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MARKETPLACE: Shlomo Maital

Israel Conquers Space

Twinkle, twinkle, little satellite
How I wonder at your radar sight
Up above clouds thick and black
Sending pictures sharp as a tack
Twinkle, twinkle, little spy
I feel safer with you in the sky

LOOK UP AT THE NIGHT SKY. Though you cannot see it, amid the stars is a small satellite circling the earth every 90 minutes, peering down through clouds and darkness. Called Ofek 9, this sophisticated eye-in-the-sky was built and launched by Israel last June 22, at a cost of $300 million. Ofek 9 is Israel's sixth spy satellite and it sends back highly detailed photographs. Among other things, Ofek 9 tracks what Israel's enemies are scheming, night or day, fair weather or foul. It is concrete evidence that, improbably, Israel has become one of a handful of nations (and by far the smallest of them), who lead in both military and civilian space technology. How this happened conveys important lessons.

The Israel Space Agency was founded in 1982. In 1984, then-defense minister Moshe Arens instructed IAI (then, Israel Aircraft Industries, and now known as Israel Aerospace Industries) to join other Israeli companies to design and build satellites, and a rocket powerful enough to launch them.

Arens was no rookie to the field. A Lithuanian-born naturalized American, he studied aeronautical engineering at MIT and Caltech, then immigrated to Israel in 1948. After a five-year stint at the Technion, he spent nine years as deputy head of IAI.

Only four years after Arens's decision, on September 19, 1988, Israel became the eighth nation in the world to launch a satellite. It was called Ofek 1 (*ofek* means "horizon" in Hebrew). It weighed 155 kilograms (343 pounds) and like many of Israel's achievements, it was done the hard way.

Every other nation's satellites, without exception, are launched from west to east to take advantage of the earth's rotation, similar to a slingshot. Depending on latitude, the earth's rotational speed can reach 1,300 kilometers per hour (800 miles per hour) and this speed can be used to help rockets gain the momentum needed to launch satellites into orbit.

But Israel cannot launch its satellites in the direction of the earth's rotation, from west to east, because that would mean sending the launch rocket's trajectory over hostile Arab territory. So Israel launches satellites from east to west, over the Mediterranean, and against the spin of the Earth. Zvi Kaplan, director of the Israel Space Agency, told The Jewish Herald, a Houston, Texas, daily, that an east-to-west launch loses "about 30 percent in the effective payload or the overall launch weight, so the policy in Israel was to miniaturize everything, yet not to pay in performance." Necessity has spurred invention. Jaime Lerner, the former Jewish mayor of Curitiba, a highly innovative Brazilian city, once said that if you want true creativity, chop two zeros off your budget. Israel's space industry is proof of that attitude. With limited resources and major constraints, Israel has become a leader in optical and radar imaging of the earth and in miniaturizing satellites, simply because it had to. But it has not all been smooth sailing. Satellite launch attempts failed in 1991 and in 1993, and in 1998, Ofek 4 fell into the sea, and in 2004, so did Ofek 6.

The former chair of the Israel Space Agency, Dr. Yitzhak Ben-Israel, who is now head of the National R&D Council, told the on-line newspaper Ynet, "with Ofek 9, Israel now has about 10 satellites working in a joint system. One of them completes an orbit every 90 minutes, then the second one comes along, then the third one, and so on. At a given moment, there is not one place which interests us in the Middle East that is not being shot [photographed]. In fact, a country will not be able to conduct any secret operations in the Middle East without the area being covered by one of our satellites, as there are no longer such moments. Iran won't be able to transfer different materials without us noticing." "There are seven independent countries in space, and in terms of quality and technology, only the United States comes before Israel," he added. Officially, Ofek satellites can see objects as small as two feet (60 centimeters) wide on the ground. In practice, Ben-Israel said, the resolution is actually far sharper.

FOR ISRAEL, SPACE HAS MORE than defense implications. It is also a vital civilian industry. The global space market amounts to a whopping $250 billion annually. Israel's goal is to capture just over 3 percent of it, or some $8 billion, within the next few years. And it has already made a good start. Geosynchronous Israeli civilian satellites already offer communication channels to companies all over the world. Geosynchronous satellites orbit the earth at precisely the same speed as the earth turns and therefore remain at one stationary spot, very useful for providing TV, phone and Internet communication channels. The first such satellite, Amos 1, was put into orbit by a European Ariane rocket in April 1995. Amos 5 will launch in 2011, and Amos 4, in 2012 (satellites are numbered according to when development begins, not when they launch). The Amos satellites have proved profitable, as there is a global shortage of satellite communication channels.

Israeli high-tech companies compete fiercely with one another in global markets. But in space technology, they collaborate like the parts of a Swiss watch. A powerful consortium links IAI, Elbit, El-Op, Rafael, Elta, Elisra, Spacecom, Gilat and other companies in designing, building and launching military and civilian satellites and selling their services. If only this model could be applied to other strategic industries, like software and semiconductors.

The major problem for Israel in converting its space technology into export dollars is, ironically, the uniqueness and excellence of its satellites. Selling this know-how would cost Israel its huge military advantage in space. This dilemma – what can be sold abroad without endangering security – exists for all of Israel's defense companies.

I spoke with Dr. Daphne Getz, a colleague at the Haifa Technion's S. Neaman Institute, and the author of two studies of the commercial benefits of space, for which she and her team interviewed a wide range of Israeli space experts. She told me that, in her view, "the space industry has benefits other than military – prestige, collaboration with other nations (Israel

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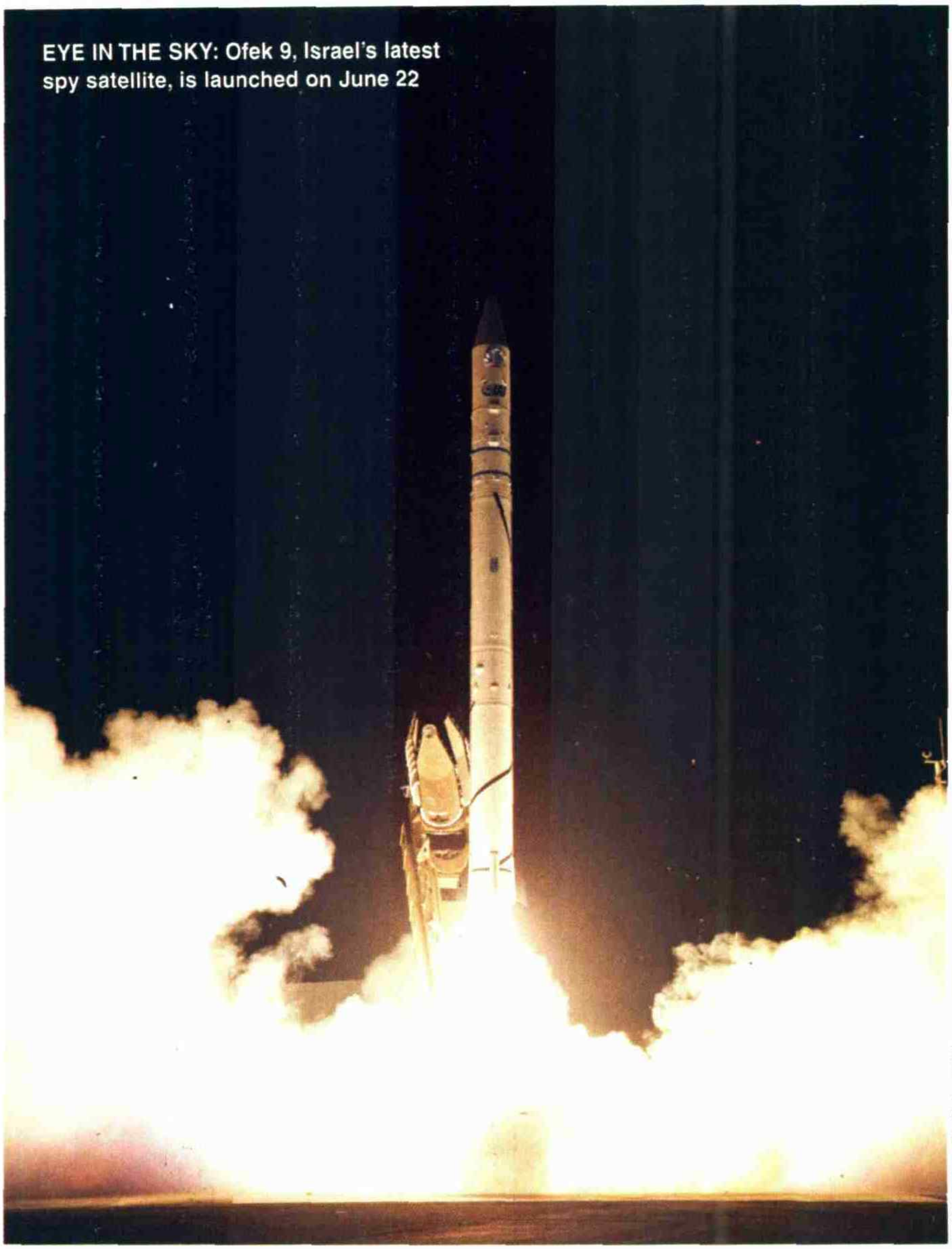

EYE IN THE SKY: Ofek 9, Israel's latest spy satellite, is launched on June 22

MINISTRY OF DEFENCE/FLASH90

works on space with the US, Russia and India), and it attracts youth to study science. We need a National Space Program with clear focused goals, to develop technology that finds wider use beyond space." The fact that space "attracts youth to study science" is, in my view, crucially important and vastly underrated. It brings to mind America's moon shot. Some readers may recall US president John Kennedy's stirring words in his commencement address, in September 1962, at Rice University: "We will go to the moon. We will go to the moon by the end of this decade." The US National Aeronautical and Space Administration was established and, seven years later, Neil Armstrong stepped onto the moon.

The cost of landing on the moon was enormous. Many bean-counting economists think the money was wasted, citing the lack of tangible benefits. I believe they are wrong: a generation of young Americans was inspired to study science and engineering by the moon project. This alone made the moon shot worthwhile. This contrasts with George W. Bush's decision in 2006 to end the space shuttle project. When the space shuttle Discovery makes its last flight next spring, America will have to rely on Russian Soyuz rockets to put its astronauts in space for years to come. Is America that poor? Israel, too, has used space to inspire youth. The visionary idea to have Technion students build a satellite was proposed in the early 1990s by physics Prof. Giora Shaviv, in partnership with Haim Eshed, then-head of space programs for the Ministry of Defense. The student-built TechSat Gurwin II (named after US textile magnate and philanthropist Joe Gurwin) had thin-film solar cells and was launched successfully in July 1998. It weighed 48 kilos (about 106 pounds) and was designed to remain operational for about a year. Instead, the little satellite sent back signals for almost 12 years, a record for university-built microsatellites, falling silent only this April. Like America's moon shot, TechSat fired the imagination of young Israelis.

It also inspired philanthropist Gurwin. In 1995, the third stage of the Russian rocket that was supposed to put Gurwin I into orbit failed and it fell into the Sea of Okhotsk. Former Technion president Zeev Tadmor told me how he called Gurwin, with great trepidation, to give him the bad news that his donation had gone "down into the sea" instead of "up into space." Gurwin reassured Tadmor, told him about his own resilience as a poor immigrant and funded another attempt. This one worked. Gurwin's philanthropic fund lost a fortune to the Madoff fraud. He was undaunted and continued to support Israel from his personal funds. He passed away last year.

For Israel's space efforts, the future is bright. At the end of this year, according to Kaplan, Israel's first "nano satellite," the Incline, will be launched by the Israel Space Agency. Weighing in at a featherweight 12 kilos (26 pounds), the tiny satellite will likely attract much interest, especially as many nations face shrinking government budgets in light of the recent global economic crisis.

"If you compare the typical Israeli radar," Kaplan told the Jewish Herald, "it's at least equivalent in performance to its European competitors, but is 20 percent of the weight. And [for satellites] weight is related to cost." "More with less" has been the mantra of Israel's space program from the outset. The question may now become not whether Israel can find buyers for its defense-driven space technology but how much of it Israel is willing to sell.

The writer is senior research associate at the S. Neaman Institute, Technion.