

## **PLANNING AIDS FOR THE MILITARY COMMANDER: FORCE PROTECTION SIMULATION OPPORTUNITIES WITH GIS**

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### **ABSTRACT**

This paper describes the development of computer simulation models by the Operational Analysis Element of the Air Warfare Centre to support Force Protection planning within the Royal Air Force. The paper illustrates both the application of rapid system development methodology to meet a military requirement, and provides a case study into how a model can develop using the Environmental Systems Research Institute (ESRI) Inc ArcView modelling suite to meet a user requirement.

### **1 INTRODUCTION**

The Operational Analysis Element (OAE) of the Air Warfare Centre provides the scientific support to front line units of the Royal Air Force, and consequently is required to develop, maintain and use simulation models and tools. Depending on the nature of the task, the models and tools can vary in size and complexity from detailed wargames requiring several days, if not weeks, to prepare and execute, down to simple spreadsheet models which can be prepared and utilised in minutes.

Many of the problems faced by military planners require responses and actions within very tight timescales. Consequently, if simulations are to contribute to the decision making process, the models will usually need to have been developed, tested and configured to meet the requirements of the task well in advance. In practice, there will be occasions when the analyst does not have the necessary simulation tools immediately available to undertake the task, and will need a framework to produce ad-hoc models to meet the user requirement.

### **2 FORCE PROTECTION**

*‘Every airfield should be a stronghold of fighting air-groundmen, and not the abode of uniformed civilians in the prime of life protected by detachments of soldiers. It must be clearly understood by all ranks that they are expected to fight and die in the defence of their airfields’.*  
Winston S Churchill.

Conflict remains commonplace in the modern world with little clear distinction between war and peace. Many nations not directly engaged in conflict are involved in efforts to monitor, manage and resolve actual or potential conflicts. Modern conflict is likely to be fought in the spotlight of the news media, and the speed of media transmission can magnify the importance of relatively minor incidents and influence public opinion before political or military authorities can fully analyse the facts. Traditional Force Protection has centred on the ‘preventing an enemy from attacking successfully or minimising the effects of a successful attack on vital air assets, to enable the continuing and effective prosecution or resumption of air operations with the minimum of degradation or delay’ (British Air Power Doctrine). Within the new spectrum of conflict, the fundamental requirement to protect deployed forces has, therefore, developed from the physical protection of aircraft and airfields to encompass protection of people and information.

In recent years Military Forces have become increasingly involved in Peace Support operation (PSO). PSO was a term first used by the Military to cover peacekeeping and peace enforcement operations, but has recent become associated with other peace related operations such as conflict prevention, peace making, peace building and humanitarian operations. PSO have increasingly been initiated in response to complex intra-

state conflicts, such as in Bosnia, Kosovo and Rwanda, often involving human rights violations. PSO invariably involve multiple agencies from a number of nations and include both the military and civilian sectors. The requirement for Force Protection is equally important in support of PSO activities as it is in support of more traditional warfighting. Whilst Force Protection will ideally be the responsibility of the host-nation, the practicality of limited host-nation resources and the local operational environment may make organic Force Protection a necessity.

## 2.1 Force Protection Planning

At the start of any Operation the Mission Commander will conduct his own Mission Analysis of the authorised mandate and produce a mission plan covering all aspects of the mission including Force Protection.

Within the Mission Analysis, Force Protection Planning will consider the whole spectrum of threats to Air Force security, covering:

- a. Civil Action - such as the effect of refugees or of civilian population disturbances.
- b. Military Action - such as ground force attack, air attack or terrorism.
- c. Environmental - such as the effect of disease or fire.

The Force Protection Process will consider:

- a. Assessment of the threats
- b. Management of the risk
- c. Prioritisation of actions
- d. Monitor situation and maintain flexibility

## 3 PLANNING MODELS AND TOOLS

Many models and simulations exist to aid Force Protection planners. Most require to a greater or lesser extent to address the issue of ‘who can see whom and from where?’ These models invariably require a significant amount of computation and consequently have tended to be hosted on specialist computers and have significant run times. The OAE’s own experience of terrain screening software dates back to the late 1980’s when a software suite was developed for SUN Workstations to enable visual and radar detection ranges from aircraft to be graphically displayed. Although maintained and enhanced for over a decade, the tool remained difficult and time consuming to use. Consequently it was difficult to provide ad-hoc responsive support to the military planning process.

The recent increases in computational power for laptop computers and the availability of sophisticated GIS

software packages have provided the opportunity for analysts to take simulation tools to the military planners and provide direct analysis support to the planning process. The OAE have subsequently developed a number of tools based on the ESRI Corporation’s ARC GIS products. Initially, tools were designed to replicate existing functionality such as terrain screening (Figure 1), but are currently being extended to include a range of other activities.

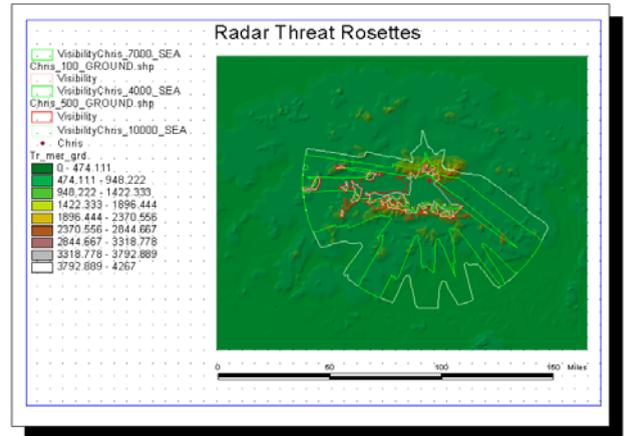


Figure 1: Radar Terrain Screening Rosettes

An example of the tools being developed is the Airfield Risk Calculator (ARC) which can be utilised to address a number of initial Force Protection planning considerations. The ARC is a simple tool which is run in ArcView that produces on screen graphics to show the potential threat area of an area depending on the user defined threat. To utilise ARC, the user is required to load a graphical image containing an active area of interest defined by the ArcView Theme Properties. The ARC tool can be activated via an icon button that produces a screen dialog box illustrated in Figure 2.

The user can select up to three different threats from the drop down list. The drop-down list can be defined by the user to include threats such as small arms, mortars and surface to air missiles. Once an active area (such as an airfield) has been selected and the Calculate Risk button selected, a graphic will be drawn onto the screen (Figure 3) which represent the threat areas that the user has selected (i.e. the above example will put 3 contour rings around the chosen area at distances of 600, 800 and 1000 meters from the area perimeter). Each contour is depicted in a different colour and with a different hatch style.

The graphical display is derived by constructing a buffer zone around the user selected active area. Since the buffer zone is constructed as a polygon, the boundary perimeter distance for each buffer zone can be calculated. Similarly, the area contained within the boundary zone can

also be derived. The user can display on the buffer area or perimeter values by choosing the 'Auto-label' option from within the ArcView Theme menu, and selecting the Area or Perimeter field from a drop down list. The chosen field will then be shown as a text box within the graphical display (Figure 4).

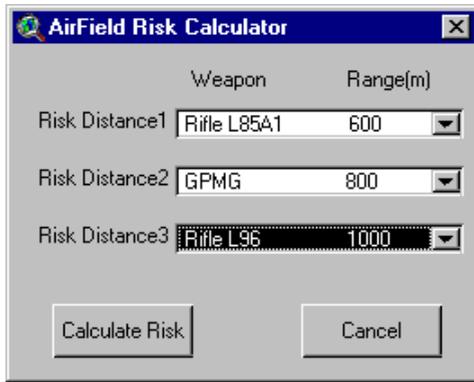


Figure 2: Airfield Risk Calculator Icon

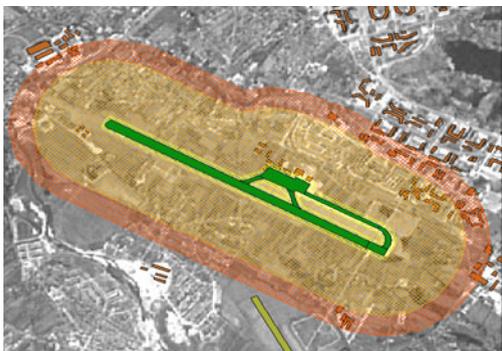


Figure 3: Calculate Risk Graphical Display

The tool has several attributes which make it very flexible for the Force Protection planner;

- a. The active area can be redefined on-line, to enable a range of scenarios to be quickly explored.
- b. Since the methodology is independent of the graphical image being overlaid, the buffer zones can be plotted over any mapping or photographic image.

The ability to overlay risk contours on detailed mapping, needs to be used with a certain degree of caution. Since the line-of-sight calculations utilise generalised terrain data, this will not generally include factors such as urban structures or foliage which could significantly affect actual inter-visibility within the buffer-zone.

#### 4 FUTURE DEVELOPMENTS

While the use of GIS tools is never likely to be able to replace the information that could be obtained from undertaking a detailed site survey using experienced military personnel, there is a definite role for such tools in supporting the initial decision making process.

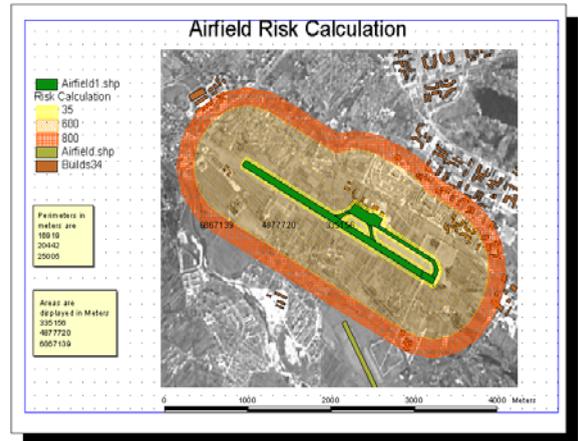


Figure 4: Graphical Display with Text Box

The tools so far developed have centred on Force Protection issues associated with physical boundary protection, but there are clearly applications associated with reconnaissance patrols either by personnel or by Uninhabited Aerial Vehicles (UAVs) which could equally be addressed in a similar manner.

Information from these models have the potential to be utilised with other combat modelling tools to address potential combat outcomes associated with any proposed force deployments. It is easy to envisage how the ARC tool could be used in conjunction with a 'search' module to address issues relating to patrol requirements, and consequently could be used to support decisions on Force Protection manning requirements.

By undertaking the model development the analysts have identified additional data items which may need to be considered by future site-survey teams to aid in the validation of the tools.

#### 5 SUMMARY

The OAE philosophy for supporting front line operations, is that 80% of the solution in 20% of the time will often best meet the customer requirement. Consequently it is valuable to have a range of quick and easy to use tools available which can help military planner during the early stages of mission planning process.

The recent increases in computational power for laptop computers and the availability of sophisticated GIS

software packages have provided the opportunity for analysts to take simulation tools to the military planners and provide direct analysis support to the planning process. Packages such as ArcView have considerable in-built functionality which can enable the analyst to develop rapid prototype models to address particular concerns of the military planner. The ARC tool is an example of how, by close involvement of the analyst and the military sponsor, it is possible to develop a model in incremental stages which although very simple and limited in scope, can address some of the issues for which the sponsor is concerned.

## **REFERENCE**

British Air Power Doctrine AP3000. Third Edition.  
HMSO April 1999.

## **AUTHOR BIOGRAPHIES**

**ALAN COWDALE** is the senior scientific advisor at the Air Warfare Centre in Lincolnshire, UK. He holds a BSc in Mathematics from the University of Southampton and an MSc in Operational Research from the University of Birmingham. He has undertaken a wide range of simulation projects for both the Royal Navy and Royal Air Force in connection with assessing weapon system performance and effectiveness.

**SUZY LITHGO** is a software engineer with Sheridan Associates. She has worked in the GIS sector for 8 years and for the past 3 years of which has been developing various GIS Software models. Since joining the Air Warfare Centre she has been involved in updating existing software models as well as developing new models in ArcView and Visual Basic.