The A-5 Vigilante

by Roger L. Wood

An Enduring Chapter of America's National Defense History

The first YA3J-1 Vigilante at the North American, Columbus, Ohio plant in 1958. (Photo from the AAHS collection)

Editor's Comment: This excellent article was written around 2001-2002. It was recently found buried in our archives with no explanation as to why it had not been previously published. In reading, you'll find statements that are obviously dated, but that, for the most part, are still applicable.

The story of the A-5 Vigilante is of a remarkable, high performance carrier-based aircraft, first fielded in the 1960s; and then evolved during the Vietnam War period into the most effective tactical reconnaissance system ever made available to American forces. Along the way, the Vigilante left some enduring legacies for national defense:

- It set technology and design standards that paved the way for today's front line aircraft.
- It set a lasting benchmark for modern, multi-sensor tactical reconnaissance.
- It used management methods that could benefit new defense programs even today.

This story is dedicated to the U.S. Navy and North American Aviation people who produced and flew the Vigilante; proud in knowing that they were part of an enduring national accomplishment.

America has rediscovered some critical warfighting lessons during recent international conflicts. High among these is the importance of modern tactical reconnaissance, using multi-sensor systems capable of collecting a full range of intelligence in the theater of battle under the control of local commanders.

America's benchmark capability for tactical reconnaissance has long been the RA-5C Vigilante, a remarkably advanced system originated early in the Cold War by Navy leaders who had the foresight to envision the worldwide tactical role that Naval Aviation so effectively provides today.

The A-5A Vigilante was started in the mid-1950s as a highly advanced attack aircraft for both nuclear and conventional weapon delivery. During the early 1960s, its versatile airframe and electronics served as the foundation for growth to a full capability reconnaissance configuration, supporting Naval Aviation's evolving tactical role at the same time systems like the SR-71 and special satellites were being developed for strategic or "national" reconnaissance.

The RA-5C served for two decades as America's most comprehensive and fully integrated tactical reconnaissance capability, including exemplary duty off Yankee Station during the Vietnam conflict.

This publication reviews three aspects of the Vigilante Story that have left an enduring legacy:

Modern Technology—It doesn't take a discerning eye to recognize that this aircraft, originated for high speed, low-altitude, carrier-based attack, also established modern design standards for front-line American and Soviet fighters that remain operational today. A look at the Vigilante's variable geometry inlets and overall planform shows close similarities to the Navy F-14 and F-18E/F, the USAF F-15 and late generation Russian MiG fighters. In addition, precedent-setting electronic capabilities like the first airborne inertial navigation and digital computer, the first operational fly-by-wire flight controls and the first subsonic and supersonic escape system made the A-5A the most advanced carrier aircraft of its time.

Integrated Reconnaissance—The definitive Vigilante was the RA-5C, the fleet's tactical reconnaissance eyes and the airborne element of the Navy's Integrated Operational Intelligence System (IOIS) for two decades. This publication is devoted to the RA-5C/IOIS because it demonstrates an important fact known in the 1960s and rediscovered in recent conflicts: collection and analysis of tactical intelligence using a well integrated, full-spectrum, multi-sensor aircraft system under the control of local theater commanders is just as essential today as it was in the Cold War Era.

Management Successes—Periodic reviews of America's defense acquisition process often include a review of lessons-learned from past successful programs. The Vigilante provides a virtual management case study of good practices that could benefit current defense acquisitions by shortening development timing and otherwise improving the affordability of national defense as America's prepares to transform its military for the 21st century.

For a decade and a half after WWII, Naval Aviation forces had the responsibility to deliver both nuclear and conventional weapons over the beach and to the enemy's heartland in the event of major hostilities. As a historical footnote, this Navy nuclear attack role and the later Navy/AF strategic triad evolved in part from postwar limitations on storage of nuclear weapons abroad.

In the late 1940s and through the 1950s, the Navy used subsonic AM Savages and A-3D Skywarriors to satisfy its nuclear attack mission. However, improving Soviet radar soon obsoleted these subsonic aircraft and fastbreaking U.S. technologies set the stage for new defense doctrines. Among these was the concept of developing a high-speed, under-the-radar attack aircraft with very accurate long-range navigation, weapon delivery and electronic countermeasures to suppress enemy defenses. Such an aircraft could also be adapted for high-speed, multi-sensor reconnaissance, anticipating a world in which enemy battlefield capabilities would be ever more mobile and advanced.

The A-5A Vigilante was selected in 1955 for this new attack mission and it provided the airframe and systems flexibility to effectively evolve to the RA-5C Reconnaissance System in the early 1960s. In these two developments, North American Aviation designed the most advanced combat systems introduced into the Navy's inventory up to that time.

Although the A-5A's many operational firsts set a precedent for years to come, they are part of a larger story starting with the difficult-to-assimilate Navy attack requirements, which heavily influenced the basic Vigilante airframe and systems design.

Subsonic performance had become outdated with many mission planners in the 1950s. The Vigilante's original attack mission requirements were therefore not only demanding, but also very diverse. As an example, the requirement for supersonic penetration at both high and low altitude would probably have led to a variable geometry wing design today. But that technology was not yet ready for operational use in the 1950s. Electronic mission requirements were likewise at the cutting edge. These included very precise long-range navigation and bombing accuracies, requiring a totally integrated system that linked navigation, weapon delivery and flight control for any required operating mode or maneuver.

Similarly, a fully integrated defensive countermeasures system was required because enemy threats had advanced to the point that they were becoming radar controlled and were beginning to track jet engine exhausts.

Trading off and optimizing a configuration for these demanding requirements led to many of the Vigilante's technology advancements and flexibility for future growth. The final design addressed supersonic hi-lo performance with a thin, sharply swept wing having 700 sq. ft. of area and blown flaps. Slot deflector spoilers were used instead of ailerons for high-speed, low-altitude stability and control. In fact, the Vigilante had the first operational fly-by-wire flight controls.

These were highly advanced technologies for the time and they provided excellent transonic low-altitude performance combined with Mach 2 high-altitude performance. Moreover, the Vigilante's low wind-over-the-deck catapulting capability provided tremendous potential for later payload and range

DEMANDING MISSION REQUIREMENTS

- Very High Speed Performance at both High and Low altitude
- High Wing Loading for Low Wind-Over-the-Deck Catapulting
- Very Precise, Long-Range Autonavigation to the Target Area
- Stealthy Penetration and Effective On-the-Deck Radar Evasion

A-5A VIGILANTE OPERATIONAL FIRSTS

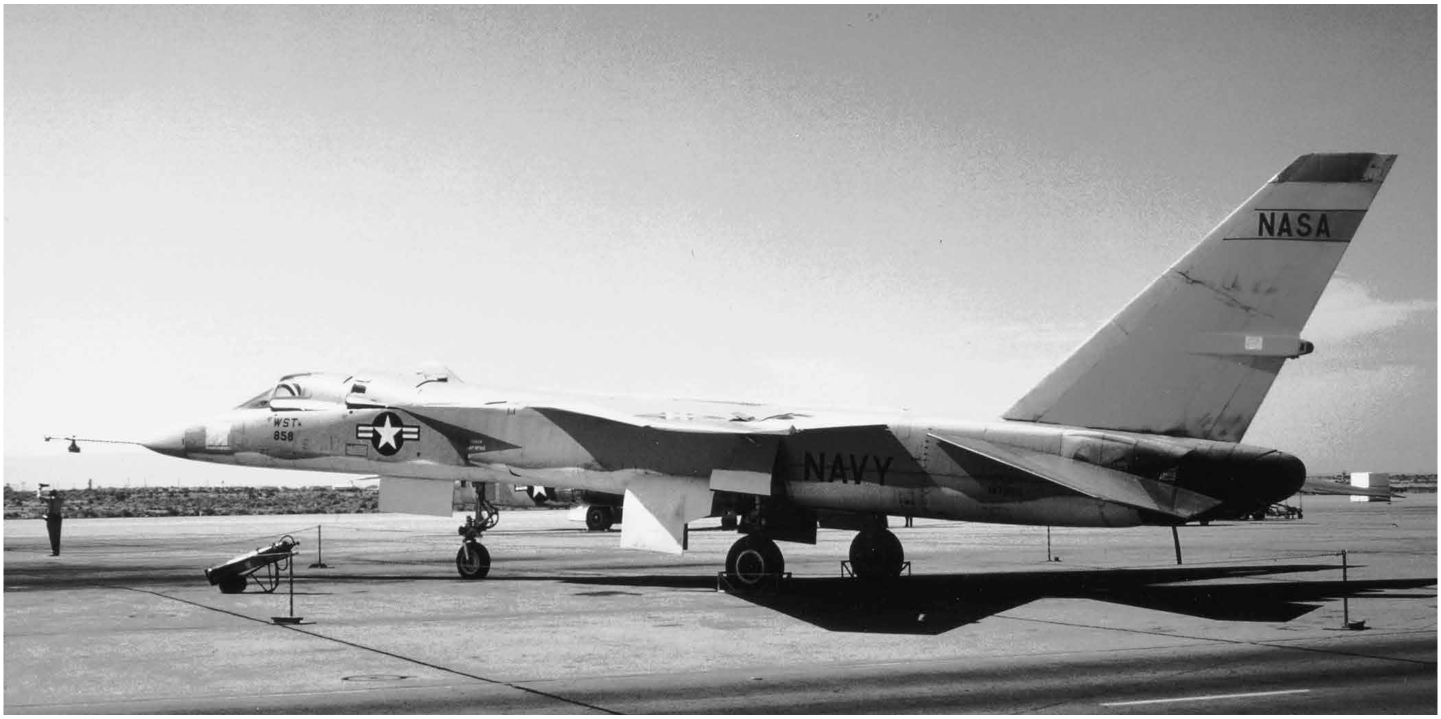
Airframe

- First Supersonic Hi/Lo-Altitude Carrier Aircraft
- First Production Fly-by-Wire Flight Controls
- First Deflector/Spoiler Controls (No Ailerons)
- First Variable Geometry Horizontal Ramp Inlet
- First Integrated Linear Bomb Bay Systems
- First Subsonic and Supersonic Escape System

Electronic Systems

- First Integrated Inertial Nav/Bombing Control
- First Digital Navigation & Bombing Computer
- First Production Heads-Up Display System
- First Intrgrated Terrain Avoidance System
- First Integrated Electronic Warfare System

These technologies all served as a strong foundation fot the RA-5C.



An early Vigilante NASA test aircraft probably at Air Force Plant 42, Palmdale, California circa 1963. (Photo from the John Dzurica, Jr. collection)

growth when launched under normal wind-over-the-deck conditions.

The Vigilante's many operational "firsts"; (above) all of which were fully integrated into the system and enabled evolution from attack to tactical reconnaissance missions. These firsts are further demonstrated by the significant planform similarities between the Vigilante and the Soviet Foxbat and later series MiG fighters that are leading Soviet air superiority assets – not attack aircraft – and remain in frontline operational service yet today.

From the day in late August 1958 when the A-5A Vigilante first flew in the hands of North American's chief test pilot, Dick Wenzel, it was clear that this was to be a remarkably capable aircraft. In flight test, it was found to have outstanding performance because of a clean aerodynamic design and highly integrated controls.

There are many anecdotes from the Vigilante's test program that demonstrate its capabilities, including significant new world speed and altitude records. In June 1960, the noted aviatrix Jackie Cochran, then President of the Federation Aeronautique Internationale, became the first woman to fly Mach 2. Riding back seat in the Vigilante, she participated in a speed run that reached Mach 2.2 at 47,000 feet. This was closely followed by a new world altitude record in the 1,000kg class when a Vigilante flying out of Palmdale, Calif., flew a zoom profile that peaked at 91,451 feet. The crew, Navy Cmdr. Leroy Heath and Lt. Larry Monroe were awarded the Distinguished Flying Cross and Air Medal.

Ed Gillespie, North American's well-known test pilot tells many Vigilante anecdotes, including two that demonstrate its speed. In 1963, Gillespie flew an RA-5C from North American's Columbus, Ohio, plant to NAS Sanford, near Orlando, Fla., on the kind of high mach, high altitude, maximum range flight that today would be referred to as a "supercruise" mission. With 22,000 lb. of fuel onboard at takeoff, Gillespie maintained constant Mach 1.5 to 1.8 speeds at varying altitudes between 35,000 and 50,000 feet, to land at Sanford only 58 minutes after brake release at Columbus, with 2400 lb. of fuel remaining. Earlier in 1963, Gillespie achieved 815 knots at 10,000 ft. during an RA-5C speed run out of Patuxent River, Maryland. Even today, there are few aircraft of any type that can fly that fast at low altitude.

Vigilante structural testing covered unprecedented static strength and fatigue life levels. Indeed, its structural design also included several "firsts," including the use of 2020 lithium aluminum alloy in the wing and the first use of H-11 steel in strength-critical fuselage machined parts. Aircraft using 2020 alloy remain at the cutting edge of structural design even today.

This sophisticated aircraft was developed and fielded much faster than systems being procured by DOD today. Perhaps DOD's largest and most costly problem with modern defense acquisitions is that the development cycle time has reached two decades or more for complex new systems and a decade or more for non-complex items. Indeed the development cycle time for the Air Force's new

VIGILANTE DEVELOPMENT CYCLE

A-5A

- Development Go-ahead – June 1955
- Mock-up Review Board – March 1956
- First A-5A Flight – August 1958
- Carrier Testing Complete – July 1960
- First Operational Squadron – June 1960

RA-5C

- Development Go-Ahead – December 1960
- First RA-5C Flight – June 1962
- Operational Deployment – July 1964

Test Locations

- Performance – NAA Cols/Palmdale
- Carrier Suitability – USN Patuxent River
- Nuclear Weapon Test – Sandia/Kirkland
- Escape System Test – USAF/Holloman

F-22 fighter has been 20 years – and it will not be fielded until 2005. In contrast, the A-5A's cycle time (below) from go-ahead in mid-1955 until first flight in mid-1958 was only two years and only four years until operational fielding in mid-1960. Similarly, the extremely advanced RA-5C took only 3-1/2 years from development go-ahead in late 1960 to operational fielding in mid-1964; and this short time period included development and installation of its associated shipboard intelligence center. This was largely the result of specific management practices developed for the RA-5C as discussed later.

After WWII and into the 1950s, U.S. intelligence was focused principally on strategic threats using single, nonintegrated sensors. Navy "P" and "Q" squadrons flew the North American AJ-2P, the Martin P4M-1Q, Douglas A3D-2Q/P and Vought F8U-1P to perform photographic and electronic intelligence (ELINT) missions out of selected bases around the world. But these assets were tasked mainly for "national" intelligence and were not equipped for full-spectrum, multi-sensor reconnaissance. Consequently, they did not support an emerging view at high Navy command levels that Naval aviation would soon take on a much larger worldwide tactical role.

The Navy's requirements for an advanced multi-sensor tactical intelligence system were conceived and firmed up in 1957 through 1959 under the leadership of the Chief of Naval Operations, Admiral Arleigh Burke, with able support from other key Navy leaders, including Admirals Russel, Pirie and Schoech.

The stimulus for their decision was the far-reaching change that they saw on the horizon for the Navy's national future defense role. Although strategic targets seemed to be the leading mission to most Naval aviators in the late 1950s, there were those like Admiral Burke who foresaw the likelihood that the Air Force's Strategic Air Command Fleet and the Navy's Polaris submarine fleet would eventually be given the mission of targeting the majority of Soviet strategic threats. Although naval aviation's strategic role would thus pass with time, it was clear to Admiral Burke and his team that U.S. carrier task forces would instead be assigned responsibility for an equally critical mission; that of worldwide force projection and rapid response to localized conflicts, independent of landbasing.

In other words, tactical operations would become the principal role of naval aviation, meaning that comprehensive and timely tactical reconnaissance would become far more important than it had been before. And, it could not be limited to past single-sensor intelligence gathering because rapidly advancing enemy weapons and improved force mobility in the tactical theater would require an integrated multisensor system. In addition, the new system should be under theater command for rapid threat assessment and targeting, rather than control at CONUS command centers as had become characteristic of centralized strategic operations.

As a result, considerable thought was given to carrier-based tactical reconnaissance. Tactical conflicts in the second half of the 20th century were expected to be characterized by highly mobile forces, both adversary and friendly, as well as a wide variety of sophisticated weapons and rapidly changing battlefield conditions. As an example, while a typical WWII over-the-beach assault mission might have engaged enemy forces within only a few miles radius, post-WWII technologies were greatly extending the range and mobility of combat systems, thereby significantly expanding the battle theater. This made comprehensive tactical intelligence hundreds of miles beyond the initial engagement radius essential to effectively counter enemy aircraft and other fast-moving mobile threats, including facilities like radar sites vectoring the enemy aircraft. Likewise, the enemy's air mobility capabilities must be destroyed to deny reinforcement of its positions

This all meant that intelligence data on the entire tactical area would have to be continuously collected, verified and updated; requiring a dramatic increase in the frequency of flight missions to deal with battlefield changes and rapidly moving forces. Day-night and all-weather collection sorties must be performed to deny the cover of darkness and inclement weather. A variety of image-forming camera, radar and infrared sensors would be essential, and detection of electromagnetic target emissions would be required by passive sensors to defend against radar and communication threats. From all of these mission requirements, it became clear that the Navy needed a new, multisensor system that could collect and correlate a wide range of intelligence, permitting timely and continuous updating of Orders of Battle for effective tactical operations.

It also became clear that such an airborne system would have to be well integrated with a shipboard system capable of processing, analyzing, storing and disseminating image forming (photo and radar) and non-image forming (ELINT)

Top: RA-5C, BuNo. 150824 from the Naval Air Test Center at Pax River, Maryland. (U.S. Navy photo from the collection of Al Hansen) Above: A North American RA-5C Vigilante runs up prior to take-off on a transcontinental flight from Pax River NAS, Maryland. (U.S. Navy photo from the Al Hansen collection) mission data to rapidly update the Orders of Battle and provide essential targeting, countermeasures, weapon loading and fueling information for carrier-launched attack aircraft.

By mid-1957, the new reconnaissance mission had firmed up and Navy officials proceeded to canvas industry for feasibility and design details for such an airborne and shipboard system. Alternate proposals were encouraged for either a new aircraft or derivation from an existing aircraft. The Vigilante fit the mission well and was selected on the strength of its performance, electronics versatility and affordability as a derivative system. Its high-altitude, Mach 2 performance provided good survivability over hostile areas. The advanced wing design enabled excellent growth for increased range and radius of action. Its linear bomb bay provided the large internal area needed for flexible reconnaissance sensor installations. Finally, it was equipped with a modern inertial navigation and bombing system capable of the precise locational accuracy required for tactical reconnaissance.

Therefore, in mid-1958 North American assisted the Navy in preparing a detailed definition of the Vigilante as a reconnaissance system, including sensor state-of-the-art analysis and mission planning. This led to a comprehensive report in early 1959, defining the operational RA-5C system and the doctrine for its tactical use. This report validated that integrated multi-sensor reconnaissance was indeed ready to move forward and that the RA-5C was positioned to be the next generation of such system.

During 1959/1960, funding plans were developed on the basis of a little-known premise -the RA-5C was to be jointly funded by the Navy and the Air Force because both services had tactical reconnaissance missions and a modern, multi-sensor capability was needed by both.

Coincident with these reconnaissance system definition and funding efforts, North American submitted studies to the Air Force for interceptor versions of the A-5, using a non-afterburning J-58 engine that provided full supercruise capability for the system. This configuration was actively addressed at a service commanders meeting in Williamsburg, VA. In addition, it became apparent to elements of the Navy and DOD that a J-58 powered RA-5C recon system could provide excellent tactical intelligence as a supplement for "national" reconnaissance needs. The loss of a U-2 over Russia and shoot-down of an RB-47 in the Kara Sea shortly thereafter, further emphasized the benefit of such an RA-5C.

Start of RA-5C full-scale development was, however, delayed by an Air Force decision not to participate in the development program funding. In spite of top-level attempts by senior Navy and DOD people, sufficient Navy funding could not be found to start a single-service development.

Finally, review of mission need at the Joint Chiefs of Staff level in late 1960 established the necessary funding and the Secretary of the Navy authorized commencement of the RA-5C/J-58 to fill the Navy's tactical reconnaissance mission. The RA-5C Vigilante program had started, and in the minds of most of the program's supporters, the system would ultimately fill both Navy and USAF missions after coordination with the incoming Kennedy administration early in 1961.

The new Secretary of Defense, Robert McNamara, instead reverted back to the J-79 engine configuration on the basis that it provided the best balance of range, payload and cost for the tactical reconnaissance mission. Joint Air Force/Navy procurement of production aircraft after development nevertheless remained as the baseline program funding plan at that time.

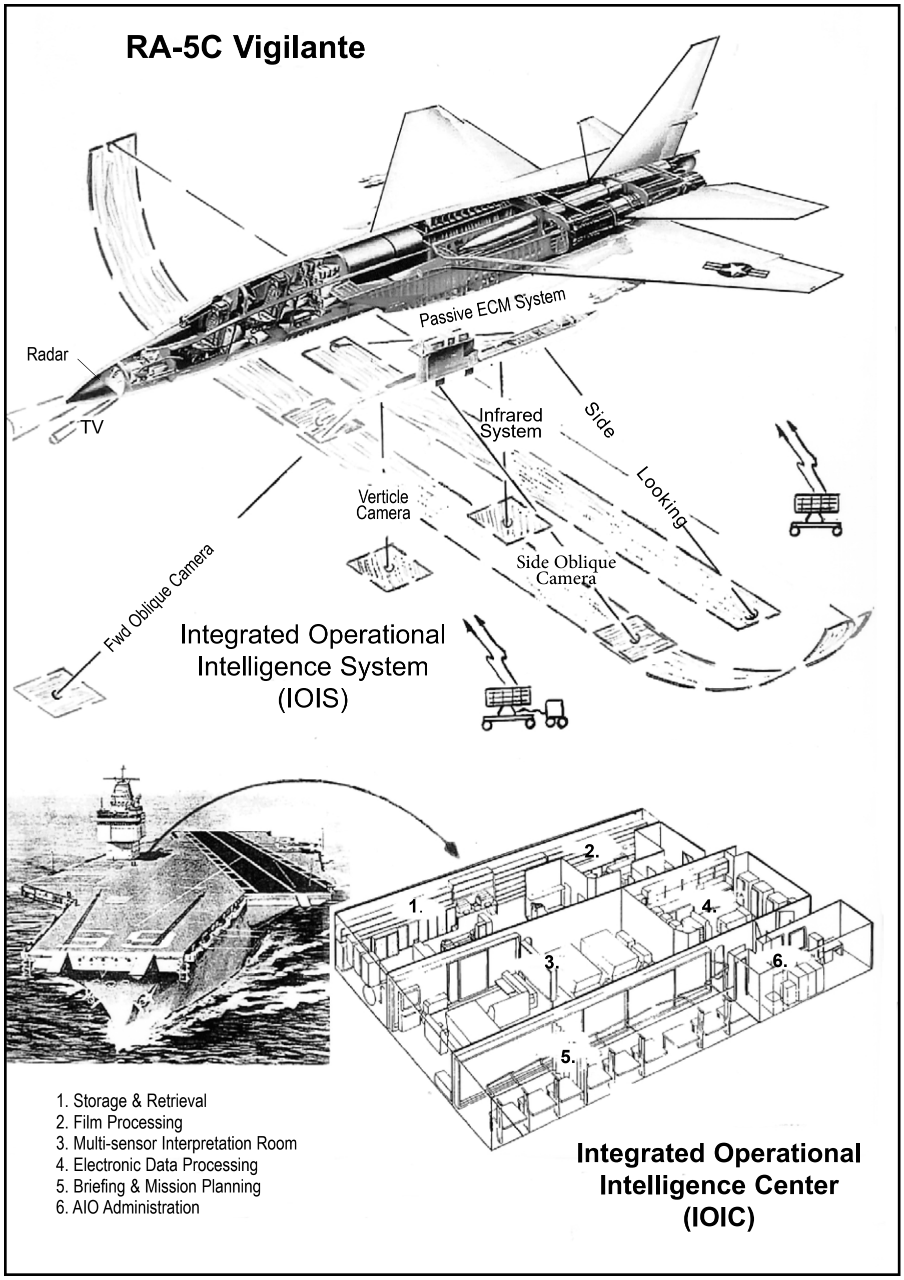
The RA-5C was deployed worldwide, aboard carriers in the Atlantic, Pacific and Mediterranean theaters. Its principal combat service was over Vietnam, where its full range of image-forming camera, infrared and side-looking radar sensors were effectively employed, along with its

North American RA-5C, BuNo. 148930, of Heavy Attack Squadron VAH-3 is ready for launch. Carrier unknown. (AAHS-3219) non-image forming passive electronic intelligence system. These reconnaissance sensors were all managed by the heart of the Vigilante – the AN/ASB-12 inertial navigation system.

The RA-5C was deployed aboard carriers off Yankee Station in mid-1964. During the Vietnam conflict, the RA-5C's panoramic cameras provided wide focal length, low- and high-altitude, horizon-to-horizon coverage along the airplane's path. Serial frame cameras obtained general purpose, high- and low-altitude, forward, vertical and oblique photography. The infrared system obtained/photographically recorded low- and high-altitude data, and the side-looking radar continuously recorded ground data on both sides of the aircraft.

The passive electronics countermeasures system (PECM) received and recorded the electromagnetic environment of an observed area for mission planning.

Ancillary mission equipment like wing-carried flasher pods and an optical cockpit viewfinder were also provided. In fact, the RA-5C had over 100 flush mounted antennas for advanced airborne communications and passive/active countermeasures.



In a typical Vietnam mission, the RA-5C would make a high- speed, high- or low-altitude pass over the target, gathering continuous full-spectrum electronic, infrared, side-looking radar, and serial frame/panoramic photographic data; all geographically position-and-time correlated by a matrix block code recorded on each sensor's media. This matrix was the key to rapid, high-volume multi-sensor data handling and analysis. Targets detected by any one sensor could be immediately evaluated by cross-referencing to all other data, providing field commanders with complete and timely information on all aspects of the tactical environment.

After an RA-5C returned to the carrier, its sensory reconnaissance records were processed and analyzed in the shipboard Integrated Operational Intelligence Center (IOIC). The IOIC consisted of advanced electronic processing and analysis equipment for the PECM data, advanced photo processing and interpreting equipment and data storage and retrieval equipment for both new and previous databases.

The term multi-sensor reconnaissance also defined the RA-5C's capability to correlate all traces of hostile enemy activity together as the basis for preparing optimum Orders of Battle and mission planning for least exposure to enemy threats. This ability to rapidly matrix the photo, radar, infrared and radiation intelligence together made mission targeting much faster and more comprehensive. In addition, prior Orders of Battle and other intelligence bases were stored, permitting fast retrieval and matching of both new and previous target locations to further support rapid Order of Battle updates and appropriate targeting of new threats as quickly as they were identified. The above graphically illustrates the multi-sensor airborne and ship-based elements of the overall IOIS.

The RA-5C became the principal U.S. tactical reconnaissance asset in Southeast Asia until the end of the Vietnam conflict. As an illustration of its capability, it was used to completely map all of North Vietnam after consistent U.S. bombing errors had been traced to inaccuracies of up to four miles in existing maps.

The RA-5C's speed and handling also proved to be of outstanding value over Vietnam, and these characteristics were frequently used to out-maneuver attacking enemy SAM missiles.

The RA-5C and JOIC components of the Navy's Integrated Operational Intelligence System served as an essential part of the Navy's overall Naval Intelligence Processing System (NIPS).

Under a series of production contracts starting in Fiscal Year 1962, 43 RA-5Cs and nine carrier-based IOICs were produced, followed by conversion of 45 earlier A-5As and A-5Bs into RA-5Cs (the A-5B had used the attack aircraft's excellent wing design, together with wing leading edge blowing, to significantly increase the aircraft's takeoff weight

KEY RA-5C MANAGEMENT PRACTICES

Rabid Development & Operational Evaluations

- Execution by "Weapons System Mgmt" Team
- Change Control Under System Manager
- Early User Testing for Tactics & Doctrine
- Initial Logistics Under System Mgr. Control
- Positive Contract Terms to Support Above

Use of Evolutionary & Non-Development Items

- Direct Design Derivations of RA-5C from A-5A
- Use of NDI Sensors With Good Integration
- Use of Comm'l & Military NDI in the IOIC
- Positive Development & Prod. Concurrency
- Similar Supportive Contract Terms

for more mission fuel).

After a production break, 36 more new-build RA-5Cs were ordered. The RA-5C was produced only for the Navy because Secretary of Defense McNamara reversed the original joint Navy/Air Force funding plan, saying that the Navy and Air Force had taken on different mission needs, with the RF-4 being adequate for the Air Force while the RA-5C provided a capability for the Navy that "could not be duplicated by any other system."

The SR-71, originally developed for strategic reconnaissance, was modernized in the 1990s to serve as a tactical reconnaissance asset, but it served only briefly. In a fitting and well-deserved tribute, a highly regarded national publication described the tactical SR-71 as the "Mach 3 RA-5C Vigilante."

Each service thus pursued separate approaches to tactical intelligence over the years. With retirement of the RA-5C in 1980, the services have recently started to develop and deploy follow-on tactical reconnaissance systems to replace it.

The Desert Storm and Balkan conflicts of the 1990s, as well as the more recent war in Afghanistan, have once again reaffirmed the importance of an integrated, multi-sensor tactical reconnaissance capability under control of the local theater command structure. Recognition of the RA-5Cs important legacy in this area is being demonstrated early in the 21st century by America's renewed effort to develop new tactical reconnaissance systems. With dedicated attention to the evolution of broadly capable, multi-sensor, manned and unmanned aerial vehicles in proper conjunction with satellite systems, America's dominance in this area can be assured.

By 1960, the Cold War with the Soviets and serious local brushfire conflicts around the world had validated the critical need for naval tactical reconnaissance. But the previously noted funding issues had delayed development of the RA-5C as one of the key assets to support the Navy's expanded tactical aviation role. So when the RA-5C was finally started in late 1960, the Navy needed to achieve a rapid 3-1/2 year development and deployment cycle for both the airborne and shipboard elements of the system. Equally important, the system had to be mission effective and operationally reliable when first deployed.

Faced with a difficult challenge, the Navy/North American team devised management approaches that contributed greatly to the program's success and that may have benefit for new systems being procured by DOD even today. These are summarized at left and generally support two primary objectives - short development cycle time and introduction of new technologies on a evolutionary basis:

With only 3-1/2 years of development time available, overlapped by an essentially concurrent production schedule to support mid-1964 deployment, an expert management team was set up to focus specific responsibility within the Navy and North American organizations for each portion of the system. Assigned individuals were largely separated from their functional organizations and given total authority to carry out the program, including steps to guard against untimely development issues that could jeopardize the planned deployment date. Combined with an appropriate level of security control in the formative stage of the program, this management approach was particularly effective and had much to do with achieving the deployment challenge.

North American's development and testing responsibility was significantly broadened by a new procurement approach known as "Weapon System Management." Under this concept, the developing contractor assumed the responsibility for all of a new aircraft's airframe and electronic systems and had increased responsibility for engine integration. This departure from the prior government-furnished equipment, or "GFE" approach, was highly beneficial because various subsystems had to be integrated and tested in parallel, including many different multisensor reconnaissance equipments for the RA-5C's nine different modular reconnaissance bays. Weapon System Management became the key factor in the successful integration of these systems because it gave North American the freedom to effectively manage interfaces and refine airborne and shipboard system performance, permitting a level of system optimization not possible under prior "GFE" policies. In fact, the RA-5C was the only system ever carried fully to service use under the Weapon System Management approach and DOD needs to give serious consideration to returning to this powerful, practical management tool.

The team also used non-developmental items (NDI) to define an evolutionary system architecture that was sufficiently mature to ensure that it would work when deployed, but could also be evolved as new technologies emerged. North American was thus able to use major non-developmental assets like the excellent A-5A airframe and electronics as well as competitively select among advanced but mature reconnaissance equipments in which the Navy, Air Force and other federal agencies had invested hundreds of millions. Likewise, North American was able to compete and select advanced non-developmental commercial and military equipments for the shipboard IOIC. The mission effectiveness of this evolutionary architecture was then optimized by overall integration of the system.

The specific business arrangements used to facilitate the above were an essential part of the management approach. As an example, RA-5C developmental "requirements creep" was avoided by stipulating that "no amount nor provision was included in the RA-5C contracts for added R&D work on the basic A-5A airframe or systems, or on the prior government airborne or IOIC equipment investments." Similarly, it was agreed that subcontract specifications would be written in a way which permitted North American to conduct full and open competitions and rapidly optimize signal interfaces between systems, but did not require already developed equipments to undergo costly re-development.

Business agreements were established to positively address the challenge of concurrent development and production. Specifically, these agreements ensured that engineering changes necessary to optimize and integrate the system would be introduced without delaying the concurrent production effort. This provision included a stipulation that although production would start prior to final development, continuous production delivery would be maintained by granting North American and the local Navy office authority to chose production effectivity points as engineering changes became necessary. North American remained responsible for retrofit of such changes in aircraft delivered prior to the change points and to logistically support fleet RA-5Cs during the concurrency period.

Many defense programs have faltered badly since the '60s, because of unacceptably long development cycles and unaffordable RDT&E/Production cost growth. In many cases, the underlying causes of these problem programs have been the same threats that the above Vigilante management practices sought to avoid – government/ industry confrontation rather than good teamwork, use of "grand design" rather than evolutionary specifications, lack of clear "Weapon System Management" responsibility and an overly risk averse rather than positive approach to issues like "concuffency.

Most of the above Vigilante lessons are sufficiently generic to apply to today's new programs. They clearly show that with good teamwork between government and industry and the use of straightforward management and business steps, America can once again field complex, high technology military systems on a timely and affordable basis.

These lessons from past successful programs like the Vigilante may be particularly timely for DOD review as it moves to transform America's military for the 21st century. ✈

The Vigilante Story remains as topical as today's front-page headlines.

The Navy-NAA Vigilante team can take great pride in the program's success. The Vigilante is a valuable case study of positive development, operational and management lessons, to which some final footnotes should be added:

- The unparalled level of R&D advancement benefitted nearly every combat aircraft that followed.
- Today's defense acquisition managers at the Pentagon should revisit the highly effective management methods used by the Vigilante team.
- America's discovery in the battlefields of Iraq, Bosnia and Afganistan that multi-sensor tacticle recon remains essential to modern warfare should provide strong national support for the follow-on tactical systems currently in development.

ABOUT THE AUTHOR:

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Mr. Wood worked at Rockwell's Columbus, Ohio facility from 1958 to 1978, when he advanced to Rockwell's World Headquarters in California.In 1984 he was named a corporate director.

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RA-5C, BuNo 156636 of RVAH-3 on final to China Lake circa 1980. (Photo from the John Dzurica, Jr. collection)