In the aerospace arena, Israel has long been the most advanced nation in the Middle East.

Aerospace Industry

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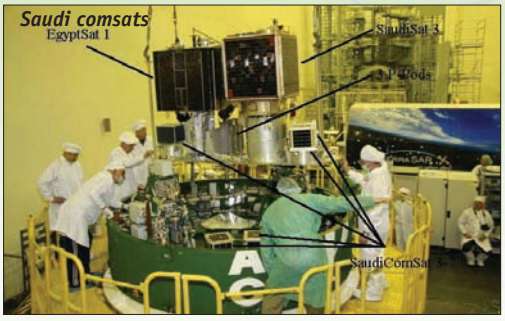
When one thinks of aerospace advances, the Middle East is not usually the first region that comes to mind. Nevertheless, some countries in the area have accumulated remarkable achievements. Turkey, for example, manufactures aircraft parts for major international projects, while Saudi Arabia operates a whole constellation of microsatellites. Tiny UAE has made inroads in the engine repair and overhaul industry, and Iran has just become the ninth member of the space club—that is, a nation that has launched a satellite on its own booster rocket.

The local aerospace industry with the least surprising record is that of Israel: With its close ties to the West, technologically savvy public, and commitment to air power, the Jewish state is years ahead of the regional competition, particularly in the areas of UAVs, satellites, and ballistic missile defense systems. In fact, in terms of technology, it could be described as the southernmost country of Western Europe.

Egypt

Egypt is not an aerospace industry powerhouse, but the country's Arab Organization for Industrialization (AOI)—a pan-Arab body nationalized by Egypt in 1979 and managed by the Ministry of Industry—does supervise nine complexes. These include the Sakr Factory (which produces artillery and air force rockets), the Engine Factory (which overhauls the engines of old cargo, trainer, and fighter aircraft as well as offering maintenance docks for Egypt Air), and Arab British Engine (doing engine overhaul and repair work for Gazelles, Mi-8s, and other aging military helicopters).



Another of the AOI plants, the Aircraft Factory, has assembled Tucano trainers from Brazil, Chenyang fighters from China, and Alpha Jet trainers from France under foreign license. Since July 2000 the plant has been assembling the Chinese K-8E trainer, and in December 2005 it was authorized by China National Aero-Technology Import and Export to produce most of the aircraft's parts.

As for a presence in space, Egypt operates four satellites, including three telecommunications spacecraft owned by Nilesat. The fourth, Egyptsat-1 (also called MisrSat-1), is the country's first remote sensing satellite and was launched aboard a Dnepr rocket in 2007. This 100-kg satellite carries a store-forward communications payload, an infrared sensing device, and a high-resolution multispectral imager. Egyptsat-1 was a joint project of the National Authority for Remote Sensing and Space Sciences (which employs a workforce of 120) and the Yuzhnoye Design Bureau, in the Ukraine.

Egypt plans to add more observation satellites in the coming years. Planned for a 2012 launch is Egyptsat-2, which is already in the works and will have 60% local content. Then there is the Desertsat program

But several of its neighbors have achieved surprising progress in recent years, in areas ranging from UAVs to satellite manufacturing. Even in countries where funding shortages have kept aircraft production from becoming a reality, aviation-related activities are flourishing.

in the Middle East

with Carlo Gavazzi. When completed and sent into orbit in 2017, this 120-kg remote sensing satellite will be able to scan all of Egypt with a medium-resolution camera to study coastal erosion and desertification. In addition, as the construction of Egyptsat-1 did before it, the Desertsat program will provide for the foreign training of Egyptian engineers.

Iran

Though Iran is blessed with oil and natural gas reserves, the country has been hit by crippling economic sanctions following the 1979 takeover of the U.S. embassy in Tehran by Islamic revolutionaries. The U.S. has stopped exporting aircraft, vehicles, and other dual-use technologies to Iran; it has also pressured other countries to adopt similar restrictions. Nevertheless, the Iranian aerospace industry has limped along, and this Febuary it launched Explorer 1, a research rocket capable of delivering an indigenous satellite to space.

Under the auspices of its Ministry of Defense, Iran Helicopter Support and Renewal Company (IHSRC, or Panha) maintains the aging U.S.-made fleet purchased by the shah before the Islamic revolution. According to some reports, Panha has also been manufacturing local versions of U.S. helicopters—namely, the Shabaviz 2-75 and 206-1, based on the Agusta-Bell A/B206 Jet Ranger and Bell 205 utility helicopters, and the Shabaviz 209-1, a derivative of the AH-1J Cobra gunship. Similarly, the Shahed-278, turned out by Iranian Aircraft Manufacturing Industries (HESA), looks like a Jet Ranger knock-off.

Tal Inbar, head of the Space & UAV Research Center at the Fisher Institute for Air and Space Strategic Studies in Herzliya, grants that the Iranians have been manufacturing spare parts. But he doubts that they are producing new platforms. "I don't think that it is [a case of] reverse engineering," he says. "It's more [one] of deep conversion….The quantities of helicopters don't indicate that they are manufacturing today." The same goes for the HESA Azarakhsh and Saeqeh-80 jet fighters, which Inbar says are really F-5 E/F Tiger IIs with minor system upgrades, and the Shafagh, a jet of questionable paternity heavily modified to resemble an F-22, as well as the Simorgh.

Shahed-278

By contrast, since 2004 HESA has been producing under license the Antonov An-140 airliner. The company also manufactures the Ababil UAV, while another state firm, Qods Aviation Industries, produces three other drones: the Talash, Saeqeh, and Mohajer-4. A number of these UAVs ended up in the hands of the Hizbullah, a Lebanese Shiite militia, and were downed during the 2006 war with Israel. Inbar says the Iranian models are 20 years behind those of Israel. "All their UAVs are old designs. Several are copies of South African and target drones," he notes. "Others are copies of

Reverse-engineered F-5

Italian designs, [or are] old Chinese UAVs."

In April 2003 the Iranian parliament established the Iranian Space Agency (ISA) to conduct space research and coordinate related efforts in the country's research centers and universities. The ISA chief serves as one of the deputies of the Ministry of Communication and Information Technology, and the agency executes directives of the Iran Space Council (ISC, also called the Supreme Space Council). The ISC, set up in December 2003, is chaired by the Iranian president and presided over by other senior officials, including the defense minister.

Iran had its first satellite, Sina-1, sent into orbit on October 2005. A Ukrainian firm built the 160-kg device, meant to conduct geological surveys (Iran suffers from devastating earthquakes), and a Russian Cosmos-3M rocket carried it into space. Still, despite the lack of Iranian input, Sina-1 has given the ISA valuable experience in ground control tracking and telemetry handling. Iran was supposed to follow up with another satellite, this one developed with help from local scientific institutions; however, the Mesbah suffered a damaging electrical short while being placed on a Russian booster. According to Parviz Tarikhi, an ISA scientist and engineer, the satellite is still awaiting launch.

The Islamic Republic has also been active at the international level. It is a member of the Asia-Pacific Space Cooperation Organization and cooperates with the U.N. Economic and Social Commission for Asia and the Pacific, especially its Regional Program on Space Technology Applications; there are joint plans for a Center for Informed Space-based Disaster Management. ISA has also worked with China and Thailand on Environment-1, used for monitoring natural disasters and launched aboard a Chinese rocket in September 2008. Iran contributed $44 million and a CCD camera toward that program.

However, it is a matter of pride for Iran to be able to launch a satellite on a native booster, says Tarikhi. Only eight countries have done so; the last to join the group was Israel, in 1988.

To this end, the ISA has been working on the Omid, an all-Iranian microsatellite, and the Safir booster rocket—similar to the Shihab-3 ballistic missile but with an added stage. In August 2008, the Safir failed during launch and lost its second stage in an explosion. Following this setback, officials declared that the Omid had not been on board, despite earlier statements to the contrary. Then on February 2 or early February 3, Iran launched an Omid satellite aboard a Safir-2 into Earth orbit, joining the small circle of nations able to launch their own satellites with their own rockets.

Israel


Shavit

The last fighter jet Israel attempted to build was the Lavi, which never made it past the prototype stage because of funding problems. Still, Israel Aerospace Industries (IAI) does manufacture Gulfstream G200 and G150 business jets, and also provides system upgrades for F-16s, C-130s, and older military aircraft. In addition, its EL/M-2075 Phalcon AEWC&C (airborne early warning, command, and control) system has been mounted on various aircraft. According to Doron Suslik, IAI deputy corporate VP for communications, Israel is second only to the U.S. in the world of UAVs.


Heron TP MALE

Beginning in the 1970s, Israel began to develop drones in order to reconnoiter its Arab enemies without losing pilots to ground fire. Now, decades later, IAI manufactures a slew of UAV models—the Heron TP MALE, Navy Rotary UAV, and tactical Searcher II, as well as the I-View and Bird Eye families of drones. And IAI is not alone. Elbit Systems turns out the Hermes family of UAVs, while Aeronautics Defense Systems has the Aerostar, Orbiter, and Dominator MALE. Indeed, the industrial infrastructure for drone production is very deep in Israel, on a par with its space industry.

The Israel Space Agency, established in 1983, operates under the auspices of the Ministry of Science, Culture and Sport. However, the agency is only a headquarters and has always played second fiddle to the better funded space office within the Ministry of Defense's Armaments R&D Directorate. Indeed, Israel's first venture into a space project was the launch of the Ofek reconnaissance satel-

lite aboard the Shavit booster (based on the Jericho-2 ballistic missile) in 1988. Similarly, TecSAR—a synthetic aperture radar satellite carried aboard an Indian rocket in January 2008—was another defense project.

Still, there are many other players in the Israeli space community. For example, Spacecom, a private broadcasting service company based in Ramat Gan, operates the Amos-2 and -3 telecommunications satellites launched in December 2003 and April 2008. Meanwhile, Imagesat, another firm, owns the Eros A and B imaging satellites, which were procured from IAI. Then there are university projects and an Israel Nano-Satellite Association, formed in 2004. Finally, as if the Israeli space program were not diverse enough, its partnership with the Galileo program is run through the Ministry of Trade, Industry and Labor.

"You cannot be too territorial on space because you spend too much time defending your territory instead of doing something," explains Israel Space Agency director-general Tzvi Kaplan.

Israel has launched nearly a dozen satellites. But unlike other Middle Eastern powers, which either buy satellites or participate in lopsided collaborative efforts, its platforms are fully indigenous. IAI's MLM division provides the launcher, while the company's Elta subsidiary supplies the radar payloads. Rafael Advanced Defense Systems is responsible for propellant tanks and hydrazine thrusters, and Elbit/El-Op builds the high-resolution cameras. Other Israeli firms, such as Rokar, Al Cielo, and Tadiran, contribute GPS receivers, fiber optical gyroscopes, and communications links. IAI/MBT Space serves as the integrator.

As an addional challenge, all satellites launched from Israel must fly westward—toward the Mediterranean Sea and against the rotation of the Earth—to avoid the risk of having classified technology fall into the hands of unfriendly neighbors. As a result, Israeli rockets sacrifice over 30% of their lift power. To compensate for this, the Israelis have had to make their satellites smaller and lighter; nevertheless, these inexpensive vehicles often outperform European platforms that are 20-30% heavier, Kaplan says. Now, scientists are looking to improve satellite coverage and to deploy hyperspectral cameras and miniaturized payloads.

Despite its relative self-sufficiency, Israel's space program has sought foreign partners to defray costs. For example, the Israel Space Agency is collaborating with France on the Venus satellite, which will be launched in 2011, and many Israeli spacecraft have been launched on French, Russian, and Indian rockets. In addition, cooperation has helped the nation achieve things beyond its capabilities, such as manned missions to space. In January 2003, Israel Space Agency sent astronaut Ilan Ramon aboard the space shuttle Columbia, making him the first Israeli in space. Ramon was killed with the rest of his crew when the shuttle exploded upon reentry.

Rocketry is another aerospace subfield in which Israel is strong, says Suslik. Israel Military Industries manufactures a number of state-of-the-art artillery rockets and air force missiles, while IAI's MLM Division produces the Shavit rocket, which carried the first Ofek satellite into space (and can also be converted into a 4,500-km ballistic missile). IAI/MLM makes the Arrow-III ballistic missile defense system, which shoots down incoming medium-range missiles. Similarly, Rafael develops other air defense systems and is working on Iron Dome, an all-weather kinetic interceptor meant to target the short-range rockets that have plagued southern Israel.

Saudi Arabia and United Arab Emirates

In the mid-1980s, the intergovernmental Arab Satellite Communications Organization (Arabsat), founded by the Arab League and based in Riyadh, started to launch communications satellites. Since that time, Arabsat has grown into a leading satellite service provider, carrying over 350 TV and 160 radio stations. However, the satellites themselves are manufactured by foreign companies such as EADS Astrium and Aerospatiale, the most recent craft sent into space being the Badr-6 (or Arabsat-4AR). Launched in July, Badr-6 is based on the Eurostar 2000+ platform and replaces Badr-1, which crashed into the Pacific Ocean in March 2006.

The Space Research Institute at King Ab-

dulaziz City for Science and Technology (KACST) in Riyadh has also been doing some manufacture of its own. Since September 2000, the kingdom has sent into LEO a dozen indigenous satellites, most of them simple, store-forward communications devices. In 2007 alone, six microsatellites (Saudi Comsats-3 through 7 and the imaging satellite SaudiSat-3) were carried aboard Dnepr boosters from the Baikonur Cosmodrome, a Russian-administered site in Kazakhstan.

The kingdom lacks its own ballistic missiles and has no plans to build a launch pad in the near future. But it has deepened cooperation with Western countries. For example, in late October, Prince Turki Bin Saud Al Saud, vice president of the KACST, signed an agreement with Stanford University in California to establish a joint center for space and aviation technology in Riyadh. In addition, the Saudis—along with Israel and Morocco—are participants in the Galileo satellite navigation program, set by the European Commission and ESA.


APID 55

Meanwhile, the UAE is home to two large companies that have staked a claim in the aircraft maintenance and parts manufacture industry. Established in February 2006, Dubai Aerospace Enterprise repairs and overhauls Honeywell, Rolls-Royce, and other aircraft engines as well as refurbishing the airframes of Learjet, Hawker, and Legacy jets. Mubadala Development, a state-owned investment firm in Abu Dhabi, owns Abu Dhabi Aircraft Technologies—formerly Gulf Aircraft Maintenance (GAMCO), which repairs engines for the F-16E Block 60, Mirage 2000, Airbus A330, and Casa CN-235 cargo lift aircraft.

In mid-July, Mubadala Aerospace, another division of Mubadala Development, signed an agreement with EADS, the European parent company of Airbus, to supply aircraft parts. The plant, scheduled to start operations in 2010, initially will manufacture spoilers and flap track fairings for A330, A340, A350, and A380 jets. Later it will supply major structures and components.

Abu Dhabi has also shown interest in UAVs. In 2004, the UAE armed forces set up the UAV Research and Technology Center, which subsequently cooperated with foreign firms to produce two vertical-lift UAVs—al-Sabr, otherwise known as the Schiebel S-100, and the APID 55, whose fuselage was built by then-GAMCO. In a similar vein, the military center has trained the talent for Abu Dhabi UAV, a company set up by the government in February 2007. This new firm will develop, manufacture, and integrate drones, primarily for the UAE armed forces.

Meanwhile, Advanced Targets Systems, a subsidiary of the ADCOM Group, produces canard-wing target drones such as SAT-400, Yabhon-HM, and Yabhon-HMD and has been leveraging that technology to create sensor-carrying UAVs. The company's most ambitious program is to develop a long-endurance, medium-altitude vehicle in the same class as the Predator. The twin-boom Yabhon RX-18 will weigh 1,250 kg and have a wingspan of 18 m. It will feature infrared and electrooptical sensors and synthetic aperture radar.


Arabsat 4A

Turkey

Offering an overview of Turkey's aerospace industry, Tuncay Deniz, author of a book on Turkish aircraft production, notes that the country has a well-educated and experienced staff as well as an up-to-date machine park. Lacking, however, are the funds to finance development of indigenous fighter or transport aircraft, Deniz points out. This leaves the local industry with aircraft overhaul, maintenance, and parts fabrication, as well as assembly of foreign aircraft and the manufacture of a Turkish light trainer and UAVs.

Indeed, besides structural modifications and maintenance work, the state-owned TUSAŞ Aerospace Industries (TAI) has produced under license various foreign aircraft, including the F-16C/D Fighting Falcon, SIAI-Marchetti SF-260D trainer, and Eurocopter AS 532 Cougar. Today, the two ongoing TAI projects involve assembly of the Italian A129 Mangusta gunship (as the T129) and the Korean KAI KT-1C Wong Bee turboprop trainer. Finally, TAI is developing its own Hürkus trainer, which underwent wind tunnel tests in Switzerland last summer.

The company also produces parts for helicopters (MD 902 Explorer, Eurocopter EC-135, Sikorsky H-60 Black Hawk, and others) and for major international projects, such as the Airbus A400M transport plane (aft-cockpit fuselage, spoilers, doors, and tail) and F-35 Joint Strike Fighter (fuselage). Similarly, TUSAŞ Engine Industries, established in 1985 as a joint venture of General Electric, TAI, and two other Turkish institutions, has been producing the engines for both the Airbus A400M and F-35, Deniz says.

In the past TAI has also produced a number of simple UAVs, such as the Pelikan, Sahit, Turna, and Keklik, the last two being target drones. Then, in 2004, the manufacturer took on a more ambitious project: developing the TIHA (Turkish Unmanned Air Vehicle), a long-endurance UAV in the same class as the MQ-1 Predator. The goal is to have three prototypes flight tested by mid-2011; in the meantime, as a stopgap, the Turkish air force is using the Israeli Heron with a locally produced Aselflir 300T electrooptical camera.

As for the final frontier, in 2000 the Turkish air force established a Space Studies Dept. at its graduate academy. In addition, it created an Aero-Space Office, meant to prepare the ground for a civilian Turkish Space Agency. The agency still awaits authorization from parliament. In the meantime there are other actors operating in the field. The Scientific and Technological Research Council of Turkey provides R&D support to the space program, while Turksat, a government corporation, owns and operates all of the country's telecommunication satellites.

The Turks have also been cooperating with, and learning from, other countries. For example, since 2003, the European Union Satellite Centre in Torrejon, Spain, has been training Turkish experts in satellite management and image interpretation. In June 2006 Turkey signed the convention on the proposed Asia-Pacific Space Cooperation Organization, headquartered in Beijing. The Aero-Space Office is also hoping to send an astronaut into space aboard a U.S. shuttle in 2012, Deniz notes.

Turkey has had telecommunications satellites in orbit since the mid-1990s. However, its whole fleet (currently consisting of Türksat 1C, 2A, and 3A) was built and launched by foreign firms. Türksat 1B, for example, the first satellite sent into space, was developed by Aerospatiale (now Thales Alenia Space) using a Spacebus-2000 platform; it was launched from Kourou, French Guiana, aboard an Ariane rocket. Not much has changed since then: Türksat 4A, scheduled for takeoff in 2011, also will be developed by a foreign contractor.

This does not mean there are no plans for domestic production. The director-general of the Turkish state satellite company has noted that Türksat 5A will be built at TAI in 2012 and launched in 2014. Likewise, the Göktürk project to build reconnaissance satellites will involve input from local defense contractors (such as Aselsan, responsible for electro-optical and communication subsystems), and will include construction of a satellite integration and test center on the TAI premises.


TIHA


Hürkus trainer

All in all, the Middle East is the scene of some modest—if not cutting-edge—aerospace developments in the assembly of foreign aircraft and the manufacture of airplane parts, UAVs, and satellites, as well as the maintenance of engines and airframes. Nevertheless, these regional achievements pale in comparison to those of Israel, which not only produces UAVs and missile defense systems but can also launch its own satellites.