Assessing the parts that combat modelling or trials cannot reach

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A paper for the 23rd International Symposium on Military Operational Research

INTRODUCTION

Traditionally, in comparing the effectiveness of options available to meet a capability gap, measures of effectiveness have been in terms of successful achievement of a mission together with more specific measures such as reduced casualties for own forces, increased tempo, reduced consumables used etc. However the provision of effective and reliable equipment to soldiers on the battlefield is also to do with risk reduction ie. reducing the risk exposure of own soldiers on the battlefield to a level commensurate with them having an adequate probability of achieving mission success. The work described in this paper is an attempt to use the language and metrics of risk assessment as a means of quantifying military benefit of different options, where benefit is difficult to quantify with more traditional means of effectiveness assessment such as combat modelling, simulation or trials.

Aim

The aim of this paper is to describe the development and potential utility of the risk OA tool developed during the FIST (Future Integrated Soldier Technology) Assessment Phase (AP) programme to address military benefits of FIST solutions that were likely to be missed by the existing FIST assessment toolset (trials, modelling, simulation, and judgement panels).

Background to FIST.

FIST is to provide light role (non mechanised) infantry, Royal Marines, and RAF Regt, a total of some 29000 soldiers with a totally integrated fighting system for dismounted close combat (DCC). Areas for improvement on the current infantry soldier equipment dismounted are seen as:

- C4I – communications, situational awareness (both enemy and own forces), planning, orders
- Lethality – weapons, sighting systems, target acquisition, hand-off of targets (with C4I)
- Mobility – weight, navigation
- Survivability – protection, stealth
- Sustainability – logistics, power sources
- Integration of all of above

Acknowledgement and caveat

The work described here was undertaken by HVR Consulting Services Ltd, sub contracted by Thales as part of the FIST AP programme, for which Thales was prime contractor. Thales in turn was contracted by DCC IPT to conduct the FIST AP on their behalf. Both Thales and DCC IPT have approved the presentation of this paper, which contains no results used in the selection of the prefered FIST system. Indeed the risk OA tool (named RASP – Risk Assessment of Soldier Performance) was developed as indicated below in response to concerns raised later in the programme, and thus was still at a prototype stage when the programme completed in Jul 2006. The results of a test usage with an ex military member of the Thales team were presented to the DCC IPT, Dstl and DG(S&A) but no formal approval for use on the

FIST programme had been given by them. The opinions expressed in this paper are therefore those of the author and should not be taken as endorsed by either Thales or the DCC IPT.

NEED FOR AN ALTERNATIVE METHOD TO ASSESS EFFECTIVENESS OF FIST OPTIONS

There has long been a concern within the FIST community that a number of military benefits offered by FIST to do "better things" as well as doing "things better" may be missed in the current OA tool set of CAEn (a simulation representing effectiveness in close combat) , ABEL (a technology seminar wargame dealing with a full (48 hour) battlefield mission (BFM) and field trials. When FIST went through Initial Gate some five years ago, improvements to the current system were seen primarily as in the areas of weapons and surveillance systems eg. grenade launchers and TI. However since then, due in part to purchase of Urgent Operational Requirements (UORs) for eg. operations in Iraq and Afghanistan, the emphasis for FIST has increasingly focussed on enhancements in the area of C4I. There are opportunities offered by FIST (primarily through C4I) to significantly reduce probabilities of not getting lost and BLUE on BLUE, to increase tempo, improve quality of planning and orders, speed up casualty location, improve situational awareness etc which planned assessments may miss.

Limitations of current toolset.

- **CAEn.** CAEn models short vignettes of DCC combat, typically of 30 – 60 minutes. It does not address the non combat parts of the BFM – planning, orders, recce, moves to start line, reorganisation. It gives mission success in the vignette, casualties, time taken (although there is some disparity between game time and real time) and ammunition used. There is a limited representation of C4I in combat, for example automatic position locating and target handoff.
- **ABEL**. ABEL addresses the non combat activities of the BFM and judgementally derives combat readiness for the start of succeeding vignettes (combat or non combat) and timings. It combines these with output from CAEn vignettes to aggregate mission success, time gained or saved, casualties, consumables used including ammunition, and readiness at the end of the BFM, for the duration of the BFM.
- **Trials.** Company level field trials to compare effectiveness of a representative FIST system with a baseline of the current system took place on SPTA in Oct 2005. Collection of data on such nebulous areas as situational awareness and the benefits of C4I (of not getting lost, potential BLUE on BLUE avoided, time saved in planning etc) was always going to be difficult: due to difficulties experienced with fielding an integrated FIST system, collection of sufficient useful comparative data on the FIST system was not possible to quantify the military benefit afforded.

Operational benefits that may be missed or quantified insufficiently

The following lists the operational benefits of FIST that may have been missed in CAEn, ABEL and trials, or quantified insufficiently:

- Command agility eg.(1) recce patrol whilst deployed is diverted to a new assembly area or, (2) BLUE if attacked can regroup more quickly
- Data transfer eg. recce patrol with FIST has capability to transfer data direct from the CTR site, thus speeding up the process and reducing the risk of loss of data if the recce patrol fail to return to the assembly area
- Complex operations such as passage of lines and relief in place can be made easier by C4I, particularly through availability of positional data and data transfer between the units involved
- Movement from place to place is more guaranteed due to navigational systems and the use of GPS – there is less risk of getting lost and less risk of BLUE on BLUE incidents
- Ability to move straight from assembly area to a SL, without gathering first in a FUP – there is a reduced risk of BLUE on BLUE, and enhanced survivability if BLUE do away with a vulnerable FUP
- Ability to bypass, covering RED with indirect fire and reducing the risk of BLUE casualties
- Improved quality of planning and orders is afforded by C4I, particularly by data transfer – it can speed up the process and potentially increases accuracy and clarity of orders given
- Location of casualties is made easier by positional data, and the use of a casualty-down button which identifies casualty and his location when activated
- Benefits in reorganisation and resupply – ie. by use of data transfer for routine logistic traffic

RISK OA TOOL – THE REQUIREMENT

The requirement is for a way to:

- Identify the risks to the baseline system in each of the activities of the BFM and, for each, quantification of probability of occurrence
- Explore the impact of unmitigated risks on battle outcome, in terms of the principal MOE – casualties, time taken, consumables used, readiness
- Examine the opportunity offered by FIST to do “things” better or differently to reduce either the probability of occurrence or the impact of each risk.

METHOD

Approach.

A military judgement panel (MJP) is convened. Each activity of the HQ Infantry BFM for FIST is briefed to the MJP by the facilitator (there are some 22 activities of which 7 are combat vignettes modelled in CAEn). For each activity, the MJP is asked to define risks to the baseline (the current soldier system), prompted as appropriate by the facilitator armed with risks previously identified. For each risk, they are asked to agree probability of occurrence and impact if the event occurs in terms of one or more of the principal FIST MOE – casualties, time taken, consumables used, readiness at the end of the activity. Finally for each risk they judge probability of occurrence and impacts for the FIST system. In addition to noting probabilities and impacts for scoring purposes (see below), key points relating to strengths and weaknesses of both systems are captured and the opportunities offered by FIST to do things differently and/or better noted.

Scoring Metrics

The scoring metrics are as follows:

- **Probability of occurrence**: V High ≥ 25% to V Low ≤ 5%.
- **BLUE Casualties**: V High ≥ 30% of force (section, company etc) to V Low ≤ 5%.
- **Time taken**: V High ≥ 50% more than BFM schedule allows eg. 2 hours in 4 to V Low ≥ 5% eg approx 15 mins in 4 hours
- **Consumables used**: V High ≥ 35% of total no of 5.56 ammo and grenades to V Low ≤ 5%.
- **Readiness**: V High = Down 2 levels in two of Situational awareness (SA), morale, decision making, physical and mental fatigue, availability to V Low = Some degradation in 1 or more of SA etc.
  Note – As part of the ABEL scoring system, definitions have been devised for 7 levels of each of the elements of readiness ie. SA, morale, decision making, physical and mental fatigue, availability

Combining probability of occurrence with impact if risk occurs to determine risk severity.

The scores are combined by the risk OA tool software as follows:

- Both the Probability (P) of a Risk occurring and the impact (I) will be in a pre-determined 6 point scale:
  - Nil
  - Very Low
  - Low
  - Moderate
  - High
  - Very High
- The risk impact will be the highest risk across all four categories
- Severity of Risk (S) will be determined by a function combining Probability and Impact. The mappings from probability and impact to severity are combinations of P and I, of the form:

  S = Nil {(P = Nil, I = Nil)}
  S = Very Low {(P = Low, I = Very Low), (P = Very Low, I = Very Low), (P = Very Low, I = Low)}
  to
  S = Very High {(P = High, I = Very High), (P = Very High, I = Very High), (P = Very High, I = High)}

The way in which these severities are determined from the probabilities and impacts can be seen more clearly in the coloured table below:

Probability	Very High	Nil	Low	Moderate	High	Very High	Very High
	High	Nil	Low	Moderate	High	Very High	Very High
	Moderate	Nil	Very Low	Low	Moderate	High	Very High
	Low	Nil	Very Low	Very Low	Low	Moderate	High
	Very Low	Nil	Very Low	Very Low	Low	Moderate	High
	NIL	Nil	Nil	Nil	Nil	Nil	Nil
		NIL	Very Low	Low	Moderate	High	Very High
		Impact					

Output.

The output from the risk OA tool will thus be a table of risks for each option considered, distributed as indicated above according to severity.

EXAMPLE

The following results are taken from a dummy MJP held with an ex military member of the Thales FIST team to test the prototype risk OA tool.

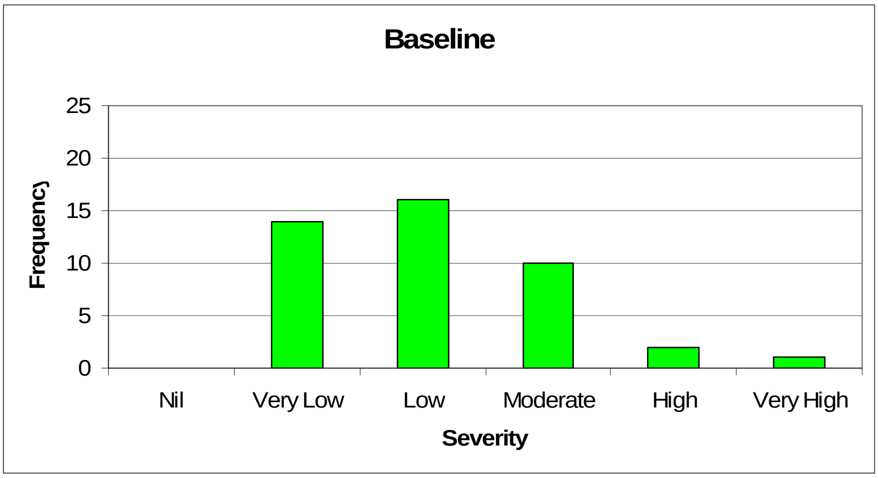
Probability	Very High						
	High				X X	X	
	Moderate			X X X X X X X O	X X X X X X X X		
	Low		X X X O	X X X X X X X X X OOOOOO	X X X X X X X OOOO	X O	
	Very Low		X OOOOO OO	X OOOOOO OOO	X X OOOOOO OOOOO	X	
	NIL		OO		O		
		NIL	Very Low	Low	Moderate	High	Very High
		Impact					

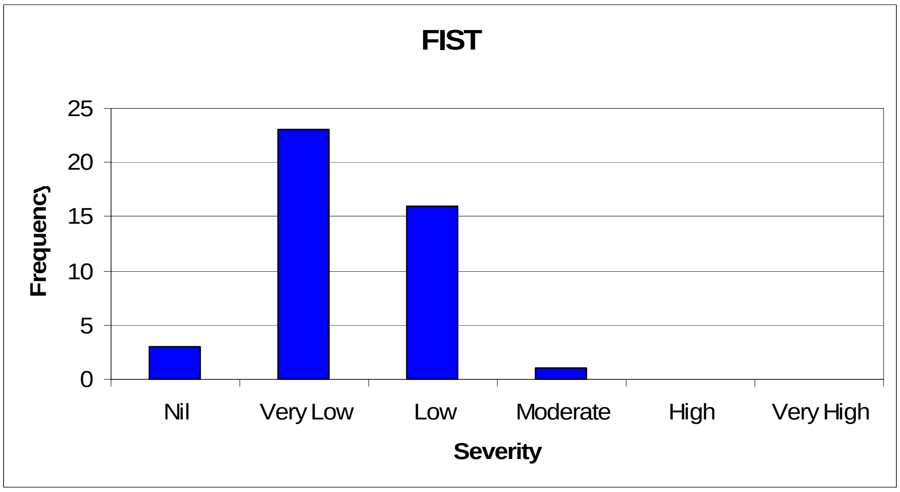
Some 43 risks were identified across the 48 hour BFM. Those relating to the baseline are shown as crosses (X) whilst those relating to the FIST system are shown as zeros (O). As can be seen, whilst the number of risks is the same, the severity of them is reduced significantly with the FIST system. Of these, the most severe risk to the baseline, scoring high for probability and impact, is to do with lack of positional information about own forces with the Bowman comms/GPS system for commanders. This probability of occurrence is significantly reduced (down to low) in the FIST system (FIST comms/INS/GPS for all) although the impact remains high.

The following table shows the risk types, the number of times they occur in the battlefield mission, and the risk reduction (reduction in severity) achieved, if any, by the FIST system. Only in one case – inability to fit through restricted areas – does the risk increase with the FIST system [ie. climbing through eg. windows, in urban situation more difficult with integrated FIST kit than baseline]

Risk Type	**Total Frequency**	**Severity Reduction**				
		-1	**0**	**1**	**2**	**3**
Being attacked	8	0	4	3	1	0
Poor defensive position	2	0	1	1	0	0
Delay in ammo re-supply	3	0	3	0	0	0
Delay in CASEVAC	3	0	1	2	0	0
Delay for other reasons	5	0	1	2	2	0
Fratricide	5	0	4	1	0	0
Failure to identify approaching enemy	2	0	0	1	0	1
Getting lost	4	0	0	2	2	0
Insufficient planning time	3	0	0	3	0	0
Poor reconnaissance	4	0	2	2	0	0
Insufficient manpower	1	0	1	0	0	0
Total exhaustion	1	0	1	0	0	0
Inability to fit through restricted areas	1	1	0	0	0	0
Comms/GPS fail to give own forces location	1	0	0	0	1	0
Totals	**43**	**1**	**18**	**17**	**6**	**1**

The following two histograms make the comparison easier to see. Whilst the number of risks remains the same for both baseline and FIST, severities centre on low for the baseline, reducing to a predominance of very low for the FIST system, with all high and very high severities eliminated.





CONCLUSIONS

For FIST, the use of the risk OA tool has demonstrated that:

- There is reduction in risk exposure in areas such as getting lost and being attacked plus
- There is benefit to be had in doing things differently eg. C4I used in planning, data transfer of recce data etc,

The risk OA tool remains a judgemental exercise, and as such is of limited value in quantifying effectiveness for use in, for example, the FIST COEIA at Initial Gate. However it may be useful in situations such as occurred in the FIST BFM which are difficult to model, simulate or trial, if only to highlight potential benefits for closer examination and/or to complement assessment by more detailed modelling or trials.

A STEP TO FAR?

An extension to the risk OA tool development to date could be :

- A combination of the qualitative approach (risk OA tool described) with the existing ABEL model. This would allow a statistically robust assessment of the impact of operational risks in a simulation (already named ABORT – ABEL Operational Risk Tool).

- The risk assessment would be changed to capture quantitative three point estimates for the impacts of each risk (time, casualties, readiness).

- ABEL Spreadsheet model could be adapted to allow incorporation of these three point estimates and @Risk functions to provide a mechanism for simulating all potential outcomes of each risk, and aggregating them for the BFM.

- The simulation would then provide S-Curves for baseline and the FIST system of time taken to complete mission, readiness and blue casualties for the total BFM.

- The S –Curves would be interpreted in the same way as in time and cost risk analysis to determine risk exposure ie 10%, 50% and 90% values for each of the MOE

This development would represent a challenge. Even if it proved possible, there is concern as to whether there is sufficient data to support it. For the moment it remains on the drawing board!