ANP SOLVER USER GUIDE

ANP SOLVER is a software tool that implements the Analytic Network Process (Thomas Saaty, 1996). The ANP SOLVER software aims to support decision-making with dependence and feedback and can be used in a variety of real life problems

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INTRODUCTION

The Analytic Network Process is a generalisation of the Analytic Hierarchy Process (AHP) developed by Thomas Saaty (1996). ANP incorporates feedback and interdependent relationships among decision criteria and alternatives and provides a general framework to deal with decisions without making assumptions about the independence of higher level elements/nodes from lower level elements/nodes or the independence within a level as in a hierarchy (Saaty, 2006). In fact, the ANP uses a network of elements/nodes without need to specify levels. Technically, the model consists of clusters and elements/nodes. The process of applying the ANP comprises of the following main steps:

- **Step 1:** Regarding the decision goal, a network structure including clusters, criteria and alternatives should be configured.
- **Step 2:** The dependences among all components of the previous structure should be identified and listed in a table, in order that the impacts among them can be defined.
- **Step 3:** Pairwise comparison matrices of the components with interval judgments have to be constructed.
- **Step 4:** Afterwards, the relative importance weights (local priorities) from each matrix can be derived.
- **Step 5:** The Supermatrix has to be filled with the elicited weights of Step 4.
- **Step 6:** The Supermatrix should be transformed to column stochastic so that the sum of the elements/nodes in each column is equal to one and thus producing a Weighted Supermatrix.
- **Step 7:** Then the Weighted Supermatrix must be limited by raising it to a sufficiently large power until it converges into a stable Supermatrix. In the end, the weights of criteria and alternatives are aggregated into final priorities.

The aim of *ANP SOLVER* is to provide a reliable and user friendly tool that gets as input the model and the decision maker's judgments and produces as output the final results by automating the needed calculations and consistency and completeness checks. Furthermore, it provides a way to get the created model as well as intermediate and final results in a form that will permit further analysis or usage as input to other software tools. This means that the software provides the user with a reliable way to:

- Design the problem's model, thus create, modify and delete clusters and nodes,
- Set and modify elements/nodes relationships,
- Get automatically computed the derived cluster relationships,
- Set the pairwise comparisons values as needed based on the model created,
- Check the consistency of the entered judgments,
- Check the completeness and validity of the values that are entered in each step,
- Perform all the needed computational steps in order to get the Supermatrix, Cluster Weight Matrix, Weighted Supermatrix and finally the Limit Matrix containing the final results of the problem.

REQUIREMENTS

Software Requirements
Microsoft® Windows® XP/Vista/7 (32-bit and 64-bit) Starter/Home Basic/Home Premium/Business/ Ultimate
Windows Installer 3.1
.NET Framework 3.5
Minimum Hardware Requirements
300 MHz or faster processor
256 MB of RAM (512 MB RAM required for Recovery Tool)
200 MB of available hard disk space
CD-ROM or DVD drive (if not installing via electronic download)

SET UP - VERSION 1.0.1

The application is delivered as a folder named ANP SOLVER v1.0.1 and containing a Setup.exe file, the ANP SOLVER USER GUIDE.pdf and the Hamburger Example folder.

Before starting the installation go through the Control Panel\Add Remove Software and make sure that there is no previous version installed or if there is uninstall it.

INSTALLATION

To install the application double click the setup.exe and either select destination folder or let the default one. If there are missing components the installer will ask to connect to the internet and download those components.

RUNNING THE APPLICATION

After the completion of the installation:

- ⇨ Browse to the previously selected destination folder (in our case G:\ ANP SOLVER) and double click on ANPSOLVER.exe as shown in Figure 1.

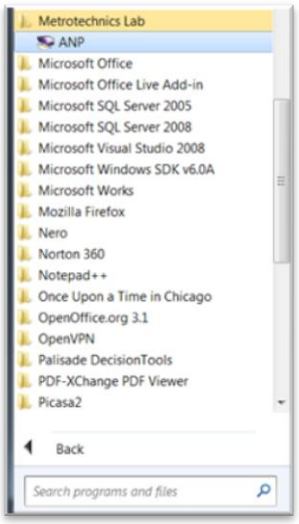


Figure 1 ANP SOLVER in Start Menu

⇨ Or use the shortcut that has been placed on Start menu during the installation process

USING ANP SOLVER

VIEW EXAMPLE

The ANP SOLVER v1.0.1 contains an ANP model example in the Hamburger Example folder. The example is based on Saaty's Hamburger model[1], a simple network application used to estimate the market share of three fast-food hamburger joints. In order to view the example:

⇨ Run the application (view corresponding section).
⇨ Click File -> Open as shown in Figure 2

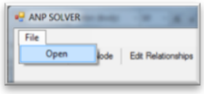


Figure 2 Open File

⇨ Browse to the destination folder (in our case G:\ ANP SOLVER v1.0.1 \Hamburger Example)

[1] Saaty, T.L. (2005) Theory and Applications of the Analytic Network Process: Decision Making with Benefits, Opportunities, Costs, and Risks, RWS Publications.

⇨ Click to select the Hamburger Example Folder as shown in Figure 3.

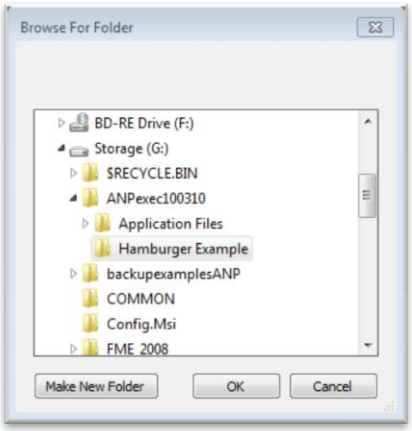


Figure 3 Selecting the Hamburger Example folder

⇨ Click Ok and the Working Folder Label will show the path to the folder you just selected as shown in Figure 4.

Figure 4 Working Folder Label

⇨ By clicking on any tab you will able to view the corresponding data of this model.

CREATE NEW MODEL

To start working on a new model:

- ⇨ Click File -> Open.
- ⇨ Click the Make New Folder button, and name the just created folder
- ⇨ Select the created folder by clicking it
- ⇨ Click Ok and the Working Folder Label will show the path to the folder you just created.

Now you can start working on the new model. All data added during the session will be saved in appropriate files in this folder.

OPEN EXISTING MODEL

To open an existing model

- ⇨ Run the application (view corresponding section).
- ⇨ Click File -> Open.
- ⇨ Browse to the destination folder as shown in Figure 5.

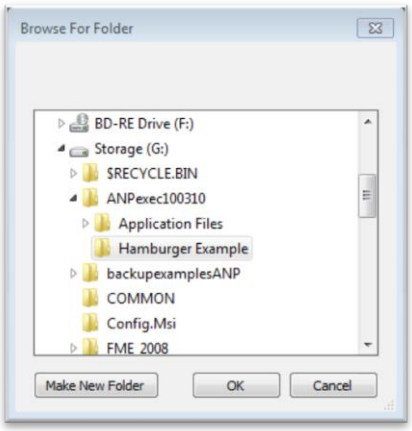


Figure 5 Browse for folder

- ⇨ Click to select the desired folder.
- ⇨ Click Ok and the Working Folder Label will show the path to the folder you just selected.

Now you will be able to view the model that you had saved in this folder and view data or make changes as desired.

HANDLE CLUSTERS

- ⇨ To start creating the model you need to have a valid model open (see Section “Create New Model” or “Open Existing Model”.
- ⇨ Click on the “Add Cluster” Tab.

ADD CLUSTER

⇨ Type in the “Cluster Name” text box the desired cluster name and click “New Cluster” as shown in Figure 6.

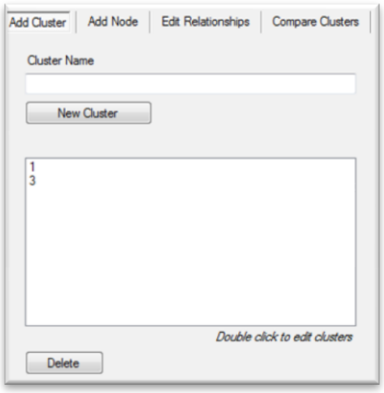


Figure 6 Add New Cluster

! No duplicate names are permitted as well as special characters. Furthermore, is suggested not to use blank spaces.

! You cannot add a cluster with empty cluster name.

RENAME CLUSTER

⇨ To rename a cluster just select it from the text box and double click on it.

⇨ A pop up window will appear asking the new name as shown in Figure 7.

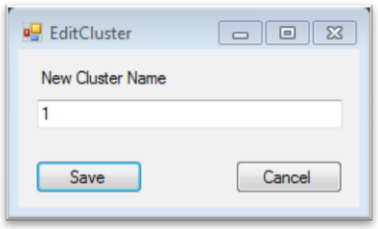


Figure 7 Edit Cluster Window

⇨ Type the new cluster name in the text box and click “Save”.

DELETE CLUSTER

⇨ To delete a cluster select it from the text box and click “Delete”.

! By deleting a cluster all contained nodes are deleted.

! By deleting a cluster all corresponding relationships and comparison data are removed.

HANDLE NODES

⇨ To handle nodes select the “Add Node” tab by clicking it.

ADD NODE

- ⇨ To add a node, you have to select to which cluster will be appended.
- ⇨ Type in the “Node Name” text box the desired node name and click “New Node” as shown in Figure 8.

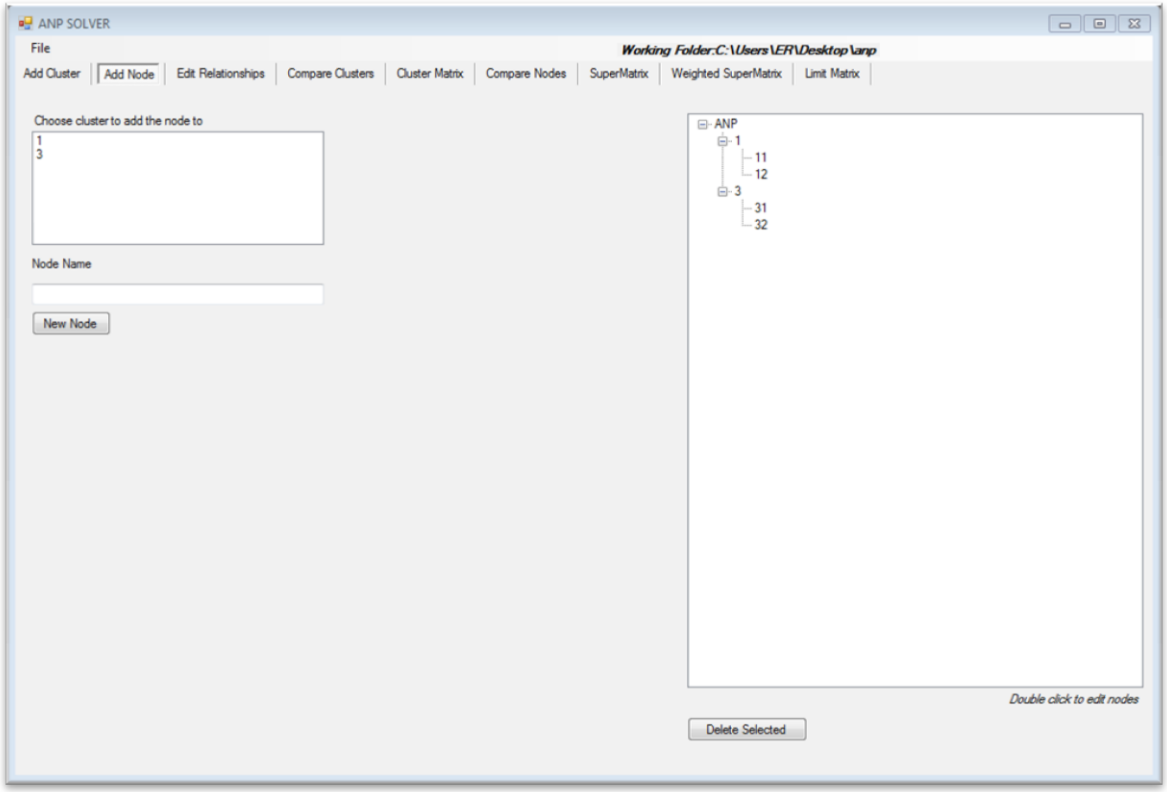


Figure 8 Add Node Tab

RENAME NODE

- ⇨ To edit a node select it from the tree view and double click.

DELETE NODE

- ⇨ To delete a node select it from the tree view and click “Delete Selected”.
- ! By deleting a node all corresponding relationships and comparison data are removed.

SET UP NODES AND CLUSTERS RELATIONSHIPS

- ⇨ Select the “Edit Relationships” tab by clicking it.
- ⇨ The Nodes Relationships Matrix is created to hold the node relationships.
- ⇨ Each row and corresponding column represents a node.
- ⇨ Nodes are sorted according to the cluster to which they belong and the creation time.

⇨ Check the (i,j) checkbox of the Node Relationships Matrix to define that the node in row i is related to the node in column j.

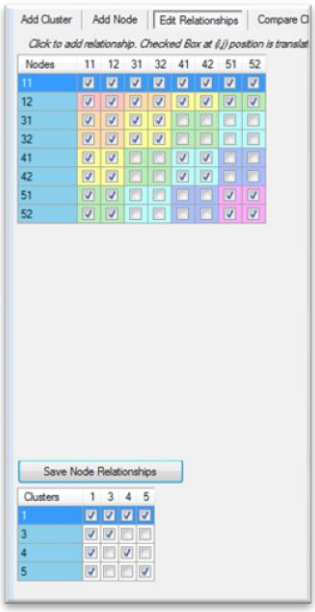


Figure 9 Nodes and Clusters Relationships

⇨ By clicking the "Save Node Relationships" button, the clusters' relationships are computed and displayed as shown in Figure 9.

COMPARE CLUSTERS

⇨ Select the "Compare Clusters" tab by clicking it.
⇨ Select with respect to which cluster you want to make the comparison by selecting the corresponding cluster from the selection box as shown in Figure 10.

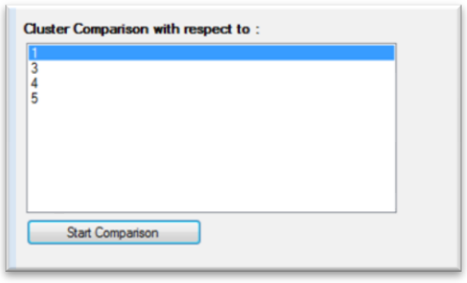


Figure 10 Select Cluster to start pairwise comparison

⇨ Click the "Start Comparison" button to start the pairwise comparisons.
⇨ A pop up window will appear. Fill in the upper triangular part of the table with values from the 1-9 scale as shown in Figure 11.

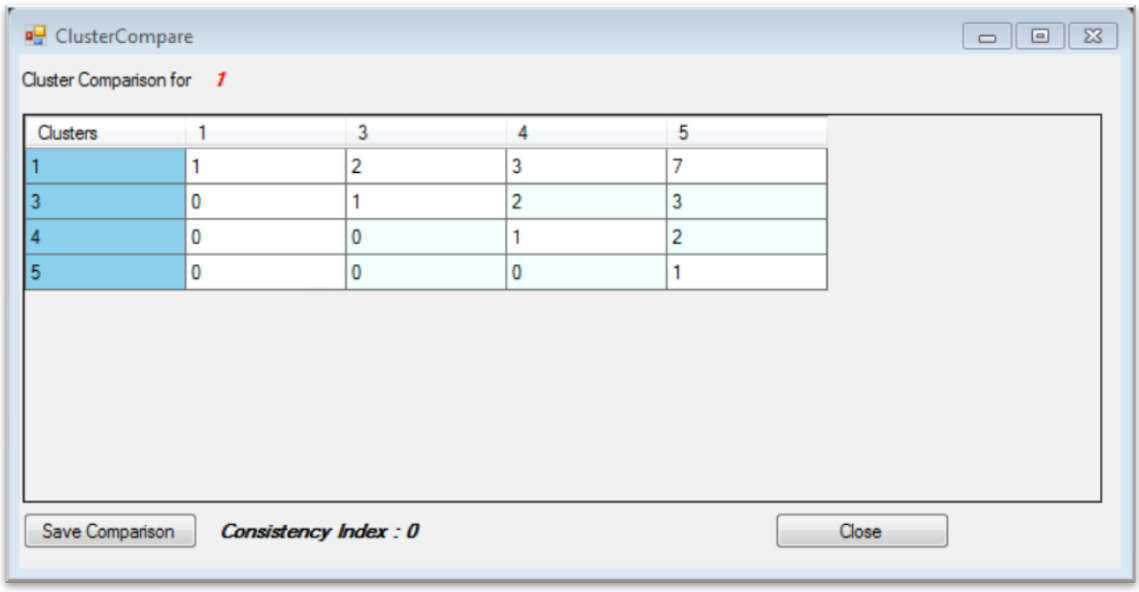


Figure 11 Clusters Pairwise Comparison before saving

⇨ By clicking “Save Comparison” the remaining values and the Consistency Index will be computed as shown in Figure 12.

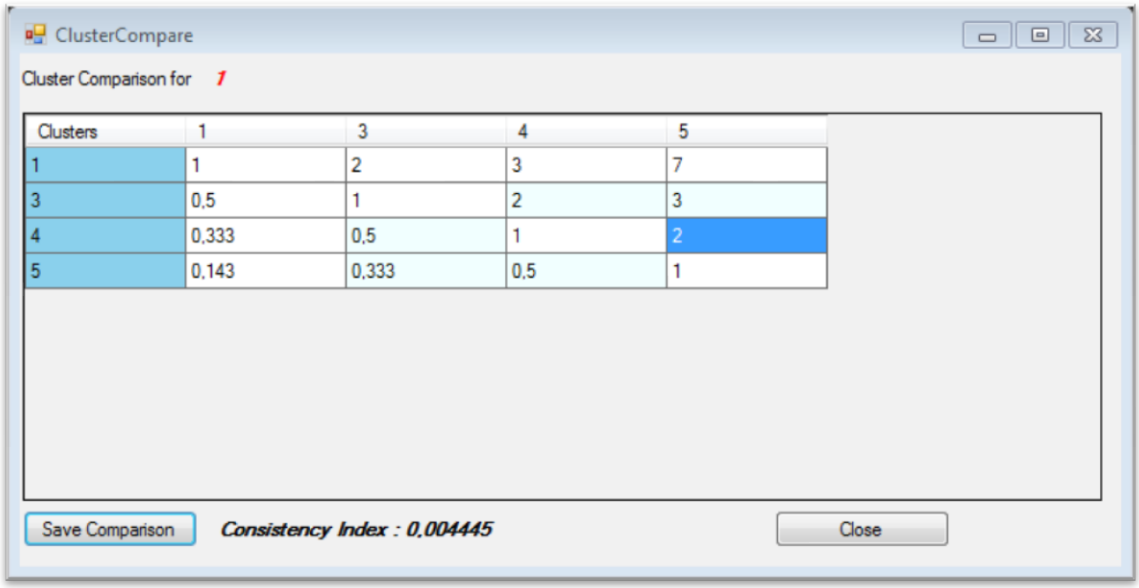


Figure 12 Clusters Pairwise Comparison after saving

⇨ To complete the process all the pairwise comparisons for all the clusters should be completed.

CLUSTER MATRIX

⇨ By clicking the “Cluster Matrix” Tab, the Cluster Matrix is computed and displayed as shown in Figure 13.

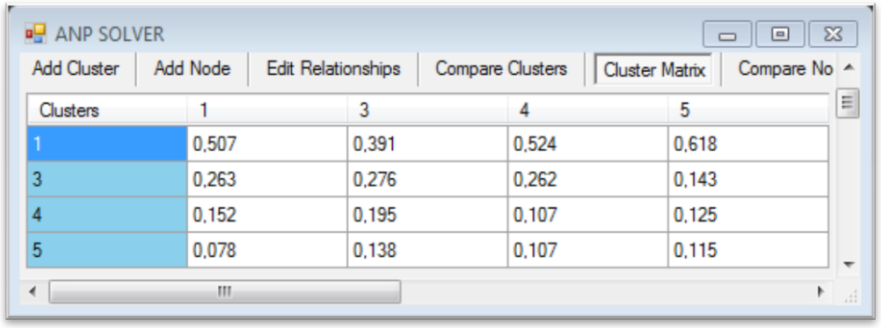


Figure 13 Cluster Matrix

COMPARE NODES

- ⇨ Select the "Compare Nodes" tab by clicking it.
- ⇨ Select with respect to which cluster and which node you want to make the comparison by selecting the corresponding cluster and node from the corresponding box as shown in Figure 14.

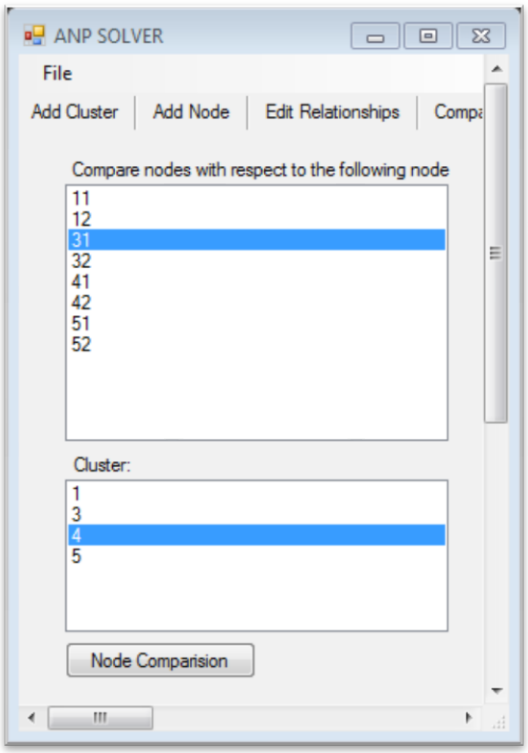


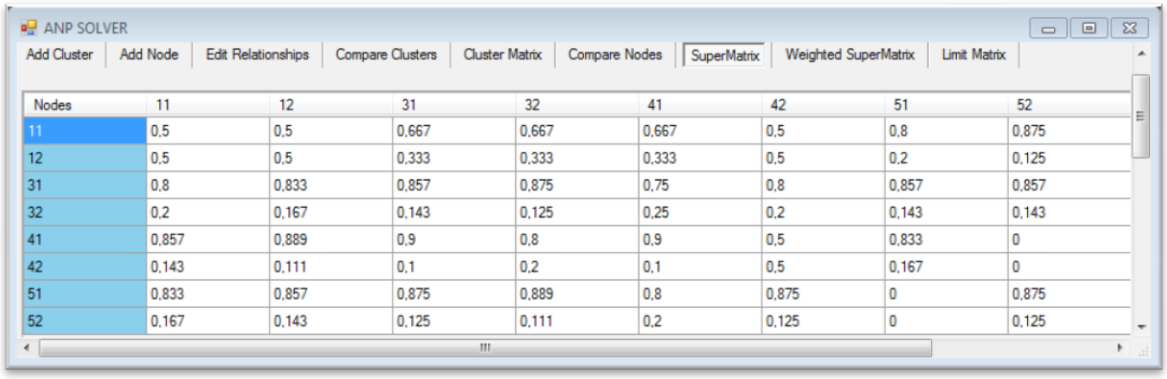
Figure 14 Nodes Comparison

- ⇨ Click the "Node Comparison" button to start the pairwise comparisons.
- ⇨ A pop up window will appear. Fill in the upper triangular part of the table with values from the 1-9 scale.
- ⇨ By clicking "Save Comparison" the remaining values and the Consistency Index will be computed.
- ⇨ To complete the process all the pairwise comparisons for all the clusters and nodes should be completed.

! Attention: not all nodes are related to all clusters, thus when selecting a node in the top selection box only the related clusters will appear in the bottom selection box.

SUPERMATRIX

⇨ By clicking the "SuperMatrix" Tab, the SuperMatrix is computed and displayed as shown in Figure15.

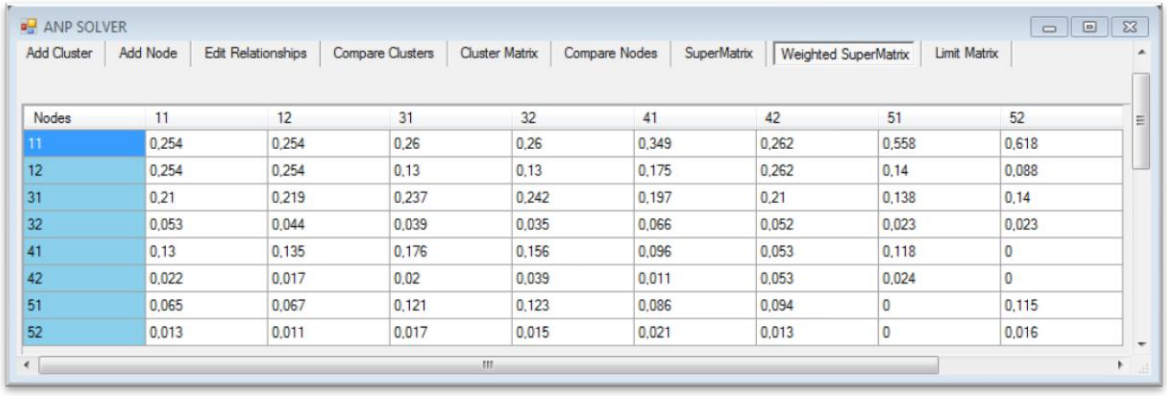


Nodes	11	12	31	32	41	42	51	52
11	0,5	0,5	0,667	0,667	0,667	0,5	0,8	0,875
12	0,5	0,5	0,333	0,333	0,333	0,5	0,2	0,125
31	0,8	0,833	0,857	0,875	0,75	0,8	0,857	0,857
32	0,2	0,167	0,143	0,125	0,25	0,2	0,143	0,143
41	0,857	0,889	0,9	0,8	0,9	0,5	0,833	0
42	0,143	0,111	0,1	0,2	0,1	0,5	0,167	0
51	0,833	0,857	0,875	0,889	0,8	0,875	0	0,875
52	0,167	0,143	0,125	0,111	0,2	0,125	0	0,125

Figure 15 SuperMatrix

WEIGHTED SUPERMATRIX

⇨ By clicking the "Weighted SuperMatrix" Tab, the Weighted Supermatrix is computed and displayed as shown in Figure 16.

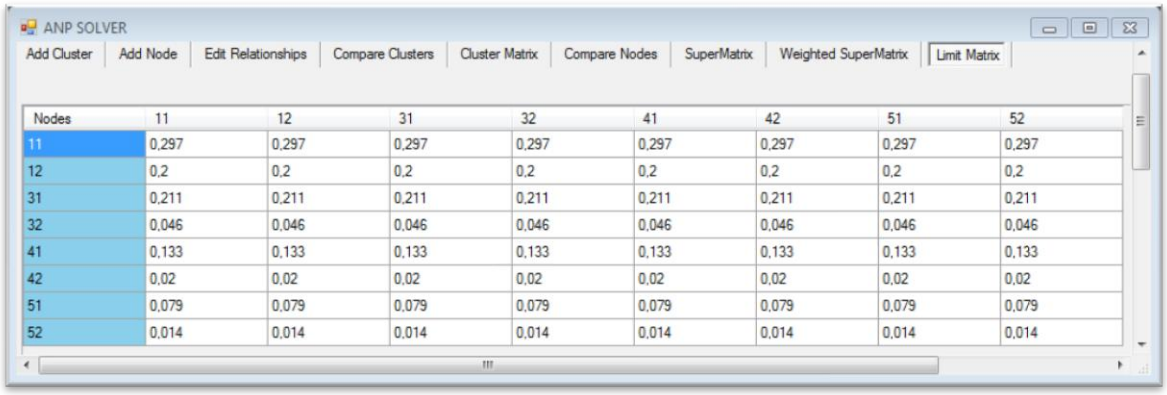


Nodes	11	12	31	32	41	42	51	52
11	0,254	0,254	0,26	0,26	0,349	0,262	0,558	0,618
12	0,254	0,254	0,13	0,13	0,175	0,262	0,14	0,088
31	0,21	0,219	0,237	0,242	0,197	0,21	0,138	0,14
32	0,053	0,044	0,039	0,035	0,066	0,052	0,023	0,023
41	0,13	0,135	0,176	0,156	0,096	0,053	0,118	0
42	0,022	0,017	0,02	0,039	0,011	0,053	0,024	0
51	0,065	0,067	0,121	0,123	0,086	0,094	0	0,115
52	0,013	0,011	0,017	0,015	0,021	0,013	0	0,016

Figure 16 Weighted SuperMatrix

LIMIT MATRIX

⇨ By clicking the “Limit Matrix” Tab, the Limit Matrix is computed and displayed as shown in Figure 17.



Nodes	11	12	31	32	41	42	51	52
11	0,297	0,297	0,297	0,297	0,297	0,297	0,297	0,297
12	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
31	0,211	0,211	0,211	0,211	0,211	0,211	0,211	0,211
32	0,046	0,046	0,046	0,046	0,046	0,046	0,046	0,046
41	0,133	0,133	0,133	0,133	0,133	0,133	0,133	0,133
42	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
51	0,079	0,079	0,079	0,079	0,079	0,079	0,079	0,079
52	0,014	0,014	0,014	0,014	0,014	0,014	0,014	0,014

Figure 17 Limit Matrix