HIMAT - HIGHLY MANEUVERABLE AIRCRAFT TECHNOLOGY

HIMAT and AFTI were both conceived in the same time frame, both are oriented toward investigation of high maneuverability aircraft technology.

HIMAT was originally chartered to explore high risk technology through use of flying scale models (RPV's).

Funding shortage caused shift to lower risk technology to make HIMAT objectives nearly identical to AFTI objectives.

Pursuing lower risk technology also increases program success probibility thereby insuring continued funding support.

Phases I & II of HIMAT are complete with three contractors generating full scale highly maneuverable fighter aircraft designs.

Phase III will investigate high maneuverability technologies incorporated in a Rockwell design through use of 44% flying scale models.

NASA is currently negotiating with Rockwell regarding specific objectives of Phase II.

The contract with Rockwell ($13.0M) will be finalized around the end of May.

Rockwell's designs for HIMAT, AFTI and ATF are of the same technological family making HIMAT results applicable to ATF as well as future air combat vehicles.

NASA talks to TAC and Navy regarding mission requirements to insure that HIMAT objectives are properly oriented towards military needs.

AIR FORCE PARTICIPATION IN HIMAT

AFFDL is currently negotiating an MOA with NASA which outlines reciprocal participation in HIMAT and AFTI.

In addition to a free data exchange, the main thrust of the MOA is reciprocal participation by the technical managers in steering committees, source selections, and program reviews.

NASA does not seem too enthusiastic about the MOA ... HIMAT is an ongoing program while AFTI is still a dream.

Even if all aspects of draft MOA are implemented, AF participation in HIMAT would be largely cosmetic.

The only substantive AF participation is a $1.0M contribution to HIMAT in FY 77 to explore 2-D nozzle/jet flap technology.

AFTI - AIR FORCE TECHNOLOGY INTEGRATOR

Exploration of high maneuverability aircraft technology through use of a manned vehicle.

Program is geared to lower risk technology which can be investigated with a manned aircraft in the immediate future.

The original AFTI conceptual vehicle, powered by J-85 engines, lacks the performance of F-15/16.

For an AFTI vehicle having performance comparable with current fighters, the program costs approach $100M (less than $40M for J-85 Program).

Alternate options being explored utilize F-15, F-16, or F-17 vehicles.

AFTI emphasizes exploration of the man/machine interface.

CONCLUSIONS:

The results of the HIMAT program will have direct military application (~~most likely will be basis for~~ basic data for generating next ATF ROC).

To insure greatest payoff to the AF, HIMAT should be oriented toward AF requirements.

If the AF is to significantly impact the HIMAT program, action must be taken immediately to make it a joint AF/NASA program.

RECOMMENDATION:

The AF should immediately program manpower and resources (dollars) to the HIMAT program to insure that orientation is maintained toward technology having direct military application.

OTHER NOTES

NASA FRC is getting #2 and #8 F-15's. Initial investigation will correlate aircraft spin data with data derived from F-15 drop model program.

NASA Langly is working with TAC to develop a missile that is highly agile.

$$\frac{PF}{PF-1} = 1.22$$

$$\frac{W_S - W_F}{W_F} = \frac{\Delta W}{W_F}$$

$$\frac{1}{1-\frac{1}{1}}$$

$$\frac{W_S}{W_F}$$

$$\left(\frac{V}{SFC}\right)\left(\frac{L}{D}\right) \ln\left(\frac{W_S}{W_F}\right)$$

$$\ln\left(\frac{W_S}{W_F}\right) = \frac{S}{\left(\frac{V}{SFC}\right)\left(\frac{L}{D}\right)}$$

$$\frac{1}{2-PF}$$

$$\frac{1}{1.22} = 1 - PF$$

$$\frac{W_S}{W_F}$$

$$\frac{1}{1-PF} = 1.22$$

$$PF = 1 - \frac{1}{1.22}$$

$$\frac{1}{1.22} = 1 - \frac{1}{PF}$$

$$PF = \frac{1.22-1}{1.22}$$

$$\frac{W_S}{W_F} = \frac{1}{1-PF}$$

$$PF = 1 - \frac{1}{1.22}$$

$$\frac{W_S - W_F}{W_S}$$

$$y = e^x$$

$$\ln y = x$$

$$PF = e^{\ln}$$

Gaining and Exploiting Initiative

In order to gain and maintain the initiative on today's high-intensity and lethal battlefield, the underlying purpose of every encounter must be to seize and/or retain independence of action through maneuver. To do this, we must continuously decide and act more quickly than the enemy. We must present him with new problems so frequently that we disorganize his forces and keep him off balance. My purpose here is to present a theory which, if put into practice in our training and operations, will enable us to do this. The theory was developed by Colonel John Boyd, USAF (Ret.), and centers around the concept of the *OODA LOOP.*

An *OODA LOOP* is an observation-orientation-decision-action (OODA) cycle. As operations are conducted, individuals and units at every level continuously are going through these cycles. As an example: a U.S. tank is in bounding overwatch and the tank commander starts a cycle by observing a *T-72.* The tank commander orients himself by identifying the tank as enemy and noting that both tanks are in range of each other. He decides to engage and acts by issuing the appropriate fire command. The enemy tank commander has made a similar observation and gone through a similar cycle. The tank that survives will be the one that completed the *OODA LOOP* first.

The *OODA LOOP* of the tank commander is not independent of other actions. Instead, while that cycle is being acted through, the platoon leader observes that, in fact, a Soviet tank company is approaching. He goes through his own cycle and acts by issuing a platoon fire command and informing the company commander. Using the spot report as an observation, the company commander orients by considering the mission of the company, the relative positions of the platoons, and their capabilities. He decides and acts by issuing orders which reposition the reserve platoon. Thus, each *OODA LOOP* is not only independent of other cycles, it may intitiate a new cycle at a higher or lower echelon, or it may already be part of a larger cycle.

Understanding and employing the *OODA LOOP* will assist us in obtaining our goal of gaining and/or maintaining the initiative in battle. Given the same observation, the tank which reaches the action phase of *OODA* first will survive. If the platoon can reach the action phase of platoon fires, it stands a good chance of evening out the 3-to-1 odds initially held by the *T-72s.* Still, these are simple advantages. The cumulative advantages of continuously completing cycles first are far more devastating.

When the Soviet tank company commander received his initial spot report (at the same time as the U.S. platoon leader), he went through his own cycle and issued a fire command to his lead platoon. However, the U.S. platoon, by cycling faster, fired on and destroyed the lead *T-72* platoon, rendering the Soviet commander's initial decision meaningless. Now, the Soviet commander must go through a new cycle observing that he has three less tanks and the U.S. platoon is now hull-down in relatively secure positions. His new decision, after taking time to complete his cycle, is to bypass and he issues orders accordingly. Except that, in acting, the *T-72s* run straight into the reserve platoon which the U.S. company commander, again by moving more quickly through his *OODA LOOP,* has already repositioned. The Soviet company commander, now totally frustrated and with only four tanks left, takes up a defensive position and calls for reinforcements.

By continuously deciding and acting more quickly than the enemy, the U.S. commander has disorganized his forces, kept him off balance, and defeated him. By repeatedly cycling through *OODA LOOPs* more rapidly than the enemy, the U.S. commander has gained the initiative by creating a situation where the Soviet is continually reacting to him and it appears to him that his force's reactions are always slower than his enemy's and doomed to failure.

Thus, given that our objective must be, at every level, to cycle through our *OODA LOOPs* as quickly as possible, we must examine the cycles we will be a part of to streamline them to the maximum extent possible. Needless to say, the examination and streamlining of the *OODA LOOP* of a platoon reacting to indirect fire is far less complex than that of a battalion absorbing an enemy attack and then conducting a counterattack. Following are examples of the *OODA LOOPs* by phase at each level:

The *observation* phase requires a rapid, accurate determination of the situation and a reporting of the information rapidly up and down the chain of command. Early warning allows cycles at each level to be initiated. Every intelligence-gathering device within the battalion must be used; bare eyes, binoculars, tank/*TOW/DRAGON* sights and ground surveillance radars must be focused on determining enemy intentions. During periods of limited visibility, every night observation device in the unit must be manned. Continuous reconnaissance patrols will assist in gaining early notice of enemy actions. Once the observations are made, command and intelligence nets must give priority to the passing of reports to commanders and staffs.

The *orientation* phase requires that the commander have a solid foundation of knowledge. At each level, the location and capabilities of friendly and enemy units, terrain, weather, and intentions of friendly higher commanders must be known. When new observations or information becomes available, the commander, with his staff (if he has one), can determine courses of action to best take advantage of the situation. Sound contingency planning, even if it is just a platoon leader thinking "what would I do if. . .?" will lead to a preparedness to transition rapidly through the orientation phase.

The *decision* phase should be the shortest of all. Given reliable observations and a solid orientation, the commander should be able to quickly make a firm decision and translate it into orders. Leaders at all levels should constantly practice and be required to make tactical decisions. Since new information will be arriving all the time, leaders must learn to act when enough information is available for a sound decision and not wait until every last detail is known.

Effective conduct of the *action* phase will, of course, be dependent on the technical and tactical expertise of the unit, as well as strong command and control procedures.

A discussion of some specific elements will aid in improving your ability to cycle through *OODA LOOPs.* Tank crews and platoons must be expert at the battle drills which make up most of their combat activities. Each drill is an *OODA LOOP* in itself and, if completed efficiently, will enable the crew or platoon to move on to their next objective. The

battalion staff is critical to the battalion being capable of rapidly cycling through an event. The tactical operations center (TOC) staff must be trained to absorb information and translate it into course of action (plans) from which the commander can make a decision. The early completion of plans will allow a rapid transition to the action phase once the commander has made his decision. During all phases of a cycle, the TOC acts as a vehicle to facilitate command and control and rapid passing of information. The tactical command post (TAC CP) allows the battalion commander to move forward to where he can add his own observations to a cycle. A well-trained TAC CP, acting as a mini-TOC, can conduct short-range immediate operations *OODA LOOPs*, allowing the TOC, with its greater resources, to handle the long-range *OODA LOOPs* that require the extensive information gathering, planning, and coordinating of more detailed operations.

In summation, we have observed that each operation, at every level, consists of an observation-orientation-decision-action loop; that these loops are occurring continuously and simultaneously at every level in both forces; that the force which understands and exploits the *OODA LOOP* first will gain and maintain the initiative by deciding and acting more quickly, thus making the enemy's reactions increasingly less effective.

The cumulative effect of the enemy losing initiative and the capability to make a meaningful response to our actions will eventually defeat him. Finally, throughout the army, we can establish and train in operational procedures at every level that will allow us to exploit the *OODA LOOP*.

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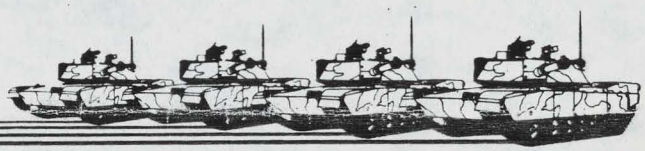

FASTS — and FASTS (Forward)

Today's armored forces will consume huge quantities of fuel, ammunition and parts in combat. Assuming the combat forces to be equal, the side that can most rapidly resupply, repair and/or replace its forces will win.

Current doctrine is based on the AirLand Battle, which entails striking at the enemy's second echelon before it is deployed. The commander will have to commit some of his mechanized forces to this effort, but if he cannot provide a viable logistic base for its support, such a maneuver is foredoomed. The introduction of the *Abrams M1* tank and the *M2/3 Bradley* vehicles have only added to the commander's logistical problems.

The majority of our present ammunition and fuel supply vehicles are wheeled and have a limited cross-country ability. This will preclude their keeping up with the tracked fighting vehicles. This situation will continue for some years to come. Compounding the supply problem further is the increased range of Threat artillery which will force our support teams even farther behind the fighting area. This dispersion not only complicates the support problem, it reduces the ability of our fighting forces to exploit any initiative they may have secured.

Currently, the forward area support team (FAST) that is committed in each brigade sector of our mechanized divisions consists of a forward support maintenance company, a medical evacuation company and elements of the division's supply and transport battalion that provide fuel, ammunition and food. With the addition of graves registration and communications assets, as well as portions of task force field trains, the FAST can be expected to cover between four and 12 square kilometers. The forward support battalion of Divison 86 will probably serve to increase the area needed to locate the support area.

Rarely will this organization be located closer than 30 kilometers to the brigade's front line. The vast majority of vehicles in the FAST will be unarmored and the commander will be unwilling to chance the destruction of a large percentage of his support by allowing it within enemy artillery range. His concerns will not be lessened by the knowledge that it is extremely difficult to electronically and visually hide this organization. Although this location will allow support of operations along the front, it will be unable to provide responsive support to a rapid strike force closing in on second echelon enemy forces that may be 20 kilometers or more behind the front.

Every round trip that task force ammunition and fuel vehicles will be required to make to the brigade support area could well take a minimum of 3-5 hours. Every disabled vehicle that task force recovery vehicles have to drag back to the FAST will remove those recovery vehicles from immediate task force support for at least five hours. An engaged task force might find itself without its organic support elements available if it were to receive a rapid change of mission.

A miniature FAST, or FAST forward, will have to be used if the task forces are to be provided with the combat support they will desperately need. This element will have to be small and extremely mobile, providing only those items that are essential to sustain the forces in contact and will have to be equipped with armored, tracked vehicles and sited within 7-12 kilometers of the line of contact. Diesel fuel, tank, TOW, and small arms ammunition will most probably be the critical supply items. Two 5,000-gallon tankers and two 12½-ton tractor trailers of ammunition will provide much of the rapidly-consumed items that the brigade task forces might need to execute a mission. When all the fuel or ammunition on one trailer is exhausted, it can return to the FAST for replenishment. Items and classes of supply not available at the forward FAST can be obtained at the rear FAST or the division support area.

Maintenance support must also be provided in the forward FAST. Contact teams from the division forward support company and battle damage evaluators need to locate with the forward FAST and begin a triage system on disabled vehicles.

These teams will repair vehicles or assist units making repairs on vehicles that can be rapidly returned to battle. The teams will also decide which vehicles must be sent to the forward support company in the FAST, to the heavy DS