# Determining and Quantifying Military Capabilities for Non-Warfighting Operations

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## ABSTRACT

CORDA has worked for national force development and planning staff, and NATO scientific staff, in helping to develop methods and tools to assist military planners in addressing the military requirements for non-warfighting operations, typically peace support, humanitarian aid and disaster relief.

Our paper firstly describes a planning framework, developed for the NATO C3 Agency and for the UK's Permanent Joint Headquarters, for determining what capabilities are required for such operations and for quantifying the amount of capability required. This framework is empirically-based, and relies on rules of thumb to derive the magnitude of generic forces needed to fulfil a given mission in the light of the situation parameters dictated by the scenario or planning situation.

We describe how the framework, used in a non-quantitative mode, assisted us to determine and to analyse potential new capabilities and technologies for such operations across the joint spectrum. These capabilities include those required to liaise with civilian organisations and with the local population.

Thirdly our paper describes work undertaken to create a non-warfighting database of operations, involving British forces, post WW2. This database has been used to ask 'what if' questions of previous operations, in support of force development and of hot planning. Finally we suggest areas where applications of historical analysis, such as the above, can be used to help to validate the empirically-based rules of thumb, which underlie current non-warfighting planning models.

## INTRODUCTION

The unifying theme of this paper is the use of analysis and the development of analytical tools to assist in the quantification of the capabilities required to conduct Operations Other than War (OOTW). The first two sections deal with techniques which are applicable to, respectively, *defence planning* – defined as the high level determination of the forces needed to be able to meet a range of possible contingencies - and *operational planning*, which deals with the more precise determination of the forces needed to meet a specific contingency.

The third section describes work done to examine further capabilities relevant to OOTW, laying the foundation for a broadening of the capability analysis which is at the heart of the planning methods. The final sections are concerned with validation, and thus form a counterpoint to the earlier ones. We describe a historical database of OOTW which can be quarried by the analyst or planner who is interested in verifying theoretical work. We describe specific historical analysis that was done to validate aircraft sortie planning in OOTW.

## DEFENCE PLANNING: AIR FORCES FOR OOTW

### AIM

The aim of this methodology development was to place broad military expertise into a quantitative analytical framework, so that civilian analysts could have tools to help with defence planning.

### CONCEPTUAL METHODOLOGY

The methodology is simple in essence and comprises five key steps. It is generic, and is illustrated in the context of planning for air forces in Peace Support Operations (PSO).

1. Define the PSO mission: the planning situation is analysed, and the (joint) PSO mission is identified.

2. Derive air tasks and required air capabilities: scenario-independent capability analysis is used to define what air tasks must be undertaken and what capabilities are needed to fulfil them.

3. Use Rules of Thumb (RoT) to derive air force numbers: Rules of Thumb, which are simple arithmetical expressions, are used to calculate how many aircraft are needed in-theatre to do the mission.

4. Allocate forces to bases: further RoT are used to come up with an allocation of aircraft to known airbases.

5. Estimate support requirements and activation times.

In practice there is some iteration between the air force and basing requirements as, for example, the amount of air-to-air refuelling (AAR) needed depends on the distance at which the aircraft are based from the Theatre of Operations (TOO). Figure 1 illustrates the above conceptual methodology.

## CAPABILITY ANALYSIS

For the analyst to be able to conduct the five steps above, it was necessary to develop the match of capabilities to tasks and the rules of thumb. A list of combined joint PSO tasks was drawn up, and from it the air tasks and their air sub-tasks inferred, using a combination of NATO and national doctrine, and military experience. Air capabilities were matched to the air tasks and sub tasks. This match was tabulated in matrix form, as shown in the example at Figure 2. Table 1 lists a number of capabilities that were excluded from the analysis, to be incorporated at a later date.

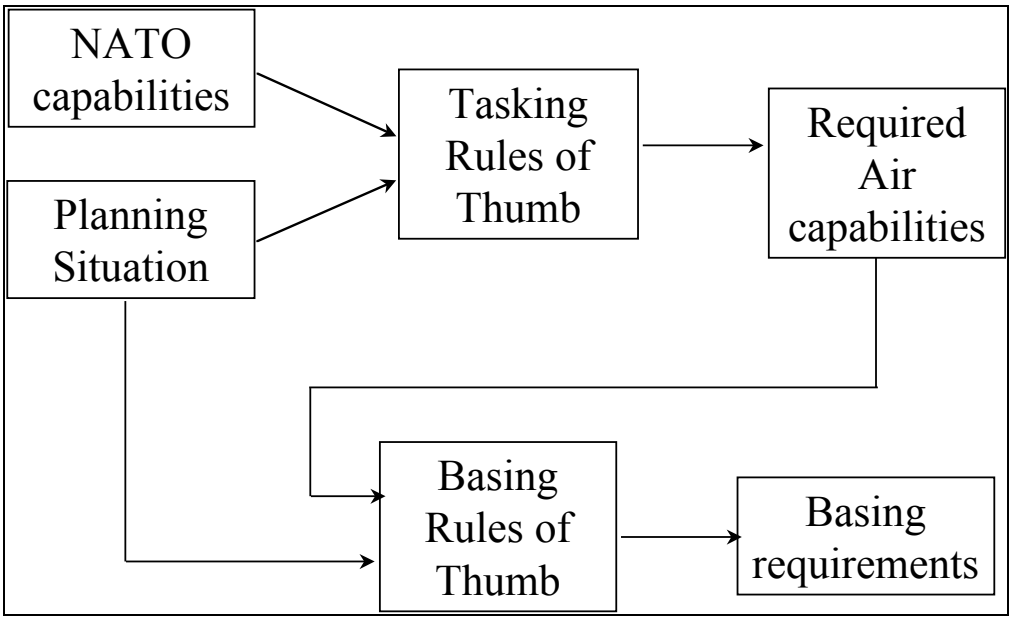

*Figure 1:* Process flow diagram.

| Air Sub-task ID | Air Sub-Tasks | DCA (AS2.1) | Air Policing (AS2.2) | Mil Info (IS2.1.1&2) | EW (Active) (IS6.1) | OCA (AS1.1) | Strat SA (SA1.1) | Interdict (SA1.3) | OAS (SA1.4) | TASMO (SA1.5) | Escort Sweep (AS3.1) | Deterrent (AP1.1) | AAR (RM2.1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AST/G2.4 | Provide and execute airborne C3 for all air assets within TOO. | X | X | | | X | | X | X | X | X | X | X |
| AST/G3.1 | Establish and maintain air defences against ground and air threats including establishment and policing of No-Fly Zones (NFZ). | | X | | | | | | | | | X | X |
| AST/G3.2 | Protect friendly air operations including deployment of air units into theatre. | | X | | | | | | | | X | | X |
| AST/G3.3 | Support defence of land, maritime, special forces and NGO operational activities and key points/areas. | | X | | | | | | X | X | | X | |
| AT/G4 | AAR support. | | | | | | | | | | | | X |
| AST/G9.1 | Provide air presence. | | | | | | | | | | | X | |
| AST/G9.2 | Demonstrate air capabilities. | | | | | | | | | | | X | |
| AST/G10.1 | Monitor and observe borders. | | | X | | | | | | | | | |
| AST/G10.2 | Monitor and report implementation/compliance measures. | | | X | | | | | | | | | |
| AST/G10.3 | Monitor progress with relocation and demilitarisation of belligerents. | | | X | | | | | | | | | |
| AST/G10.4 | Monitor movement of refugees/displaced persons. | | | X | | | | | | | | | |
| AST/PE1.1 | Conduct defensive counter air operations (DCA). | X | | | | | | | | | | | X |
| AST/PE1.2 | Conduct offensive counter air operations (OCA). | | | | | X | | | | | X | | X |
| AST/PE1.3 | Conduct surface attack operations (excluding OCA). | | | | | | X | X | X | X | X | | X |
| AST/PE1.4 | Conduct electronic warfare operations (EW). | | | | X | | | | | | X | | X |

*Figure 2:* Task-Capability matrix.

| PASSIVE AIR DEFENCE |
|---|
| COMMAND AND CONTROL |
| COUNTER-INFORMATION (INCLUDING PSYOPS) |
| PASSIVE ELECTRONIC WARFARE |
| PUBLIC INFORMATION |
| AIRLIFT |
| SEARCH AND RESCUE (SAR) /COMBAT SAR |
| ANTI-MINING |

*Table 1:* Capability areas excluded.

## RULES OF THUMB

The next development was the rules of thumb. These fall into two categories - rules for aircraft numbers and rules for basing requirements. In order to be able to apply a rule, the analyst must know:

- *Situational Factors:* these define the capabilities required in the air packages e.g. if all-weather capability is needed for fighters;

- *Critical Factors:* these provide the numerical inputs for the rules, e.g. size of area to be patrolled, which affects the number of aircraft required.

The application of the rules follows two main steps. Firstly the required numbers of aircraft to conduct the task are calculated. Then sustainment is added in, to give the numbers in-theatre.

## EXAMPLE RULE

A typical RoT is that used to calculate the number of fighter aircraft needed for an air policing or 'no-fly zone' task. The rule takes the form:

$$N = (A/F) * P * C * D/(R * T)$$

where: N = Number of fighters required, A = Area to be patrolled, F = Size of a fighter area of operations (FAOR), P = Number of combat air patrols (CAP) per FAOR, C = Number of aircraft per CAP, D = Required hours of patrol per day, R = Daily sortie rate, T = Time on station for one aircraft. In this list, D and A are the critical factors, while all the other parameters relate to aircraft performance and operating procedure. This formula therefore does the first of the two steps; a similar formula then calculates the total number of aircraft needed in-theatre arising from this task, allowing for aircraft availability, crew days off, and so on.

## BASING RULES

The basing rules follow a slightly different format:

- Aircraft are divided into three types: small (e.g. fighter), large (e.g. air-to-air refuelling tanker), very large (e.g. AWACS).

- Airfields are assessed for 'go/no-go' factors (such as runway length and area of hard-standing). These factors cannot be readily changed and, if not present,preclude the deployment of aircraft of the given type.
- Support required is then assessed as 15 men per aircraft at the 'first level' and 45 men per aircraft at the 'second level.'

- Bases can be categorised as bare, austere, well-found civil and well-found military.

The methodology above was developed for NATO's Consultation, Command and Control Agency (NC3A) in The Hague, who then incorporated it into their Defence Requirements Review Methodology. Although simply described above, the methodology comprised upwards of 36 rules and encompassed 10 examples of PSO (both Peacekeeping and Peace Enforcement). It was developed by a four-person team of an operational analyst, a programmer, and two military (air force) consultants.

The RoT are quite comprehensive and could support operational as well as defence

planning. Further developments required for an operational planning support tool lie in two areas:

- Data input, especially inputs to RoT, equivalence between aircraft types and a comprehensive airfield database.
- Software implementation tools to support the method.

## OPERATIONAL PLANNING: LAND FORCES FOR OOTW

In parallel with the work on developing air PSO rules for defence planning, CORDA undertook the development of a prototype force packaging tool, primarily designed for land PSO operations.

The aim of the work was to develop a test bed demonstrator of a PC-based force planning support tool that would allow various ideas associated with, for example, capabilities, capacities and time to be explored. A first prototype test bed has been developed and evaluated, and a second prototype with improved functionality is now being tested.

The concept of this tool was similar to the defence planning methodology described above. It was to analyse the mission into constituent tasks, to define the capabilities required by those tasks, to define the capabilities and the capacities for given force elements, and then to undertake a force matching based on capabilities, capacity and time.

The principles of its operation may be summarised as:

- Missions are analysed into tasks, with the assistance of a 'task template'
- Each task requires one or more capability components
- The force elements, typically units, e.g. an infantry battalion, inherit capabilities from their weapons, equipment and organisation
- The force element with 'right' capabilities is selected for the task
- The required capacity is established and the availability of this capacity is checked
- The selected force element is then added to the package.

The above concept is illustrated below in Figure 3.

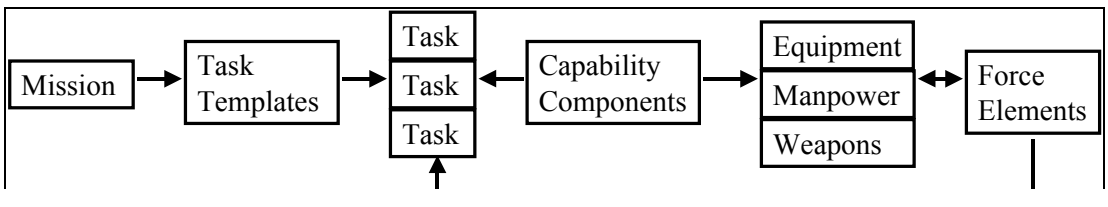

*Figure 3:* Force planning tool concept.

The capacity matching is illustrated below in Figure 4.

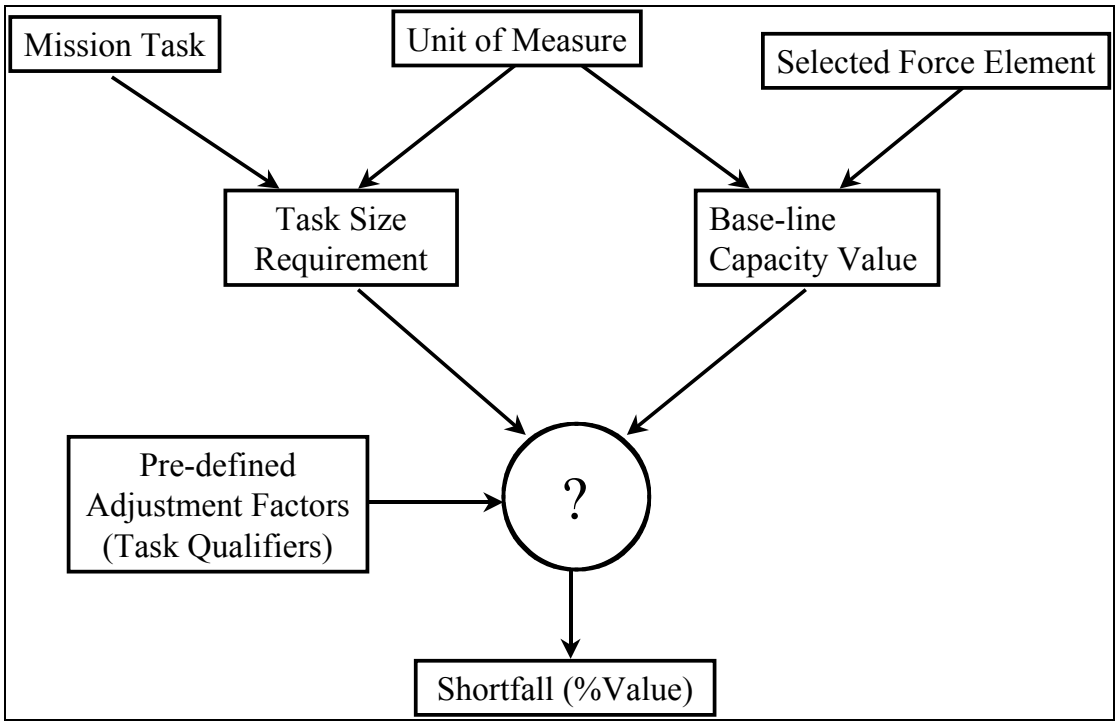


*Figure 4:* Capacity Matching.

Having calculated the numbers of units necessary to undertake the various tasks, in isolation, the next step is to constitute the elements into a coherent force, adding in any additional force elements that may be required, e.g. communications, command and control. There may be some tasks that are implied by the analysis conducted, but not explicitly stated. This will usually result in additional support units being identified.

At this stage the planner may have a long list of units in no particular order and with no specific command structure. If these raw units are used as the force requirement, the total force requirement will be greatly over-estimated, due to the large degree of overlap among the tasks. A further step therefore is to derive a sensible military grouping of all the identified units. This includes identifying role overlap, where a unit can double up for a task either in time or location, removing redundant units, etc. This can be quite a complex optimisation process.

The current demonstrator is made up of three separate database components corresponding to the organisation and maintenance of Force Packaging information. These components are defined as follows by three separate databases:

1. *System Data Database*. This contains information about force composition and organisation, threat, terrain and weather definitions, mission task templates, etc, judged to change relatively infrequently. There is no user

functionality associated with this part of the system, which is linked to the other two components.

2. *System Maintenance Database*. Maintenance of this stored information is handled by a maintenance database that allows the planner to update the stored tabular information. This database allows the 'system maintainer' to define specific mappings between Capabilities, Forces and Tasks, and to create new and separate mission databases.

3. *Mission Database*. Mission specific information changes with each new mission and as planning proceeds within a mission, and must be kept with the mission itself. Separate mission databases are used to store specific mission information such as task start and end dates, and allow the planner to choose and compile a force packages for each.

This tool contains data sets defining available force units in terms of their equipment holdings and capabilities, and tasks and their associated capability requirements. These data sets are contained in the System Maintenance database, separate from the Mission database that the planner accesses. Separate mission data sets can therefore be created and stored to allow "what- if" considerations to be rapidly considered. The above is illustrated below in Figure 5.

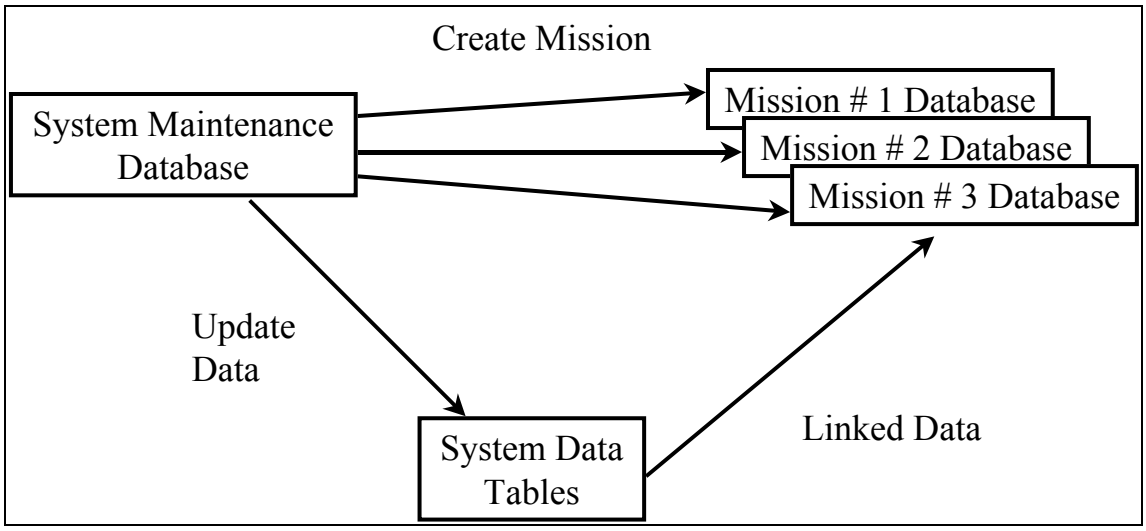


*Figure* 5: Database Access.

The first prototype has been used as a test bed for the development of the above representation and matching ideas. It has been demonstrated to national MoD and to NATO authorities. Through this work, CORDA has been invited to assist in a joint operational planning tool for NATO planners at Major NATO Command level (SHAPE and SACLANT).

CORDA has recently undertaken further development work to improve the functionality of the tool, i.e. improved representation of forces, improved capability categorisation and aggregation of force capacity, provision of a simple visual scheduling facility (showing task

and mission concurrency), and representation within a more object oriented structure, to aid future expansion. Other areas to be addressed include a better representation of threats and of force balance, both of which are appropriate for warfighting rather than OOTW.

The benefits that the tool is able to demonstrate include the following:

a. Transparency to the planner or analyst who can readily understand why the generated force is structured as proposed by the tool.

b. Provision of a full audit trail so that each component of the final force can be tracked back to a task requirement.

c. Encapsulation of previous military experience and judgement, exceeding that otherwise available.

d. Help to avoid oversights in the force packaging process.

e. Enabling a fast response to planning information or support.

The tool is thus able to provide added confidence to the planner in recommending feasible and robust force package options to the Commander for decision.

## CAPABILTIES RELEVANT TO OOTW

### BACKGROUND

The accepted plan for OOTW is to acquire equipment and to train as for war fighting and to adapt for OOTW. Therefore standard military capabilities are used to fulfil the requirements of OOTW. However military acquisition processes, which define the equipment requirements and options, may suffer from deficiencies due to the relative novelty of OOTW, and PSO in particular. CORDA therefore undertook some work for industry whose aim was to identify additional future capabilities that would make armed forces better in undertaking PSO.

### PROCESS

A workshop was held with as wide a representation as possible to identify capabilities that would be relevant to PSO. A brainstorming approach was adopted, with no attempt to rule out capabilities on the grounds of short-term infeasibility.

A list of PSO Combined Joint Tasks was drawn up, based on the PSO planning work described above, and a simple proforma drawn up, which would allow workshop participants to decompose the tasks and identify capabilities which would be needed or would be useful in accomplishing them. Participants were encouraged to focus on capabilities that were not already in the UK inventory, or would need modification in some way to be used for PSO.

They were also encouraged to envisage the fulfilment of the tasks in a range of geographical contexts, in order to stimulate creative thinking and identify gaps needing to be filled. These contexts were described as:

- *Balkans:* temperate, mixed terrain, rural and urban.
- *Middle East/N Africa:* desert, urban.
- *Equatorial Africa:* hot, wet, low infrastructure, populous.

Participants were also asked to categorise the capabilities, according to the following scheme:

- Capability not possessed.
- Capability weakly possessed.
- Capability inappropriately possessed.
- Expected to require advances in technology.
- Better done by civilian agency.
- Capability possessed but requires change in doctrine and training.

## POST-WORKSHOP ANALYSIS

The post-workshop analysis concentrated on categorising the capabilities identified, using the Universal Joint Task List. The UJTL categories, with some modification are:

- Deployment/movement/manoeuvre.
- Intelligence, Surveillance, Reconnaissance.
- Employ forces/firepower.
- Sustainment/logistics.
- C2.
- Protection.
- At Strategic levels only: Foster/maintain relationships, and Force Development.

Examination of requirements identified in the workshop revealed that UJTL Task categories need to be extended in two ways. First, in PSO there is a need to bring external

relationships down to the operational and tactical level. This suggests the following new task categories for the UJTL:

- Foster and maintain relations with local populations and non-governmental organisations (NGO); information operations .
- Foster relationships between factions, between NGO and locals, and between NGO and NGO.

Second, there is a need to extend all the categories to generate new tasks (and hence capabilities) involving civilian organisations and populations. This involves:

- Guarantee and denial of movement.
- Supply of intelligence to civilian bodies.
- Support appropriate training of certain factions.
- Provide aid.
- Control civilian activities, and facilitate civilian control of own populations.
- Protect civilian populations and safe areas,
- Provide police and legal services.

## OOTW HISTORICAL DATABASE

### ORIGIN AND PURPOSE

The above methods and tools assist planners by codifying and extending the planning processes for military forces. It is possible to supply further assistance to planners in the form of plan validation. The only true validation of a plan is its execution, which by definition is impossible to do in advance. Analysis of historical data may, however, go a long way to give assurance that planning principles are correct and are well applied. A disadvantage of historical analysis is that it is slow and labour intensive to undertake. To overcome this disadvantage, an OOTW Historical Analysis Database was developed.

The database helps HQ planners in a number of ways. Firstly, it can be used to check assumptions and rules applied in contingency or hot planning by referring to what happened in previous OOTW. Secondly it can be used to generate estimates such as the likely casualties that would arise from a planned operation. The tool is also of great potential value to analysis organisations and colleges, as a learning, validation and teaching aid.

## SCOPE OF DATABASE

The current database covers the following types and sub-types of operation

- Peacekeeping:
  - > Observing.
  - > Interposition.
- Wider Peacekeeping:
  - > Conflict Prevention.
  - > Demobilisation.
  - > Military Assistance.
  - > Humanitarian and Disaster Relief.
  - > Guarantee and Denial of Movement.
- Peace Enforcement:
  - > Enforcement of Sanctions
  - > Direct Intervention
- Counter-insurgency.

## STRUCTURE AND FIELDS

The database is relatively deep; it currently contains the analysed data from 25 operations, structured according to:

- The stages of the operation, including the situations, causes, and policies adopted by each side or faction.
- The details of 'own' military forces including C3 arrangements, intelligence, police, medical, engineers, logistics and host nation support.
- Details of casualties and POW.
- Similar, but lesser, details of opposition forces or factions, their C2, and casualties.

The decision to develop a deep database was in accord with UK MoD wishes. An alternative approach, adopted by a partner US company working to the US DoD, has been a statistical approach, collecting shallower data for a much larger number (up to 200) of OOTW. A feasibility study is underway to see if it is possible to merge these two databases to produce a more flexible product for use by both governments.

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## USE FOR VALIDATION

Apart from its wider application in support of planning, the database can be used to help answer questions such as:

- Do generic scenarios and tasks match real situations?
- Are the outcomes of defence or operational planning comparable with history?

In this process, omissions are interesting and relevant, and sample size is important, hence the proposed Transatlantic initiative above. When the merging and further development work is complete, the OOTW database will be an invaluable part of the defence planner and analyst's inventory.

## HISTORICAL ANALYSIS OF AIRCRAFT SORTIE GENERATION

The air force planning rules described earlier in this paper are based on military experience and doctrine. As part of their development, their outputs were validated against known historical data from Bosnia. The validation focussed on an apparent discrepancy between the sortie rates used for planning and those found in the operation. A typical air force planning assumption is 2 sorties per aircraft per day (for example, for fighters). Actual Bosnia rates were of the order of 0.5 sorties per aircraft per day. The planning figure leads to a requirement only a quarter that obtained using the actual rates. There are a number of significant features in the Bosnia data:

- On any given day, each sortie was flown by a different 'tail number.'
- Squadrons operated a cycle of several days on followed by one or two days off, the precise pattern being determined nationally.
- The overall force was multinational, with each nation signing up to a certain number of sorties per day.

These features, taken together, indicate a pattern of operations by which a sortie generation rate of about half a sortie per aircraft per day could be explained. Because each nation apparently agreed to take one time slot in the day, the sortie generation rate could not be more than one per aircraft per day. Hence, the achieved rate would have to be less than one. Accounts of Bosnia operations make it clear that each national unit agreed to fly their sorties so as to be available on task at a particular pre-agreed time. In order to meet this commitment, more aircraft and crews were made ready than were actually used, to allow for last minute unserviceability.

The PSO was conducted under peacetime conditions for the NATO participants. They therefore worked on a less demanding cycle than would apply in war. A typical squadron might work five days in seven, with other squadrons covering for the days off. The precise rota depended on the nationality of the squadron, but typically a further 40% increase in the total air resources is required to cover this. The combination of these factors together lead to a factor of about two in the number of aeroplanes required to ensure that one package is achieved per working day, i.e. the achieved rate would be about half a sortie per aircraft per day.

An alternative way of approaching this issue is to consider the number of flying hours required. If it were possible for aircraft to fly two sorties per day, then a 4-hour sortie would lead to 240 flying hours per aircraft in a typical month. Historical evidence suggests that in the Falklands war, Harriers were flown for 55 hours per month, which is about a quarter of the suggested planning hours. Even this figure is high compared with peacetime flying, which amounts to 20 – 25 hours per month (Braybrook 1996). In the light of flying hours, it therefore appears that half a sortie per aircraft per day is a credible assumption when sustaining long term PSO.

## SUMMARY

This paper has described work to address high level defence planning and more immediate operational planning using methods of logical analysis and synthesis. Much of the input data is available within planning databases. The novel element is the systematic generation and use of rules of thumb which embody military expertise or actual operational experience. Current military capabilities for OOTW are based on those for available for war fighting.

In an exploratory piece of work we addressed modified and additional capabilities that would desirably be present. Finally, the ability to refer to past operations through prior historical was described. This leads to important future possibilities for validation. Work to improve the methodology and tools is ongoing in all of these areas.

## ACKNOWLEDGEMENTS

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## REFERENCE

Braybrook, Roy, 1996. *Harrier: The Vertical Reality*. RAF Benevolent Fund Enterprises.