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Command: Modern Air Naval Operations is the high-fidelity warfare simulator from **WarfareSims.com**. Combining massive scale (the entire earth is your theater) and incredible depth and breadth (conflicts from 1946 to 2020+) with unprecedented detail, realism and accuracy, a powerful Windows interface and challenging AI, Command has set the new standard for air-naval war games.

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>
> **Michael Peck, War Is Boring:** *"This isn't just a game. It's a simulation that's as close as many of us will ever get to real Pentagon simulation.* C:MANO*, as fans call it, is a real-time game that boasts an incredibly rich—and unclassified—database of the aircraft and ships of the Cold War and beyond. [...] I strongly suspect that this game won't prove any less accurate than the government's tippity-top-secret simulations."*

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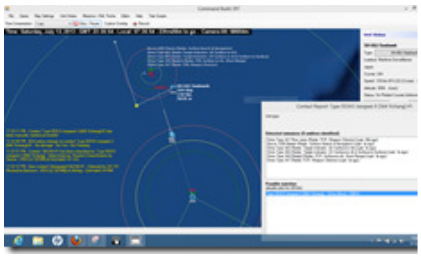


KITTING-UP FOR MUD-MOVING

Weaponeering for ground-attack air missions

By **Dimitris V. Dranidis**

Recently, we had a resurgence of posts on the discussion forum (http://www.harpoonhq.com/phpBB2/) on the subject of appropriate air-ground ordinance. The central question emerging is simple: what are the most appropriate munitions to load on aircraft that are going to perform a ground-attack mission. The answer is not as straightforward, and hinges on a multitude of factors. While experienced Pooners will by now probably have formed their personal-preference stock of weapons, it is quite easy for new players to get overwhelmed by the variety of loadouts available. To this end, it is useful to get back to the basics and examine the subject from the mission's perspective. The guidelines are H3-oriented, but can easily be adapted to any other version or even other simulations.

Mk-82 bombs being loaded on a B-52 prior to a strike mission

The end mission

The end objective of a ground-attack sortie is, almost invariably, the destruction of one or more land targets. As with all missions assigned to air assets, it is highly desirable that it be carried out

- In the shortest possible time
- With minimum losses
- With the lowest expenditures of munitions

Compromises

Ideally, the target will be located close to the base of air operations, will be fixed in location, in clear weather and under no cover from natural or man-made camouflage, and totally unprotected. Under these ideal conditions, the aircraft can simply load with virtually any weapon loadout and have an easy time pounding the target to eventual destruction. This however, is quite rarely the case.

As various restrictive factors begin entering the equation, the effective offensive payload has to rub shoulders with other items essential to the mission:

- Self-defence & SEAD equipment (both soft- and hard-kill) to deal with both area-coverage and terminal anti-air defences guarding the target(s).
- Fuel tanks, to increase the tactical strike radius
- Additional external-mounted navigation & targeting sensors, to increase the probability of correctly locating and attacking the target in bad weather conditions or in adverse background environment
- Air-to-air weaponry to deal with fighter patrols in the target area.
- Other items essential to the successful prosecution of the mission.

All these items will usually occupy both pylon space and weight, drastically restricting the available carriage options for the actual strike weapons.

Targeting-data provided by external platforms such as this E-8 JSTARS aircraft can greatly facilitate the effective employment of weapons

It can of course be argued that these restrictions can be considerably relaxed by off-loading some of the key mission necessities (navigation, fuel provision, self-defence etc.) to other platforms, leaving the actual striker free to carry more of its actual bombload. The USAF has long been a strong believer of this mindset, typically complementing its dedicated strike assets with tankers, specialised EW aircraft, fighter escorts and frequently long-range sensor platforms (AWACS/JSTARS etc.) in order to provide these necessities. However, specialising the task of each airframe has its own problems.

To begin with, such specialised assets tend to be very expensive and maintenance-intensive, dragging the mission planning schedules to their own readiness cycles, often prolonging the time at which a fully-assembled strike package is ready to launch. Furthermore, the reduced cross-redundancy that naturally follows task-specialisation can lead to "single point of failure" situations for the entire package. What if the

fighter escorts are neutralised or even simply drawn-off by enemy opposition on the way in? What if the highly-sophisticated navigation & sensor systems of the “pathfinder” aircraft simply break-down or are unable to perform their task due to an external factor? What if the tanker gets shot down or is forced to abort? What if the JSTARS misses a mobile SAM launcher that one of the strikers is in better position to detect (but has its own radar switched-off, relying on JSTARS instead)? Each of these trouble scenarios (and a gazillion variations of them) can lead to the mission having to be aborted or, even worse, the offensive package suffering unacceptable losses

As a result of this, many air forces are emphasizing the swing-role or "self-escorting" capability on their strike assets. This includes the USN which, although very strong in absolute numerical terms, suffers from having a limited number of air assets available at any given time and thus has to make maximum use of them. This is a mindset faithfully adhered to for decades in the Eastern block (although influenced there by other factors too, technological as well as doctrinal), and it is now gaining increased acceptance in the West as well. This can be clearly seen on the main features present on both new tactical aircraft as well as upgraded versions of older designs:

- Conformal fuel tanks for increased range without air-refuelling
- Greater number of stores pylons. Typically the extra pylons are not cleared for heavy attack stores and are instead used for self-defence weapons (A2A/SEAD) & electronic systems.
- Increased presence of on-board integrated self-protection suites, including active jamming and decoy systems.

It is interesting to note that most of these features result in a (sometimes significant) decrease of the platforms' outright flight performance, unless a significant propulsion uprate is included in the improvement package. It may thus be assumed that the majority of operators are prepared to accept a relative degradation of a mission profile's tangible "numerical specs" (speed & tactical radius at specified altitude, maneuvering ability with specified warload etc.) in order to increase the ability of their assets to survive and accomplish the mission.

Lots of pebbles or one big rock?

A question that can be the source of intense debate is whether the specified offensive load should be spread on a large number of munitions of relatively small warhead size, or instead concentrated on a few heavy-hitters. While testosterone-fuelled natural aggression would instinctively point to the latter option, the case is not so clear-cut. The employment of multiple weapons on a single target will generally yield a higher probability of at least some of them impacting successfully, whereas a single weapon will force a one-shot, hit-or-miss operation. This means that there is less risk of mission failure (as a result of a weapon miss) when multiple smaller weapons are employed. More weapons also means a larger number of available aimpoints, useful in a target-rich environment (e.g. a large airbase or port complex).

A definite heavy-hitter: a Kh-22 (AS-4) missile as carried under a Tu-22M bomber

On the other hand however, there are quite a few cases in which the nature of the target will mean that heavy-hitting weapons **have** to be employed. Heavily armoured targets for instance (armoured ships, hardened aircraft shelters etc.) may effortlessly absorb the damage caused by small weapons and require a direct hit by a heavy warhead (or preferably a penetrating one) in order to receive any substantial damage. Furthermore, one or a few heavy weapons can be released on a single one-pass attack, whereas multiple smaller munitions are usually difficult to ripple-fire (ROF limitations) all at once and have to be released in multiple successive passes, which increases the vulnerability of the parent aircraft to the enemy's defences.

Warhead characteristics

The various warheads of the different anti-surface weapons serve different needs with respect to the nature of the targets. For example, against numerous independent small targets (e.g. tanks or other vehicles) it would be desirable to employ cluster munitions rather than single HE warheads. Alternatively, an area-effect weapon such as a FAE bomb (or a nuclear weapon) might be employed in a similar situation. Runways are another interesting case. Special penetrating weapons such as the Durandal bomb or the Russian BetAB-series or the Czech Phobos system are most effective in this case. Other typical land-targets such as bridges, bunkers, oil tank farms and buildings can be effectively targeted with a wide range of weapons, including the most common HE warheads.

Enemy defences

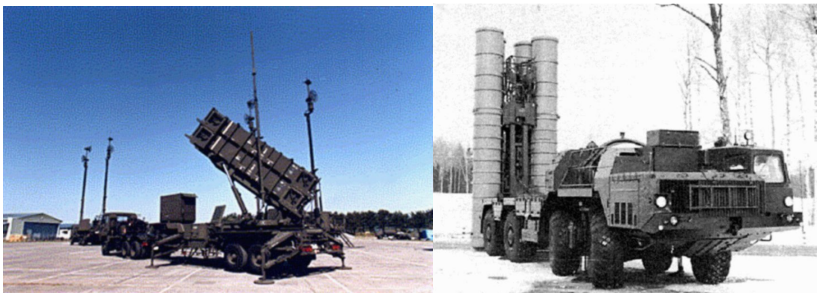
Another important consideration is the nature of enemy defences that will be encountered during the strike mission. The neutralisation of these defences is going to require additional weapons and other systems to deal with them. Ideally, these systems should be of the same type with the ones used for the strike itself (for example, air-to-surface missiles or cluster bombs to destroy SAM launchers) in order to provide the strike commander with the maximum in-

flight flexibility for shifting the employment of these weapons depending on how the tactical situation unfolds. However, this is rarely the case, for several reasons:

- The weapons most effective for the neutralisation of enemy defences are often specialised items quite different from the ones used for the main strike itself (e.g. air-to-air missiles or passive anti-radiation missiles)

- If the primary strike weapons require closing with (or overflying) the target area, as for example in the case of LGBs, the employment of similar weapons against enemy defences would dictate for the strikers (or their SEAD escorts) a significant and unnecessary increase of exposure (=vulnerability) for them.

- In the case where the primary strike weapons are long-range stand-off weapons (typically of a huge price tag, and thus of limited availability), it is difficult to justify the employment of such weapons for each and every type of target in the mission, as this would imply an inefficient expenditure of weapons. Although this normally not a consideration for a typical H2/3 scenario, campaign-style scenarios can really stretch the weapon resources and thus increase the importance of this point. (Of course, an alternative strategy is to employ the most capable weapons on the defences themselves, and then use the remainder on the primary targets).



The presence of high-end SAM systems such as the Patriot or the SA-10 can greatly complicate mission planning and weaponeering considerations

Thus the need arises to devote a portion of the overall package's stores capacity to defence-suppression weapons. If enemy fighter activity is expected, and the strikers are not swing-role then friendly fighters will have to be attached to the package. Otherwise, the defensive armament will have to share pylon space with the business-load on the strikers themselves. The exact type & quantity of defensive systems and weapons will be dictated by the capability level of the expected defences – it is one thing to strike a barracks complex guarded by a SA-2 battery and maybe the occasional export MiG-23, and quite another to attack the Severomorsk fleet support facilities, fending off waves of MiG-31s and Su-27s and jousting with multiple SA-10 sites. In the latter case, the strike-payload may well comprise a very small percentage of the total warload carried.

Weather

The prevailing weather patterns over the target area can also have a large impact on the weapons selected as well as on their delivery profile. Optically-delivered munitions (including those delivered in HUD-assistance modes e.g. CCIP/DTOS etc.) face severe restrictions in employment during nighttimes and/or in bad weather. Unguided free-fall weapons (iron bombs, cluster canisters etc.) can be delivered "blindly" during such circumstances using radar as a director (e.g. in CCRP mode). This delivery profile however is usually less accurate than optical HUD-assisted delivery. *(H2/3 factors-in the presence of such bombing-aiding systems as "computing bombsight" or "advanced bombsight", in order to model the inclusion of such components in real-life platforms).*

The employment of laser-guided weapons such as the US Paveway series is also significantly hindered in environments of severe humidity (including heavy storms) or in the presence of clouds, and also increases the vulnerability of the aircraft by forcing it to remain on the general target area until impact. Stand-off weapons that implement an EO or IR seeker for terminal guidance (such as the AGM-84E SLAM or the Kh-59/AS-13) face similar difficulties. Radar-guided weapons face no such difficulties but are of course actively emitting, which increases their vulnerability to detection and destruction. Satellite-guided (GPS, GLONASS, Galileo etc.) munitions are close to the ideal in this respect, as they can be guided to their targets under any weather conditions and fully autonomously – however they can fall victim to GPS-jammers depending on the enemy's level of technological sophistication.

Weapon inventory considerations

A sound rule of thumb in both real-life and the Harpoon simulation is that the more capable a weapon is, the fewer of them you will have at your disposal. This means that it is very important to manage these few silver bullets in a responsible manner. One often has to think not only in terms of the immediate mission at hand, but also of any necessary subsequent follow-up attacks either on the same target or in others (and also of other missions, yet unplanned but coming down the road). This becomes particularly important in longer-duration scenarios which revolve around the repetitive use of airpower against strongly-defended targets, where the prospect of extended offensive air-ops looms (it becomes even more critical in campaign-style scenarios where logistics alone can win or lose the fight).

A fairly popular method is to use the few high-tech weapons as force-multipliers, employing them against critical nodes in the enemy defences, hopefully opening-up gaps through which less sophisticated weapon systems can afterwards be successfully employed. This concept was employed to its full extent in Desert Storm: although PGMs and stand-off weapons (including cruise missiles) in that conflict were used relatively sparingly and in much smaller numbers than conventional unguided munitions, their disrupting effect allowed the latter weapons to be employed with high effectiveness. The effect of relaxed inventory restrictions can be clearly observed in the Kosovo air operations – here, a near-decade of PGM-stockpiling (combined with an emphatic political directive for minimal friendly casualties at all costs) allowed for a much more liberal use of advanced weapons even against targets of relatively low significance.

The AGM-130 stand-off weapon (shown here hung under an F-15E), was widely employed in the Kosovo air campaign. Its direct ancestor, the GBU-15 glide bomb, was used in small numbers in Desert Storm.

The advent of low-cost, precision or near-precision guidance kits for air-delivered munitions, such as the JDAM kit for HE-unitary bombs or the WCMD adaptation for cluster munitions, is likely to accelerate this trend of increased use of PGMs on the full spectrum of air-strike missions and across the full range of potential targets.

For most air forces however, the stockpile situation remains similar to that of NATO in the 70s/80s: an abundance of low-tech weapons that cannot be employed effectively unless enemy defences are first significantly reduced, and a small cache of advanced weapons & systems whose employment is hoped to achieve exactly that effect. Therefore the tactics & doctrine developed over these periods and extensively demonstrated during the second Gulf War remain relevant to a large extent.

In conclusion…?

All that is fine and dandy, I hear you say, but it doesn't directly answer the central question. What do I hit this bridge with? What do I use against tanks? Or against bunkers, or ships?

Currently, the mechanics of all computer versions of Harpoon treat damage-modelling to land facilities with a significant degree of abstraction. Although land units can be granted few or many damage points in order to represent the amount of damage they can absorb before being destroyed, and although there is the further modifier of four different armor protection levels, that is that. There is no differentiation between, say an unarmored 1000-DP bridge and an unarmored 1000-DP bunker: the same weapon may be used on both with the same exact results of DP-attrition. Flight-sim users may cringe at the thought, being accustomed to endless arguments about, say, whether a GBU-24B/B or a GBU-27 is more effective against a Type-X bridge and so on, but when one considers the scale at which Harpoon models air operations (actions involving entire TVDs and/or fleets are not uncommon), the necessity of some abstraction and simplification becomes apparent.

On the other hand, Harpoon models accurately many other parameters and factors that help determine the most suitable munition type for a given mission. These are some of the considerations that the wise player will take into account when planning:

- What is the weather in the target area like? Is the weapon under consideration capable of effective guidance on the target under the current weather? How is the weather and the general visibility (day/night?) going to affect the ability of the attack aircraft to locate the target?
- Is the target location fixed/predetermined or does a pre-strike reconnaissance have to be performed? If the target is a mobile platform then many stand-off weapons will be useless (cruise missiles until very recently, for example). If an active target search has to be performed just before the strike things can get quite tricky. Is the selected weapon going to provide sufficient targeting flexibility for such a case? (e.g. lock-on-after-launch capability)

- Is the weapon powerful enough for the selected target? Is it suitable to the target's nature? Damage-modelling simplifications aside, H2/3 does a good job at differentiating between the various warhead effects and the results of extra target armor. Sprinkling cluster munitions on an underground bunker, for instance, is probably not going to be on much effect – a hard-target penetrating bomb or missile (or a nuke) is in order. Likewise, a cluster of tanks is a rather poor choice for a single LGB. Light- and medium-caliber guns may have minimal effect against heavy or special armor, necessitating the use of heavy-caliber projectiles (or fast missiles).
- What stands between your forces and the target(s)? Does the primary strike weapon have the necessary range to avoid the worst of the defensive fire, or are additional defence-suppression weapons/systems in order? What are the capabilities of the enemy SAMs? Can they shoot down your stand-off weapons in-flight or can you just lob them and forget them? What about fighters? Are you going to avoid them, confront them or relegate them to others?
- What are the release parameters for the weapon in question? Does it have an unacceptably high minimum-release altitude that is going to ruin your by-the-book NOE ingress at the last moment? What about speed parameters? Does your high-speed bomb-truck have to slow-down in order to employ it? (Not good!)
- Is the target worth the weapon(s) you are considering? Are you going to use a half-million dollar Harpoon on a $1-billion cruiser or against a $20-grand gunboat? A $40.000 LGB is a good investment for a $30-million parked aircraft, but very inefficient for a $10.000 truck. Wasting precious munitions on cheap targets is a good way to run out of them when you really need them.
- What are the restrictions posed to your aircraft after weapons release? Are the weapons launch-and-leave (unguided, GPS-guided etc.) or do they require you to "stick around" until impact (LGBs etc.)? What effects will that have on the survivability of your assets? Are they going to be massacred by AAA or SR-SAMs while waiting for their payloads to hit? What alternatives are there?
- What about fuel? What is the ingress and egress profile? How much of the time are the aircraft going to spend in low-altitude or, worse, in afterburner? What about surprises? If an unexpected fighter group shows up, do all assets have enough fuel to either stay and fight or run like hell? A tanker or diversion airstrip can relax this issue a lot, but without it you need to plan for extra fuel tanks.

Obviously, the subject of weapon selection cannot be discussed in isolation, but rather has to be integrated into the greater subject of mission planning. This is exactly the course taken by real-life air force mission-planning systems around the world and thus, it is only natural that a similar procedure be followed in Harpoon. Once the big picture of the mission becomes clear, and with a bit of basic knowledge on weapons abilities and limitations (and logistics issues etc.), the choice should become significantly clearer.