Chapter 4 – WHAT HUMAN FACTORS DOES THE OPERATION INVOLVE?

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4.1 INTRODUCTION

Pew and Mavor (1998) pointed out that Human Behaviour Representation (HBR) is a very challenging endeavour. We are trying to understand humans in complex contexts to the extent that we can write formal rules that describe human thinking, their behaviours, and the resulting performance.

A model, by definition, conceptual or computational, is a simplification of reality. Thus, a lot of abstractions and tradeoffs concerning level of representation have to be made in any modelling project. It is likely the case that HBR entails more abstractions and approximations than a model of a technical system, as human activity is so complex, and much has to be inferred about how the human "works".

As the choice of factors to include frames any modelling project, the organizing panel thought it would be fruitful to discuss whether or not the choice of which human factors to include in a specific model should be left up to the good judgement of the modeller. Further, would it be beneficial if we could gather some recommendations on how to move this modelling issue from art to more of a formal method. Thus, the topic for discussion was whether there are any formal approaches to decide what human factors to include in specific HBR projects.

One answer to the question of what human factors does an operation involve, and thus factors to include in a model, is that "it depends". The intention of the topical discussion was not to identify a long list of human factors that might affect an operation, but rather to see if good advice on how to formally approach the question of what human factors to include and scenarios to use could be gathered from the present HBR experts.

Related questions also raised at the introduction were:

- How do you link customer higher level questions to requirements for which human factors to include in the model? (e.g., How can the sustainability of a force be increased?)
- How to choose the appropriate fidelity level for representation?
- How to do trade-offs between level of detail and budget?

4.2 DISCUSSION

During the discussion, several modellers acknowledged that transforming the customer's higher level questions to design decisions of which human factors to include in a model was a challenging problem. To move this process from an art to more of a formal process, discipline by both analysts and customers will need to be high. Customers should clearly define what they want and not move their objectives as the study proceeds. Modellers should be very clear on why they include or exclude a certain human factor. A badly defined study will likely result in invalid, or worse misleading, results and customers should be educated about the need for and cost of validation. Validity is a big concern in all modelling projects. According to some modellers present, 60 – 70% of the study cost may be spent on data collection used to create and validate a model. Specialists may not agree with the customer on what he may get and the customer should take responsibility for the basic research that needs to be done in order to develop valid models in the direction they need. Data sets independent from the data that were used to shape the model are needed for evaluation of predictive validity.

The use of a human factors checklist and rationale for inclusion versus exclusion of each human factor in a modelling project was proposed. This checklist could take the form of a guided interview that could also be a basis for classification of models. Such a guided interview could form the basis for discussion with the customers on what to include and what to leave out.

The question was raised whether the granularity in model studies is sufficient to test hypotheses. One suggestion was to analyze the relationship in the literature between human factors and state variables to deduce specific hypotheses, rather than doing statistical analyses. Statistics do not reveal causes, just co-occurrence.

When a model permits the manipulation of many variables, it is good practice to initially manipulate only one at a time to gain understanding of how this factor affects the model. Even though this might be part of basic good practice for any scientific study, at least one anecdote from the discussion suggests that some end users of modelling software (rather than modelling specialists) manipulate many or all variables at once, stressing the models beyond their original design scope and causing them to fail in unexpected ways during execution. Development and use of models still requires in-depth knowledge of the application domain, the model, the modelling environment, the simulation settings, and the objectives of the study to have a reasonable expectation that the results obtained are meaningful.

The decision of which human factors to include in a model should be taken in light of where the model will be used (e.g., an acquisition project). If the factor, due to what stage the project is in or other reasons, cannot be affected, the rationale for inclusion of this factor decreases, i.e., the "So what?" question. For example, if recruitment to the army will never be based on personality type, the inclusion of this factor in a model of personnel selection and placement procedures might be less important than some other factor that can be affected.

The short-term versus the long-term requirements of a model can provide input to which human factors to include as well as the appropriate level of representation and abstraction. A simple model can be cheaper initially, but can become more expensive in the end if it has to be remodelled rather than simply elaborated in the future projects. We must also realize that we are a long way from turnkey applications of HBR and that there is no cookbook for abstraction; abstraction and modelling is an art and a skill guided by knowledge.

4.3 SESSION RECOMMENDATIONS

1) The use of a NATO developed checklist of existing human factors and presentation of why each factors was included or excluded in a specific model should be part of good practice.

2) It is still necessary to emphasize the need for "hooks" in the simulation of the physical environment where the behaviour models can get information form. It is also necessary to link HBRs to a context so that the effects of model behaviour are seen more clearly.

3) NATO should develop an ongoing capability to collect and disseminate data to support modelling of non-kinetic warfare, asymmetric situations and the long terms problems faced by commanders on a strategic level, as addressed in Bob Foster's keynote presentation. Much of this data will involve human factors from a number of domains.

4.4 PRESENTATION

In order to provide one example of a modelling project where the discussion topic could be exemplified Andy Belyavin presented an overview of a project concerning the prediction of aircraft collisions in the UK Low Flight System. The example showed that considerable insight into problems can be achieved by including relatively few human factors, but that these factors have to be chosen judiciously to be successful.

Also discussed was the need for a modular modelling environment that allows the analyst to expand the model as additional questions are asked that were not part of the original project problem scope or design specification.