Using Saaty's method in contract negotiations*

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This note (motivated by the STSM at the Imperial College London), is devoted to combining ontologically demarcated information with the Analytical Hierarchy Process (AHP; [4]) for assessment of offers during contract negotiations. The AHP is widely used [1], while an attempt at combining it with ontologies was reported in [3]. Here, the context for the AHP method is provided by the *Agents in Grid* project (AiG; [5]), aiming at development of an agent-based infrastructure for resource management in the Grid where agents negotiate (1) joining a team to earn money, or (2) finding a team to execute a job, and ontologically described contracts result from autonomous negotiations. Therefore, multicriterial (AHP-based) assessment of proposals may be used to reach an agreement. Here, we consider how the AHP method can be used to assess ontologically described contract proposals in the *AiG* use case.

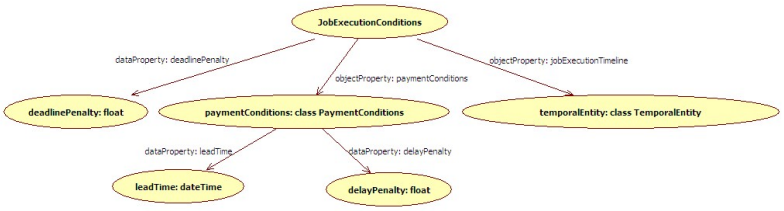

Fig. 1: Part of the contract structure from *AiG* ontology

In the *AiG* ontology [2] a set of classes and properties describe a contract. Since an ontology can be represented on a acyclic directed graph, one can determine the structure of the decision hierarchy with the top node being "main goal" (see, Figure 1). For the user (expert) with preferences regarding the contract, we construct pairwise comparison matrices for each level in the hierarchy, where the elements in the lower level are compared with respect to the element immediately above them, e.g. lead time and the delay penalty are compared with respect to the payment conditions. For comparisons we follow Saaty and assign numerical values to expressions like: equally important etc. For the structure from Figure 1, an expert has to consider matrices in the following tables.

In the AHP algorithm, weights of criteria are coefficients of normalized eigenvector corresponding to the maximal eigenvalue. Thus weight of the lead time

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	deadline Penalty	payment Conditions	jobExecution Timeline
deadline Penalty	1	$\frac{1}{3}$	3
payment Conditions	3	1	5
jobExecution Timeline	$\frac{1}{3}$	$\frac{1}{5}$	1

	leadTime	delay Penalty
leadTime	1	3
delay Penalty	$\frac{1}{3}$	1

is 0.75, delay penalty is 0.25, deadline penalty 0.2, payment conditions 0.68 and job execution timeline 0.12. Next, for every alternative, an evaluation matrix is created, estimating badness of an alternative for the user (expert) for a given criteria; found in the next two tables.

Criteria	Badness for expert 1
deadlinePenalty	1
leadTime	3
delayPenalty	5
jobExecutionTimeline	1

Criteria	Badness for expert 1
deadlinePenalty	3
leadTime	-1
delayPenalty	5
jobExecutionTimeline	3

Results for alternatives 1-2 are 2.7 and 1.3 and alternative 1 is the winner. We have demonstrated, how to utilize the *AHP* method to compare ontologically described offers. A full graph of the ontological contract, would result in Saaty's hierarchy with more levels, and more elements on each level. Moreover, the method should be able to deal with arbitrary large structures, and knowledge of multiple experts captured as comparison matrices.

References

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