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## DEVELOPMENT of METHODOLOGY for CLOSE AIR SUPPORT

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### 1. DISTINCTION BETWEEN CAS AND INTERDICTION

The distinction between the two modes of operation should be made in terms of purpose rather than of targets, depth behind FEBA, or other such criteria. Both operations are intended to influence the outcome of ground combat. However, CAS is used to support the immediate objectives of the ground units in contact, while Interdiction has a purpose of weakening the enemy's capability for sustaining combat in the (finite) future.

The actual target may well be the same in the two cases. The tank that is in position to deliver fire against supported (Blue) units is a CAS target; the tank that is moving up from the rear is an Interdiction target. The importance, which we term value, of the two targets is not the same. This value is measured in terms of the damage which the tank can do to Blue objectives. The tank that is moving up has a value equal to that of all other tanks at the same depth behind the FEBA. The tank which is committed has a value greater or less according to the effectiveness of its position and its potential influence on Blue tactics. It may have a value several times that of the average tank not yet committed, or it may be out of place and essentially valueless. Further, its value is likely to be highly time-dependent. To destroy it immediately may be a key to the local situation; to destroy it sometime later may not salvage a situation already lost.

CAS, if it is to fulfill the purpose of directly influencing the local ground combat, must be highly target-selective and time-responsive. Useful analysis of CAS requirements and performance must bring out these characteristics; it cannot be based on average performance against some static target list.

## 2. CAS AS A COMPONENT OF SUPPORT FIRE

The committed Blue units are normally backed up by a sizable inventory of Support Fire elements - mortars, artillery of various calibers, surface-to-surface missiles. In terms of destructive power for the investment in manpower (or in dollars) the expensive modern aircraft is simply not competitive with each of these surface means. Yet aircraft remains an important part of the Support Fire mix, because of unique attributes not shared by surface-launched weapons.

It is very important that analysis of CAS be made in a total battle context, including a modeling of other major Support Fire resources. In this way, CAS resources can be shaped to exploit their strengths rather than to compete directly with ground-launched weapons.

The major strengths of CAS are these:

- 1) Rapid concentration of "reinforcing" firepower at critical points.
- 2) "Direct" fire in "heavier caliber".
- 3) Optimum approach.
- 4) Greater suppressive effect.

These points will be discussed in turn.

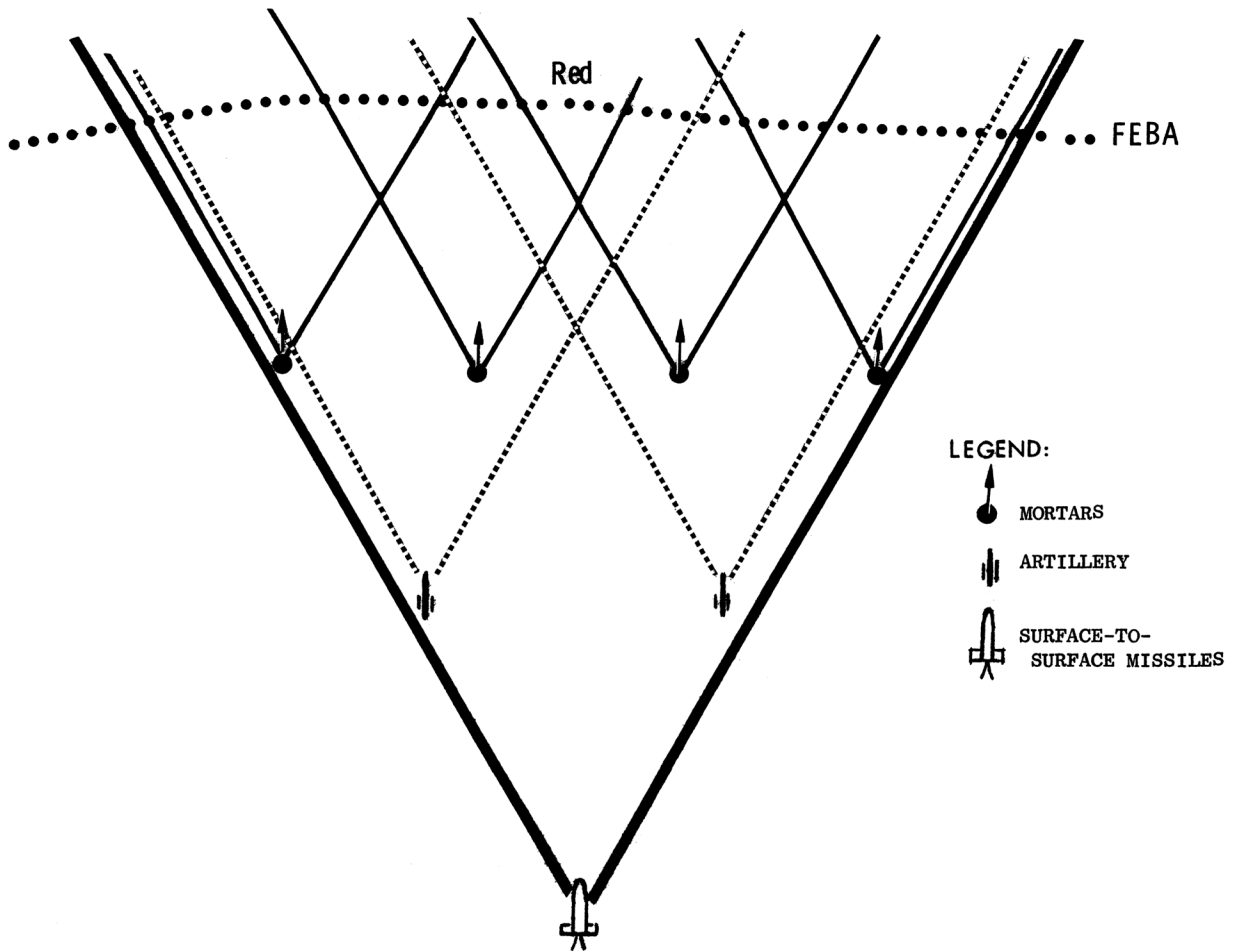
### 2.1 "REINFORCING" FIRE:

Typically, ground fire support systems are interlocked to cover the FEBA as shown schematically in Figure 1. Concentration at any designated point is limited to perhaps 1/3 of the available firepower of supporting weapons. Displacement of artillery is of course quite slow. By contrast, the entire CAS effort can be concentrated rapidly (and with tactical surprise) at any critical point.

### 2.2 "DIRECT" FIRE:

The aircraft can of course reach much further beyond the FEBA than can artillery. It sometimes seems that this leads to neglect (by CAS) of the "artillery zone". But aircraft have one natural advantage over artillery - the pilot can see what he is shooting at. Direct fire is inherently more accurate and responsive than indirect fire. Although indirect artillery fire can be observed and adjusted, a time lag is involved.

This advantage of aircraft vanishes, of course, with "stand-off" weapons.



*Figure 1 - Ground Support Fires are Interlocked*

### 2.3 OPTIMUM APPROACH:

Artillery is of course constrained to just one approach to a given target. Its firing position is fixed as is the trajectory for any range. In contrast, the aircraft can select that approach from which the target is most vulnerable. As an example, artillery fire will normally strike an advancing tank head-on, whereas a pilot can attack from the side with greater probability of at least a "mobility kill".

### 2.4 SUPPRESSIVE EFFECT:

Fire affects enemy elements in two ways - by damage and by suppression. Damage affects only one element, while suppression can cause all threatened elements to modify their behavior during the period of the threat. CAS aircraft on station have this attribute to a greater extent than artillery.

Until they leave the area enemy movement and functioning may well be severely limited to reduce probability of detection and/or damage.

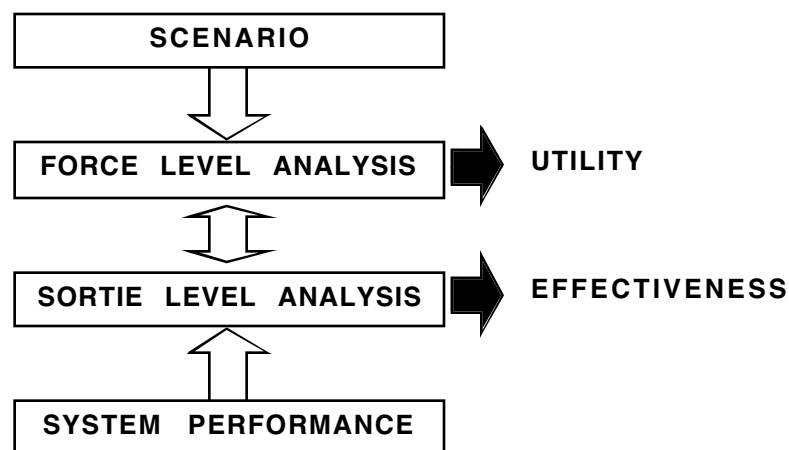
### 3. ANALYSIS FRAMEWORK FOR STUDY OF CAS

In its simplest form a quantitative analysis of CAS performance compares the performance capabilities of some specified weapon system against the requirements imposed by some selection of tasks (targets) and emerges with some measure of weapon effectiveness. This effectiveness measure may then be combined with considerations of dollar or other cost in an attempt to establish some measure of the utility (desirability) of incorporating the system in future force mixes.

The sortie-level analysis can be quite complex and consume most of the available analytic effort. This approach is naturally favored by design engineers, since it provides the type of detail on which design decisions can be based.

However, when most of the analytic effort is devoted to this task, the higher-level inputs and implications perforce are radically simplified. The study is readily attacked and discredited by simply questioning the assumed scenarios and postulated missions. Any subsequent study with different assumptions, but similarly narrow, is equally subject to attack.

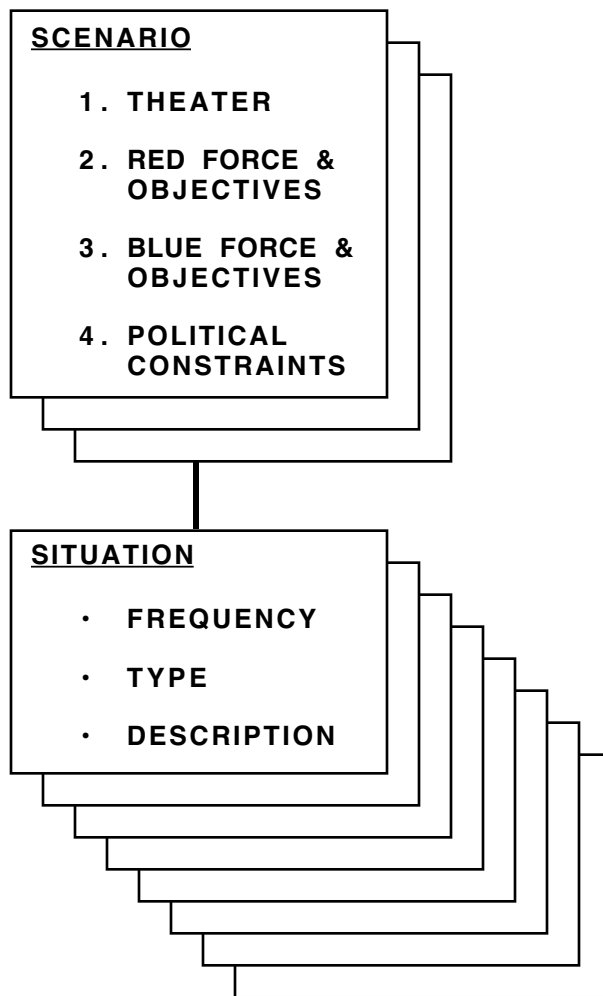
It is suggested that any organization having a continuing responsibility for analysis of CAS (or any other) operations should institute, and persevere in, development of some analytic framework which provides a continuing context for shorter-term studies. The remainder of this paper describes the constituents of one such analytic framework pictured in Fig. 2.



*Figure 2*

#### 4. SCENARIO AND SITUATIONS

At this unfortunate point (post-Vietnam) in our national history, it seems more important than ever before that military thinking cover a wide range of future contingencies. Previously employed "scenarios", with concentration on massive conflict in Europe, simply do not cover the range of critical situations within which the U.S. might find it advantageous to have a capability for the selective application of appropriate military force. "Isolationism" may predominate for a while, but this has always previously been a transient phenomenon, and military men have a duty to think beyond it.



*Figure 3*

As represented in Figure 3, a scenario should specify the following:

- 1) The theater of conflict, which of course implies terrain and climate.
- 2) Red (enemy) force and objectives. The objectives can be specified in both space and time; the combination of assets (force) and objectives establishes strategy and tactics.
- 3) Blue (friendly) force and objectives.
- 4) Any major political constraints - sanctuaries, prohibitions on certain weapons, etc.<sup>1</sup>

Any one scenario should be precise in definition of each of the above, so that alternative solutions may be measured against a standard scale. This means of course that the number of possible scenarios is unlimited. To be practical, one must select some limited number of scenarios for development, and these should differ sufficiently to have a significant effect on the outcome of the projected analysis.

It is not yet established what (and how much) scenario variation does have a significant effect on weapon design and effectiveness. To date the *Anatomy of Combat* approach has been to use three scenarios (Europe, Mid-East, and Vietnam), which have each had some development though the European scenario is the most complete. These were selected because of the radical differentiation as to theater, Red force and objectives, and political constraints.

As noted above, CAS requirements should be studied in a much more detailed context in order to bring out its relation to other Support Fire means. What is needed is a panel of "micro-scenarios", herein called "situations". To a reasonable extent suitable situations can be postulated from detailed development of a credible scenario. However, this is one point where the input of combat-experienced pilots is indispensable. Map study and logical analysis is unlikely to portray the wide range of conditions encountered in the field.

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<sup>1</sup> N.B. Our experiences in both Korea and Vietnam have shown some of these constraints (sanctuaries) to be very crippling, or perhaps fatal. This should not lead to refusal to study the problem. The scenario is an analytic tool, and study of the same scenario in versions both with and without sanctuary could be most illuminating.

The number of potential situations in any one scenario is as unlimited as the number of possible scenarios. It will be necessary to "type" the possible situations and form some estimate of the probable frequency of each type.

The situation has as many variables as the scenario, or perhaps even more. The following is a list of the chief characteristics which will distinguish one CAS situation from another.

- 1) "THEATER" (read Local Environment)
  - Terrain - Concealment, Cover, Trafficability
  - Weather - Day/Night, Adverse Weather
- 2) RED FORCE
  - Type Elements
  - Density of Terrain
- 3) RED OBJECTIVES
  - (Dictate degree of exposure)
- 4) BLUE FORCE
  - Available Support Fire Means
  - Proximity to Target
  - Observation and Communication Support to CAS
- 5) BLUE OBJECTIVES
  - (Establish value and urgency of targets)
- 6) POLITICAL CONSTRAINTS

It is not a priori obvious which of the above will be of importance in distinguishing among candidate CAS weapons, supporting systems, and tactics. Yet the list is too long to permit detailed variation of "type" situations for each characteristic. The best procedure will be to extract a few type-situations of widely varying characteristics, analyze weapon systems in each of them, and then determine sensitivity of results to variation in each of the above characteristics. In such way one could develop over a period of time, a panel of standard type-situations. Their importance and relative frequency in various scenarios is likely to be imprecise, but military experience can probably assist in this evaluation.

5. SORTIE-LEVEL ANALYSIS

The type-situations should be used to determine the effectiveness of CAS systems. "Effectiveness" should be regarded as the contribution made to the success of supporting units in attaining their objectives. Within *The Anatomy of Combat Tactical Warfare* methodology, effectiveness is measured by the magnitude of contribution to Blue Combat Potential ( $\pi_{C,B}$ ).

Effectiveness is only partially determined by destructive capability. Also of prime importance in CAS operations are timeliness, suppressive effect, and avoidance of damage to Blue assets or substantial impedance of other Blue operations. The measure of effectiveness must include these considerations; the concept of Combat Potential permits this inclusion.

Once the target and the fundamental conditions of engagement are defined, it is relatively simple to assess probability of damage or destruction. The analysis of timeliness, and of responsiveness to other conditions imposed by the situation is considerably more difficult. What is required to assess these considerations is a modeling of the total process diagrammed in Figure 4. It will be noted that a majority of the actions shown are information-handling.

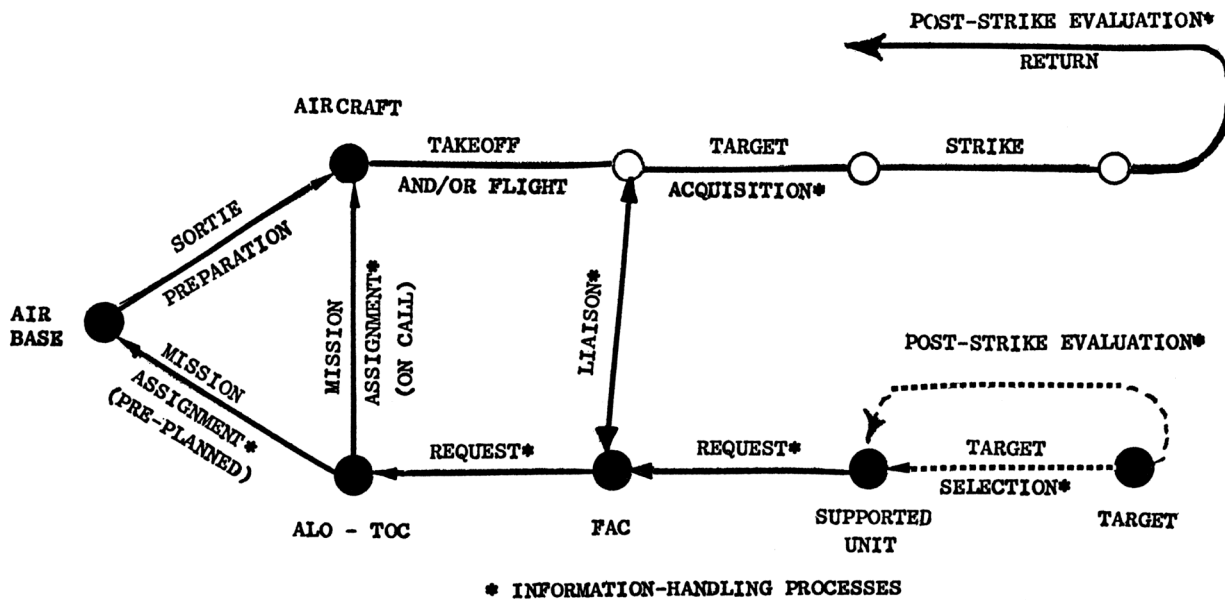


Figure 4 - Situation Level Analysis Response Time & Situation Constraints

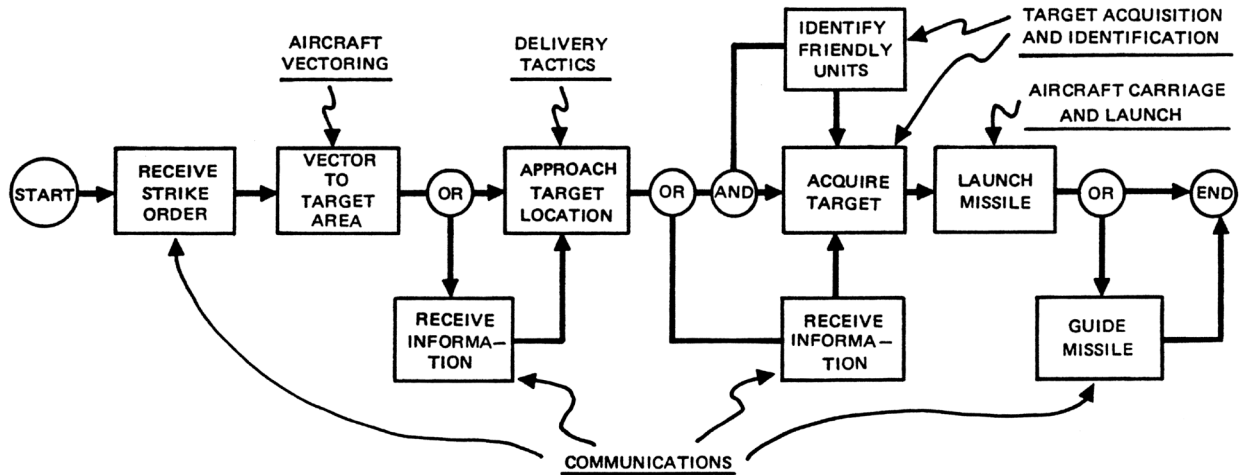
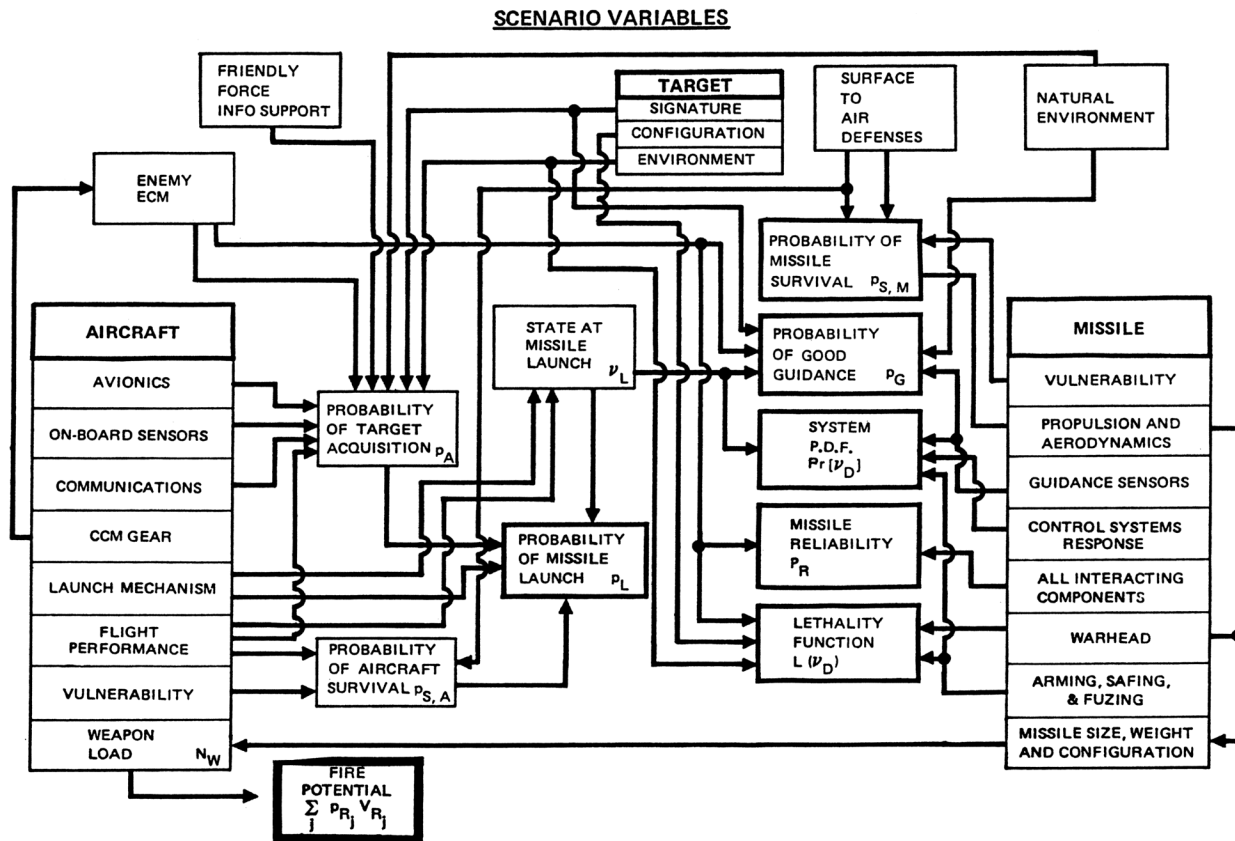


Figure 4 (a)

The Anatomy of Combat Tactical Warfare methodology recognizes three information-handling functions - Command, Intelligence, and Signal - and includes the concepts necessary for incorporating information-handling capabilities and limitations in an overall evaluation as diagrammed in Figure 5. However, to progress from concepts to a practical analytic procedure would require further development.



*Figure 5 - Close Air Support Evaluation Model*

The development required is actually two-fold.

- 1) An analytic procedure for assessing the probable delay between supported-unit request and weapons on target.
- 2) A procedure for expressing the effect of this delay on supported-unit operations. This would be expressed as a time-dependent target value.

## 6. FORCE LEVEL ANALYSIS

Situation level analysis will not establish a limit on the benefit to be derived from CAS (or any other form of support). Such limit must be derived from some calculation of "cost". During actual operations the "sunk costs" of original procurement and previous "life-cycle costs" are irrelevant. The assets are there to be used for military purposes and the only true "cost" is employment of assets for less than maximum return or wastage by non-employment.

These questions must be handled by force-level analysis; this compares the usage of aircraft for CAS to usage for Interdiction Fire, Strategic Fire, or Air Superiority operations. It should also compare the "return on investment" for aircraft to that of an equal investment in other military assets.

The Tactical Warfare methodology accomplishes these comparisons by use of a "Productivity Index",  $\mu$ .  $\mu$  is the ratio of Combat Potential increment ( $\Delta\pi_c$  in man-days) to manpower investment ( $W \Delta t$ , also in man-days). That system displaying the highest  $\mu$  is the most useful; the value of  $\mu$  is dependent on both scenario and performance variables.

## 7. SUMMARY

A complete analytic procedure for evaluation of Close Air Support should include:

- 1) Scenario and situation selection and development.
- 2) Situation-level analysis.
  - a. Of weapon effectiveness.
  - b. Of response to time and situation constraints.
- 3) Force-level analysis.

Repeated short-term studies tend to concentrate effort in the area of weapon effectiveness at the situation level (Area 2) a. above), neglecting the other tasks, which are considerably more complex and difficult.

These areas should be approached by longer-term studies at moderate level of effort.

## 8. REFERENCE

1. *The Anatomy of Combat*, 1996. [www.AnatomyOfCombat.com](http://www.AnatomyOfCombat.com)

