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BUILDING AND USING AN APPROPRIATE ANALYTICAL HIERARCHY FOR A MILITARY ASSESSMENT PROBLEM

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Against the background of a military technology assessment problem, this presentation will address the problem of defining an appropriate hierarchy while trading off feasibility regarding available time and required effort with the quality of modelling and meaningfulness of weighting and scoring. While the details of the military issues of the problem will not get much attention in this presentation for reasons of confidentiality, they are illustrative of prioritization problems where clients feel that many aspects are relevant and must be taken into account in one way or another.

The basic question was where to spend money for technology development effectively so as to improve the execution of certain types of future military operation. In preparatory steps a wealth of technologies and military capabilities were defined, and future systems were conceived that could make use of those technologies in different scenario contexts. During a four-day meeting military experts and OR analysts discussed the matter and arrived at tentative conclusions based on those discussions and a few ranking exercises. One of the conclusions was, however, that a more thoroughly analytical approach based on multi-criteria analysis might be worth-while to try as a "second-opinion analysis". However, this had to be carried out at short notice and by only part of the experts and analysts initially involved. Less than one day (5-6 hours) would be available for agreeing on the evaluation model, the weighting, the scoring and the (sensitivity) analysis.

The presentation will illustrate the steps of building the final analytical hierarchy. It will be shown that in order to capture the issues at stake both comprehensively and meaningfully, the hierarchy turned out to be complex and (very) large. The initial aim was to assess and prioritize 142 technology items (in 3 groups) with respect to their impact on the execution of future military operations in 3 different scenario contexts. The operations were characterized by defining 35 military capabilities which had to be related to the technology items. And, finally, 12 future battlefield systems making use of the technologies had to be thrown in as well. The time constraint imposed, however, forced us to make decisions on how to reorganize the hierarchy so as to be able to better cope with it. In doing so, not only the structure and size of the hierarchy itself changed, but also the meaning of weights and scores changed in some respects. This will be clarified while discussing what was lost and what was gained when comparing the final analytical hierarchy with the previous ones which were not adopted.

The actual expert session-based weighting and scoring process will be addressed as well, in particular a problem of structural weight bias that was encountered owing to the unbalanced nature of the hierarchy. In a paper (1998) Barzilai addressed this type of bias in the broader context of hierarchy decomposition, but it had already been observed by this presentation's author (1996) in the context of Expert Choice's incorrect structural weight adjustment. This adjustment, already proposed in Saaty's original book on the AHP (1980), is meant to overcome that bias and will produce correct linear value functions at the lowest criterion level of a hierarchy, if applied correctly. Barzilai did not notice this in his paper.

References

Barzilai, J. (1998), "On the decomposition of value functions", *Operations Research Letters*, 22, 159-170

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