

# **HAM User Manual**

DI-FCT/UNL

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# 1. Introduction

This document gives an overview of the tool developed to implement the HAM algorithm (Pimentel, 2009). To collect the NFRs, the HAM tool works in collaboration with the EA-Miner tool, which mines NFRs from <u>textual</u> (requirements) files. HAM starts by opening the Requirements Description Language (RDL) file produced by EA-Miner. RDL files are XML-style files that contain the NFRs. The HAM Tool filters the Non-Functional Requirements (NFRs) from the produced RDL file. We can add new NFRs to the list obtained from the RDL file, or remove NFRs from that list if we consider that there are NFRs wrongly identified by the EA-Miner. The stakeholders, architecture styles and products are elicited manually.

### 2. Installing and running

The installation process for the HAM Tool is very simple. Just copy and paste the HAM Tool plugin into the Eclipse plugins folder. Notice that the HAM plugin has the follow dependencies: *org.eclipse.emf.common, org.eclipse.emf.ecore, net.ample.tracing.core, net.ample.tracing.core.query;* this is present in the AMPLE Eclipse bundle ("AMPLE Project," 2006). Start Eclipse. You need to include the RDL file of the system you are assessing in the current Eclipse project.

To run the HAM Tool just right click on the RDL file and select "HAM TOOl". A window with four tabs opens, each one presenting: "Quality Attributes" for raking NFRs according to the opinion of a set of Stakeholders, "Architectures" for ranking architectural styles with respect to the one set of NFRs, "Products" for ranking product configurations with respect to a set of NFRs and "Features" for ranking features of a software product line configuration with respect to one set of NFRs and detect possible conflict between NFRs in a feature.

### 2.1. Working with the HAM Tool

For the example in this user manual, we used the "Quality Attributes" functionality. The HAM Tool's main window is displayed in **Erro! A origem da referência não foi encontrada.** Considering the top-half of the window, we can observe, on the left-hand side, a tree-like structure with aiming at assessing the selected criteria and alternatives. In the top-middle of the window, there is the pair-wise comparison matrix. This is where the tradeoffs between the criteria will be filled. We just need to fill the right-upper side of the pair-wise matrix. The lower-left cells will be filled automatically. On the right-hand side is a matrix that displays the weights of the criteria. If the criteria weights are inconsistent, one message pop-up will warn the user. Under the pair-wise matrix we can see a combo box to Assign Value,. This component is used to assign values to the pair-wise matrix cells. In the bottom-half

of the window, we offer scale help, so that the user has a quick access to the meaning of the scale values. In the bottom-middle is the decision matrix, where the user elicits the importance/contributions of the alternatives to the criteria. To fill this matrix, we can use the combo box as before, or use the keyboard. Finally, on the bottom right-hand corner is the ratings matrix, where the ratings of the alternatives are presented. The ratings are displayed in absolute percentage.

Comentário [AMM1]: Vector?

🛎 нам										
File Import Weights Help										
Quality Attributes   Features   Architectures   Products										
Contractor reactor reactor reactor										
Stakeholders   Company   user   administrate   architect   NFRs   availability   flexibility   safety	company user administrator architect	Company 0 3 -4 -3	user -3 0 -1 -1	administrator 4 1 0 -1	architect 3 1 1 0	Weights     0.286184     0.290019     0.213309     0.210488				
8 Extreme	availability	2	user 1	administrator	2	25.07				
6 Very Hic	flexibility	4	1	-4	4	11.63				
4 High	safety	4	-4	3	4	11.95				
2 Medium	portability	5	-6	1	4	11.81				
0 Equal	extensibility	6	-8	-4	4	12.06				
-2 Medium	usability	2	6	1	3	15.59				
-4 Low -6 Very Lo -8 Extreme	interoperability	2	4	1	1					
Add/Del NFRs		Close	Sa	ve		Calculate Ratings				

Figure 1 HAM Tool main window.

To fill the pair-wise comparison matrix cells we have to:

- Select an empty cell in the pair-wise matrix;
- Use the combo box to select the value to assign to that cell.

As we said before, the lower-left side of the matrix is filled automatically. When finished filling the pair-wise matrix, press the button "Calculate Weights". You can view the criteria normalized weights (i.e., priority vector) in the weights matrix. If the consistency ratio is less than 10% the logical consistency is guaranteed, otherwise you will be prompted with an error message and you will need to adjust some values of the pair-wise comparison matrix (Triantaphyllou, 2000). If the consistency value is below 10%, you will be able to start editing the decision matrix. To fill this matrix you

can use the keyboard. If you consider that there is a value in the pair-wise matrix that, for some reason, you would like to change, you can edit the pair-wise matrix whenever you want and press the "Calculate Weights" button to recalculate.

Once you are done, press the "Calculate Ratings" button. The alternatives ratings will be calculated and displayed in the ratings matrix.

You can save the results by pressing the "Save..." button, or going to "File  $\rightarrow$  Save...", which will open a save dialog. Just select the location where you want to save the project and the name of the file. This will create a new Microsoft Excel file with the name you provided, or a new sheet in the file if it exists.

After the information in the matrices is saved, the tool also allows you to add new criteria, for example a new Stakeholder, or new alternatives, for example a new NFR, to existing analysis. For instance, to add a new criterion just click "Add/Del Stakeholders" button. A new window (Figure 2) opens and you can enter the name of the Stakeholder you want to add. This allows you to perform a what-if analysis. For example, it enables you to see what happens if a new Stakeholder comes into play, or if a new NFR is added.

🕌 HAM Tool - Select Stakeholders			
File			
Enter the stakeholder role:: Example: User; Administrator; etc.	Add Stakeholder		
Selected Stakeholders:			
Stakeholders	Clear		
company			
user			
administrator			
architect			
	ОК		

#### Figure 2 Select Stakeholders.

You can also use the ranking of NFRs calculated in Quality Attributes in Architectures, Products and Features, where the ratings of the NFRs in the first assessment will be their weights when ranking. To perform this click in "Import" and select the correct option, for example "Import  $\rightarrow$  Import RE Ranking to Architectures".

# 2.2. Tool Specifications

The tool was developed in Java 1.6 using Eclipse IDE 3.4.1 to actually implement the HAM algorithm, and NetBeans IDE 6.5 to develop the Graphical User Interface. To use this plugin the only thing to have in consideration is the dependencies mentioned above.

# 3. References

AMPLE Project. (2006). Retrieved 2009/09/28, 2009, <u>http://www.ample-project.net</u>.

Afonso Pimentel. (2009). *Multi-criteria Analysis for Architectural Choices in Software Product Lines.* Universidade Nova de Lisboa, Lisbon.

Evangelos Triantaphyllou. (2000). *Multi-Criteria Decision Making Methods: A Comparative Study.* Kluwer Academic Publishers.

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Formatada: Português (Portugal)