



Israeli Space Program – The Challenges Ahead

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Israel is one of the few countries that has been able to develop its own indigenous space program since the '70s. Though, presently, it is facing a significant slowdown in its various space programs, till now there are five functional Israeli earth observation satellites in place along with multiple telecommunication and reconnaissance satellites.

Israel's space program began with university-based research in the early 1960s. The Israel Academy of Social Science and Humanities formally established the National Committee for Space Research in 1963. The growth, in scope and depth, of research-related activities led to the creation of a strong academic community that fostered a new generation of scientists and engineers.¹

The value of satellite imagery was not unknown to the Israelis before the Yom Kippur war. Faced with invading armies on two fronts in October 1973, Israeli military attachés in Washington urgently requested satellite information from the United States about the disposition of the Egyptian and Syrian forces. According to former Israeli Defence Forces (IDF) Chief of Staff Gen. Mordechai Gur, who had been one of those attaches, US authorities responded that the information was unavailable due to 'damage' to the satellite.² It was later revealed that the United States had acquired "wonderful coverage, but...didn't get the pictures until the war was over".³ For the Israelis, the lesson was immediate, which made it clear to them, that during periods of such extreme exigencies, they have to fall back on technologies that they have indigenously acquired or have control over. This forced them to develop and acquire an independent space reconnaissance capability. Though information about the development of the satellite program remain limited, after the launch of *Ofeq-1* in 1988, Israel Space Agency (ISA) chairman Yuval Ne'eman disclosed that Israel had been working on the satellite since the early 1970s.⁴

At the beginning of the 1980s, Israel set its sights on developing the industrial and scientific infrastructure required for full-fledged membership in the "Space Community". The

government established the Israel Space Agency in 1983 in affiliation to the Ministry of Science, Culture and Sport and charged it with the coordination of the nation's space program. The emphasis continues to be on building a broad space infrastructure, and following the Ofek and its Shavit launcher, a diverse scope of activities was established both for defence led by Israel MOD and for civilian applications under the leadership of ISA.

The creation and the advancement of the Israel's space industry was a natural outgrowth of the defence industrial infrastructure. Later on, private initiatives were established to develop space components and space-based services. The industry's prime contractor and system house is the Israel Aircraft Industries. Other industries such as "El Op" and "Rafael" are producing core technologies and main sub-systems. In the third circle, there are additional medium and small companies jointly creating a fully indigenous capability.⁵

The Present Status

Israel's space activities are highly focussed on High-Resolution-Imaging satellites in Low Earth Orbits.⁶ The funding levels for Israel's space program are relatively modest. Nevertheless, the program's achievements are among the most impressive of Israel's high-tech industries. On the basis of cost-to-performance and weight-to-performance, there is no doubt that Israel's imaging satellites are among the best in the world.

At present, there are five Earth observation active satellites and eight reconnaissance satellites in orbit:

EROS A – Operating as a commercial venture supplying imagery to the international market. To be followed by OFEQ 5, EROS B, OFEQ 7 (the second generation of Electro-Optical Remote-Sensing satellites).

TecSAR – Launched in 2007, employing a state-of-the-art Synthetic-Aperture-Radar payload. It enables night images and penetration through clouds.

In the coming years (under development and construction) the next generation of satellites will include:

OPTSAT – 3rd a new generation of high-resolution Electro-Optical remote sensing satellites.

VENUS – A Joint Israel/France Multi-spectral Mission to monitor vegetation and coasts (water quality). Partners: ISA –Israel Space Agency and CNES the space agency of France.

The State of Israel has been engaged with Communication Satellites since the early '90s. Two satellites were launched to a geosynchronous orbit, Amos-1 in mid-1996 and Amos-2 in late 2003. Amos-1 and Amos-2 are providing communication services to the Middle East, Central Europe and the East Coast of the United States. Amos-3 was launched in April 2008, to replace Amos-1. The Amos-1, 2, 3 series is of small-class (up to 1.5 ton) satellites.

The Amos-4 program was started in July 2007 and was planned to be launched by the end of 2011 which was delayed till December 2013. It offers coverage across Southeast Asia along with high-power coverage beams offering communication links from East Asia to the Middle East. Amos-4 is a medium-class (up to 4.0 ton) satellite. IAI/MBT-SPACE provides the satellite owner (Spacecom) with control operations service.⁷ Amos-5 was launched on 11 December 2011, providing coverage over the continent of Africa, as well as Europe and the Middle East. Amos-6 was proposed to be launched on September 1, 2016, which exploded in the launch pad in Florida.

Israel has independent capabilities to launch satellites into low Earth orbits. It also has capabilities developing, manufacturing and maintaining light high-resolution remote-sensing satellites as well as communication satellites. The main research objectives of the ISA are to assure that Israel continues to lead in areas in which Israel has relative advantages, such as miniaturization, light materials, remote sensing, communications, and fundamental and applied research. These research objectives have applications for all national needs, both military and civilian.

Task Force 2009

In the last few years, Israel space program underwent a long and comprehensive process of re-evaluating its space-related objectives and policies, which led to creation of a Task Force in 2009. The main objective of the task force was to focus on civil and scientific applications that would allow Israel to develop a greater industrial scale and competitive edge in the growing, global space market.

The main recommendations of the Task force were as follows:

- To maintain an Israeli presence in space for scientific, national and commercial uses.
- To maintain its' strategically leading position among the top five countries in the community of nations engaged in space science and space research technologies, in areas in which Israel has relative advantages.
- Engaging a public-private partnership in developing Israeli space program, while increasing the revenues of the global space market.
- Enhancing Israel's bilateral and multilateral cooperation in space to expand the business opportunities, upgrade foreign relations between partner countries in space science and exploration, and encourage the peaceful use of outer space for the benefit of the human race.
- Improving Israeli knowledge and upgrading its industrial infrastructure in R&D areas that are suggested for funding, such as: satellite miniaturization, remote sensing and communication; as well as in fundamental, basic and applied research.
- Strengthening the interrelationship between space research and applications, and Israeli society.⁸

National Civil Space Policy 2012

The recommendations of the task force were later adopted and implemented as the National Civil Space Policy in 2012.

Presently, Israel's aerospace industry has focused on the following three product families:

- Mini-satellites such as Ofek and Eros. These satellites weigh about 300 kg and perform various observation missions on very low orbits (LEO).
- Ground launchers of the Shavit family. These are multi-phase rockets that can launch mini-satellites weighing up to 300 kg into LEO orbits. These launchers were developed for the purpose of launching satellites of the Ofek family.
- The family of Amos satellites – geosynchronous communications satellites weighing about 1,000 kg. Until now, these satellites were launched by Ariane 4 or Soyuz launchers.⁹

The nano-satellites are also one of the flagship projects of the Israel Space Agency, developed by research at the Technion – Israel Institute of Technology, Haifa, in cooperation with the defense-systems maker Rafael and Israel Aerospace Industries. The project known as Samson, for Space Autonomous Mission for Swarming and Geolocation with Nanosatellites, has been designed to make satellites, each weighing a mere eight kilograms, requiring the expertise in miniaturization that Rafael has. Each satellite is built out of six cubes, each 10 cubic centimeters. They will be thrust into space together with the Israeli-French Venus microsatellite, another innovative project whose goal is to provide precision agricultural imaging and environmental monitoring. The three satellites will work as a team, with a “leader” and two “followers,” orbiting in fixed formation no more than 250 kilometers apart from each other – a kind of coordination never achieved before by satellites in orbit 600 kilometers above Earth's surface. The programs and algorithms that manage the flight were developed by Technion Space Research. Apart from proving that it is possible to hold satellites in formation for a year or more, their purpose is to find signals of people on Earth who are missing or in distress. But the team has other ideas for their satellite technology, among them as a platform for speedier communications and very-high-resolution photography.¹⁰ The nano-satellite project has developed the Inklajn series of satellites which are fit with a fusion of high spectral and low resolution pan cameras, which is sought by many countries for its reconnaissance capabilities.¹¹

Presently, various countries have been approaching Israel to acquire such satellites for strengthening their respective military infrastructure. Five years ago, Meir Nissim-Nir, the then Head of the Department for Satellite Control and Command for Israel Aircraft Industries stated that Israel possesses strategic capabilities in space satellites that produce targets for the Air Force.¹²

In Israel, ISA's partners include industry and academia. In general, some 30 industries nationwide are involved in the space program, Israel Aerospace Industries being its prime contractor. In academia, Israeli universities lead in astrophysics, space research and space engineering.

As a government agency, ISA also coordinates external relations and collaborations with foreign countries and other space agencies. These activities include developing space systems and

subsystems, running the “ground segment” systems that communicate with space missions from Earth, scientific research and exploration initiatives that involve Israeli academic institutions and industry.

As a long-standing space-faring nation, Israel has established cooperation with leading space-faring nations. For example, ISA is currently developing Vegetation and Environment New Micro Spacecraft (VENUS) together with the French Space Agency - Centre national d'etudes spatiales (CNES), exploring the SHALOM project with the Italian Space Agency - Agenzia Spaziale Italiana (ASI), which involves a hyperspectral satellite. ISA also collaborates with NASA in the Mediterranean Israel Dust Experiment or the MEIDEX project, which studied the Mediterranean region and its influence on the weather and climate, the European Space Agency and others.¹³

The ongoing projects under the Israeli space program are Samson, which has been discussed before; ULTRASAT, a small space mission designed to carry out a wide-field UV transient survey, which is being jointly carried out by Weizmann Institute of Science, Israel Aircraft Industries (IAI) and Elbit Systems Electro-optics - Elop in collaboration with NASA AMES and CALTEC and the Space IL project, which aims to successfully launch, fly and land a robotic spacecraft on the moon, operate the spacecraft across the lunar surface, and transmit video, images, and data back to Earth by using a micro satellite.¹⁴

There are multiple private satellite companies in Israel and Europe that operate in tandem with the Israeli Space Program assisting ISA—Gilat Satellite Networks, Global TT Satellite provider (based in Brussels), Elbit Systems, Satlink Communications and Spacecom under Eurocom to name a few.

Challenges

In the past few years, Israel's space community underwent a comprehensive process of re-evaluating its goals, objectives and policies. But it faces some specific challenges in the present which is stated below.

- ❖ With the creation of the National Civil Space Policy in 2012, the Finance Ministry had approved an investment of NIS 180 million for Israel's new civil space program, which was at that year the top of their defence space budget.¹⁵ However, within the last few years, there have been significant reduction of budget for the space programme, which was stated by the Knesset Committee of Science and Technology to the Israeli parliament, after the explosion of the Amos 6 satellite in Florida, pointing out the manner in which it was becoming difficult to run the space program due to lack of funds.¹⁶ As per Joseph Weiss, President and CEO of Israel Aerospace Industries (IAI), Israel's communications-satellite industry is about to reach its end unless the government immediately intervenes for its survival and provides a higher budget for its space program.¹⁷
- ❖ Israel's communications-satellite industry is about to reach its end unless the government places more orders for furtherance of its space program. Joseph Weiss warned that following the scheduled launch of the Amos-6 communications satellite (which failed) and a military spy satellite, IAI's infrastructure dedicated to constructing communication

satellites will be disbanded due to the lack of any indication of future orders by the government. He further stated that the Israeli space industry launches a communications satellite once every three to four years, while competitors build five to seven in a year. He mentioned that the future of reconnaissance satellites is assured due to commitments by the government to build additional satellites in the future.¹⁸

- ❖ There is a need for the immediate formulation of a conclusive Israeli space policy, which is a major impediment for the program's growth. As per Opher Doron, head of IAI's MBT Space Division, "Israel has no space policy, and we are moving backwards."¹⁹
- ❖ Amos 6 built by Israel Aerospace Industries and operated by Israeli company Spacecom, in partnership with France's Eutelsat Communications, was set to provide services to Israeli telecom networks and to be part of Facebook's Internet.org platform to expand Internet access to remote areas, which was meant to be operational for the next 16 years.²⁰ Beijing Xinwei Technology Group owned by Chinese tycoon Wang Jing has been planning to take over Spacecom for \$285 million, a 100 percent stake in Spacecom Satellite Communications through its unit Luxembourg Space Telecommunications.²¹ However, with the failure of the Amos 6 satellite, the acquisition of Spacecom by Xinwei Technology has been postponed, which remain to be a major hurdle for future growth for the industry.²²
- ❖ The State Comptroller's Office had begun investigating Israel's satellite communications program from mid 2016. Based on preliminary findings, the comptroller believes there are serious long-term planning gaps in the development of such satellites in Israel. The state comptroller's investigation into Israel's satellite communications is being led by its security division, under Brig. Gen. (res.) Yossi Beinhorn. Although most of the satellite program's goals are civilian, many of the satellite projects are in the hands of Israel Aerospace Industries, which is considered a defense company and therefore scrutinized by the security division of the State Comptroller's Office. One aspect set to come under scrutiny involves the National Security Council and the extent to which it was involved in drawing up a long-term plan for satellite development in light of the technological, economic and security-related aspects of the program for the state. The report into the satellite program is expected to be included in State Comptroller Joseph Shapira's 2017 report.²³
- ❖ The fast growth of regional space programs, especially of Iran, poses a challenge to Israel's national security. Brig.- Gen. (res.) Abraham Assael, CEO of Fisher Institute for Air and Space Strategic Studies, pointed out, while speaking in the 11th Ilan Ramon International Space Conference, that post withdrawal of sanctions Iran will speed up Tehran's space program and missile development which might be one of the causes of enhancing instability in the region.
- ❖ If defence technologies that have been developed indigenously by Israel through public - private partnership, and such private firms are taken over by foreign acquisition, chances of next generation defence weapons and sensitive technology also being transferred

through such take-overs, might pose as a strategic challenge for other regions, disturbing their specific regional securities. Additionally, the likelihood of soft interference in the operation of space systems by jamming or cyber attacks is on the rise along with the development of ASAT technologies . This was also recognized by many in Israel who perceive a direct link between cyber threats (Levi and Dekel 2011; Levi and Dekel 2012) and assuring the security and safety of space systems (Ben-Israel 2012).²⁴

Israel – India Space Cooperation

Israeli reconnaissance satellite TecSAR, equipped with synthetic aperture radar developed by Elta Systems, was launched on 21 January 2008, by PSLV C-10 Launch Vehicle, from the Satish Dhawan Space Centre in India.²⁵

Indian satellite RISAT-2, with X-band Synthetic Aperture Radar (SAR) was realised in association with Israel aerospace industries and launched onboard PSLV-C12 on April 20, 2009. The satellite enables imaging of the surface features during both day and night under all weather conditions. RISAT-2 has enhanced the country's capability in the disaster management support activities. The satellite has completed more than five years in orbit.²⁶

India has been jointly developing the Barak-8 missile system, along with Israel Aerospace Industries.²⁷

The Indian Space Research Organisation (ISRO) will also be launching 68 foreign satellites from Israel, along with the US, Britain, Germany, France and Canada.²⁸

It can be noted here that Indian defense manufacturer Premier Explosives has reported to the Bombay Stock Exchange (BSE) in Mumbai that it has signed, a memorandum of understanding (MOU) with Israel Aerospace Industries Ltd. (IAI) (TASE: ARSP.B1) for exploring potential business opportunities. Premier Explosives designs, develops and manufactures solid propellants for Indian missiles such as the Akash and Astra. The company also operates a state-of-the-art chemical manufacturing facility of Indian Space Research Organisation (ISRO) at Sriharikota and a solid fuel complex of advanced systems laboratory at Jagdalpur.²⁹

The Indian Space Research Organisation (ISRO) has already successfully developed its own flagship projects of micro- and nano-satellites, which was launched in May 2016. There is significant scope for India-Israel collaboration in this sphere, furthering the scope of developing both the nations' respective space programs.

India-Israel relations have been dominated by third-party issues, and the scope of bilateral high-tech cooperation remains mostly untapped. India has specialised technical institutes dealing exclusively with India's space program and is developing its cryogenic engines indigenously, which has been successfully tested. India has already moved on to its Phase 2 of its Lunar Exploration Program developing its spacecraft for soft landing on the surface of the moon. It has successfully developed its Integrated Space Cell which is governed by three services of the Indian Armed Forces, the civilian Department of Space and ISRO. It goes without mentioning that India has been able to develop its own satellite launch station of international standards since 1971 and

has conducted more than 55 successful launches since then. The collaboration of ISRO with other international space stations for future launches has been discussed above. Besides other avenues of collaboration, India and Israel can build and strengthen their space capabilities in the future.

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Disclaimer: Views expressed are of authors and do not reflect the views of the Council.

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