# Introduction

This is the documentation of the RA2CE Toolkit Python Package on the (currently closed) Deltares Github repository <https://github.com/Deltares/ra2ce>. This is a Deltares internal document and not to be shared with externals without approval from Margreet van Marle.

The document starts with an explanation of the RA2CE workflow in Chapter 2. This chapter is recommended reading material for first-time users of RA2CE. The types of possible analyses are described in Chapter 3. Chapter 4 explains the use of the initialization files that are required to run RA2CE. The required folder structure and locations of input and output files are explained in Chapter 5. Contact details and the RA2CE development team are listed in Chapter 6.

# Workflow

We recommend understanding the RA2CE workflow before making use of the toolkit for the first time. Follow Figure 2.1 from top to bottom to understand the high-level workflow. RA2CE is developed to be used in three ways:

* Create one or multiple networks
* Execute one or multiple analyses with an existing network
* Create a network and execute analyses

To create a network, a network configuration file, also called initialization file, is required. We call this the **network.ini** file. To execute analyses, an analyses initialization file is required, we call this the **analyses.ini** file. Both initialization files are required if users want to create a network and execute analyses. The content of these files is elaborated in Chapter 4.

When run, the toolkit starts by reading the setting in the initialization file(s) in *read\_settings* and validates the (data) input in *input\_validation*. When these steps completed successfully, it creates a network in *create\_network* (see Section 2.1) with the settings in the network.ini file, when provided. The types of possible input file formats are:

* **Shapefile** of network;
* **Geojson** polygon of area of interest;
* **OSM PBF** file;
* **Gpickle** – a NetworkX python data format for graphs.

When the network.ini file is not provided, it assumes a network is already created and continues to *analysis* (see Section 2.2), in which the analysis/analysis defined in the analyses.ini are executed.

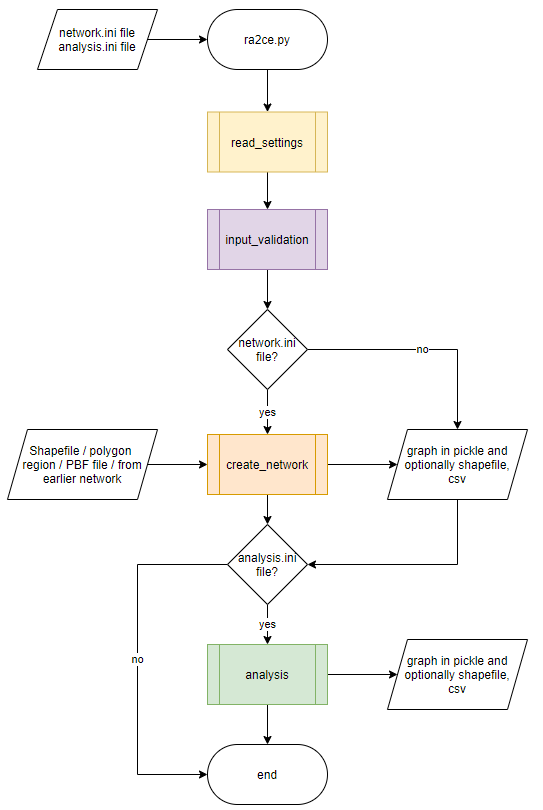


Figure 2.1 High-level RA2CE workflow. **Create network** and **analysis** are expanded in the next figures.

## Create network

Follow Figure 2.2 from top to bottom to understand the *create\_network* module of the RA2CE toolkit. Depending on which type of network should be created, different modifications are done to the graph. It starts by checking is there are **base network files**available. These are files that represent the graph required for the simplest analysis: the single link redundancy analysis. It is a graph that represents the simplest network as created from the input data: with nodes on intersections and edges as links between the nodes.

If a base network file (a gpickle) is available from the standard file location (see Chapter 5), it can read that in directly as a graph – the format that is used to do the analyses on within RA2CE. If no base network is available, it is created from the input data (OSM PBF, shapefile, or geojson polygon).

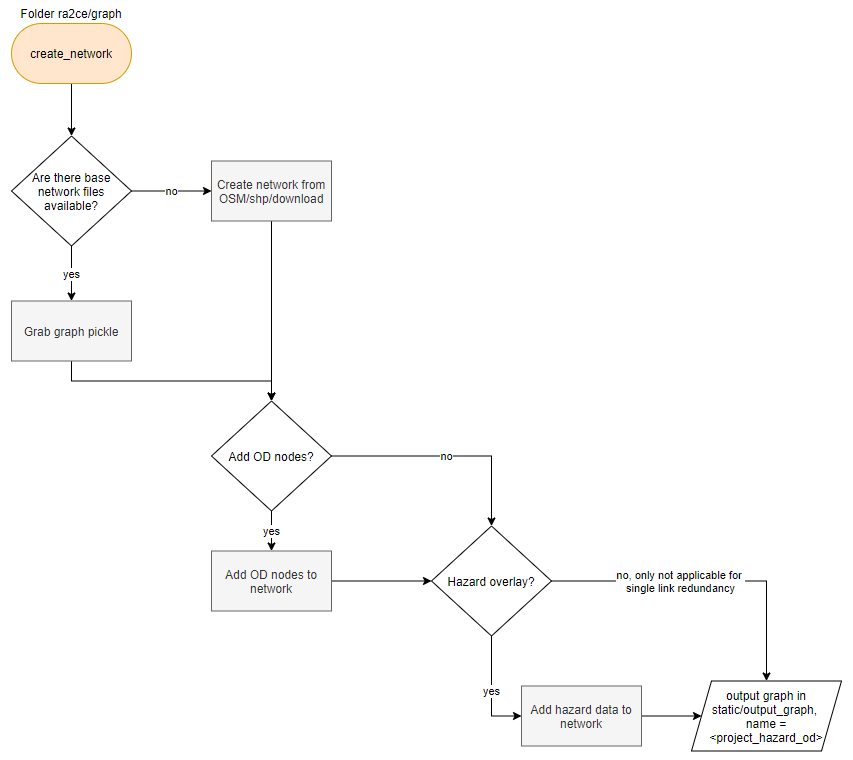


Figure 2.2 **Create network** workflow.

In the next step is checked whether Origin-Destination (OD) nodes should be added. This information comes from the network.ini file (see Chapter 4). When OD nodes are required for the analysis, they are added to the network, which is then saved as a separate network file.

In the final step is checked whether (a) hazard map(s) need(s) to be overlaid with the network. This is also user-configured in the network.ini file (see Chapter 4).

## Analyse

There are two main types of analysis: the assessment of **direct** damages or **indirect** damage (see Figure 2.3). Multiple direct and indirect analyses can be executed in a single RA2CE run. The possible direct and indirect analyses are explained in Chapter 3. The location of the output resulting from the run is described in Chapter 5.

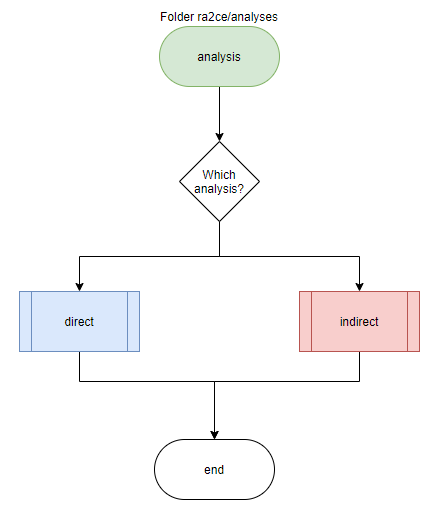


Figure 2.3 **Analysis** workflow.

# Analysis types

## Direct damages

## Indirect damages

### Single link

#### Redundancy

#### Losses

### Multi-link

#### Redundancy

#### Losses

### Origin-Destination, defined OD couples

#### Optimal routes, no disruption

#### Optimal routes, hazard-induced disruption

### Origin-Destination, defined origins to closest destinations

#### Optimal routes, no disruption

#### Optimal routes, hazard-induced disruption

# Initialization files

## network.ini

## analyses.ini

# Folder structure and file locations

# Contact - RA2CE development team

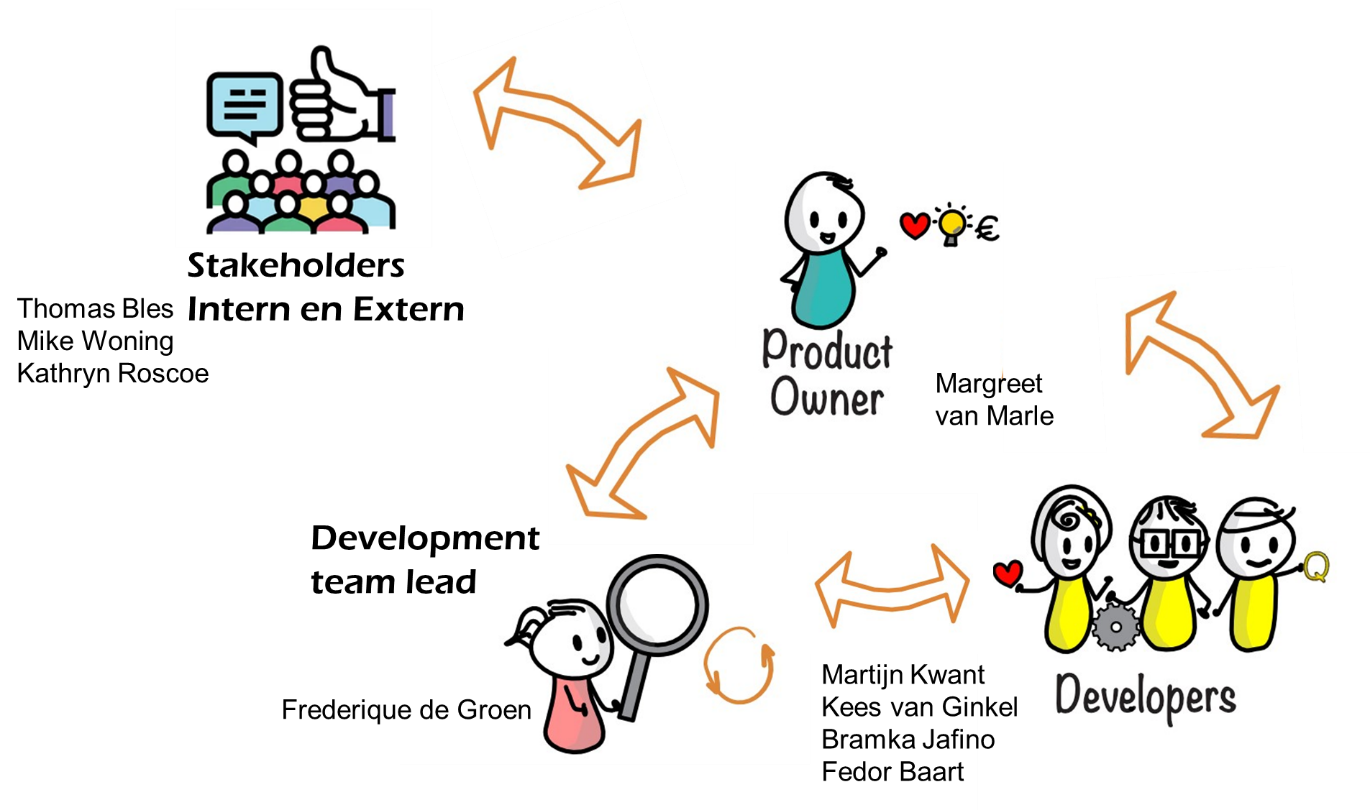
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