METAX DASHBOARD USER’S GUIDE

This document explains how to install the METAX dashboard and how to use it. A use case scenario is provided in order to depict its usage. The use case scenario is based on a representative set of data.

# Installation instructions:

Before beginning installation and throughout the demo process, it is recommended that User Account control be fully disabled.

1. Install Chrome using "ChromeSetup" with default options
   1. <http://support.google.com/chrome/bin/answer.py?hl=en&answer=95346>
2. Install XAMPP using "xampp-win32-1.7.7-VC9-installer" with default options
   1. <http://sourceforge.net/projects/xampp/files/XAMPP%20Windows/1.7.7/xampp-win32-1.7.7-VC9-installer.exe/download>
3. Install Python using "python-2.7.2" with default options. Note that Python 3.2 will NOT work with the dashboard
   1. <http://python.org/ftp/python/2.7.2/python-2.7.2.msi>
4. Install Numpy using "numpy-1.6.1-win32-superpack-python2.7" with default options
   1. <http://sourceforge.net/projects/numpy/files/NumPy/1.6.1/numpy-1.6.1-win32-superpack-python2.7.exe/download>
5. Install Matplotlib using "matplotlib-1.1.0.win32-py2.7" with default options
   1. <http://sourceforge.net/projects/matplotlib/files/matplotlib/matplotlib-1.1.0/matplotlib-1.1.0.win32-py2.7.exe/download>
6. Install Vuesz using "veusz-1.13-windows-setup". Choose installation location to <python path>\Veusz. Add this location to the system path after installation. Reboot the computer in order to make the new path effective.
   1. <http://download.gna.org/veusz/Binaries-Windows/veusz-1.14-windows-setup.exe>
7. Copy "metax" folder into the following directory "C:\xampp\htdocs\xampp". Note that if updating the dashboard, the existing "metax" folder must be deleted and then replaced by the updated "metax" folder.

**To run:**

1. Start XAMPP. Windows Firewall may request web access. Do not allow access.

2. In the XAMPP control panel, click on the "Start" button next to "Apache". No other modules need to be started.

3. Start Chrome

4. Type the following address into the url bar: "localhost/xampp/metax/dashboard.php"

The dashboard should appear. To confirm that the python code is working, move one of the sliders in the **Evaluation Criteria Weightings** section and confirm that the pie chart in the **Evaluation Criteria Weightings Breakdown** section changes.

**Note:** If you use Skype on the machine that is running XAMPP it is necessary to make the following configuration change to Skype to avoid port conflicts which will prevent Apache from running.

1.Start skype.

2.Go to Tools>Options>Advanced>Connection

3.Uncheck "Use port 80 and 443 as alternatives for incoming connections"

**Note:** Installing the entire GME program bundle changed several system parameters and may result in veusz being rendered non-operational. If this is the case, there are several known bug fixes that may make the dashboard work.

1. If the PYTHONPATH variable is set, delete it. This will return it to the default setting.

2. Install a second copy of VEUSZ to the GME directory. (C:\Program Files (x86)\ISIS\ESMoL

# Usage Instructions

The METAX dashboard supports TOPSIS and OEC ranking methods. Ensure that the desired ranking method is selected from the **Ranking Method** dropdown menu before continuing.

Once a ranking method has been selected, **Evaluation Criteria Weightings** can be set according to the user’s preference for each of the five tier 1 metrics (Mobility and Payload, Survivability, Transportability, Manufacturability, and Complexity). Once the tier 1 weightings are set, the user may adjust tier 2 metric weightings found under the **Tier 2 Weightings** section. Note that each of the Tier 2 metrics are listed under one of the five tier 1 metrics. The **Evaluation Criteria Weightings Breakdown** section shows the combined effect of the tier 1 and tier 2 weightings as a pie chart. The formula used to calculate the overall weighting for each metric is shown below.

Overall Weighting = Tier 1 Weighting \* Tier 2 Weighting

This pie chart represents how much each tier 2 metric contributes to the overall ranking given the current weightings. Before continuing the user should ensure that this pie chart accurately reflects his or her actual preferences.

The **Vehicle Design Metric Summary** section allows the user to impose requirements on designs. This is done by setting the requirement to active by checking the checkbox under the “Requirement (Filter)” column. Once the requirement has been set to active, the user may adjust the requirement to their desired value via the slider bars or drop down menus in the “Requirement” column. After imposing a requirement, the 10 designs that meet that requirement will be shown in white at the right side of the table in ranked order from best to worst according to the currently set tier 1 and tier 2 weightings and ranking method. Only the 10 best ranked designs will be shown. Designs that fail to meet the requirement are shown in grey or not at all if there are at least 10 feasible designs.

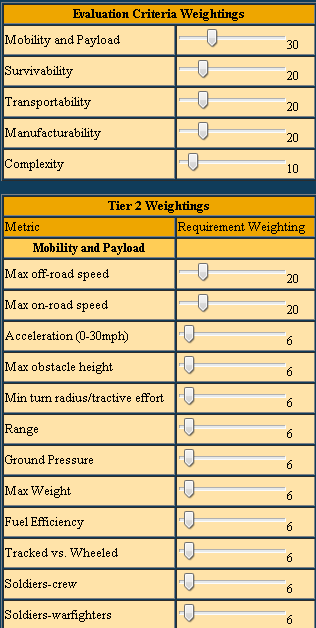
The **Pareto Frontier** section may be used to view a 2-dimensional cross section of the hyperspace created by the five tier 1 metrics. To change which cross section is viewed, the user may select different tier 1 metrics from the drop down menus. The designs that achieve the best score in the selected dimensions will form a Pareto frontier outlined in blue. Infeasible configurations, as defined by active requirements in the “Vehicle Design Metric Summary” section are shown as red, whereas feasible designs are shown as green.

The **Configuration Ranking** section may be used to view the results of the TOPSIS or OEC ranking. The contribution to the overall score from each tier 1 metric is identified by a different color. For TOPSIS ranking, the best configuration is listed at the top of the bar chart and the worst at the bottom. Infeasible configurations, as defined by active requirements in the “Vehicle Design Metric Summary” section are listed below the red line labeled “infeasible cases”. These are designs that may have scored well in the ranking, but do not meet the defined requirements.

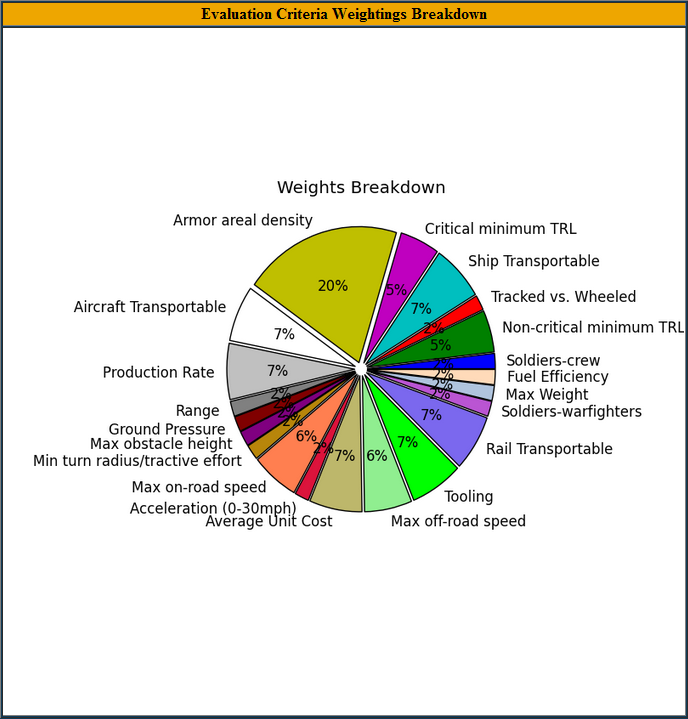
The **Scatterplot** section allows the user to view a plot of each configuration’s tier 2 metrics. The displayed tier 2 metrics can be changed via the drop down menus at the top of the section. As before, red dots indicate configurations that do not meet the imposed requirements whereas green dots are configurations that meet all imposed requirements. The shaded region of the graph shows an imposed requirement for that dimension. Note infeasible designs may appear within the (white/feasible) region if a requirement is imposed on a tier 2 metric that is not currently displayed as one of the scatterplot axes.

The user may view the raw design information in the Vehicle Design Attribute Summary table at the bottom of the page. Here each configuration is shown in its own column with several of its design attributes shown below.

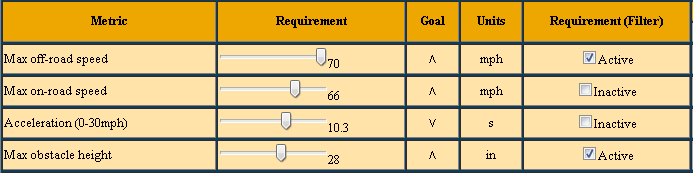
# Use Case Scenario

You have been contracted to design an armored troop transport vehicle. After interviewing the stakeholders to determine their design preferences you have determined that mobility and payload are highly desired in the final design. Additionally, they specifically mentioned high maximum on-road speed and maximum off-road speed as metrics that they would like to see in the final design. As the interview goes on, you determine that complexity is much less important. Next you review the requirements documents to determine if there are any explicitly stated requirements that your final design must meet. From this review you determine that the vehicle must have a maximum off-road speed of at least 70 miles per hour and it must be able to clear a 28 inch obstacle. Taking careful note of this information you begin the process of selecting a design using the METAX web-based dashboard.

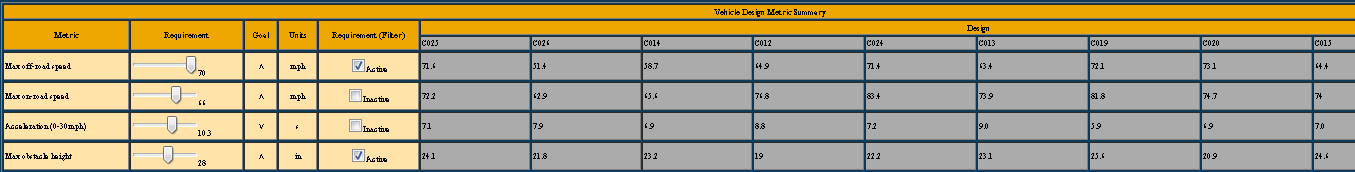
The first step in selecting a design is determining which MADM technique is appropriate for your problem. The METAX Dashboard supports TOPSIS and OEC ranking methods. TOPSIS stands for Technique for Order Preference by Similarity to the Ideal Solution. It is based on the best solution having the least Euclidean distance from the ideal solution. Its advantages are its simplicity and indisputable rankings. The disadvantages to TOPSIS are its heavy reliance on accurate preference weighting values and that the criteria are modeled as having monotonically increasing or decreasing utility. An OEC or Overall Evaluation Criterion ranks alternatives by maximizing a mathematical expression which compares each alternative to a baseline for each of the metrics of interest. Its advantages and disadvantages are very similar to TOPSIS however TOPSIS is more likely to produce more well-rounded solutions whereas OEC rankings are more easily skewed by extreme values in a single metric. For this analysis you select TOPSIS is selected from the **Ranking Method**

Once you have selected the MADM technique you can move on to input the stakeholders preferences into the dashboard. You begin to do this by setting tier 1 metrics to the appropriate values in the **Evaluation Criteria Weightings** section. For mobility and payload you select a value of 30; survivability, transportability, complexity to a value of 20; and manufacturability to a value of 10. In doing so you are reflecting the stakeholders’ preference for mobility and payload and disinterest in manufacturability. Note that you may not be able to set exact values since other metric values change as you move individual metrics’ slider bars.

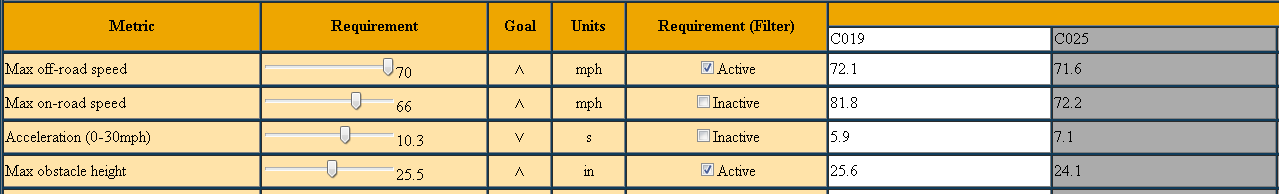
After correctly entering the tier 1 metric weightings, you move on to enter the tier 2 metric weightings in the **Tier 2 Weightings** section. Here you express the stakeholders’ preference for off-road speed and on-road speed by moving their slider bars to set their values to 20 and all other metrics under the **Tier 2 Weightings** section to 6. You then confirm that the weightings accurately reflect the stakeholders’ preferences by viewing the pie chart in the **Evaluation Criteria Weightings Breakdown** section. You leave the tier 2 weightings in Survivability, Transportability, Manufacturability, and Complexity balanced since the stakeholders expressed no specific preferences. You are satisfied with the weightings and move onto entering the requirements you found in the requirements documents.



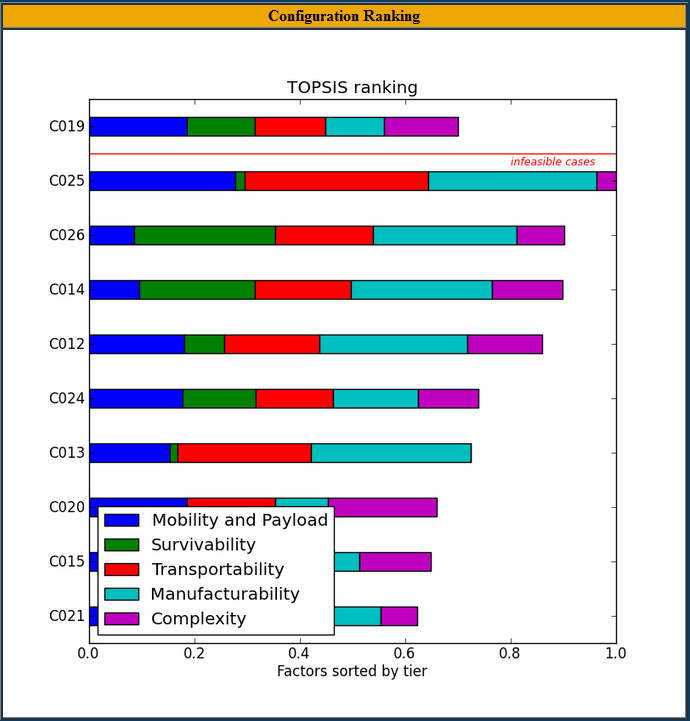
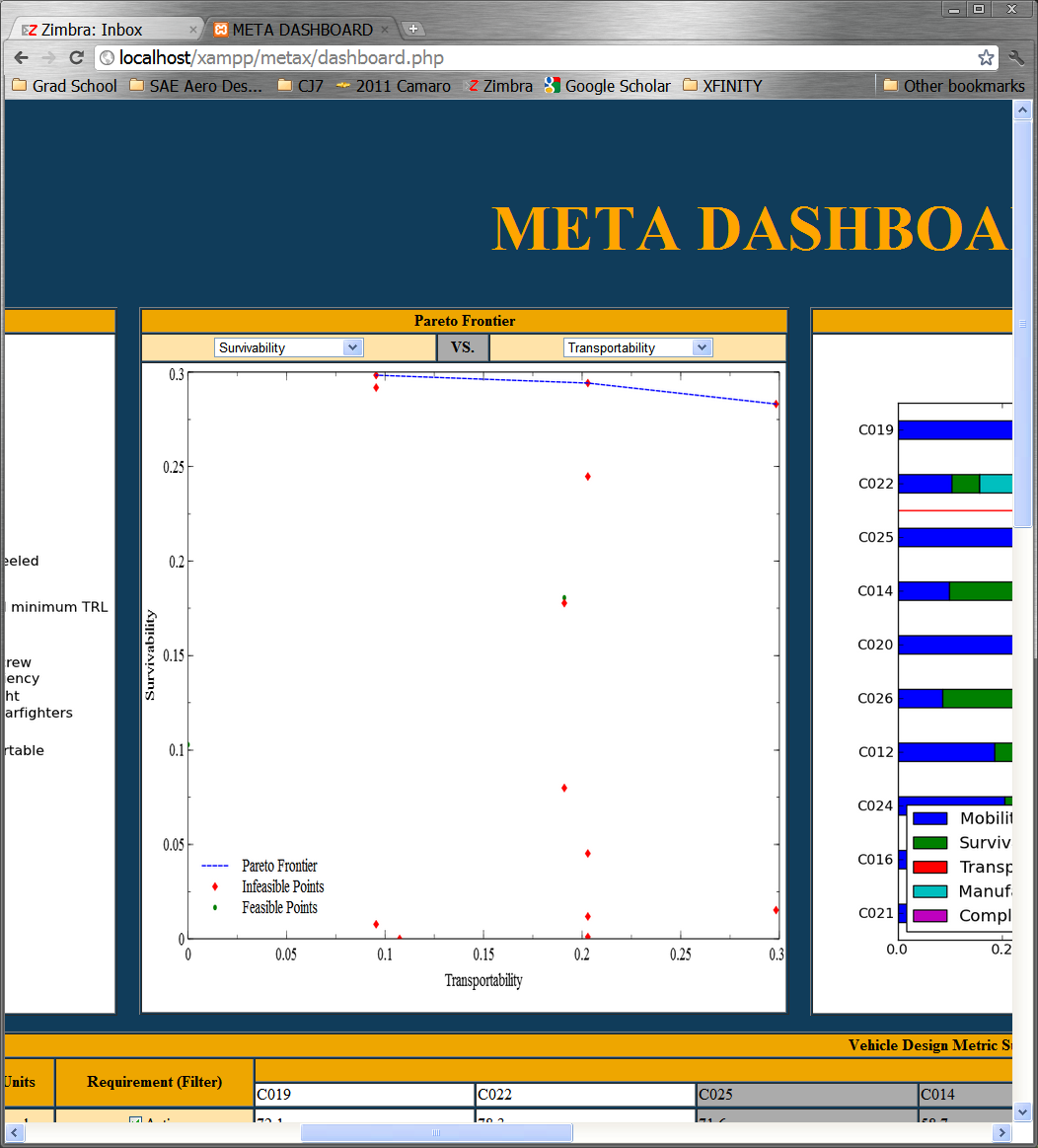
The requirements for obstacle height and max off-road speed are entered in the **Vehicle Design Metric Summary** section. To do this, you make active those requirements by checking the checkbox in their row in the “Requirement (Filter)” column. Next you enter the specific requirement values (at least 70 miles per hour max off-road speed and 28 inch obstacle clearance) by using the slider bars in the “Requirement” column.



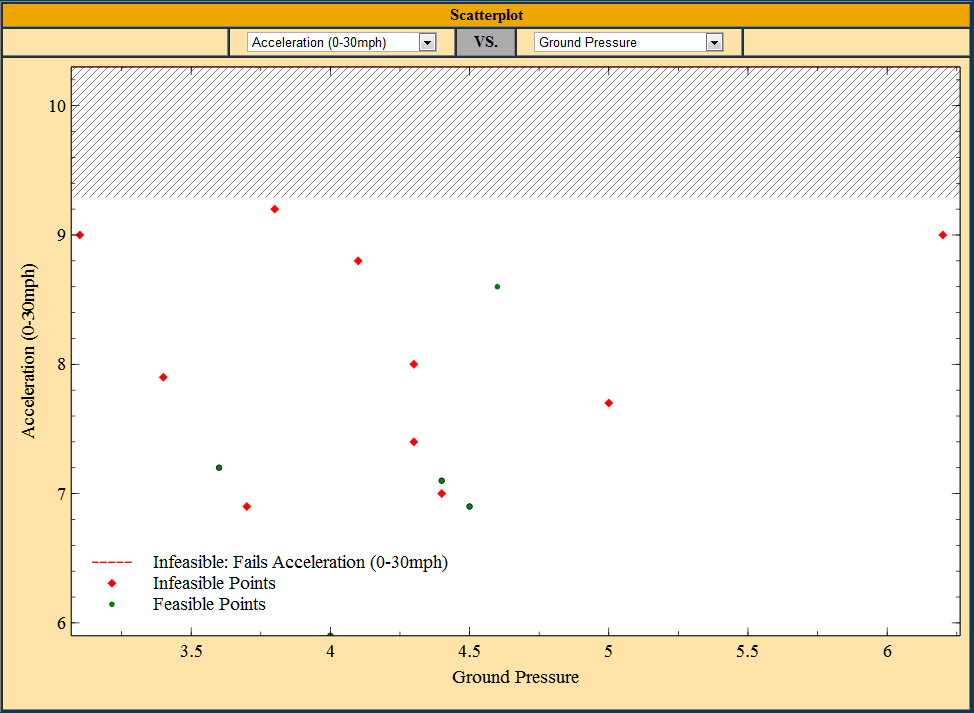
With the requirements set you notice that all of the designs are shown in grey indicating that none of them are able to meet the specified requirements. In order to choose the best design from those available, you move to the scatterplot and plot max off-road speed vs. obstacle height to investigate designs that offer the best compromise between max off-road speed and obstacle height. By relaxing the obstacle height constraint to 25.5 inches you see that the design that most closely meets both requirements is C019.



Once the requirements have been relaxed you look at the **Configuration Ranking** section to see how the designs are ranked. A red dashed line divides the feasible designs on top to the infeasible designs below. From looking at this bar chart, you can confirm that C019 is the only configuration that is shown as feasible. The bar chart also shows you how each tier 1 metric contributes to the overall score. You notice that C019 gets the second highest score in Mobility and Payload, the key metric of interest to the stakeholders.

To determine how C019 compares to other designs in the areas of Mobility and Payload and Survivability, you look at the Pareto frontier. By looking at the Pareto frontier you’re able to determine how one feasible design (in green) compares to other feasible designs as well as any designs that were rendered infeasible (in red) by your imposed requirements. In particular you are looking to make sure that C019 is not a dominated solution in these areas. A dominated solution is a solution that is not on the Pareto frontier meaning that some increase in either Survivability or Transportability is possible without reducing the other. By verifying that C019 lies on the Pareto frontier shown in blue you know that it is not a dominated solution. Alternatively, if the Pareto frontier is formed by infeasible cases you look to see that the current best configuration appears above and/or to the right of any other configurations. After doing this you wish to investigate the actual performance data in terms of Acceleration and Ground Pressure. To do this, you look at the scatterplot and set the axis to “Acceleration (0-30mph)” and “Ground Pressure”.

C019



Finally you visually inspect configuration C019 in the **Configuration** section to verify that the generated design makes sense.

