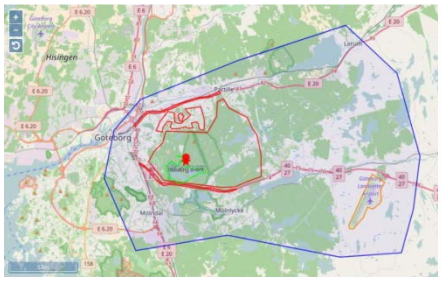
Anders Lönnermark[1]

IET Getting Started User Guide



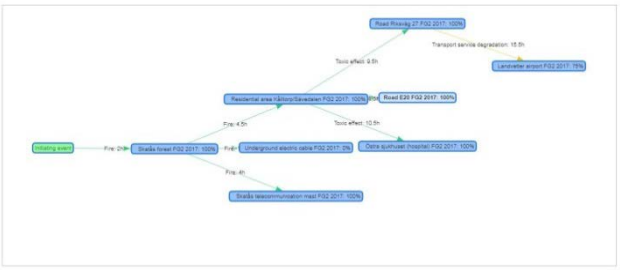


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Table of Content

Nomenclature

Abbreviations

IEM	Incident Evolution Methodology
IET	Incident Evolution Tool
IMT	Incident Management Tool

Glossary

Most of the terminology relating to cascading effects used in CascEff have been assembled and described in D1.6. In this section the terms most important for the use of the IET are presented.

Buffer time
The time between the start of an outgoing effect in the originating system and the time before a cascading effect occurs in a dependent system, i.e. when the performance of the dependent system starts to degrade. The buffer time is the sum of the Propagation time and the Endurance time.

Cascading Effects
The CascEff consortium agreed on the following definition of cascading effects:

Cascading effects are the impacts of an initiating event where

1. *System dependencies lead to impacts propagating from one system to another system, and;*
2. *The combined impacts of the propagated event are of greater consequences than the root impacts, and;*
3. *Multiple stakeholders and/or responders are involved.*

Dependency
Mechanism whereby a state change in one system can affect the state of another system.

Dependency type
In the IEM and the IET the following types of dependencies are used (for other types, see D1.6):

- Geographic dependency occurs when systems are located in one region and where changes in the local environment can create state changes in all of them.
- Functional dependency occurs when the state of a system is dependent on the output(s) of another system(s).
- Logical dependency occurs when a state change in one system results in a state change in another, without any of the other dependencies occurring.

Dependent/Impacted system
A system that is negatively affected by either an initiating event or an originating system.

Endurance time
Time a system can resist incoming effects before they start to create impact on the system

Initiating event (initiator)
The first in a sequence of natural (e.g. flood), accidental (e.g. fire) or intentional (e.g. bombing) events that may affect one or several systems.

Intra-system propagation
Propagation of effects between sub-systems within the same system.

Key decision points
An opportunity to affect the links between the originating system and the dependent system when an intervention may prevent the event from cascading or cause such effects.

Originating system
A system in which a failure propagates to another system.

Propagation time
The time it takes for the effects from the initiating event or an output of a system to propagate and reach the borders of a dependent system. The concept can be used to understand how fast effects spread, irrespectively of systems abilities to tolerate disturbances. Some effects can be seen as having zero propagation time (i.e. infinite spreading rate), e.g. power outage. To determine the impact on the dependent system, and the timing of such an impact, see Endurance time.

System
A "system" refers to a distinct societal unit (such as a sector, function, collective, infrastructure or nature resource) which may be affected by, or give rise to, consequences in another unit.

Vulnerability
Intrinsic properties of something resulting in susceptibility to a risk source that can lead to an event with a consequence.

1 Introduction

1.1 IEM and IET

The Incident Evolution Tool (IET) described in the user guide is based on the Incident Evolution Methodology (IEM), presented in CascEff D4.2. Both the IEM and the IET have been developed within CascEff. IEM constitutes of six steps:

1. Set the case area and the individual systems in a given territory. All the systems are described in terms of functionality/provision services, vulnerability and potential outgoing effects;
2. Identify dependencies between systems. Dependencies are identified in regard to systems' proximity and functionality,
3. Propagate the effects between systems. An initiating event is set in the case area, threatening the systems which can be impacted and which can impact, through cascading effects, other dependent systems,
4. Determine temporal aspects. Buffer time, time-delay and overviews of timeline and tree-view are assessed in order to evaluate the potential time interval emergency responders have for mitigating effects,
5. Assess the impacts. Social, human, economic, environmental and infrastructure impacts are evaluated for each impacted system in order for the emergency responder to compare impacts of cascading effects,
6. Identify the key decision points. The combined assessment of timeline (step 4) and impacts (step 5) help the emergency responders to prioritize mitigation actions.

The content of the different steps of the IEM has been implemented in the IET, but the IET and the description in this user guide are not structured exactly according to the different steps. One reason for this is that it was identified to be more efficient in the IET to focus on the systems and create them even before the case of interest is created in the IET. Therefore, the user of the IET does not necessarily follow the exact same order as the steps in the list above, but the steps are sometimes referred to in this user manual. The IET saves, calculates and/or visualizes most of steps 1-5 based on the input of the user. Then the user can use the simulation results to conclude step 6. The IET does not yet by itself identify key decision points. Through possibilities to manipulate the views (as described in the sections above) and to exclude systems from the simulations, the IET enables the user to evaluate what systems, parameters, effects, etc. have the greatest influence on the cascade and its impacts.

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 607665.

1.2 Aim of the IET

The aim of the CascEff IET is that it can be used for simulating cascading effects in the different phases of incident management: preparedness (planning & training) and response. That means that the tool can be used in different ways and by different organisations based on their current needs. The primary end user is the emergency services, but the results from the tool are relevant and useful also for other agencies or organisations, e.g. agencies responsible for

risk and vulnerability analyses, other competent authorities and critical infrastructure providers.

1.3 How to reach and access the IET

The IET is a web based tool in which a user connected to the internet can reach and use the IET after having registered as a user. A (potential) user can reach and access the IET via the link:

http://casceff.container.cerpus.se

To be able to use the IET, the user needs to first register as user. This is done via the registration form shown in Figure 1.1. This form is reached via the link above, if the user has not yet registered and logged in. Registered users can sign in at the bottom of the form. When later using the same link, the user will automatically reach the IET, if not logged out.

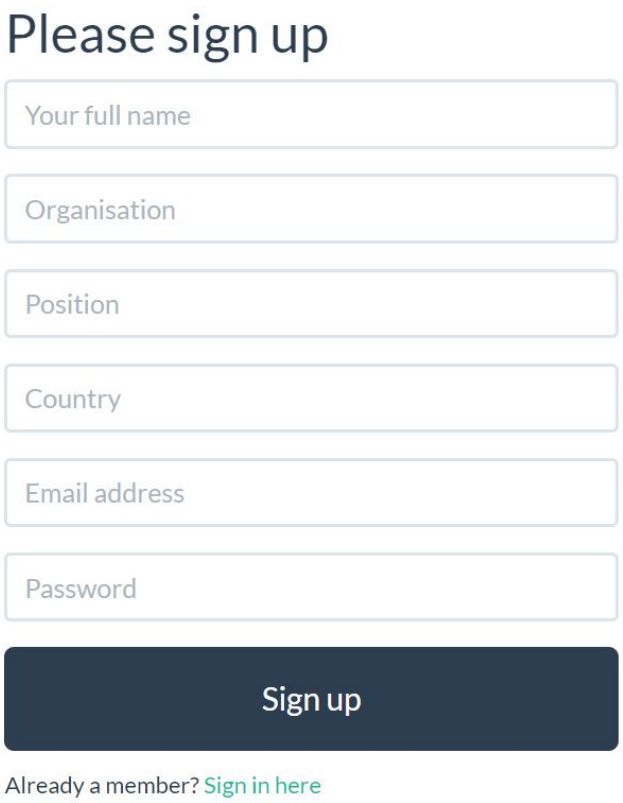


Figure 1.1 Registration form for the IET.

When a user runs the IET for the first time, the user will see a page with some menu options, but otherwise little information (see Figure 4.1).

The CascEff project has also an external web site (www.casceff.eu) where the project, the consortium and results (in the form of deliverable reports) are presented. Figure 1.2 presents the upper part of the main page of the CascEff web site. There is a list of menus containing links to information in different parts of the project and on the partners in the consortium.

Under the Tools menu a summary on the IEM and the IET can be found, including the link to the IET.

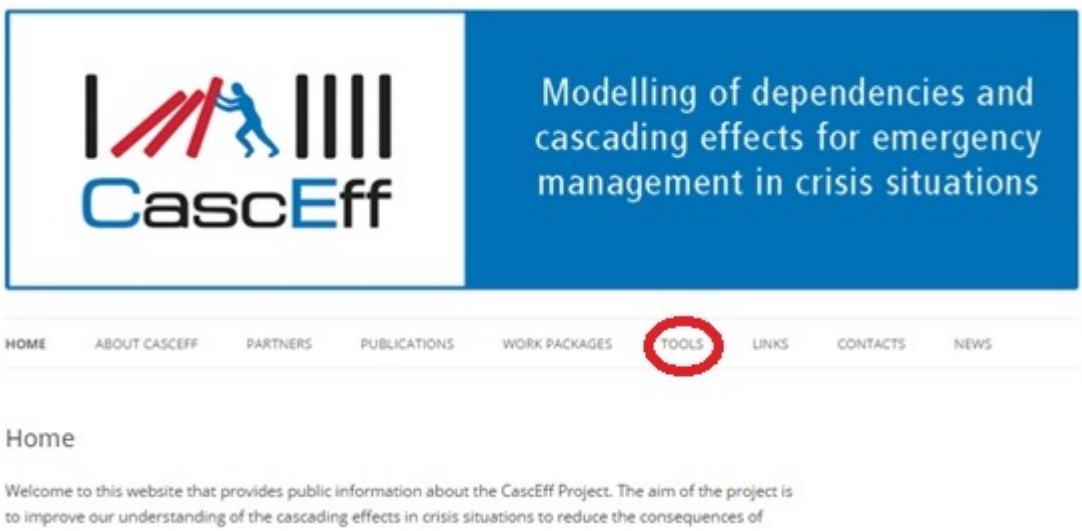


Figure 1.2 The upper part of the main page of the CascEff web site (www.casceff.eu).

1.4 Version register

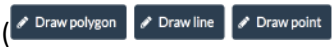
Table 1.1 Document versions

Date	Version	Author	Comments
2017-07-28	v1.0	Anders Lönnermark	First uploaded version

2 Summary of how to build up a case to simulate

In this chapter a very brief summary (list) is given of the steps to take to reach a case that can be used to run a simulation of cascading effects.

1. Select the [Systems] tab
2. Add new system
    a. Click 

    b. Give the system a name
    c. Select a drawing tool (

) and add the system boundaries by clicking on the systems location on the map. A polygon should be ended by double-clicking the last point of the polygon (not the starting point)
    d. Assign a system category and subcategory
    e. Click 

3. Edit system
    a. Find the system in the list of systems and open the edit dialog (click on the pencil)
    b. Click on System effects
    c. Add new
    d. Choose incoming effect. Incoming effect means the effects your system is vulnerable to.
    e. Give corresponding thresholds: the lower is the lowest level before there is any impact; the upper level corresponds to maximum impact (even though the incoming effect could be higher)
    f. Select an Outgoing effect and press [+Add]
    g. Add number to the different parameters.
    h. Press [Save]
    i. Click on System maximum impacts
    j. Add relevant numbers for the different subcategories
    k. Click [Save]
4. Repeat point 2 and 3 for another system
5. Go to the Case page and add a new case (one can click on [Home] to select Cases)
    a. Add new
    b. Give the case a name
    c. Draw a polygon surrounding the systems to be evaluated.
    d. Add information to the other parameters (only the date and time are used in the simulation)
    e. Save
6. Edit a case
    a. Continue with the created case or find the case in the list of cases and click on the pencil
    b. Click on systems
    c. Click on [+Add systems]
    d. You see a list of systems situated within the case border
    e. Click either on each system to add or on [Add all systems] above
    f. Click on [Initiating Event]

   g. Click on [Place initiating event] and click then on the map to place the initiating event
   h. Click the [Save] button just under the map
   i. Select an effect and click on [+Add]
   j. Fill in the different parameters
   k. Click on the [Save] button next to the Effect
7. Run a simulation
   a. Click on [Simulation]
   b. Click on [Run]
   c. You should then get a timeline with boxes, a tree view, a log list, a map view, and a table with impact

The different steps and substeps are described in more details in the chapters below.

3 Create and edit systems

The basic entities of the IET are systems. A system refers to a distinct societal unit which may be affected by, or give rise to, consequences in another unit (see D1.6). This can be e.g. a power plant, a school, a chemical industry, or a hospital, but also represent many other different units. In Table A1.1 a number of system categories are listed (see D2.3 and D4.2).

3.1 Create a system

Select the Systems tab on the Home page.

Initially the view of the Systems tab is an empty list of systems and a map over Europe. The first step is to add a new system by clicking on the "+ Add New" button (see Figure 3.1).

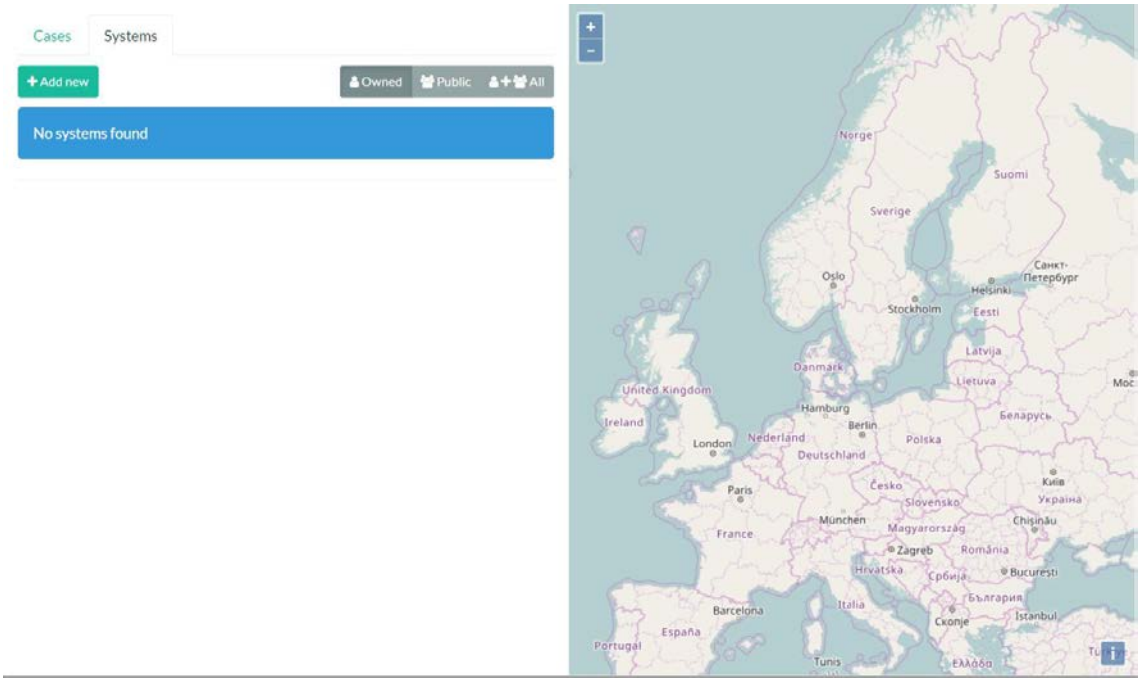


Figure 3.1 The System view before any systems have been created.

3.1.1 Create new system

The Create new system view (see Figure 3.2) contains the following parts:

1. Name of the system
2. A map where the borders of the system can be created
3. Selection if Public system
4. Selection if Template system
5. Category and Subcategory

The system should be given a name, which will be shown in the list of systems. Each system has its own unique id to be handled by the IET, but it is good to give the system a logic name to make it easier to select when to edit a system or to add the system to a case.

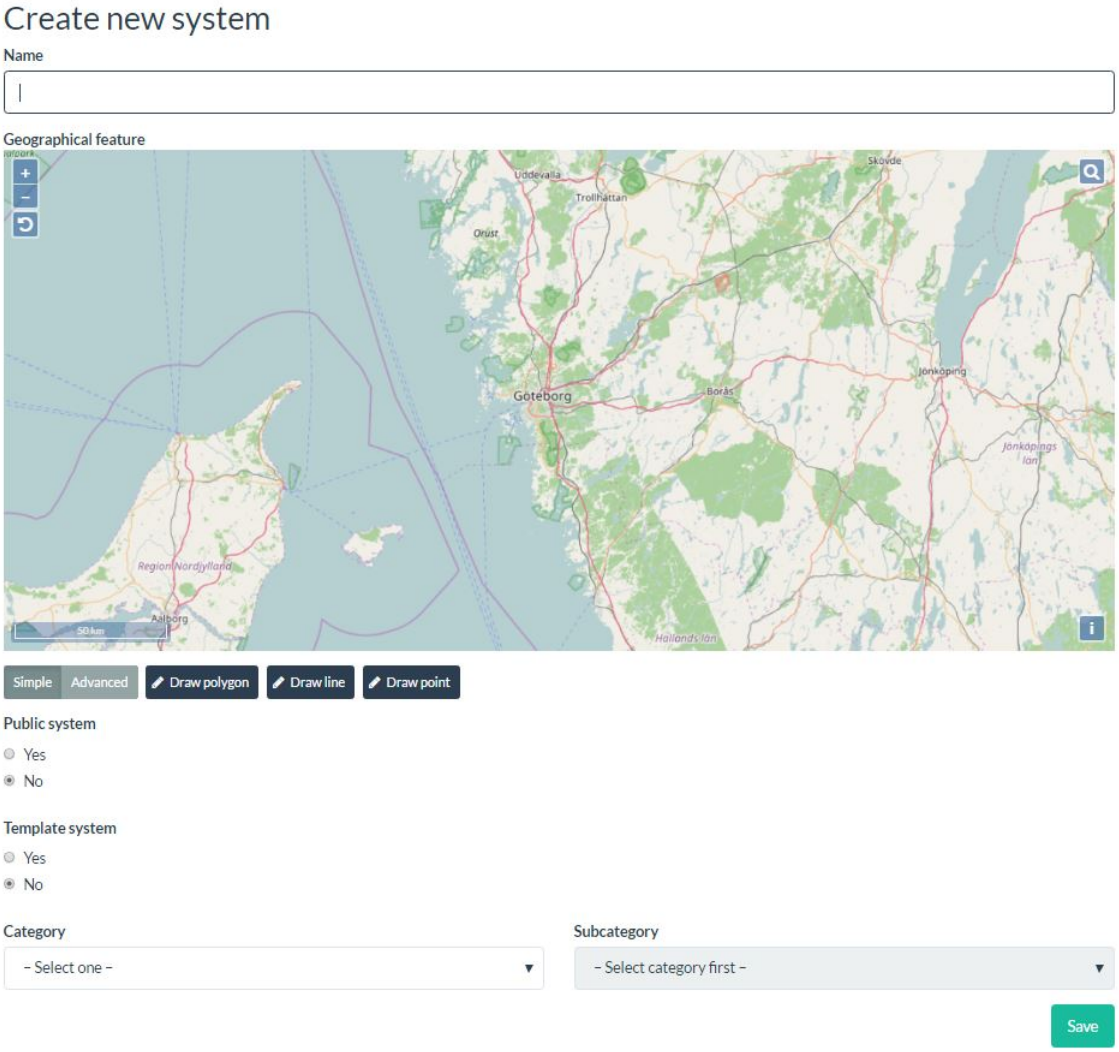


Figure 3.2 Create a new system dialog.

To find the correct area on the map for the system to be created, one can either use the + and − buttons, move (pan) the map with the mouse and the left mouse button, the mouse scroll function, or search for an address after clicking the at the top right of the map (see Figure 3.2).

3.1.2 Defining the system border

The borders of the system need to be defined. If the user tries to save the system without having defined the borders, an error message will be shown.

There are different ways of creating the border of the system, divided into two groups: “Simple” and “Advanced”, respectively. The main difference between these two groups is that in the latter it is possible to add additional geometries, allowing more than a single geometry, when defining the geographical extent of the system.

In each group there are three different geometry options: Polygon, Line and Point. For the polygon and the line, each “corner” is marked with a click, but for the last one which is created by a double-click finalizing the figure. The point is created with a single click.

In the Advanced mode, the different geometries are shown in a list of layers, to the right of the map (see Figure 3.3).

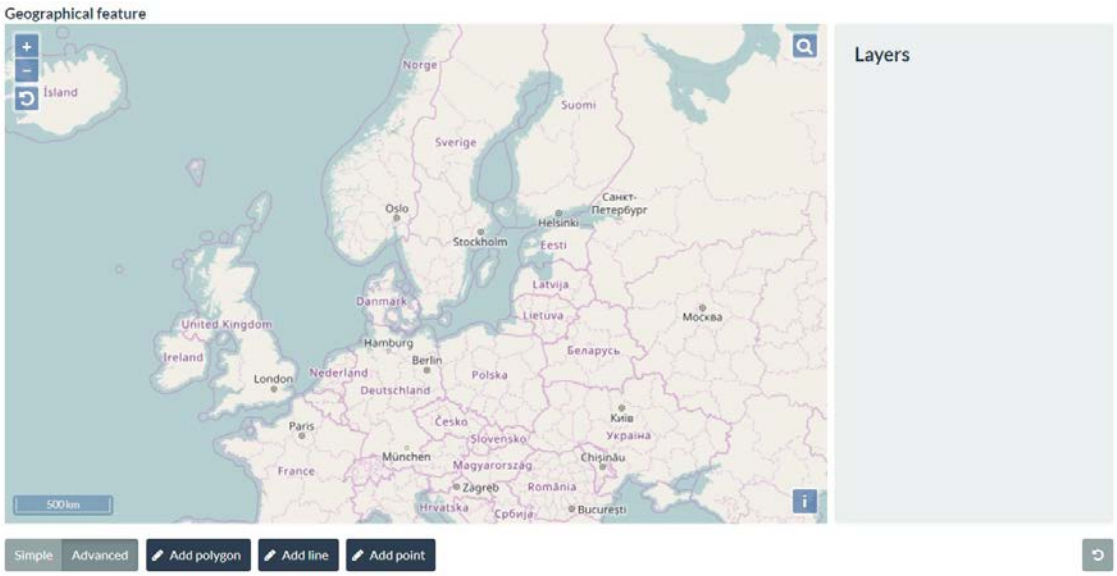


Figure 3.3 The view when using Advanced mode for defining the geographical extent of a system.

3.1.3 Other settings

If the system is defined as “Public”, also other users can see the system in their list of systems. Other users can, however, not alter the system but needs to make a clone (copy) of it to use it. This is done in the list of systems.

The system can be marked as “Template”. At the moment this is only marked in the list of systems. In the future this will add additional functionalities and relations between systems. However, it can already now be used to mark systems with properties of general interest.

The system can be categorized using the different options for Category and Subcategory, respectively. See Table A1.1 for available system categories and subcategories.

The system is saved by clicking on the “Save” button at the bottom right.

3.2 Edit a system

Find the system in the list of systems and open the edit dialog (click on the pencil symbol). Then the different properties of the system can be altered (including the geometry of the system) in the same way as when the system was created (see Section 3.1). Save the changes by clicking on the Save button.

3.3 Adding and editing effects

If having just created a system one can directly select “System effects”. Otherwise select the system of interest from the list of systems under the Systems tab. If one has many systems, the list of systems can be very long. By default only 20 systems are shown. To show more systems, click on the “Show 20 more…” button at the bottom left. One can also search for the system by adding some letters or a word in the Search system… text box. The system with names corresponding to the text will immediately be shown in a shorter list and the wanted system should be found.

When the correct system has been found, click on the pencil symbol to edit the system. Click then on the “System effects” link to the left.

On the System effects page, there are yet no effects added (see Figure 3.4).

Figure 3.4 System effects dialog, without any listed effects yet.

To add effects click on the [+ Add new] button. The form gives the opportunity to add incoming effect (see Section 3.3.1) and outgoing effects (see Section 3.3.2). This is what determines the dependencies between systems. The Add new system form is shown in Figure 3.5.

3.3.1 Incoming effect

A number of different effects (for incoming and outgoing, respectively) can selected (see Table A2.1). Each effect is defined by one or two parameters and for each parameter there is a Lower threshold and an Upper threshold to define. These thresholds are used both for determining whether the system will be affected or not, and for determining how large the impact will be.

Below the Lower threshold, the system is not affected by the incoming effect. The Upper threshold determines at what level the system should give maximum impact according to the incoming effect in question.

There is also a possibility to set a System impact factor, which determines how large percentage of the Maximum impacts level for the system the maximum impact of the specific incoming effect should constitute. The default value is 100 %.

The maximum impact levels for the system for different impact subcategories are described in section 3.4.

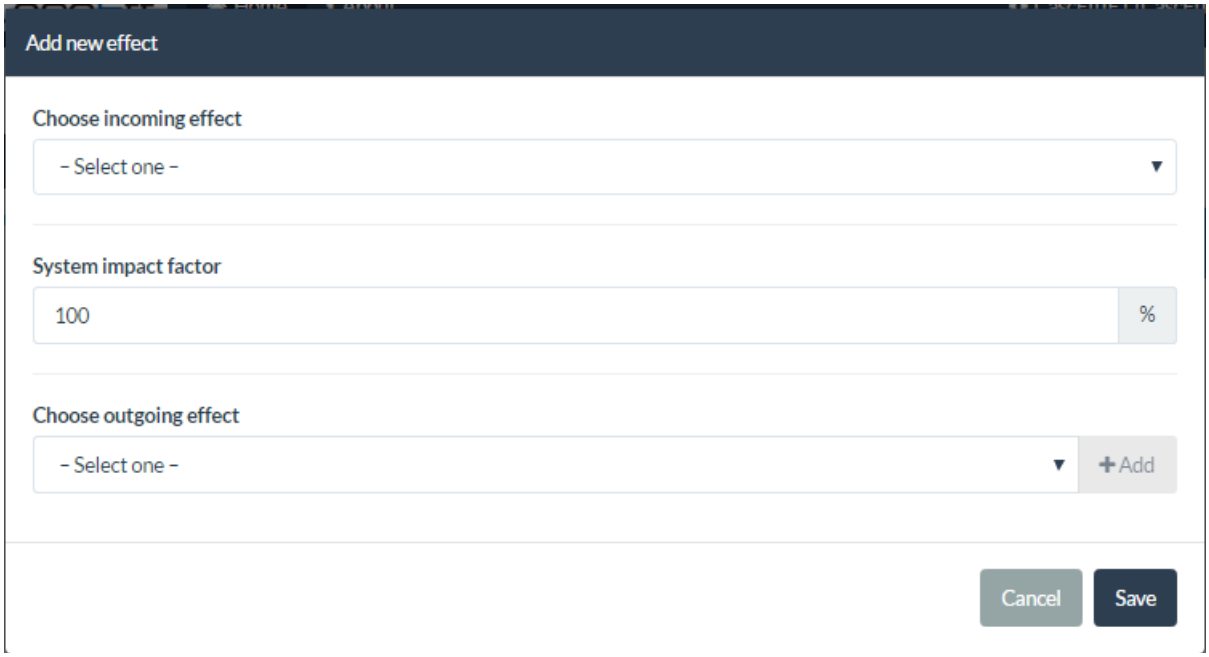


Figure 3.5 Add new system effect dialog.

For each incoming effect it is possible to set an Endurance time. This time corresponds to the time period the system can endure the incoming effect before it will be affected. The reason for this can be a specific protection, redundancy, or something else that prevents the system from being affected directly.

Note that even if a manual functional dependency (see section 4.4) has been added to the case, the correct incoming effect (type of vulnerability) needs to be added for the system to be sensitive to the functional dependency.

3.3.2 Outgoing effect

For each incoming effect one or several outgoing effects can be added. The outgoing effects can be selected from the list given in Table A2.1, and then click [+Add]. The basic form for adding an outgoing effect is given in Figure 3.6. An outgoing fire is used as an example. The user should state the distance of the fire spread, the thermal radiation from the affected region and the time it takes for the fire to spread the set distance. For the Propagation time, either hours or days can be used as unit. With this Simple Spread type, the effect is spread radially up to the given distance. When the relevant numbers have been added to the different parameter, click [Save]. After having saved the effects, the incoming effect with correlating outgoing (Produced) effects are shown in a list (see example in Figure 3.8)

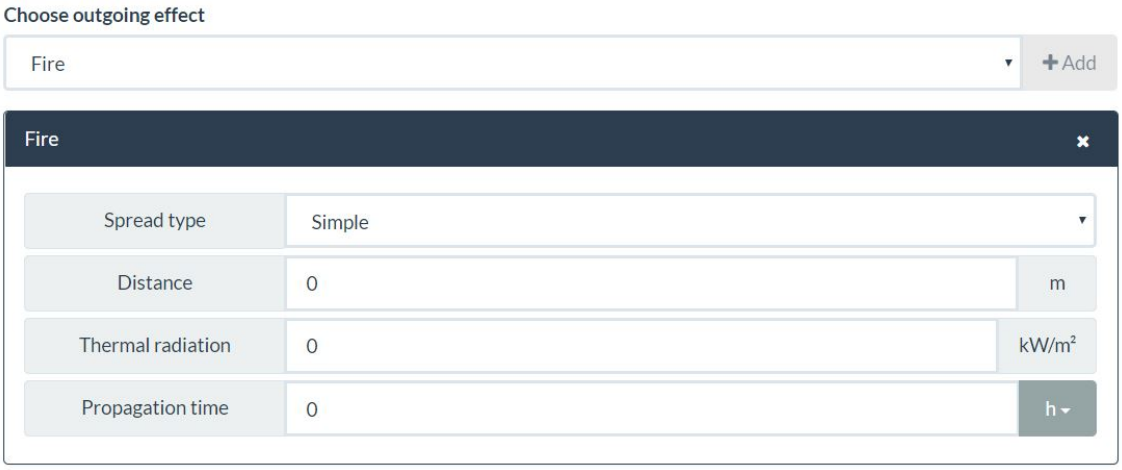


Figure 3.6 Add outgoing effect form (Simple spread type).

Instead of given only a distance for the spread of the outgoing effect, it is possible to define a specific area for the spread. This is useful when one wants to take other parameters into account, e.g. influence from wind or landslide in a certain direction. The spread area is defined as a polygon with the same type of polygon tool that can be used for defining the borders of a system. An example of the outgoing effect form with Advance spread type is presented in Figure 3.7.

As indicated above one can add more than one outgoing effect for the same incoming effect. One can also add more than one incoming effect, but one shall not have more than one incoming effect of the same effect type.

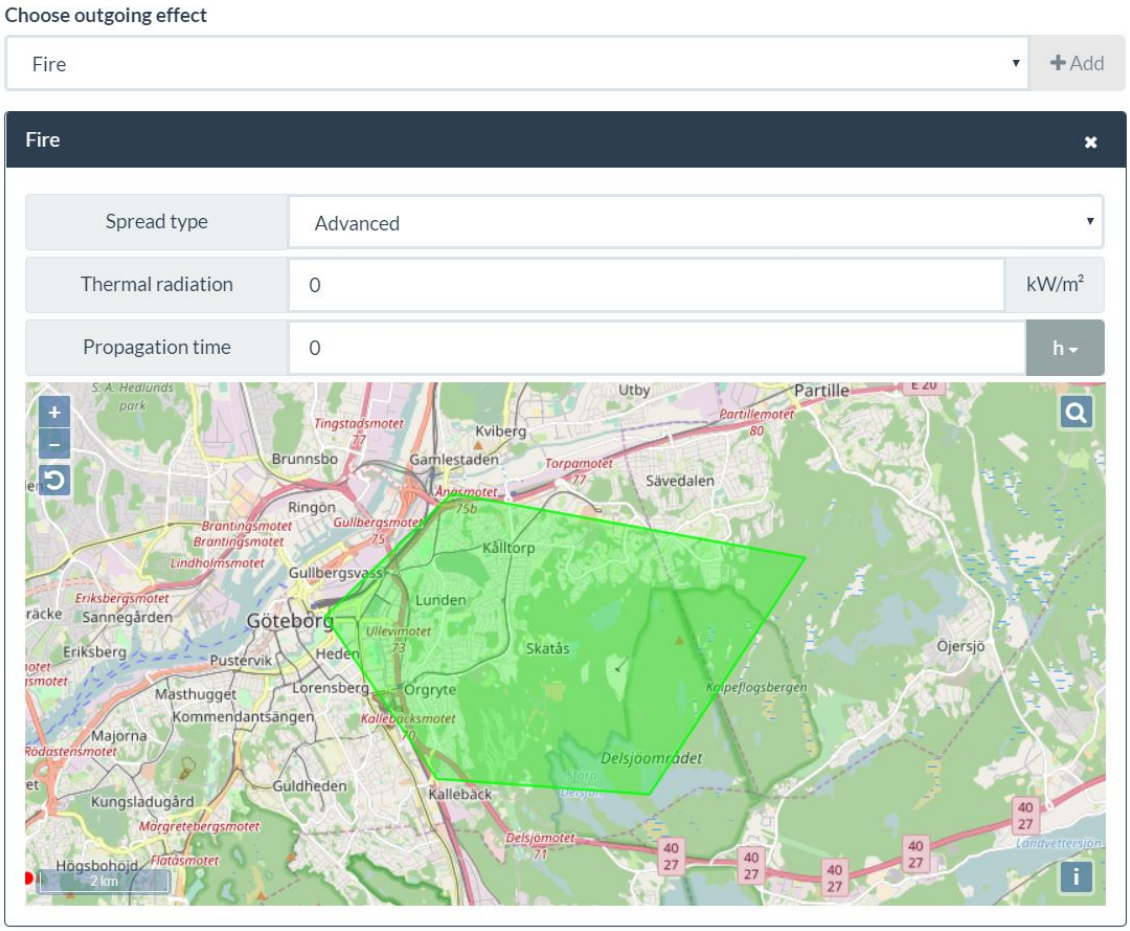


Figure 3.7 Add outgoing effect form (Advanced spread type).

Figure 3.8 Example of list of incoming effects and correlating outgoing (produced) effects.

3.4 System maximum impacts

The system impacts are defined as the consequences for the system and its surroundings if affected by incoming effects. The impacts are divided into five categories and 18 subcategories (see Figure 3.9). For each subcategory it is possible to assign a maximum impact. These system maximum impacts are used for all incoming effects. However, the system impact factor defined for each incoming effect (see Section 3.3.1 and Figure 3.5) determines how large part of the system maximum impact can be reached when affected by that particular incoming effect.

The default values in the form are 0 for each subcategory and it is only needed to give values to those impact subcategories relevant for the specific system. When the relevant numbers have been inserted, click [Save].

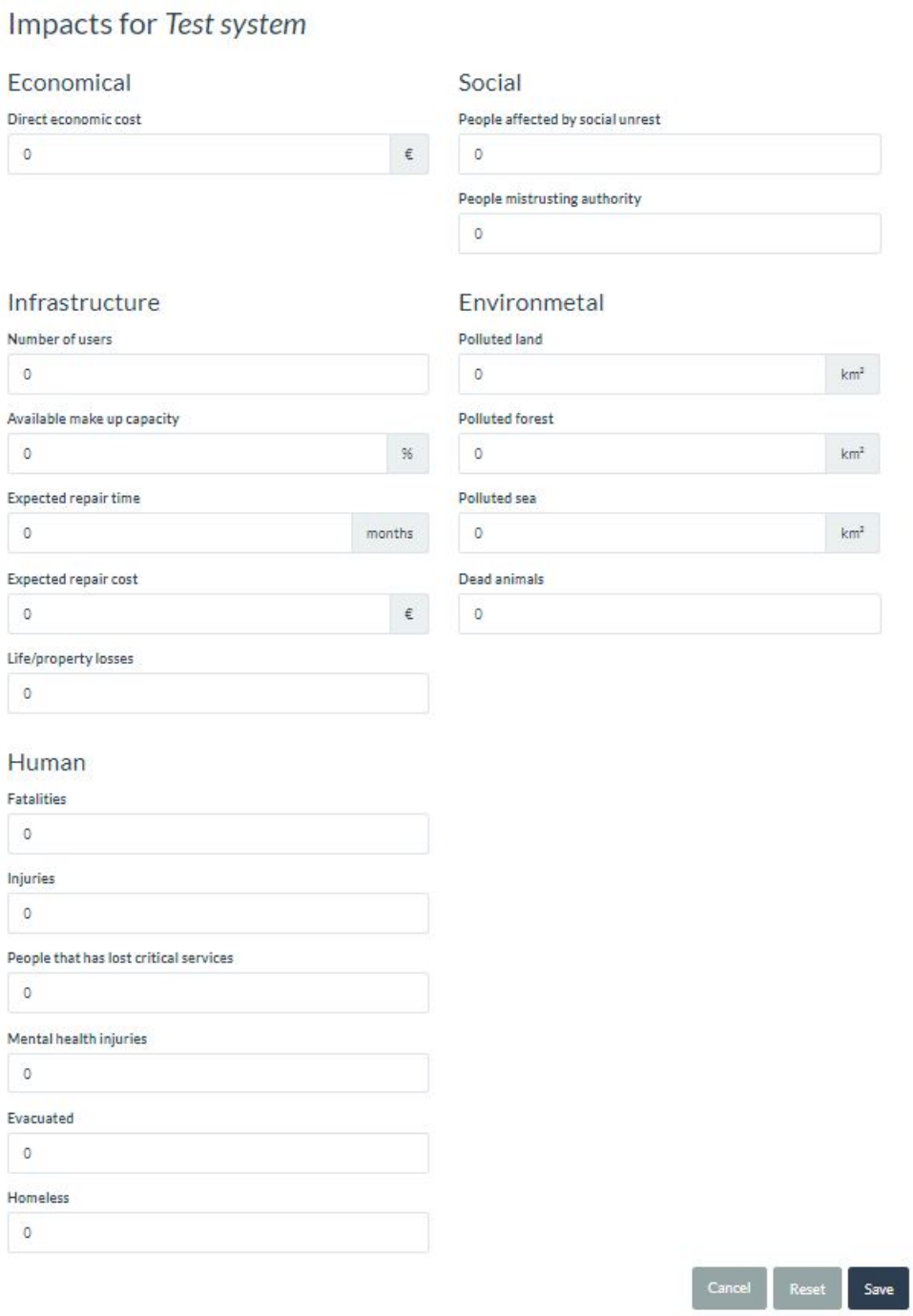


Figure 3.9 System maximum impacts form.

4 Create cases

When the case is to be defined, e.g. when the relevant systems have been created, the start page for cases can be reached via the case menu on the Home page. When starting IET the first time, there are no Owned cases in the list (see Figure 4.1). There might, however, be public cases available and by clicking on the Public button, all public cases are listed. There is also a third button, which can be used to show both Owned and Public cases.

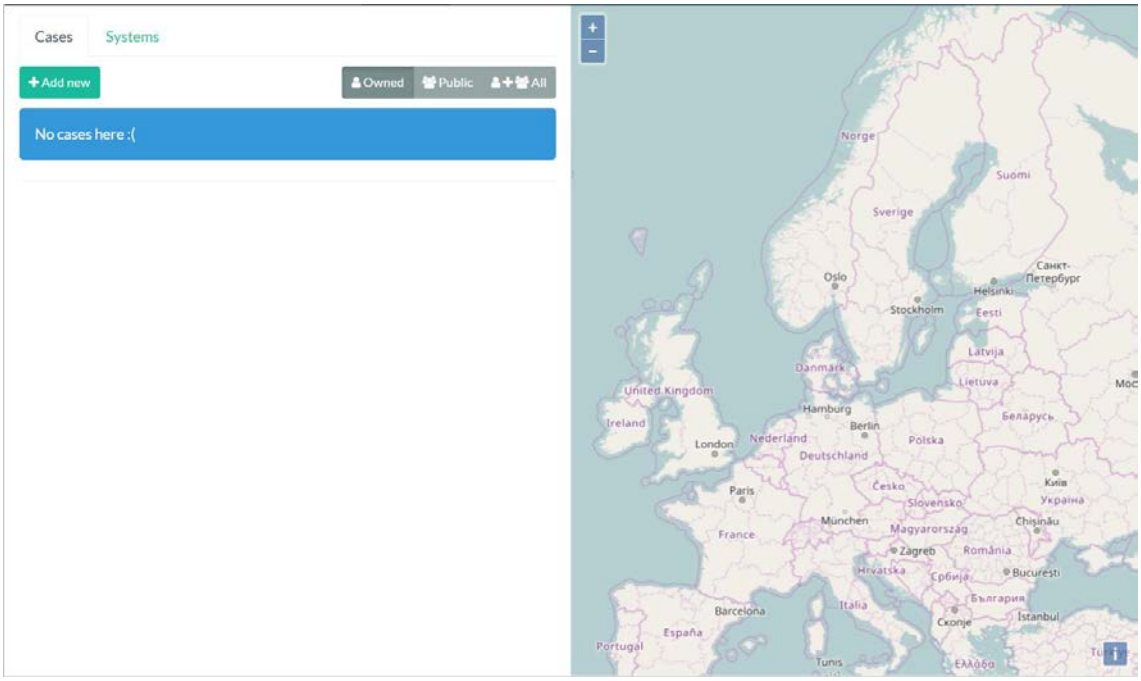


Figure 4.1 Start page of the Cases menu.

4.1 Create a new case

When clicking the [+ Add New] case button, the form in Figure 4.2 is shown and the first thing to do is to give the case a relevant name. As for systems, cases have their unique id, but a representative name is needed to find the case of interest later on in the list of cases. The second thing to do is to define the border of the case. This is done by creating a polygon on the map representing the geographical borders of the case. The polygon is created by clicking on “Draw polygon” and then mark the corners of the polygon on the map. Double-click when marking the last corner to enter of the polygon.

The user should decide if the case should be public or not, by selecting “Yes” or “No” under “Public case”. This can also be selected later when all relevant information has been entered or whenever the user would like the case to be public.

The rest of the fields are not used in the simulation, but can be added for information on the specific case. The fields with Temperature, Rain and Wind, respectively must be filled in.

Then save the case by clicking on the [Save] button at the bottom of the page.

When the case has been saved, it is given a unique id, which can be seen on the screen for future references, if needed. The case is also shown in the list of cases.

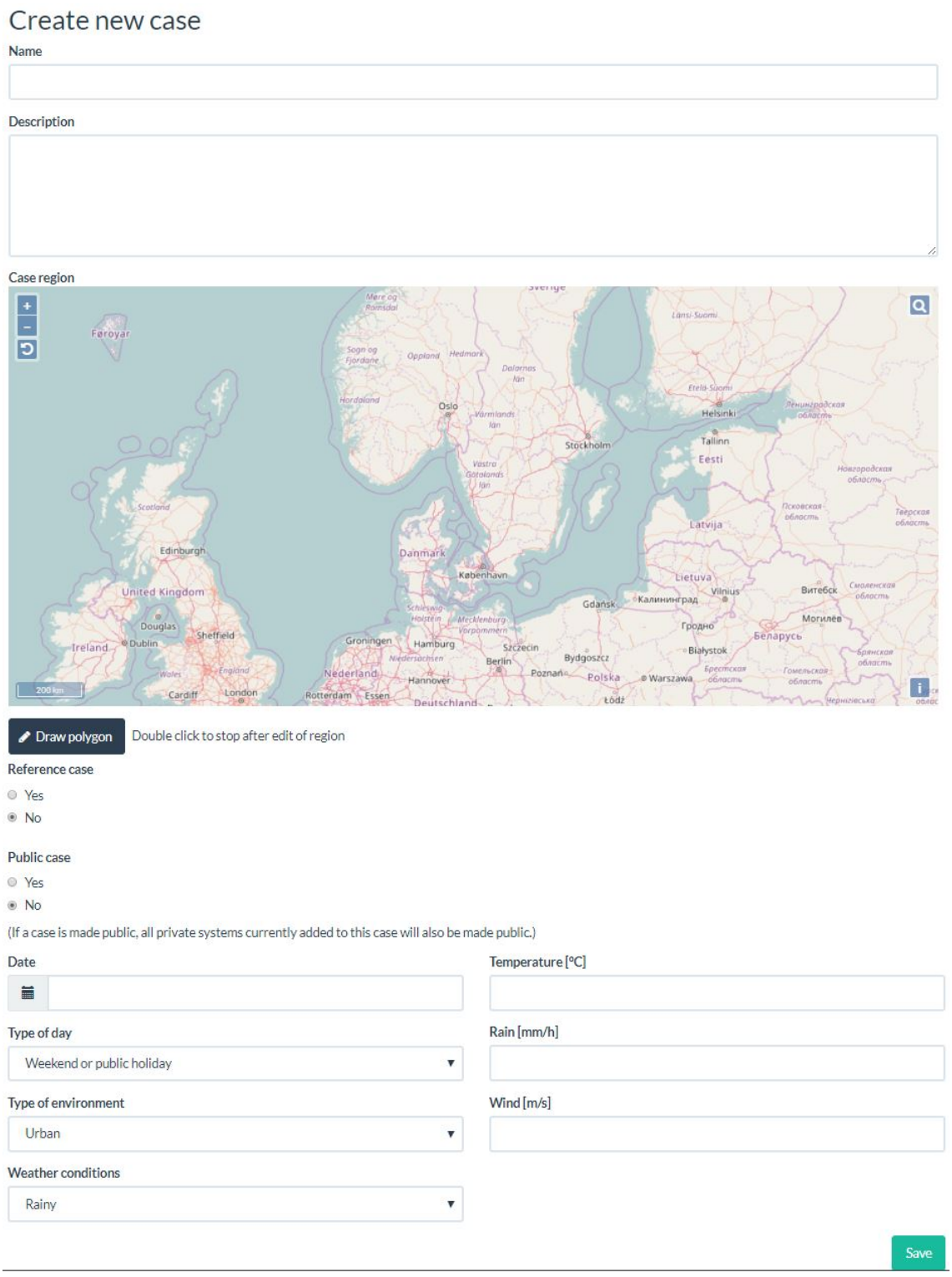


Figure 4.2 Create new case form

4.2 Edit a case

As soon as a case has been created, or when a case is opened via the Edit button, the case menu is shown to the left of the page and the general information on the case (including the map with the case border) is shown to the right. The menu has five different menu options:

1. General: This is the first page with the name, map and other general information on the case (see Section 4.1)
2. Systems: Here systems can be added to the case, or existing systems in the case can be removed (see Section 4.3).
3. Dependencies: Here functional dependencies between systems in a cases are added or handled (see Section 4.4).
4. Initiating Event: Here the initiating event is defined and given relevant properties (see Section 4.5)
5. Simulation: Here is where the simulation is run based on the set properties in the case (see Chapter 5).

4.3 Add systems to a case

It is easy to access all the systems in a case by clicking Systems in the menu to the left. Then a list of all systems appears. The first time, before any system has been added, the list is empty, see Figure 4.3.

By clicking [+Add systems …], a list of available (owned) systems appear. To be on the list, the system needs to at least partly overlap the geographic area of the case. One can either pick the systems one by one on the list of include all systems on the list (by clicking on the button: [Add all systems above]. When finished, click on [Done].

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Figure 4.3 Empty list of systems in a case.

When having added a number of systems, or when visiting the Systems menu of an existing case, it can look like in Figure 4.4. If one wants to remove a system from the case, it is done in a similar way as when adding a system, but instead clicking on [-Remove systems …] and then either remove systems one by one or all at once by clicking on [Remove all systems above]. When finished, click on [Done]. The systems can be individually removed from the case also from the main list of systems, by clicking on the waste bin symbol next to a system.

By clicking on the name of a system in the list of systems, that particular system is opened and ready to be edited as described in Chapter 3, if needed. To get back to the case again, click [← Return to last case] at the top of the page.

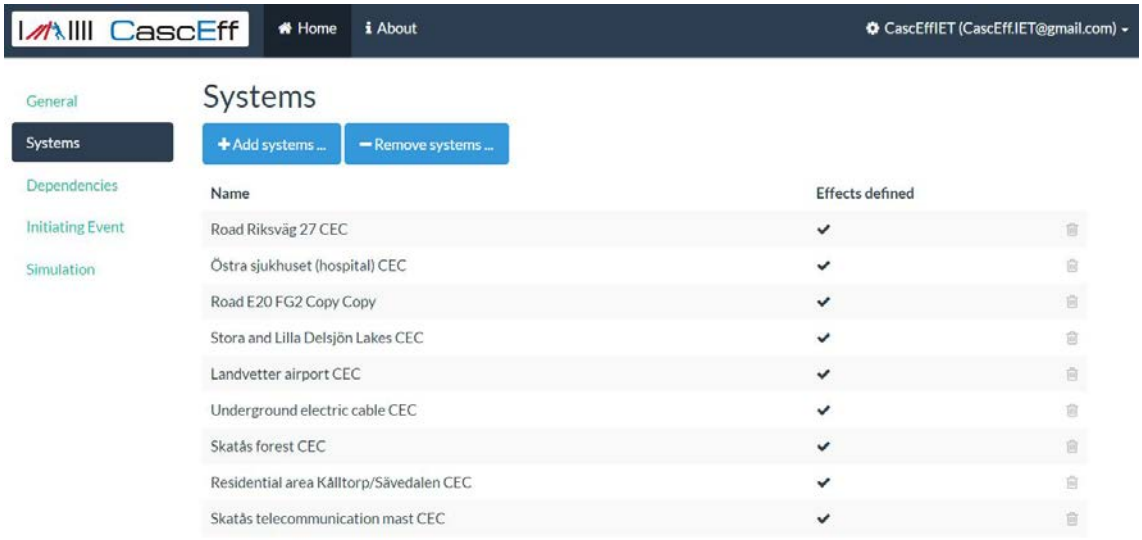

Figure 4.4 Example of list with nine systems in a case.

4.4 Define functional dependencies

Much of the dependencies and cascading effects in the IET are based on the geographical proximity between systems and the vulnerability to the incoming effects. There are, however, also other types of dependencies that not primarily depend on the geographical proximity, but rather the functional dependency between systems, e.g. the need for delivery of electricity or gas from a distant system.

Such functional dependencies between systems in a case can be added by selecting the [Dependencies] menu option. As default there are no functional dependencies assigned, see Figure 4.5. If the case does not yet contain any systems, the view looks as shown in Figure 4.6.

The dependencies are defined by clicking on the [+Add new] button. The information to fill in the form (see Figure 4.7) to add a new dependency is Originating system, Target system, Effect type, Proportion of (target) system affected, and Propagation time. The effect types are the same as for incoming and outgoing effects described in Sections 3.3.1 and 3.3.2, and in Appendix 2. The check box “Ignored” is not in use. When the relevant information has been inserted, click [Add] to save the dependency.

Figure 4.5 Dependencies menu option without any defined dependencies.

Figure 4.6 Empty list of dependencies, when the case does not contain any systems.

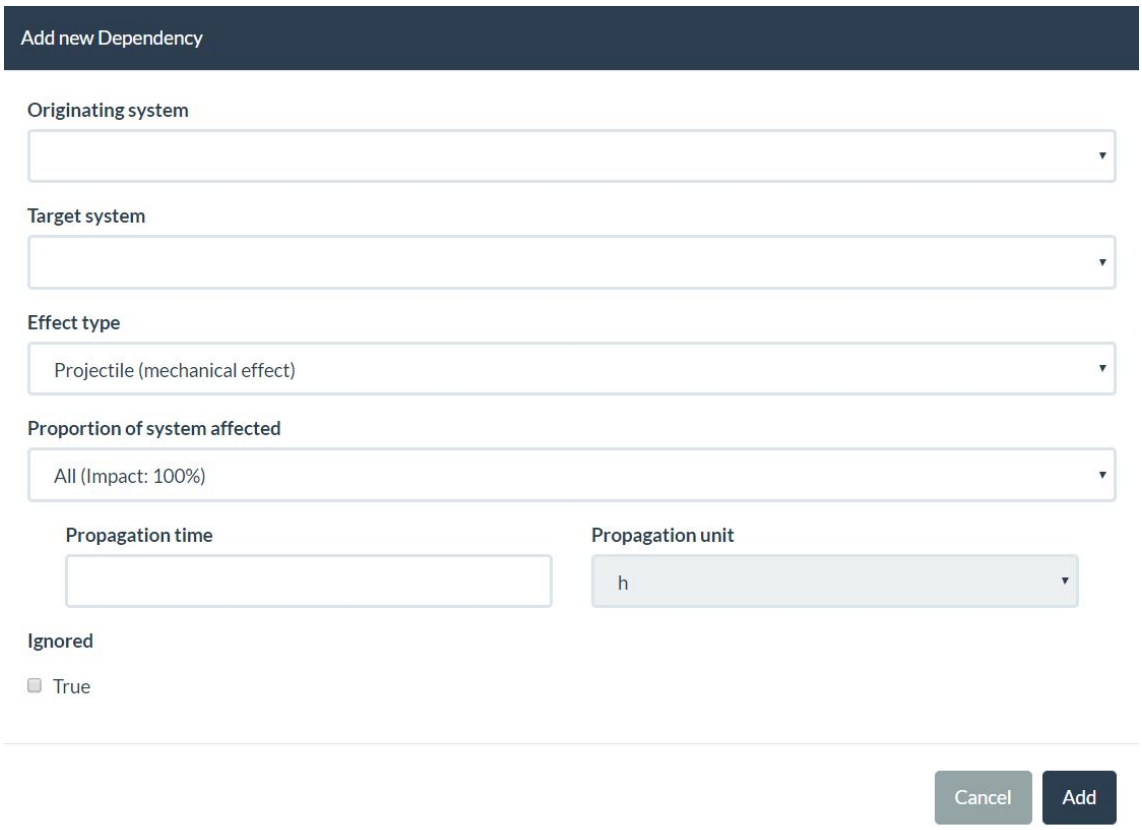

Figure 4.7 Add new Dependency form.

When a number dependencies have been added, they are listed as shown in Figure 4.8. Each row contains information on Origin system, Target system and Effect type. To edit a dependency click the (edit) button. To delete an existing dependency, click the (waste bin) button.

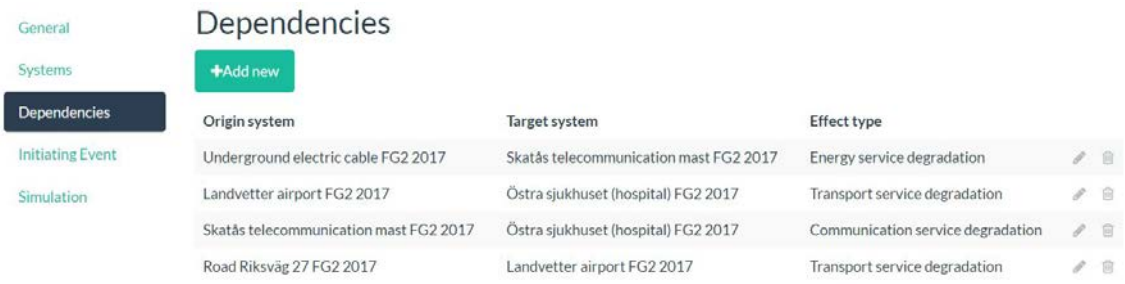

Figure 4.8 List with dependencies.

Note that even if a manual functional dependency has been added to the case, the correct incoming effect (type of vulnerability) needs to be added for the system to be sensitive to the functional dependency (see Section 3.3.1).

4.5 Define initiating event

To start a cascading incident (simulation), an initiating event is needed to be defined. It is the first event that risks affecting other systems. To define an initiating event, select the Initiating Event menu option in the menu for the specific case. In Figure 4.9, the start page for Initiating Event is shown before any initiating event has been defined. To define an initiating event, click the “Place initiating event” button. When doing so the cursor takes the form of a red star. Use the red star to mark the place on the map where the initiating event should take place or start. Then click the [Save] button below the map. If the position of the initiating event is incorrect, just click [Place initiating event] again and place the red star again, at the correct position. If having placed a new initiating event, but would like to go back to the previously saved position, it is possible to do so before the new position has been saved by clicking on the (undo) button.

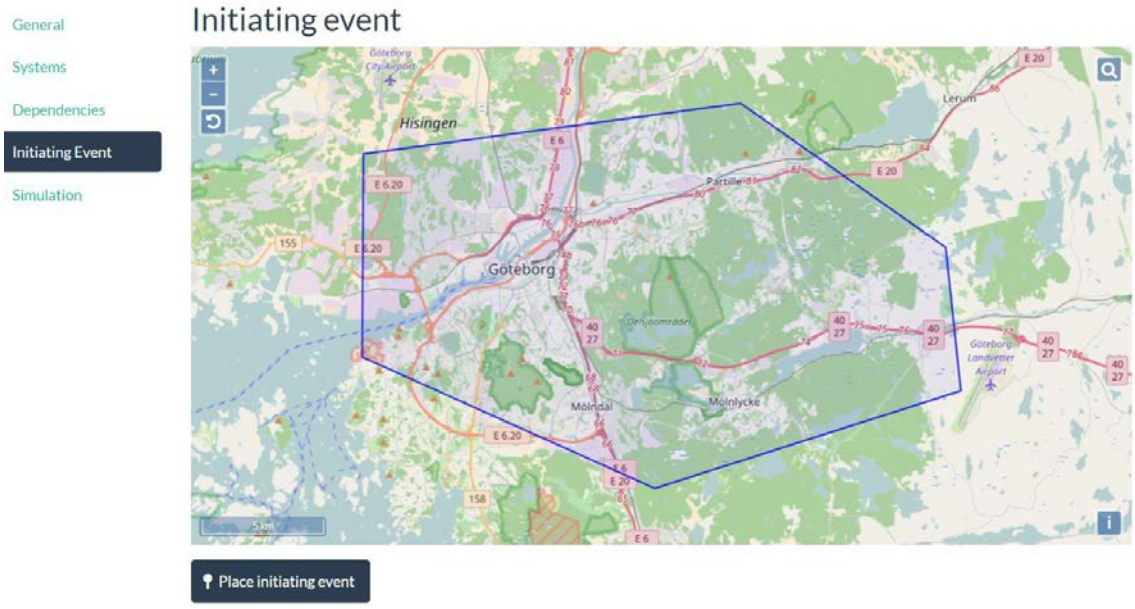

Figure 4.9 Initiating Event page, before any initiating event has been defined.

When the initiating event has been positioned, it is time to add its properties. First select the correct effect type form the pull down list and then click [Add]. A number of boxes are then available in the same way as for outgoing effects, the exact boxes depending on the selected type of effect. As for outgoing effects, the spread of the effect can be defined as either "Simple" or "Advanced" (see Section 3.3.2 for more details). When the initiating event has been defined with its extent and properties, it is shown on the map. An example, with Simple spread type, is shown in Figure 4.10.

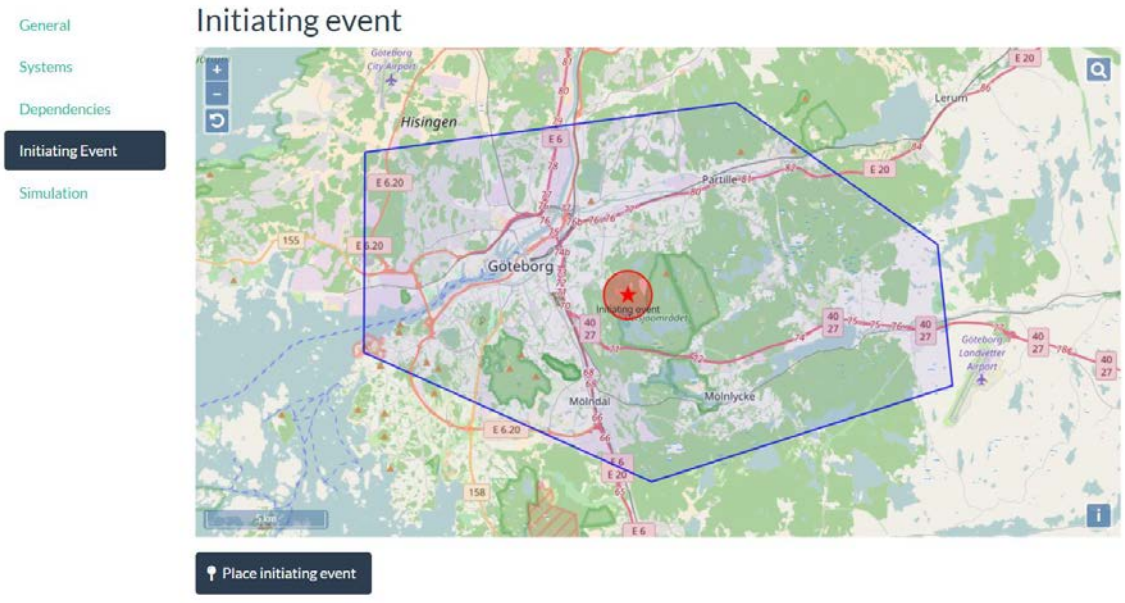

Figure 4.10 Placed initiating event.

4.6 Clone a case

By clicking on the [Public] button in the Case view, the list of public cases is presented. To show the geographical extent of a certain case, just click the name and the case border (blue) is shown on the map. On the map also the different systems (green) in the case and the defined functional dependencies (yellow) are also shown.

If one wants to use a public case, one needs to clone it. That is done by clicking on the  (Clone) button far to the right on the same line as the name of the case. Then a copy of the case is created and can be found in the Owned cases list. The copy by default gets the same name as the original case name with a “Copy” added at the end of the name. It is recommended to alter the name somewhat to easier separate from other copies of the same case.

When the clone has been made, it can be used as any other case, either run with already existing properties or after having changed the properties and settings. To open the case, click the  button. How to set different properties is explained in the previous sections in this chapter.

5 Run a simulation

As soon as systems have been created (and assigned relevant properties) and added to a case, and an initiating event has been defined, a simulation can be run. As explained in Section 4.4 also functional dependencies can be defined, but those are not necessary to be able to run s simulation. When the user has reached this stage, most of the work has been done. How to run the simulation is described in Section 5.1. The other sections in this chapter describes the different way in which the results are presented and how these different views can be manipulated by the user.

5.1 Simulation setup

When clicking on the [Simulation[option in the case menu, the Simulation set-up is opened. This constitutes of two parts (see Figure 5.1): a list of the systems included in the case and green run button. There is a check box for each of the systems in the list. By default all check boxes are marked, which means that all systems will be included in the simulation when run. It is, however, possible for the user to uncheck a system to exclude it from the simulation. There can be several reasons for wanting to exclude a system, but a common reason for doing this is quickly check the results when making changes to a scenario. One can for example first make a simulation with all systems included and then, based on the results, see what happens when one or several systems are excluded from the simulations (see also Section 5.7 on Key decision points).

When the systems to include in the simulation have been selected, the simulation can be run by clicking the [Run] button.

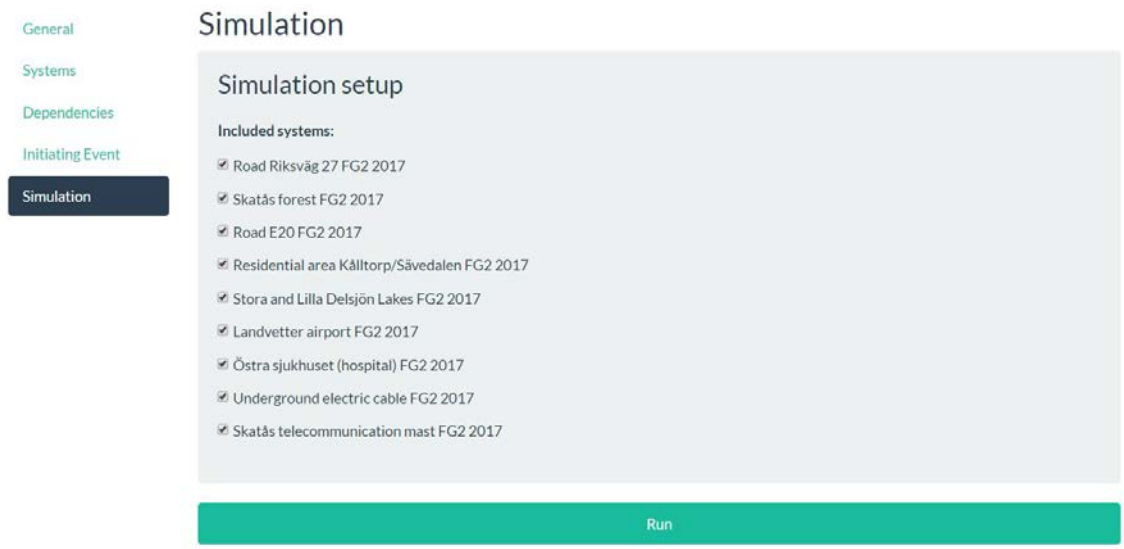

Figure 5.1 Simulation setup

The first part of the results from the simulation contains information on the run itself (see Figure 5.2), i.e. the sequence number of the specific simulation for the particular case, the

name of the case, when the simulation was run, and information on what systems were included and excluded, respectively.

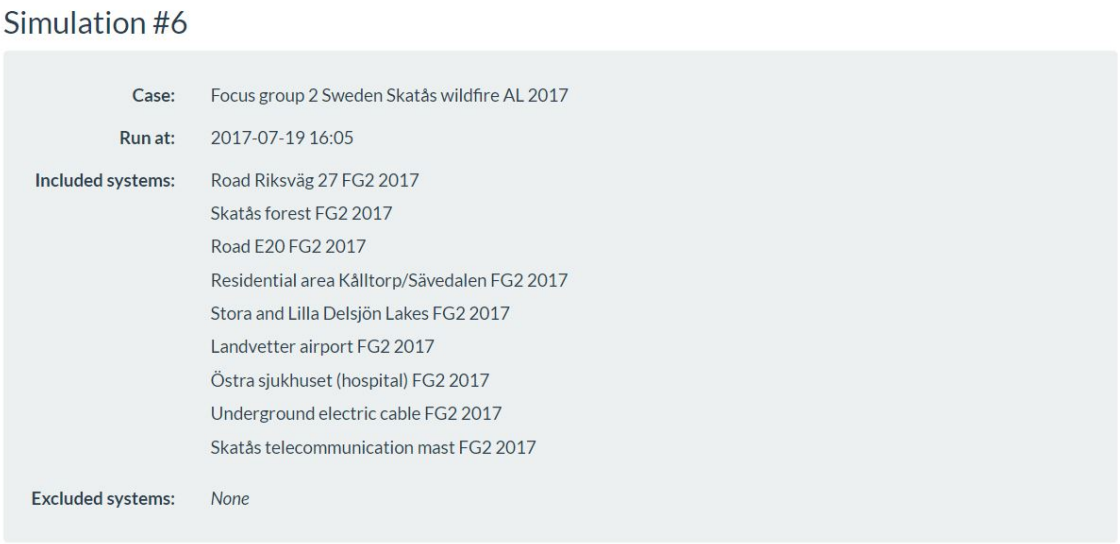

Figure 5.2 Information on a simulation run.

5.2 Timeline

The first result view is the Timeline. It starts with the initiating event at a certain time (depending on the settings at the first page of the case). For each effected system there is a box with two part which represents three different times (two different time periods). The left part of the box represent the time when a certain effect is “released” as an outgoing effect. The light (left) part of the box represents the propagation time, while the dark (right) part of the box represents the endurance time. This means that the far right limit of the box represent the time when the system is actually affected.

If the simulation (case) includes many systems it might be so that not all effects or systems can be seen at the same time, but the view can be changed in different ways. Firstly, the view can be moved by the holding the left mouse button on the view and then move in preferred direction. One can also use the buttons above the figure to move or zoom. If using a mouse with scroll wheel, that wheel can also be used for zooming (together with the Ctrl button).

If one is interested in a specific impact subcategory and what systems and dependencies have the largest impacts, one can select a specific impact subcategory to display from a menu (see Figure 5.4 and Figure 5.5).

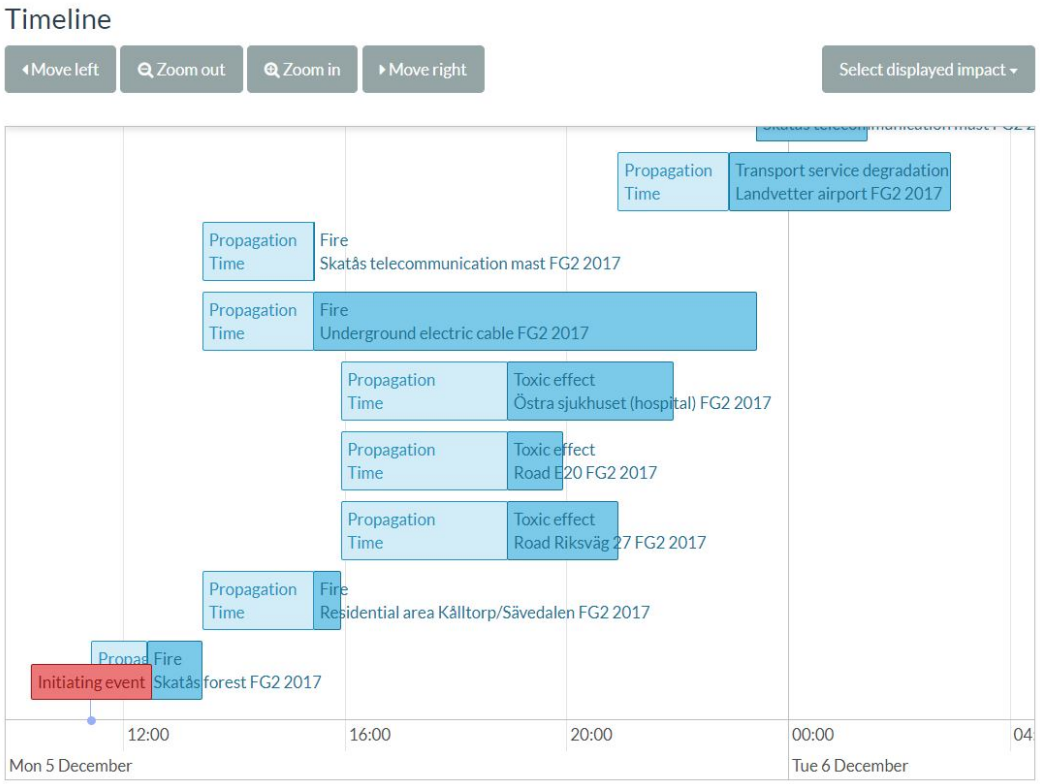

Figure 5.3 Example of timeline

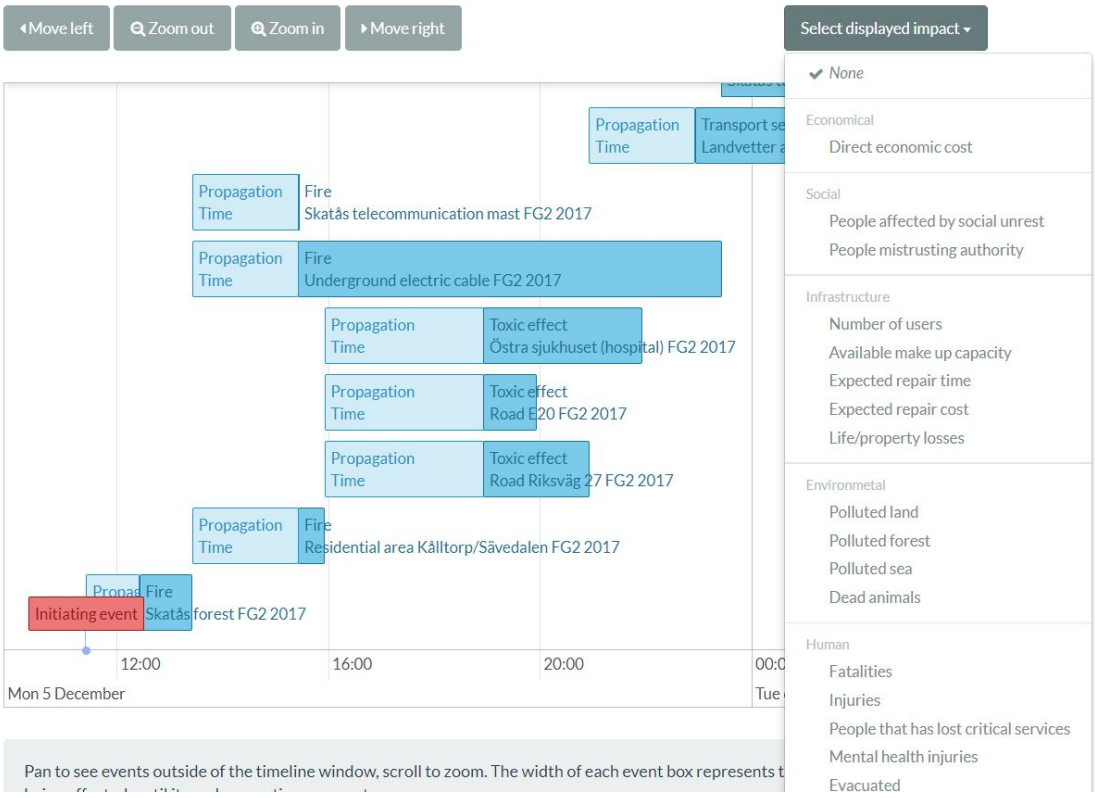

Figure 5.4 One can from a menu select the impact subcategory to display.

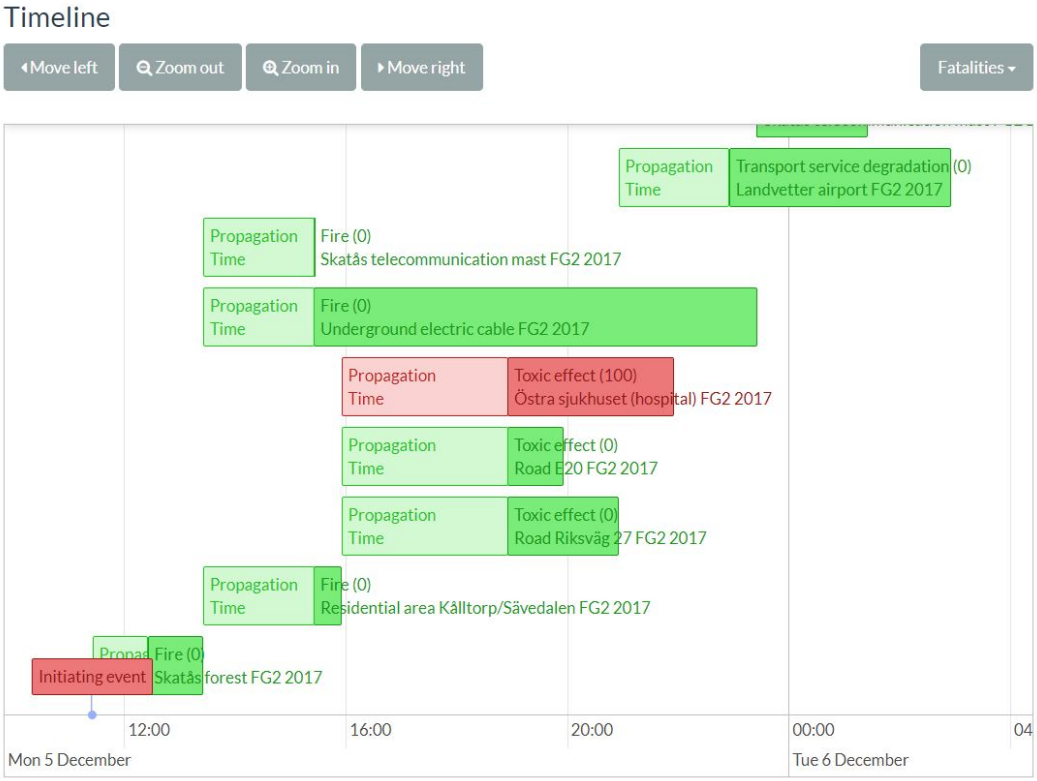

Figure 5.5 Timeline with Fatalities as the impact subcategory to show.

5.3 Tree view

The second view for the results is the tree view (see Figure 5.6). From the tree view it can be seen what system is affected by what type of effect from what originating system. Also the times for the effect are included. Furthermore, green arrows represent geographical dependencies while yellow arrows represent functional dependencies.

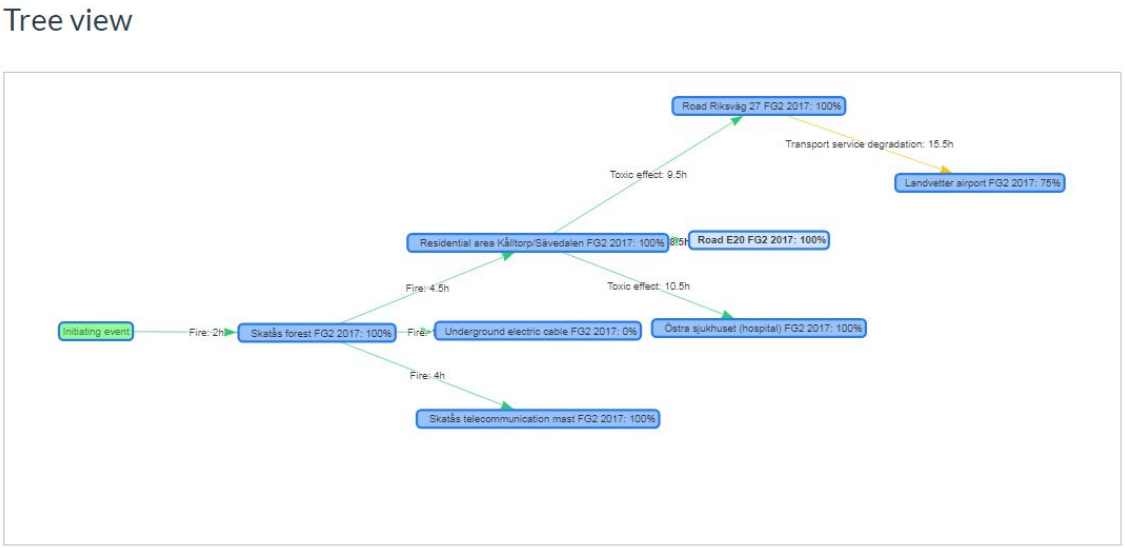

Figure 5.6 Example of tree view.

5.4 Output log

In addition to the visual views of the results, there is also an output log. This is mostly included for easier debugging, and it can be helpful to study when having expected a different results and trying to find what input might be erroneous. It can also assist in helping understand some of the other views, but in most cases the visual views (together with the impact table described in Section 5.6) are more than enough to understand the cascading effects.

5.5 Map with affected systems

The systems included in the simulation are shown on a map (see Figure 5.7), and colour coded based on the rate (percentage) of impact of the system. If the system is totally affected (100 % impact), the system border is red. If the system is not affected at all, the border is green. The border of systems with partial impact is coloured based on a colour scale between green and red.

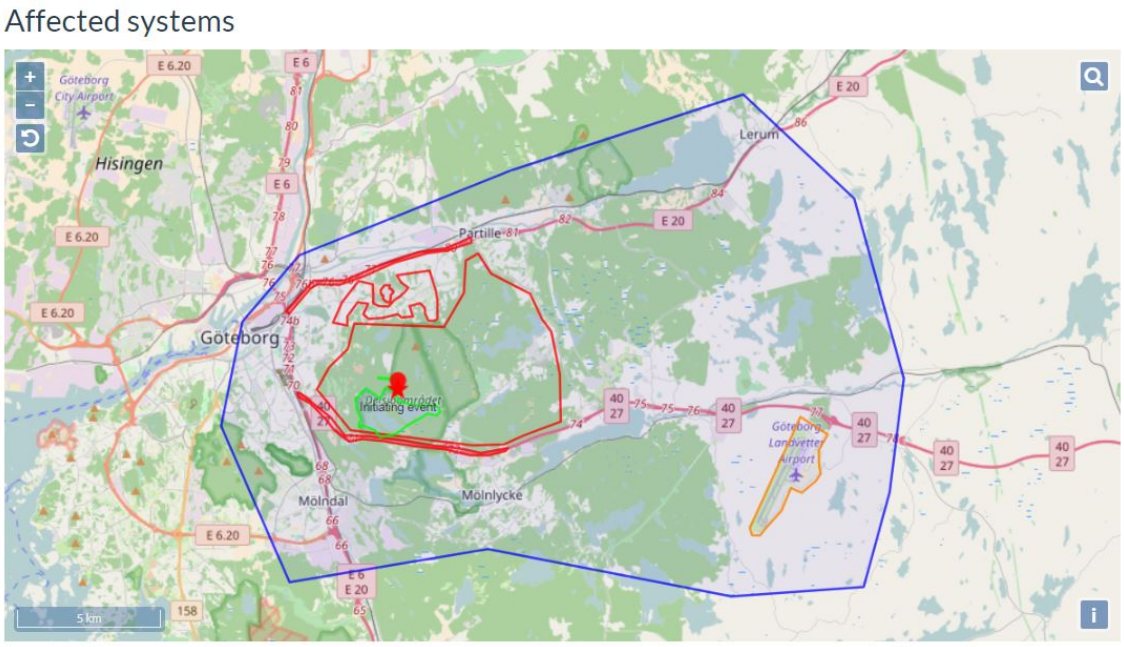

Figure 5.7 Map visualizing the affected systems.

5.6 Total impact

The table presents the contribution of each system to each impact subcategory. One needs to scroll to the right to see all systems. Far to the right there is also a column summing up the total value for each sub-category.

The percentage number shown beneath each value corresponds to the percentage a specific system contributes to the total sum for the impact sub-category in question. The results for a specific impact category or subcategory are never summed up with results from e.g. another subcategory. The results for each sub category are always presented separately. The reason for this is that then different weights would have to be given to each subcategory and that is more of a political decision and therefore that is left for the user to do.

If one is only interested in the results for some of the systems it is possible in a menu above the table to select the systems to show (see an example in Figure 5.8. The total sum is, however, still correct for all the systems included in the simulation.

Total impact

Select systems (2/9)

	Skatås forest FG2 2017	Östra sjukhuset (hospital) FG2 2017	All systems
ECONOMICAL			
Direct economic cost	1,000,000 € 27%	1,000,000 € 27%	3,750,000 € 100%
SOCIAL			
People affected by social unrest	0	0	0
People mistrusting authority	0	0	0
INFRASTRUCTURE			
Number of users	0 0%	0 0%	200 100%
Available make up capacity	0 %	0 %	0 %
Expected repair time	0 months 0%	0 months 0%	4 months 100%
Expected repair cost	0 € 0%	0 € 0%	1,000,000 € 100%
Life/property losses	0	0	0
ENVIRONMETAL			
Polluted land	0 km²	0 km²	0 km²
Polluted forest	0 km²	0 km²	0 km²
Polluted sea	0 km²	0 km²	0 km²
Dead animals	0	0	0
HUMAN			
Fatalities	0 0%	100 100%	100 100%
Injuries	0 0%	1,000 100%	1,000 100%
People that has lost critical services	0	0	0
Mental health injuries	0	0	0
Evacuated	0 0%	2,000 100%	2,000 100%
Homeless	0	0	0

Figure 5.8 Example of impact results per system and impact subcategory when two systems have been selected to be displayed together with the sum for all systems.

5.7 Key decision points

An important step of the IEM is step 6 when key decision points are identified. The IET does not by itself identify key decision points, but the possibilities to manipulate the views (as described in the sections above) and to include and exclude systems from the simulations makes it possible for the user to see what systems, parameters, effects, etc. have the greatest influence on the results and how the consequences, e.g. impacts, vary when making variation, which could be based on potential decisions.

5.8 Report

At the bottom of the results page it is possible to print a report from the simulation. This is still a relatively rough function, but a way to save the results and to compare with other results.

6 More information

The underlying methodology Incident Evolution Methodology (IEM) is described in detail in deliverable D4.2. The methodology was validated by potential end users using different scenarios. The performance of the validation sessions and the results from these sessions are described in deliverable D5.4.

During the development of the IET, national focus groups were formed and used to assess the development, to comment and to give advices for future development. This work is summarized in deliverable D5.3.

One of the wishes from end users and what has also been discussed within the CascEff consortium for future functionalities, is the possibility to communicate between existing incident management tools and the IET. Some work has been done on how such communication could be achieved and that is reported in deliverable D4.5.

For more information in general on cascading effects and on how to analyse them, the reader is referred to deliverables D2.1 and D2.2. Terms and terminology are described in deliverable D1.6.

More information on the CascEff project in general and on different publications and deliverables can be found on the project web site, www.casceff.eu.

7 References

D1.6, Lönnermark, A., Criel, X., Johansson, J., Cedergren, A., Van Heuverswyn, K., Judek, C., Lange, D. Arnell, K. Reilly, P., ”CascEff Glossary and Definitions”, CascEff, 2016.

D2.1, Hassel, H., Johansson, J., Cedergren, A., Svegrup, L., Arvidsson, B., ”Method to study cascading effects”, CascEff, 2014.

D2.2, Johansson, J., Svegrup, L., Arvidsson, B., Jangefelt, J., Hassel, H., Cedergren, A., ”Review of previous incidents with cascading effects”, CascEff, 2015.

D4.2, Carre, F., Prats, F., Willot, A., Cherkaoui, A., Salmon, R., D’Osterlinck, T., Edjossan-Sossou, A. M., Sammels, M., Tiripelli, G., Lönnermark, A., “Methodology for creating a model of an incident with cascading effects for future threats”, CascEff, 2017.

D4.5, Kempe, M., Rask, F., Criel, X., Lönnermark, A., Mörn, C., ”Specifications for communication between CascEff IET and Incident Management Tools”, CascEff, 2017.

D5.3, Edjossan-Sossou, A. M., Judek, C., Verdel, T., van Campen, S., Damen, J., Hooft, S., Criel, X., Lönnermark, A., Reilly, P., ” Report on initial testing simulations”, CascEff, 2017.

D5.4, Sammels, M., Edjossan-Sossou, A. M., Judek, C., Carre, F., Lönnermark, A., ” Report on validation of implemented incident management methodology.”, CascEff, 2017.

Appendix 1 System categories and system subcategories

Table A1.1 presents a list of system categories and system subcategories available in the IET.

Table A1.1 List of system categories and system subcategories.

System categories	System subcategories
Agriculture	Not specified
	Crops
	Cattle
	Forest
	Fishing
	Plantations
	Dairy
Air transportation	Not specified
	Airports
	Flight control
	Airplane traffic
Business and industry	Not specified
	Raw material
	Construction
	Manufacturing
	Service sector
	Retail
	Import
	Export
	Hotel & Restaurant
	Tourism
	Chemical industry
District heating	Not specified
	Production plants
	Distribution
	Raw material supply
Education	Not specified
	Primary school
	Secondary school
	University
	Research
Emergency response	Not specified
	Emergency health care
	Police
	Rescue services

System categories	System subcategories
	Call centres
	Coast guard
	Defence forces
	National guard
Environment	Not specified
	Flora
	Fauna
	Lakes
	Ocean
	Forests
	Rivers
	Deserts
	Mountains
Financial	Not specified
	Central banking system
	Credit cards
	Financial transactions
	Stock exchange
	Cash availability
	Insurance
	Currency exchange
Food supply	Not specified
	Distribution
	Processing
	Control
	Primary production
Governmental	Not specified
	Border control & immigration
	Court system
	Prosecutors office
	Customs
	Correctional system
	Pension systems
	Waste treatment
	Embassies & Consulates
	Local
	Regional
Healthcare	Not specified
	Primary care
	Medicine and material supply
	Child care

System categories	System subcategories
	Disabled persons
	Elderly care
	Psychiatry
	Social services
	Disease control
	Hospitals
Marine transportation	Not specified
	Ports
	Cargo traffic
	Passenger traffic
Media	Not specified
	Newspapers
	Social media
	TV
	Radio
	Web-based information
Oil and Gas	Not specified
	Production
	Distribution
	Refining
Political	Not specified
	Local level
	Regional level
	National level
Power supply	Not specified
	Production
	Local Distribution
	Sub-Transmission
	Transmission
	Raw material supply
The public	Not specified
Rail transportation	Not specified
	Railway stations
	Railway network
	Subway
	Trains
	Trams
	Train control
	Rail yards
Road transports	Not specified
	National Network

System categories	System subcategories
	Regional Network
	Local Network
	Bridges
	Tunnels
	Road traffic
Sewage	Not specified
	Waste water
	Storm water
	Combined Waste/Storm
Telecommunication	Not specified
	Telephone landline
	Telephone mobile
	Internet
	Radio-communication
	Satellite/GNSS
	Postal system
Water supply	Not specified
	Water treatment plants
	Distribution
	Infiltration areas

Appendix 2 Incoming and outgoing effects

Table A2.1 presents a list of effects (incoming or outgoing) available in the IET, and their characteristics.

Table A2.1 List of effects (incoming or outgoing) and their characteristics.

Effect name	Characteristicsa	Units
Communication Service degradation	Severity	[%]
Energy Service degradation	Severity	[%]
Epidemic	Percentage of diseased How severe / contagious it is	[%] [%]
Fire	Thermal radiation	[kW/m^2]
Flood	Height Velocity	[m] [m/s]
Food supply degradation	Severity	[%]
Ground movement	Acceleration Displacement	[m/s^2] [mm/m]
Humidity	Humidity Humidity variation	[%] [%]
Industrial accident pressure	Pressure value Pressure variation	[mbar] [mbar]
Precipitation	Precipitation rate	[mm/h]
Projectile (mechanical effect)	Energy	[kJ]
Public health deterioration	Severity	[%]
Radiation	Level of radiation	[mSv]
Service degradation	Severity	[%]
Social effect	Severity	[%]
Temperature	Temperature	[°C]
Toxic effect	Concentration	[%]
Transport service degradation	Severity	[%]
Water Service degradation	Severity	[%]
Wind speed	Wind speed	[m/s]
Workforce degradation	Severity	[%]