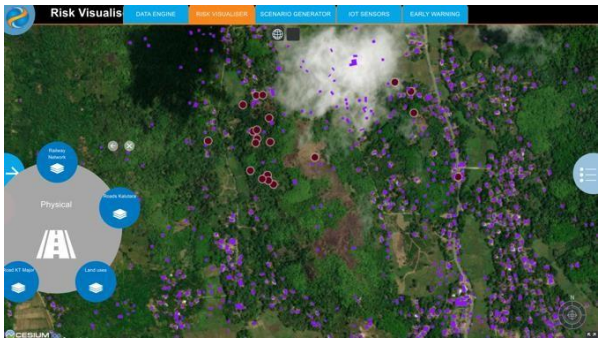


Figure 4c: Residential building Layer and with landslide symptoms layer: This overlaps the landslide symptom locations and building layer. The landslide symptom layer mark in red dots and buildings are represented in purple colour.

Figure 4d: Landslide flow path simulation: The landslide flow path simulation was derived based on the Yellow/Red zoning concept. The yellow zone represents the low-impacted areas, and the red zone shows the high-impact areas.

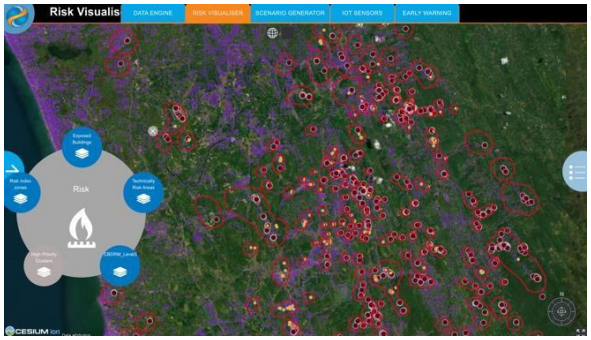


Figure 4e: Clustering of high-risk areas: The landslide clustering was conducted in the Kalutara district by considering the landslide symptom locations and landslide hazard zonation layer. Accordingly, 160 landslide high risk clusters were identified in the Kalutara District area. The red boundary shows the landslide high risk clusters in the Kalutara district.

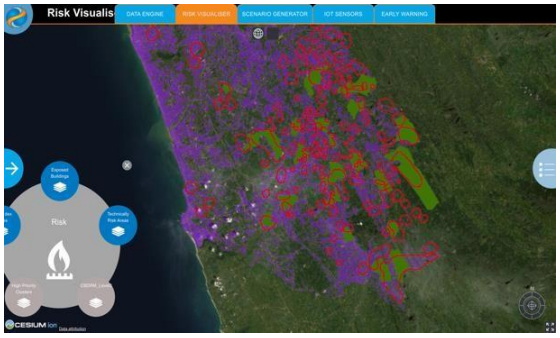


Figure 4f: 30 Chosen High-risk Communities for engagement: The results were communicated with the stakeholder agencies, and based on the feedback, 30 communities were identified for further investigations.

All this information were uploaded to the MOBILISE platform and shared with all the stakeholders. Separate user logins were created to access and upload the information from each institute.

Step 3: Presentation of the 160 risk clusters to the divisional secretaries and Grama Niladharies to discuss the local risks and identify 30 clusters for initiating community engagement activities.

Step 4: Assessment of risks of these clusters using a risk matrix. An example of the risk matrix developed for Diganna is presented in Figure 5 below.

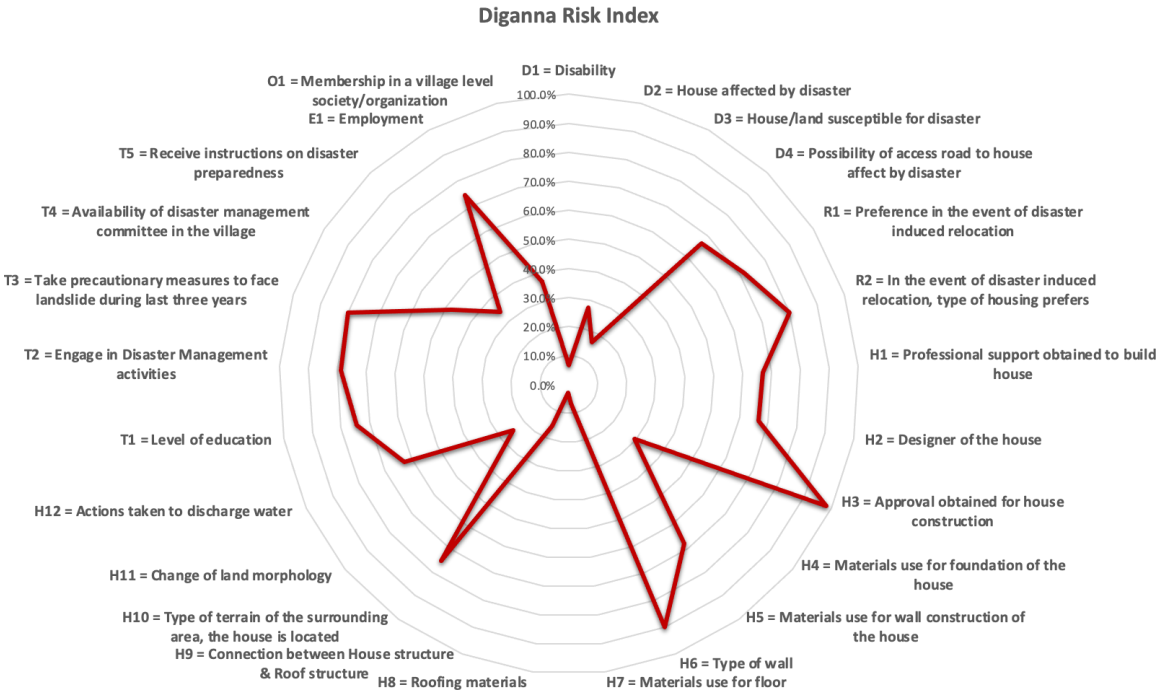


Figure 5: Risk matrix for the Diganna GN

A risk index was developed to monitor the risk status of the community by using the NBRO surveyed information under the risk profile development programme. The twenty-five indicators were developed to monitor the risk levels, and the peak in the graph presents a gap in the community.

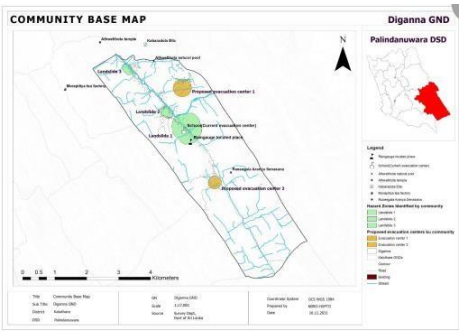
Step 5: Carry out a collaborative Risk Strategy Development involving the local actors (Eg. The following strategies were agreed upon for an area called Diganna).

Table 1: Strategy for addressing local risks at Diganna GN

Identified Strategies	**Strategies linking to RISK index**
Establish the Disaster Management Committee to Diganna area.	T1, T2, T3
Practice the Planning and Building Regulations for Building Construction and Approval.	H1, H2, H3, H5, H6, H10
Identifying the core economic value as trading and strengthening core value with infrastructure.	E1

Increasing the internal accessibility of the Diganna GN Division by strengthening the local road connectivity.	D4, R1, R2
Providing drainage system to discharge wastewater.	H12
Enhance the communication facilities	T5, O1

Step 6 : Conduct community to present the risk assessment in their local area and capture their concerns and proposals for risk reduction. (The following feedback was received from the community).

 Community-based hazard map was developed during the discussion.	 A community awareness programme was conducted before getting the feedback.

- ✓ Community is **requesting a safe location** during a disaster.
- ✓ Since the early warning system is not proceeding properly due to the unavailability of proper communication network. The community requested to **solve the communication issues**.
- ✓ Requesting to **investigate the new springs** which recently occurred around the area.
- ✓ Currently, the school is used as the evacuation centre, and the community requests a new on**e.**
- ✓ People asked to organize a CBDRM program.
- ✓ People request to **create a new village in forest areas** (Harambakanda/Thennapita) which locates in the GND.
- ✓ The community opinion is that the government allocates money only for resettlements, not mitigation actions. They requested to develop a mechanism to secure their current living space.
- ✓ Request to do **rapid investigation for high-risk areas**.

During the execution of the above application scenerio, the evaluation of the overall MOBILISE platform was conducted involving the following subjects:

- NBRO and DMC Officers who are interested in representing and communicating local hazards and risks to other local actors. (received feedback from 3 officers)
- Staff from the Land Use Policy and Planning Department who are interested in using the system to understand local risks to ensure their land use plans are risk-sensitive. (Received feedback from 2 officers)
- Staff from the District secretary who are interested in developing resilient communities and economic growth ((received feedback from 2 officers)
- District Secretaries and Grama Niladharies who are interested in developing resilient communities (presented to 40 Grama Niladharies and 14 district secretaries, and received feedback).

The following table summarises the overall feedback captured in order to further develop the MOBILISE platform.

Table. 2: Evaluation feedback from the stakeholders

Area	Features	Evaluation Feedback
Data Management	Data upload	Data upload process is not clear. Further training is required to understand the data upload and data styling features.
	Data cleansing	Some geospatial data is not positioned at the correct location on the map during the data preparation. Some GIS fields have field names which are not easy to comprehend. Therefore, it is important to provide support for providing meaningful names for such fields.
	User Management features	At present data in the data engine can be deleted by staff from other organisations. Therefore mechanisms should be in place to avoid others deleting the data by accident. Only the data owners should be allowed to delete data if necessary.
	Data ownership	At present the data ownership is fixed to one organisation.
	Data Configuration	The category names are fixed. The user should be able to define their own data categories.
	Visualisation of data layers	The scrolling feature of data engine interface is not visible and hard to manipulate.
Risk Visualisation	Layer visualisation	Not possible to scroll the layers in the legend interface as the number of layers grows.
Scenario Generator	Risk analysis	It is useful to provide support for analysing the local risks within different administration boundaries. The user should be able to explore risks at district and divisional levels and go down to GN levels based on their interest.
Useability	Menu system	Easy to understand, but some menus need extra support for traversing lists.
	Look and feel	Easy to understand the overall structure of the menu system

	Learnability	The system can be mastered within a short period of time.

The outcome of this evaluation has been used to prepare the MOBILISE platform for the final user validation.

EVALUATION OF APPLICATION SCENARIO 2: COMMUNITY-BASED MULTI-HAZARD EARLY WARNING SYSTEM

Step 2: Participants were chosen to have a good representation of different age groups ensuringgender balance as shown in Table 3 below. They were chosen from the Maragahadeniya area which was identified as a high-risk cluster during the case study 1.

Table 3: Profiles of Subjects chosen for evaluation

No	Group	Ages	Group Members
1	Gen Z	10 - 25	06 members in each group (03 Mens, 03 Females)
2	Millennials	26 - 41	
3	Gen X	42 - 57	
4	Boomers	58 - 76	

Step 3: The evaluation of MOBISense was conducted in two stages. During the first stage, a community discussion was organised to collect the baseline data about their challenges in receiving early warnings and the media they used to receive early warnings. This feedback is already summarised in Section 3. The initial MOBISense was installed on their mobiles for daily use.

Step 4: The second community workshop with the subject groups was conducted after 3 weeks to collect their feedback.

Figure Z : Workshop to receive community feedback on MOBISense

The following feedback was received from the participants:

- The community has frequently used the mobilize – sometimes daily on days with adverse weather conditions
- The community mostly use the app for obtaining weather forecasting
- The ability to report the incident is one of the motive features of the application
- The community has identified the "location-specific information" feature as one of the weaknesses of the app.
- The community requested the following additional features:
    - Ability to view the warnings for other areas (Other Districts and Divisions)
    - Ability to function in a low bandwidth network condition
    - Ability to view the app information in an offline situation
    - News/awareness material sharing feature

In addition to the above feedback, the community engagement experts from NBRO requested the following features:

- To provide registration of digital volunteers who can authorise community reported incidents rather than waiting for the government officials to authorise to avoid delay.
- Allow people to configure the app to receive early warnings from more than one location.
- Allow officers to access early warnings across the country.
- Ability to download the messages when connected to the internet and use them at offline locations to communicate messages to digitally excluded communities.

These features are now being integrated onto the MOBISense app before conducting the final evaluation.

APPLICATION SCENARIO 3 : INFLUENCING LAND USE POLICY TO ENSURE RISK-SENSITIVE URBAN DEVELOPMENT

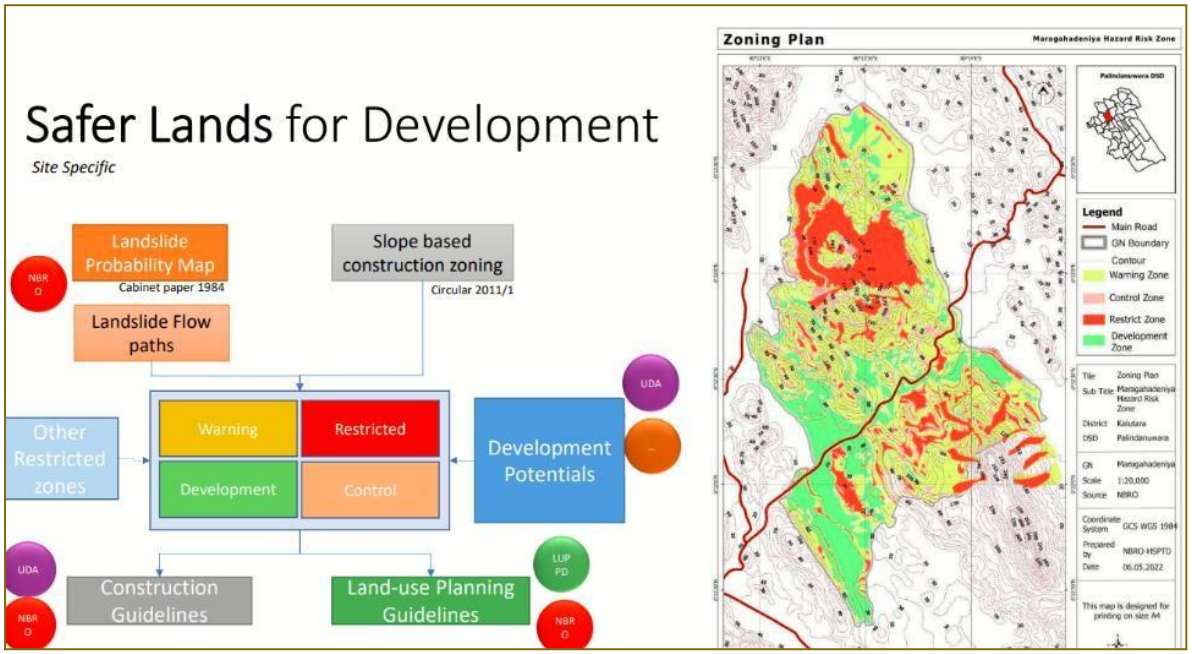


Figure 1: Hazard zonation maps developed by NBRO

A study is being carried out by NBRO in Maragahdeniya and Diganna in the Baduraliya Division of the Kalutara District, using the MOBILISE platform. These are two Gamaniladhari (village administration) divisions, in Baduraliya that were identified as high risk clusters during the first case study of this project. The NBRO is working closely with the communities in these two villages to build their resilience to disasters. As a part of this work, NBRO is using the MOBILISE digital platform to work with various agencies, such as the Urban Development Authority, Kalutara Land Use Planning and Policy Department to support safer land use in these two villages.

The current ongoing work includes:

- Hazard Zonation Mapping, taking current landslide threats into consideration
- Collaboration with Urban Development Authority and local partners to promote risk-sensitive development
- Working with communities living in hazard zones to build their resilience.

NBRO has inserted the landslide hazard digital layers to the MOBILISE platform. The hazard map includes layers based on landslides' potential and possible flow directions. During this mapping, the slope angles of the terrain has been used to define 4 hazard zones (Figure 8). The Red (Restricted) Zone resembles the areas with critical risks and therefore they are restricted for construction. The Yellow (Warning) Zone has comparatively less landslide risk, but the populations in the area can apply early warning measures for their safety while living there.

The Amber (Control) Zone is also with high landslide risk, but the areas in the Amber Zone can apply landslide mitigation measures to control landslides and the Green (Development) Zone is representing the areas that could be used for safer development.

However, due to the delays in structural mitigations and the relocation process, people are living in restricted, control and warning zones. They are currently 'living with hazards' and relying on landslide early warnings. Therefore, they must be vigilant of their surroundings and be well informed about potential landslide threats. But the restricted and control zones are unsuitable for future development. In the Warning Zone, future development is possible but must rely on early warning of disaster (landslide, flood). As a result, NBRO is planning to introduce the MOBISense app to enhance these communities' ability to receive early warnings to ensure their safety.

To make the development safer, these maps are to be compared with the area development plans of the Urban Development Authority (UDA), District Secretariat, and the Local Authorities. Discussions have been held with the UDA to promote risk-sensitive urban development, and to make some supportive standards. Work is underway within NBRO to study the existing guidelines of the UDA to make sure they fit into the risk-sensitive urban development concept.

APPLICATION SCENARIO 4 : CLIMATE-INDUCED SOCIAL IMPACT ASSESSMENT THROUGH MOBILISE SCENARIO GENERATOR

During the initial gap analysis and high-level user requirement gathering phase, several organisations showed interest in using the MOBILISE platform for conducting climate impact assessments. In response to this interest, NBRO is now using the MOBILISE platform to conduct a land use impact assessment and agricultural economic loss due to climate change. The Figure 9, below shows the planned process for this work.

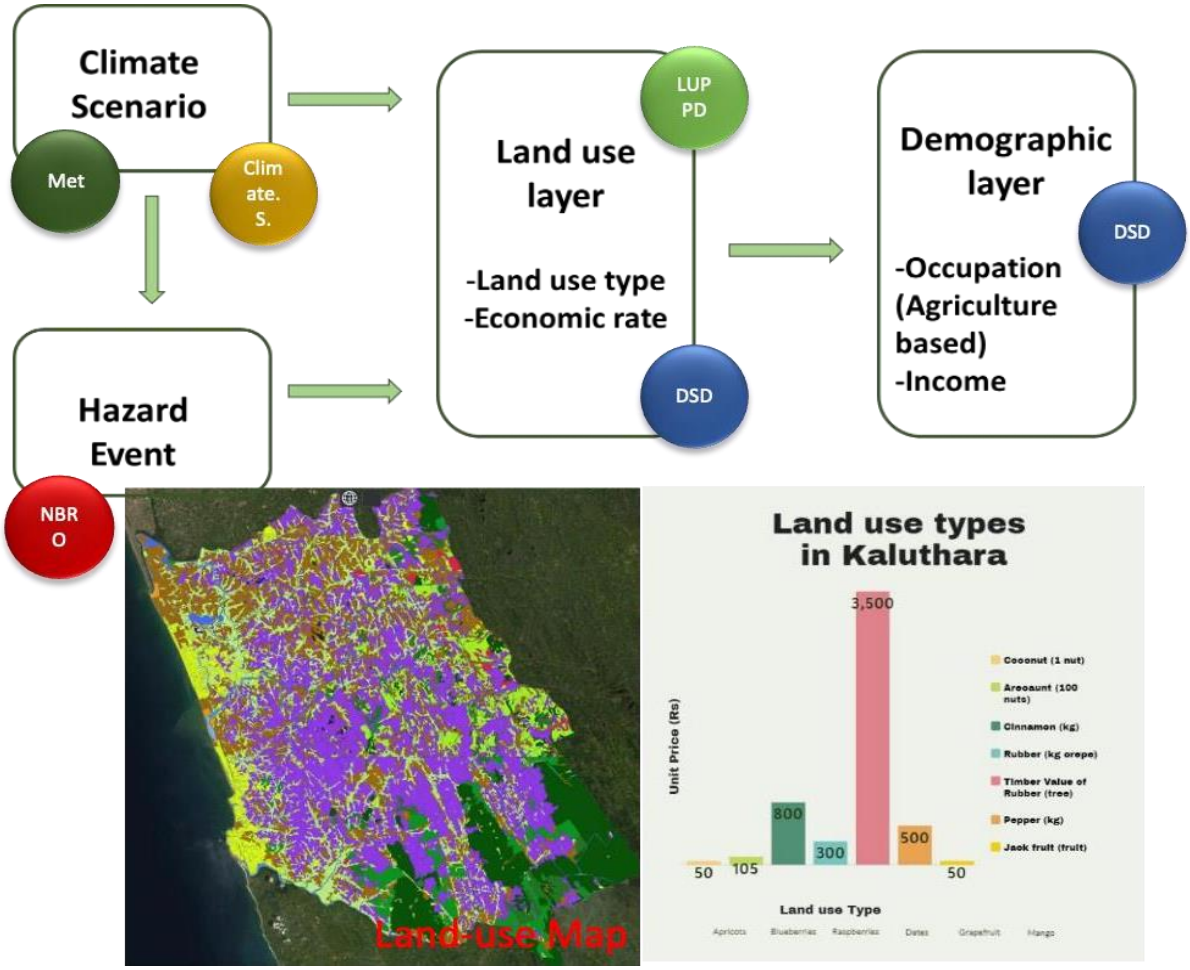


Figure 9: Approach for conducting climate change impact on land use and agricultural economic losses

In order to initiate this work, the Department of Meteorology (DOM) has already shared the anticipated Climate Change scenarios for 'Representative Concentration Pathway (RCP)' values 4.5 & 8.5 for Kalutara. In addition, the Land Use Policy Planning Department (LUPPD)has provided land use plans. NBRO is now working with the Department of Census and Statistics (DCS) to receive the demographic data. A combination of inputs from those technical agencies will be used to visualize the climate-induced disaster risk to communities and infrastructure. The MOBILISE Scenario Generator will then be used to identify the impact on the different land areas per different climate change scenarios.

MOBILISE PLATFORM (PROTOTYPE 1)

Figure 2 below shows the overall system architecture of the MOBILISE platform, which has been built on a micro-service architecture. It offers a set of cloud-based digital **services** for local and national government agencies to collaborate in building local community resilience. The current digital services provided by the MOBILISE 3.0 platform include MOBILISE: Data Engine, MOBILISE: *Risk Explorer*; MOBILISE: *Scenario Generator*; MOBILISE: *IoT*

Network Integrator; MOBILISE: *Early Warning System*; MOBILISE: *Community App – MOBISense.*

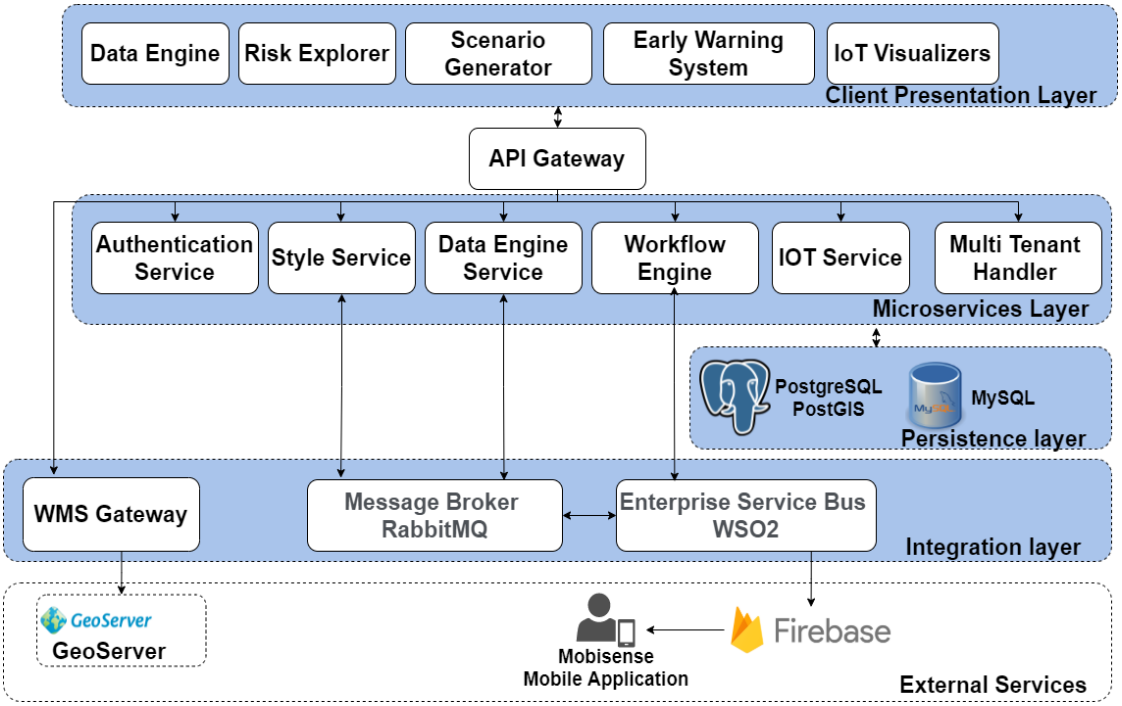


Figure 2: MOBILISE Platform

During the Pilot phase of this project, the digital services of the MOBILISE platform were refined and integrated as follows to prepare for the user evaluation:

1. A Dedicated MOBILISE platform node was created to support the collaboration among the partners (**https://kalutara.mobilise-srilanka.org/webapp/**).
2. Following the initial requirement captured from the users, the MOBILISE Data Engine was extended with the following features:
    a. Online registration and login features for the partners
    b. Three types of user roles (Superuser for setting up the node; GIS expert users who can upload data to the platform; domain experts who are interested in exploring data and making decisions)
    c. Specify the ownerships of the data loaded onto the platform

MOBISENSE MOBILE APP FOR EARLY WARNING (PROTOTYPE 1)

The initial requirement captured during the first phase of the project suggested the following requirements for the MOBISense App :

- Although the project is mainly focusing on landslide warnings from NBRO, it should provide an integrated app to receive warnings for floods (from the Department of Irrigation), and hazardous weather conditions (from the Department of Meteorological).

- Communities should be able to upload incidents to inform relevant government organisations and other community members of hazard incidents.
- Communities should be able to have access to river gauges to monitor the status of a river so that they can take necessary actions as they wish.
- The interface should be easy to use and support three languages (English, Singhalese and Tamil).

By taking these initial requirements as the basis, the underlying architecture of the MOBISense app was refined as presented in Figure 3. The implementation of this architecture involved redesigning the user interface to improve its feasibility as well as redesigning the MOBILISE: Workflow engine to support the management of the early warning message coordination among the government organisations as well as handling of the community engagement and their reported hazard information.

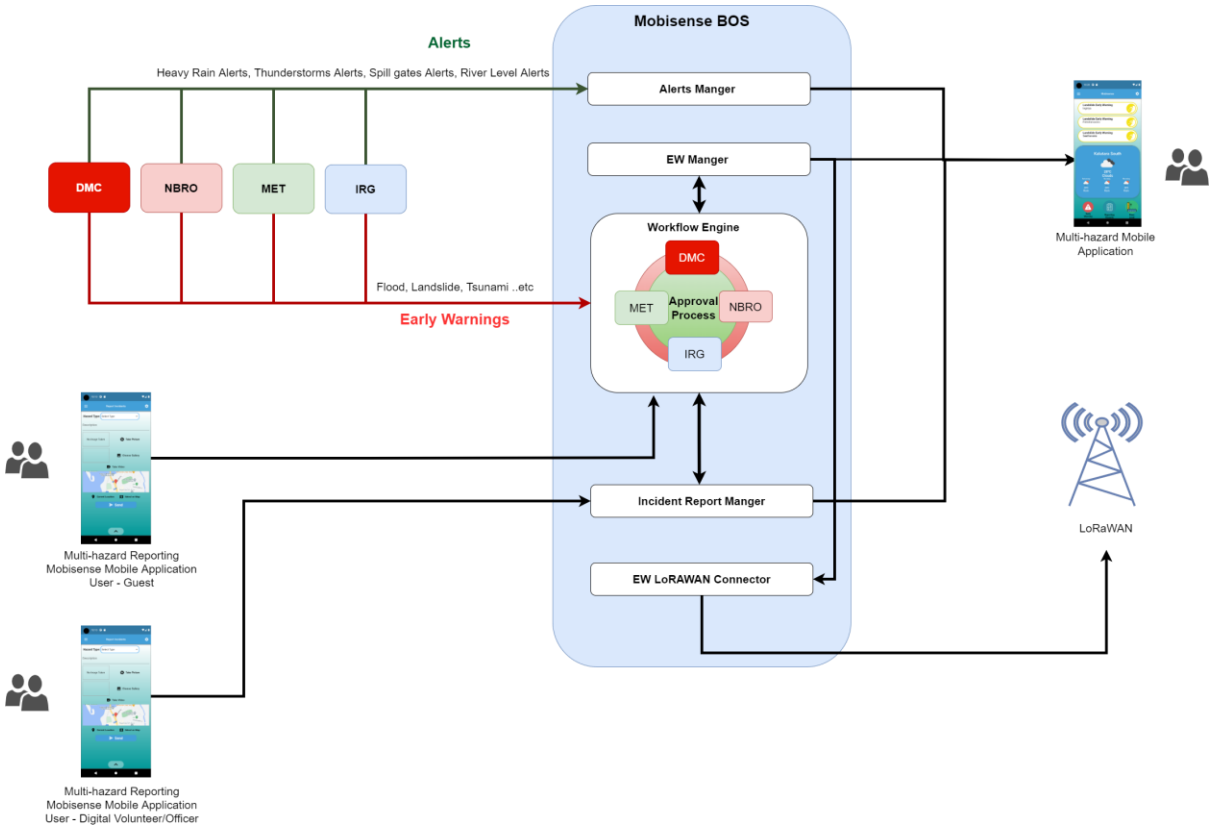


Figure 3: MOBISense EWS System and Mobile App

USER CONTROLS

The Mobilise system has different user control system to manage the data privacy. Therefore, in each organisation can nominate the uses in main three different categories: admin user, supper user, and basic user.

User type	**Description**
Admin User	This is the higher-level user in the system, and the person can add or delete the users to the system. Also, he can define the user roles in the system. Only a few admin officers considered as admin officers. Following are the admin officers to each LIVING lab node: • Malaysia – • Pakistan – • Sri Lanka –Dayan Munasinghe - d.munasinghe@edu.salford.ac.uk • Thailand – Susantha Jayasinghe – susantha@adpc.net
Specialist	This is the second level user in the system, and the person can add or delete the data layers to the system. This person should have adequate GIS knowledge and understand the data structure, coordinate systems, scales, etc.
Basic User	This is the third level user in the system, and the person can use the system to analysis and visualise the data. The person cannot upload any data to the system, or cannot do any modification to the system.

02
GETTING START

CHAPTER 02: GETTING START

BUILD THE USERR NARRATIVE

The user narrative is an important section of the MOBILISE platform. The users should create their own narrative before starting the process. Let's see a few samples to understand.

How can we develop the MOBILISE data visualisation?

01. Write the user story and what do the user want to present/ market.

Narrative 01 – "NBRO is engaged in the disaster risk management sector, especially in landslide hazard mitigation. NBRO identified landslide probability areas in the district and the socio-economic survey was conducted in landslide high hazard areas between 2016 to 2019. NBRO wanted to further assess the disaster risk situation and generate solutions to reduce the landslide risk in the community. NBRO developed a landslide risk index to prioritise the communities and identify suitable strategies for risk reduction. As a result, 30 GN (Grama Niladari) divisions were identified as the initial step to conduct the community-based disaster risk management programmes. These programmes were conducted in the community and identified the community-related issues. Two GN Divisions were selected to trial out MOBILISE project outputs and evaluate the user experiences."

Narrative 02 – "NBRO had experienced on damage assessment in several landslide activities of Sri Lanka. A damage assessment methodology was developed with the consultation of different stakeholders, especially valuation experts, and it was applied to the landslide hazards in 2017. We extended similar thoughts to investigate climate change's impact on economic crops. Climate change will trigger the landslide probability by increasing the rainfall levels, and these landslides impact on land uses. In addition, the climate will impact the production of different crops. These changes primarily affected the estate workers, and gradually their income is going to change. Therefore, these communities require attention to cope with disasters in the future"

Narrative 03 – "Kalutara district secretary has requested to identify safer lands in the Kalutara district at the beginning of LIVING lab. The project team has considered this answer a special request from the project partners. During the discussion, the safer lands in Kalutara are disaster-free, developable lands. "

02. The user has to identify the data availability in the stakeholder agencies.

Narrative	**Stakeholders**	**Data requirement**
01 – Landslide impacts	NBRO	Landslide Hazard Map, Landslide flow paths, Landslide symptom locations, building information, Community-Based Disaster Risk Reduction Programme information,
	LUPPD (Land Use Policy	Land use pattern,

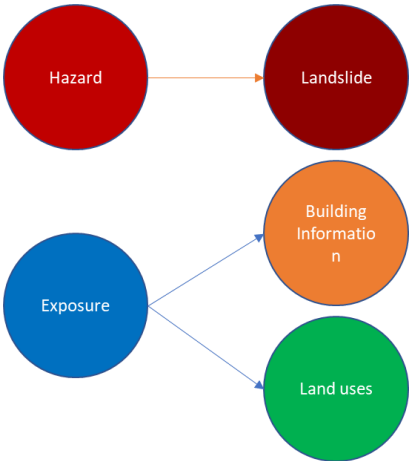
	Planning Department)	

Narrative	**Stakeholders**	**Data requirement**
02 – Climate-induced Social Impact assessment	NBRO	Landslide Hazard Map, Landslide flow paths, building information,
	LUPPD	Land use pattern,
	Department of Meteorology	Climate Change scenarios, weather information

Narrative	**Stakeholders**	**Data requirement**
03– Safer development	NBRO	Landslide Hazard Map, Landslide flow paths, building information, Resilient Construction guideline.
	LUPPD	Land use pattern, Land use planning guidelines
	UDA	Potential development criteria
	Department of Meteorology	Climate Change scenarios, weather information
	Irrigation Department	River gauge information/ flood zoning map

03. Develop a data classification diagram.

Here, we have to develop a data classification diagram to visualise the data more effectively. Narrative 1 expresses, landslide vulnerability in the Kalutara district and identifies the stakeholders for the project. Each stakeholder provides specific information to the platform, and it should be organised. Accordingly, the hazard information comes from NBRO, and the building information in the landslide-prone areas also comes from NBRO. The land use policy planning department shares the land use data with the system. Therefore, we can mainly classify the data into Hazard and Exposure. That has started to represent the landslide information and exposure combines building and land use information.



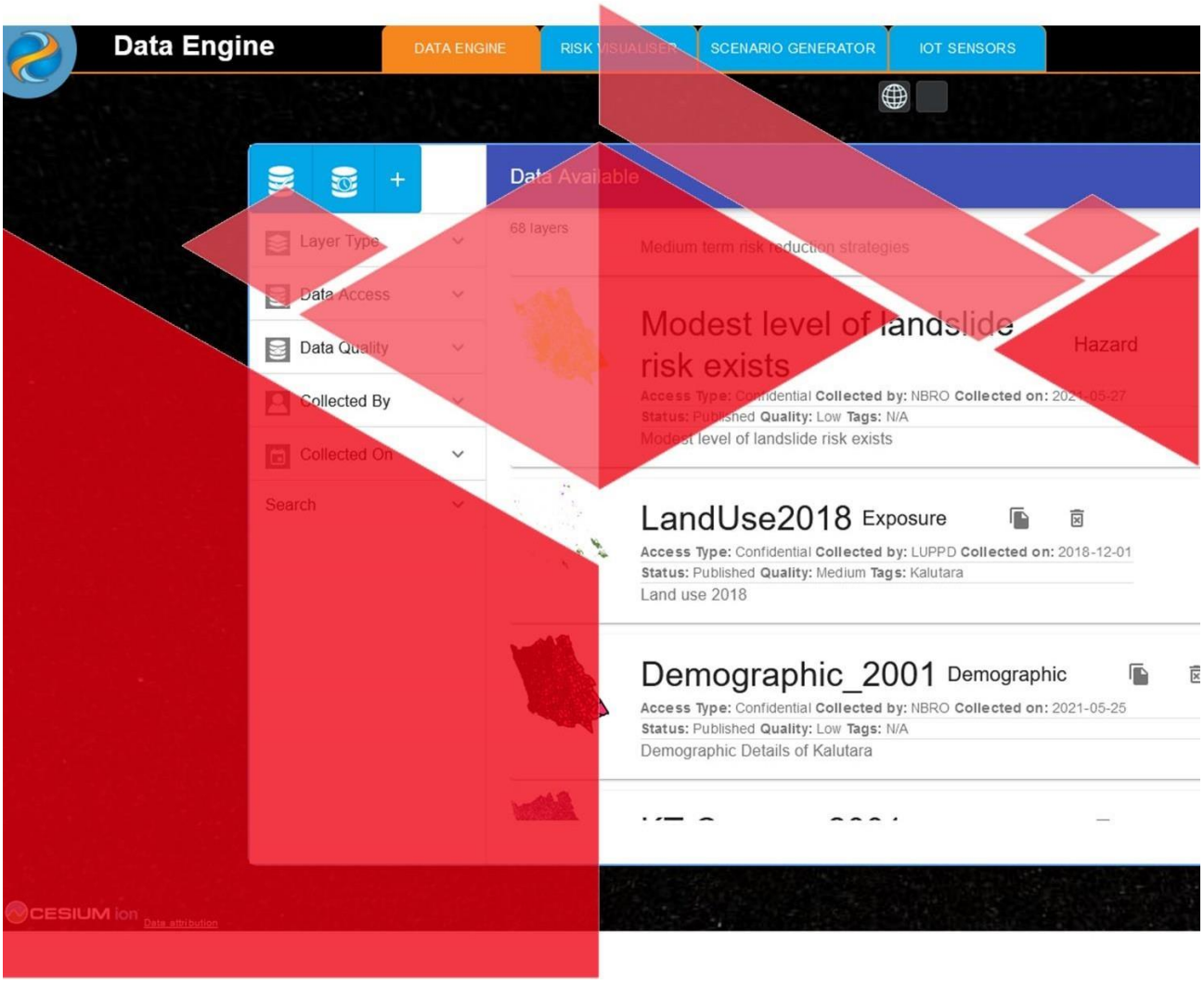
In the final stage of the classification, we can combine all the classifications into one, and then we can build our MOBILISE system interface. The data classification system for the Kalutara living lab is as follows. The final classification included the following groups: hazard, risk, background, human settlements, risk evaluation, and case study.

Class	**Description**	**Subcategories**
Hazard	This class integrates all the hazard information published by the various organisations in the Kalutara district. We can classify the data into different hazard types, such as floods and landslides. The flood zones were developed by gathering the information from the Irrigation Department and simulating the flood zones. Landslide hazard information was collected from the NBRO.	Landslides Flood
Human Settlements	The exposure layers were categorised into this group. This tab had five subcategories: physical, social, economic, environmental, and governance.	Physical: building, road, railway line Social: Census data 2011, population density, Census data 2001 Economic: economic sensitive zones Environment: Environmentally sensitive locations Governance:
Background	This includes general layers of Kalutara: administrative boundaries classified as Grama Niladhari, DSD and District level.	GN Boundary DSD Boundary District Boundary
Risk	Understanding risk is an important factor in the settlement. This section	CBDRM completed GN Divisions

	includes the pre-calculated risk information because of landslide hazard events. Several assessments were conducted by the NBRO officers, and they estimated the risk status of each community. The high-risk clusters were identified in the community and marked on the map. The Community-Based Disaster Risk Management (CBDRM) programmes were conducted considering the risk status. Finally, risk strategies were identified in each high-risk cluster to reduce the landslide risks. This information is presented in this section.	High priority clusters Technical risk assessment Pre-calculated risk buildings
Risk Evaluation	Every risk assessment needs to follow a risk evaluation procedure to understand the status of the risk reduction behaviour. The Disaster Crunch Model is a risk evaluation model most in community-based risk reduction approaches. We used this approach to disseminate the initial risk evaluation results to the stakeholders.	Risk Perception Fragile Forces Forcing Factors Undulating Forces Risk Mitigation

Once the user develops the classification system, the user are ready for the data preparation stage.

03
DATA PREPARATION



PREPARATION OF DATA

DATA FORMATS AND COORDINATE SYSTEM

The MOBILISE system is not designed for most of the data formats. Therefore, the user should develop the supported data formats for the MOBILISE system. Mobilise Platform stores and manages geographic data in several formats. The two basic data models that are used are vector and raster.

In a Vector Model, one way of representing geographic phenomena is with points, lines, and polygons. Vector models are particularly useful for representing and storing discrete features such as buildings, rivers, or parcel boundaries. Points are pairs of x,y coordinates. Lines are sets of coordinates that define a shape. Polygons are sets of coordinates defining boundaries that enclose areas.

In a raster model, the world is represented as a surface that is divided into a regular grid of cells. The x,y coordinates of at least one corner of the raster are known, so they can be located in geographic space. Raster data includes images and grids. Images, such as aerial photographs, satellite images, or scanned maps, are often used for generating GIS data.

The supported data formats are as follows.

Table 1: Data types for MOBILSIE system

Data Type	Formats
Vector Data	.shp (Shapefiles)
Raster Data	.geotiff,

ArcGIS, QGIS or any GIS-related software can be used to prepare the data. These data should have defined the coordinate system. But the MOBILISE system was developed by considering the EPSG 4326 (WGS84) coordinate system. Once user upload any file, it automatically converted to EPSG 4326.

Tip

It is recommended to upload the data in EPSG 4326 coordinate system to avoid many projection errors.

The Kandawala coordinate system was used for the Kalutara living lab datasets, and the properties of the coordinate system are as follows.

Coordinate system:
Kandawala / Sri Lanka Grid [EPSG-5234]

Properties

- Units: meters

- Static (relies on a datum which is plate-fixed)
- Celestial body: Earth
- Method: Transverse Mercator

WKT

```
PROJCRS[”Kandawala / Sri Lanka Grid”,
  BASEGEOGCRS[”Kandawala”,
    DATUM[”Kandawala”,
      ELLIPSOID[”Everest 1830 (1937 Adjustment)”,6377276.345,300.8017,
        LENGTHUNIT[”metre”,1]]],
    PRIMEM[”Greenwich”,0,
      ANGLEUNIT[”degree”,0.0174532925199433]],
    ID[”EPSG”,4244]],
  CONVERSION[”Sri Lanka Grid”,
    METHOD[”Transverse Mercator”,
      ID[”EPSG”,9807]],
    PARAMETER[”Latitude of natural origin”,7.00048027777778,
      ANGLEUNIT[”degree”,0.0174532925199433],
      ID[”EPSG”,8801]],
    PARAMETER[”Longitude of natural origin”,80.7717111111111,
      ANGLEUNIT[”degree”,0.0174532925199433],
      ID[”EPSG”,8802]],
    PARAMETER[”Scale factor at natural origin”,0.9999238418,
      SCALEUNIT[”unity”,1],
      ID[”EPSG”,8805]],
    PARAMETER[”False easting”,200000,
      LENGTHUNIT[”metre”,1],
      ID[”EPSG”,8806]],
    PARAMETER[”False northing”,200000,
      LENGTHUNIT[”metre”,1],
      ID[”EPSG”,8807]]],
  CS[Cartesian,2],
    AXIS[”(E)”,east,
      ORDER[1],
      LENGTHUNIT[”metre”,1]],
    AXIS[”(N)”,north,
      ORDER[2],
      LENGTHUNIT[”metre”,1]],
  USAGE[
    SCOPE[”Engineering survey, topographic mapping.”],
    AREA[”Sri Lanka - onshore.”],
    BBOX[5.86,79.64,9.88,81.95]],
  ID[”EPSG”,5234]]
```

Proj4

```
+proj=tmerc +lat_0=7.00048027777778 +lon_0=80.7717111111111 +k=0.9999238418 +x_0=200000 +y_0=200000
+ellps=evrst30 +towgs84=-97,787,86,0,0,0,0 +units=m +no_defs
```

Extent

79.64, 5.86, 81.95, 9.88

However, some data layers need to use additional parameter corrections while projecting the layers to EPSG 4326. The datum transformation factors related to EPSG 5234 are as follows;

Datum transformation parameters

SL 99 to WGS 84

X= - 0.2933

Y= 766.9499

Z= 87.7131

Kandawela to WGS 84

X= - 97

Y= 787

Z= 86

DATA PREPARATION MECHANISM

Once the user gathers the data, he/she should save it as a zip file (file format should be '.zip'). The user can select the files related to a specific layer and make them a zip file by choosing the "compressed zip folder" in the right-mouse-click menu. Different types of files are created with a shape file and a geo tiff file. All these files should select before converting them as a zip file. The number of files also depends on the software package used to create the layers. The below table shows the file formats included in each zip file.

Vector Files (shape file)	**Raster files (geo tiff)**
AutoCad shape source (.shp) AutoCad Compiled source (.shx) CPG file (.cpg) DEF file (.def) PRJ file (.prj) QMD file (.qmd)	TIF file (.tif) TFW file (.tfw) XML file (.xml)

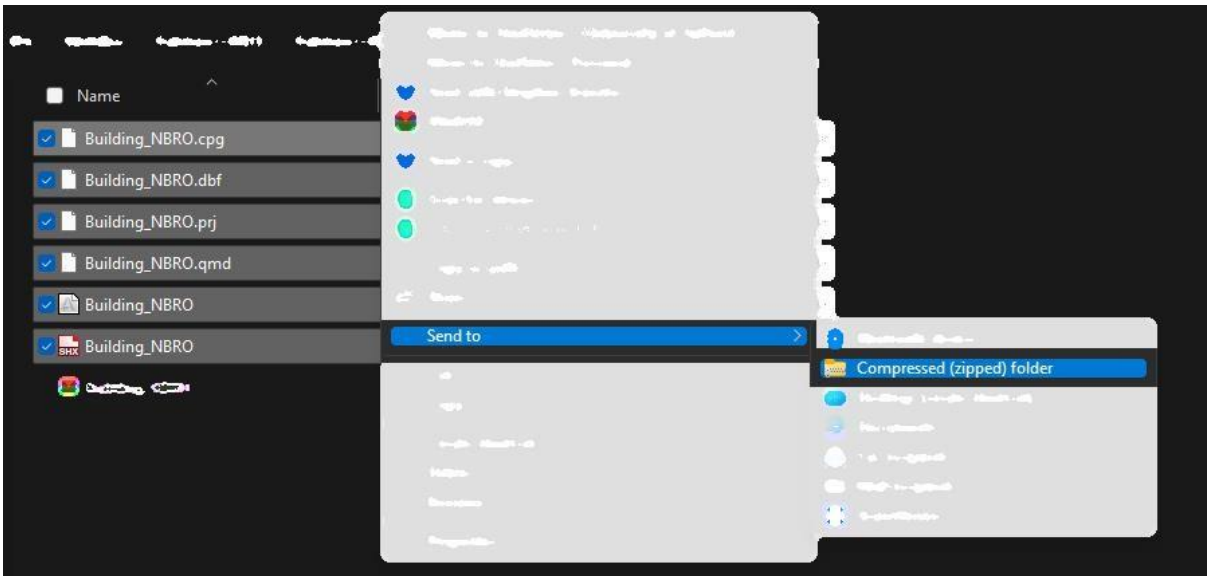


Figure 3: right click and select compressed to a zip

Tips:

- Before selecting the layers, remove the opened layers in the GIS software.

- Select all the files containing the layer name and select the compressed option.
- The zip file format should be '.zip' format.

warning:

- During the compression, the GIS layer should not be open on any GIS platform. If the user found the name phase of "LOCK" in the layer name, don't select that layer to compress.
- Do not use other compression software to do the compression work.

DATA UPLOAD

MOBILISE system has the capacity to upload the data into a shared space that can be accessed to the all the stakeholders. However, the user controls are introduced to manage the data privacy of each institute. Let's look at how we can upload the data to the MOBILISE system.

The MOBILISE system is a secured data space for collaborative decision-making among stakeholders. The user can login to the system by inserting the user credentials provided by the THINK lab.

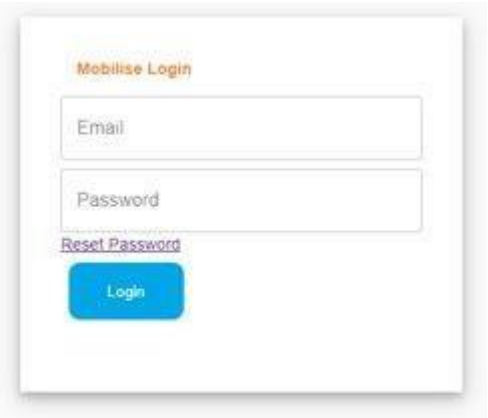
Contact us:

The stakeholders should contact THINK lab to get a secured space for their company/ institute. Once the process is completed, THINK lab will share a link to the requested email address, and the user needs to enter the password to the system.

warning:

The user should remember the username and password to log in, and no one is authorised to access the user space. However, if the user loses the user password, there is an option to request a new password.

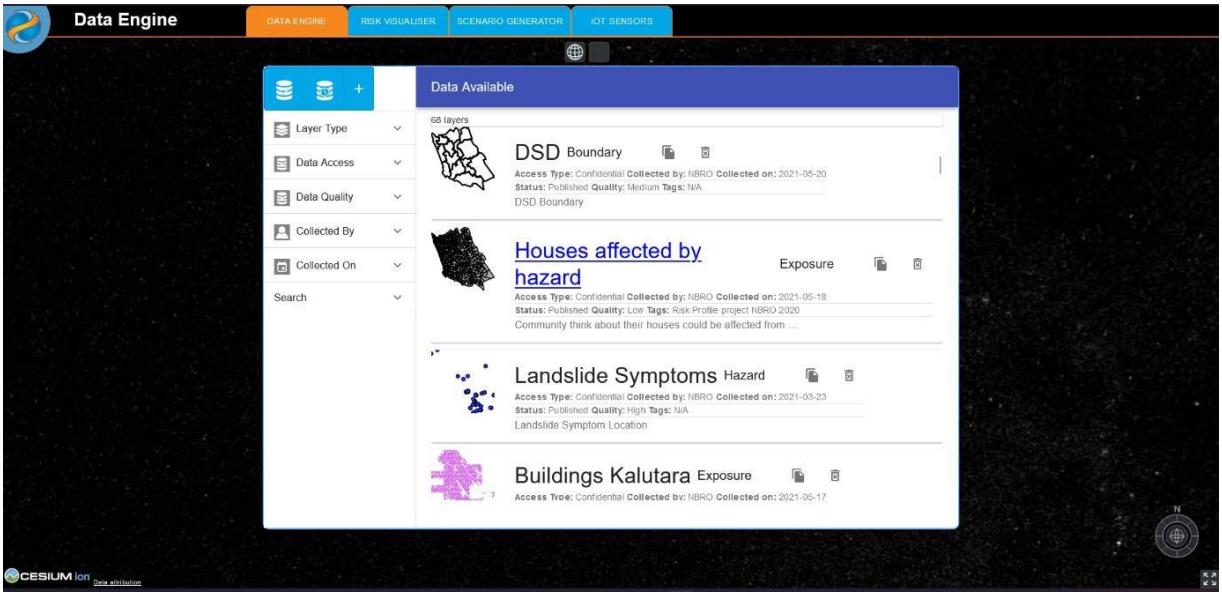
The living lab website provides a login direction to the web server, and a dialog box appears to enter the user credentials. In here, the user must insert the requested email address, and the generated password as the credentials. If the user forgets the password, use the 'Reset Password' choice to recover it.



There are three types of users in the MOBILSIE system: Admin user, Specialist user, and Basic user. Each user type has different facilities.

User Type	Description
Admin User	Capability to add or remove the users in the system and define the user's role within the node. The user can upload the GIS layers to the node and access many new services. This user has to understand the background of the MOBILISE system, and knowledge of GIS to solve many issues raised by the Specialist user and Basic user.
Specialist User	The user has GIS technical knowledge on uploading the data to the MOBILISE system. The user has the authority to upload or modify the information in the MOBILSIE system.
Basic User	The user has only the data visualisation facilities, and S/He doesn't require any GIS skills to operate the system. Most of the non-technical decision makers are in this category.

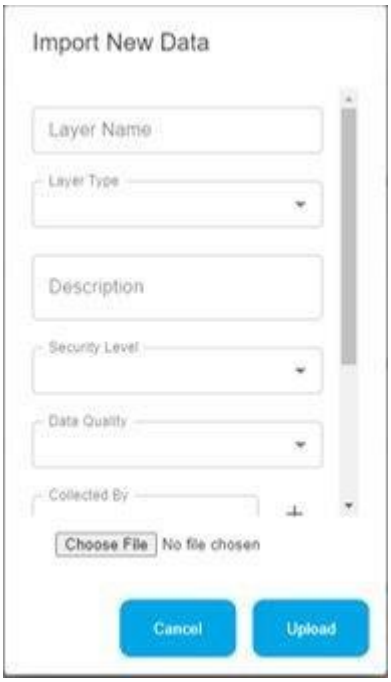
The successful user login reaches to the 'Data Engine', which is the data catalogue of the system. It shows the uploaded information, data filtering, data attributes, map view and many features. Let's look at each feature to understand the Data Engine.



The data available window is the default view of the Data Engine, and it shows all the data layers uploaded by different institutions. The left-hand panel consists of data uploading options and filtering options.

Click on the  (Plus) mark to upload new data to the system. Then a dialog box appears in the system and needed information should be clearly inserted to the system. This information

shared with the database and users can be understood by referring the meta data.



The following table shows the details of each metadata and how the user can insert the data in an acceptable way.

Parameter	**Description**
Layer Name	Data name, and it can be long up to 50 characters. This name is visible to everyone, and understandable name should be chosen for the layer. Don't use any special character for the file names. (!,@,#,$,%,^,&,*,(,),+,=,-. But you can use "underscore" (_), and space ( ) for the names. Use maximum word size as 25 characters.
Layer Type	There are pre-defined layer types in the system, and it can be categorised as follows. **Hazard Layer**: This includes the hazard, perturbation, disaster information which are either natural or man-made causes in the settlement. E.g., flood, landslide, cyclone, etc. The layer should be in vector format. **Exposure Layer**: All potential damage structures are listed under this layer. E.g., buildings, roads, land uses, social infrastructure, etc. The information should be in vector format. **Boundary Layer:** all boundary information should be listed here. E.g., administrative boundary, project boundary, etc. This layer should be in a vector format. **Risk Layer**: The risk information should be listed here. E.g., the earlier disaster events. The layer should be in a vector format. **Demographic Layer**: The population and housing census information should be listed here. Also, any other demographic

	information should be listed under this layer type. The layer should be a vector format. **Image**: The raster type data can be uploaded to the system through this layer type. E.g., aerial images, raster maps, etc. Resource:
Description	A suitable description should be written here and then, all the users can understand about the layer. The text should be limited to 150 characters.
Security Level	Data security level defines at this position. **Open data**: This is open access data, which is collected thorough open access. On the other hand, the institute can be nominated for the file as open data, then everyone has an authority to use the data without mentioning the source. **Confidential data**: This is confidential data, which cannot use without proper acknowledgement from the contributors.
Data Quality	Data quality defines in this stage. This is a personal judgement, and the institute can recognise the quality by comparing to the accuracy of the information. This can be classified as low, medium, and high.
Scale	*This feature will be considered in the future development. But time being, the user can insert the scale as a text message.*
Collected by:	The authorised agency should select the data owner institute, and if the name is not visible-try to add the institute to the system by pressing the '+' (plus) mark.
Date Collection on	We should mention the data captured date. Data format is DD/MM/YYYY.
Tag	Enter the geographic location name or administrative location name.
Uploaded by	*The account login details are automatically appearing in the metadata. If there is an error on the data, later admin can contact the user based on this tag.*
Recently Updated by	*Need to put the username.*

After completion of the metadata, now the user is ready for data uploading. Click the 'choose file' button to navigate the zip file and click 'OK' to upload the data files to the system. This will take a few minutes to several hours depend on the data size.

Take a cup of tea!

Once the user uploaded the data, the uploading window will close and automatically start the data processing stage. This is a completely automated process, and it will take a few minutes to several hours depend on the user data size. If needed, the user can switch off the user computer after during the data processing stage.

warning!

If the user thinks the data processing is taking unusual time, then there might be an error on the user layer. Recheck the user layer coordinates, setting and try to do the same process. If any issue, the user should contact his/her immediate trainer to solve the issue.

Activity

The MOBILISE admin should develop the data entering guidelines for entering the layer names and data descriptions. Thiis will create standardize data set in the MOBILISE environment.

Once the data uploading and data processing stages are completed, a dialog box appears, and the user can see the layer meta details and attributes. Data cleaning is an important stage, and the data attribute table was designed to change the names or delete the unnecessary data columns. The user can visualise the data before publishing, and to do this, there is an on-off button at the top-left corner of the dialog box.

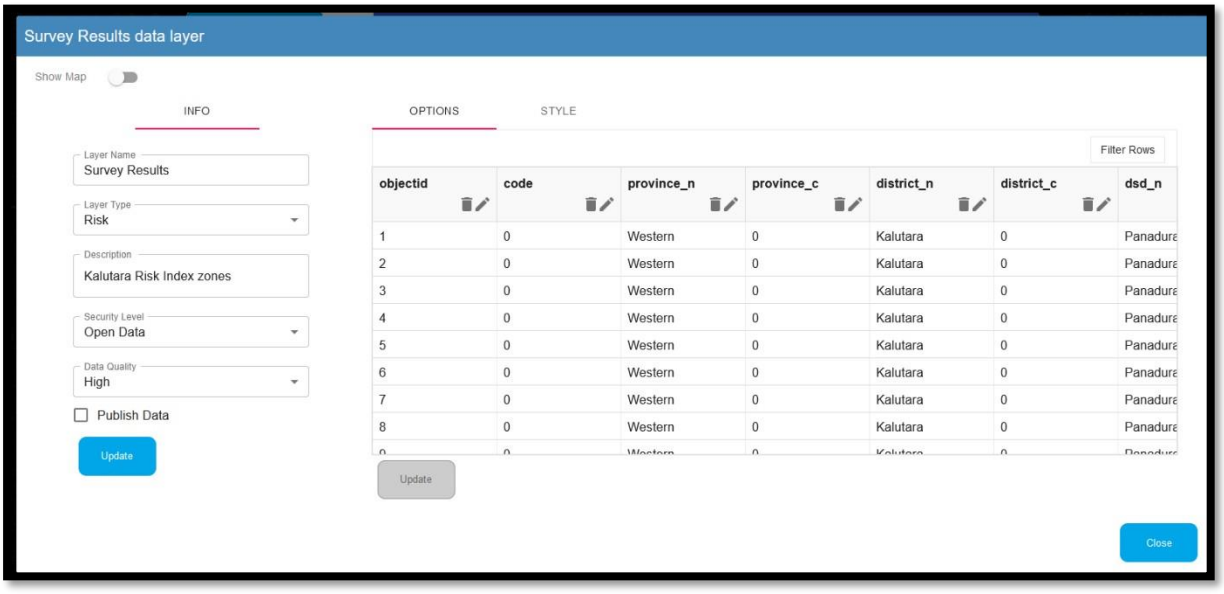


Figure 4: Data attribute table

Now the user can style the layer by considering the attribute values. There are different filter options in the styling, and based on the styling filtering option, the styling procedure is changing.

Suggestions:

Vietnam team suggest having an ‘Undo’ button in the Data Engine, the if accidentally removed a column then they can role back the system.

RASTER DATA

The user needs to select the image option when uploading the raster data in to the MOBILISE system. The file format should be in TIFF format, and it take considerable time to upload the image based on the pixel quantity.

Once upload the raster data, the system automatically processes the image and following window appears. The window gives the option to select the transparency colour on the image.

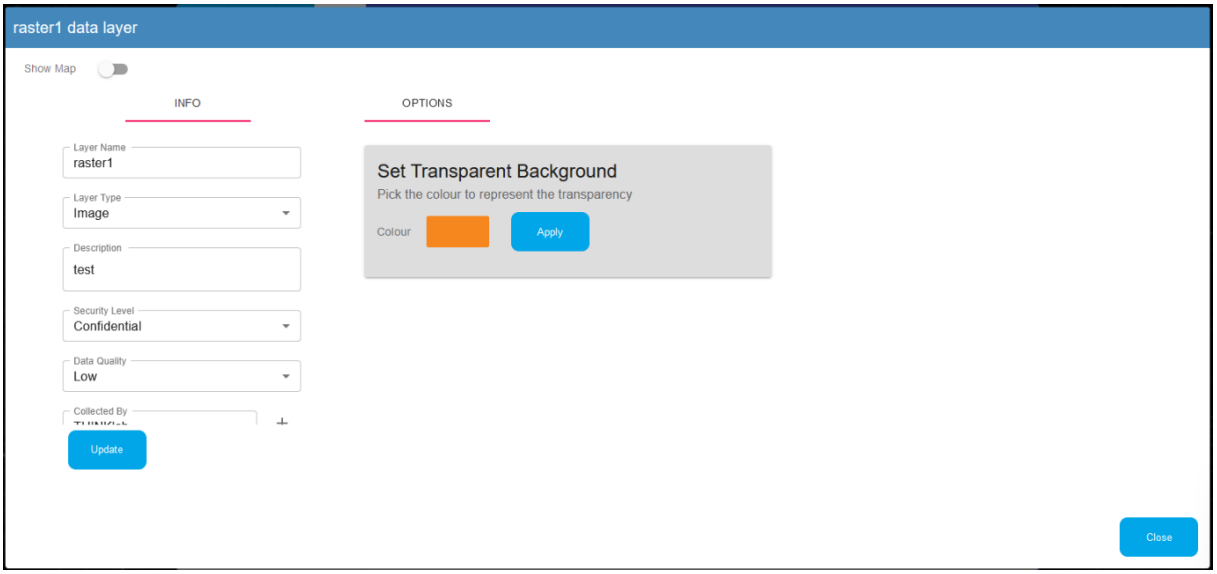


Figure 5: Raster image processing window

STYLING FILTER: SINGLE

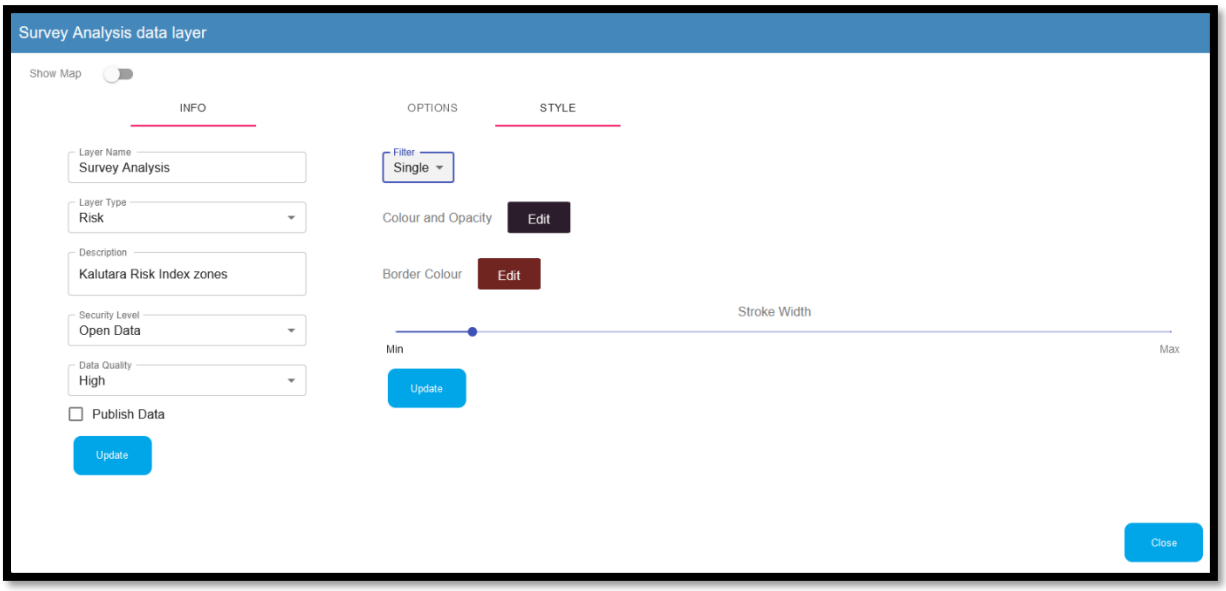
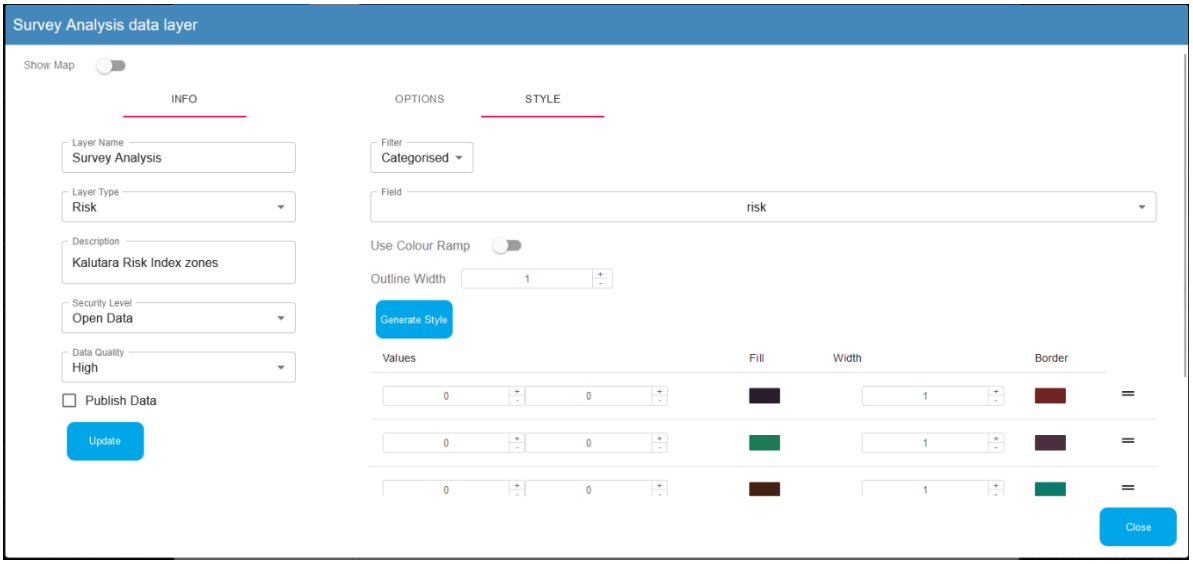


Figure 6: Styling filter- Single

There are a few options in the single styling: colour and opacity, border colour, and stroke width. This option is to colour the layer in one colour. As an example, the user can colour the boundary layer. The user can click on the "Edit" coloured button in front of the "Colour and Opacity" label to change the colour of the layer. Similarly, the user can change the border colour by clicking on the "Edit" coloured button in front of the "Border Colour" label. The stroke size can be changed by using the below scale bar and it has a minimum (=no line) and maximum size (=10).

STYLING FILTER: CATEGORISED

The next styling filter is "CATEGORISED", which can visualise the attributes in different colours.



Once the user selects the categorised filtering option, then the user has to identify a field attribute in the dropdown menu for the styling purpose. If the selected attribute is a scale data, then the user should enable the “Use of Colour Ramp” slide bar to generate the classes in the attribute. The system auto-generates the classes based on the selected attribute.

A histogram shows in the window, and the breakpoints can be adjusted. The user can use the mouse pointer to adjust the default natural breaks. The number of breakpoints and the stroke width can also define. The following figure shows the histogram chart used for the classification of scaled data.

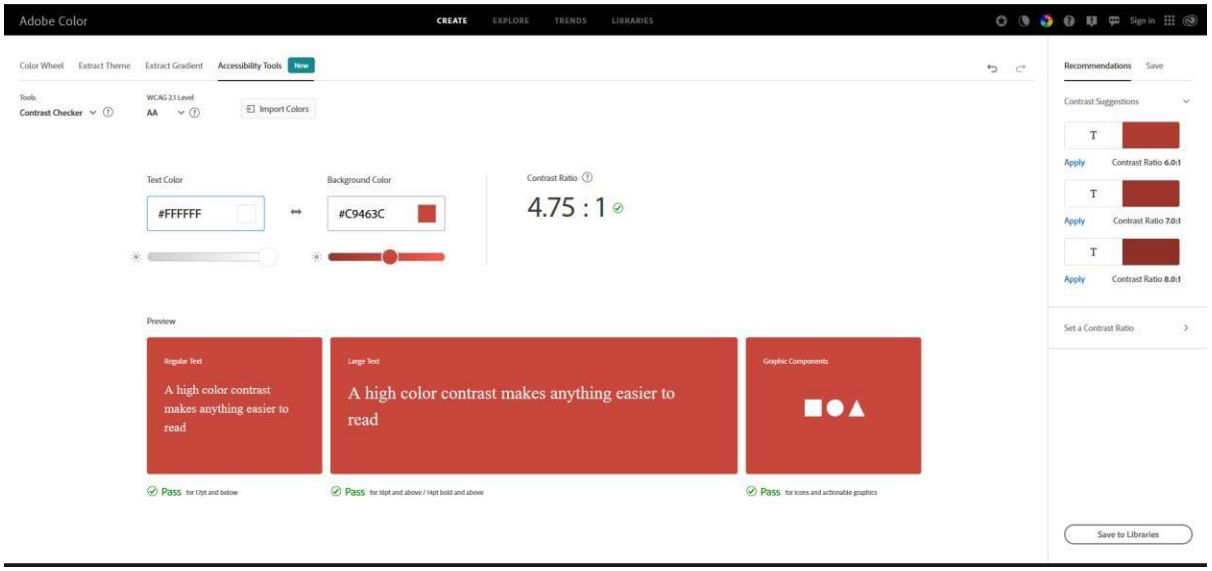
Research

Research studies are ongoing to improve the data clustering and classification methods. Most GIS software has similar classification methods to grouping the data: Natural breaks, percentile breaks, etc.

Figure 7: Categorised the scaled data attributes

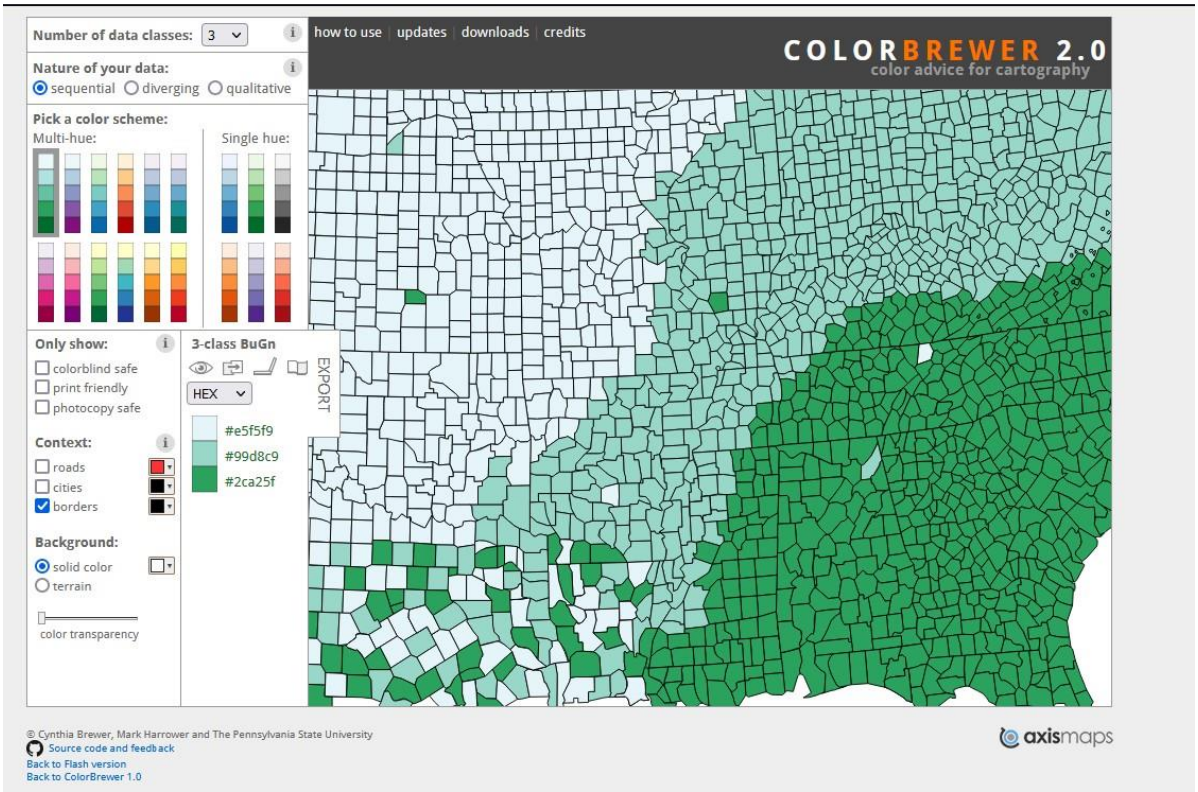
It is essential to select the appropriate colour scheme to represent the data. There are several free sources that can be used to get ideas to select the colour codes.

- Adobe Colour - https://color.adobe.com/
  This has different toolsets to check the colour accessibility, and it guides to develop proper outputs.



- Colour Brewer2 - https://colorbrewer2.org/

This will also have tools to select colour codes, and the user can get the colour code values.



However, the selected attributes are set data, then the user should click the “Generate” button to create classes. The system automatically classified the classes values. If the data is in numerical format, the system auto-generates five classes with the range adjustments. If the data is in text format, the system auto-generates the number of classes based on the attribute names.

The user can change the order of the classes by dragging the "=" at the left corner of the class.

warning

User should have a clear understanding about the data type before starting the styling.

Once the user completes the data classification, the user is ready to upload and share the information with wider stakeholders.

Tip

The system is designed for the interactive data environment, and it is recommended to use the layer opacity option during the styling process. It will give several benefits to the risk visualiser. If the user use two layers with the data opacity levels, then it is easily understood the layer combinations.

60% opacity levels were used in most of the vector layers in the Kalutara LIVING-lab project.

PUBLISHING THE DATA

There are main three icons in the 'Data Engine' window which show the different stages of data uploading and publishing.

Data Available	This tab shows all the published data in the MOBILISE system. Users can select the data from the list for their visualisation or scenario analysis purposes.
Data in Preparation	This is a user-specific environment during the data uploading mechanism. All the data cleaning and styling activities conduct in this environment.
Import New Data	This is the data uploading window. All the layer information is required enter to the dialogue box.

After the data cleaning and styling, the user can publish the data to the 'Data Available' tab by clicking the check box below the left corner of the window. However, the user should click on the update button once any changes are made to the layer styling and data cleaning activities.

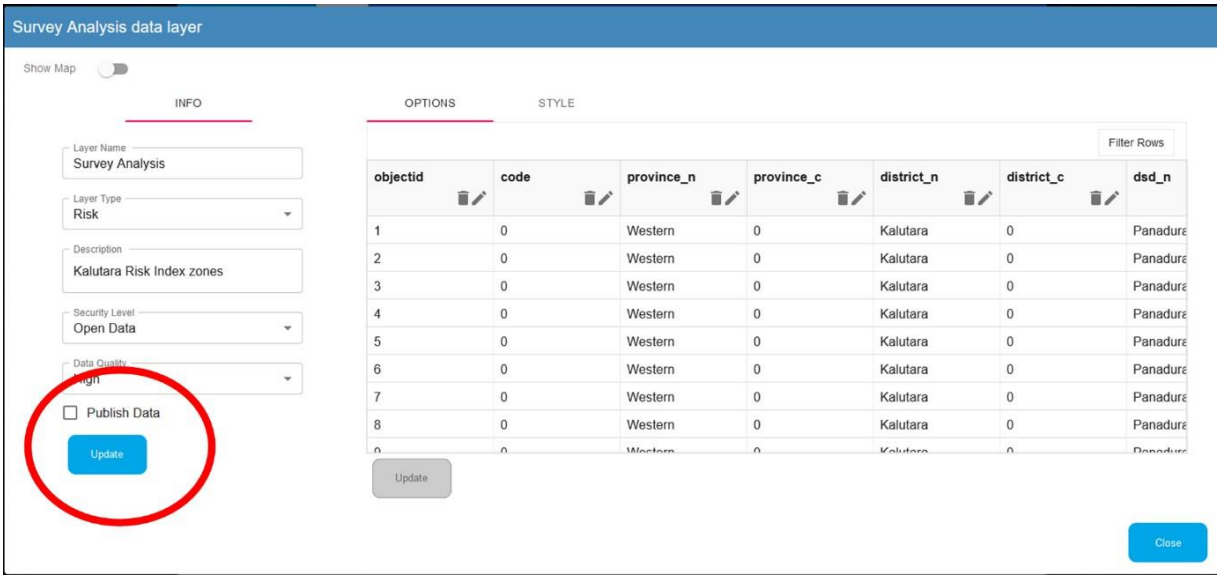
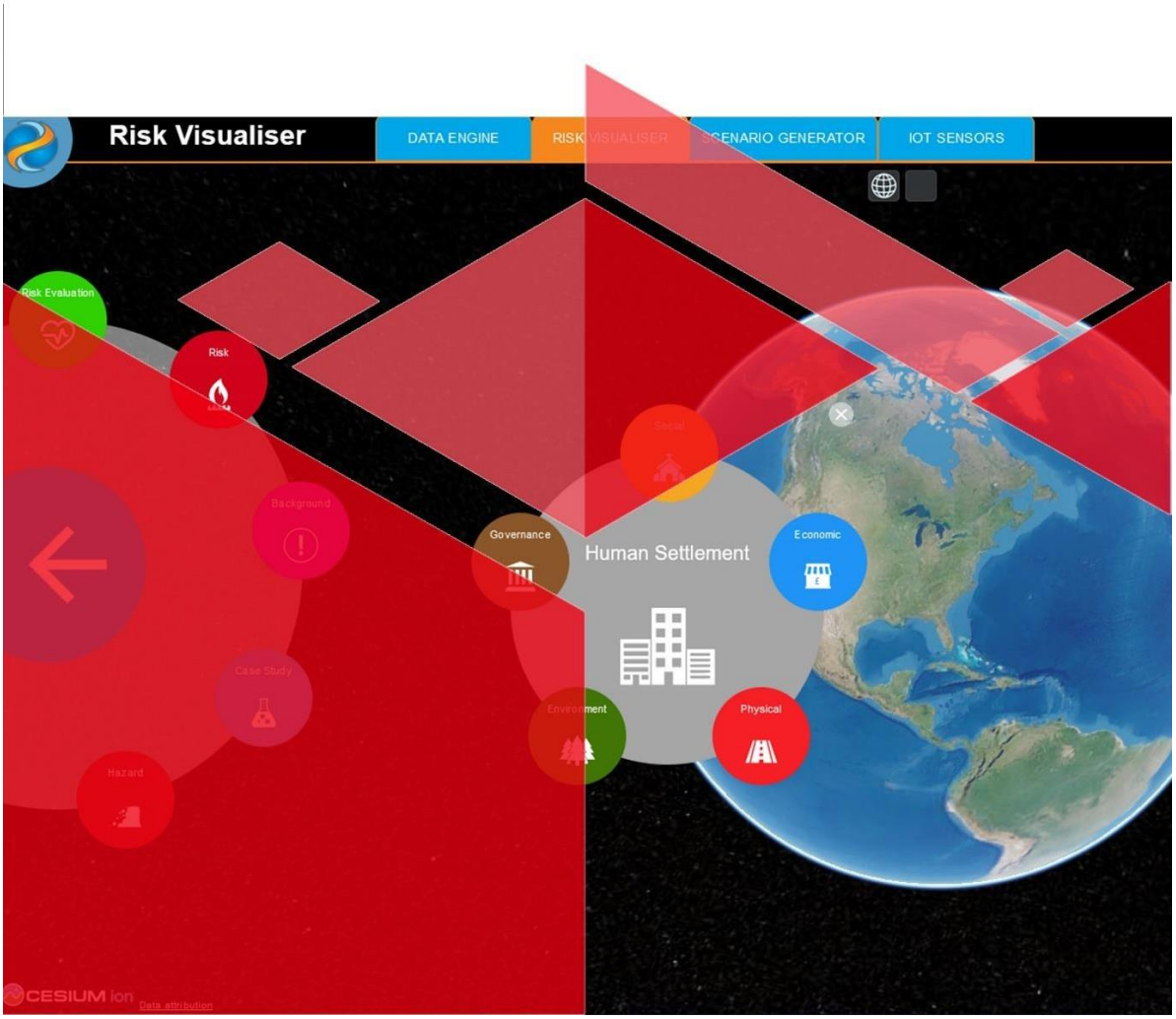


Figure 8: Data Publishing

04
DATA VISUALIZER



DATA VISUALISATION

This is the data interactive tab for the stakeholders, and they can create their narrative based on the requirement by using the uploaded information. Figure 9 shows the interface of the 'Data Visualiser'. The interface has an arrow key at the left middle of the window, and it shows different data categorised according to the narration. Different data catalogue can be developed based on the categorisation, and the data layers can be connected to each. Let's explore these statements in step by step.

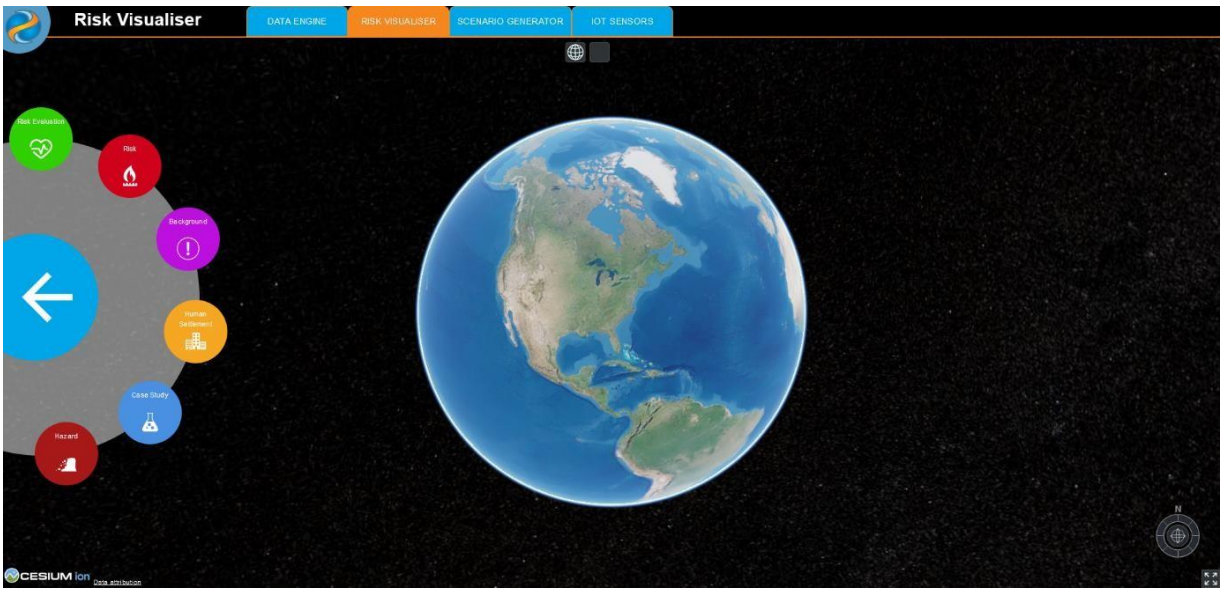


Figure 9: Risk visualiser

CREATING DATA CATEGORY

In this section express the creating of a data category in step by step.

1. Users need to click on the mobilise symbol at the left-upper corner, and then select the "Configure Categories".

2. Once selected the 'Configure Categories', a dialog box appears to add categories to the system. Click on the add folder button at the left top corner of the window to create a new category. In here, user need to enter the category name and need to assign symbol and colour. Previously entered data categories also shown in the window. Similarly, different categories can create based on the user narratives.

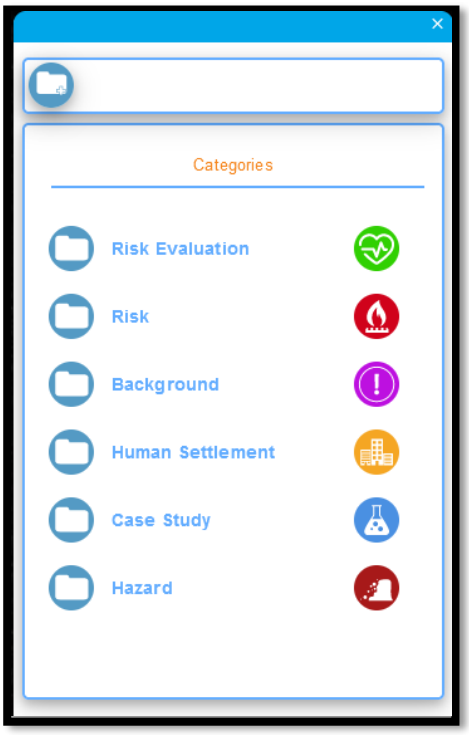
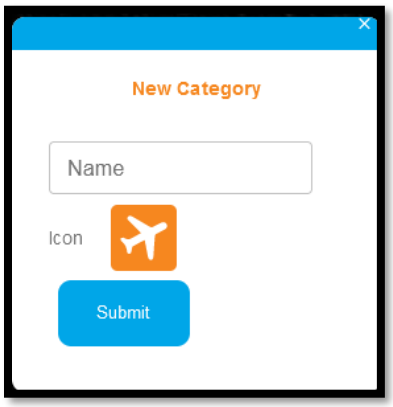


Figure 10:Configure Categories window



F gure 11: Assign new names to category and symbolised

3. The next step is to add the data to the categories. To do this, the user should click on the (add layer) button to brows the layer in the data engine. A window appears and needs to tick checkbox located in front of the selected layer. Then click on the "Select"

button at the bottom of the window. The selected layer added to the “category”, and now the user can see it in the data visualiser.

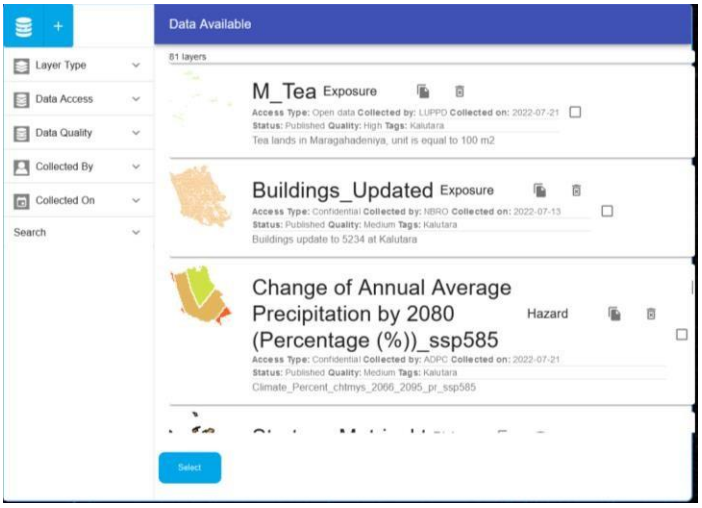


Figure 12: Add data window

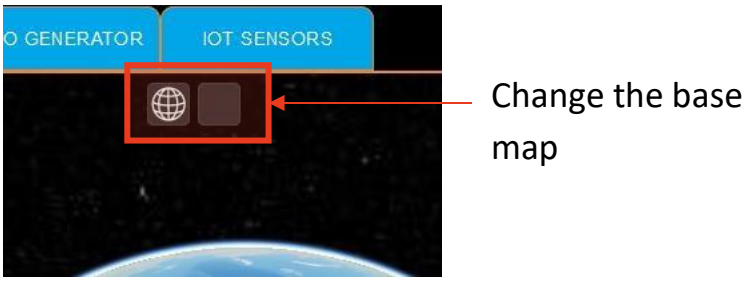
Tip

The user narrative is the key to developing the risk visualiser in the MOBILISE system. If the user can identify the different data levels, then a good data environment will be created.

Attractive colours can bring the user into an attractive environment. Therefore, try to use attractive colours and symbols while preparing the categories.

CHANGING THE BASE MAP

The user can change the base map based on their preference. The maps can be viewed on the globe or the 2D surface. In additionally, they can change the background satellite map into various other satellite images. The user needs to click on the two buttons locate at the top of the globe on the screen, and they can access to the different categories.



SCENARIO GENERATOR

The scenario generator is an analytical platform for developing the scenarios by using the data. The two different layers, mainly hazard and the exposure layer, overlays each other and identify the intersect areas. The tool can generate the statistics by auto calculate the number of intersect polygons and generate pie charts for each layer.

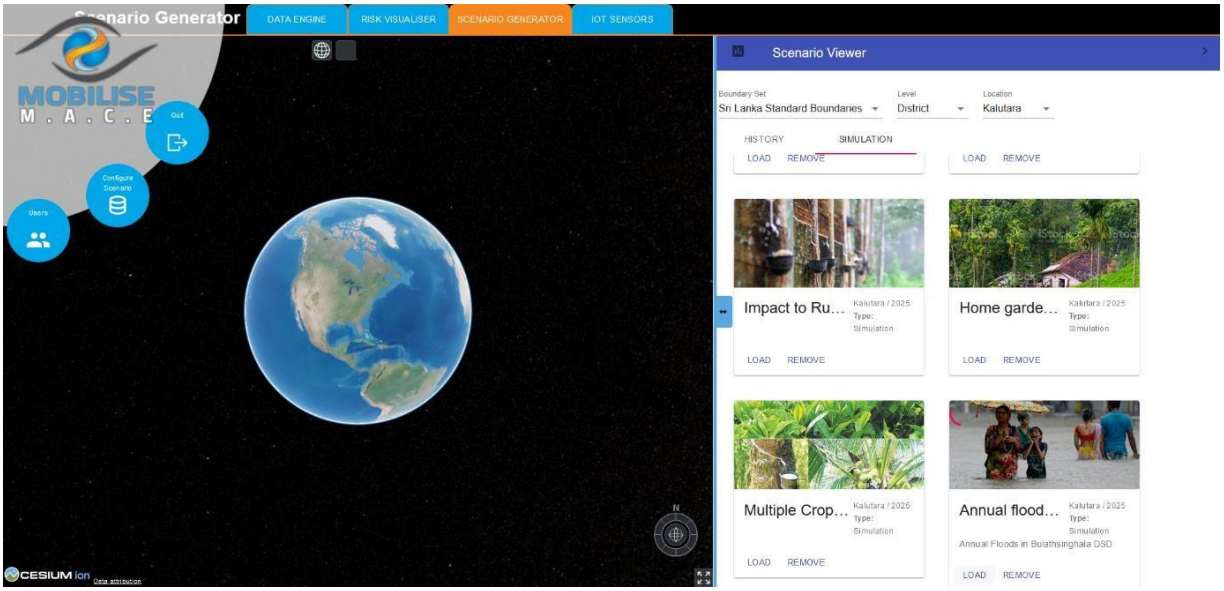


Figure 13: Scenario Generator window

The scenario viewer loads at the beginning, and the user needs to select the geographic location to view the available scenarios. The scenarios classified into two categories: historic events and simulations.

CREATING A SCENARIO

The user can create a different number of scenarios based on the data in the data engine. The following steps guide to create a new scenario from the existing data. The Kalutara Living Lab data used for the demonstration purpose.

The user needs to click on the mobilise logo at the top-left corner of the programme window to expand the functions. Then select the “configure scenario” button. Once the user click the button, a dialog box appears.

Step 1: Provide the basic information of the Scenario

The user needs to fill the information about the scenario in this section.

Name	**Assign a name for the scenario, this shows on the tile.**
Description	Insert the detailed description of the scenario and the description of the results. This information shows on the tile, though the user wants to see the description before loading the scenario.

Boundary set	Identify the relevant geographical data sets relevant to the scenario. The information is updated in two categories: national level and regional level.
Scenario Type	Select the scenario type: historical or simulation. Historical means the simulation of past events, and simulation means the predicted events in the future.
Image URL	This is the tile picture, and it is nice to have an attractive image describing the scenario.
Scenario Year	Mention the scenario year of the event.

Figure 14 shows the system generator window. Click the next button once the information feed up to.

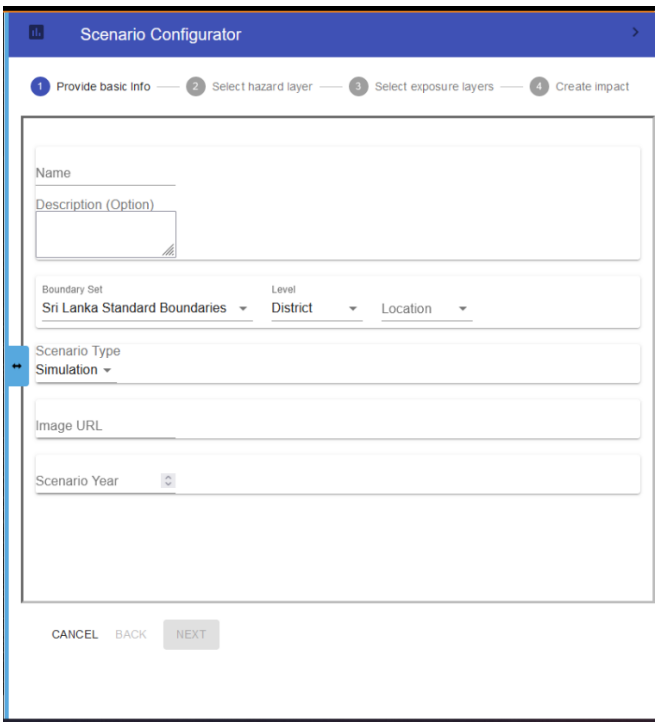


Figure 14: System Generator window

Step 02: Select the Hazard Layer

This shows all the hazard layers in the data engine, and user needs to select one layer to proceed the scenario.

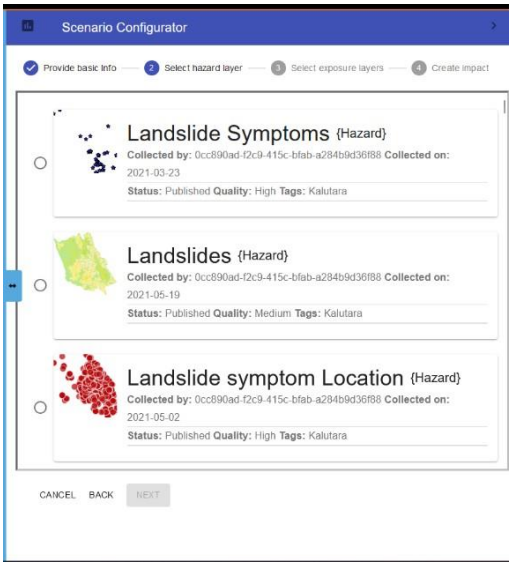


Figure 15: Select the Hazard layer for the simulation

Step 3: Select the Hazard Complementary Layers

The Hazard complementary layers refer to the complementary information with the hazard layers. For example, if the user selected a flood layer, the complementary layers could be precipitation changes over time. The layer should be in Vector layer format.

Step 4: Select the exposure layers

This is the last step to create the scenario. In this step, the user needs to select one or more exposure layers to proceed with the analysis. In each layer, the user needs to select the type of vector layer as polygon or poly line. Press the “next” button to add additional information.

Step 5: Additional information

The user might have required to overlay additional information over the simulated results. In such case, the required information could be listed in the additional information tab. Then, the user can switch on and off the layers to better understand of the output.

Step 6: This is the summary page of the scenario data inputs. Press “Create Impact” button to start the scenario.

A message displays on the window as “The processed scenario: (file_name) is processing”, and when the scenario generated, the second message displays as “The processed scenario: (file_name) has finished processing”.

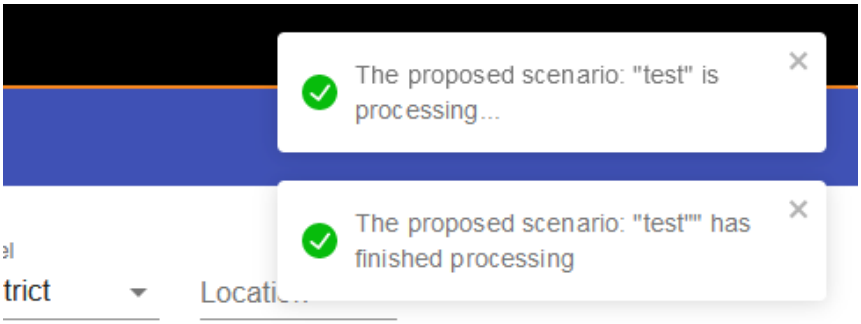


Figure 16: Pop-up messages

VISUALISE THE SCENARIO

In this section, the user can see the previously developed scenarios in the scenario generator tab. The user needs to understand the scenario type, historical scenario, or a simulation, and then the user can select the "Load" button below the tile. The user can delete the existing scenarios by clicking the "Remove" button in the tile.

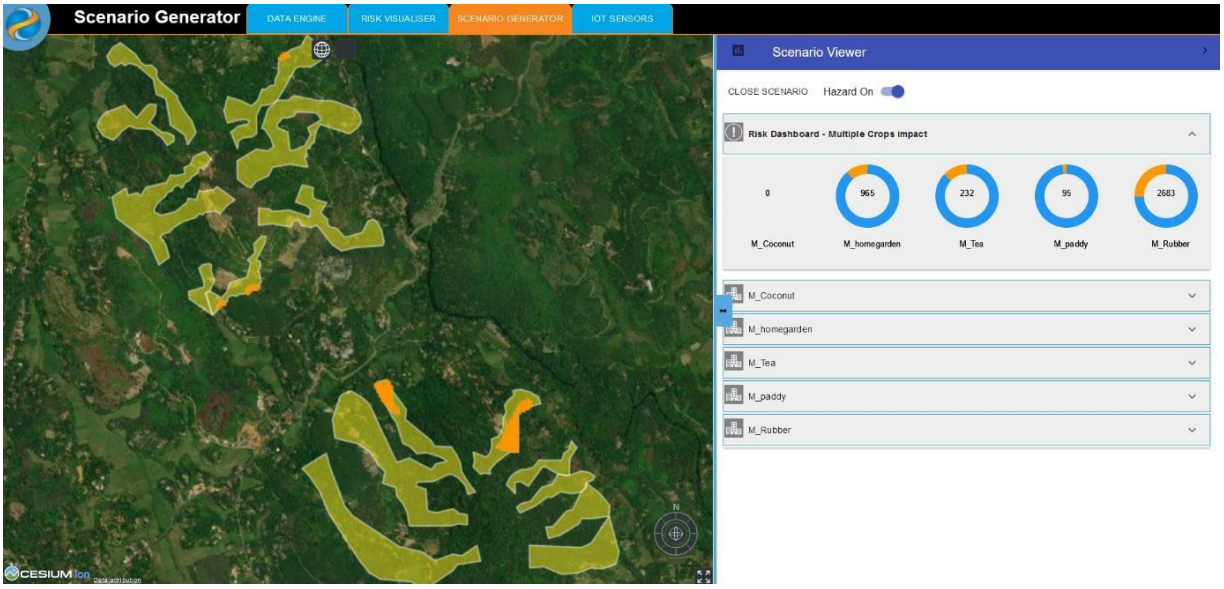


Figure 17: Loaded scenario

The user can load a selected scenario and see the overall results in pie charts at the top of the window. Details of each chart can be got from the bottom layers, and user can see the information according to the geographic boundaries. The user can see more details by clicking the small square located near to the column name. The graph shows the affected and non-affected area sizes.

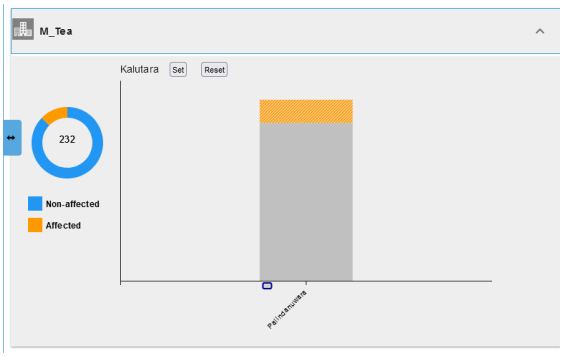
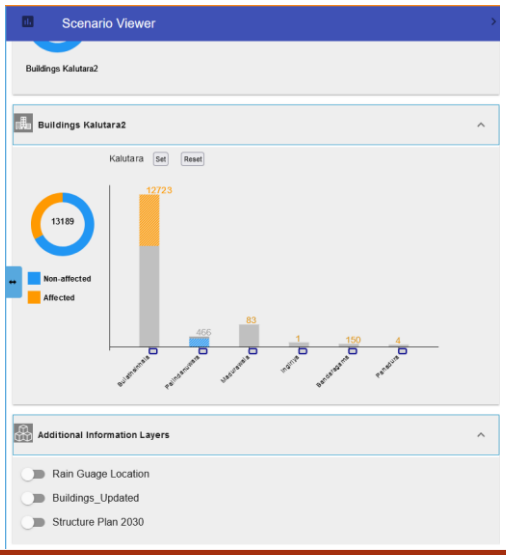


Figure 18: Detailed scenario information

The users can see the additional information tab in the scenario viewer and by click on the on-off button, the information can be overlayed with the simulation data.



FREQUENT ERRORS

1. White screen appears:
    a. This was mainly happened due to mismatch of coordinate systems. The user needs to clarify the coordinate system of each layer to WGS 1984 (GCS) or EPSG4326.
    b. If the user enters the wrong geographic information in the “TAG” this problem may occurred. User needs to verify the correct geographic boundary information.
    c. The arithmetic errors of the layer will also create this problem.