Iran’s space programme: Riding high for peace and pride

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Abstract

Iran’s efforts to develop space technology for civil and peaceful purposes began many years ago. Almost all its success in this connection is the result of indigenous potential in terms of human resources, available expertise and experience along with international cooperation and exchange of knowledge. There are considerable civilian entities involved in space-related development and production in Iran. This article describes the history and current status and capabilities of Iran’s space programme and its aim to use space for peace and prosperity and to attain the position that it deserves in the global arena. Stepping into space using an indigenously developed system has provided Iran with a notable and unprecedented national pride. Only international cooperation, as already exists in the framework of COPUOS activities on the peaceful uses of outer space, can improve 21st century understanding of the space policy and visions of Iran for the world community. Iran’s space programme is really no different from that of any other nation. It is committed to developing its assets in space both for peaceful purposes and for use as part of various multinational space projects. It should not be ignored that such achievements require a high degree of expertise, ability and comprehensive knowledge about the subject, while the attitudes and visions of leaders in each nation who also influence and contribute to the pace, progress and developmental objectives of any nation’s space program should not be disregarded.

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1. Introduction

The roots of humanity’s attention to space go back to the early days of human history.1 The eye-catching contribution of the Iranians in this connection is undeniable. Wishing to fly up to the sky and voyage in space is a common idea not only in national myths but also in religions.2,3 In the Iranian myth, for example, Kay Kavus flies up to heaven using propulsion by hungry eagles, as described by Ferdowsi, one of the world’s greatest epic poets, in his magnificent work Shah-Nameh (see Fig. 1).4 By examining the phenomena happening in the sky and space humans have developed astronomy, physics, mathematics, art and literature.5,6 There are many examples and documents on the attention and interest paid by Iranian scholars and poets to space in their work.7,8

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4 Parviz Tarikhi: Institutionalization of Space Activities in Iran. Iranian Remote Sensing Center (IRSC), Tehran, Iran, 2002.


2. Background

2.1. Origins

In recent decades Iran has pursued a space programme for several years. The idea of using space and its technologies for peaceful purposes and the nation’s welfare dates back to the time when Iran joined 17 other countries to establish the United Nations ad-hoc Committee for International Cooperation on Space in 1958, which later changed its name to the Committee on the Peaceful Uses of Outer Space (COPUOS). The Committee aims to review international collaborative programmes to exploit and use space for civil purposes, serve as a forum for information exchanges, and encourage development and facilitate the advancement of national programmes to study outer space.\(^9\),\(^10\)

Increasing and promising attention has been given to the application of space technologies in recent decades in Iran. The country has consistently held a peaceful position on the applications of space science and technology. It has been a continuous contributor to COPUOS deliberations. Historical records on Iran’s space endeavours are not easily accessible. Available

The Shah was reportedly strongly supportive of the peaceful uses of outer space. His interest in and commitment to establishing the UN ad-hoc Committee on International Cooperation in Outer Space in the early years of the Space Age and sending active delegations to the meetings of COPUOS and its subcommittees in later years are an indication of such willingness. Iran signed and/or ratified four UN Treaties on space and actively proceeded to ratify four international agreements relating to activities in outer space, including the treaty which bans nuclear tests in outer space. In the meantime a strong intent to develop applications of new space technologies in different fields, particularly communications, broadcasting and earth observation can be seen in the 1970s. Iran was ready to establish its space agency early in 1977.

2.2. Legislation and institutionalization

Space technology applications were spread in Iran by various organizations, indicating the country’s serious interest in further understanding and benefiting from space. Soon after the launch of the USA’s first earth observation system, Landsat, Iran built the MSRS facility 65 km west of Tehran to obtain remote sensing imagery. The Iranian Remote Sensing Center (IRSC) was established, with responsibility for collecting, processing and distributing relevant imagery products to users throughout the country for resource planning and management. Availability of remote sensing data assisted, for instance, in identifying areas suitable for development and those prone to earthquakes, floods, landslides and other natural disasters and threats, in investigating greenhouse gas emission and air pollution in the large urban areas; in monitoring wetlands and water basins inland and those shared with neighbouring countries; and in other useful activities for

recorded information mostly comes from sources where Iran has worked together with international bodies; however, not much information has been preserved from the early days. From the records of the UN Office for Outer Space Affairs (UNOOSA) it can be determined that Iran was involved in space decisions in the early days, although the records do not provide much insight into the country’s space developments. They do show that a Dr Mehdi Vakil was the permanent representative of Iran at the General Assembly early in the 1960s, while he also appears in other documents and at those times he seems to have been Iran’s voice in space debates.

Iran entered the space applications era in 1969 by establishing the Asad-Abad Ground Station and installing a 30 m-diameter standard-A antenna to connect to the Pacific Intelsat for international communications. With the assistance of the USA the Mahdasht Satellite Receiving Station (MSRS) was established in 1972 following the launch of US ERTS (Landsat-1). The station was among the only five stations around the world receiving Landsat data at that date. Establishment of the station was Iran’s first bilateral cooperation in space technology. Telecommunications, TV broadcasting, remote sensing, navigation, tele-education, weather forecasting, environmental modelling, internet, relief and rescue, etc. are common applications of space technology that have spread widely in Iran.

The history of Iran’s space efforts and its drive to pursue independent space projects began during the reign of Muhammad Reza Shah Pahlavi. The chief aim in 1977 was to establish an Iranian communications satellite system called Zohreh. In addition, a number of national organizations were involved in plans to send research satellites into space. Iran could not achieve these goals purely indigenously and needed foreign assistance in the fields of technology and knowledge. It turned to Russia, China and India, which were established spacefaring countries; however, North Korea and later Italy were its partners for cooperation. In 1977 the first official step to establish a space agency was taken: a plan to create the Iranian Space Agency (ISA) was presented to the Planning and Budget Organization by the Iranian National Organization of Radio and TV. However, the Islamic revolution in Iran in 1979 and the eight-year war with Iraq starting in 1980 halted all efforts in the process of institutionalizing space activities in Iran. Only the continuation of some space applications, such as communications and remote sensing, was allowed.

15 Parviz Tarikhi: Mahdasht Satellite Receiving Station Verging into a Space Center, Res Communis., The University of Mississippi School of Law, USA, October 13, 2008 http://rescommunis.wordpress.com/2008/10/13/guest-blogger-parviz-tarikhi-mahdasht-satellite-receiving-station-verging-into-a-space-center/ [accessed May 10, 2009].
global benefits. For telecommunications and broadcasting, as well as other applications, the Ministry of Post, Telegraph and Telephone (MPTT), the Iranian Broadcasting Organization and the Ministry of Science were involved. However, Iranians had to wait until February 2004 for the full institutionalization of such efforts, when the ISA began its activity according to Article nine of the Law for Tasks and Authorizations of the Ministry of Communications and Information Technology (CIT), passed on 10 December 2003 by the Parliament of the Islamic Republic of Iran. The president of ISA held the position of Vice-Minister of CIT and of the secretariat of the Space Supreme Council (SSC) at the same time. ISA was mandated to cover and support all activities concerning the peaceful applications of space science and technology under the leadership of the SSC, chaired by Iran’s president. While ISA hosts the SSC’s secretariat, the main members of SSC include 1) The President of the Islamic Republic of Iran, who is president of SSC at the same time; 2) the Minister of Communications and Information Technology; 3) the Minister of Science, Research and Technology; 4) the Minister of Defense and Armed Forces Logistics; 5) the Minister of Foreign Affairs; 6) the Minister of Industries and Mines; 7) the Minister of Roads and Transportation; 8) the Director of the Islamic Republic of Iran Broadcasting (IRIB); and 9) the President of ISA, who is the secretary of SSC at the same time. The SSC also has other members with observer and advisor status (see Table 1).

The establishment of ISA is considered a big and practical step forward not only towards concentrating efforts to advance relevant science and technology in the effective use of outer space for peaceful purposes but also in enhancing cooperation at the international level for this highly desirable purpose.

The SSC assigned ISA the following tasks:

- policy making for space technology applications;
- manufacturing, launch and use of national research satellites;
- approving the space-related programmes of state and private institutions and organizations;
- promoting partnerships among the private and cooperative sectors in the efficient uses of space;
- identifying guidelines for regional and international cooperation in space issues and clarifying the country’s position to the abovementioned bodies.

Promoting the applications of space science and technology for peaceful purposes is both a vital part of Iran’s current plan and an essential part of its strategy. This includes paying close attention to important concepts such as public awareness, capacity building, research and exchange of experience simultaneously with the expansion of bilateral and multilateral cooperation at the regional and global levels.

ISA continued to implement its tasks and duties under the supervision of the SSC until the state’s decision to merge the supreme councils according to the approval of the Administrative Supreme Council in August 2007 and in line with the implementation of the country’s fourth Development Programme. The “Supreme Council of Education, Research and Technology” (SCERT) was established by merging 12 supreme councils, including the SSC. However, the new SCERT was dissolved soon afterwards in February 2008 and its functions were placed with the newly set up “Science, Research and Technology Commission” under the Cabinet of Iran. This change in the status of the SSC occasioned a revision in ISA’s statute to allow it to function based on the new legislation and approved laws and regulations. In this connection on 15 June 2008 Iran’s Council of Ministers approved the amendments to the statute of ISA ratified in June 2005, which led to final approval on second July 2008.

The most important change in the new statute in comparison with its predecessor was that the SSC, under the leadership of the President of Iran, no longer has a supervisory role. As a result, ISA is only an administration under the Ministry of CIT that reports to the related Minister. This is a clear indication of the limits and constraints on ISA, although the new statute does provide it with more financial authorization to focus and regulate its efforts on institutionalizing space activities and benefiting from the available sources to reach its goals. The new statute, moreover, authorizes ISA to establish space research centres and firms with the endorsement of the Council for Development of Higher Education. This task was

not included in the older ISA statute approved in June 2005. It is also authorized to receive the approved tariffs for offering space services and can act based on the rates approved by the Cabinet and settle the funds to the state public revenue account. In addition, ISA has received further financial authorizations according to the new statute. 34

As mentioned above, the dissolution of the SSC and revision of the statute of ISA were passed on 15 June 2008 and ratified on 2 July. However, the Iranian Parliament considered the dissolution of the councils illegal and decided to revive the dissolved councils through approval of the “Assembly for Distinguishing the Prudence of the Regime” on 27 September 2008. The state is mandated to revive the dissolved councils eight months after their dissolution. By reviving the SSC the need to change the statute of the ISA is mandatory. The statute should ratify the relation of the revived SSC with ISA and redefine the functions and duties of the agency in the new configuration based on the aims and mandates of the SSC.35

3. Infrastructure and capacity building

3.1. Space segment

In parallel with Iran’s efforts to institutionalize its space activities, the need to expand national capabilities in technology applications is always felt. This expansion has been recognized in the country’s mid- and long-term plans, leading to the emergence of an earth observation and satellite manufacturing industry in Iran (see Table 2). Continuous capacity building and development of expert human resources and scientists in the past few decades have resulted in many practical achievements, which are discussed below.

3.1.1. Zohreh

Zohreh (which means Venus in Farsi) is the satellite whose manufacture was planned to meet Iran’s telecommunication needs from the 1970s. Although its manufacture has not yet been achieved, it is still a concern of the Iranian authorities, particularly in the telecommunications domain, to manufacture and launch such a satellite into geostationary orbit to provide numerous services including TV and radio broadcasts, internet and e-mail access. France, Germany and China have all been parties to different abortive contracts with Iran to make the satellite. The Russian Federation is the last such, signing a US$132 million contract with Iran for Zohreh’s assembly and launch. Zohreh would have a life-time of 15 years, with Ku Band frequency for receiving and transmission with an Alcatel and Astrrium payload including 12 transponders consisting of eight units of 36 MHz each and four units of 72 MHz.
3.1.2. Mesbah (Lantern)
Apart from early plans (1977) to own an Iranian satellite communications system (Zohreh), there apparently are no records of the design and production of satellites at Iranian organizations prior to 1996. During that year a number of researchers from the Iranian Research Organization for Science and Technology (IROST), affiliated to the Ministry of Science, Research and Technology (SRT) were given the task of launching a space project. A plan to design and manufacture the research satellite Mesbah was drawn up and related research projects began. Iran was to pursue space technology in order to jointly develop (originally with Russia, later with Italy) a satellite for research purposes.

The Mesbah micro-satellite is a store and forward communication satellite basically aimed at acquiring know-how in the process of design and assembly and in the expansion of international cooperation in the space domain. The system is initially intended to obtain images for a variety of civilian purposes, to include larger data collection and distribution, and assisting in efforts to find natural resources and predict the weather. Costing US$10 million the project was implemented in cooperation with the Italian Carlo Gavazzi Space Company (CGSC). Having dimensions of $70 \times 50 \times 50 \text{ cm}^3$ the satellite weighs 65 kg. It will fly 900 km over land and will be controlled from a ground station located in the Iran Telecommunications Research Center (ITRC), while the back-up station will be operated by the CGSC in Milan. Mesbah is the first satellite produced in Iran. Research work on the project began at the beginning of President Muhammad Khatami’s administration in 1997. A prototype was constructed during 1999–2001 in cooperation with the Ministry of SRT, the Ministry of CIT, IROST and ITRC. It will orbit the Earth 14 times daily, while it will be observable from Earth-based stations four times in 24 h. The satellite has an expected life-time of three years but it could be capable of continuing operations for up to five years. It is designed to cover Iran, but will be able technically to render services in Europe and the Americas.36

Although the Mesbah project was jointly implemented by IROST and the Ministry of CIT at first, responsibility for conducting and advancing the project was given to ISA as soon as the agency was established early in 2004. The Space Technology Group of the Electrical and Computer Science Engineering Department at IROST is active in the fields of developing and studying the satellite payloads and ground stations, as well as in space and aerospace applications. Development of the first Mesbah satellite was carried out through the abovementioned department in cooperation with the Ministry of CIT. The Space Technology Group is reportedly using Mesbah’s systems engineering design plan for its follow-on, Mesbah-2, for ISA.37

3.1.3. SMMS
Iran, along with China, South Korea, Mongolia, Pakistan and Thailand, signed a memorandum of understanding on 22 April 1998 to build a joint Small Multi-Mission Satellite (SMMS). This was a project under the initiative of the Asia-Pacific Multilateral Cooperation in Space Technology and Applications (AP-MCSTA) group. SMMS was mainly aimed at disaster and environmental monitoring, civilian remote sensing and communications experiments.38 It is a medium-Earth orbit Sun-synchronous satellite weighing 490 kg to fly 650 km above Earth. Iran’s share of the US$44 million cost of manufacturing and launching the satellite is $6.5 million. Access to advanced earth observation satellites could greatly help Iran, particularly after a natural disaster, since emergency personnel, rescue and control organizations would be able to coordinate relief efforts effectively. The satellite carries a low-resolution charge-coupled device (CCD) camera and an experimental telecommunications system. Iran contributed to building the satellite’s CCD sensor. Some of the technologies used to develop the device have enhanced Iran’s long-term sensor design and manufacturing capabilities. The satellite’s launch was initially planned for 2004, but delays pushed back the intended launch year to sometime in 2007. The satellite was reportedly launched by China, Iran and Thailand in 2008 but there is some confusion about this.39

### Table 2
Details of the Iranian satellites.

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Weight (kg)</th>
<th>Size (cm³)</th>
<th>Orbit</th>
<th>Mission</th>
<th>Cost (million US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zohreh</td>
<td>na</td>
<td>na</td>
<td>Geo-synchronous</td>
<td>Telecommunications</td>
<td>132</td>
</tr>
<tr>
<td>Mesbah [-1]</td>
<td>65</td>
<td>70 × 50 × 50</td>
<td>Sun-synchronous</td>
<td>Store &amp; forward communications</td>
<td>10</td>
</tr>
<tr>
<td>SMMS</td>
<td>490</td>
<td>83 × 85 × 133</td>
<td>Sun-synchronous</td>
<td>Remote sensing</td>
<td>44</td>
</tr>
<tr>
<td>Sina-1</td>
<td>160</td>
<td>80 × 130 × 160</td>
<td>Sun-synchronous</td>
<td>Environmental-monitoring communications</td>
<td>15</td>
</tr>
<tr>
<td>Omid</td>
<td>27</td>
<td>40 × 40 × 40</td>
<td>Sun-synchronous</td>
<td>Disaster monitoring communications</td>
<td>~0.5</td>
</tr>
</tbody>
</table>

[Source: Author].


3.1.4. Sina-1

Sina-1, the first Iranian satellite, launched by a Russian Kosmos-3M rocket from Plesetsk in Murmansk Province of the Russian Federation to an altitude of 700 km, is a 160-kg small satellite with a research mission in remote sensing to monitor natural disasters and observe agricultural trends, and in communications. It is a Sun-synchronous near-polar orbiter with an inclination of 98.18° and a period of 98.64 min. The US$15 million satellite with dimensions of 80 × 130 × 160 cm³ images the Earth’s surface from the Arctic to the Antarctic with a 50 m resolution in panchromatic mode with a 50 km swath, while in multispectral scanning mode the resolution is 250 m with a 500 km swath. Sina-1 is used to study natural disasters, resources and farmland and transmits and receives the information on VHF and UHF frequencies. The launch of Sina-1 into orbit on 27 October 2005 made Iran the 43rd nation to own a satellite. Despite the lack of Iranian input, Sina-1 has provided Iran with valuable experience in ground control tracking and telemetry handling.40

3.1.5. Omid, Iran’s first indigenous national satellite

On 2 February 2009 Iran successfully launched its first domestic Satellite Launch Vehicle (SLV), named Safir-2, carrying the country’s first domestic telecommunications satellite called Omid and put the satellite into low-Earth orbit (LEO). It was a great step forward in space technology development. All the work, from design to manufacturing to test and operation of the satellite and development of its launch vehicle, was carried out by Iranian experts and engineers.41

Omid (which stands for “Hope” in Farsi) is the first Iranian home-built satellite, launched by a domestic launcher. This puts Iran in the exclusive club of nine countries that benefit from their own independent satellite launching and manufacturing capacities. The then USSR launched the world’s first artificial satellite, Sputnik-1, in October 1957. The USA was next with the successful launch of Explorer-1 in January 1958. France, Japan, China, UK, India and Israel later developed and successfully flew their own space launchers. In the new Millennium Iran is the newcomer and first new spacefaring country since Israel joined the club in 1988 (see Table 3).

Omid, whose design and manufacturing began in February 2006, was a store and forward telecommunications 40-cm³ satellite weighing 27 kg. Its thermal control was passive and worked in the UHF band. The satellite’s nodal period was 90.7 min with an inclination of 55.71°. Omid’s apogee was 381.2 km, its perigee was 245.5 km.

Since the Omid project was the first step in building an indigenous satellite, the most important and complicated task before producing a domestic product was to set up the needed infrastructure for a satellite industry. The development of Omid was carried out in different phases that included setting up the satellite’s electronics, building the space receiver and transmitter, quality systems management, thermal vacuum testing, environmental tests for quality assurance, setting up the space GPS for tracking, mounting of the ranging facility, satellite flight simulation, space systems engineering, satellite in-orbit operation, period and satellite rise assessment, and necessary software development.

The main achievements of the Omid project have been:

- manufacturing the first domestic space system;
- acquiring space technology to drive other industries;
- persuading academia to cooperate in and contribute to the development of space technologies;
- capacity building in satellite manufacturing, integration and testing;
- cooperation with the private sector;
- interaction between launcher, satellite and ground stations;
- design and manufacturing of the first domestic telemetry, tracking and command (TT&C) station;
- design and implementation of satellite monitoring and control;
- telemetry coding and decoding and using satellite tracking software.

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Omid’s ground stations network included three TT&C stations, one central flight control station, four ranging stations and the ground receiving stations and terminals.

According to official announcements Omid’s mission was ended on 24 March 2009, 50 days after its launch.42 Re-entry of the satellite has not been officially announced but calculations suggest that Omid entered the atmosphere in mid-April 2009, while the second stage of the Safir-2 would have decayed before the end of May 2009.43 Although Omid was an experimental satellite with a short-term mission of taking orbital measurements, the experience and knowledge gained through orbiting and operating it no doubt open the routes to building more sophisticated systems carrying remote sensing tools as well, and guarantees further success in advancing into space for the benefit of the country and humanity.

3.2. Satellite launch vehicle development

Responsibility for developing satellite launch vehicles is mainly in the hands of the Ministry of Defense and Armed Forces Logistics (MODAFL). MODAFL carries out this effort in cooperation with research and academic bodies affiliated with the Ministry of SRT and also those affiliated to MODAFL. Bilateral cooperation with countries such as North Korea, China and the Russian Federation should not be ignored.

Achievement of the sophisticated SLV technology requires mastering such things as systems engineering, conceptual design, preliminary design, simulation, detail and critical design, integration and test, and quality assurance. Engine development technology includes manufacturing the first stage engines capable of reaching a maximum altitude of about 70 km and then development of the second and third stage engines to carry the payload to upper orbits, as well as angle correction for final payload shooting.

For structural development of SLVs high thermal and mechanical resistances have to be attained. Working with propellant technology has created a base for the propellant production industries. Through control and navigation technologies Iran has gained experience in flight simulation, navigation systems, power sources, power storage, actuators, barometers, cabling and testers. Development of the velocity and acceleration sensors is among the achievements in sensor technologies, which also requires expertise in the application of navigation systems. Through launch pad technology good experience has been gained in logistics, accessories, transport vehicles, launch tower, launcher integration and test, propellant charging, and the use of launcher flight control stations.

Safir-2 is the first Iranian domestic SLV for carrying lightweight satellites to LEO. With a perigee and apogee of 250 km and 500 km, respectively, Safir-2 is 22 m long with a diameter of 1.25 m. It weighs more than 26 tons. The mission of Safir-2 was to place Omid into an orbit of 250 km (See Fig. 2).

The success of Safir-2 was the result of experiments and achievements resulting from the successful launch of the sub-orbital rocket Safir (which stands for “Envoy” in Farsi) on 4 February 2008 from Iran’s domestic launch site in the northeast of the country. The test was noted to be a major step towards the country’s the attempt to launch its first home-built low-orbit research satellite Omid. The launch of Safir, using the Islamic Republic of Iran’s Launch Vehicle (IRILV) was a preparatory mission for orbiting Omid.44–47

3.3. Future plans

According to the Minister of CIT, Iran plans to design, manufacture and launch four low-orbit satellites weighing less than 100 kg while three satellites would be placed in high orbits. The lightweight small satellites are going to be designed and produced by universities for research and exploration purposes. The heavyweight satellites are being designed by state organizations and entities for earth observation, environmental monitoring, telecommunications, broadcasting and data transmission. Mesbah-2, Besharat (under the Organization of Islamic Conference) and Sina-2 are examples of new satellites, whose design, manufacture and very likely launch are planned for the near future. Iran is also going to start a 12-year manned mission with the aim of sending an astronaut into space by 2021.

3.4. Ground segment

In addition to its space segment, Iran has been developing its ground segments and facilities for communications and data acquisition throughout the country for many years.Boomhen, Asad-Abad and Isfahan are the ground stations established mainly for communication purposes, while the MSRS, whose mission was receiving data from Landsat three decades earlier, is being developed to become the Mahdasht Space Center (MSC) in the near future. The site will comprise the most comprehensive and multi-task ground space complexes as well as working, living and leisure facilities for Iran’s space science and technology specialists, scientists and officials. ISA’s remote sensing activities are presently conducted by its “Remote Sensing Administration”, which is largely situated in the MSC. There is only one office for remote sensing located in ISA headquarters. The official tasks

of the former IRSC are presently allotted by the Remote Sensing Administration of ISA.

There are also other ground stations established for receiving remote sensing data managed and controlled by the private sector, universities and non-civilian sector. ISA is in the process of developing the ground facilities in a few new sites in Tabriz (East Azerbaijan Province), Isfahan (Isfahan Province), Shiraz (Fars Province), Mashad (Khorasan-e Razavi Province) and Chabahar (Sistan and Baluchistan Province).

3.5. Research, education and promotion

In the past two decades Iran has worked on basic capacity building in space science and technology by developing education and training in this domain at graduate and postgraduate levels. There is a notable number of leading universities and scientific institutions involved in teaching air and space sciences and technologies and their applications, such as remote sensing, satellite telecommunications and global positioning systems, throughout Iran.48,49 The country is optimistic that the new generation of scientists, experts and educated human resources in space science and technology will play an evolving and long-lasting role to benefit space science and technology for the country’s sustainable development and its people’s well-being. Table 4 presents a list of the academic institutions and universities throughout the country involved in education and research in space science and technology. Nearly 80% of the concentration in terms of importance and development is found in Tehran, while the provinces of East Azerbaijan, Isfahan, Fars, Zanjan, Kerman, Khuzestan and Qazvin also host research institutions and universities involved in space science and technology education.

Space science and technology education and research in Iran has a large network of private, public, and state affiliated universities offering degrees in higher education in space science and technology including aerospace, astronomy and astrophysics, satellite telecommunications, remote sensing and global positioning systems. State-run (technical) universities of Iran are under the direct supervision of the Ministry of SRT. (Note: B: bachelors degree, M: masters degree, D: PhD degree).

<table>
<thead>
<tr>
<th>University/Institution</th>
<th>Location</th>
<th>Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sh. Chamran University of Ahvaz</td>
<td>Ahvaz/Khuzestan</td>
<td>B, M</td>
</tr>
<tr>
<td>- Physics Department/Remote Sensing Department</td>
<td></td>
<td></td>
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<tr>
<td>Malek Ashtar University of Technology (MUT)</td>
<td>Isfahan/Isfahan</td>
<td>B, M</td>
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<tr>
<td>- Department of Mechanical and Aerospace Engineering</td>
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<td></td>
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<tr>
<td>University of Isfahan (UI)</td>
<td>Isfahan/Isfahan</td>
<td>B, M</td>
</tr>
<tr>
<td>- Surveying Department</td>
<td></td>
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<tr>
<td>University of Kashan</td>
<td>Kashan/Isfahan</td>
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<tr>
<td>- Department of Astronomy</td>
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<tr>
<td>International Center for Science and High Technology and Environmental Science (ICSHTES)</td>
<td>Kerman/Kerman</td>
<td>M</td>
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<tr>
<td>- Research Institute of Environmental Sciences</td>
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<tr>
<td>Islamic Azad University of Maragheh</td>
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<td>- Faculty of Human and Social Sciences</td>
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<td>- Faculty of Electrical Engineering</td>
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[Source: Author]
Public awareness and capacity building in the space domain at a public level are also a major concern for Iran, with lots of work being done by the state-run and private sector to this end. Celebrating World Space Week (WSW) is now a fruitful promotional programme for ISA, which takes part in its fulfilment in cooperation with related bodies and organizations; WSW has been well received by the public, particularly young people. Some universities are also developing plans to organize contests and competitions to draw the attention and participation of youth and university students in fields such as aerospace, rocketry and projectiles, distance control and robotics. Iran also celebrates global occasions like the International Year of Astronomy-2009 (IYA-2009) publicly.

4. Outreach

4.1. Cooperation and contribution to space law

After joining with 17 other countries to establish the UN ad-hoc Committee for International Cooperation on Space in 1958 a further logical step for Iran was to sign the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty) in 1967. Iran ratified both the Treaty on the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (Rescue Agreement) and the Convention on International Liability for Damage Caused by Space Objects (Liability Convention), which entered into force, respectively, in 1968 and 1972. Iran also signed the Convention on the Registration of Objects Launched into Outer Space (Registration Convention), which became effective in 1976. The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement) is the only one of the five UN treaties on space to which Iran is not a party. In addition to the UN treaties on space Iran is a party to some international agreements relating to activities in outer space. It has ratified the Treaty on Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and under Water (Nuclear Test Ban Treaty) effective since 1963, the Agreement Relating to the International Telecommunications Satellite Organization (ITSO) entered into force in 1973, the Convention on the International Mobile Satellite Organization (IMSO) effective since 1979, and the International Telecommunications Union’s (ITU) Constitution and Convention entered into force in 1994. For other UN declarations and legal principles as well as other principles and international agreements Iran holds a non-party position.

The country has given special priority to the legal aspects of space applications in recent years. In this connection Iran will make a contribution by holding the chairmanship of the Legal Subcommittee of COPUS in 2010—2011. Moreover, ISA follows the core activity of conducting domestic symposia on space law. The UN and Iran plan to hold a joint Workshop on Space Law in November 2009 in order to discuss capacity building in space law and regulatory frameworks governing space activities, in particular for countries in Western Asia.

4.2. Global, regional and bilateral cooperation

Since its establishment ISA has given the highest priority to international cooperation, in line with the country’s policy for international positive interaction in space applications and taking advantage of all feasible opportunities in this connection, a policy established a decade earlier. In light of this goal ISA has made its chief contribution since its establishment by cooperating in the UN COPUSOs, while its representative contributed to the COPUSOs Bureau work in the capacity of Second Vice-Chairman and Rapporteur from 2004 to 2006. Iran’s contribution to the implementation of the third UN International Conference on Exploration and Peaceful Uses of Outer Space (Unispace III), particularly chairing its Action Team number one focusing on the Development of a Worldwide Comprehensive Strategy for Environmental Monitoring that has continued since 2001, and taking part in the endeavour to establish a UN Space-based Platform for Disaster Management (SPIDER), along with the constructive deliberations of the Iranian delegations on various space-related issues from technical and scientific concerns to legal aspects, provide a strong indication of Iran’s interest in actively working in

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50 World Space Week Association (WSWA), Members, http://www.spaceweek.org/iran.html [accessed May 9, 2009].
51 http://www ima ir/View/FullStory/?NewsId=472384 [accessed May 9, 2009].
59 The first Iranian that has joined COPUSOs Bureau since its establishment in 1958 http://www.geocities.com/parviztarikhi/COPUSOS/copausbureaumember.htm [accessed May 11, 2009].
the global arena to use space peacefully. ISA has organized and hosted different workshops and seminars related to space science and technology applications with special emphasis on remote sensing and disaster monitoring and mitigation in cooperation with UNOOSA, the Inter-Islamic Network on Space Technology (ISINET) and other global and regional organizations and bodies. At the regional level Iran actively cooperates with the UN Economic and Social Commission of Asia and the Pacific (ESCAP) and follows the plans and efforts made by its Regional Program on Space Technology Applications (RESAP). ESCAP and Iran have worked closely at establishing a Centre for Informed Space-based Disaster Management and an affiliated research centre in recent years. On the initiative of the AP-MCSTA Iran cooperated in manufacturing a small multi-mission satellite for disaster management. Iran joined the Convention of the Asia-Pacific Space Cooperation Organization (APSCO) under AP-MCSTA on 28 October 2005 as one of its founders and signatories along with China, Indonesia, Pakistan, Thailand, Bangladesh, Mongolia, Peru and Turkey; this was an important step in entering a new era in space cooperative activities and will be beneficial for the nation in its peaceful use of space science and technology. APSCO could become a successful organization like the European Space Agency. The growing interest in space science and technology in the Asia Pacific region is considerable. There are big players like China, India, Japan and Australia, while South Korea, Thailand, Pakistan and Iran are advancing rapidly. If these enthusiastic nations can join forces and pool their potential and capabilities in this regard, they could save a lot of time and money while benefiting greatly from the collective synergy and outcomes.

Another space-related organization to which Iran belongs is the Committee on Space Research (COSPAR) of the International Council of Scientific Unions (ICSU), now the International Council for Science, which organized its first Space Science Symposium in 1960. Activity and membership in the International Society of Photogrammetry and Remote Sensing (ISPRS), the Asian Association on Remote Sensing (AARS), the Asia-Pacific Satellite Communications Council (APSSC), among others are all a mark of Iran’s concern to be active in the international cooperation programmes in space applications and science. Last but not least, it should not be ignored that almost all of Iran’s endeavours in implementing its satellite projects such as Mesbah, Zohreh, SMMS and Sina-I have been the result of international cooperation. The same goes for the establishment of the MSRS and the installation of other space ground stations and facilities.

5. Looking ahead

According to ISA’s president, space technologies are among those sophisticated and expensive technologies that have been achieved by only a limited number of countries and Iran is trying to attain independence in development of space services in the course of its fifth and sixth five-year Development Plans.

The country’s fourth five-year Development Plan ends in 2009. High priority has been given to space technology applications as an effective tool for the sustainable development of the country. In the meantime, according to the 20-year Vision Decree of the country, issued on 4 November 2002, potential and capacities throughout the country should be focused on increasing Iran’s contribution to global scientific production. In this connection Iran should gain access in particular to new technologies, including nanotechnology, biotechnology, information and communications technology, environmental technology, and aerospace and nuclear technology. At the end of the implementation of the 20-Year Development Plan, in 2025, it is expected that Iran should have become the number one country in applications and development of space technology in the Middle East.

“According to the Fourth Five-Year Development Plan of the country [2005—2010] US$422 million is allocated for space science and technology development”, said M. Suleiman, the Minister of CIT. “Space science and technology could lead to facilitating and accelerating communications, saving expense, time and increasing efficiency, and forecasting and mitigating damage caused by disasters.” He continued, The Iranian government in its 10-year plan aims at providing the software and hardware and creating the infrastructure for attaining capability and capacity in design, manufacturing, test, launch, operationalizing and control of satellites. Increasing public awareness, training and education of expert human resources, research on new technologies, benefiting domestic potential and developing international cooperation are the strategies of the plan in the space domain.

66 Peter J. Brown: Le nouveau satellite traien met la Chine a l’epreuve Asia Times Online, Hong Kong, Wednesday 11 February 2009 http://questionscrictures.free.fr/editor/AsiaTimesOnline/satellite_Iran_Israel_Chine_090209.html [accessed May 11, 2009].
70 APSCC Members, http://www.apssc.or.kr/ [accessed May 9, 2009].
There is considerable enthusiasm for design and manufacturing micro- and nano-satellites in the country, particularly those designed in academic and research institutions with different missions. However, there are also plans for larger satellites. “The satellites are designed to be used for the management [and monitoring] of natural disasters, earthquakes, natural resources, agriculture, etc., and in this connection three satellite design and manufacturing programmes have begun jointly with three leading technical universities of Iran - Amirkabir University of Technology (AUT), Iran University of Science and Technology (IUST), and Sharif University of Technology (SUT), whose finance allocated for each program exceeds about US$10 million”, according to ISA’s president.

Satellite-based remote sensing is one of Iran’s top priorities.71 The idea of having self-owned satellites to secure the needs of the country for remote sensing data in addition to other demands, including communications and broadcasting, is also considered important. International professional cooperation and exchange is indeed a key factor in developing the satellites. They have always been regarded as important and vital and it is hoped they will be followed up in the future.

6. Conclusions

Iran began its efforts to develop space technology for civil and peaceful purposes many years ago (decades ago in a sense). The design and development of satellites like Zohreh, SMMS and Mesbah are examples that required the development of relevant industries by the Ministries of SRT and CIT in particular. The manufacture of Mesbah has had a clear civilian basis. It was actually developed as a cooperative effort between the Ministries of SRT and CIT with the foreign partnership of CGSC of Italy. The SMMS too, since it is designed and manufactured in a multilateral framework at the regional level, is also considered a civilian satellite for disaster monitoring whose development Iran has been involved in. The same is true for the Zohreh satellite project that has been the concern of the Iranian authorities for decades. It is clear that Iran’s civilian space industry has much to say. Of course, one should not ignore the fact that the amount of finance allocated to the space industries for national security is much more considerable in comparison to the investment in civilian space industries, which is mainly secured by the Ministries of SRT and CIT, and IRIB. It is also clear that much effort is being expended on developing the space transportation systems to provide the country with independent access to outer space, while the main focus of the civilian sector is on developing satellite and communication systems, as well as systems for remote sensing and navigation as the next priorities. Table 2 supports this idea, while it can be seen that the civilian sector has financed 12 times more satellite development projects in comparison with the non-civilian sector. This proportion will increase to 14 if the finance allocated to the ongoing research—academic micro-satellite projects is taken into account.

Iran’s space programme is really no different from that of any other nation. Iran is committed to developing its assets in space both for peaceful purposes and for use as part of various multinational space projects. Space technology applications are substantially of dual use. It is up to us to make a selection, and either pave the way to, or place limitations and obstacles on each of these uses and orientations. It is more than wise to use such possibilities for the welfare and wellness of humanity - and for its sustainable development - at the national and global level.72 In the meantime, it should not be ignored that such achievements require a high degree of expertise, abilities and comprehensive knowledge about the subject. Highly specialized and talented human resources must emerge in each country, while the attitudes and visions of leaders of each nation, who also influence and contribute to the pace, progress and developmental objectives of any nation’s space programme, should not be disregarded.73–75

To attain the position that it deserves in the global arena and for its own well-being Iran relies on its human resources as well as expertise and knowledge that are being achieved continuously in the course of enthusiastic experiments and experiences in heading to space for peace and prosperity. Entering into outer space using an indigenously developed system has provided Iran with a notable and unprecedented amount of national pride. Iran is developing its space programme to provide the nation with space-related applications services. Like the other spacefaring countries, Iran also uses its successes in space as a tool of communication, both within its borders and beyond. Iran’s advances could potentially provide a considerable motivation for further productive cooperation in space between Iran and the West, particularly now that normalising relations between Iran and the West in general — and the USA in particular — has emerged as a new concern. Only international cooperation, as already exists in the framework of COPUOS activities on the peaceful uses of outer space, can improve the world

73 Peter J. Brown: Le nouveau satellite iranien met la Chine à l’épreuveAsia Times Online, Hong Kong, Wednesday 11 February 2009, http://questionscritiques.free.fr/edito/AsiaTimesOnline/satellite_Iran_Israel_Chine_090209.htm/ [accessed May 11, 2009].
74 Peter J. Brown: Iran’s new satellite challenges China Asia Times Online, Hong Kong, Monday 10 February 2009, http://www.atimes.com/atimes/Middle_East/KB10Ak04.html/ [accessed May 11, 2009].
community’s understanding of Iran’s space policy and visions in the 21st century. Investing in space is expensive. It can only be justified in Iran if all aspects of the country’s space programme are integrated into the social, economic, educational, technical and political life of the nation. Stepping forward in this important way requires international cooperation and collaboration as the main requisite for the success of such an endeavour.77

After all, Iran’s space programme needs expertise, competence and informed and good management. It requires the contribution of the immense resource of the enthusiastic younger generation along with the experience and expertise achieved over the course of years of efforts and perseverance.

“… Once upon a time in the land of fables Kay Kāvus purposed to fly up to heaven; and now in the real world his descendants ride high to space with Omid (Hope)!…”

Parviz Tarikhi http://www.geocities.com/parviz_tarikhi is a space science and technology specialist in Iran majoring in radar remote sensing since 1994. He holds a PhD in physics focusing on microwave remote sensing. He heads the Microwave Remote Sensing Research Core at the Mahdasht Satellite Receiving Station. He has been involved with the United Nations Committee on the Peaceful Uses of Outer Space (UN-COPUOS) since 2000, including as Second Vice-Chair and Rapporteur in 2004-06 of the committee bureau. Since 2001 he has co-chaired Action Team number 1 of UNISPACE-III with the mission ‘to develop a comprehensive worldwide environmental monitoring strategy’. From 2004-07 he led the Office for Specialized International Cooperation of the Iranian Space Agency. He is also a freelance journalist and technical writer. He has made in the mean time years of research and study on the developments and status of space science and technology with a particular focus on Iran.