Security Requirements Modeling Tool

User Manual

(rev 1.0)

For STS-Tool Version 2.1

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1 First use

The Socio-Technical Security Modeling Tool (STS-Tool) is a standalone application distributed as a compressed archive and is available for multiple platforms.

To start using STS-Tool, extract the content of the archive, which contains the tool binaries, to a folder on your computer. Then, run the launcher file (STS-Tool) - no setup is needed. A splash screen with the tool logo and the tool version appears in the middle of your screen indicating that the program is loading (Figure 1.1).

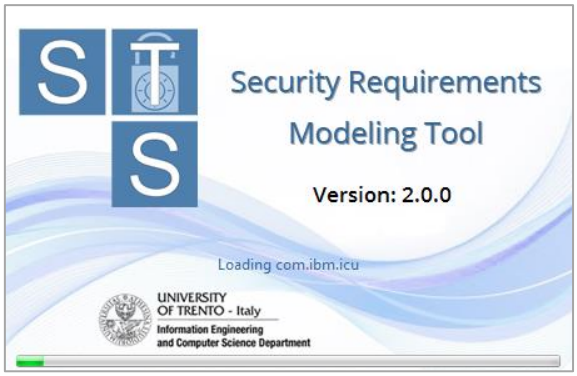

Figure 1.1 STS-Tool Splash Screen

Then, you will be asked to read and accept the terms of use. Read them carefully, select the check box on the bottom and click the button "I Agree". By clicking the button "Decline", you will close the program. Once you agreed to the license, the tool will welcome you with a change log describing differences from previous versions (Figure 1.2).

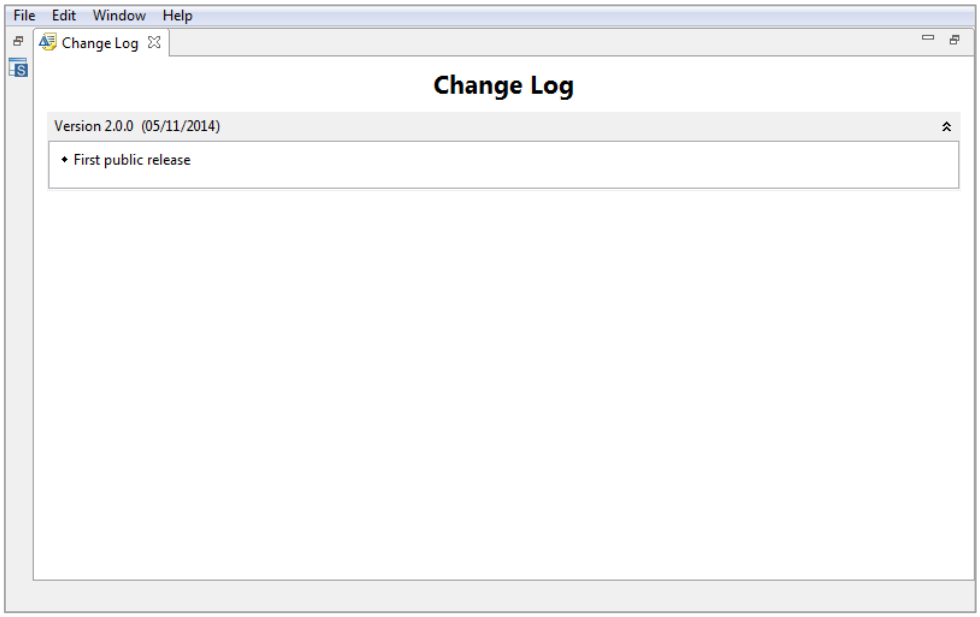

Figure 1.2 STS-Tool change log

You can close the change log with the little "X" right to the "Change Log" Tab.

2 GUI Overview

This section presents the Graphical User Interface (GUI) of the STS-Tool, and shows how to specify security requirements. The modeling language is described extensively in the STS-Tool Modeling Language document.

2.1 Environment overview

Figure 2.1 shows how the STS-Tool looks like when a new diagram is created. The work environment is horizontally split into three areas.

- The upper area contains the **Menu Bar** and the **Toolbar**;
- The middle area or the drawing area contains the **Projects Navigation Area**, the **Editor Area** or simply "the editor" and the **Palette**;
- The lower area is composed of two parts, on the right we find the **Outline View** while on the left area, grouped together we find the **Property View** the **Analysis Result View** and the **Security Requirements View**.

The name of the tool and its version are shown in the topmost application bar.

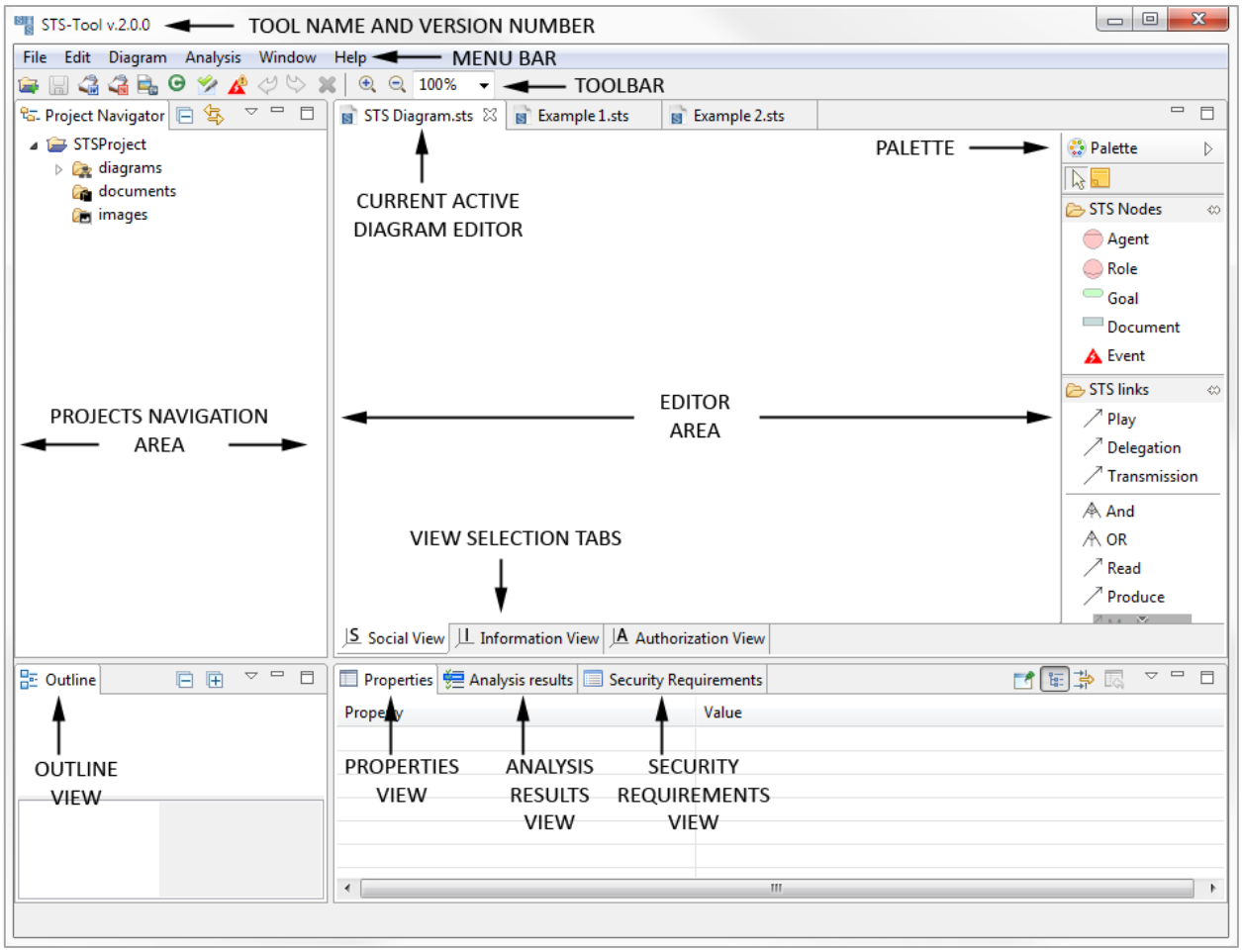

Figure 2.1 STS-Tool overview

2.1.1 Customize the environment layout

The environment layout (perspective) can be freely changed by the user to make it more comfortable when working with STS-Tool.

It's possible to change the perspective layout in different way.

- Drag one of the two sashes (Figure 2.2) to change its area size.
- Drag and drop one of the views, grabbing it from its tab (Figure 2.3), and move it in another area, or move it outside the tool window, to put it in a new separate window.

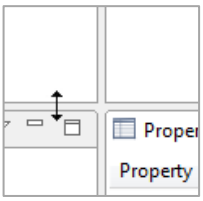

Figure 2.2 Drag sash

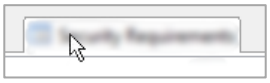
Figure 2.3 Drag view

To reset the perspective layout to the original state go through the menu "Window" → "Reset Perspective" as shown in Figure 2.4.

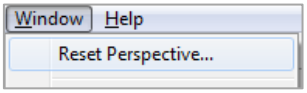

Figure 2.4 Reset perspective menu

2.2 Main menu and toolbar

In the upper most part of the STS-Tool you can find the main menu (Figure 2.5) with different entries divided by functionality.

Just below the main menu there is the toolbar (Figure 2.6) that contain the commons commands for a faster access.

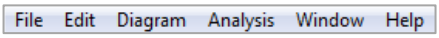

Figure 2.5 Main menu

Figure 2.6 Toolbar

Some menu entries and toolbar buttons are not always visible, because they are added dynamically when necessary.

2.2.1 File menu

The file menu (Figure 2.7) contains commands useful for manipulating (e.g., creating, opening, saving, closing etc...) files or projects, as well as the "Exit" button to exit the tool.

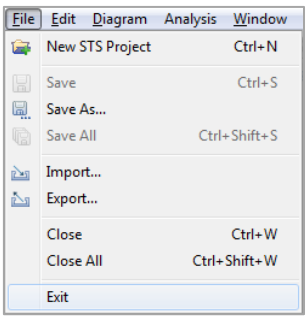

Figure 2.7 File menu

More details about each command will be given in the next paragraphs

The command text visible on the right side of some commands is the respective keyboard shortcut.

2.2.2 Edit menu

The edit menu (Figure 2.8) is used mainly to modify the current selected object;

- **Undo** (Ctrl + Z):"Undo" command lets you undo your last operations.
- **Redo** (Ctrl + Y): "Redo" command lets you redo your latest undone operations.
- **Copy**: "Copy" command lets you copy the current selected object.
- **Paste**: "Paste" command lets you paste a previous copied object.
- **Rename**: "Rename" command lets you rename the current selected object.
- **Delete**: "Delete" command lets you delete the current selected object.
- **Select All** (Ctrl + A): "Select All" command lets you select all the object in the selected context.

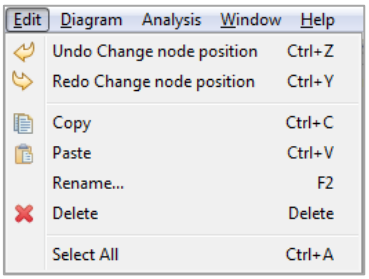

Figure 2.8 Edit menu

2.2.3 Others menu

Other menu's commands will be described in detail in the following paragraphs.

2.3 Views

2.3.1 Project Navigator

The project navigator allows the user to easily manage his resources through the concept of projects. A project can be defined as a collection of different resources like files and folders that have a common relationship.

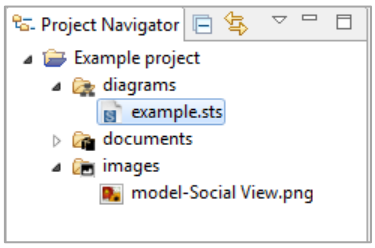

Figure 2.9 Project navigator

In the project navigator, resources are structured hierarchically as shown in "Figure 2.9".

The behavior and the usage of the project navigator are very similar to the classic "file explorer".

To expand or collapse elements use the little arrow on its left.

To select a single resource simply click it with the mouse, while if you need to select multiple resources you must also press on the keyboard the "Alt" or "Ctrl" key before clicking the resources with the mouse.

Next paragraphs will illustrate in detail some common operations that are available in the project navigator.

2.3.1.1 Open files

To open a file, simply double-click it.

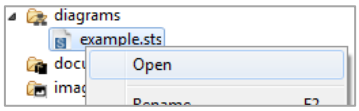

Figure 2.10 Open a file

You can also open a file by selecting it with the mouse and pressing enter on the keyboard, alternatively you can right click it and select open from the contextual menu.

2.3.1.2 Rename projects, folders and files

To rename a project a folder or a file click it with the mouse, at this point you can press “F2” on the keyboard, or use the “edit” menu and then select “Rename”. You can also right-click it and select “Rename” in the context menu that will appear.

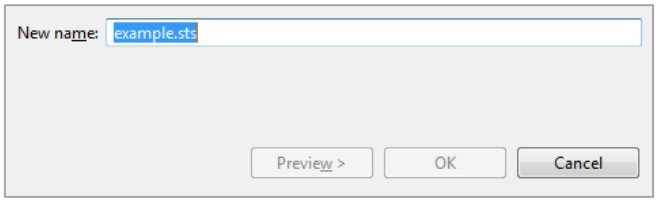

Figure 2.11 Renaming dialog

At this point a new dialog will appear (Figure 2.11) that will let you choose the new name. When done press “OK” to confirm or “Cancel” to abort the operation.

Note that some default folders cannot be renamed.

2.3.1.3 Deleting projects, folders and files

To delete a project a folder or a file click it with the mouse, at this point you can press “Del” on the keyboard, or use the “edit” menu and then select “Delete”. You can also right-click it and select “Delete” in the context menu that will appear.

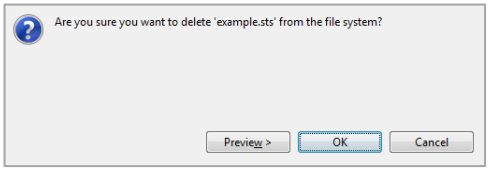

Figure 2.12 Delete folders and files

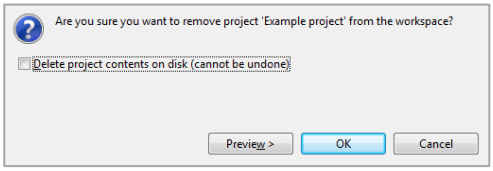

Figure 2.13 Delete projects

At this point a new dialog will appear (Figure 2.12) that will ask you to confirm the deletion.

The confirm dialog is slightly different for projects deletion (Figure 2.13). In addition there is a check mark, that indicates to physically delete the file from the file system. If not checked the project is removed only form the navigator and will be recoverable later, but it will not be possible to create a new project with the same name.

Now if you are sure press “OK” to confirm otherwise press “Cancel” to abort the operation.

Note that some default folders cannot be deleted.

2.3.2 The editors area

The editor's area (Figure 2.14), is the largest area in the tool. It is the default location where diagrams are opened for editing. STS-Tool supports the opening of multiple diagrams at the same time. For each diagram a new editor is added. The active editor has its tab highlighted.

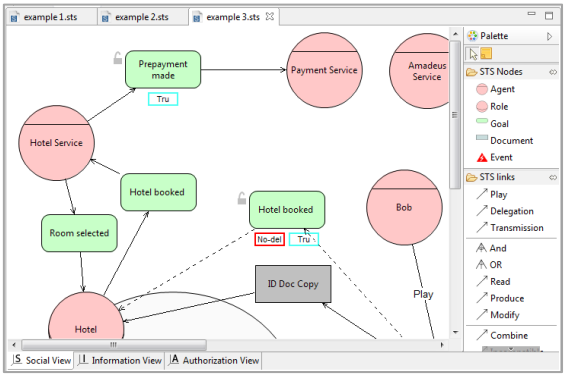

Figure 2.14 Editors area

More details on the editor are provided in chapter "4.1 The Editor".

2.3.3 Outline

The outline view becomes active when there is an opened model. It supports the designer during the creation of a model, giving a fast overview of the entire model.

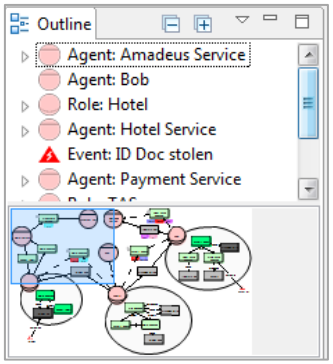

Figure 2.15 Outline

As it can be seen in "Figure 2.15" the outline view is divided in 2 parts.

The lower part is a miniature of the entire model where the light blue selection is the actual area visible in the editor.

In the upper part instead there is a hierarchical representation of the model. Using the 2 buttons in the uppermost part it is possible to collapse or expand all the elements.

Selecting one element of the tree will automatically reveal that element in the editor.

The outline view has another functionality that is explained in detail in chapter "4.7 Security needs and security requirements".

2.3.4 Other Views

Other views will be illustrated afterwards in a more specific context.

3 Working with projects and diagrams

3.1 Creating a new project

To start working with STS-Tool and being able to create a new diagram, you have to first create at least one project.

To create a new STS project, click anywhere in the project navigator and then go in the menu "File" and select "New STS Project" (Figure 3.1), you can also use the contextual menu of the project navigator (Figure 3.2).

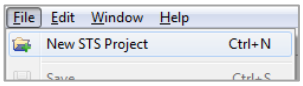

Figure 3.1 New project menu

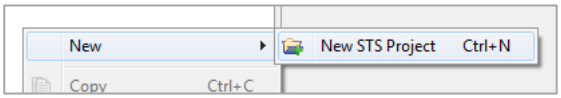

Figure 3.2 New project context menu

A new dialogue window will appear, and you will be asked for a project name, once done you can click the "Finish" button.

The new created project will appear in the project navigator.

3.2 Creating a new diagram

Once a project is created you can create a new STS diagram.

To create it, click the "File" menu and then "New STS Diagram". As for creating project you can always use the navigator context menu.

From the dialogue window which will appears, first select a destination project (Figure 3.3) where the created diagram will be saved and after enter a file name (Figure 3.4). When done press "Finish".

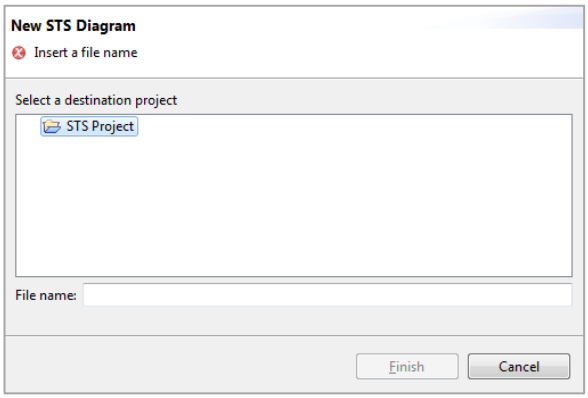

Figure 3.3 Create new diagram wizard

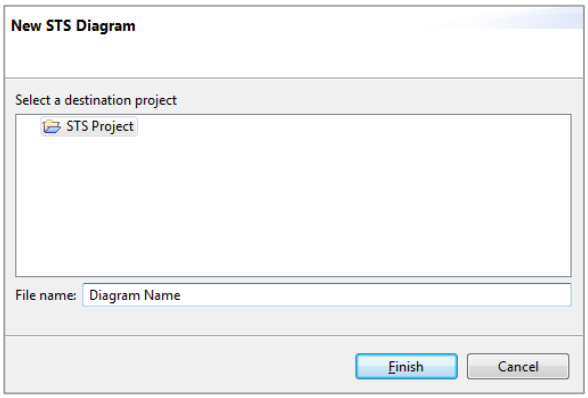

Figure 3.4 Naming a new diagram

3.3 Export and import

STS-Tool allows to export and import projects.

3.3.1 Export a project

STS projects can be exported as a file that can be stored for backup purposes or shared with collaborators.

To export a project, go to menu “File” and then select “Export”; a pop-up window will appear, as shown in Figure 3.5. In the wizard select “Projects”, and click the button “Next >”. After that, a new window will appear with the list of projects present in the project explorer, shown in Figure 3.6. Select the projects you want to export, choose the destination path and click the “Finish” button. The projects will be exported in the file you specified.

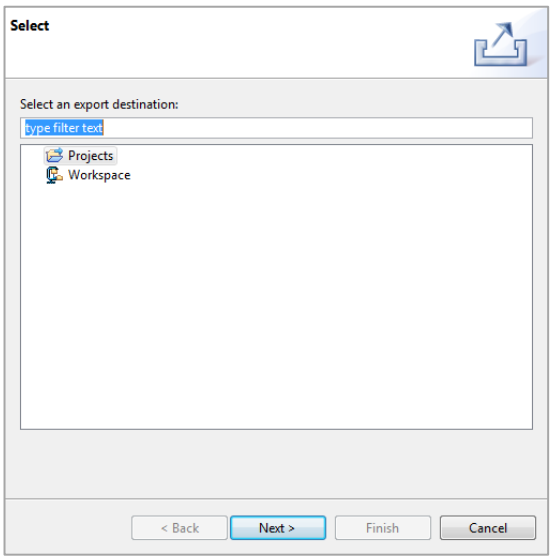

Figure 3.5 Export pop-up window

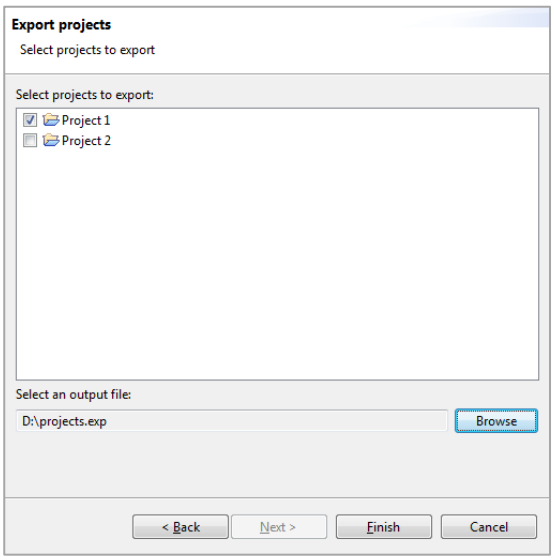

Figure 3.6 Export project pop-up window

3.3.2 Import a project

To import a previously exported project, go to menu “File” and then select “Import”. A pop-up window will appear, as shown in Figure 3.7. Select “Projects”, and click on the button “Next >”. Another pop-up window will appear, as shown in Figure 3.8.Use the browse button to select the file containing the exported projects. Once selected, the list of projects contained in the file will appear.. Select the projects that you want to import and next press “Finish” to load them into the workspace.

Please note that STS-Tool does not allow projects with the same name in the workspace. Therefore, projects to be imported, but with the same name of a project already present in the workspace will be marked in gray and they will be not selectable..

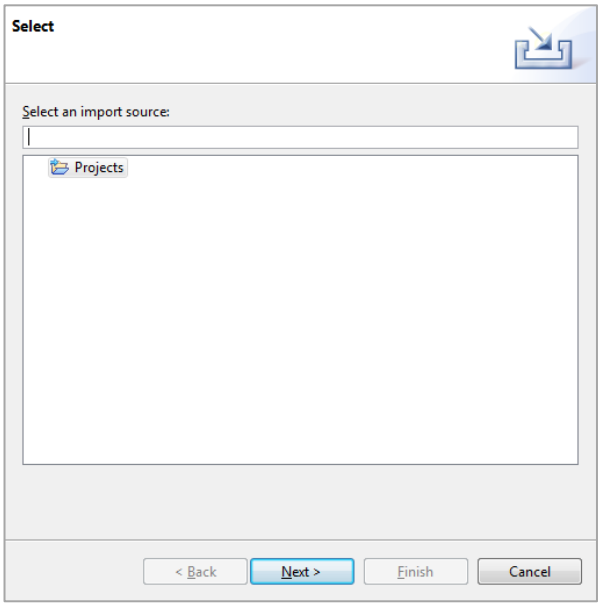

Figure 3.7 Import project menu

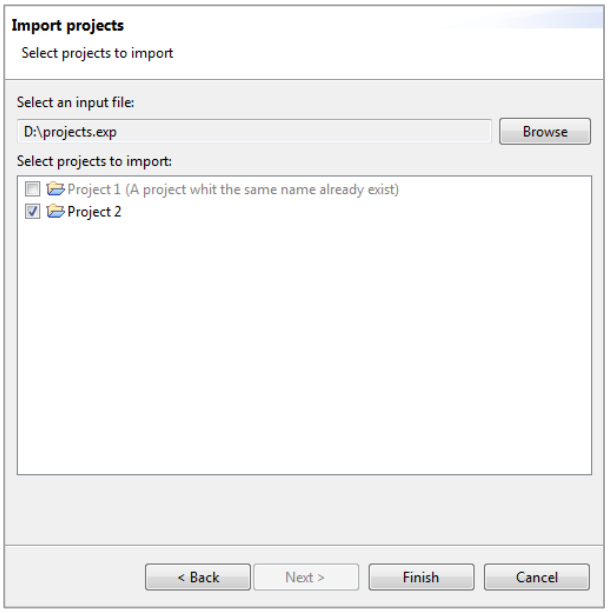

Figure 3.8 Import project wizard

3.3.3 Export a diagram to an image

STS-Tool allows to export a diagram with different formats.

To export a diagram as an image, first of all you must open the desired diagram.

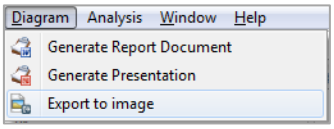

Figure 3.9 Export to image menu

Once opened go in the “Diagram” menu and choose the “Export to image” command (Figure 3.9).

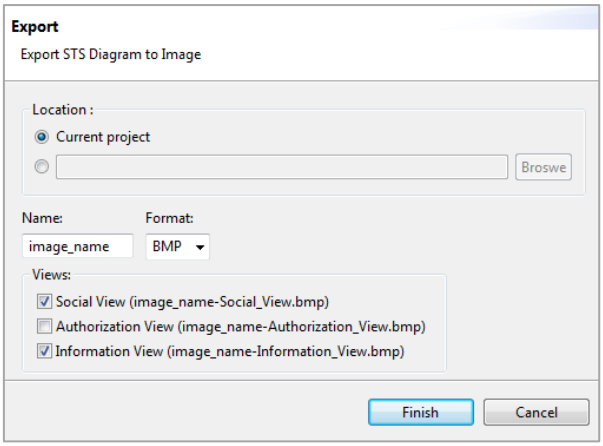

Figure 3.10 Export image wizard

A wizard will open (Figure 3.10) and you are required to input some data.

First choose the destination location:

- Current project: Images will be saved in the "Images" folder of the current projects.
- Filesystem: Images will be saved in the specified location on the filesystem.

After input a name for the file/s (no extension is required) and select the output format from the cascade menu. At this point select the views you want to export and the press "Finish". Images will be saved in the location specified.

4 Modeling a scenario

In this section, we describe how to carry out modeling with the STS-Tool. In particular, we show how to add elements and relations and how to set their properties.

4.1 The Editor

The editor (Figure 4.1) is mainly composed by 2 areas.

The main and biggest area on the left side is the “editing area” or “modeling area”, here is where the modeling occurs and where the user will draw and model is diagram.

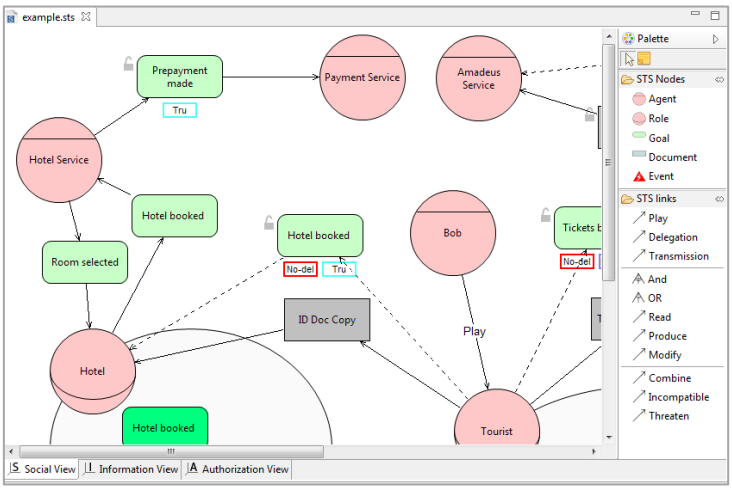

Figure 4.1 The editor

At the bottom of the editor area is possible to notice 3 different tabs (Figure 4.2). These tabs allow switching to a different view: "Social view", "Information view" and "Authorization view".

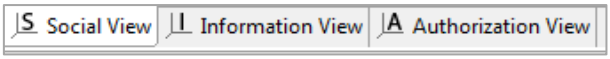

Figure 4.2 Editor views tabs

Views permit various aspects of a model to be separated to simplify the modeling activity. Each view has an independent layout, meaning that the position of elements and their size are view-dependent. The default view when you create a new diagram is the social view. When switching to a different view, the content of the canvas changes, by hiding/showing the elements and relations available in such a view. Similarly, each view has a specific palette that enables elements/relations related to the current view to be added

Once an editor is opened, the toolbar is contributed whit new buttons (Figure 4.3).

Figure 4.3 Editor toolbar contributions

The first 3 buttons are the undo/redo/delete buttons, while the others 3 allow zooming into the editor area.

Zooming can be achieved also via a keyboard shortcut: "ctrl +" to zoom in and "ctrl -" to zoom out.

On the right side of the editor instead we find the “Palette”. The palette contains the tools, grouped by category, used for modeling.

Figure 4.4 Standard tools

The first group (Figure 4.4) contains the default or selection tool used to select and move objects, and a tool to add notes.

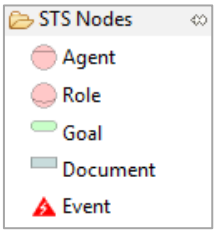

Figure 4.5 Node tools

The second group (Figure 4.5) contains the tool used to create elements. More details in next paragraph.

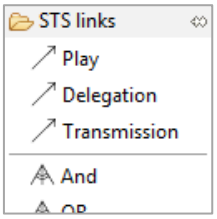

Figure 4.6 Link tool

The third group (Figure 4.6) contains the tool used to create relations between elements.

4.2 Adding nodes

To add a new node, please follow the following four steps (Figure 4.7):

1. Select an element from the palette area with the mouse (Elements group); just click on the element;
2. Move the mouse cursor over the diagram canvas (the cursor will change its icon);
3. Click with the left mouse button on the point where you want to add your element;
4. The new element is added and you are asked to insert a new name. Afterwards you can press “enter” or click outside the element to automatically return to the “Selection tool”. (Note: the name must be unique among all elements of the same type).

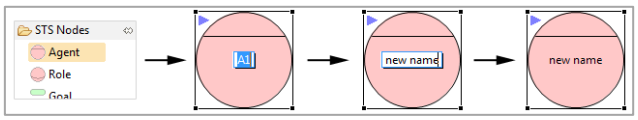

Figure 4.7 Adding a node

Note 1: While creating elements you can press the “Ctrl” (“apple” on Macintosh) button to create a sequence of elements, without having to select the “Element creation tool” every time.

Note 2: As you will see later, not all elements can be created on the canvas. Look at the section “5 Elements and Relations” which has a detailed description of every element.

4.3 Adding relations

A relation is a link between two elements, so to create it you must have at least two different elements to relate. Follow these steps to create a new Relation (Figure 4.8):

1. Select with the mouse a relation from the palette area (Relations group); just click on the element;
2. With the mouse cursor, click the first element (source);
3. Click the second element (target) with the mouse, without keeping the button pressed.
4. The relation is now created.

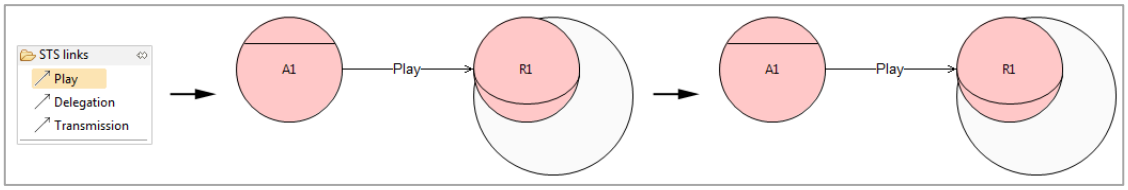

Figure 4.8 Adding a relation

Note: Each relation has its own creation constraint. Look at the section "Elements and Relations descriptions" for more details.

A more complex case occurs when you create a relation of "delegation" or "transmission". To do this (Figure 4.9):

1. Select a relation from the palette area (Relations group), with the mouse just click on the element;
2. Move the mouse cursor, click the first element (source), goal or document;
3. Click the second element agent or role (target) with the mouse, without keeping the button pressed.
4. The relation is now created.

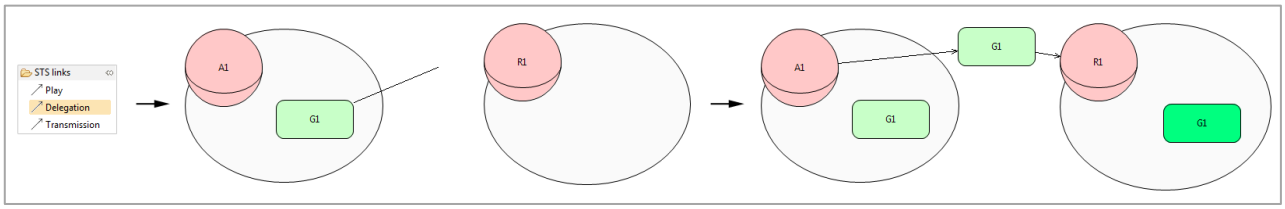

Figure 4.9 Adding a delegation or a transmission

4.4 Setting properties

All elements and relations have their own properties and values. Once an element or a relation is created, the tool assigns a default values to its properties.

To change the property values of an object, first select it in the diagram, and then use the "Property view" to edit any of the provided properties (Figure 4.10). The properties view is automatically updated each time an object is selected to reflect the object properties.

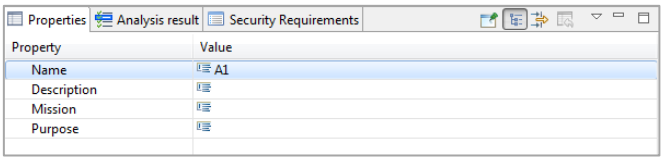

Figure 4.10 Property view

The "Property Tab" is a table with two columns. The first column displays the name of the property, and the second shows the value of that property. Clicking on a value cell of a specific property, you can input the new value for the property. The type of the editor can be different based on the type of the property. Look at the section "Elements and Relations descriptions" for more details about each object properties.

4.5 Frequent operations on elements

4.5.1 Moving nodes

Elements can be moved by selecting them and dragging them to a new position. While dragging a phantom figure shows the new location of the element if the mouse were to be released (Figure 4.11).

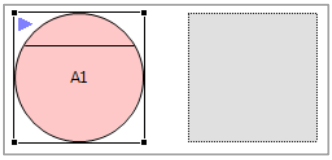

Figure 4.11 Moving node

Note that when an element is moved from one actor scope to another one (i.e. goal or document), a side effect occurs: the actor who wants (possesses) the goal (document) changes. Notice that elements that are in a compartment area can't be dragged out or inside another compartment.

4.5.2 Moving relations

Relations can be moved after selection. When selected, relations display a little handle in the middle, which can be dragged with the mouse (Figure 4.12) to move around the given relation. This operation "splits" the connection in 2 new segments that have a new small handle in the middle. Using these new handles allows creating unlimited points.

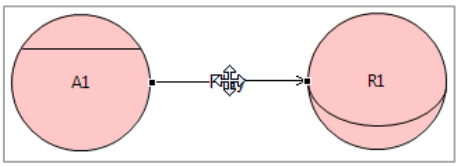

Figure 4.12 Moving relation

To remove a point, move it along the imaginary line between the previous and next point in the connection.

4.5.3 Deleting elements

Element deletion can be done in two different ways, either by keyboard or mouse:

- Keyboard: select the element/relations you want to delete and press button "Del";
- Mouse: select the element/relations, "right-click" and select "Delete" from the menu (Figure 4.13).

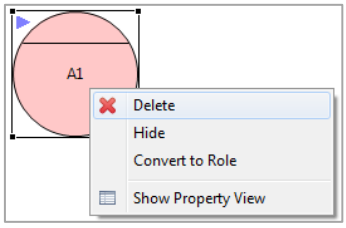

Figure 4.13 Delete from context menu

Note: not all elements can be removed, to avoid cascade deletions. However, the STS-Tool supports users by introducing pop-ups to warn about this. As an example consider the deletion of a delegated goal / transmitted document. The goal/document that automatically appears in the delegatee actor scope cannot be deleted. To delete it, the associated delegation/transmission needs to be deleted first. This concept applies recursively. Take a delegated goal / transmitted document that has been re-delegated/transmitted. The original delegation or transmission cannot be deleted until the re-delegation/re-transmission is removed.

4.5.4 Renaming nodes

A node can be renamed in three ways:

- Select the element to rename and press F2. The agent's label is highlighted and the user can define the new name (Figure 4.14);
- Double click on the element. The agent's label is highlighted and the user can define the new name
- Select the element to rename and start typing the new name. Press enter to confirm.

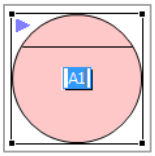

Figure 4.14 Renaming a node

Note: This version of the STS-Tool not allows for multiple elements of the same type to have the same name.

4.6 Expand and collapse compartment

As shown in "Figure 4.15", an agent (or role) can be shown in two different forms: "expanded" and "collapsed". In the expanded form a black circle is visible under the element. This area represents the "compartment area", where other elements such as goals and documents can be inserted. The collapsed form hides the compartment and all elements inside it. To switch between these visualizations you must first select the element and then you can use the little arrow placed on the top left corner of the element's selection bound. Once in expanded form the compartment area can be resided using the handles placed on the element's selection bound. Optionally you can double-click the pink area to automatically adjust the compartment area size.

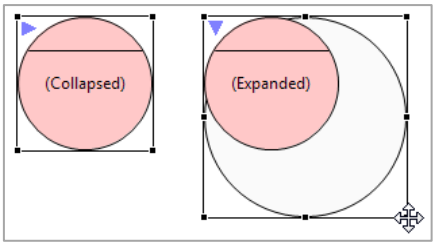

Figure 4.15 Compartment

4.7 Security needs and security requirements

Some elements have special attributes called security needs (To know which elements support security needs see chapter 5 "Elements and Relations").

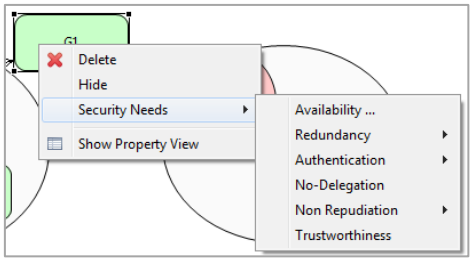

Figure 4.16 Example of security need menu

Security needs can be applied/removed by right-clicking on the element and selecting the appropriate command under the "Security needs" sub menu (Figure 4.16).

There are three types of security needs:

- Without parameters: This security needs are displayed as a simple menu entry.
- With fixed parameters: This security needs are displayed as a menu with a sub menu containing the possible choices.

- With a valued parameter: This security needs are displayed as a simple menu, but the name ends with three dots. When enabled a dialog is open asking the user to input the required values (Figure 4.17).

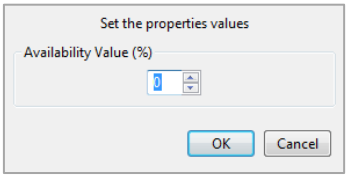

Figure 4.17 Security need parameters input example

Once a security need is applied, a small padlock appears near the element. This indicates that one or more security needs are applied on the object.

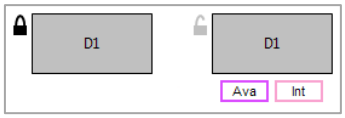

Figure 4.18 Security needs lock example

It is also possible to double-click the small lock to show or hide the list of applied security needs under the object (Figure 4.18).

The specification of security needs allows the derivation of security requirements, which are listed in the "Security Requirements" view (Figure 4.19). Security requirements are automatically updated and generated whenever is necessary (reflecting any change in the diagram regarding the specification of security needs).

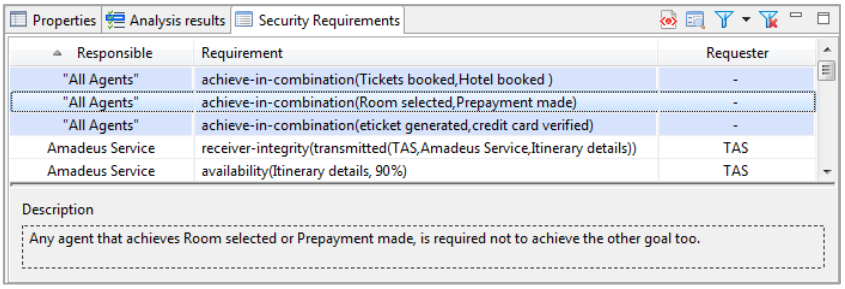

Figure 4.19 Security requirements view

The most visible part in the security requirements view is the table containing the list of security requirements. This table has three columns, and is possible to sort the security requirements in a different way by clicking a column's header.

In the bottom part, the description area is used to display a full description of the current selected security requirement.

On the topmost right corner of the view, there are 4 different buttons.

The first button ( ) export the current list of security requirements in an xml file.

The second button ( ) allow to filter the security requirements, showing only those related on the elements that are actually selected in the diagram. This filter automatically updates the list whenever a new element in the diagram is select.

The third button ( ) add a textual filter while the last ( ) remove all the textual filters previously set.

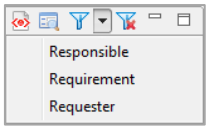

Figure 4.20 Filter menu

To set a filter click the small black arrow button near the blue funnel and in the menu that will appear (Figure 4.20) select the column on which the filter must be applied. At this point a new dialog opens. Here is possible to insert a text that will be used as a filter.

4.8 Hiding and restoring nodes

An interesting feature of STS-Tool is the possibility to hide nodes. Hiding a node will "remove" it from a specific view but it will maintain it in other views. This is useful to have clean diagrams.

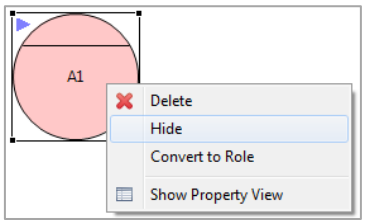

Figure 4.21 Hiding a node

To hide a node, simply select it and from the contextual menu press the "hide" command (Figure 4.21). The node is then removed from the view.

A thing to notice is that hiding a node from all the views will *not delete* the node!

Once a node is hided it can also be restored. To restore a node you must use the outline view.

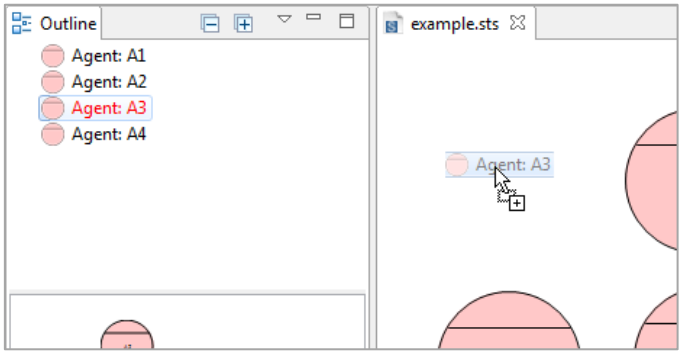

Figure 4.22 Restoring a node

By default the outline view show the list of nodes in the model. Hided nodes are displayed whit a red name.

To restore a node you must drag the hided node from the outline view and drop it into the editor area (Figure 4.22).

Note that when restoring goals or documents, the node must be dragged inside the right actor compartment.

5 Elements and Relations

We describe here how to create elements and relations.

5.1 Agent and Role

Agents and roles are similar elements from a modeling point of view. An agent/role can be created with the "Agent tool"/"Role tool". They are represented with a pink circle. with a line running across it (Figure 5.1). They are visible in all the views, and can be created only on the diagram canvas.

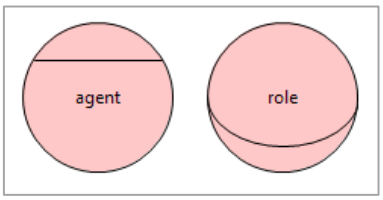

Figure 5.1 Agent and role

Properties available for the agent are:

- **Name**: a text field containing the name of the object. This filed is not modifiable trough the property view;
- **Description**: a text field containing a general description of the object;
- **Abilities**: a text field to describe the Agent's abilities;
- **Other Important Features**: a text field to describe other important features of the Agent;
- **Possessed Certifications and Accreditations**: a text field to describe certification and accreditations of the Agent;
- **Type Of Organization**: a text field to describe the type of organization of the Agent.

5.2 Goal

A Goal can be created with the "Goal tool". It is represented with a green rounded rectangle (Figure 5.2). It is visible in the social view and can be created only inside an agent or a role compartment.

Figure 5.2 Goal

Properties available for a goal are:

- **Name**: A text field containing the name of the object. This filed is not modifiable trough the property view
- **Description**: A text field containing a general description of the goal;

5.3 Document

A Document can be created with the "Document tool". It is represented with a gray rectangle with a solid border (Figure 5.3). It is visible both in the social view and in the information view, and can be created only inside an agent or role compartment.

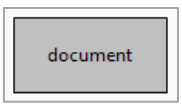

Figure 5.3 Document

Properties available for a document are:

- **Name**: A text field containing the name of the object. This filed is not modifiable trough the property view
- **Description**: A text field containing a general description of the object;

5.4 Information

Information can be created with the "Information tool". It is represented with a gray rectangle with a dashed border (Figure 5.4). It is visible in the information view and in the authorization view, and can be created only on the canvas.

Figure 5.4 Information

Properties available for information are:

- **Name**: A text field containing the name of the object. This filed is not modifiable trough the property view
- **Description**: A text field containing a general description of the object;

5.5 Event

An Event can be created with the "Event tool". It is represented with a red triangle (Figure 5.5). It is visible in the social view and can be created only on the canvas.

Figure 5.5 Event

The properties available for an event are:

- **Name**: A text field containing the name of the object. This filed is not modifiable trough the property view
- **Description**: A text field containing a general description of the object;
- **Countermeasures**: A text field to insert the countermeasures to prevent this object.

5.6 Play

This relation can be created with the "Play tool". It is visible only in the social view and it is represented by a simple arrow with the label "Play" in the middle (Figure 5.6). The source of "Play" must be an Agent and the target must be a Role.

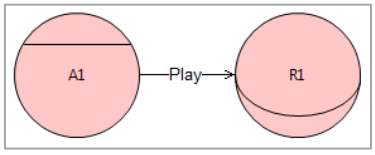

Figure 5.6 Play

The properties available for a play relation are:

- **Description**: A text field containing a general description of the object;

5.7 Delegation

A delegation can be created with the "Delegation tool" and it is visible only in the social view. It is represented by a line with two arrows indicating the direction of the delegation and the goal in the middle (Figure 5.7). The source/target of a delegation can be either an agent or a role.

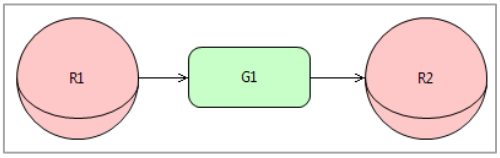

Figure 5.7 Delegation

The properties available for a transmission are:

- **Name**: A text field containing the name of the delegated goal. This filed is not modifiable trough the property view
- **Description**: A text field containing a general description of the object;
- **Security needs**: A comma separated list of applied security needs. This field is not modifiable ad is automatically updated.

Applicable security needs are (for more details see chapter "4.7 Security needs and security requirements"):

- **Availability**
- **Redundancy**
- **Authentication**
- **Non-Delegation**
- **Non Repudiation**
- **Trustworthiness**

5.8 Transmission

A Transmission can be created with the "Transmission tool" and it is visible only in the social view. A transmission is represented by a line, which has two arrows indicating the direction of the delegation, and a document in the middle (Figure 5.8). The source of this relation is an agent or a role and the target must also be an agent or a role.

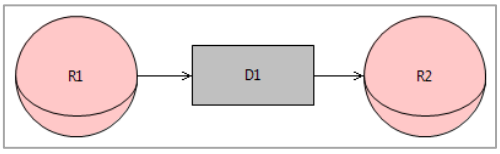

Figure 5.8 Transmission

The properties available for a transmission are:

- **Name**: A text field containing the name of the transmitted document. This filed is not modifiable trough the property view
- **Description**: A text field containing a general description of the object;
- **Security needs**: A comma separated list of applied security needs. This field is not modifiable ad is automatically updated.

Applicable security needs are (for more details see chapter "4.7 Security needs and security requirements"):

- **Availability**
- **Integrity**
- **Confidentiality**
- **Authentication**

5.9 AND Decomposition / OR Decomposition

These relations can be created respectively with the "OR Decomposition tool", and "AND Decomposition tool. They are visible only in the social view. They are represented with a semicircle under the source goal and an arrow pointing the target goal (Figure 5.9). A label indicates the type of decomposition, namely "AND" or "OR". The source and the target of these relations must be a Goal, and they cannot coexist on the same source goal.

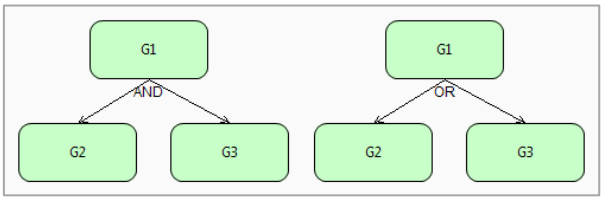

Figure 5.9 AND / OR Decomposition

The properties available for an AND decomposition / OR decomposition relation are:

- **Description**: A text field containing a general description of the object;

5.10 Read / Produce / Modify

These relations can be created respectively with the "Read tool", "Produce tool" and "Modify tool". They are visible only in the social view and they are graphically represented by a simple arrow with the corresponding label in the middle (Figure 5.10). The source of these relations must be a goal, the target must be a document, and they can be drawn only within the scope of an actor, as they represent actors' intentions on reading, modifying, or producing documents to achieve their goals.

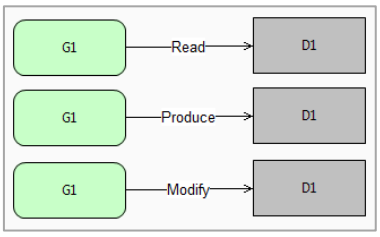

Figure 5.10 Read / Produce / Modify

The properties available for a read / produce / modify relation are:

- **Description**: A text field containing a general description of the object;

5.11 Combine

This relation can be created with the "Combine tool". It is visible only in the social view and it is represented by a simple line with a circle in the middle with the label "=" (Figure 5.11).Since in STS-ml there are two levels for expressing incompatibility, either among roles or among goals, then in the first case the source must be a Role and the target must be a Role, while in the second case the source must be a Goal and the target must be a Goal.

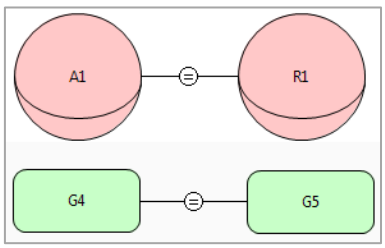

Figure 5.11 Combine

The properties available for a combine relation are:

- **Description**: A text field containing a general description of the object;

5.12 Incompatible

This relation can be created with the "Incompatible tool". It is visible only in the social view and it is represented by a simple line with a circle in the middle with the label "≠" (Figure 5.12). The source of "Incompatible" must be a Role and the target must be a Role or the source must be a Goal and the target must be a Goal.

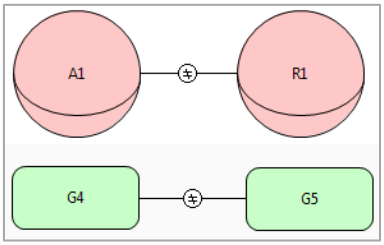

Figure 5.12 Incompatible

The properties available for an incompatible relation are:

- **Description**: A text field containing a general description of the object;

5.13 Threaten

The threat relation can be created with the "Threat tool" and it is visible only in the social view. It is represented by a simple arrow with a label in the middle (Figure 5.13). The source of this relation must be an event and the target can be an agent, role, goal, document or a delegation.

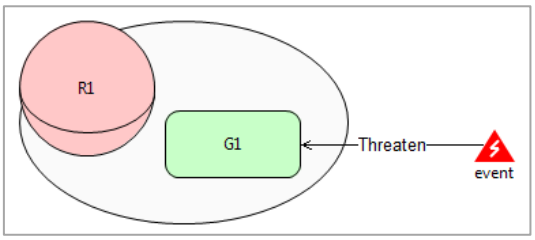

Figure 5.13 Threaten

The properties available for a threat relation are:

- **Description**: A text field containing a general description of the object;

5.14 Own

The Own relation can be created with the "Own tool" and is visible in the Authorization view. It is represented by a line with a double arrow on the end (Figure 5.14). The source can be either an agent or a role and the target is an information entity.

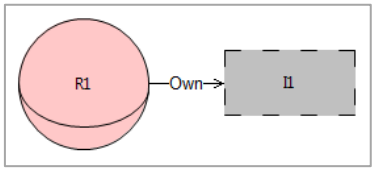

Figure 5.14 Own

The properties available for a own relation are:

- **Description**: A text field containing a general description of the object;

5.15 Part Of

The Part Of relation can be created with the "Part Of tool" and it's visible only in the Information view. It is represented by a simple arrow with a label "Part Of" in the middle (Figure 5.15). The source element can be a document and in that case the target must also be a document. Alternatively, if the source is a piece of information, the target must be a different piece of information.

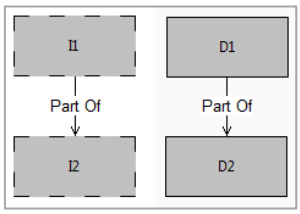

Figure 5.15 Part Of

The properties available for a part-of relation are:

- **Description**: A text field containing a general description of the object;

5.16 Tangible By

The Tangible By relation can be created with the "Tangible By tool" which is visible only in the information view. It is represented by a simple arrow with the label "Tangible By" in the middle (Figure 5.16). The source must be a piece of information and the target a document.

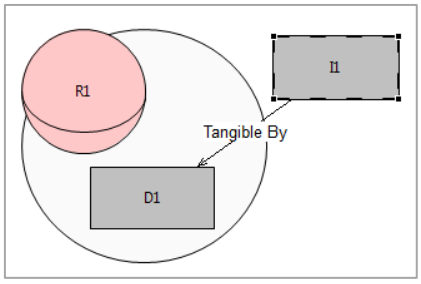

Figure 5.16 Tangible By

The properties available for a tangible-by relation are:

- **Description**: A text field containing a general description of the object;

5.17 Authorization

An Authorization is created with the "Authorization tool" and is visible only in the Authorization view. The source and the target can be either an agent or a role. It is represented by an arrow and in the middle a box divided into three different areas (Figure 5.17).

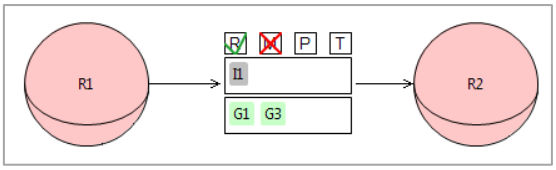

Figure 5.17 Authorization

The top part contains four small boxes and each box refers to an operation:

- **R**: Read
- **M**: Modify
- **P**: Produce
- **T**: Transmit

By double-clicking each box is possible to change is state. Three states are available:

- **Not expressed**: Is the default value, represented without symbols in the box. Means that this operation is not involved in this authorization.
- **Allowed**: Allow the authorization's target to perform this operation. It's represented with a green check symbol in the operation's box.
- **Prohibited**: Prohibit the authorization's target to perform this operation. It's represented with a red cross symbol in the operation's box. Prohibiting the read operation expresses a non-reading security requirement, which requires the information is not read in an unauthorized way; it implies that the authorizee should not read any documents making tangible the specified information. When an actor does not delegate the authority to modify information, it is expressing a security need about the non-modification of such information. With non-production, it requires the information is not produced in a new document in an unauthorized way. With non-transmit, it requires that no document representing some specific information is transmitted to other actors.

The information entities, over which authorization is specified, are represented right below the operations.

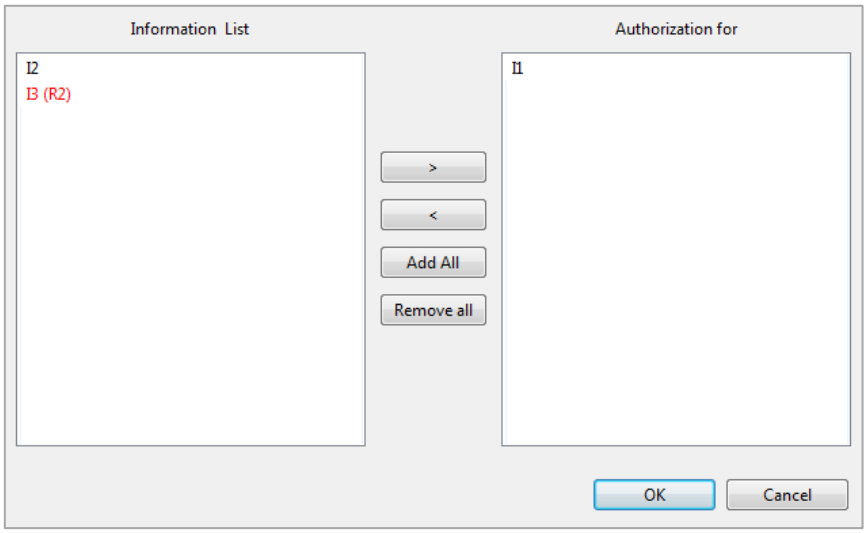

Figure 5.18 Select Information dialog

To select the information, double click in the middle area. A new window opens showing two lists (Figure 5.18). The left list contain all the information in the diagram, that are not still added to this authorization. Information entities not directly owned by the authorization's source actor are shown in red to give the modeler a warning when adding those information entities. On the right list instead are shown the selected information entities. Using the buttons in the middle of the window, or directly by double-clicking the information in the lists, is possible to add or remove the information from the list of selected information. Once done press “OK”.

Similar for the information is possible to add goals to restrict the scope of the authorization, by clicking in the lower box.

The properties available for an authorization relation are:

- **Description**: A text field containing a general description of the object;
- **Transferable**: A Boolean value indicating whether the authorization can be further transferred. Once set, the authorization line becomes dashed, to give a visual feedback.

6 Automated Analysis

Apart from supporting modeling activities, STS-Tool is equipped with analysis capabilities, implementing the semantics of STS-ml. The analyses that are performed over STS diagrams are:

- **Well-formedness analysis**: perform syntactical checks over STS diagrams to verify that they comply with the semantics of STS-ml;
- **Security analysis**: after well-formedness analysis is run and does not verify any errors over STS models, the security analysis allows designers the possibility to verify whether the security properties expressed over the STS model can be satisfied over the designed model or not;
- **Threat analysis**: given a set of events threatening the various assets (being these goals or documents), the threat analysis calculates the propagation of these threats, that is, which other assets are affected by the considered events.

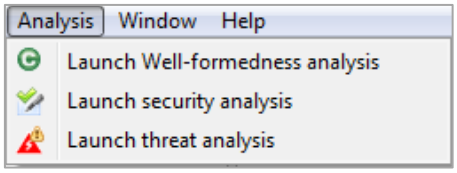

Figure 6.1 Analysis menu

Analysis can be launched trough the "Analysis" menu (Figure 6.1) where each subentry starts a different type of analysis; alternatively it's possible to use the buttons in the toolbar.

Since the steps required by the user to perform an analysis are the same for all types of analysis, for simplicity we'll now explain how to perform only one analysis and how to visualize the results.

Once an analysis button is pressed, a dialog whit an empty white area is shown (Figure 6.2). To effectively start the analysis the user must press the "Run Analysis" button.

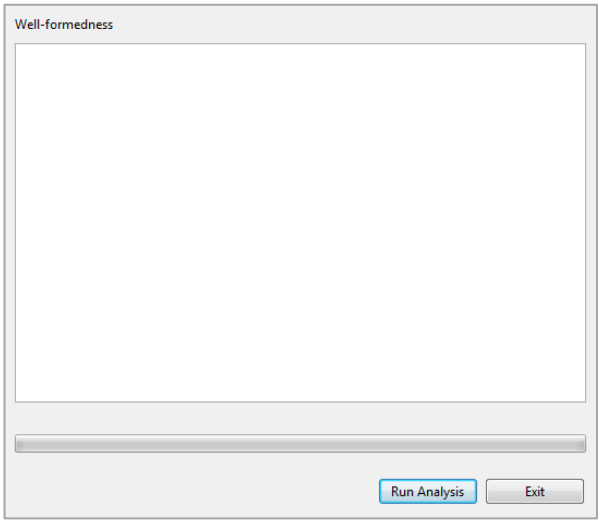

Figure 6.2 Analysis before start

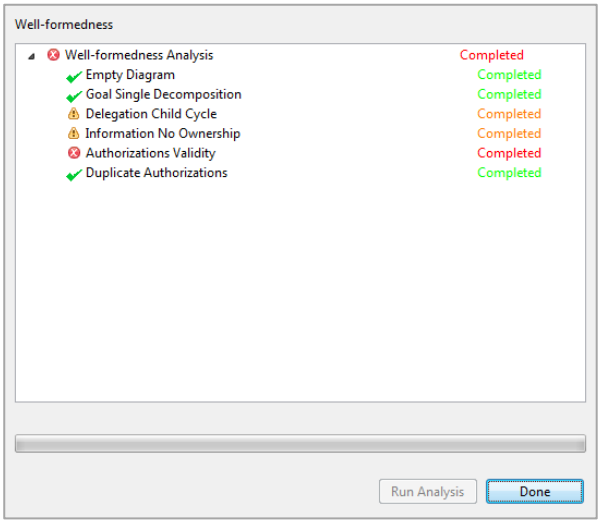

Figure 6.3 Analysis complete

At this point the analysis engine start to perform the required checks while in the white area, the list of tasks performed are progressively shown, and a label on the right display the actual status of the task. On the bottom a progress-bar also indicate the current total progress of the analysis.

There are 4 different status:

- **Started**: The task has started and is performing the required checks.
- **Completed (Green)**: The task completed without finding any errors.

- **Completed (Orange):** The task completed finding some non-serious errors
- **Completed (Red)**: The task completed finding some serious errors
- **Exception**: The task has encountered an internal error while executing. (This should never occur, in case you revive this error, please contact the STS-Tool support).

Once the analysis is complete the "Done" button must be pressed (Figure 6.3).

Now all the analysis results are listed inside the "Analysis results" view (Figure 6.4).

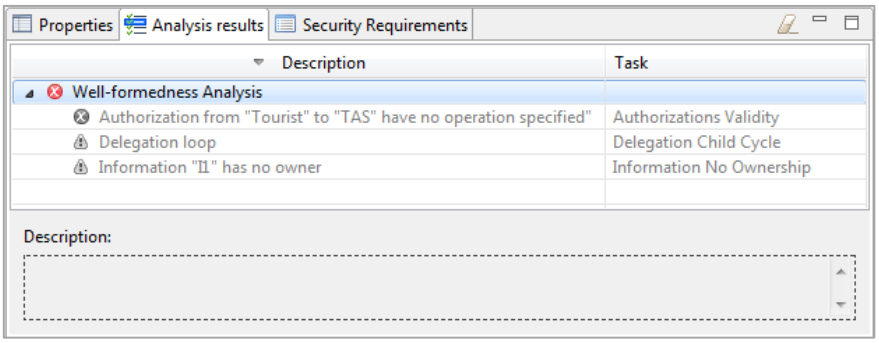

Figure 6.4 Analysis results view

Initially all results are displayed in gray, this means that no feedback is displayed in the diagram.

By selecting a result is possible to read a full description of the error in the description area, while with a double-click it is possible to enable or disable the visual representation in the diagram (Figure 6.5).

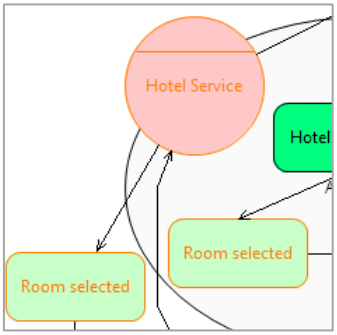

Figure 6.5 Example of error feedback

If the diagrams get modified after an analysis have been performed, the results in the analysis result view change their icon, showing a yellow exclamation mark ( ) indicating that the results are not anymore valid.

To clear all results from the view use the rubber button ( ) located in the top right corner of the view.

6.1 Well-formedness Analysis

STS-Tool can evaluate automatically the diagram well-formedness. To launch a new Well-formedness analysis, click the "Analysis" menu and then "Well-formedness Analysis".

The purpose of well-formedness analysis is to verify whether the diagram built by the designer is well-formed and valid. A diagram is considered to be well-formed if its constituent elements (concepts and relationships) are drawn and interconnected following the semantics of the modeling language (STS-ml). Thus, well-formedness analysis performs post checks to verify compliance with STS-ml semantics for all checks that cannot be performed live over the models. The following checks are performed during well-formedness analysis:

- **Empty Diagram**: this check verifies whether the given diagram is empty or not. If that is the case, then no other well-formedness checks are performed. If the diagram is not empty, the well-formedness analysis returns: "No errors found" and continues performing the rest of the checks.
- **Goal Single Decomposition**: this check verifies the well-formedness of goal decompositions. Following the semantics of STS-ml a given goal is decomposed in to two or more subgoals. As a result, the decomposition should specify at least two sub goals. Therefore, goal single decomposition verifies whether there are cases of decompositions to a single sub goal.
- **Delegation Child Cycle**: this check verifies the well-formedness of goal delegations, so that no cycles or loops are identified as a result of the delegatee decomposing the delegatum (delegated goal) and re- delegating back one of the sub goals. Delegation child cycle verifies exactly this and gives a warning in case of inconsistency.
- **Information No Ownership**: this check verifies that all information entities have an owner. If there are cases of information without any ownership relationships from any actor in the diagram, the well-formedness analysis returns a warning.
- **Authorizations Validity**: this check verifies that all authorization relationship between two given actors are valid. An authorization relationship specifies authorizations or permissions an actor grants to another on some information, to perform some allowed operations. The authorizations could be limited to a goal scope and they can be re-delegated or not. However, the first two attributes should be specified for an authorization relationship to be valid. If there are no informational entities specified, the well-formedness analysis returns an error. The same applies to the cases, in which no allowed operations are specified.
- **Duplicate Authorizations**: this check verifies that there are no duplicate authorization relationships that could be merged. There are several cases that are addressed by this check: (i) we encounter two identical authorization, i.e., between the same roles, in the same direction, for the same set of information, allowed operations and goals, and having the same value of transferability; (ii) identify authorization relationships between the same roles, in the same direction, in which one grants permissions that are a subset of the other authorization's relationship.

6.2 Security Analysis

STS-Tool can automatically analyze the security issues related to the diagram. To launch a new security analysis, click the "Analysis" menu and then "Launch Security Analysis".

A thing to notice is that the Security Analysis require that the Well-formedness analysis complete without serious errors, otherwise the "Security Analysis" don't even start, and user is informed whit a dialog.

STS-ml allows for the specification of security needs over actors' interactions. It currently supports a non- exhaustive set of security needs and organizational constraints, namely non-repudiation, redundancy, no- delegation, non-reading, non-modification, non-production, non-disclosure and need-to-know. The purpose of security analysis is to verify whether the drawn diagram allows the satisfaction of the specified security needs or not. As a result, for all security needs expressed by stakeholders, it checks in the model whether there is any possibility for the security need to be violated. This analysis takes into account the semantics of STS-ml, defining the behavior of the different elements represented in the models. The elements' behavior is defined by propagation rules that consider what concepts and what relationships the specification of a given security need affects. Datalog is used to define the semantics of STS-ml to express facts (things always hold) and rules. In the following are provided the details for all the checks performed during security analysis:

- **No Delegation Violation**: this violation is verified whenever a delegatee actor further delegates a goal, over the delegation of which a no-delegation security need is specified from the delegator actor. No delegation is specified over a goal delegation by the delegator, who requires the delegatee not to further delegate the delegated goal. Therefore, to check for any violations of no delegation, the analysis searches for redelegations of the delegatum (delegated goal) or any of its sub goals.
- **Redundancy Violation**: this check verifies if redundancy is satisfied by controlling that single-actor-redundancy or multi-actor-redundancy are not violated. At design time we cannot make the distinction between fallback and true redundancy, so they cannot be verified at this stage. Therefore, both fallback redundancy single and true redundancy single are mapped to single actor redundancy.
  Similarly for multi-actor-redundancy. The analysis verifies a redundancy violation if one of the following occurs: (1) actor does not decompose the delegated goal in any or-sub goals, for which both types of redundancy are violated; (2) actor decomposes the goal into or-sub goals and delegates one to another actor when single actor redundancy has been specified, for which this type of redundancy is violated; (3) actor

decomposes the goal into or-sub goals, but does not delegate any of the sub goals to another actor when multi actor redundancy has been specified, for which this type of redundancy is violated.

- **Pre-Analysis: Authorization Conflict**: this task identifies a conflict of authorization whenever at least two authorization relationships for the same information are drawn towards the same actor from two illegible actors (being the owner of information or another authorized actor) such that: (1) one limits the authorization to a goal scope (requiring a need-to-know security need) and the other does not (authorizing the actor without any limitations); (2) for the same goals or intersecting goal scopes, different permissions are granted in terms of operations or authority to transfer authorization. That is, one passes the actor the authority to perform operations (use, modify, produce, distribute) on a given information, and the other does not (requiring non-reading, non-modification, non-production, non- disclosure); one passes the actor the authority to further transfer authorizations and the other requires no further authorizations take place.
- **Pre-Analysis**: Operation Violation: this task includes a set of checks that verify that no unauthorized operations are performed by any actor.
    i. *Non_Disclosure Violation*: this violation is detected whenever an actor discloses information without having the right to distribute it. Non-disclosure expresses the need of not disclosing or further distributing the given information to other actors, apart from the authorizer. Thus, authority to distribute the information is not passed. The way actors exchange information is through document transmission. In order to disclose some information, an actor would have to transmit to others the document(s) containing that information. Hence, to verify if there are any unauthorized disclosures of information, the analysis checks for transmissions of documents representing the given information from any unauthorized actors towards other actors.
    ii. *Non_Reading Violation*: This violation is detected whenever there is an inappropriate modeling of the reading relationship. Transmission should encapsulate reading too. A carrier serving as a transmission point needs to have only transmission permissions, not necessarily any about reading what is being transferred.
    iii. *Non_Modification Violation*: this violation is detected whenever an actor modifies information without having the right to modify it. Non-modification expresses the need that information should not be changed (modified), i.e. authority to modify the information is not granted. To verify if there could be any violations of non-modification, the analysis looks if the authorizee (or an actor that is not authorized by authorized party) modifies the given information. For this, it searches for modify relationships from any goal of this actor to any document representing the given information.
    iv. *Non_Production Violation*: this violation is detected whenever an actor produces information without having the right to produce it. Non-production expresses the need that information should not be produced in any form, i.e. authority to produce the information is not granted. To verify if there could be any violations of non-production, the analysis checks whether if the authorizee (or an actor that is not authorized by authorized party) produces the given information. For this, it searches for produce relationships from any goal of this actor to any document representing the given information.
    v. *NTK Violation*: this violation is detected whenever an actor uses, modifies or produces information for other purposes (goal achievement) than the ones for which it is authorized. Need-to know requires that the information is used, modified, or produced in the scope of the goals specified in the authorization. This security need concerns confidential information, which should not be utilized for any other purposes other than the intended ones. To verify if there could be any violations of need-to-know, security analysis checks if the authorizee (or an actor that is not authorized by any authorized party) uses, modifies or produces the given information while achieving some goal different from the one it is authorized for. In a nutshell, it searches for read, modify, or produce relationships starting from goals different from the specified ones towards documents representing the given information.

Apart from the verification of violations of security needs, security analysis performs checks to verify that actors comply with their authorities. For this, it searches for eventual unauthorized passages of rights. For the time being, the following violations are detected:

- **Pre-Analysis: Authority Violation**: this task includes a set of checks that verify that no actor transfers rights to others in an unauthorized way.
    i. *Authority Violations*: verifies whether a given actor transfer rights to others even when it does not have the authority to further delegate rights.
    ii. *Unauthorized Delegation of Usage Violation*: verifies whether a given actors transfer to other actors the right to use a given information, without having itself the right to do so.
    iii. *Unauthorized Delegation of Modification Violation*: verifies whether a given actors transfer to other actors the right to modify a given information, without having itself the right to do so.

iv. *Unauthorized Delegation of Production Violation*: verifies whether a given actors transfer to other actors the right to modify a given information, without having itself the right to do so.
v. *Unauthorized Delegation of Distribution Violation*: verifies whether a given actors transfer to other actors the right to distribute a given information, without having itself the right to do so.

- **Pre-Analysis: Business Violation**: this task includes a set of checks that verify that there are no violations of organizational constraints. As far as organizational constraints are concerned, security analysis verifies that the specification of SoD and BoD constraints can be satisfied in the given model.
  i. *Sod Violation*:
     1. Role-based: this violation is detected whenever a single actor plays both roles, among which an SoD constraint is expressed. Role-based SoD requires that no agent can play both roles, if it plays one of them.
     2. Goal-based: this violation is detected whenever a single actor may perform both goals, between which an SoD constraint is expressed. Goal-based SoD requires that there is no actor performing both goals among which SoD is specified. To perform this verification, the analysis checks that the final performer of the given goals is not the same actor.
  ii. *CoD Violation*:
     1. Role-based: this violation is detected whenever there is no agent to play both roles, among which a BoD constraint is expressed. Role-based CoD requires that the same agent plays both roles, if it plays one of them.
     2. Goal-based: this violation is detected whenever a single actor may perform only one of the goals, between which a CoD constraint is expressed. Goal-based CoD requires that there is an actor performing both goals among which CoD is specified. To perform this verification, the analysis checks that the final performer of the given goals is the same actor, whenever this actor has taken actions to pursue one of the given goals.

6.3 Threat Analysis

STS-Tool can predict automatically the propagation of threats over a given diagram through the threat analysis. To launch a new threat analysis, click the "Analysis" menu and then "Threat Analysis". This analysis evaluates all the threats in the diagram. Is also possible to propagate the effect of a single threat, right-clicking it in the diagram and choosing the "propagate threat" command (Figure 6.6).

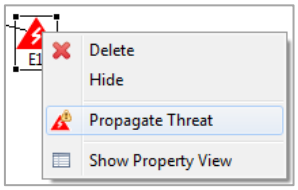

Figure 6.6 Propagate threat

Threat analysis focuses on events threatening goals or documents, and as such it propagates the effects over goal trees and goals/documents relationships internal to the actor (read, modify, produce), as well as social relationships involving goals and documents (goal delegation, document transmission). Therefore, starting from the specified threats we identify the impact of these threats over the rest of the diagram. The analysis starts with the known events, and propagates their impact over goal trees, documents and social relationships. The new discovered elements are treated as threatened elements. The analysis ends when no new elements are found. The propagation rules are the following:

- If an event threatens a goal, then:
  i. If the goal is an and-sub goal of some other goal, then the second goal is considered to be threatened;
  ii. If the goal is delegated, then the threat is propagated to the goal of the delegator;
  iii. If the goal produces a document, then the threat is propagated to the document too.
- If an event threatens a document, then:
  i. If the document is read in order to achieve a goal, or modified by some goal, then the goal is considered to be threatened too;
  ii. If the document is transmitted to some other actor, then the receiver's document is threatened too;
  iii. If the document is composed of other documents, then the threat is propagated to the parts of the document.

7 Generation of the Security Requirements Document

STS-Tool can generate automatically a security requirements document for the current STS diagram. The document provides a detailed description of the graphical socio-technical security requirements diagrams (Social, Information, Authorization) drawn with the tool and lists the security requirements derived from them.

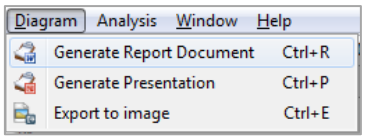

Figure 7.1 Generate report menu

To create a new document, click the "Diagram" menu and then "Generate Report Document" (Figure 7.1). A wizard that will customize the generated report will open (Figure 7.2).

In the first 3 fields the user is ask to insert respectively the title, the author and the institution that will be added in the first page. Below the wizard ask for a location where the generated report will be saved offering two options:

- **Current project**: The generated document will be saved in the documents folder of the project.
- **Filesystem**: The generated document will be saved on the filesystem, in the location specified in the field below.

In the bottom part the user must select the file format of the generated document.

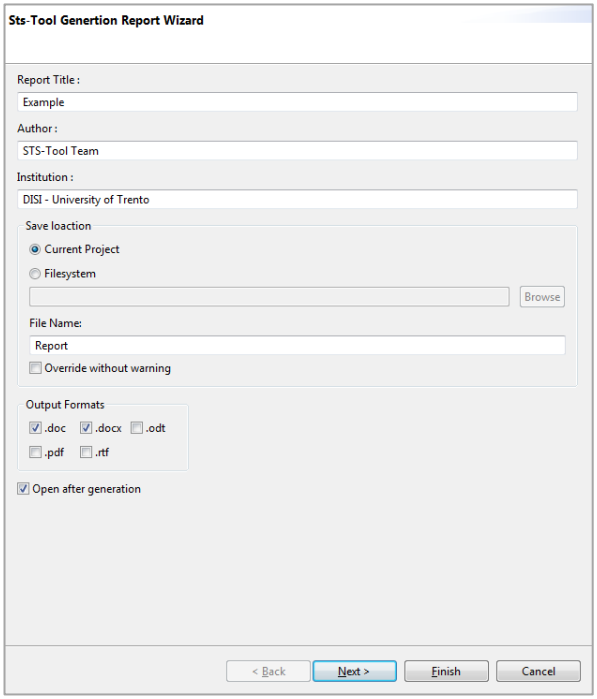

Figure 7.2 Generate document wizard main options

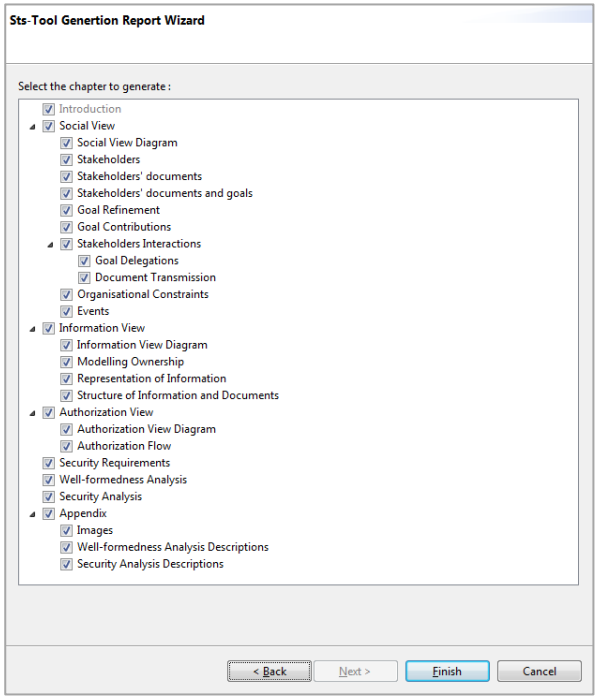

Figure 7.3 Generate wizard chapters selection

After all required fields have been compiled, press "Next" to choose which chapter include in the final document (Figure 7.3), otherwise press "Finish" to generate the document.

If "Open after generation" was previously selected, all generated file are automatically opened using the default associated system application.

8 Install new software

STS-Tool support a plugin management system, which permits to install new components and add new functionalities. The integrated update system will update the installed plugins whenever a new version is released.

To receive the updates or be able to install new modules, STS-Tool must be connected to internet. In the next chapter "9 Preferences" is explained how to configure the network preferences, and also how configure the updates system behavior.

8.1 Install additional plugins

STS-Tool integrates a plugin management system that allows users to install additional plugins. It permits STS-Tool to be customized for the type of usage required by each single user. The plugins are developed by the STS-Tool team, with the high standards used for the development of the other parts of the software. In case of plugins not developed by STS-Tool teal, users will be notified.

To install new modules, go to the "Help" menu and select "Install new software" (Figure 8.1).

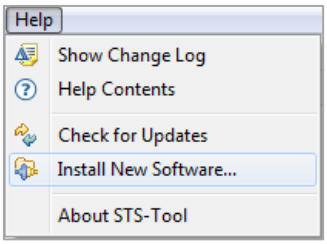

Figure 8.1 Install new software menu

An updated list of plugins, not yet installed, will be listed, as shown in Figure 8.2.

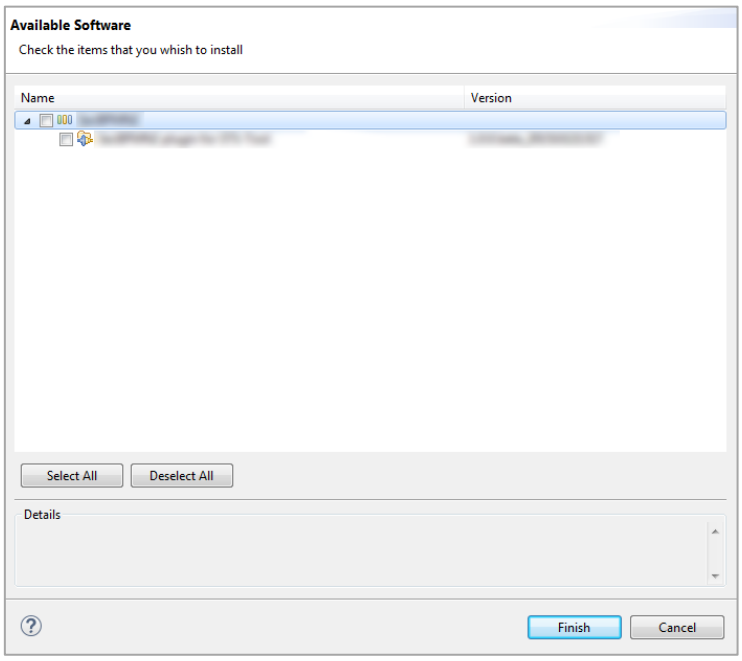

Figure 8.2 Install new software dialog

Users can select which plugin to install and press the button "Finish". After the plugin are downloaded and installed, STS-Tool will automatically restart.

Please, note that some plugins may request other plugins, STS-Tool will automatically install them.

8.1.1 Update existing projects

Existing STS projects are not automatically updated with the features installed with the plugins installed their creation. In order to use additional functionalities offered by the freshly installed plugins, old STS projects shall be manually modified.

This is done by right-clicking on the project and selecting "Add modules to project" entry, as shown in Figure 8.3.

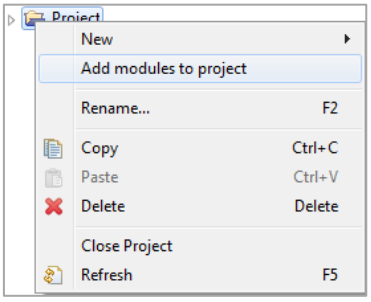

Figure 8.3 Add module to project menu

After that a pop-up windows will show the modules compatibility to add in the project (as shown in Figure 8.4.).

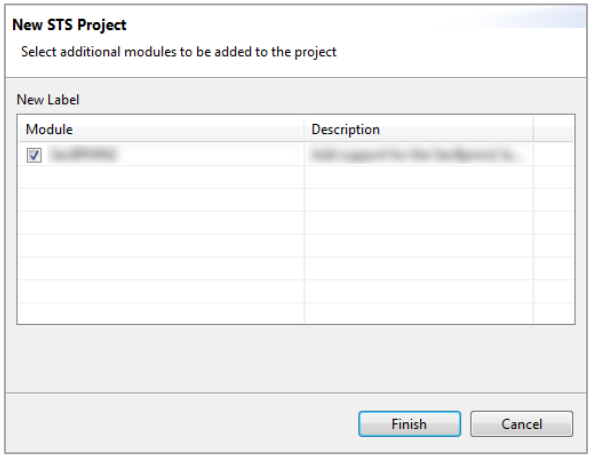

Figure 8.4 Add module to project

Select which module to add and press the button "Finish".

8.2 Updates

By default, STS-Tool is configured to automatically check for updates at startup, but it is also possible to check them manually.

To perform a manual check, go to the "Help" menu and select "Check for updates" (Figure 8.5).

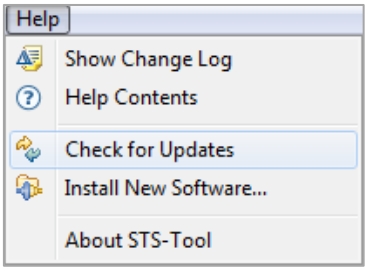

Figure 8.5 Check for updates menu

STS-Tool will check if new updates are available. If no new updates are found the user is informed whit a message, otherwise pop-up windows, as shown in Figure 8.6, will appear.

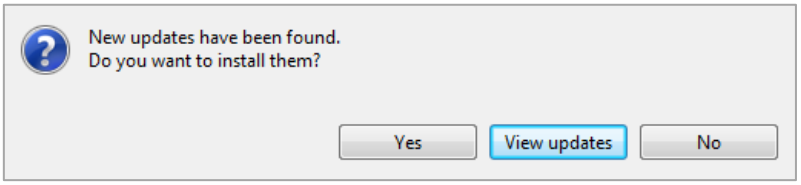

Figure 8.6 Update dialog

The user is asked to choose from 3 options:

- No: stops the installation of the updates
- Yes: installs the updates.
- View updates: shows the list of available updates (core and modules) before installing them.

When the procedure is complete, the user is asked to restart STS-Tool to complete the update.

9 Preferences

The preferences allow you to customize some settings of the tool. To open the preference window, select the "Preferences" menu under the "Window" menu (Figure 9.1).

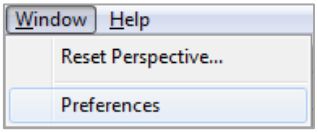

Figure 9.1 Preference menu

The preference window is mainly divided in two parts. On the left side there is a selectable list of preferences categories, while on the right there are the real settings.

Let's see these settings in detail.

9.1 Network preferences

Network preferences (Figure 9.2) allow you to customize the proxy settings used by the tool to connect to the internet.

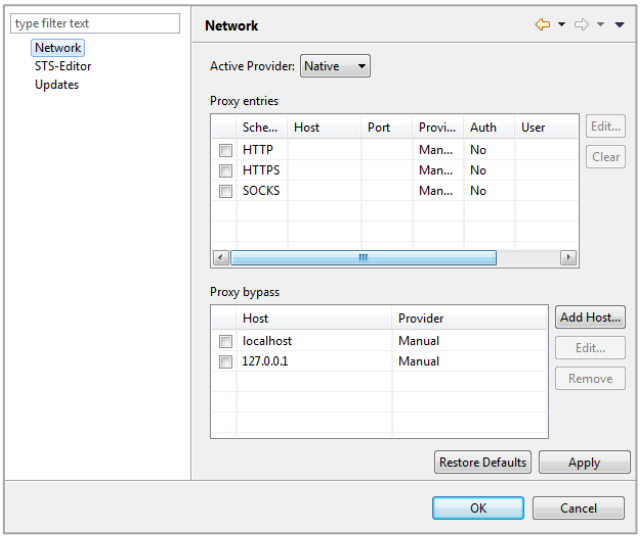

Figure 9.2 Preference window

To configure the network proxy select from the Active Provider dropdown menu one of the available options:

- **Direct**: Select this to manually disable the proxy.
- **Manual**: Allow you to manually set the proxy, using the table below.
- **Native**: This is the default setting and indicates that the settings are automatically taken from the operating system.

9.2 Editor preferences

Editor preferences (Figure 9.3) allow you to customize the aspect and the behavior of the diagram editor.

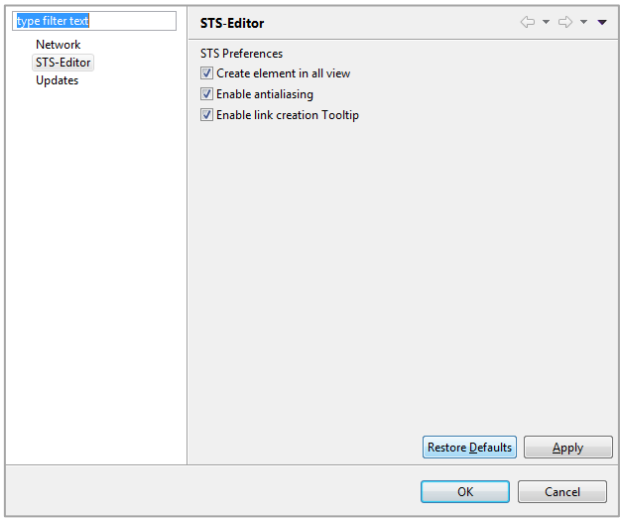

Figure 9.3 Editor Preferences

Here the meaning of this setting:

- **Create element in all views**: When this option is checked, creating an element in a view also create the element in the other views. Otherwise, it creates the element only in the active view.
- **Enable anti-aliasing**: When this option is selected, it smoothness the jagged edges of a diagram. If there are problems on the visualization of the diagram, try to disable this option.
- **Enable Link creation Tooltip**: When this option is selected, tooltips displayed during the creation of links are shown.

9.3 Updates preferences

Update preferences (Figure 9.4) allow you to customize how and when updates are searched and installed.

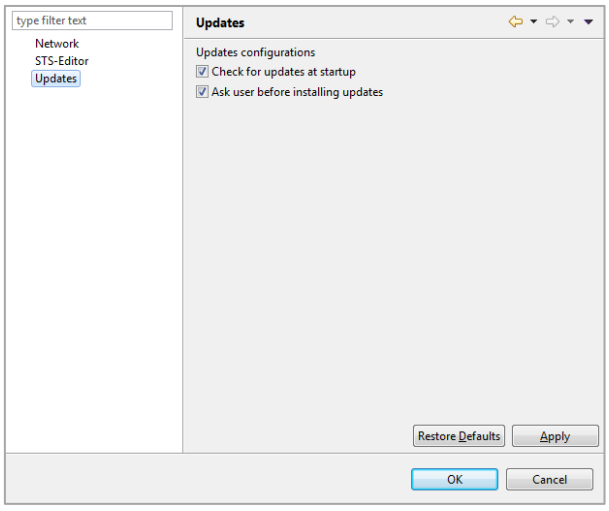

Figure 9.4 Updates Preferences

- **Check for updates at startup**: When this option is checked the tool will automatically check for new updates every time it starts, Otherwise updates are searched only when the user expressly search for them.
- **Ask user before installing updates**: When this option is checked the tool always ask the user a confirmation before installing any update.

10 Shortcuts

The following is a list of keyboard shortcuts that can be used when modeling with STS-Tool.

CTRL+N: New STS project

CTRL+D: New STS diagram

CTRL +S: Save the open diagram

CTRL +SHIFT+S: Save all the open diagrams

CTRL +W: Close the open diagram

CTRL +SHIFT+W: Close all the open diagrams

CTRL + Z: Undo changes

CTRL + Y: Redo changes

CTRL + A: Select all elements in a diagram

CTRL + E: Export to image

CTRL + R: Generate security requirements document

CTRL + P: Generate presentation