A massive study considers the Air Force's place in a future that will be much different from today.

By John A. Tirpak, Senior Editor

A LITTLE over a year ago, the Air Force tasked some of its most promising midlevel officers and members of other services to look hard at technology, global politics, social trends, and other critical factors and then conjure the "most stressful" situations that might confront the US three decades hence. The Air Force, thus forewarned, could begin to prepare itself for the challenges.

That forecast, called "Air Force 2025," is now complete, and the potential dangers that it identifies are daunting.

They include arrival on the world scene of a gigantic, hostile Asian meganation or, alternatively, a network of collaborative transnational corporations. The world of the future might well be plagued by widely dispersed weapons of mass destruction or swarms of robotic "insects" sent to attack cities. The American armed forces might have death rays capable of vaporizing aircraft.

If the forecasters are right, the Air Force in 2025 will be significantly different from that of today, despite the fact that most of the systems on which USAF will depend decades from now are already in service or development. Most strikingly, the team found that the Air Force three decades out will be oriented far more toward space than toward air. This shift in emphasis will be so profound, said participants, that they grappled with whether the Air Force should spin off an all-new "Space Force" or, at a minimum, rename itself "US Aerospace Force."

"We grappled with that," said Col. Joseph A. Engelbrecht, Jr., who headed up the Air Force 2025 effort. "But we found that the heritage of the name is still important and valuable." For most civilians, he said, the name Air Force "already connotes 'air and space'—and, increasingly, 'air, space, and information.' "

More important, however, the team decided to stick with the name because "integration of all these disciplines—air and space and information—will be the key to success. Air [forces] alone won't be effective without space and information tied in, . . . and the Air Force is pretty good at integrating them right now. So separating them into different branches or services makes less sense now than it ever did." Making that

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integration more seamless "is the main challenge facing the Air Force," the Colonel observed.

The 3,300-page, ten-volume report was produced at Air University, Maxwell AFB, Ala., with input from technologists, futurists, science fiction writers, scientists, historians, active-duty officers, and retired Air Force generals. It is billed as a projection of the economic, political, and military conditions that could arise around the year 2025, as well as a prescription for the capabilities USAF must have if it is to remain relevant under those conditions.

Lt. Gen. Jay W. Kelley, USAF (Ret.), who headed Air University during the 2025 effort, said that satellites "will increase in quantity and quality" and that many nations will have the ability to develop and launch them, "cutting our margin of superiority in this area." Additionally, a need is likely to arise for satellites that can "maneuver"—to avoid or fight one another in orbit—as dependency on satellite-provided information becomes greater. There will also likely be a decrease in the size of ground stations for controlling space operations.

Sword and Cyber

In 2025, General Kelley continued, "most major battles" between nations or coalitions of nations "may not be to capture territory, and they may not be fought on the Earth's surface." Instead, conflicts between technologically adept entities might occur entirely or chiefly "in space or cyberspace." According to General Kelley, the Air Force will probably develop manned and unmanned transatmospheric and hypersonic vehicles "with multiple functions." High-power lasers employed both within and outside the atmosphere will increasingly become a "weapon of choice."

"We see a trend where there will be an increase in the number of vehicles in space as opposed to vehicles in the air," said Colonel Engelbrecht. "And more of the air vehicles will be unmanned, while there will be more manned space vehicles."

The fundamental insight of the 2025 study, said General Kelley, is that the Air Force "must pursue the exploitation of information and space with the same fervor with which it has mastered atmospheric flight." USAF must become comfortable and practiced at dominating "the atmospheric, exoatmospheric, and infospheric" realms.

Completed this summer, the study is one of several forecasting efforts ordered up last year by the Air Force Chief of Staff, Gen. Ronald R. Fogleman. In one of them, called "New World Vistas," the Air Force Scientific Advisory Board evaluated the technologies now emerging, looking for the ones that, with proper investment, could yield breakthrough capabilities for tomorrow's USAF *[see "New World Vistas," March 1996, p. 20].*

The Air Force 2025 participants took a different approach. First, they determined the possible characteristics of the most stressful future worlds in which USAF might have to operate. Then, they looked for "common-denominator capabilities"—that is, systems that would be critical to military success in any of these scenarios.

The study participants emphasized that they were working in the "worst-case" realm. While the major scenarios they used were certainly possible and plausible, they "do not represent the 'most likely' potential futures," contended Colonel Engelbrecht.

He went on, "What we were trying to do was consider alternative futures that represent very difficult challenges for the Air Force. It's a way to think about the future and devise a strategy. . . . We want to try to avoid being surprised by the challenges that confront us in thirty years."

The 2025 team made several predictions:

- Information—as a commodity as well as a combat medium—will be "more influential than bombs" in thirty years, and expertise in manipulating information will offer the United States its most telling advantage over future adversaries.
- Industry, not government, will be responsible for developing critical new technologies, and government more often than not will borrow, license, or lease systems rather than buy or develop them on its own.
- Human beings increasingly will direct operations at a distance from the scene of action—"in the loop" as opposed to "in the cockpit"—as uninhabited machines assume ever-greater importance.
- Military education will become more frequent and more tailored, with gaming and simulations—of everything from air combat to running an expeditionary base—taking on greater significance. With the aid of computers and digital technology, the distinction between taking a course "in residence" and "by correspondence" will become moot.

"These evolutions may each or all have dramatic or even revolutionary effects," General Kelley wrote in his executive summary of Air Force 2025. The impact of these trends, he added, is "unavoidable."

To think systematically about what kinds of conditions may prevail three decades hence, the 2025 team decided to bound the future along three axes.

The first of the three axes was labeled the "American World View." Would the United States tend toward isolationism or remain fully engaged around the globe?

The next axis was the rate of technological change in the world, and its distribution, abbreviated "Delta TeK." Would high technology remain in the hands of a few world actors or become widespread?

The final axis reflected the "World Power Grid." Would economic, political, cultural, and military power be concentrated in a few major nations or be broadly dispersed?

The intersection of these variables defines the box that contains the range of possible futures. The study participants gave each of the box's corners a name and a "plausible history" describing how that world came to exist.

"Gulliver's Travails." The first corner features the intersection of global world view, modest technological progress, and dispersed world power grid. In this future, the US is pinned down by a host of microcrises around the world, much as Jonathan Swift's character, Gulliver, was bound by Lilliputians. The US is "overwhelmed and preoccupied with worldwide commitments, such as counterterrorism and counterproliferation efforts, humanitarian assistance, and peacekeeping operations," according to the report.

The US, the report contends, at-

tempts to be "the world's policeman, fireman, physician, social worker, financier, and mailman." Unwelcome at overseas bases, the US must maintain a high operations tempo at long distance, with tight funding.

"Zaibatsu." In the next corner, the variables change. The US is self-absorbed; technology growth around the world has become exponential; and power has been concentrated in a few transnational corporations—hence the use of the Japanese word for corporate collaboration. In this future, the military faces a struggle to demonstrate why it is even relevant as corporations rule the world in loose coalitions. Conflicts are few and brief, and the US military serves chiefly to guard access to resources, assets, and trade routes. There is a rising threat from a rapidly growing underclass, but, with foreign tensions eased, the United States turns inward and focuses on its domestic problems.

"Digital Cacophony." This is a world in which real power and technology are widely dispersed, and the US continues to focus outward. In this future, nearly everyone has access to high technology, up to and including weapons of mass destruction. However, the most likely threat to the nation comes in the form of an attack from cyberspace. For example, terrorists or hostile nations could attempt to "crash" the US banking or air traffic control systems via computer. This world would be characterized by a gradual breakdown of order and traditional forms of authority.

"King Khan." At this corner, the 2025 study speculates on the rise of a "Sino-colossus" incorporating the lands, peoples, and economies of China, Hong Kong, Malaysia, Singapore, and Taiwan. Here, the US turns inward because of severe economic problems; in the study's words, "the American Century has given way to the Asian Millennium." American defense budgets hit bottom, and only a few capabilities can be afforded. The United States, according to the study, resembles Britain in the 1950s, after losing its empire: "a superpower has-been." The King Khan scenario occupies a corner characterized by concentrated power, gradual technological progress, and a domestically oriented US.

By special request, the team produced two other future-world scenarios.

- Fifteen percent of the world's population—including the people of the US—is relatively wealthy. The other eighty-five percent lives in squalor and has nothing to lose. The threats to the United States increase. Here, the US looks outward in self-defense, but power and technology are in flux. This alternative future was requested by regional commanders in chief as a kind of "middle of the box" comparison model with other alternatives.
- General Fogleman requested exploration of a specific future, "Crossroads 2015," which arrives ten years before the other scenarios. Here, the US faces economic hard times, and the pace of technological progress has slowed. Russia, its power on the rise, attempts to seize and incorporate independent Ukraine. The US confronts the danger of fighting a major war using those forces developed with the investments of the late 1990s. The choices the US makes in this crisis—whether to strike an isolationist stance or accept the costs of remaining the military leader of Western democracies—has a lot to do with which of the 2025 scenarios becomes more likely.

Peering thirty years into the future, the Air Force sees the need for stealthy air bases, high-powered lasers on trans-atmospheric craft, tiny "attack microbots," solar-powered weapons, and the biggest, fastest, most powerful information systems possible.

Common Themes

A number of common themes shook out of these scenarios, according to General Kelley. First and foremost, he warned, the world "is not likely to be more benign" in thirty years.

The 2025 team anticipates that the world will see a rise in the number of nation-states—witness the breakup of the Soviet Union and Yugoslavia in the past decade—but each will have less influence. "Coalitions and empires may emerge," General Kelley wrote, "but the state sees much of its dominance of the twentieth century ebbing away to nonstate entities, both larger and smaller than itself."

The US will face the threat posed by weapons of mass destruction, but it will increasingly have to defend itself against information warfare attacks that are "nonviolent but powerfully destructive," said the Air Force report. The value of information itself will be outweighed by "the architecture of and infrastructure for its collection, processing, and distribution."

The forecast team believes that the ICBM—a dominant system in the Air Force of thirty years ago and a key system today—will still be around, but its importance will have diminished, with no upgrades to ICBMs or nuclear weapons anticipated.

In addition, space and information systems will more and more become the enablers of surface and air operations, while also allowing the US to keep out of such conflicts while exerting just as much power. Though there will be competitors who can challenge the US on an even footing in selected areas—such as aircraft technology, information warfare, or space systems—very few, if any, will be able to compete in all areas at once.

There will be nations or coalitions with the ability to project military power on the surface and in the air, but they won't be able to sustain high-tech combat for long. Thus, the forecast perceives a continued need for a "full-service" Air Force.

In each of the postulated scenarios, operations analyses were run to see which capabilities—real, prospective, and not-yet-invented—would prove

most useful and cost-effective to USAF. These capabilities were weighted and ranked against each other to identify a core group of technologies that would be essential regardless of the future that plays out.

The group considered a total of forty-three of these capabilities. From that group, ten systems or technologies were deemed essential for the Air Force's toolbox in 2025, having application across the spectrum of missions it might be called on to perform.

The Top Ten

"These ten systems were found to be high leverage," General Kelley noted. "No matter what kind of world you're living in, you need these [systems] . . . or something very much like them."

First on the list is a Global Information Management System (GIMS), described as a "pervasive network" of information and data collectors, processors, and analyzers. It would not only be "smart" in the sense that it "sees all and knows all," but it would also be smart enough to tailor the information at its disposal to a particular user, giving him the data he most needs, and at an appropriate level of detail. The GIMS could also provide a three-dimensional "holographic war room," summarizing instantly and in real time what it could take hours to figure out from numbers, reports, or even flat-panel images.

Another high-leverage capability is the sanctuary base. This would essentially be a stealthy air base, hard for an enemy to detect, target, or hit, and able to set up and repair, maintain, and manage itself, largely through the use of robots. Security, fire-fighting, and even ordnance-loading could be automated. Chemical or biological agents could be cleaned up by microscopic machines—called "nanobots"—and biotechnology.

A Global Surveillance, Reconnaissance, and Targeting System would be a spacebased sensor and data-distribution system that could create and relay a real-time, three-dimensional image of a target or other area of interest to a ready room or gathering of decision-makers. It would be useful for command-and-control and situational awareness "at all levels."

The combination of a high-energy laser system, a kinetic-energy weapon system, and a transatmospheric vehicle would constitute the Global Area Strike System. Groundbased lasers could be bounced off of satellite mirrors to hit ground, air, and orbital targets. Rods of denatured uranium could be dropped from orbit to hit ground targets with great precision and huge destructive effect "with and without explosive enhancers," while the vehicle could provide support for the space systems and rapidly transport special operations forces directly to the scene of action from a CONUS base.

Like "New World Vistas," Air Force 2025 portends a large role for uninhabited combat aerial vehicles (UCAVs). Without the need for a person on board, they could loiter in the target area for twenty-four hours or more, maneuver at many times the human limit of nine Gs, and carry a vast array of sensors and precision munitions. In secondary roles, UCAVs could perform jamming and bistatic radar functions.

A Spacebased High-Energy Laser System is seen as a multimegawatt chemical laser that can zap ground, air, or space targets. At lower power settings, it could disable enemy optics, perform passive sensing missions, actively illuminate a target with a laser, or even modify the weather. Between fifteen and twenty such satellites could provide global coverage.

A Solar-Powered High-Energy Laser System would perform much the same function but derive its power from the sun rather than an on-board power source.

Like a UCAV, an uninhabited reconnaissance aerial vehicle can stay airborne for long periods, can remain on station high in the atmosphere, and could perform outside of human limits. Carrying a multispectral suite of sensors, such as infrared, optical, radar, and laser, it could also collect electronic intelligence as an aerial "listening post" and as a bistatic radar sensor.

As computer chips and mechanical devices get smaller and smaller, attack microbots become more feasible. These would be one-millimeter-scale devices that could fly in a swarm and collectively attack an armored column, powerplant, or virtually any target. Launchable by almost any means, they would have "full flying and crawling autonomy," according to the 2025 text. They could spy, gum up mechanical works, designate targets, or short-circuit equipment and would be inherently stealthy and have "high penetration capabilities."

Also deemed critical is a Piloted Single Stage to Orbit Transatmospheric Vehicle. This rocket/hypersonic air-breathing hybrid would take off vertically, refuel in air or space, and land conventionally on a runway. It could lift a variable payload weighing up to 10,000 pounds and serve as a sensor or weapons platform. It would be uniquely suited to placing satellites in orbit, repairing them, or bringing them home for maintenance and eventual replacement.

Big Payoff, Big Challenge

Not surprisingly, the systems deemed to be of highest utility in the world of thirty years from now are among "the most technically challenging" of those looked at, General Kelley observed. The 2025 team also recognized that it would at present be premature to try to develop most of these systems. The technologies to make them possible must first be mastered.

The team therefore recommended investments in a number of disciplines so that the proposed critical systems will be available in three decades. The short list of highest-leverage technologies for USAF investment are data fusion, power systems, advanced materials, micromechanical devices, high-energy propellants, and high-performance computing.

As a postscript to 2025, General Kelley included "the null hypothesis"—namely, that the Air Force itself won't be around in thirty years. One of the white papers included in the study, "Paths to Extinction," suggested that the Air Force could disappear from the landscape due to forces already at work, such as the strong emphasis on joint operations and shrinking defense budgets.

The white paper also warned that the service risks its future if it fails to invest in the right technologies, loses its vision, or mismanages its people. "The only element common to all the paths to extinction," the paper concluded, "is the failure to understand the significant attributes of airpower." ■