After forty-five years, automation is finally on the way to replace paper charts and stubby pencils.

New Tools for Mission Planners

BY F. CLIFTON BERRY, JR.

SCENE 1: Late 1944, Eighth Air Force bomber and fighter bases in England, shortly before a mission to Germany.

Action: Aircrew members plan the mission. Their tools: fragmentary operations orders, target data, and intelligence on the enemy from higher headquarters; aeronautical charts for the route to Germany and back; aircraft performance charts and tables with weapons load factors; pencils, lined tablets, E-6B circular slide rules; and lots of hot coffee.

Scene 2: Early 1953, Far East Air Forces bases in South Korea, before a strike against Chinese forces and installations in North Korea.

Action: Aircrews plan the mission. Tools: same as 1944.

Scene 3: Mid-1960s through 1972, Seventh Air Force bases in Thailand, before strikes against enemy targets in North Vietnam.

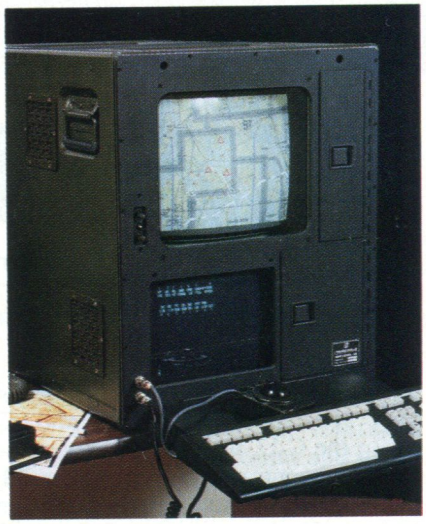
Action: Aircrews plan the missions. Tools: same as 1944 and 1953.

Even for the USAF air strike against Libyan targets in April 1986, aircrews' planning tools were about the same as in 1944.

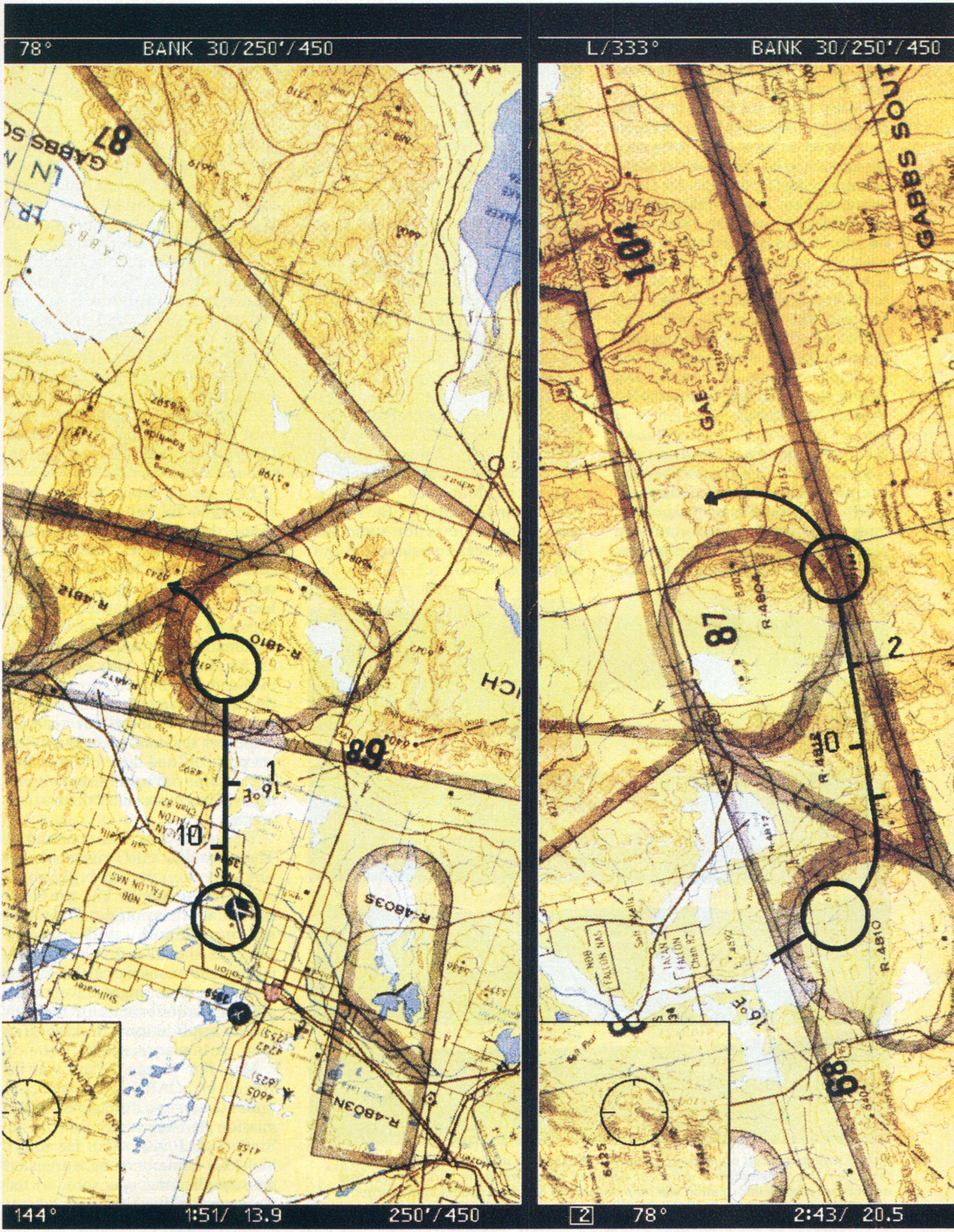
Between 1944 and the mid-1980s, the technology of airpower cascaded through several generations. Military aircraft advanced from pistons to jets, and the speed of air warfare leaped from 150 knots to Mach 2. Man leaped from the earth to the moon. Sensors of many kinds vastly expanded the volume of information on friend and foe. High-speed computers transformed information processing, navigation, and communications.

Yet through all these advances, the tools for mission planning didn't keep pace. Aircrews of the Air Force and sister services were able to fly faster and farther and to fight better. The tools for mission execution advanced with technology. But the tools given the crews to plan missions for the 1980s were those used in the 1930s and 1940s.

Visits to reconnaissance and fighter wings in the early 1980s verified that reality. In the squadron ready rooms before a mission, aircrew members cut aeronautical charts into strips and pasted them together with rubber cement. They calculated their headings and times for waypoints along the flight route by using slide rules and handheld



New devices such as the Mission Support System II (above) are bringing about startling change in USAF mission planning. Computers, optical disk storage techniques, fiber optics, and other high technologies integrate vast amounts of data in usable form such as map printouts (right). With MSS II, complex strike missions can be planned in minutes rather than days, as in the past.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calculators. They transferred route information to charts by hand with colored pens. They filled out mission cards with vital information and then were ready to go.

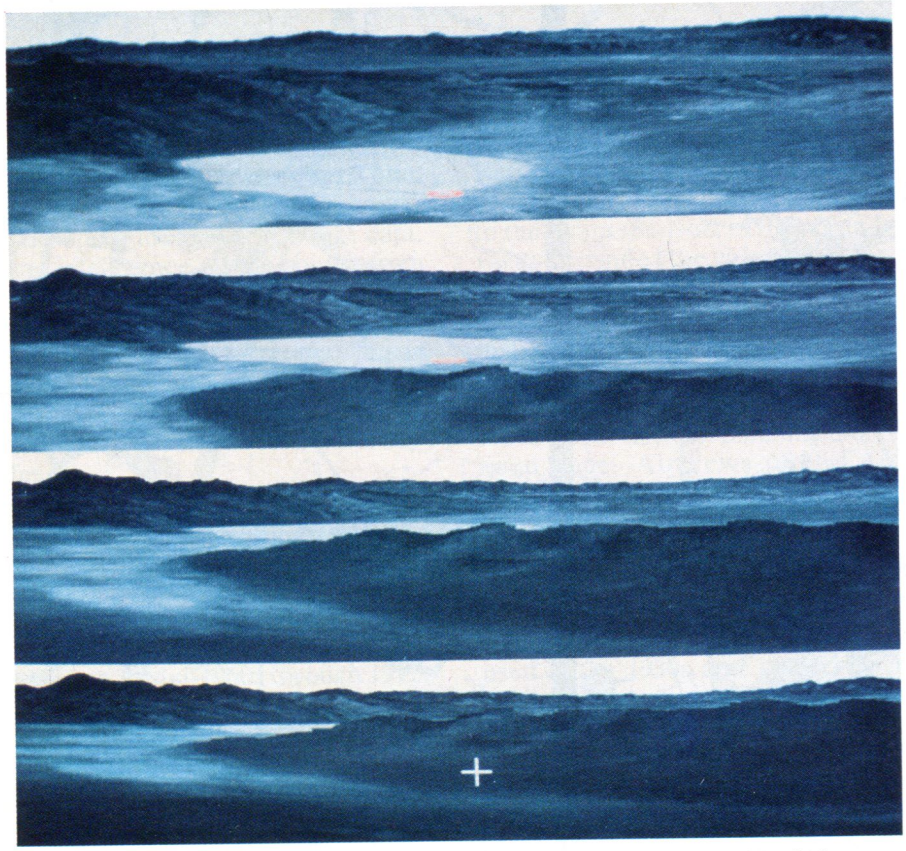
Using such methods, mission planning took a long time. It could range from an hour or so for a simple mission up to ninety-six hours to prepare a single Strategic Air Command mission folder. Planning for El Dorado Canyon, the 1986 strike on Libya, took many days.

Given its multiple missions, scarce resources, and requirements for fast action worldwide, the Air Force of the late 1980s and early 1990s finds that it can no longer tolerate use of such antiquated mission planning systems, if pencils and pasted charts can be dignified with the title "systems."

Making Up for Lost Time

Well before El Dorado Canyon, aircrews and commanders throughout the Air Force knew that something better was needed for mission planning. They knew, for example, that personal computers could do the job at the crew level and that they were available. Thanks to technology, the Defense Mapping Agency was able to convert maps of most of the world's topography to a digital format and maintain databases in that form. Plenty of information about the locations and characteristics of enemy weapons was available. But the Air Force as an institution had done very little to pull together the technologies and operational aircrew requirements into affordable systems capable of automated mission planning.

Within the tactical air forces, Hq. TAC/DRI was tasked to be the single focal point for mission planning. One of the many stimuli to improve automated mission planning came chiefly from US Air Forces in Europe (USAFE), then commanded by Gen. Charles L. Donnelly, Jr. In 1984 and 1985, General Donnelly and his Deputy Chief of Staff for Operations, Maj. Gen. William L. Kirk (later CINCUSAFE), heeded calls from aircrews for something better and began pushing the system to respond.



Armed with advanced equipment, planners will soon be able to inspect a mission area from the perspective of different altitudes, as shown in the photo above. This and other types of information will help determine optimum routes to the target, waypoints, navigational aids, target locations, where and when to expect SAM attacks, and best return routes.

The awesome and onerous task of planning El Dorado Canyon early in 1986 brought matters to a head. General Donnelly, now retired, remembers shuttling C-12 courier aircraft from USAFE and other locations in Germany to bases in the UK in the weeks before the mission. They ferried load after load of aeronautical charts, intelligence estimates, aerial photos, and other types of imagery to flying units for use in their mission planning.

After the Libya strike, it became obvious at all levels of the tactical, strategic, and airlift forces that improvement was needed fast. To begin the process, a review group of USAF leaders convened at headquarters in Washington, D. C., to focus automation at the unit level with emphasis on automated mission planning. Its title: Squadron Operations Automation Review Group (SOARG).

This special group worked from June 1986 to February 1987. It found that USAF squadrons had plenty of computers; indeed, it concluded that they probably had too many. Each of the major commands had recognized the need and had begun its own fix, as had USAFE. Commands were acquiring computers for everything, mission planning included. The SOARG review found that a single squadron might be fitted with up to forty-four separate computer systems, each for a different purpose, and that virtually all of the systems ran on different operating systems that couldn't talk to one another.

This was chaos with a capital C. The central SOARG recommendation was intended to bring some order. It was simple: The Air Force should address computer-assisted mission planning with a single voice. It should and could do this even while recognizing that different commands might have vastly different requirements or find different applications in executing their particular missions.

Maj. Jim "Snake" Clark was involved in SOARG work and continues to serve as the chief of USAF mission planning systems on the Air Staff (USAF/XOOOE). He told a mid-1989 conference on automated mission planning, sponsored by the Aerospace Education Foundation-New Jersey *(see box)*, what hap-

New Jersey Spreads the Word

In mid-May, the Aerospace Education Foundation-New Jersey conducted a symposium on Automated Mission Planning (AMP). Gen. W. L. Kirk, USAF (Ret.), was the keynote speaker. General Kirk, who had retired as Commander in Chief of USAFE only a few weeks before, began by saying, "Automated Mission Planning and this symposium are both long overdue."

He has been advocating progress in AMP for years, first in the mid-1980s as USAFE Deputy Chief of Staff for Operations with Gen. Charles L. Donnelly, Jr., and later as Commander of TAC's Ninth Air Force and as USAFE Commander in Chief from May 1987 to April 1989.

The AEF-NJ symposium, he continued, was especially useful because it brought together representatives from several groups with a stake in the issue. They included users from the major commands; developers from Air Force Systems Command, Electronic Systems Division, and its laboratories; planners and acquisition specialists from the Air Staff and the secretariat; and representatives of domestic and foreign industry.

More than 260 persons attended the three-day symposium. The Air Force advanced its ideas in automated mission planning. Industry gained a clearer understanding of USAF needs and requirements.

Brig. Gen. James E. Young, USAF (Ret.), trustee of AEF-NJ, explained that the New Jersey foundation advances aerospace education in five major ways: by providing funds for Doolittle and Eaker fellowships, by supporting Air Force ROTC programs with cash awards to outstanding junior and senior cadets, by providing funds to New Jersey chapters of AFA that take part in the President's Partners in Education programs, by working with the New Jersey Department of Education on programs of merit, and by donating funds to CAP's flight-training program.

—F.C.B.

pened next. The Air Force initiated a survey of USAF systems and found a number of prototypes, such as one the wizards at the Electronic Warfare Center had developed—an "improved many on many" model using off-the-shelf computers, software, and interconnections. Meanwhile, a rational strategy was developed.

What emerged was a three-track approach to the challenge. First came immediate action to get a system out to the field as soon as possible, though of limited capabilities and in minimal numbers. The second track was use of that limited system to provide hands-on experience for aircrews and thus promote feedback to permit quick reprogramming and identification of operational and support problems. This led to the third track: long-term acquisition. Experience on the first two tracks permitted the Air Staff, working with users, to define long-term requirements and work out an acquisition strategy to integrate automated mission planning into USAF force structure.

Formalizing the Effort

The three-track approach worked and began to produce practical results. A program element manager (at first, Lt. Col. Rich LeClaire and now Lt. Col. Jim Wisneski) was established in USAF's acquisition secretariat in the Pentagon. That step ensured that mission planning requirements could be validated and compete for funds within the acquisition process.

Air Force Systems Command established a systems program office (SPO) for automated mission planning, independent of any particular aircraft and dedicated to meeting the users' needs quickly and at a reasonable cost. The SPO for Automated Mission Planning (AMP), established within Aeronautical Systems Division in March 1988, relocated to Electronic Systems Division six months later to incorporate mission planning into the Air Force battle management program. It is now the focus of USAF developments in automated mission planning and the point of contact for industry.

While organizational changes were under way, USAF also importuned operational commands to make their true needs known. They fell into four major areas: tactical, strategic, airlift, and special operations. When those commands compiled and forwarded their requirements, the senior USAF structure had the raw materials it needed to orchestrate a cohesive effort.

There was much to orchestrate. The tactical air forces alone, for example, identified and justified approximately sixty requirements.

Meanwhile, the first mission planning systems began moving into the field for the required hands-on experience and feedback. The first sixty-five units of the system, called Mission Support System I (MSS I), were delivered in late 1987 and early 1988.

Even as these first-generation systems were being delivered, early lessons from their development were incorporated into Mission Support System II (MSS II). A contract for MSS II systems went to Fairchild Industries. Between October 1988 and December 1989, Fairchild is to produce 138 of the systems and also provide maintenance and support during their service lives.

Field users of MSS I and MSS II have been quick to respond with recommendations drawn from operational use. At the same time, developmental work by USAF laboratories and contractors has produced additional progress. Promising applications are available for the next generation of mission support systems, known as MSS III.

The request for proposals (RFP) for MSS III will call for 560 systems. ESD is expected to issue the RFP this fall. MSS III will be the baseline system for the future, a logical upgrade of earlier systems that will incorporate new technologies. Intense competition is sought and expected. At present, the acquisition strategy is on schedule and within budget.

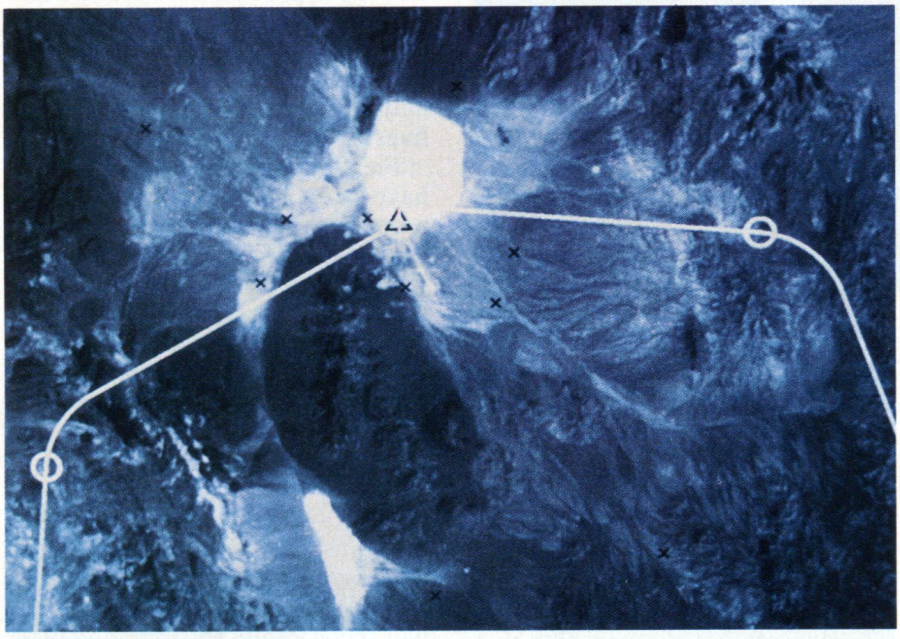
The goals for automated mission planning systems are simple, yet can yield significant beneficial results in utility, cost, and in the application of new technologies. One key goal is to fashion a system that can meet the needs of the several different types of potential users, all the while using databases that are both common and interoperable. Other goals are simplicity, sensible conception and execution, upward compatibility, an open-form system architecture, and redundancy in combat use.

Using the Systems

Even now, the difference between old ways of mission planning and the methods made possible by the development of MSS II is nothing short of startling. Planning for a complicated F-16 strike mission, for

instance, can be completed in minutes rather than the full day that it traditionally has taken. SAC mission folders can be updated in two hours instead of the usual ninety-six.

Much like the first time one saw a television broadcast or watched the operation of a Polaroid camera, witnessing the MSS II system in action makes a deep and lasting impression. The interrelated workings of numerous technologies create the illusion of sorcery.



Proposed mission route superimposed on a satellite image of local terrain. Once ready to fly, the aircraft crew can enter essential information in a special data transfer module, plug it into the craft's computer system, and call it up for use during flight. Information can be updated en route to target.

First is computing power, taking advantage of existing capabilities. Next is the capability for linking computers in networks and transmitting data via paths such as satellites, wires, and fiber optic cables. Also included is massive memory capacity, taking advantage of optical disk storage media. Color graphics displays and color printers round out the ensemble. The conductor of this multidisciplinary orchestra can be found in the integrated software that has been made portable and interoperable with other software.

Contemplate, for a moment, all of the variables that must be considered, processed, and displayed to be useful to a crew about to set out on a mission.

First and foremost are the aircraft characteristics and weapons load for the mission. Then come parameters such as takeoff roll, fuel consumption, and optimum airspeed. They now have been recorded on hard or floppy disks at the squadron center.

Routes to and from the target must be considered. Data on starting points, waypoints, navigational aids, target locations, and return routes are essential. Once the crew would have been issued paper aeronautical charts that would cover the route. Now the Defense Mapping Agency has converted those charts and their data to digital form on high-capacity, portable memory means, such as optical disks.

A massive amount of intelligence about the enemy must be considered. Again, that is either on a storage medium (such as a disk) in the squadron, or instantly available from a central data source. Information includes target data, location of defenses along the route and in the target area, and their lethality.

Because all of this information is available and can be manipulated, crews can plan their missions faster and more prudently. They can examine tradeoffs between fuel consumption and exposure to enemy radar or SAMs, for example. It is the "what if?" of civilian financial planning spreadsheets carried to life-and-death considerations. The aircrew can speculate, "What if we dropped 200 feet lower at this point? What would be the added safety from SAMs and increased hazards from terrain?"

Even better, thanks to the marriage of simulators and digital images from the automated mission planning systems, aircrews can "rehearse" missions before flying them. This procedure can be especially useful for special operations crews.

Finally, the warriors can take the knowledge along for the ride. Once ready to fly, the crew can enter essential information into a data transfer module, take it to the aircraft, and plug into the aircraft's computers and other systems. Information for navigation, communication, threat avoidance, and other mission-essential functions is readily available for use during the mission. Such information can be updated during the mission, as the situation changes and as new information is communicated to the crew.

The upshot is that, however belatedly, high technology is now being thrown against a problem that has bedeviled air-combat operations for decades. Dollar amounts expended seem puny when compared to those spent on such glamorous weapon systems as the B-1B and B-2 bombers. Those weapons of the 1990s cannot be employed effectively with the planning technology of the 1940s. Money spent now on automated mission planning could well make the difference between success and failure in the air combat of tomorrow. ■

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