User Manual: CARO Tool ver: 1.0

July 2, 2021

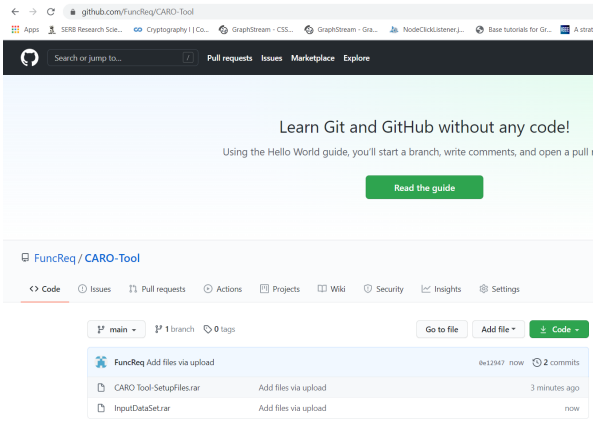
1 Download and Setup

The following steps need to be followed diligently for the correct setup of the tool in your machine.

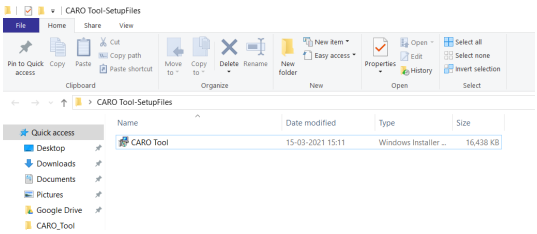
$\mathcal{STEP}$-1. **Pre-requisite**: User must have Java SDK installed in their machine.

$\mathcal{STEP}$-2. **Download**: User needs to download the following files from the github repository (refer to 1(a)) for using the tool:

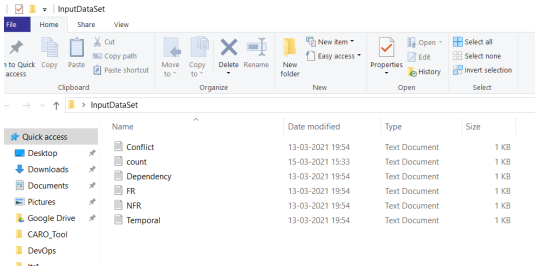
- *CARO_TOOL-SetupFiles.rar*: It contains the tool installation files (refer to 1(b)).
- *InputDataSet.rar*: It contains some sample data set that the user can use while running the tool (refer to 1(c)).



(a) Files in the repository



(b) Contents of CARO_TOOL-SetupFiles folder



(c) Contents of InputDataSet folder

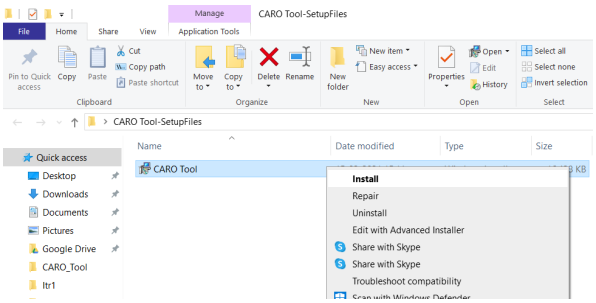
Figure 1: Tool SetUp

$\mathcal{STEP}$-3. **Extract**: The downloaded RAR files need to be extracted at any suitable location.

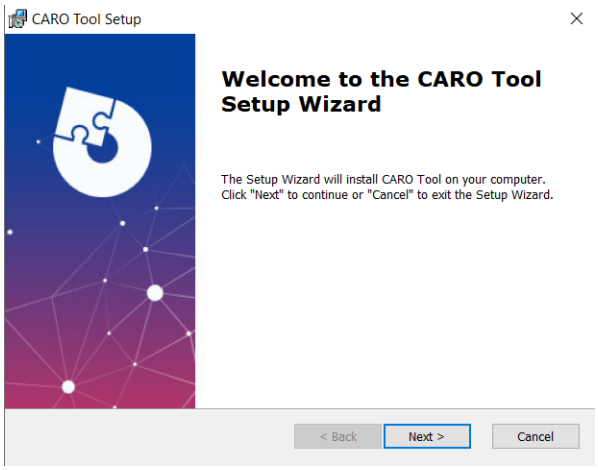
$\mathcal{STEP}$-4. **Installing the Tool**:

- Open the CARO_TOOL-SetupFiles folder.
- Right click on CARO_Tool.msi file and select install option (refer to 2(a)).
- The installation wizard appears. Click on the *"Next"* button at the bottom of the wizard (refer to 2(b)).
- Next select a suitable installation location and click on *"Next"* button (refer to boxed portion in 2(c)).
- On the next screen of the wizard click on *"Install"* button at the bottom to start the installation process (refer to 2(d)).
- Finally on completion of the installation click on *"Finish"* button to exit the wizard (refer to 2(e)).

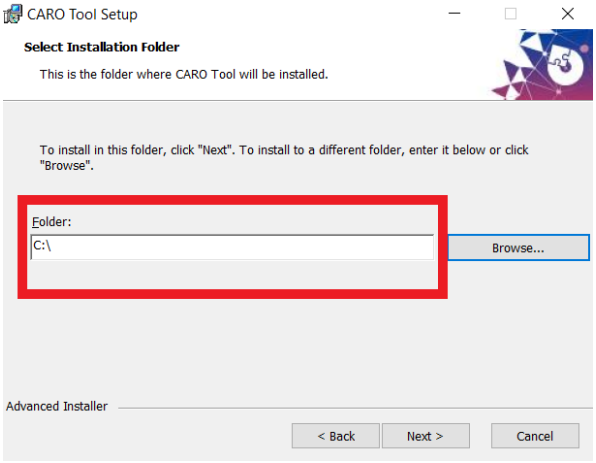
Now go to the location in your system where the tool is installed.



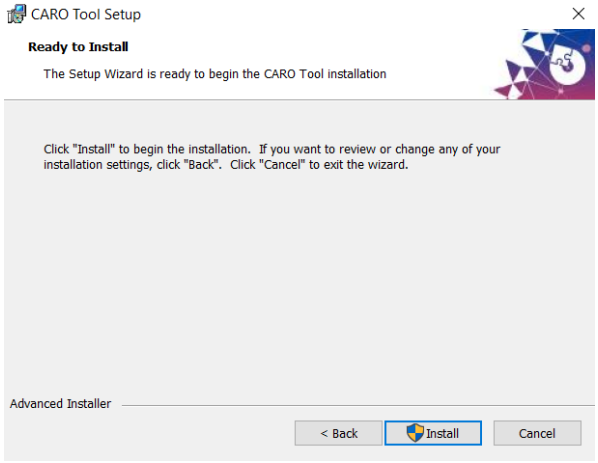
(a) Install Option



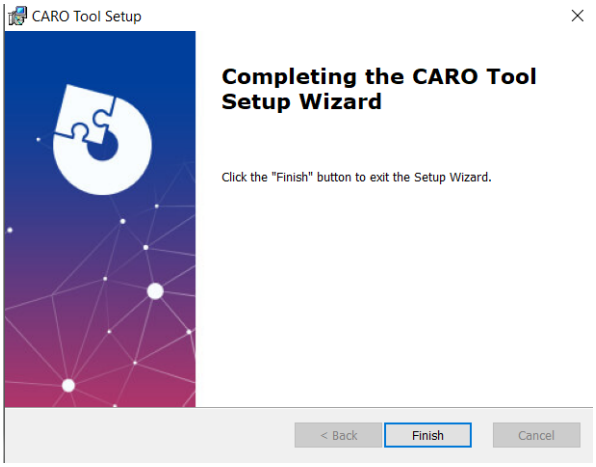
(b) Wizard opening screen



(c) Location for installation



(d) Beginning installation



(e) Completion

Figure 2: Installing CARO Tool

2 Using the CARO Tool

Before starting the tool, if you want to use the sample data set extract the contents of *InputDataSet.rar* folder and copy the files into same location as that of the tool (refer to Figure 3).

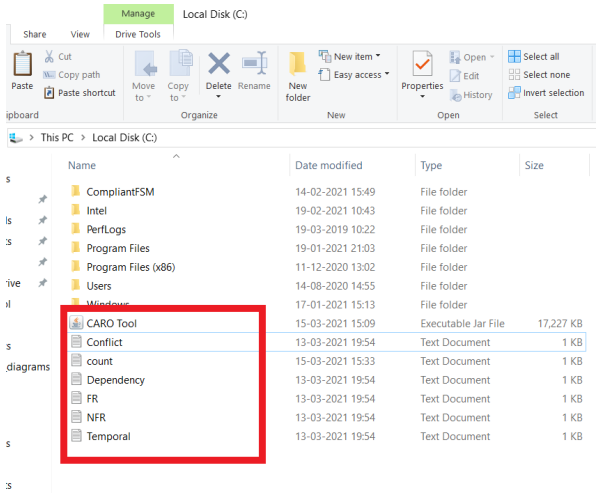


Figure 3: Tool and data set at the same location

The CARO Tool consists of the following three components-

- Requirement specification component.
- Partial order generation and risk assessment component.
- A dashboard to view different statistics.

Now, right click on the Tool icon (i.e. CARO_Tool.exe) and select *"Open"* option (refer to 3). The tool interface opens (refer to 4). Figure 4 shows the starting interface of the tool. The buttons marked as **A** is used to navigate to requirement specification module, **B** button to partial order generation and risk assessment module and **C** to view the dashboard.

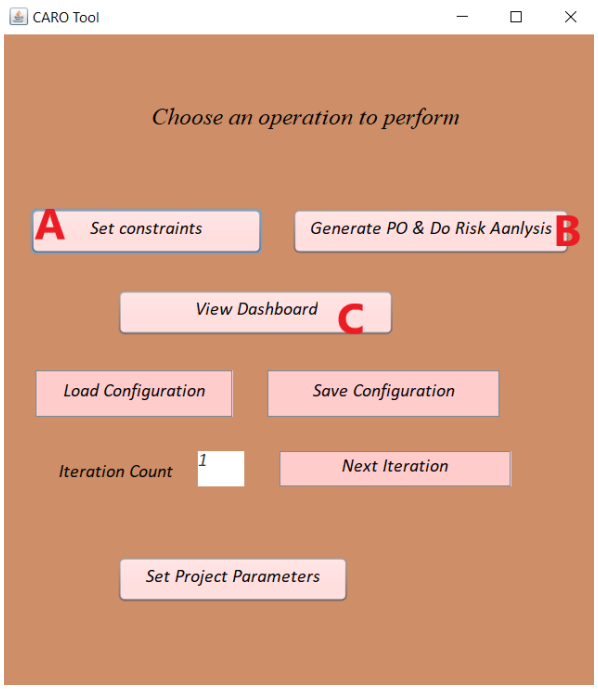


Figure 4: Starting interface of CARO Tool

2.1 Requirement Specification Component

Click on button marked as **A** (refer to Figure 4) to open requirement specification interface. Figure 5 shows the requirement specification interface.

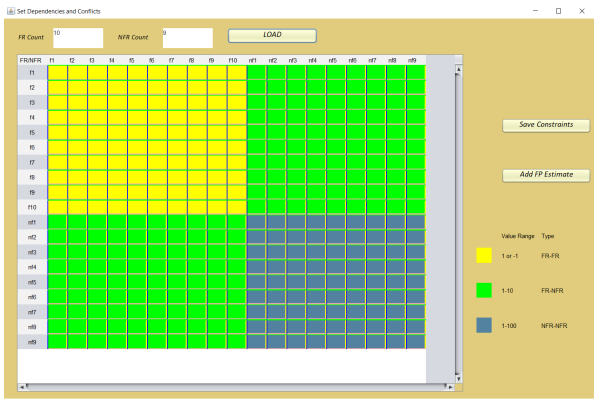


Figure 5: Requirement Specification Interface

The set of functional, non-functional requirements, dependencies and conflicts can be provided in the following ways:

$\mathcal{STEP}$-1. Specifying the requirement constraints:

- *Option 1*: The user can choose to use the sample data set that is installed along with the tool (refer to Figure 1(c)).

(a) Click on the *"Load Configuration"* (refer to Figure 4) button to load the data of the sample data set in the tool.

(b) Now click on *"Load"* button in Figure 5.

(c) Figure 6 shows the data sets that are loaded in the tool.

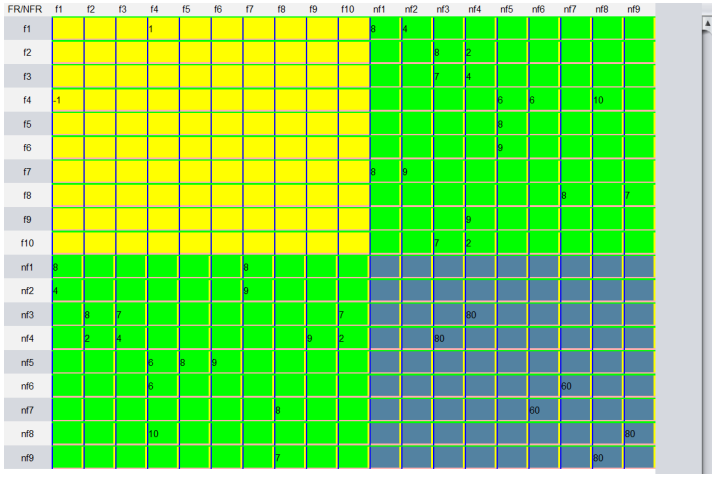


Figure 6: Data Loaded

- *Option 2*: User can directly provide input in the tool as follows:

  (a) In Figure 5 specify the number of FRs and NFRs in the *FR Count* and *NFR Count* box respectively and click on *"Load"* button. The matrix for specifying the relationships between the requirements will be generated with specified number of FRs and NFRs.

  (b) It can be observed the matrix is divided into three different colored regions. The yellow region is for specifying relationship between any pair of FRs. The green colored region is for specifying dependencies between FRs and NFRs. Finally the blue colored region is for specifying conflict between any pair of NFRs.

  (c) **Adding or Updating FR & NFR Dependency**: In the green colored region in the matrix, for any FR that depends on a particular NFR, mark the corresponding cell with a numeric value between 1-10. This value indicates the importance of a particular NFR for a FR. When cell [i][j] is marked with a value, the same value is duplicated in cell [j][i] as well.
  In case the previous set of values are loaded in the tool, just click on the particular cell whose value you need to change and edit it.

  (d) **Adding or Updating NFR conflicts**: In the blue colored region in the matrix, for any NFR that conflicts with another NFR, mark the corresponding cell with a numeric value between 1-100. This value indicates the degree of conflict between the two NFRs. When cell [i][j] is marked with a value, the same value is duplicated in cell [j][i] as well. In case the previous set of values are loaded in the tool, just click on the particular cell whose value you need to change and edit it.

  (e) **Adding or Updating temporal dependency between FRs**: In the yellow colored region in the matrix, for any FR i that depends on another FR j, mark the corresponding cell [i][j] with 1. When cell [i][j] is marked with 1, the cell [j][i] is marked as -1.
  In case the previous set of values are loaded in the tool, just click on the particular cell whose value you need to change and edit it.

  All cells that are kept empty indicates no associations exist between such FR-FR, FR-NFR or NFR-NFR pair.

- After specifying all the constraints click on *"Save Constraints"* button.
- User can specify function-point estimates of each FR by clicking on *"Add FP Estimate"* button in Figure 5. Figure 7 shows the interface for recording function-pint estimates. The *"Prev"* and *"Next"* button in Figure 7 helps to navigate through different FRs.

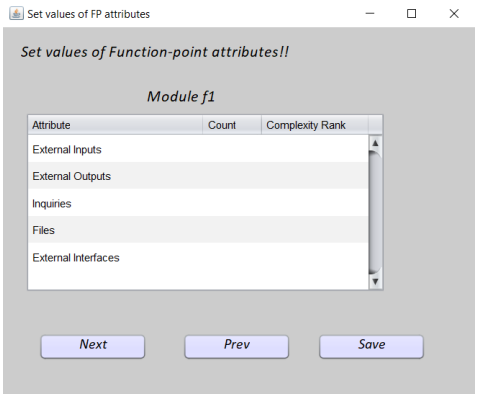


Figure 7: Function-point Estimates

- User can also set values of different project parameters by clicking on *"Set Project Parameters"* button in Figure 4. Figure 8 shows the interface for specifying project parameters values.
- The project parameters and FP estimate must be set before performing rollback at any iteration.

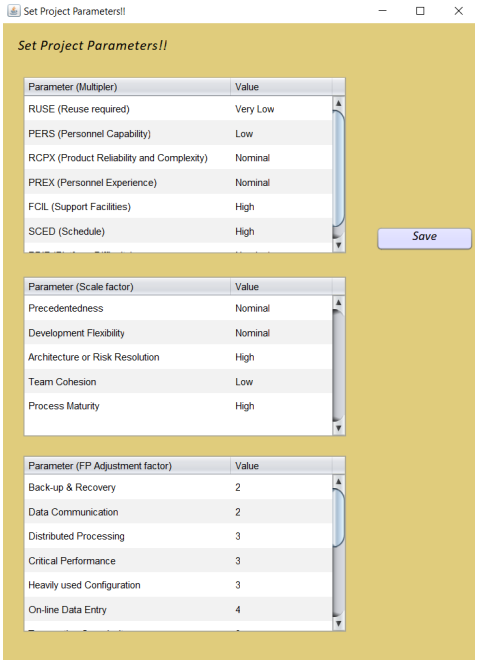


Figure 8: Project parameter specification

2.2 Partial Order Generation & Risk Assessment

Click on button marked as **B** (refer to Figure 4) to open partial order generation and risk assessment interface. Figure 9 shows the partial order generation and risk assessment interface.

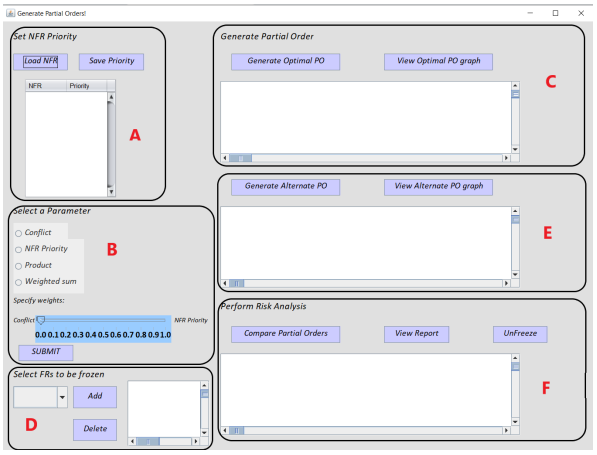


Figure 9: Setting NFR priority

Now do the following steps-

$\mathcal{STEP}$-1. Click on *"Load NFR"* button to load the NFR and set their priority values (refer to to portion marked as **A** in Figure 9). Put priority value against each NFR and then click on *"Save Priority"* button.

$\mathcal{STEP}$-2. Now select any one of the parameters in the *"Select a Parameter"* section on the right ((refer to to portion marked as **B** in Figure 9). In the case of parameter Weighted Sum, specify the weight to be assigned by dragging the slider to a position. The value at the left portion of the slider indicates weight assigned to the conflict and the right portion to the NFR priority. After selecting the parameter click on the *"Submit"* button to set the parameter.

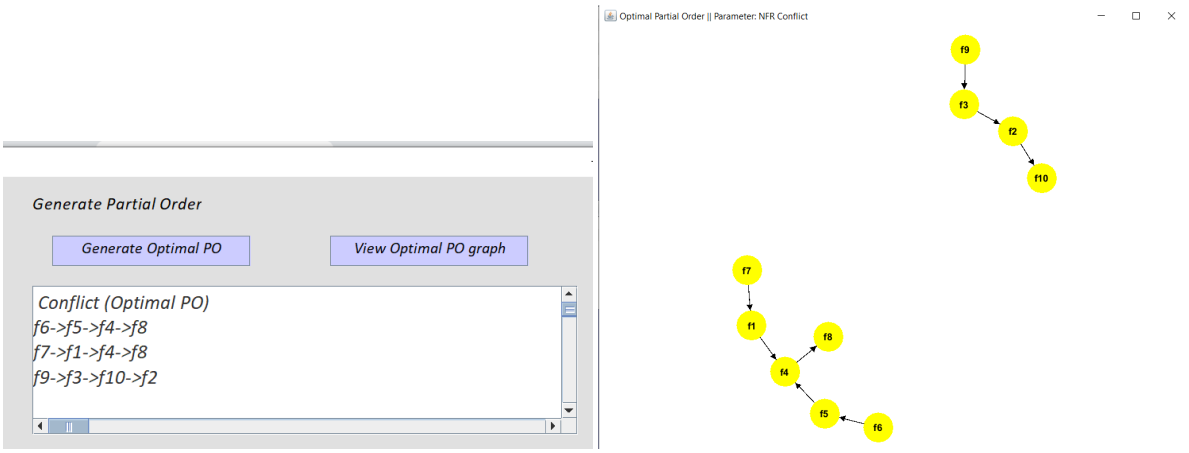
$\mathcal{STEP}$-3. Now, click on the *"Generate Optimal PO"* button to generate the Optimal Partial Order (refer to to portion marked as **C** in Figure 9). Partial order in the form of linear sequence(s) that will be displayed in the white text area (refer to Figure 10(a)) .

$\mathcal{STEP}$-4. Click on *"View Optimal PO Graph"* button (refer to to portion marked as **C** in Figure 9) to see the optimal partial order in the form of a graph (refer to Figure 10(b)).

$\mathcal{STEP}$-5. Select the set of FRs to be frozen in the next increment in the *"Select FRs to be frozen"* section (refer to to portion marked as **D** in Figure 9). Click on the drop-down list to select an FR and then click on *"Add"* button. We will see that the FR is added to the text area in portion marked as **D** in Figure 9. To remove an FR from the list, select the FR from the drop-down list and click on *"Delete"* button.

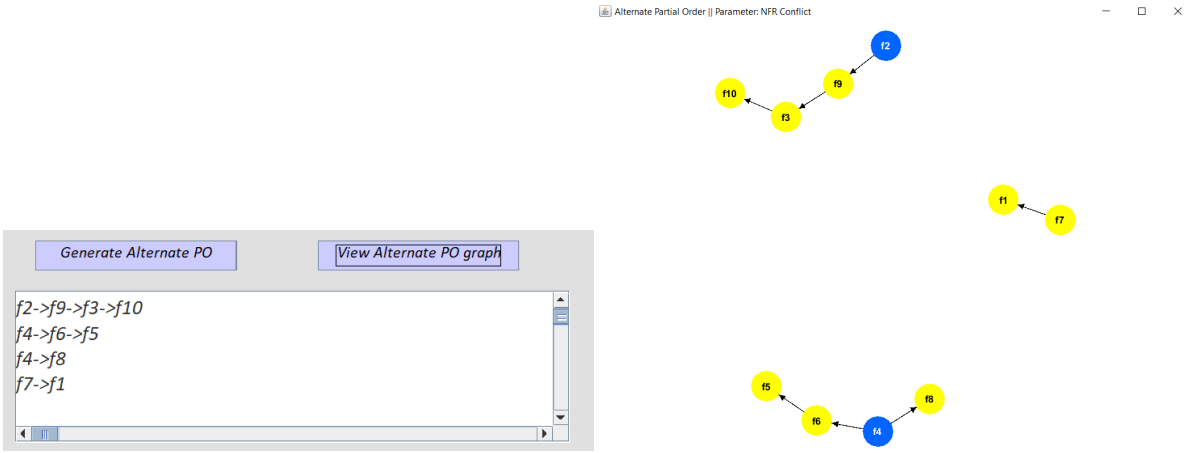
$\mathcal{STEP}$-6. Click on the *"Generate Alternate PO"* button (refer to to portion marked as **E** in Figure 9) to generate the Alternate Partial Order. Partial order in the form of linear sequence(s) that will be displayed in the white text area (refer to boxed portion Figure 11(b)).

$\mathcal{STEP}$-7. Click on *"View Alternate PO Graph"* button (refer to to portion marked as **E** in Figure 9) to see the alternate partial order in the form of a graph (refer to Figure 11(b)).



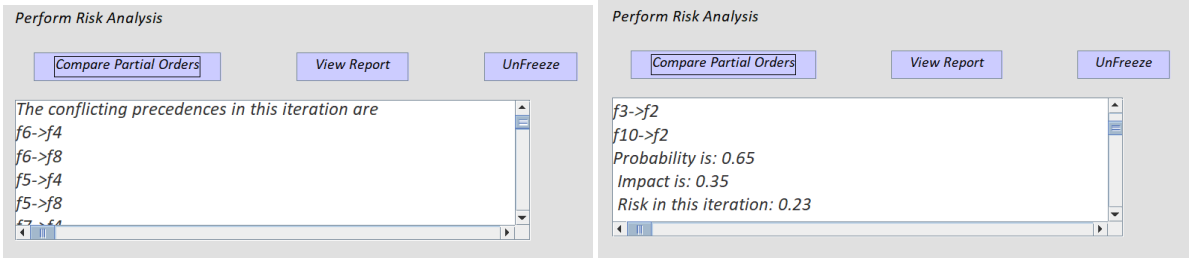
(a) Partial Order in text (b) Partial Order as a graph

Figure 10: Optimal Partial Order in Iteration 1



(a) Partial Order in text (b) Partial Order as a graph

Figure 11: Alternate Partial Order in Iteration 1



(a) Conflicting Precedences (b) Risk measurement

Figure 12: Partial Order comparison result

$\mathcal{STEP}$-8. Click on the *"Compare Partial Orders"* button to see the set of conflicting precedences (refer to to portion marked as **F** in Figure 9). It also displays the quantative risk exposure values (refer to Figures 12).

$\mathcal{STEP}$-9. Then click on the *"View Report"* button (refer to to portion marked as **F** in Figure 9) to view the qualitative risk analysis and risk reduction strategies (refer to Figure 13).

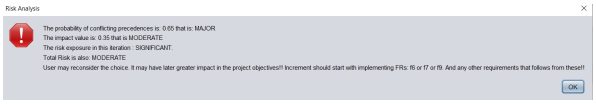


Figure 13: Qualitative Risk Analysis

$\mathcal{STEP}$-10. Before moving to next iteration click on *"Save Configuration"* button to save the results of the present iteration.

$\mathcal{STEP}$-11. Then click on the *"Next Iteration"* button (refer to Figure 4) to move to the next iteration of the software development.

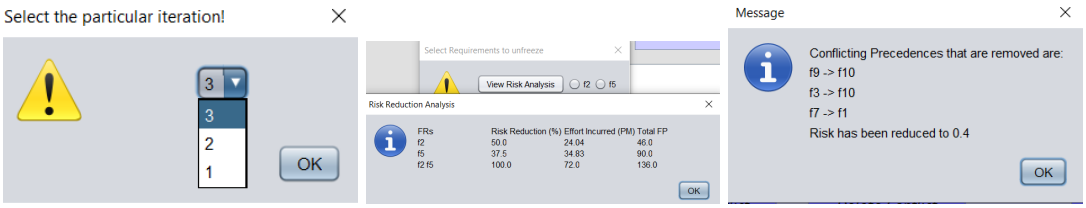
$\mathcal{STEP}$-12. Add new FR, NFR dependencies, conflicts, or modify them using the steps mentioned in Section 2.1.

$\mathcal{STEP}$-13. If there are new NFRs then repeat $\mathcal{STEP}-1$ to set the priority of the new NFR.

$\mathcal{STEP}$-14. To set a new parameter follow the instruction in $\mathcal{STEP}-2$, otherwise one can also continue with the already set parameter in the previous iteration.

$\mathcal{STEP}$-15. Follow steps $\mathcal{STEP}-3$ to $\mathcal{STEP}-8$ to generate partial orders and to perform risk analysis.

$\mathcal{STEP}$-16. At any $n-th$ $(n>1)$ iteration user can click on *"UnFreeze"* button (refer to to portion marked as **F** in Figure 9) to remove choices from previous iterations to reduce the risk. Figure 14(a) shows user need to select the increment from which requirements need to be removed. Figure 14(b) demonstrates the risk that can be reduced against different choices. Figure 14(c) shows the result of how much risk is reduced and additional effort required.



(a) Selecting increment (b) Risk reduction analysis (c) Risk measurement after unfreezing

Figure 14: Unfreezing requirements

"Load Configuration" button is used to save data for each iteration. When an application is re-opened and *"Load Configuration"* button is clicked the data of the last iteration saved gets loaded into the system.

2.3 Dashboard

Click on button marked as **C** (refer to Figure 4) to open requirement specification interface. Figure 15 shows the requirement specification interface.

- The dashboard shows all possible data of different iterations.
- In the `Partial Order` column the buttons can be clicked to view the partial order of any particular iteration.

- In the `User Choice` column the buttons are used to open a text file that shows the requirements frozen in any iteration.
- At the bottom of the interface user can select any parameter from the drop-down list and click on *"Submit"* button. The data for the selected parameter in the form of a graph is displayed (refer to Figure 16).

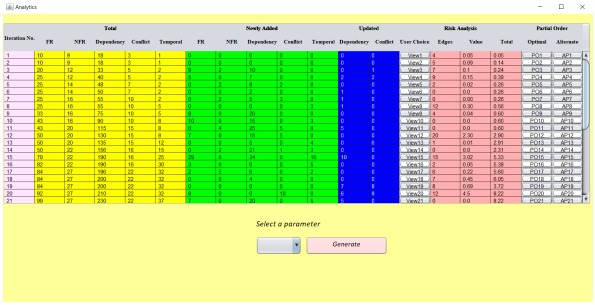


Figure 15: Dashboard

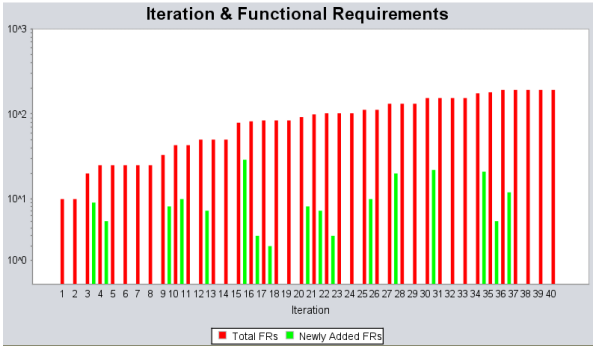


Figure 16: Graphical Analysis