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LEVERAGE IN AIR PENETRATION OPERATIONS

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In our Tactical Warfare methodology, the "value" to Blue at some specified future time $\left(V_{B_i}^B \right]_{t_2}$ of a Blue asset is a measure of the utility to Blue of possessing that functioning asset at time t_2 . The "value" to Blue of a Red asset $\left(V_{R_j}^B \right]_{t_2}$ is a measure of the disadvantage to Blue of Red possession of that asset at time t_2 .

This general definition implies several characteristics for the "value" computations:

- 1) Value deals with the future and has nothing to do with "sunk" costs, which are in the past.
- 2) Value must be calculated in connection with some "course of action". The asset being valued must contribute to the expectation of successful accomplishment of that course of action, and its value is proportional to the magnitude of its contribution.
- 3) Because of 2) above, value must be calculated in some "scenario" - presentation of some problem facing a decision maker.
- 4) The quantification of value depends on the "level" (echelon) and purposes (objectives) of the decision maker.

The method for quantification of Value ¹ applies to the problem of a Theater Air Force commander, or the commander of a major Air Force tactical unit, who must select targets for an Interdiction campaign. It is based on an assumption that the enemy (Red) has fielded a "well-designed force",

¹ See Chapter 6, *The Anatomy Of Combat*, RJVolluz & RMVolluz, 1996. www.AnatomyOfCombat.com

one in which the average long-range value of any one of his assets is proportional to the manpower investment in operation and maintenance of that asset.

This assumption is useful for the study of Interdiction, in which the targets are assets not yet committed to the battle. It neglects, however, the situational fluctuations in value which occur when the asset is committed. Red defense sites are always committed.

One could make the "well-designed force" assumption to establish the desirability of some "trade-off ratio" between Blue offensive aircraft and Red defense sites. However, the assumption would lead to neglect of one of the important aspects of the situation - the existence of Blue "leverage".

A Red defense site has value only to the extent that it defends something of greater value. It is committed to a single purpose, with no capability for the accomplishment of other military functions. Further, the Blue aircraft have the initiative - the choice of when and where to strike - and can employ several different strategies, or combinations thereof - to accomplish the penetration objective. Utilization of these advantages by Blue can result in making Red's fielded force "ill-designed" in the sense that the manpower investment in defense sites is out of proportion to the benefits realized.

In our opinion, the inventories of air defense means typically ascribed in scenarios to Warsaw Pact forces already represent an "ill-designed force". Guns and missile units, with logistic support and the necessary Command and Communications facilities can represent up to 15% of the postulated Red Order of Battle. Such a diversion to purely defensive assets should leave the Red force relatively deficient in other capabilities of great importance to their overall theater objective.

This aspect of the problem cannot be properly studied if the Red inventory is left "open-ended" and the enemy allowed to grow "ten feet tall". This effect occurs when scenarios are designed for special purposes (such as the study of aircraft penetration), or when the most pessimistic assumptions of intelligence agencies are taken as "threat" data.

The remedy would be to study scenarios in which the Red commitment to surface-to-air defense is treated parametrically, assumed to be at two or three different percentages of the total force.

Blue always has a choice as to the use of his aircraft. He can concentrate on Close Air Support and very shallow Interdiction, or he can attempt deep penetration against airfields (Air Superiority) and deep Interdiction targets. Against light defenses, he can accomplish both without excessive expense

in lost aircraft. Against very heavy defenses, he should probably concentrate on Close Air Support (CAS), while retaining the threat of deep penetration in order to freeze Red defenses.

By proper selection of strategy, Blue can lower the "Productivity" of the Red defense assets. Productivity is the ratio of utility (contribution to Combat Potential) to cost in committed manpower.

For some time period t_1 to t_2 the Productivity of the Red defenses would be calculated by:

$$\frac{\sum_i p_{B_i} \Big]_{t_1}^{t_2} \cdot V_{B_i}^R \Big]_{t_2} - \sum_k p_{T_k} \Big]_{t_1}^{t_2} \cdot V_{T_k}^R \Big]_{t_2} - \sum_j p_{R_j} \Big]_{t_1}^{t_2} \cdot V_{R_j}^R \Big]_{t_2}}{W_R(t_2 - t_1)}$$

where -

$p_{B_i} \Big]_{t_1}^{t_2}$ is the probability of kill of the i^{th} Blue aircraft during the period.

$V_{B_i}^R \Big]_{t_2}$ is the disutility to Red of having that aircraft functioning at t_2 .

$p_{T_k} \Big]_{t_1}^{t_2}$ is the probability of kill of the k^{th} prime target during the period.

$V_{T_k}^R \Big]_{t_2}$ is the utility to Red of having that target functioning at t_2 .

$p_{R_j} \Big]_{t_1}^{t_2}$ is the probability of kill of the j^{th} Red defense site during the period.

$V_{R_j}^R \Big]_{t_2}$ is the utility to Red of having that site functional at t_2 .

W_R is the Red manpower investment in Air Defense means.

Blue, by his selection of prime targets and penetration routes, controls the numerator within certain limits established by the inventory and capabilities of the Red defense sites.

If the overall Blue theater strategy, and the air resources, are sufficiently flexible, Blue can adjust the balance between deep and shallow penetration to reduce the Red defense Productivity. This would require that ground forces, supported by Close Air Support, have the capability to take advantage of the Red imbalance toward defensive means.

Even if some deep penetration is advisable, Blue can concentrate in a corridor of his choosing, using ECM, ARMs, Saturation, Exhaustion of defensive missiles, and Flak suppression to assist penetration. Red, meanwhile, is committed to a very dense defense of all available approaches.