1 Start

Select “Systems Developmental Dependency Analysis (SDDA)” in the menu in the main GUI. The following window opens. The user can choose among three possibilities.

2 Demo Scenario

2.1 Loading the scenario

Click the “Demo Scenario” button. A Littoral Combat Warfare scenario, comprised of 6 nodes, will be loaded, and the main SDDA window will appear. While the topology cannot be modified, inputs for the demo scenario are loaded, but can be modified by the user.
2.2 Settings and parameters

2.2.1 Dependencies
Click the “Visualize” button to visualize the matrix of dependencies. The whole window and the columns of the matrix are resizable. A tick in a cell means that the node in the corresponding column has a developmental dependency on the node in the corresponding row.

2.2.2 Labels
Labels of the nodes can be modified using the corresponding text boxes in the main window. The labels will appear in the matrices and results window.

2.2.3 Parameters of the dependency
Click the “SOD” (Strength of Dependency), and “COD” (Criticality of Dependency) buttons to visualize and modify the parameters of the developmental dependencies. New windows will pop up.
SOD values range between 0 and 1, and a SOD value must be given for each dependency in the dependency matrix. When the desired values have been input into the matrix, click the “Apply” button.

![Criticality of Dependency (COD)](image)

COD values range between 0 and 100, and a COD value must be given for each dependency in the dependency matrix. When the desired values have been input into the matrix, click the “Apply” button.

2.3 SDDA network mapping

Click the “Map Network” button to visualize a graphic representation of the developmental dependency network under analysis. Each node represents a system or a capability, and each edge represents a developmental dependency.

![SDDA network](image)
2.4 Node inputs

2.4.1 Minimum and maximum development time
Click the “Min and max development time” to visualize and modify the input regarding the expected development time of each system. A new window will pop up:

When the desired values have been input into the matrix, click the “Apply” button.

2.4.2 Self-effectiveness
Click the “Self Effectiveness” button to visualize and modify the input regarding the internal status of each system. A new window will pop up:
In this case, the internal status of each node is a deterministic value, that can range between 0 and 100. Alternatively, stochastic analysis can be performed. In this case, the user can input the number of instances to simulate, the time at which the analysis is performed (this will impact the amount of available information about the actual completion time of the development), and the level of uncertainty. Three levels of uncertainty are available, low, medium, and high. When the desired values have been input, press the “Apply” button.

2.5 Results
Select the desired output. Three methods are available for the analysis: basic SDDA, a modified version of SDDA where the beginning time of development of a system is based on the most critical dependency, and PERT. The resulting schedule, which will be represented with a Gantt chart for each method, can be sorted by method or by node. Sorting by method means that the schedules for all the nodes, relative to a specific method, are grouped together. Sorting by node means that the schedules for each node, relative to all the selected methods, are grouped together. In the case of stochastic self-effectiveness, the user can decide if to visualize the probability density functions of beginning and completion times of each node, above the bars in the GANTT chart.

2.6 Running the analysis
Click the “Run” button to run the analysis and visualize the results. A new window pops up. If the nodes have a deterministic value of Self-effectiveness, the upper part of the windows shows the Gantt chart for the development of the systems. The table in the lower part lists the self-effectiveness of each node, and the beginning time and completion time of its development, in all the selected methods.
Deterministic results grouped by method:

![Deterministic results grouped by method](image1)

Deterministic results grouped by node:

![Deterministic results grouped by node](image2)
If the nodes have a stochastic value of Self-effectiveness, the upper part of the windows shows the stochastic Gantt chart for the development of the systems. The shadowed sections on the bars represent higher probability of beginning and completion time. If the user selected the appropriate option, the probability density function of the beginning and completion times is shown above the corresponding bar. The table in the lower part lists the mean self-effectiveness of each node, the level of uncertainty, and the expected value of beginning time and completion time of development, in all the selected methods.

2.7 Saving the results
Once results have been generated, a “Save results” button will appear both in the main window, and in the results windows. Press the “Save results” button on either window and a dialogue window appears, to select an output MS Excel (.xlsx) file for the results.
If the results come from a deterministic analysis, the spreadsheet will list the node labels, the minimum and maximum development time, the self-effectiveness, and the beginning and completion times in each of the selected methods.
It the results come from a stochastic analysis, the spreadsheet will list the number of instances, the timestep of analysis, the node labels, the minimum and maximum development time, the self-effectiveness, the level of uncertainty, and the expected values of beginning and completion times in each of the selected methods.

2.8 Saving the architecture

The user can save the dependency matrix, parameters matrices, self-effectiveness, minimum and maximum development time and node labels for future use. Click the “Save structure” button in the main window and a dialogue window appears, to select an output MS Excel (.xlsx) file for the structure.

The file will have six spreadsheets, with the following information:

1. Number of nodes
2. Strength of Dependency matrix
3. Criticality of Dependency matrix
4. Minimum and maximum development times
5. Type of analysis.
   a. If deterministic, self-effectiveness
   b. If stochastic, number of instances, timestep of analysis, mean self-effectiveness, and uncertainty levels
6. Node labels

3 User-defined scenario
3.1 Loading the scenario
Select the number of nodes (2-8), and click the “User defined” button. An empty network, comprised of the number of nodes \( n \) defined by the user, will be loaded, and the main SDDA windows will appear.

3.2 Settings and parameters

3.2.1 Dependencies
Click the “Update” button to input the matrix of dependencies. The network must be directed acyclic. Select the appropriate cells and click the “Apply” button.
3.2.2 **Labels**

Labels of the nodes can be modified using the corresponding text boxes in the main window. The labels will appear in the matrices and results window.

3.2.3 **Parameters of the dependency**

Click the “SOD” (Strength of dependency), and “COD” (Criticality of Dependency) buttons to input the parameters of the operational dependencies. New windows will pop up.

SOD values range between 0 and 1, and a SOD value must be given for each dependency in the dependency matrix. When the desired values have been input into the matrix, click the “Apply” button.
COD values range between 0 and 100, and a COD value must be given for each dependency in the dependency matrix. When the desired values have been input into the matrix, click the “Apply” button.

### 3.3 SDDA network mapping
Click the “Map Network” button to visualize a graphic representation of the developmental dependency network under analysis. Each node represents a system or a capability, and each edge represents a developmental dependency.

![SDDA network diagram](image)

### 3.4 Node inputs
#### 3.4.1 Minimum and maximum development time
Click the “Min and max development time” to visualize and modify the input regarding the expected development time of each system. A new window will pop up:
When the desired values have been input into the matrix, click the “Apply” button.

3.4.2 **Self-effectiveness**

Click the “Self Effectiveness” button to visualize and modify the input regarding the internal status of each system. A new window will pop up. The internal status of each node can be a deterministic value, ranging between 0 and 100. Alternatively, stochastic analysis can be performed. In this case, the user can input the number of instances to simulate, the time at which the analysis is performed (this will impact the amount of available information about the actual completion time of the development), and the level of uncertainty. Three levels of uncertainty are available, low, medium, and high.

When the desired values have been input, press the “Apply” button.

![Self-Effectiveness](image)

### 3.5 Results

Select the desired output. Three methods are available for the analysis: basic SDDA, a modified version of SDDA where the beginning time of development of a system is based on the most critical dependency, and PERT. The resulting schedule, which will be represented with a Gantt chart for each method, can be sorted by method or by node. Sorting by method means that the schedules for all the nodes, relative to a specific method, are grouped together. Sorting by node means that the schedules for each node, relative to all the selected methods, are grouped together. In the case of stochastic self-effectiveness, the user can decide if to visualize the probability density functions of beginning and completion times of each node, above the bars in the GANTT chart.
3.6 Running the analysis

Click the “Run” button to run the analysis and visualize the results. A new window pops up. If the nodes have a deterministic value of Self-effectiveness, the upper part of the windows shows the Gantt chart for the development of the systems. The table in the lower part lists the self-effectiveness of each node, and the beginning time and completion time of its development, in all the selected methods.

If the nodes have a stochastic value of Self-effectiveness, the upper part of the windows shows the stochastic Gantt chart for the development of the systems. The shadowed sections on the bars represent higher probability of beginning and completion time. If the user selected the appropriate option, the probability density function of the beginning and completion times is shown above the corresponding bar. The table in the lower part lists the mean self-effectiveness of each node, the level of uncertainty, and the expected value of beginning time and completion time of development, in all the selected methods.
3.7 Saving the results

Once results have been generated, a “Save results” button will appear both in the main window, and in the results windows. Press the “Save results” button on either window and a dialogue window appears, to select an output MS Excel (.xlsx) file for the results.

If the results come from a deterministic analysis, the spreadsheet will list the node labels, the minimum and maximum development time, the self-effectiveness, and the beginning and completion times in each of the selected methods.

If the results come from a stochastic analysis, the spreadsheet will list the number of instances, the timestep of analysis, the node labels, the minimum and maximum development time, the self-effectiveness, the level of uncertainty, and the expected values of beginning and completion times in each of the selected methods.
3.8 Saving the architecture

The user can save the dependency matrix, parameters matrices, self-effectiveness, minimum and maximum development time and node labels for future use. Click the “Save structure” button in the main window and a dialogue window appears, to select an output MS Excel (.xlsx) file for the structure.

The file will have six spreadsheets, with the following information:

1. Number of nodes
2. Strength of Dependency matrix
3. Criticality of Dependency matrix
4. Minimum and maximum development times
5. Type of analysis.
   a. If deterministic, self-effectiveness
   b. If stochastic, number of instances, timestep of analysis, mean self-effectiveness, and uncertainty levels
6. Node labels

4 Import data from file

Version 2.1 of SDDA Graphic User Interface allows the user to import data from an excel file, either created by the user or generated when saving the architecture during a previous run of the GUI. Importing from an excel file one more advantage: the number of nodes is not limited to 8 (as it happens in the manual input).

4.1 The Excel file

The data must be contained in an Excel (.xlsx) file, with five worksheets, and an optional sixth one. Files with .xls extension are not suitable for unix-based or Mac-OS-based machines.

The first sheet contains the number of nodes $n$, in the cell A1.

The second sheet contains the SOD matrix, of size $n$-by-$n$, starting in the cell A1. This matrix also defines the dependencies (non-zero terms), that must result in a directed acyclic network. For each dependency, SOD ranges between 0 and 1.
The third sheet contains the COD matrix, of size $n$-by-$n$, starting in the cell A1. The non-zero values correspond to non-zero values in the SOD matrix. For each dependency, COD ranges between 0 and 100.

The fourth sheet contains the minimum and maximum development times, in the first and second column respectively.

The fifth sheet contains the values for the Self-effectiveness. Cell A1 is the type, that can be deterministic (the cell must contain “d”, “D”, “deterministic”, or “Deterministic”) or stochastic (the cell must contain “s”, “S”, “stochastic”, or “Stochastic”). If the type is deterministic, values of self-effectiveness ranging between 0 and 100 must be put in the first column.
If the type is stochastic, the worksheet must have the desired number of instances in cell B1, the timestep of analysis in cell C1, the mean value of self-effectiveness in the first column, and the level of uncertainty (1 for low, 2 for medium, 3 for high) in the second column.

4.2 Loading the scenario

Click the “Browse” button. A browse windows will appear. Select the appropriate excel file. The name of the file will appear in the text box, and the “Import” button will become available.

Click the “Import” button, to import the topology, the parameters, and the inputs. The main SDDA window will appear. If the nodes are more than 8, the button to map the scenario, as well as text boxes to label nodes other than the first 8 will not be available.
4.3 Settings and parameters

4.3.1 Dependencies
Click the “Update” button to input the matrix of dependencies. The network must be directed acyclic. Select the appropriate cells and click the “Apply” button.

4.3.2 Labels
Labels of the nodes can be modified using the corresponding text boxes in the main window. The labels will appear in the matrices and results window.

4.3.3 Parameters of the dependency
Click the “SOD” (Strength of dependency), and “COD” (Criticality of Dependency) buttons to input the parameters of the operational dependencies. New windows will pop up.
SOD values range between 0 and 1, and a SOD value must be given for each dependency in the dependency matrix. When the desired values have been input into the matrix, click the “Apply” button.

COD values range between 0 and 100, and a COD value must be given for each dependency in the dependency matrix. When the desired values have been input into the matrix, click the “Apply” button.

4.4 SDDA network mapping
Click the “Map Network” button to visualize a graphic representation of the developmental dependency network under analysis. Each node represents a system or a capability, and each edge represents a developmental dependency. This function is only available if the number of nodes is 8 or less.
4.5  Node inputs

4.5.1  Minimum and maximum development time
Click the “Min and max development time” to visualize and modify the input regarding the expected development time of each system. A new window will pop up:

When the desired values have been input into the matrix, click the “Apply” button.

4.5.2  Self-effectiveness
Click the “Self Effectiveness” button to visualize and modify the input regarding the internal status of each system (only first 8 nodes). A new window will pop up. The internal status of each node can be a deterministic value, ranging between 0 and 100. Alternatively, stochastic analysis can be performed. In this case, the user can input the number of instances to simulate, the time at which the analysis is performed (this will impact the amount of available information about
the actual completion time of the development), and the level of uncertainty. Three levels of uncertainty are available, low, medium, and high. When the desired values have been input, press the “Apply” button.

4.6 Results
Select the desired output. Three methods are available for the analysis: basic SDDA, a modified version of SDDA where the beginning time of development of a system is based on the most critical dependency, and PERT. The resulting schedule, which will be represented with a Gantt chart for each method, can be sorted by method or by node. Sorting by method means that the schedules for all the nodes, relative to a specific method, are grouped together. Sorting by node means that the schedules for each node, relative to all the selected methods, are grouped together. In the case of stochastic self-effectiveness, the user can decide if to visualize the probability density functions of beginning and completion times of each node, above the bars in the GANTT chart.

4.7 Running the analysis
Click the “Run” button to run the analysis and visualize the results. A new window pops up. If the nodes have a deterministic value of Self-effectiveness, the upper part of the windows shows the Gantt chart for the development of the systems. The table in the lower part lists the self-effectiveness of each node, and the beginning time and completion time of its development, in all the selected methods.
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4.8 Saving the results

Once results have been generated, a “Save results” button will appear both in the main window, and in the results windows. Press the “Save results” button on either window and a dialogue window appears, to select an output MS Excel (.xlsx) file for the results.

If the results come from a deterministic analysis, the spreadsheet will list the node labels, the minimum and maximum development time, the self-effectiveness, and the beginning and completion times in each of the selected methods.
It the results come from a stochastic analysis, the spreadsheet will list the number of instances, the timestep of analysis, the node labels, the minimum and maximum development time, the self-effectiveness, the level of uncertainty, and the expected values of beginning and completion times in each of the selected methods.

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4.9 Saving the architecture

The user can save the dependency matrix, parameters matrices, self-effectiveness, minimum and maximum development time and node labels for future use. Click the “Save structure” button in the main window and a dialogue window appears, to select an output MS Excel (.xlsx) file for the structure.

The file will have six spreadsheets, with the following information:

1. Number of nodes
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4. Minimum and maximum development times
5. Type of analysis.
   a. If deterministic, self-effectiveness
   b. If stochastic, number of instances, timestep of analysis, mean self-effectiveness, and uncertainty levels
6. Node labels

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