

REFLECTING SOVIET THINKING IN THE STRUCTURE OF COMBAT MODELS AND  
DATA

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## REFLECTING SOVIET THINKING IN THE STRUCTURE OF COMBAT MODELS AND DATA\*

### INTRODUCTION

The overall concept of the Rand Strategy Assessment Center (RSAC) was provided in an earlier paper by Paul Davis and Bill Schwabe.<sup>1</sup> In this presentation, I will focus on how we have attempted to capture asymmetries in U.S. and Soviet thinking in the RSAC models of combat and military force operations ("Force" models).

The RSAC's approach to such models is quite different from that of other war games and simulations. Since 1982,<sup>2</sup> our approach has been to develop a Force model that:

- Handles superpower conventional through general and protracted nuclear warfare.
- Covers broad geographic areas (from Europe to Asia to the American hemisphere).
- Reflects asymmetries in terminology and operational concepts between Red and Blue.
- Includes "special" warfare phenomena that have long been excluded from models because they are difficult to handle, in spite of their importance.
- Facilitates sensitivity testing by running fast and allowing transparent access to all major parameters--both interactively and by changes in the basic data base.
- Operates interactively in both human and automated gaming environments.

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\*This paper was prepared for an invited address at the National Defense University's "Thinking Red" War Gaming Workshop on 24 April 1985.

<sup>1</sup>Paul K. Davis and William L. Schwabe, "Search for a Red Agent," The Rand Corporation, P-7107, forthcoming.

<sup>2</sup>See Paul K. Davis and Cindy Williams, *Improving the Military Content of Strategy Analysis Using Automated War Games: A Technical Approach and an Agenda for Research*, The Rand Corporation, N-1894-DNA, June 1982; and Bruce W. Bennett, "Strategic Forces Modeling," unpublished, 1982.

- Uses extensive computer graphics to support the player and analyst in assessing the implications of various force options and the outcomes of games.

Because of the breadth of our modeling work, it is possible here only to say a few words about the overall content of the model. Therefore, after briefly describing the structure of CAMPAIGN, we will focus on some examples of how this model includes a Red perspective within its basic design.

### THE STRUCTURE OF THE MODEL

The Force model is called CAMPAIGN (Combat Assessment Model for Policy Analysis of Issues in Global coNflict). Figure 1 provides a simplified view of the CAMPAIGN model and supporting programs. CAMPAIGN is run through its user interface program, CAMPER, which handles inputs and requests from either human players or external models in other parts of the overall RSAC simulation.<sup>3</sup> CAMPAIGN is also supported by a graphics program (Graffer) and a data base preparation program (Input

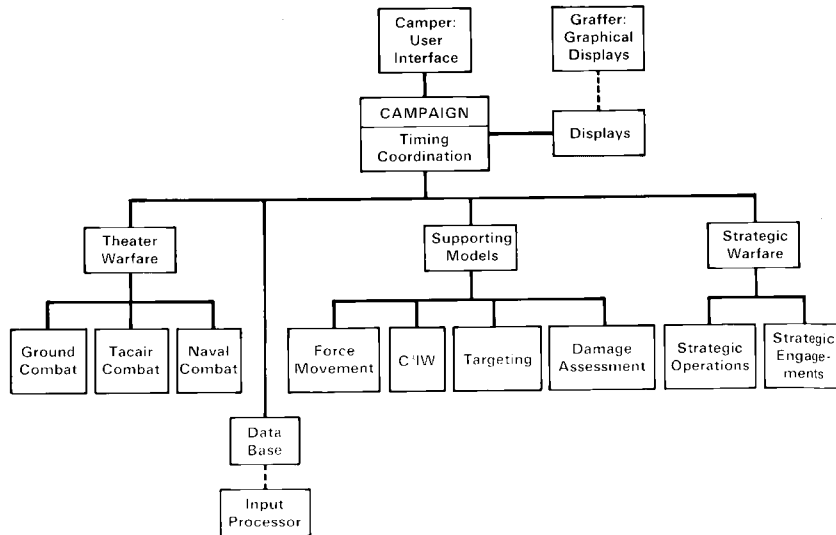


Fig. 1 -- A Simplified View of CAMPAIGN

<sup>3</sup>See Davis and Schwabe, op cit.

Processor), both of which are run separately. More will be said below about each of these supporting programs.

CAMPAIGN itself is a time driven model with variable time steps, the length of the time steps being determined by the world situation and by "wake-up" rules the humans or external models (akin to so-called expert systems) set up. For example, a Red wake-up rule might amount to something like: "If intelligence indications of Blue preparation for a nuclear strike are received, wake me (the human team or automated player) up." Unless a wake-up rule triggers, CAMPAIGN will continue advancing based upon internally determined time steps for whatever duration the analyst has specified.

Within CAMPAIGN itself, there is a modest separation of theater warfare, strategic warfare, and supporting models. This separation is only modest because there are significant interactions between the models themselves, and in some cases the same model is used for both theater and strategic purposes (for example, a single model disperses all aircraft types). The break-downs in Figure 1 primarily aid in controlling complexity and in model documentation, in the sense that they allow us to partially modularize the work and descriptions. Also, in some cases users will be able to substitute models at differing levels of detail for the standard RSAC module (e.g., in theater air combat).

## REPRESENTING THE WORLD IN CAMPAIGN

A view of geography gives perhaps the best first perspective on how CAMPAIGN handles detail. To keep CAMPAIGN fast, most forces and targets within the model are represented by country, as suggested by Figure 2. Thus, we would know how many infantry brigades are in Britain, but would not know where they are within Britain unless we had set up to model ground combat there, which we have not. Within ocean areas, some 30 regions are identified as areas for locating ships in the same manner.

While speaking of countries, it is important to note that, consistent with the overall RSAC design, CAMPAIGN allows each country in the world to be played independently. Thus, the effects of potentially important Red political actions to disrupt NATO unity can be captured.

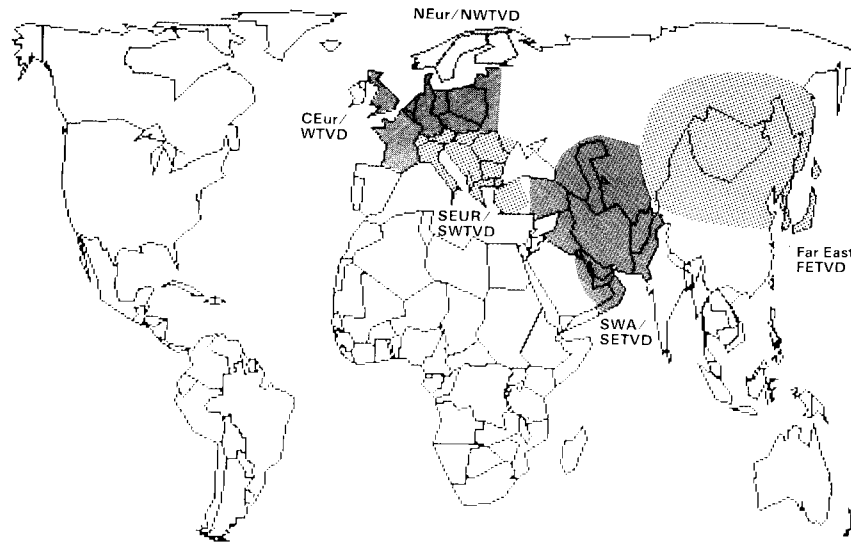


Fig. 2 -- RSAC Combat Theaters

Each individual country can determine whether or not to participate on either side of a conflict with its forces, and can also decide whether or not to grant overflight, transit, or basing rights. Once a NATO or Pact nation commits itself completely, its forces are handled as part of Blue or Red, but the nationalities of units are still tracked and constraints imposed as appropriate (e.g., French forces are unlikely to fight in NORTHAG).

CAMPAIGN uses greater geographic detail than individual countries in two instances. First, large countries like the United States and the Soviet Union are divided into several regions (for example, CONUS is divided into 6, the Soviet Union into 8). Second, in areas where ground conflict is anticipated (such as Central Europe), a much more detailed overlay structure is provided as will be described below.

Before describing the overlays, note that Figure 2 (and CAMPAIGN's data structure) uses both Red and Blue names for the theaters. For example, we refer to Central Europe as CEur from the Blue perspective, and WTVD<sup>4</sup> from the Red perspective.

<sup>4</sup>TVD is the abbreviation of the Russian words which mean theater of military operation. The Western TVD usually refers to Central Europe, and is flanked by the Northwestern TVD and the Southwestern TVD.

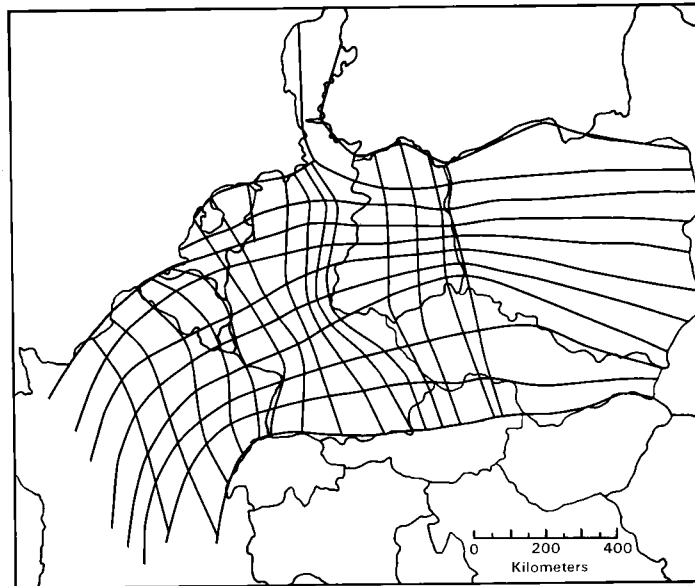


Fig. 3 -- Geography in the CEur Theater

In defining the geography of theaters, two kinds of approaches are used. In theaters with relatively rich transportation options, a grid overlay like that shown for Central Europe in Figure 3 is employed. The grid is developed by starting in the area where major combat is expected (in this case, in West Germany), and defining likely avenues of advance (the eight NATO corps sectors, the Landjut sector, and an Austrian axis). These avenues are then extended to the West and East to cover lines of communication.<sup>5</sup> A set of vertical lines are then overlaid to match river lines and international boundaries as closely as possible, providing the grid. Individual cells within the grid are referred to as zones. Any given zone might be perhaps 80 kilometers wide and 60 kilometers deep; for such a zone, we would have data on the crossput and throughput capacities for transportation, data on the defensibility and movement implications of terrain, and information on any natural or man-made barriers. Ground force units are located by zone, and by position along the zone's longitudinal axis. The grid provides a convenient reference system to allow units to move from one location to any other,

<sup>5</sup>The axes can be tailored to a particular study effort, for example one involving unusual strategic-level maneuver.

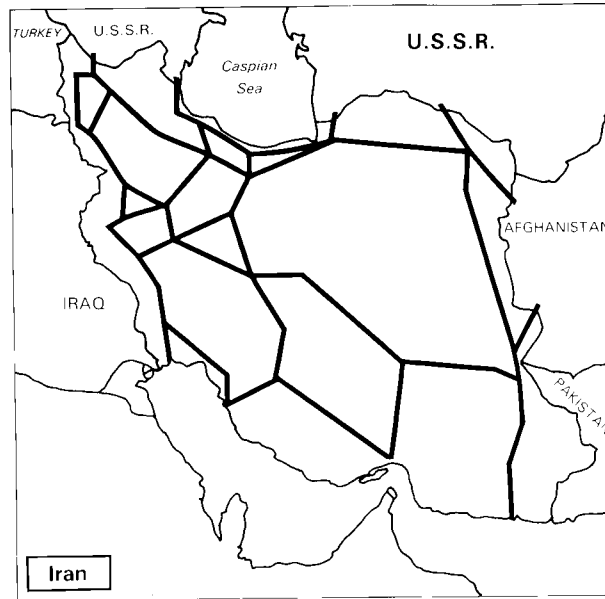


Fig. 4 -- Geography in the SWA Theater

recognizing the constraints on movement as the force proceeds. This approach has much in common with that used in older "piston" models of ground combat, but CAMPAIGN includes many processes going far beyond those of a standard piston approach.

In theaters with relatively poor transportation options, an aggregated network is used like that shown for Southwest Asia<sup>6</sup> in Figure 4.<sup>7</sup> In Iran, the road and rail systems provide a natural network, limiting mobility in both administrative and combat movements. To capture the essence of the geography, the network is divided into elements which we also refer to as zones. A particular zone could reflect three parallel roads running through a wide valley in which 3 divisions could advance abreast; alternatively, a zone might be very narrow to reflect a mountain pass in which even a small number of

<sup>6</sup>See Robert Levine, *Flying in the Face of Uncertainty: Alternative Plans and Postures for Interdiction in Southwest Asia*, The Rand Corporation, P-7050-RGI, January 1985. Networks have also been used by OJCS (JAD) in work by Ray Barrett (unpublished).

<sup>7</sup>While the grid and network approaches vary significantly in many respects, they are both specific manifestations of a single, integrated methodology within CAMPAIGN.



interdiction sorties or a small defending unit could make the zone impassable for some period of time.<sup>8</sup>

### GROUND COMBAT OPERATIONS

Units in the overlay are located in one of three generic kinds of places: in a combat sector (referred to as an "axis"), in the theater reserve, or moving from the reserve to the combat sectors (reinforcements). Theater reserve forces are held well behind the front in specific areas, and are available for use as occupation forces and reinforcements. The reinforcement state is a temporary condition of forces moving toward the front, provided for bookkeeping and interdiction purposes. Within an axis, forces are assigned either to the first echelon (committed troops) or to the second echelon (the axis reserves, effectively the second operational echelon of the first strategic echelon) as shown in Figure 5. The second echelon structure is provided to reflect Soviet operational procedures, and would not

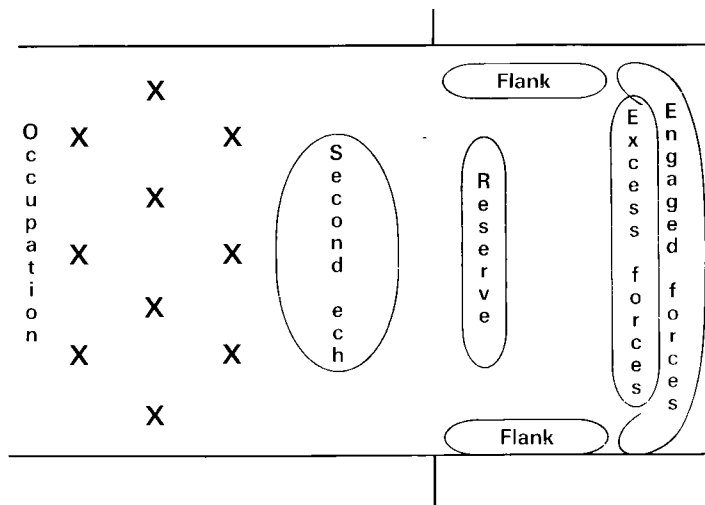


Fig. 5 -- Forces in a Combat Sector

<sup>8</sup>In the case of interdiction sorties, the pass becomes available once repair has been affected. Throughout CAMPAIGN, most sources of damage have offsetting repair functions (some of which may take a very long time).

normally be used by NATO. The first echelon forces are further divided: some forces engaged in combat, some directly behind them but unable to engage the enemy because of terrain limitations, some covering the flanks, and some in a first echelon (tactical) reserve. For example, if two normal NATO divisions were assigned to the first echelon of an axis, it would be standard practice for each to have two brigades engaging the enemy, and one brigade in tactical reserve.

While most combat operations are adjudicated on a corps/army sector level, massing is a basic offensive concept that has been added because it is fundamental to Soviet operational art. Massing allows an attacker to concentrate his combat capability in a narrow sector, as shown in Figure 6, in an attempt to achieve a breakthrough. The sector of concentration is typically 6 to 10 kilometers wide,<sup>9</sup> compared to a normal axis width of perhaps 60 kilometers.

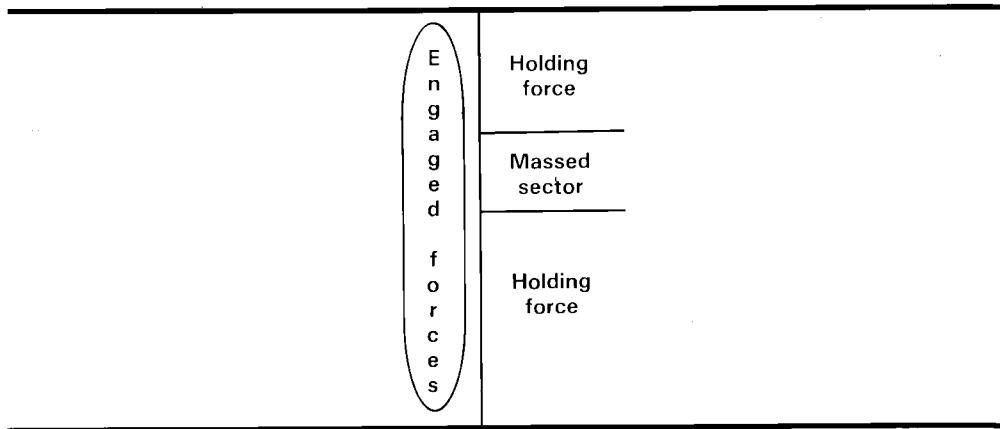
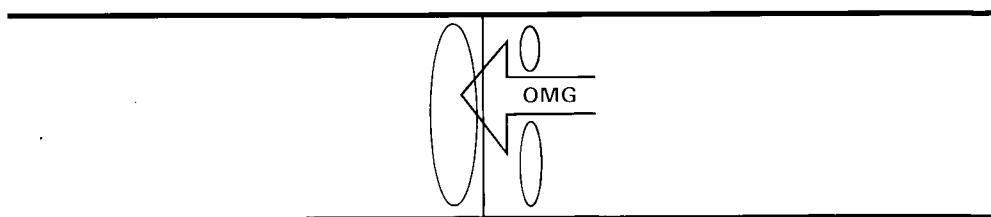


Fig. 6 -- Massing in Combat Operations

<sup>9</sup>See, for example, Allan S. Rehm and John F. Sloan, *Operational Level Norms*, Science Applications, Inc., SAI-84-041-FSRC, April 24, 1984, p. 2.4.

The procedure used to reflect massing in CAMPAIGN involves several parts. First, the attacker establishes a requirement for forces to be maintained in the non-massed sectors as a percentage of the opposing forces. For example, the attacker may require a force ratio of 0.8:1 be maintained in holding areas, in order to prevent a counterattack. Second, the attacker then masses remaining forces in the chosen subsector, subject to terrain limits on force density. Third, the defender is assumed to maintain a uniform force density, across both the massed and non-massed subsectors. Finally, both attacker and defender may bring artillery to bear in the massed sector from lateral areas within range of this sector. CAMPAIGN then assesses movement rates and attrition for the massed and unmassed subsectors, and a net result is computed.

The operation maneuver group (OMG) is another fundamental Soviet concept reflected in CAMPAIGN, as shown in Figure 7. The simulation of OMGs, while quite aggregated, involves three components: (1) criteria for committing the OMG, (2) determination of whether a particular commitment is successful, and (3) following OMG operations behind enemy



Commitment rules  
Adjudication:  
Will the OMG penetrate?  
If not, at what cost?  
If so, with what effect?  
Operations behind enemy lines

Fig. 7 -- OMG Operations

lines if commitment is successful. As an example of these components, the commitment rules require that before an OMG can be committed, the opposing forces must be in contact with each other, with one side attacking and the other defending. The attacker then will commit an OMG if: (1) the attacker has penetrated any prepared (non-hasty) defenses, (2) no other OMGs are currently operating in the sector, (3) a force specifically tagged as OMG capable is available to become an OMG, and (4) the attacker has achieved a threshold force ratio.

As suggested above, an extensive package of graphics is available with CAMPAIGN to monitor the developing conflict situation. For example, Figure 8 shows the westward advance of the FLOT in the British (Axis 4) and Belgian (Axis 5) corps sectors over time, with combat beginning in this scenario on day 63. Several hundred simple measures of ground combat can be produced and analyzed in this manner.

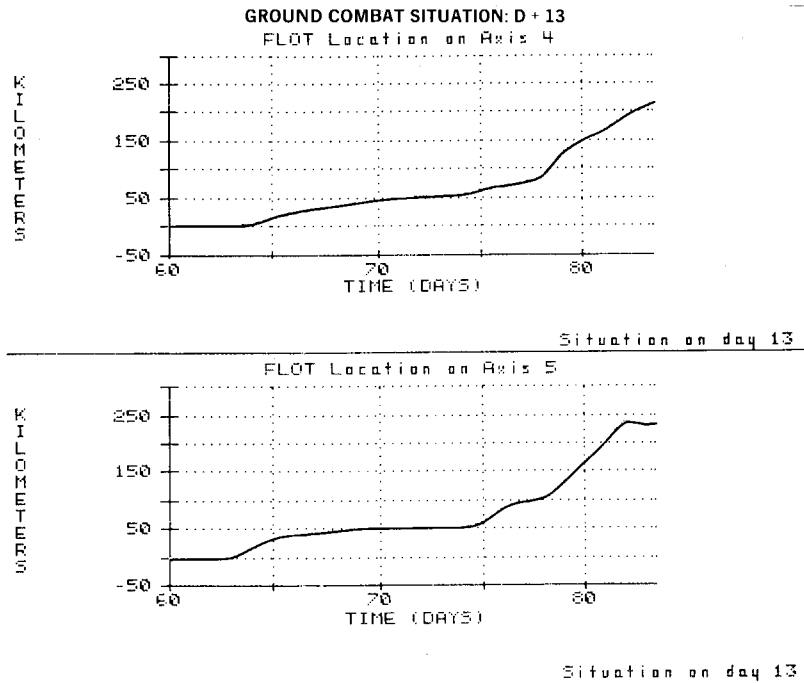


Fig. 8 -- Ground Advances During the First 20 Days of War

## MEASURING GROUND UNIT STRENGTH AND EFFECTIVENESS

CAMPAIGN distinguishes between equipment strength and effective strength, and also keeps track of equipment strength by gross category. The procedure involves two steps: (1) determining the quality and quantity of equipment assigned to a unit, and (2) determining how effectively that equipment would likely be used.

The first step involves aggregating off-line, detailed data on unit equipment into six categories (tanks, other armor, artillery, attack helicopters, air defense systems, and other), and recording the pieces of equipment and determining total strength<sup>10</sup> by equipment category. The strength values can be added across categories to give an overall unit capability, referred to as "Equivalent Divisions" (EDs), where 1 ED is defined as the strength level of the 1984 U.S. 1st armored division (without the addition of corps support assets). Thus "strength," as measured by EDs, refers to equipment (rather than personnel), and is similar to the concept of "armored division equivalents" (ADEs) which is widely described in the literature. As discussed below, CAMPAIGN is sensitive not only to a unit's ED score but many other factors as well (including its "type," with, for example, constraints preventing infantry from attacking armored units in Central Europe).

The second step produces each unit's *effective strength* or effective equivalent divisions (EED) score by multiplying its equipment strength in EDs by a number of effectiveness factors. These factors reflect:

1. mobilization state
2. training state
3. cohesion problems caused by attrition in combat, which may be offset to some extent by rejuvenation time and equipment replacement

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<sup>10</sup>Strength is measured using the WEI/WUV III methodology to compare different systems (capturing, for example, the relative capabilities of an M60A3 tank and an M-1 tank).

4. national fighting effectiveness (whether due to psychology, *quality* of training, leadership, or enthusiasm for the particular conflict)
5. tactical surprise attack effects
6. having less-than-nominal days of supply available
7. fighting on home territory

Having such multipliers is extremely useful for sensitivity analyses, and for seeing in simulations some of the complex decisions that must be made by commanders as they contemplate alternative strategies. For example, it is possible for the Soviets to forgo<sup>11</sup> waiting for a cadred division to be fully trained, instead committing the unit earlier at a lower combat effectiveness. Similarly, it is surely a mistake for a Pact planner to assume that Soviet, East German, Polish, and Czech forces are all equally capable and ferocious with comparable equipment and manning (and, indeed, we have reason to believe he would not make such assumptions<sup>11</sup>). In short, while we may not be able to precisely capture some of these qualitative factors, we feel it more important to include them and treat them approximately, as the Soviets seem to do, rather than to ignore them and act as if they are not important. As a minimum, we use them in the extensive sensitivity runs that are a fundamental part of the RSAC's multiscenario analysis.<sup>12</sup>

#### TACTICAL AIR OPERATIONS

With regard to tactical air operations, let me simply illustrate two areas in which we have tried to capture issues important to Soviet operational art. First, with regard to Soviet air mission planning, a number of conversations with authoritative sources convinced us that the Soviets employ a mission structure that is, in important ways, different from that used by NATO. Our attempt to reflect these differences is illustrated in Table 1. For example, according to this plan, the Soviets would fly 5 percent of their fighter aircraft on a mission

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<sup>11</sup>See, for example, Rehm and Sloan, *op. cit.*, pp. 3.2-3.4.

<sup>12</sup>Paul K. Davis, *Game-Structured Analysis as a Framework for Defense Planning*, The Rand Corporation, P-7051, January 1985.

Table 1

SOVIET TACAIR MISSION PLANNING: AN EXAMPLE

Missions	Medium Bombers	Fighter Bombers	Fighters
Air interdiction	90%	20%	--
Nuclear reserve	10%	0%	--
Direct support	--	0%	--
Defense suppression	--	80%	--
Escort	--	--	30%
Corridor security	--	--	5%
Attack	--	--	5%
Cover	--	--	0%
Airfield defense	--	--	20%
Area defense	--	--	40%

referred to as "attack." The attack mission involves fighter sweeps deep in enemy territory which attempt to engage NATO high-valued C<sup>3</sup> aircraft operating behind the FLOT, such as AWACS, TR-1s, and so forth. We do not allow for a similar NATO mission since such a mission does not exist in NATO doctrine; however, if we were to play a future game (say for 1995) in which the Pact utilized very effective AWACS aircraft, we would consider adding such a mission for NATO, assuming that NATO doctrine would evolve in response to the new threat.

Our second example has to do with the ground-to-air threat posed against penetrating aircraft. Most models worry almost exclusively about the theater SAM belt and terminal/area SAMs thereafter, ignoring the significant air defense weapon inventories organic to ground forces. CAMPAIGN recognizes that all penetrating aircraft (especially low flyers) will be subjected to fire from these organic assets, though the precise character of the mission will determine the extent to which that fire will be successful. For example, organic air defense may cause 5 percent attrition to CAS aircraft, and 2 percent attrition to aircraft penetrating on OCA missions. Note that the Soviet investment in such organic air defense systems suggests that the Soviets place some stock in their ability to affect tactical aircraft penetration.

## COMBAT MANAGEMENT

There is a fine line between strategic decisions and troop control. Ideally, the human player or automated model should make *all* major decisions down to and including important theater commander decisions such as how to allocate reserves among sectors. However, in practice, this allocation requirement is burdensome. Experience in war gaming has taught us that many players like to be able to play some forces in great detail, while other players would prefer that the operations of forces be handled by the computer after specifying some simple guidance.<sup>13</sup> The RSAC accounts for the former preference by providing detailed orders, and for the latter by providing a set of support packages constituting an "operational control level" (OCL) model. With regard to ground combat, three levels of OCL are provided: (1) the Theater Commander, (2) the Theater Support Staff, and (3) the Corps Commander. Currently, both the Theater Commander and the Theater Support Staff are options available to the player, and may be suppressed if so desired (allowing the user to play these roles through the normal CAMPER orders); however, the Corps Commander must be run in an automated mode since appropriate CAMPER commands do not exist to allow human players to handle its roles.

The current OCL rules are not designed to optimize force use, but rather to reflect the kinds of operational decisions we would expect to see real commanders make. Thus, in the development process, the rule writers (Carl Jones and Robert Howe) sought to reflect how human experts play manual war games. These rules already reflect specific Soviet operational practices to some extent, and we plan improvements in this area.<sup>14</sup>

With regard to OCL specifics, the Theater Commander makes decisions about where to place his priorities in attacking and defending. He does so in light of certain rules (such as where forces of specific nationalities can be sent), and based upon his campaign plan and the

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<sup>13</sup>Indeed, for strategic- (theater-) level studies, it is inappropriate to dwell on operational- and tactical-level detail.

<sup>14</sup>At present, CAMPAIGN does not *explicitly* reflect Soviet front structures or the detailed dynamics of echeloned movement. Some of these considerations are, however, implicit and a more "Red" representation is being designed.



evolving situation. The Theater Support Staff accepts these priorities, and uses them to handle force assignments and allocate logistics. With regard to forces, the support staff may commit units from the theater reserve to specific axes, and may also "shift" corps boundaries by moving units from one axis to a neighboring axis. The staff may also pull units from an axis to reconstitute a reserve. Several rules and parameters guide these operations, including a minimum theater reserve requirement and a maximum rate of force allocation. The Corps Commander is responsible for determining which of the brigades or divisions within the first echelon will fight at the front, and which will be held in axis reserve. If combat power becomes too limited to cover the given terrain, the Corps Commander may be forced to commit many of his reserves, and eventually to pull out of contact and withdraw unless reinforced (in order to avoid a breakthrough).

#### **STRATEGIC (INTERCONTINENTAL) FORCE OPERATIONS**

Since the focus of this conference has tended to lie in the theater area, I have focused most of my comments on theater operations. Let me briefly illustrate our operations with strategic forces through three simple examples. First, many people who deal with combat models--and almost all "simulators"--tend to assume that the more detailed a model is, the more accurate it is. In our experience, this is not necessarily the case: many detailed models ignore important phenomena (e.g., OMGs and sub-sector massing) because they are difficult to model, distorting the results of the analysis. An example important to Soviet operational art in the realm of strategic forces illustrates this point. Most detailed models of strategic bomber penetration ignore the operations of mobile surface-to-air missiles (SAMs) because they would have to develop a logic for moving such missiles from one latitude/longitude to another. CAMPAIGN ignores this detail but insures greater accuracy by increasing the penetrator encounter rate and making it more difficult to suppress SAMs that have been moved. Also, because CAMPAIGN is being iteratively developed, we attempt to capture such primary effects first, and then over time add additional effects (such as loss of SAM availability while being moved and support problems in the mobile mode).

The second example of strategic forces modeling in CAMPAIGN has to do with the difference between targets and forces--or, in some instances, between fixed targets and *functions*. Many strategic forces models implicitly assume that hitting army bases with nuclear weapons will somehow greatly affect Soviet military capabilities, regardless of whether troops are present! By contrast, Figure 9 illustrates the approach taken within CAMPAIGN. Before mobilization, an attack designed to destroy, say, 80 percent of the ground forces bases may destroy an even higher percentage of the forces themselves, assuming that the more valuable bases are targeted. However, some time after mobilization when Soviet ground forces have dispersed from their bases, relatively little damage would be done to the forces themselves by hitting their bases. And while the logistics associated with ground forces may not be quite as movable as the forces themselves, their vulnerability should also decrease because of dispersal. Although our analytic models are very simple in this case, they reflect first-order effects too often ignored altogether.

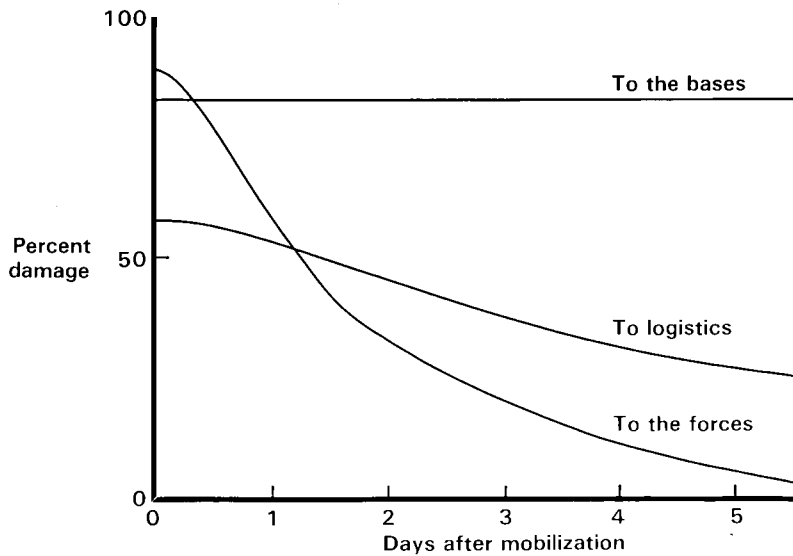


Fig. 9 -- Targeting Soviet Ground Forces

The third example of strategic forces in CAMPAIGN focuses how information is presented to the user. Figure 10 illustrates one type of display. In it, we first look at the number of warheads that the Soviets have committed against various attack objectives, and compare that number to the number required to achieve basic Soviet objectives (shown by the lines on either side of the bars). The second perspective at the bottom of the chart shows the damage expectancy in each category (for example, 80 percent of the targets in the nuclear threat category would be expected to be destroyed). Finally, the middle "effectiveness" representation indicates whether or not the indicated target damage is likely to effectively stop the assets from functioning. This includes such issues as dispersal and the establishment of back-up, redundant systems, as well as how much of each kind of asset is required to perform specific kinds of tasks (such as EAM dissemination for the military leadership or destruction of some number of theater targets for the theater nuclear forces).

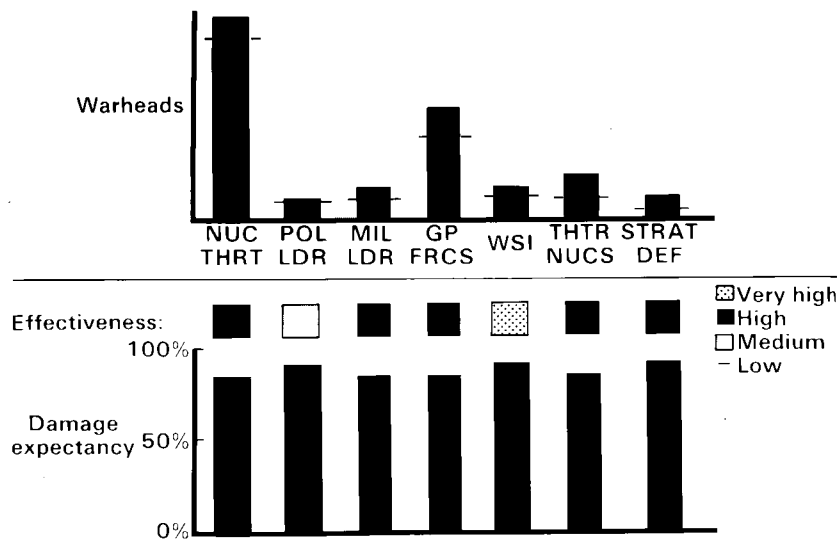


Fig. 10 -- Soviet Intercontinental Capabilities

Table 2

AN ILLUSTRATIVE LIST OF VARIABLE PARAMETERS

Player may vary:	Analyst may vary:
Attack threshold	Effectiveness of forces
Flank parameters	Attrition/movement rates
Attack intensity	Hold density
Parameters for massing	CAS effectiveness
Deployment threshold	Logistics consumption rates

**SENSITIVITY TESTING**

Having provided this quick survey of CAMPAIGN as it stands in April of 1985, let me conclude by emphasizing that we have designed CAMPAIGN to be very flexible, allowing a player or controlling analyst to vary a wide range of parameters. This capability reflects the fact that many combat parameters are uncertain, and thus alternative values should be considered in attempting to assess the range of potential outcomes for any given conflict situation. Parameters like those shown for ground forces operations in Table 2 are all accessible either in the initial Force data bases, or on-line in an interactive mode. A series of on-line "help aids" also assist the user in understanding each parameter's basic character, standard default values, and the sources of those values. The time required to call up a "help file," check a parameter's meaning, issue a command changing the parameter, run a 30-day European war, and record the data to generate upon demand any of hundreds of graphs (e.g., Figure 8), is about 15 minutes on a VAX 11/780. This capability for fast and flexible multiscenario analysis is unprecedented and exciting.

