

2

From air into space: formation of infrastructures

The way into space passes through the atmosphere that surrounds planet Earth. Before we developed the tools and facilities to enable us to venture into space an immense effort, time, energy and financial resource was expended by a large number of enthusiastic people around the globe to overcome gravity to float in the air in balloons and fly in 'heavier than air' machines. Since the early days of mankind, the sky has been the source of many unknown and strange things, the origin of hopes and fears. The rain and snow that fall from the clouds are sometimes pleasant, making the surroundings and nature fresh. Rain turns the landscape green and promotes crops, but sometimes it causes floods, destruction of homes, and other damage and loss of life. The Sun shines in the sky, moving from east to west on a daily basis, raising the spirits of people, but when its rays are too strong it, too, can cause harm. Mankind realized early on that both good and bad things originate in the sky, blessings and disasters. On clear nights, man became aware of various wonderful and puzzling things such as the Moon, the bright points that remain fixed relative to one another, which we now know to be stars, and those that move relative to that background in the form of planets, comets, meteors. It was realized that the dark night sky was in some sense beyond the blue sky of daytime. Where did it end? Were these entities in the sky located on nested celestial spheres which had the Earth at their center? Or did they travel in a vast and otherwise empty space? And how did this relate to Heaven? The nature of the sky was one of the ancient mysteries.³

The eye-catching contribution of the Iranians in this connection is undeniable. Flying into space is a common theme of mythology that manifests itself in religions in terms of Heaven.^{4,5} Our interest in flying may have originated when prehistoric peoples observed birds doing so. In the myths of Persia, India, and Egypt, a bird is replaced by a magic carpet or a mythological flying rug that would rapidly transport the persons who were on it to their chosen destination. One example is Solomon's rug, which is Ghaalichey-e Hazrat-e Suleiman in the Persian language. This was reputedly made of green silk and was large enough to carry Solomon's throne together with his coterie of living people standing on his right and spirits or souls on his left. The rug was shielded from the Sun by a canopy of birds, and the wind obeyed Solomon's commands in order to deliver its passengers to their destination. This legend clearly has similarities with several verses of the Holy Koran which refer to Solomon (e.g. Surah 38, Verses 33-35).⁶

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2.1 A page from *Shah-Nameh* (Book of Kings), in which Ferdowsi describes how Kay Kāvus ascends to Heaven with the aid of hungry eagles. [Fitzwilliam Museum]

There are frequent references in Iranian mythology to flying, the most popular being the flights of two Iranian mythical kings Kay Kāvus and Jamshid, and the Iranian hero Rustam.⁷ For example, Kay Kāvus ascended into the sky with the aid of hungry eagles. This was described by the highly revered Persian poet Hakim Abul Ghasim Ferdowsi-e Tusi (940-1020)⁸ in his magnificent masterpiece *Shah-Nameh* (Book of Kings) which is the national epic of Iran and the Persian-speaking world.⁹

By studying the phenomena of the sky, mankind has developed astronomy, physics, mathematics, art, and literature.^{10,11} There are many examples of interest in space in the works of Iranian scholars and poets.^{12,13} Scientific and technical progresses over the centuries made it possible to develop the tools with which to overcome gravity and experience for ourselves the joy of floating and traveling in the atmosphere. By the advent of the industrial revolution, aeronautics was underway. It was difficult, but the will to succeed was overwhelming and experiments revealed solutions. For the Iranian society that witnessed the rapid changes in science and technology, progress and advancements in relation to aeronautics were dazzling and wonderful. In order to share in this venture, Iran sent its

talented elites abroad to learn the technology and its engineering aspects, and began to create its own aeronautical facilities. The initial focus was on the technology of aeronautics and the benefits that it could bring, but it was also essential to understand the fundamentals of the science. Over the course of the years, the construction of engineering and educational facilities provided an indigenous infrastructure for aeronautics.

But the sky continued to beckon and the next milestone was to ascend above the atmosphere into 'outer space', a realm of vacuum and weightlessness where aeronautics does not apply. But as usual, solutions were found and gave rise to the science of astronautics. The first success was achieved on October 4, 1957 with the launch by the Soviet Union of the artificial satellite Sputnik, initiating the Space Age. On April 12, 1961 Yuri Gagarin became the first human being to launch into space and circle the globe during a 108 minute flight in a spaceship named Vostok.

Those great and wonderful events ignited great enthusiasm in Iran. When, one year later in 1958, the United Nations decided to launch a plan for international cooperation in space, Iran, as a member nation, was enthusiastic. Reportedly, Shah Muhammad Reza Pahlavi was supportive of the peaceful uses of space and Iran's participation in the ad-hoc Committee on International Cooperation in Outer Space that was established by the United Nations, subsequently to be renamed the Committee on the Peaceful Uses of Outer Space (COPUOS). Iran signed up to and/or ratified four UN Treaties on space and also ratified four international agreements relating to activities in outer space, including the treaty that bans nuclear tests in outer space.¹⁴ In the 1970s Iran eagerly sought to apply space technologies in different fields, in particular communications, broadcasting, and Earth observation. The fact that Iran was ready to establish its space agency in 1977 is evidence of the country's intention to institutionalize space activities.

As with aeronautics, in order to benefit from developments in space Iran needed to build up an infrastructure that combined educational and technological facilities. Some institutions and entities were established or commissioned to take responsibility for handling and coordinating space-related issues. To attract early expertise and assist with financing, international cooperation was an effective solution. Inevitably, non-civilian entities became involved. As with aeronautics, Iran was fortunate enough to draw upon the support of the more advanced spacefaring countries in addressing its ever increasing requirements. But the Iranian revolution in 1979 derailed this orderly program. The new revolutionary government was in conflict with the leading powers of the world, which were also the most advanced spacefaring nations. Owing to these international disputes, and shortly thereafter the onset of the war with Iraq, Iran became ever more isolated in the community of nations. As a result, international cooperation in the development and application of new technologies soon petered out. But by then Iran had its own aeronautics infrastructure, and over the years this was adapted to serve the nascent indigenous space industries by filling the technological gaps caused by the international sanctions and bans imposed on Iran.

Starting with the Fourth Five-Year Development Plan (2004-2010), the Iranian government called for further development of the aerospace industry. Indeed, aerospace would receive top priority in the General National Scientific Plan which was established in 2010. This document specified the goals, objectives, and quantitative indicators by which to judge the success of the strategies for developing these technologies.

BUHL VS. TURLEY IN SERIES TODAY (See Sports Section)

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SATURDAY MORNING, OCTOBER 5, 1957

44 PAGES

DAILY 10c

RUSS SATELLITE ORBITING EARTH

Polish Capital Swept by Riots

20,000 Battle Police and Militia, Shouting 'Down With Gomulka'

WARSAW, Oct. 4 (AP) — An estimated 20,000 Polish battle-swinging police and militia tonight in Central Warsaw. Many of the rioters shouted for the downfall of Communist Party Chief Wladyslaw Gomulka.

Two separate clashes took place in the city center, involving some 10,000 rioters and police. The rioters were shouting "Down With Gomulka" and "Freedom for Poland."

Police fired tear gas and shot at the rioters. The rioters were armed with stones, bricks and Molotov cocktails. The rioters were also shouting "Down With Gomulka" and "Freedom for Poland."

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PITT BEATS TROJANS, 20 TO 14

Pittsburgh handed Southern California its third straight loss last night as the Panthers put on a brilliant ground attack, producing a 20-14 victory over the 42-0 team in Memorial Stadium.

Pittsburgh scored first in the first period and never trailed. The Panthers put on a brilliant ground attack, producing a 20-14 victory over the 42-0 team in Memorial Stadium.

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SATELLITE IN SKY—With Russian announcement that it has launched first earth satellite, this is artist's conception, superimposed on actual photograph of Southern United States from 140 miles up, of what the U.S. satellite would look like in flight. Drawing of 20-inch diameter globe was prepared of Naval Research Laboratory in Washington, D.C. Russian satellite is said to be 23 inches in diameter, weigh 185 pounds and orbit 500 miles above the earth.

First 'Moon' Sent 560 Miles High

MOSCOW, Oct. 5 (Saturday) (AP) — The Soviet Union announced today it has the world's first artificial moon streaking around the globe 560 miles out in space. A multiple-stage rocket launched the earth satellite yesterday, the Russians said, shooting it upward at about five miles a second.

They said the satellite, a globe described as 23 inches in diameter and weighing 185 pounds, can be seen in its orbit with glasses and followed by radio through instruments it carries.

In New York radio signals on the wave length of the Soviet moon—sounding as a deep "beep, beep, beep"—were picked up by electronic engineers of the National Broadcasting Co. The British Broadcasting Corp. in London reported similar reception.

The Moscow announcement said: "The successful launching of the first man-made satellite makes a tremendous contribution to the treasure house of world science and culture."

Spies Travel Predicted "Artificial earth satellite will pave the way for space travel and it seems that the present generation will witness how the freed and opulent lives of the people of the new Socialist satellite states even the most daring of man's dreams into reality."

In a special bulletin early this morning the Soviet Press Agency said the Russian moon "is now revolving around the earth at the rate of one circuit every hour and 30 minutes."

The launching occurred just three months and four days after the opening of the International Geophysical Year.

In Cambridge, Mass., officials at the Smithsonian said the satellite will be visible to the naked eye from the North Pole.

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The Huntsville Times

Man Enters Space

'So Close, Yet So Far,' Sighs Cape

U. S. Had Hoped For Own Launch

CAPE CANAVERAL, Fla. (AP) — The Redstone rocket which the United States had hoped would launch the first man into space stands on a launching pad here. The Soviet Union beat the firing down by at least two weeks.

"So close, yet so far," commented a technician who is helping ground the Redstone to send one of America's astronauts on a first solo orbital flight, hopefully one this month or early in May.

"We had to get the Redstone out of the state and get it out of the state and get it out of the state," he said. "We had to get it out of the state and get it out of the state and get it out of the state."

"But you have to give the Redstone a good launch," he said. "It's a launch."

Dr. Hugh Steward, deputy director of the National Aeronautics and Space Administration, said:

Hobbs Admits 1944 Slaying

By Bob Wicks

Soviet Officer Orbits Globe In 5-Ton Ship

Maximum Height Reached Reported As 188 Miles

MOSCOW (AP) — A Soviet astronaut has orbited the globe for more than an hour and returned safely to review the feasibility of scientific and political endeavors.

Soviet announcement of the feat brought praise from President Kennedy and U. S. space experts who believed in the contest to put the first man into space.

By the Soviet account, Major Yuri Gagarin, 34, took a five-hour spacewalk around the earth in an orbit taking an hour and 23 minutes. He was in the air a total of an hour and 45 minutes.

The whole sequence of events and the astronaut's return to earth is a matter of a number of questions. The Soviet announcement said the flight took place between 8:07 and 10:50 p.m., but some persons, including Western scientists, were skeptical that the feat actually occurred.

VON BRAUN'S REACTION:

To Keep Up, U. S. A. Must Run Like Hell

2.3 'Man Enters Space' was the headline of *The Huntsville Times* on April 12, 1961 after Yuri Gagarin became the first man to orbit the Earth in a spaceship named Vostok. [*The Huntsville Times*]

FLIGHT International, 4 January 1962

UN Agreement on Space

from James Avery Joyce

United Nations, New York

AFTER a period of frustration lasting nearly two years, the end of 1961 saw a significant breakthrough at the United Nations on the subject of the peaceful uses of space. The UN Committee on the Peaceful Uses of Outer Space, formed in December 1959, held its first meeting on November 27, 1961; and on December 11 a resolution drafted by this committee was adopted "unanimously and by acclamation" by the main Political and Security Committee.

This resolution (reproduced in full below) clearly lays down the dual principle that international law, including the UN Charter, applies to outer space and that celestial bodies are not subject to national appropriation. Although it has formally to be presented to the plenary body, its unanimous backing by the 103 members of the main UN Committee—and especially the prior agreement of the USA and USSR on the text—means that its position in contemporary history is assured.

The original membership of the outer-space committee comprised

Albania, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Czechoslovakia, France, Hungary, India, Iran, Italy, Japan, Lebanon, Mexico, Poland, Rumania, Sweden, USSR, United Arab Republic, United Kingdom and United States. To this membership are now added Chad, Morocco, Mongolia and Sierra Leone, and the committee is asked to meet not later than March 31, 1962 and to report to the UN Assembly next year.

The resolution calls on all States to inform the committee of space launchings, and to register them through the Secretary-General. The secretariat, by providing for the voluntary exchange of information on outer space by governments and non-governmental organizations, would become "a focal point for international co-operation in the peaceful exploration and use of outer space."

The resolution also requests the World Meteorological Organization and the International Telecommunication Union to report on such matters as "the possibility of large-scale weather modification" and long-range communication by the use of satellites. On the latter point, it invites the Expanded Program of Technical Assistance and the United Nations Special Fund to give "sympathetic consideration" to requests by member States for assistance in the survey of their own communication needs.

During the five days of debate which preceded the adoption of this history-making agreement, over thirty delegations contributed a variety of viewpoints and speculations which—even if generalities prevailed—provided a conspectus of the space question of absorbing interest.

Mr. Adlai Stevenson of the United States presented the resolution in a speech already reported in *Flight* (December 21, 1961). He emphasized that the fifth part of the programme sought to give new life to the Committee on the Peaceful Uses of Outer Space. This committee would study the legal problems and plan an international conference on outer space.

It was on the subject of the composition and "veto" powers of the space committee, incidentally, that a debate arose—as it did two years ago—with the Soviet Union; but it is to be noted that, by the time the final text was put to the vote on December 11, the

Continued overleaf

2.4 A page from the weekly magazine *Flight International* dated January 4, 1962, reporting on the efforts of the United Nations on the peaceful uses of space. It refers to the original membership of the outer space committee, which includes Iran. [*Flight International Magazine*]

10 From air into space: formation of infrastructures

Aerospace encompasses the science of the Earth's atmosphere and the vacuum of outer space, and deals in particular with the technologies of aerodynamic flight and space travel. It currently includes some of the most advanced research subjects and attracts large research and development funds from both civilian and non-civilian sources. This research boosts progress in other aspects of engineering because aerospace is a multidisciplinary topic that applies physics, mechanics, materials science and metallurgy, computer science, electronics, and so on. This chapter will address the establishment and development of the entities and organizations that are active in aerospace. A considerable number of them were founded prior to the Space Age in order to accommodate the needs of aeronautics.

2-1 AERONAUTICS, THE RUNWAY FOR DEPARTURE TO SPACE

In discussing the Iranian space endeavor, it is difficult to separate the air and space aspects because they are tightly linked. Astronautics is actually an extension of aeronautics and complementary to it, so there is no clear separation between them. Let us see how advances in aeronautics allowed Iran to expand its activities into space.

2-1-1 Early developments of aeronautics

Iranian dreams of flying were first realized by sending two unmanned balloons into the sky in Tehran and another similar balloon in Tabriz during the reign of Naser al-Din Shah (1848-1896), who was the fourth king of the Ghajar dynasty which ruled prior to the Pahlavi dynasty.¹⁵ There are reports in the newspaper *Vaghaye-e Ettefaghyeh* of the Dar ol-Fonoon Academy of Learning (or simply the Dar ol-Fonoon, standing for polytechnic in the Persian language) producing hydrogen gas in order to carry balloons aloft. Dar ol-Fonoon was Iran's first academy of education and training to be established in the Western Europe style. It was founded in 1849 by Mirza Taghi Khan-e Farahani (1807-1852), one of Iran's greatest reformist statesmen, better known as Amir Kabir. In his diary, Nasser al-Din Shah describes witnessing the first flight of two balloons in Tehran, both occurring on the same day in 1877.¹⁶ Late in 1913, the people of Tehran for the first time saw an airplane flying over the city. All across the city, astounded people rushed outside to get a closer look at the strange bird. The airplane landed in the city center at an army exercise field, then known as Meidan-e Mashgh in the Persian language. On landing, it was slightly damaged when it nudged the barrel of a cannon on the ground. This airplane, a Bleriot XI, was flown into Tehran from Russia by a Russian pilot. The aircraft was repaired with the assistance of Iranian army technicians and then it flew back to Russia.¹⁷

In more recent times, Iran's commitment to developing the infrastructure for its aviation industry dates from the 1930s, when it was initiated by Shah Reza Pahlavi with the assistance of the Junkers aviation company in Germany. Aviation was further expanded in Iran in the 1970s during the reign of Shah Muhammad Reza Pahlavi, who not only ordered a large quantity of the most advanced weapons produced by the United States but also attempted to acquire the capability to manufacture those arms indigenously.



2.5 In 1877 Tehran residents gather to watch the landing of a balloon for the first time in Iran.
[Wikipedia]

Bell Helicopter, a division of Textron, Inc., built a factory in Isfahan to produce Model-214 helicopters and Northrop partnered with Iran Aircraft Industries, Inc., to maintain many of the US military aircraft that Iran purchased. The Iranian company was expected to go on to produce aircraft components and eventually complete planes.¹⁸

Commercial development of the aviation industry in Iran started even earlier, with the creation in 1923 of the first airline office in Tehran in cooperation with Junkers. It ran air travel services between Tehran, Mashhad, Shiraz, Bandar Anzali, and Bushehr. Shah Reza Pahlavi initiated the establishment of a non-civilian body in 1922 as the first official aviation organization in Iran.

Although the initiatives for the development of the aviation industry in Iran were commercial at the outset, in the 1930s the authorities decided to develop this important new industry both for civilian and non-civilian means. The airlines started their services in Iran in 1923, in parallel with the non-civilian developments. The implementation of civil aviation services required the establishment of technical and civil supporting

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2.6 Colonel Muhammad Taghi Pesyan (1892-1921), born in Tabriz, was a popular military leader of Iran and the first Iranian to successfully pilot an aircraft. He was the commander of Gendarmerie in 1915, and wrote two books in the Persian language *Sargozasht-e yek javan-e vatan-doust* (The Story of a Young Patriot) and *Jang-e Moghaddas az Baghdad ta Iran* (The Sacred War from Baghdad to Iran). [Wikipedia]

organizations alongside the non-civilian services and logistics. The rapid pace of development resulted in a partnership between the private sector and Iran Airways in 1944 by Iranian private investment. The next in this group was the Persian Air Service (PAS), which began operating in 1952. Iran Airways and the Persian Air Service merged as Iran Airline in 1961. In 1962 state nationalization of the air transportation industry established the Iranian National Airline (called Homa in the Persian language) to operate under the regulations imposed by the International Air Transport Association (IATA). Over the ensuing years, the number of active air agencies grew to 13 with 120 airliners. Homa and Iran Air Tour were both state air agencies and Aseman was operating as a semi-state agency.

In his 2007 book *Tarikhchey-e Havapeymai-e Bazargani dar Iran az Aghaz ta Emrooz* (The History of Iranian Commercial Aviation from the Beginning to the Present Day),

Abbas Atrvash, one of the most distinguished managers of the air transportation and airline industry in Iran, divided it into eight periods:

1923-1927:	Iranian Air Force
1927-1932:	Junkers Airlines in Iran
1932-1938:	Absence of commercial air transport
1938-1946:	The airline of the Ministry of Post, Telegraph and Telephone (MPTT) or 'Iranian State Airlines'
1945-1961:	Iranian Airways and Persian Air Services
1961-1962:	United Iranian Airlines
1962-1979:	Iran National Airlines (Iran Air), the flourishing years
1979-Present:	Post-revolution, the era of multiple airlines.

2-1-2 Foundation of the Iranian Air Force

As elsewhere, Iran's air force played a key role in the early formation of the country's commercial air transportation. The first Iranian passengers were actually carried by air force planes. In addition to the civilian passengers, air force planes were also performing services to meet some public needs, such as medical relief, and carrying postal packages and items of freight. In the early stages of the commercial airlines, some of the pilots were active air force officers. In later years many of the airline pilots were former air force pilots. Prior to the establishment of a national airline, the air force officially allocated aircraft and personnel exclusively for the purpose of transporting government and military executives between Iranian cities. Nevertheless, it supported civil air transportation. Because of the contribution of Iran's air force in providing civilian air services it is fair to say that the history of air transportation in Iran was initiated by the air force that was established prior to commercial aviation. The Iranian Air Force later became the Imperial Iranian Air Force. After the revolution in 1979 that ended the Pahlavi dynasty, the country's air force continued its activity under the new regime.

In February 1921 when Reza Khan led the coup d'état that ended the Ghajar dynasty after a reign of 131 years, he came to power as the commander of the armed forces. Later, as Reza Shah, he assigned a small office in the military headquarters in Tehran to investigate the feasibility of creating a national air force, even though the military had neither aircraft nor pilots. The mission of acquiring aircraft got underway in 1922, when the government of Iran approached that of the United States to negotiate the purchase of American military aircraft and the training of pilots and technicians. But this request was rejected owing to commitments to peace treaties, which the USA had signed with other countries. Iran therefore made approaches to Germany, the Union of Soviet Socialist Republics (USSR), France, and later Great Britain. Finally, one German-made Junkers-F13 was bought and delivered to Iran. Later in 1923, a shortage of government finance prompted people in the Gilan and Mazandaran provinces to donate the funds to enable the government to purchase two more Junkers-F13 aircraft, which were named after these two provinces in appreciation. Between 1923 and 1925 a number of aircraft from a variety of countries were added to the nascent Iranian Air Force, including British-Soviet De Havilland Avro 504K (or Avroshka), and French Spad-42, Breguet-14 and -19 and Potez-8 models. However, in spite of the fast growing fleet, Iran's air force still did not have its



2.7 Colonel Ahmad Nakhchivan (1893-1966), born in Tehran, was the first commander-in-chief of the Iranian Air Force. In June 1923 he was dispatched to France under the program for air force pilots and technicians to train as a member of the first group of officers. On finishing his training he took off from Paris on one of the Iranian Breguet-19 airplanes marked with the flag and logo of Iran, and landed at Ghaleh Morghi airfield on February 25, 1925. [Wikipedia]

own pilots to fly them. Following the purchase of aircraft from France and the USSR, both of these nations were chosen to train Iran's air force pilots and technician. In June 1923 the first group of officers was dispatched to France to receive training, and the following year another group of officers was sent to the USSR.

Despite its humble beginnings in 1921 as a small department of the army, the Iranian Air Force became one of the world's outstanding, well-equipped and technologically advanced air forces. It had a large fleet of sophisticated fighter aircraft, military transports and other specialized aircraft, and was staffed by an exceptional group of highly qualified officers, pilots and technicians.¹⁹



2.8 Iran's Junkers-F13 aircraft. [Iranian Chamber Society]

2-1-3 Activity of Junkers Luftverkehr Persien

On February 8, 1927, Junkers officially initiated Iran's first biweekly scheduled passenger air service from Tehran to Bandar Pahlavi (currently Bandar Anzali) in the north of Iran, and biweekly flights to Ghasr-e Shirin at the western border of the country. This marked a milestone in the history of Iranian commercial aviation. At that time, when air transportation was in its early stages of development and air travel was still a novelty in Europe and the USA, operating scheduled air services in Iran was a considerable achievement. When the Junkers air services started in Iran, the railways system was still under construction. With the airways developing more rapidly than the railways, they readily proved their worth.

The Junkers company was created in Germany in 1895 to manufacture thermodynamic products. However, in 1915 it produced its first aircraft, the Junkers-1. In February 1922, under an agreement signed with the newly formed USSR, the company began its activity in the Soviet Union, going on to form the Junkers Luftverkehr Russia (Junkers Airlines in Russia) to undertake air transport services. When the Soviet Union initiated its own airlines in 1924, Junkers terminated its activity in the USSR and switched its attention to Persia, the name by which Iran was known at that time. In September 1924, Junkers contacted the Iranian government with a proposal to operate postal services between Baku and Bandar Pahlavi. While the proposal was under review by the Iranian government, Junkers started experimental non-scheduled flights between Tehran and Baku in Azerbaijan, taking advantage of previously granted traffic rights. The first flight took place on December 20, 1924, and the project ran to March 1925. The next year, Junkers signed a 5-year agreement with the Persian government to establish an airline to provide air services within Persia, and this company was registered as Junkers Luftverkehr Persien (Junkers Airlines in Iran). The company operated Junkers-F13 aircraft, a single-engine type that was capable of 160kph and was a popular commercial aircraft at that time. It carried two pilots and four passengers. The first services were launched in two directions, one from Tehran to Bandar Pahlavi and the other one from Tehran to Ghasr-e Shirin via Hamadan and Kermanshah. In February 1928, the northbound route was extended to Baku and the westbound route to

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Baghdad in Iraq. Later, three more services were added: a southwest route to Bushehr via Isfahan and Shiraz, a northeast service to Mashhad, and a northwest route to Tabriz via Ghazvin. Between 1927 and 1932, Junkers played the role of a small internal and regional airline, carrying a considerable number of passengers and a large amount of cargo and mail. It also flew weekly services from at least ten cities in Iran to Baku, Baghdad and Kabul in Afghanistan, and arranged for the first time for the Iranian airmail to be carried from London, Paris, Vienna (via Berlin), and Moscow to Baku, and from Baku to Iran by its own airplanes.²⁰

2-1-4 State airline substitutes Junkers

Junkers Luftverkehr Persien was the only civilian air transportation and commercial air service to operate in Iran between 1932 and 1938, when the government formed a national airline. However, the Iranian Air Force occasionally carried mail and civilian passengers, particularly government officials and employees. From its inception, the Ministry of Post, Telegraph and Telephone (MPTT) – which in 2003 became the Ministry of Communications and Information Technology (MCIT) – was Iran's only national entity for the carriage of airmail. MPTT became involved in air transportation in 1924, when the airmail service was first started in Iran, before Junkers initiated its services in Iran. The ministry often operated non-regular flights using air force aircraft to distribute mail across the country. By the time that Junkers ceased its operations in Iran, the government had in place a plan for MPTT to use airplanes that would be handled, maintained and flown by the Iranian Air Force. Two De Havilland DH-89s (also known as 'Dragon Rapid') were purchased, and this fleet was later increased to four aircraft. This twin-engine model was capable of carrying up to eight passengers, and it was initially operated between Tehran and Baghdad. Thus MPTT organized the 'Iranian State Airlines'. It began scheduled services on March 15, 1938 by running once a week on the Tehran-Kermanshah-Baghdad route. Later, another service between Tehran, Isfahan, Shiraz, and Bushehr was added. This airline also carried passengers on its regular airmail flights. This operation provided valuable service during World War II. Although the Iranian State Airline performed limited operations, with a small number of aircraft, it did an efficient and productive job until its services were reassigned to a new company named Iranian Airways on April 6, 1946.²¹

2-1-5 Private airlines and 'aero-preneurs'

In December 1944 a number of influential and affluent Iranian investors led by Reza Afshar (1887-1964) established Iranian Airways as a private company. Afshar, a prominent politician and shrewd businessman, had already helped to set up Iran Tour, the first Iranian travel and tourism organization. The other active partner in this new airline was Gholam Hussein Ebtehaj, a former mayor of Tehran. He simultaneously served as the managing director of both Iran Tour and Iranian Airways. The most senior manager at Iranian Airways was Houshang Tajadod, an icon of the Iranian airline industry to 1982. Iranian Airways signed an agreement with Trans World Airlines (TWA) in the United States for technical assistance in return for 10% of its shares. When this agreement ended, the French company of Cie General de Transport (CGT) stepped in. Next in line was the American company Trans Ocean Airlines (TOA), whose contract concluded in 1961 when the airline was nationalized.



2.9 Reza Afshar (1887-1964), an influential and affluent Iranian investor and *aeropreneur*, a prominent politician, and a shrewd businessman who was also the main founder of Iran Tour and Iranian Airways. Born in Urmieh, he studied political economy and public finance in the USA and was the Minister of Roads, a member of parliament and the governor of several provinces. [Iranian Chamber Society]



2.10 Gholam Hussein Ebtehaj (1897-1967), managing director of Iran Tour and Iranian Airways. Born in Rasht, he was educated in France, Lebanon, and Iran, and served as the mayor of Tehran and the parliament member. [Iranian Chamber Society]



2.11 Houshag Tajadod (1920-2010), an icon of the Iranian airline industry and a pioneer and the most senior and qualified management member at Iran Air. [*Tarikhchey-e Havapeymai-e Bazargani dar Iran az Aghaz ta Emrooz* (The History of Iranian Commercial Aviation from the Beginning to the Present Day)]

By the end of March 1945, Iranian Airways had added three US-surplus military C-47s to its fleet. Also known as the DC-3 Dakota, this was a type of transport aircraft introduced during World War II. Iranian Airlines went on to purchase a total of 20 of these airplanes. The first scheduled flights started from Tehran to Mashhad and were followed by Tehran to Isfahan, Shiraz, Bushehr, Abadan, Ahwaz, and limited flights to Zahedan. When Iranian Airways started to operate international flights, its first destinations were Cairo and Baghdad. Beirut and Tel Aviv were added in 1946. Following the start of the internal and regional flights in the early years after World War II, Iranian Airways introduced an international flight to Paris via Beirut and Athens, and in April 1947 it opened its first office outside Iran in Paris. Prior to 1946, most of the pilots and technical personnel of Iranian Airways were from the USA, where the aircraft originated. After that, the Iranian Air Force assigned some of its pilots to fly with Iranian Airways. In addition, civilian pilots who were trained at the Iranian Aero Club joined Iranian Airways. The first three women pilots Effat Tejaratchi (1917-1999), Ina Afshid (1921-2005) and Sadigheh Dowlatshahi (1915-2005) were licensed to fly at that time.



2.12 Effat Tejaratchi (1917-1999), born in Tehran, became the first Iranian female pilot in 1939. She, Sadigheh Farrokhzad Dowlatshahi (1915-2005), and Ina Afshid (1921-2005) were the three brave women pioneers of Iranian aviation. She was also a belletrist and a poet. [*Farheekhtegan Daily*]

An airline which operated at the same time as Iranian Airways was Persian Air Services (PAS). It was founded in 1954 and was predominantly a cargo carrier.

After Iran Airways had been operating for 16 years the company suffered a shortage of financial resources, failed to make upgrades, modernize its fleet, and improve its quality of service. Declining safety measures and a number of accidents prompted the government to nationalize the entire airline industry in Iran.²²

2-1-6 Nationalization of the airline industry and foundation of Iran National Airlines

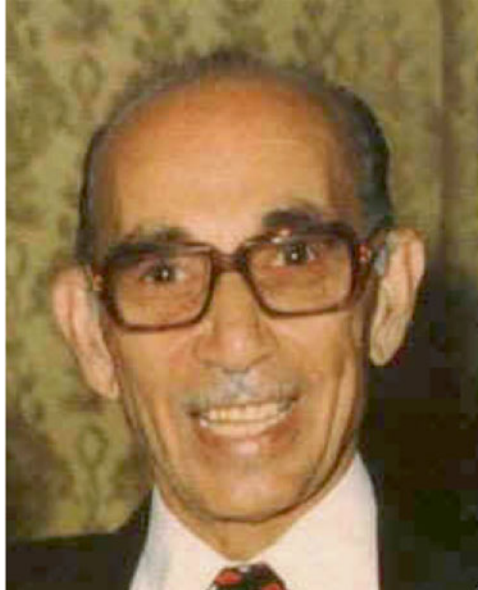
As a result of the nationalization of the airline industry, in August 1961 Iranian Airways and Persian Air Services were merged as United Iranian Airlines. Then in February 1962 the new Iran National Airline Corporation (shortened to Iran Air) was founded. In the Persian language it is known as Homa after the acronym for Havapeymai-e Melli-e Iran. This took over United Iranian Airlines by acquiring all its assets, which were the combined resources of Iranian Airways and Persian Air Services. Under its able managing director, Major General Ali Muhammad Khademi, Iran Air became a world-class national air carrier and gained an undisputed international rank. Khademi will go down in history for the highest level of service to his country's aviation industry. According to Abbas Atrvash,



2.13 Major General Muhammad Amir Khatam (1920-1975), born in Rasht, was a pilot and served as Commander of the Imperial Air Force. [Wikipedia]

‘General Ali Muhammad Khademi was a gifted, self-made, tireless, hard-working man and a management and leadership genius. He was an uncompromising fighter with unusual fortitude and self-confidence, who did not accept anything less than perfect. Utterly fair and honest, he possessed a strong humane spirit, an extremely light heart and wonderful sense of humor. He hated favoritism and selected his colleagues on their merit. He gave young men and women, particularly those who were not from, or related to, the privileged class unprecedented opportunities for growth.’

Iran Air was soon considered one of the most important players in the world of aviation. Known for the pace of its growth, it was an extremely well managed national and international airline. In 1970 its managing director was elected as president of the International Air Transport Association (IATA), the highest regulating entity of the international air transportation industry. Although Iran Air was a state-owned airline, it remained a profitable enterprise and its financial self-sufficiency was unprecedented in Iran as well as internationally right through to 1979. This prized reputation, which at the same time brought a number of prestigious awards and certificates for Iran Air, was not achieved easily. It firstly reflected the importance that the management placed on safety. And next it was



2.14 Major General Ali Muhammad Khademi (1913-1978), the Iranian Air Force Chief of Staff and the first managing director of the national airline Iran Air. Born in Jahrom, he was the first Iranian Air Force officer to become a licensed commercial pilot by obtaining his first rate license from the Iranian Civil Aviation Department. [*Tarikhchey-e Havapeymai-e Bazargani dar Iran az Aghaz ta Emrooz* (The History of Iranian Commercial Aviation from the Beginning to the Present Day)]

due to the efforts and endless endeavor of a group of highly educated and skilled Iranian engineers and pilots.²³

The attention given to aeronautics and the aviation industry in Iran in the five decades following its inception in the 1930s led to the establishment of a robust infrastructure, ever increasing capacity, and the emergence of able and specialized human resources. It raised the country's rank to the strongest in the Middle East, a status that it continued to benefit from even after the revolution in Iran in 1979 and particularly during the course of the subsequent war with Iraq.

Iran can be proud of its aviation dignitaries, including its competent and avant-garde managers and personnel, and its pioneering pilots – both male and female – in particular Muhammad Taghi Pesyan (1892-1921), Ahmad Nakhchivan (1893-1966), Ali Muhammad Khademi (1913-1978), Effat Tejaratchi (1917-1999), Muhammad Amir Khatam (1920-1975), Nader Jahanbani (1928-1979), Houshag Tajadod (1920-2010), Abbas Atrvash (1937-2009), Hassan Shafti (b.1939), Akram Monfared Arya (b.1946), Mansour Sattari (1948-1993), Jalil Zandi (1951-2001), and Houshang Shahbazi (b.1956).



2.15 Major General Nader Jahanbani (1928-1979) was a pilot and became ‘father’ of the Iranian Air Force and the Commander of the Golden Crown of the Imperial Iranian Air Force. Born in Tehran, he played a crucial role in the Iranian Air Force in the 1960s and 1970s by helping to create effective training programs for a new generation of top-gun pilots and set the standard of flying excellence for Iran’s air fleet. [Pakistan Defense Forum]

2-1-7 Post-revolution years and the era of multiple airlines

Following the revolution of 1979 in Iran, the country’s airline industry entered an entirely new phase. Although then operating the largest number of airliners in its 17 year history, it was unable to exploit its strong position.

The Western embargo that followed the revolution in Iran changed the country’s general policy for aviation from having the best available in the world to being able to



2.16 Abbas Atrvash (1937-2009), born in Abadan, was one of the great dignitaries of commercial aviation in Iran and the world, and one of the eminent managers of the Iranian National Airline (Homa). [Radio Zamaneh]



2.17 Akram Monfared Arya (b.1946) was born in Tehran. She and Princess Fatemeh Pahlavi (1928-1987) were the first Iranian women to be awarded a pilot's license. Currently living in Sweden, she is a poet, a pilot, a writer and a politician. [Personal website of Akram Monfared Arya]



2.18 Brigadier General Jalil Zandi (1951-2001), born in Garmsar, was the ace fighter pilot in the Islamic Republic of Iran's Air Force. He served for the full duration of the Iran-Iraq war. [Wikipedia]

manufacture indigenously to meet domestic needs, especially technological products, in order to become 'sanction proof'. Therefore Iran avoided the need to purchase the improved Western aircraft which became available to it from time to time, in favor of those that it could manufacture itself by purchasing licenses and technologies as well as reverse-engineering parts.²⁴ From the beginning of the 1980s until the end of the Iran-Iraq war in 1988, both internal and international travel reduced considerably owing to the war and the restrictions imposed on Iranians traveling abroad. However, after the ceasefire in 1988 the demand for air travel increased enormously. The two leading state-owned airlines, Iran Air and Aseman (earlier Pars Air) were apparently incapable of meeting this new demand. Consequently, some entrepreneurs and even government agencies showed interest in making up this shortage in capacity in order to gain a share of the lucrative air travel market. The government decided to abolish the airline's monopoly, relaxed the policy of awarding operating permits, and reduced the initial investment capital required for a startup airline. As a result, a large number of investors applied for permits to operate airlines. Domestic air travel was greatly expanded, more destinations were served, the frequency of flights

was increased, and more passengers were carried. On the other hand this hasty expansion led to chaos in the nation's air transport service, halting the entire industry's improvement. In the absence of adequate state laws, regulations, and policies to standardize and control airline operations, the quality of service declined, resulting not only in disarray and public dissatisfaction but also a number of incidents, disasters, and loss of life. The problems faced by the Iranian airline industry during this period were the direct result of adopting inappropriate strategies and either making incorrect decisions or failing to make a decision at the right time. One of the first mistakes was replacing highly qualified, experienced managers with inexperienced ones, many of whom were incapable of operating to professional standards. Then there was the sudden loss of a large number of irreplaceable personnel with specialist skills. The collective dismissal of highly qualified employees for contrived reasons that subsequently proved to be baseless was extremely destructive and irreversible.²⁵ Nevertheless there were still people in the Iranian airline industry whose efforts and services during the dangerous conditions of the 8 year war had kept aircraft flying, and were still managing to fly several million passengers each year.²⁶



2.19 Hassan Shafti (b.1939), born in Isfahan, was a distinguished manager of the air transportation industry in Iran, founder of the Iranian Aerospace Society, and the first president of the Iranian Space Agency, serving from February 2004 to October 2005. [ISA]

2-1-8 Space Age and upgrading of aeronautics to aerospace

On December 17, 1903, the Wright brothers in the USA achieved the world's first 'heavier than air' flight with their handmade airplane. On October 4, 1957, the Space Age was initiated by the USSR launching the first artificial satellite. Iran, which was heavily committed to aviation, welcomed the start of the Space Age and in 1958 joined with 17 other countries to establish the United Nations ad-hoc Committee for International Cooperation on Space in order to use space technology for peaceful applications in the interests of economic and social development. The aims of this organization, later renamed the Committee on the Peaceful Uses of Outer Space (COPUOS), were to review international collaborative programs to exploit and use space technology for civilian purposes, serve as a forum for information exchange, and encourage the development of national programs to study outer space.²⁷

In 1969, by establishing the Asad-Abad Ground Station in Hamadan and installing a 30m-diameter standard-A antenna to connect with the Intelsat international communications network stationed above the Pacific Ocean, Iran became a participant in the American telecommunications system. The Asad-Abad Telecommunications Center had been established a decade earlier by Mahmoud Hessabi (1903-1992),²⁸ a prominent Iranian scientist, researcher, and distinguished university professor. A polymath whose interests included



2.20 Mahmoud Hessabi (1903-1992), born in Tafresh, was a prominent Iranian polymath whose interests included space science and technology. He founded the Asad-Abad Telecommunications Center, the Iranian satellite tracking observatory in Shiraz, and the Geophysical Institute of the University of Tehran. He was also the Iranian delegated to the Scientific and Technical Subcommittee of UN-COPUOS from 1962-1968. [Professor Hessabi Foundation]

space physics, he developed space technology in Iran. Holding the title of ‘father of modern physics in Iran’, his achievements include setting up the first modern observatory of Iran in 1945 and establishing the satellite tracking center of Iran in 1957, both of which are in Shiraz, and founding and managing the Geophysical Institute of the University of Tehran (1951-1965).²⁹ He was also the Iranian representative on the Scientific and Technical Subcommittee of UN-COPUOS from 1962 to 1968.^{30,31} Furthermore, he initiated the membership of Iran in the Committee on Space Research (COSPAR) and represented Iran in the UNISPACE-82 (United Nations Second International Conference on the Exploration and Peaceful Uses of Outer Space in 1982).³² In 1972, after launching the Earth Resource Technology Satellite (ERTS), later renamed Landsat-1, the USA agreed to provide the technical assistance required to enable Iran to construct the Mahdasht Satellite Receiving Station (MSRS), which was at that time one of only five satellite data receiving stations around the globe, as Iran’s first bilateral cooperation in space remote sensing technology.

Iran readily adopted the most common uses of space technology: telecommunications, television broadcasting, Earth remote sensing, navigation, tele-education, weather forecasting, environmental modeling, and relief and rescue operations. In 1974 Iran and the General Electric (GE) Company in the US entered into an agreement for the installation and operation of a satellite data receiving station. But with the onset of revolutionary upheaval in Iran in 1978, the company canceled its commitment to provide technical assistance for the installation and operation of the facilities for tracking the Earth resource satellites and the reception of their data. The initial Iranian efforts to establish independent space projects began in 1977, when the country decided to develop its own communications satellite system called Zohreh. However, despite the participation of a number of national organizations in the development of plans to operate research satellites in space, Iran was unable to pursue these projects entirely indigenously and required foreign assistance in certain fields of technology. Facing Western refusal to supply these technologies, Iran turned to the leading non-Western spacefaring countries of the USSR, China and India. North Korea and later Italy were Iran’s other partners in space research and development. Along with the plan to develop its own first communications satellite system, Iran aimed to set up an Iranian Space Agency but the unstable revolutionary conditions and the protracted war with Iraq forestalled efforts to institutionalize space activities in Iran. What remained were some activities relating to space applications such as communications and remote sensing.

2-2 POLICY MAKING AND DEVELOPMENT

In Iran, the decision-making sources in the aeronautics industry are fixed. The policy-making and coordinating entity that promotes an indigenous Iranian aeronautical industry is currently the Iran Aviation Industries Organization (IAIO). It was established in 1966 with a mandate to plan, control, and manage the Iranian aviation industry. It also provides and assists with the required technologies, parts and knowledge. IAIO has five complementary aviation organizations under its umbrella: SAHA (Iranian Aircraft Industries-IACI), HESA (Iran Aircraft Manufacturing Industries Corporation-IAMI), PANHA (Iran

Helicopter Support and Renewal Company-IHSRC), the Ghods Research Center, and Shahid Basir Industry.³³

Nevertheless, the structure and role of policy-making bodies for the development of aerospace in recent decades were altered as a result of expanding the domain of aerospace in Iran from aeronautics to astronautics. Those policy-makers are the Ministry of Post, Telegraph and Telephone (MPTT) that became the Ministry of Communications and Information Technology (MCIT) in 2003, the Islamic Republic of Iran Broadcasting Organization (IRIB), and the Ministry of Science, Research, and Technology (MSRT) that cooperated for telecommunications and broadcasting purposes, as well as various other applications.

Other national entities participating in policy-making for space-related issues are the Ministry of Defense and Armed Forces Logistics (MODAFL), the Ministry of Foreign Affairs, the Ministry of Industries and Mines (which merged with the Ministry of Trade in 2011 to form the new Ministry of Industry, Mines and Trade), and the Ministry of Roads and Transportation (which merged with the Ministry of Housing and Urban Development in 2011 to become the Ministry of Roads and Urban Development). The entities within MCIT involved with the application of space technologies include the Communications Regulatory Authority (CRA), the Telecommunication Company of Iran (TCI), the Telecommunications Research Center (TRC), and the Iranian Space Agency (ISA).

Although it has not yet been approved legally, since September 2010 ISA has been annexed by the Presidential Institution of the state. Established in 2003, CRA is a supervisory foundation intended to provide the basis for competitive marketing of telecommunications and incremental promotion and optimization of the quality of services that rely on space technology.³⁴ MODAFL is one of the major users of aerospace technologies in terms of defense and security issues at national level and beyond. Consequently, it has been traditionally one of the main policy-makers on aerospace issues since Iran became involved in these technologies. Indeed, in some cases MODAFL initiated the development, import and growth of a variety of technologies. The Aerospace Industries Organization, the Aviation Industries Organization, the Iran Electronics Industries Organization, and the National Geographical Organization are involved in the use of space applications.

There are important entities in the Ministry of Roads and Urban Development which, along with applying aerospace technologies, play a considerable role in policy-making. The Roads, Housing and Urban Development Research Center (RHUDRC), the Ports and Maritime Organization (PMO), the IR Iran Meteorological Organization (IRIMO), the Airline of the Islamic Republic of Iran (Iran Air), and the Technical Laboratory of Soil Mechanics (TLSM) affiliated with the Ministry of Roads and Urban Development are all involved in the use of aerospace technologies. The Ministry of Industry, Mines and Trade is also in charge of policy-making in the domains of industry, mines and trade, and hence plays a critical role in the policies and strategies related to the aerospace industry.

Other ministries and organizations involved in space technology applications are governed by the policies and strategies established for aerospace. These include the Ministry of Jihad of Agriculture, the Ministry of Interior and the Iran Department of Environment that is active under the Presidential Institution of the state. The Forests, Rangelands and Watershed Management Organization (FRWO) affiliated to the Ministry of Jihad of Agriculture determines the functions, including conservation of renewable natural

resources by combating and preventing illicit trafficking of forestry products that contravene the development and management of those resources. One of the important ways in which FRWO uses space technology is to monitor and mitigate undesirable degradation of natural resources owing to floods, overcharging dam reservoirs, soil erosion, landslides, desertification, environmental degradation and climate change, extinction of wildlife, reduction of livestock products, outbreak of pests and diseases, and extinction of forest and range species.³⁵ In the Ministry of Interior, the main user of space technology is the National Disaster Management Organization (NDMO) and its branches in the major cities, such as the Tehran Disaster Mitigation and Management Organization (TDMMO). NDMO is active in the forecasting and prevention of disasters, disaster response and preparedness, and reconstruction and rehabilitation. These tasks involve remote sensing, geographic information system (GIS), global positioning system (GPS), communications and so on.^{36,37}

But the full institutionalization of these efforts was not achieved until February 2004, when ISA began operating according to Article 9 of the Law for Tasks and Authorizations of the Ministry of Communications and Information Technology (MCIT) that was passed by the Iranian parliament on December 10, 2003. The president of ISA simultaneously held the posts of Vice Minister for MCIT and the secretariat of the Space Supreme Council (SSC). ISA's mission was to monitor and support activities involving the peaceful application of space science and technology under the leadership of the SSC, which was chaired by the President of Iran. The creation of ISA was a major practical step towards advancing relevant science and technology in the effective use of outer space for peaceful purposes. The agency also played an important role in promoting international cooperation in these fields. Some of the key tasks assigned to ISA by the SSC were to undertake studies, research, and design and engineering in space services, to undertake remote sensing, to strengthen domestic and international space networks, to prepare medium- and long-term plans for space exploration, and to conduct studies and research in the design, construction and launching of satellites.

But then to increase the managerial efficiency of the space administration, the state decided on a number of organizational changes, including dissolving the SSC and then approving a new statute for the space agency. These changes occurred in 2007 and 2008 and resulted in the establishment of the Science, Research and Technology Commission that operates within the Cabinet of the President of the state of Iran. Under this new organizational structure, ISA was mandated to operate under MCIT and report to its Minister.

In a political dispute after the SSC was terminated, the Iranian parliament judged its dissolution to be unlawful and sent the matter to the supreme authority, the Expediency Council, which revived the SSC on September 27, 2008. Accordingly, the Executive branch of the government was mandated to revive the SSC just 8 months after its dissolution. Finally, the Iranian Vice President for Science and Technology established nine agencies to integrate the development of science and technology in their respective administrative fields. The administration of aerospace technology development commenced work in 2009. Although the SSC was revived in September 2008, according to the revised ISA statute the agency is not legally mandated to work under its auspices. Annexation of ISA to the Presidential Institution in 2010 has also caused more ambiguity, and in practice there is no legitimate statute for ISA to rely on in undertaking the basic and substantial functions and duties for which it was created.

Table 2.1. The civil organizations and bodies in Iran that play a role in space policy-making, research, development, and applications. [Author].

<i>Entity/Organization</i>	<i>Policy Making</i>	<i>Research</i>	<i>Development</i>	<i>Applications</i>
Supreme Space Council (SSC)	*			
Ministry of Communications and Information Technology (Ministry of CIT)	*		*	*
Iranian Space Agency (ISA)	*	*	*	*
Ministry of Science, Research and Technology (Ministry of SRT)	*	*	*	*
Ministry of Defense and Armed Forces Logistics	*	*	*	*
Ministry of Foreign Affairs	*	*		
Ministry of Industry, Mines and Trade	*		*	*
Ministry of Roads and Urban Development	*		*	*
Islamic Republic of Iran Broadcasting (IRIB)	*		*	*
Iranian Research Organization for Science and Technology (IROST)		*	*	
Space Research Center of Iran, ISA		*	*	*
Remote Sensing Administration of ISA		*	*	*
Alborz Space Center (ASC), ISA		*	*	*
Observatory of ISA, ASC		*		
Electrical and Computer Science Engineering Department (ECEDEP)		*	*	
Applied Science and Research Association (ASRA)		*	*	
Iran Telecommunication Research Center (ITRC)		*	*	*
Islamic Republic of Iran Meteorological Organization (IRIMO)			*	*
Iranian National Center for Oceanography (INCO)			*	*
National Committee on Natural Disaster Reduction (NCNDR)				*
Geological Survey of Iran (GSI)			*	*
Soil Conservation and Watershed Management Research Center (SCWMRI)				*
Research Institute for Astronomy and Astrophysics of Maragheh (RIAAM)		*		*
International Center for Science and High Technology and Environmental Science (ICSHTES)		*		*
Research Institute Applied Physics and Astronomy (RIAPA)		*		*
Institute of Geophysics (Solar Physics and Astronomy Section)				*

2-2-1 Policy-making organizations and entities related to development and applications

Some organizations and entities play important roles in the development of aerospace applications, and their contributions are discussed below.

Supreme Space Council (SSC)

Article 9 of the Law for Tasks and Authorizations of the Ministry of Communications and Information Technology established the Iranian Space Agency in February 2004 as an autonomous organization mandated to implement those strategies authorized by the Space Supreme Council (SSC), which was legitimized following the endorsement of this law.³⁸ Based on its approved statute, ISA was mandated to cover and support all the activities in Iran relating to the peaceful applications of space science and technology under the leadership of the SSC, as chaired by the President of the state, who was at that time Muhammad Khatami.³⁹ The SSC met for the first time on July 20, 2005. Its main goals included: policy-making for the application of space technologies; manufacturing; launching and the use of national research satellites; approving space-related state and private sector programs; promoting partnerships in private and cooperative sectors for the efficient use of space; and identifying guidelines for regional and international cooperation in space activities. But the SSC was dissolved in August 2007 and since its reestablishment in September 2008 it has not been legitimized by parliament. ISA was responsible to the secretariat of the SSC in Tehran during the period of its legitimate activity.

Ministry of Communications and Information Technology (MCIT)

The Ministry of Communications and Information Technology was the Ministry of Post, Telegraph and Telephone until 2003, when it was renamed. It is responsible for exercising frequency-spectrum management and protecting the national radio rights at both the regional and international levels; centralizing policy-making; writing regulations and standards and supervising their implementation in different areas of post, communications and telecommunications such as common and new services in post, telecommunications, space communications, radio communications, data transmission, sound and picture transmission, remote sensing and computer communications; developing a conducive environment for communications, testing, information processing and remote sensing methods, and supporting them; and also making policy for the development of the appropriate communications facilities and services, in line with the state-of-the-art in scientific, experimental and information technology.

Iranian Space Agency (ISA)

In addition to its policy-making role, ISA is the only national (governmental) space agency of Iran mandated to promote and participate in the civilian and peaceful applications of space science and technology. Practically, ISA is involved in conducting engineering and research in the fields of aerospace such as satellite development, communications and remote sensing. It was created in February 2004 by the Ministry of Communications and Information Technology to operate under the supervision of the Supreme Space Council chaired by the President of Iran, as specified in a 2005 statute. However, in 2007 the SSC was dissolved, and in 2008 a new statute was passed in which the ISA president was legally the deputy minister at MCIT. Prior to the approval of the 2008 statute, ISA was

responsible for implementing the space policy set by the SSC based on the 2005 statute. Then on September 29, 2010, ISA was annexed to the Presidential Institution by the Iranian Administrative Supreme Council. The agency is presently responsible for the execution of the space policy throughout the country. While its headquarters are located in Tehran, its subordinates are spread around the capital and other cities such as Karaj, Tabriz, Shiraz, Isfahan, Semnan, Chabahar, Ghesm and Mashhad.

Ministry of Science, Research and Technology (MSRT)

MSRT is responsible for higher education, research, and technology promotion in Iran. It conducts its activities mainly through deputyships for education, planning and development, technology, student affairs, research, culture and social issues, and legal affairs. Other bodies active in the realm of MSRT include the Supreme Council of Cultural Revolution, the Research Institute for Education Planning, the Iranian Research Organization for Science and Technology (IROST), the National Organization for Educational Testing, the Student Welfare Fund, the Central Board for the Selection of Educators, Students and Officials, Universities, Science and Technology Parks, and the Institutes of Higher Education and Technology.

Iranian Research Organization for Science and Technology (IROST)

The Iranian Research Organization for Science and Technology was approved and ratified by the Revolutionary Council of the Islamic Republic of Iran and established in 1980. Located in Tehran, it is a comprehensive science policy research center directly attached to the Ministry of Science, Research and Technology. It is engaged in the development of strategies, policies, research and development systems, management, foresight and evaluation of related science and technology development and economic progress. Its main goal is to support the development of technology through research and development at the national level. To achieve this goal, IROST offers scientific, technical, financial, legal, administrative, and cultural support to applicants. It creates conditions conducive to efficient, effective interaction between the demand for, and supply of technology. It thereby provides fertile grounds for creativity and innovation in applying the results of research, and commercializing in a competitive environment the technologies derived from research and development. One of the six institutes of the organization is the Aerospace Mechanics Group of the Mechanics Institute. This is responsible for important projects such as the design and construction of the Mesbah satellite.⁴⁰

Electrical and Computer Science Engineering Department (ECEDEP)

The Electrical and Computer Science Engineering Department was established in 1980 as an IROST subdivision to support researchers and talented people. Its objectives include the accomplishment of research, applicable semi-industrial projects, compiling technical knowledge and transferring this to industry. Based in Tehran, it has a Space Technology Group that works on satellite payloads, ground stations, and space applications. A number of technology laboratories are associated with the Space Technology Center of ECEDEP, including the Satellite Signal Processing and Data Center, the Space Battery Laboratory, the Space Simulator, the Solar Cell Test Bed, the Space Quality Assurance, the Telemetry and Telecommand (TMTC) Laboratory, the Space Software Test-bed, the Telemedicine Laboratory, the Space Sensor, Monitoring and Control Laboratory, the Electromagnetic

Compatibility (EMC) Laboratory and the Electrical Ground Support Equipment (EGSE) Laboratory.

Islamic Republic of Iran Broadcasting Organization (IRIB)

Based in Tehran, the Islamic Republic of Iran Broadcasting Organization is a state-run enterprise belonging to the so-called cultural institutions, and as such is subordinated to the Secretariat of the Supreme Council of Cultural Revolution.

Applied Science and Research Association (ASRA)

ASRA is subordinated to the Department of Mechanical Engineering at the Khajeh Nasir-e Tusi University of Technology in Tehran, and functions as the Iranian member of the Inter-Islamic Network on Space Sciences and Technology (ISNET).

Iran Telecommunications Research Center (ITRC)

This is affiliated to the Ministry of Communications and Information Technology. It is a well-known research entity in the fields of information and communication technology. Based in Tehran, it runs advanced research facilities and laboratories that enable research teams to conduct studies and carry out experiments.

Islamic Republic of Iran Meteorological Organization (IRIMO)

With its headquarters in Tehran and branches in almost all provincial centers, IRIMO is responsible for all meteorological information and weather forecasting in Iran. It uses data from meteorological satellites not only for weather forecasting but also for atmospheric disaster mitigation objectives.

Iranian National Institute for Oceanography (INIO)

Located in Tehran, this center operates under the auspices of the Ministry of Science, Research and Technology and carries out research in all fields involving marine science. It proposes better use of marine resources, promotes commercial utilization of marine activities, formulates marine strategies within the framework of government activities, and improves the level of knowledge, research and marine technology.

National Committee on Natural Disaster Reduction (NCNDR)

The responsibilities and functions related to disaster management at the national level in Iran were assigned to the Ministry of Interior (MOI) in 1991. To manage these functions, MOI established the National Disaster Task Force (NDTF) and the Bureau for Research and Coordination of Safety and Reconstruction Affairs (BRCSR). The NDTF is a coordinating inter-organizational entity that varies its activities during the sequential phases of a disaster. It is headquartered at the MOI in Tehran and relies for its activities upon BRCSR, whose director is also the manager of the NDTF. Around 4,550 staff work at national, provincial and local levels, mostly dealing with administrative and logistical support services. As part of the International Decade For Natural Disaster Reduction (IDNDR), the Islamic Consultative Assembly approved the establishment of the National Committee for Natural Disaster Reduction (NCNDR) in 1991 headed by the Ministers of Energy, the Ministry of Jihad of Agriculture, the Ministry of Health and Medical Education, the Ministry of Industry, Mines and Trade, and the Ministry of Roads and Urban Development. Its membership also includes the directors of the Iran Department of Environment, the IR Iran Meteorological Organization, the Forests, Rangelands and Watershed Management

Organization (FRWO), the Institute of Geophysics of Tehran University, and the Iranian Red Crescent Society. Any other organizations that the chair of the committee deems necessary are also allowed to participate. The National Committee was designed as a policy-making body to facilitate the exchange of information and provide a mechanism to enable the government to authorize, support and pursue related activities. It has set up a coordination committee presided over by the Minister of Interior and nine specialized subcommittees presided over by deputy ministers and 30 provincial committees presided over by general governors.

Geological Survey of Iran (GSI)

The Geological Survey of Iran was established in 1962 by a special fund of the United Nations. The GSI is authorized to carry out geological and mineral investigations throughout the country, to collect the results of such activities, to establish an interrelationship and coordination between them, and to produce geological maps of Iran. In 1999 the exploration duties of the Ministry of Mines and Metals were transferred to the GSI. It is responsible for geologically surveying the country and assessing all mineral resources except hydrocarbons. These activities are undertaken by GSI groups which include Stratigraphy, Petrology, Sedimentology, Marine Geology, Paleontology, Tectonics, Seismotectonics, Exploration, Geophysics, Geochemistry, Geomatics, and other laboratories according to the general directions laid down by the former Ministry of Mines and Metals and current Ministry of Industry, Mines and Trade in accordance with the approved Mining Law. The headquarters are in Tehran, and there are five branches in the northwest (Tabriz), northeast (Mashhad), south (Shiraz), southwest (Ahwaz) and southeast (Kerman) of the country to undertake local functions. It has a staff of 700 highly skilled people. The GSI also cooperates with other organizations in Iran and abroad through bilateral cooperation or joint research programs. Since the autumn of 1992, GSI has published the *Geosciences Scientific Quarterly Journal* as a vehicle for transferring geological knowledge and promoting new scientific findings.

The General Office of the Space Services and Remote Sensing of ISA

The General Office of the Space Services and Remote Sensing of the Iranian Space Agency currently performs the official tasks of the former Iranian Remote Sensing Center (IRSC). There is an office for remote sensing located at ISA headquarters in Tehran, but the agency's remote sensing facilities are at the Alborz Space Center (ASC), which consists of the Mahdasht Satellite Receiving Station (MSRS), an observatory, and various communication systems and satellite ground systems. The National Data Archive and the Remote Sensing National Laboratory are being developed at ASC. In addition, for around a decade in the 1970s and 1980s, MSRS hosted the headquarters of the Iranian Remote Sensing Center.

Alborz Space Center (ASC)

The Mahdasht Satellite Receiving Station (MSRS) was created in 1972 under a bilateral agreement between the USA and Iran. The current Alborz Space Center, which is affiliated with ISA, was built on the former site of the Mahdasht Satellite Receiving Station in the vicinity of Karaj approximately 65km west of Tehran, which was set up to receive data from the Landsat satellite. The site is being developed to accommodate the most comprehensive and multi-function ground space complexes, as well as work, living and leisure

facilities for space science and technology specialists, scientists and officials. The main elements of the General Office of Space Services and Remote Sensing, the part of ISA which carries out the tasks of the former Iranian Remote Sensing Center, are located at ASC. In addition to the receiving stations for data acquisition from the US National Oceanic and Atmospheric Administration (NOAA), the US Terra, and the Chinese FY2-C, -E and -D satellites, new installations have been added in recent years, in particular an optical observatory, reference tracking and control ground installations for the Navid microsatellite that was developed by the Iran University of Science and Technology (IUST), and the facilities for monitoring the frequency spectrum of Iransat (Badr 5; Arabsat). There are also plans to include the National Data Archive and the Spectral Laboratory of the Remote Sensing National Laboratory.

Soil Conservation and Watershed Management Research Institute (SCWMRI)

The Soil Conservation and Watershed Management Research Institute of the Agricultural Research and Education Organization (AREO) is the focal point for soil conservation, watershed management, flood management and exploitation, river engineering and training, coastal protection, hydrology and water resources development in the Ministry of Jihad of Agriculture in Iran. It is located on a campus in Tehran and focuses on research topics in the aforementioned topics.

2-2-2 Industries and companies involved with aerospace development and production

Apart from basic skills and technologies, the development and production of satellites and launch vehicles requires the availability of high-technology industries. In Iran a considerable number of organizations are involved in technology development, production and research for the aerospace field. The following industries support the Iranian space endeavor.

Iran Aviation Industries Organization (IAIO)

The Iran Aviation Industries Organization, known as the Sazeman-e Sanaye-e Havai-e Iran, is the pivotal entity for aeronautics in Iran in terms of both policy-making and technology development. Located in Tehran, it was established in 1966. Under the IAIO, the Iran Helicopter Support and Renewal Company (IHSRC), known by its abbreviation in the Persian language as PANHA, was established in 1969. The Iran Aircraft Industries (IACI), known as SAHA, was established in 1970. The Iran Aircraft Manufacturing Industries Corporation (IAMI), known as HESA, was founded in 1976. Two other important companies, the Ghods Research Center and the Iranian Armed Forces Aviation Industries Organization (IAFAIO), which is also known as Shahid Basir Industry, were established in the 1980s. As an agency of the Ministry of Defense and Armed Forces Logistics (MODAFL), the IAIO and its many subsidiary companies are involved in building jet engines, parts for a variety of aircraft, repair and maintenance, overhauling passenger planes, and the construction of hangars for wide-body aircraft. It is judged the largest company of its type in the Middle East.⁴¹ By September 2004, Iranian Aviation Industries had produced more than 1,600 aircraft, 2,182 aero-engines, 1,751 helicopter engines, 149 industrial jet engines, and was repairing more than 11 models of aircraft and 18 models of military, commercial and industrial aircraft engines. Furthermore, Iran was mass



2.21 The indigenously designed and manufactured Azarakhsh fighter jet. [ISNA]

producing the indigenously designed Azarakhsh and Saegheh fighter jets and had plans to expand its production to helicopters, turboprops and passenger planes.⁴² The country's Boeing 737-800 simulator is the first in the Middle East. Iran currently possesses only nine aircraft for every million citizens but the objective is to make 6,300 airplanes available to the Iranian population of 70 million.⁴³ The Research Institute of IAIO is involved in the design of piloted and pilotless aircraft, the simulation of aerodynamic processes in computational fluid dynamics laboratories, the provision of aerodynamics tests, the development of aviation products using the national wind tunnel, the design of systems for launching and retrieving aircraft, the standardization and validation of avionic products for training purposes, the promotion and development of laboratories appropriate to the aviation industry, and the evaluation, control and auditing of aviation projects.⁴⁴

Iran Helicopter Support and Renewal Company (IHSRC)

Based in Tehran, the Iran Helicopter Support and Renewal Company, or Sherkat-e Poshtibani va Nowrazi-e Helicopter-e Iran in the Persian language, known as PANHA, is the largest of its kind in the Middle East. In the military aviation sector the company maintains and repairs helicopters such as the Bell 205, 206, 209, 212, 214 and 412, and the CH-7, RH-53D, SH-3 and MIL-171 in accordance with military standards. In the civilian field, this is the only firm that has received a license from the National Aircraft Organization for maintenance efficiency. This company also produces helicopters, black boxes, floating systems, and many other aircraft parts.⁴⁵

Iran Aircraft Industries (IACI)

Iran Aircraft Industries or Sanaye-e Havapeymai-e Iran, known as SAHA, was established in 1970 in Tehran mainly for the repair of fighter, passenger, and air support aircraft. Over time, SAHA became an important part of the nation's aviation industry. In 1998, IACI started designing, engineering, and manufacturing complex engine parts and airplane



Photo : Ali Mohammadi

FARS NEWS AGENCY

2.22 The manufacturing line for the IrAn-140, the Iranian HESA Maritime Patrol Aircraft in the Iran Aircraft Manufacturing Industries Corporation (IAMI). [Fars News Agency]

parts, as well as manufacturing turbine engines like the Tolou-4. Its most recent activities include working on the TV-3 turboprop engines for the IrAn-140 aircraft. The company mass produces the Tolou-4 mini jet engine, and is capable of repairing aircraft such as the Boeing 747. It is also experienced in repairing Dart engines, and building the repair lines for heavy engines such as the Astazo, F, and Solar.⁴⁶

Iran Aircraft Manufacturing Industries Corporation (IAMI)

The Iran Aircraft Manufacturing Industries Corporation or Karkhanejate Sanaye-e Havapeymai-e Iran, also known as Hava-peyma Sazi-e Iran, HESA was established in 1976. The corporation is located in Shahin-shahr of Isfahan but has its head office in Tehran. It was the first aircraft manufacturer in Iran. By technology transfer from the Ukraine, this company manufactures IrAn-140, a 52-seat passenger airplane with a jet propeller engine and a flight range of 2,000km. It also designs and manufactures a variety of drones, fuselages, and other aircraft.⁴⁷ IAMI is a large industrial complex affiliated with the Ministry of Defense and Armed Forces Logistics (MODAFL). It is a major defense contractor for the Guardian Corps of the Islamic Revolution and its projects, including development of the Ababil unmanned aerial vehicle (UAV).⁴⁸⁻⁵⁰

Iranian Armed Forces Aviation Industries Organization (IAFAIO)

The Iranian Armed Forces Aviation Industries Organization, Sazeman-e Sanaye-e Havai-e Niroohaye Mosallah-e Iran, more famous as Shahid Basir Industry, was created in 1987 in Tehran as an aviation manufacturing company. Presently, it is the main center for the production of over 5,000 military and non-military parts and accessories. To produce more and better parts, it exchanges information with universities, research centers, and private companies around the country. It also provides services to the nation's ground and air forces.⁵¹

Ghods Research Center

Located near Tehran, the Ghods Research Center, also known as Ghods Aviation Industries, is an Iranian aviation manufacturing company created in 1985. It makes pilotless aircraft, including the Ababil, Saegheh, Talash and Mohajer, as well as powered paragliders and other products. It has also developed a variety of parachutes, including free-fall personal parachutes, Strato Cloud parachutes, Ofogh parachutes, and Fakhteh parachutes. Its many services include the design and manufacture of ground control station electronics, imagery, targeting, and optical tracking and aviation systems.^{52,53}

Aerospace Industries Organization (AIO) of Iran

The Aerospace Industries Organization of Iran, Sazmane Sanaye-e Hava-Faza, known as SSH, is located in Tehran. It is a leading high-tech industry and military subsidiary of the Sanam Industrial Group, which is Department 140 of the Defense Industries Organization of the Ministry of Defense and Armed Forces Logistics (MODAFL). Its products include the Shahab ballistic missile, launchers, rocket and booster propellants and components. It also supplies non-military items and services such as fuel pumps, technical and engineering services, and research and development. AIO is the obvious organization to lead the development and production of the space assets of Iran. It manages a number of factories and research centers, including the Missile Center of Saltanat-Abad, the Vanak Missile Center, the Parchin Missile Industries factories, the Bagheri base factories 1-3, the Tabriz Bakeri base factory, the Bakeri Missile Industries factory, the Hemmat Missile Industries factory, the Bagh Shian (Almehdi) Missile Industries, the Shah-Abadi Industrial Complex, the Khojir Complex, the Bagherol-Olum Missile Research Center, the Mostafa Khomeini base factory, and the Ghadiri Base factory.⁵⁴

Shahid Hemmat Industrial Group (SHIG)

Based in Tehran, the Shahid Hemmat Industrial Group is subordinated to the Aerospace Industries Organization and has several divisions that are involved in the manufacture and operation of launch vehicles, such as Kalhor Industry (launchers), Karimi Industry (spares that transfer propellants to the engine and other parts of the launch vehicle), Cheraghi Industry (production of propellants), Rastegar Industry (launch vehicle engine production), Varamini Industry (launch vehicle guidance and control systems), and Movahed Industry (manufacturing and assembly of launch vehicles).⁵⁵

Iran Electronics Industries (IEI)

Known as the Sanaye Electronic-e Iran (SEI) in the Persian language and more famously as SAIran, Iran Electronics Industries was established in 1973. It is presently the country's leading producer of electronic systems and related products. Its main office is located in Tehran. It has eight subsidiaries and around 5,200 experienced staff who are involved in manufacturing over 100 different electronic products. IEI is the largest electronics corporation in Iran, and about 65% of its personnel are highly trained engineers in various disciplines. In the aerospace domain, it designs, develops, manufactures, tests and uses various types of research, remote sensing, and communications satellites in addition to various ground stations, including image receiving, telemetry, tracking and command (TT&C), flight control center (FCC) and user terminals (UT). SAIran designed and

developed the first indigenously produced satellite of Iran, named Omid, which was launched in February 2009. Its military products include telecommunications, electronic warfare, radars, optics, electro-optics and lasers, security and encryption, and command, control, communications, computers and intelligence (C4I). It also makes modern tactical communications systems in the HF, VHF and UHF ranges, and field telephones and switchboards. Moreover, it designs, produces and develops a wide range of security systems in the field of Security of Communications and Information Technology. In optics and electro-optics, IEI makes thermal imagers, night vision systems, laser range finders, and the optics for daylight sights.⁵⁶ Its subsidiaries include Shiraz Electronics Industries (electronic technology), Iran Communication Industries (communications technologies), Information Systems of Iran (information technologies), Electronic Components Industries (microelectronics), Isfahan Optics Industries (optics), Security of Telecommunications and Information Technology (communications security), the Iran Electronics Research Center (research and development) and the Iran Space Industries Group (manufacturing of satellites).⁵⁷

Iran Space Industries Group (ISIG)

Located in Tehran, the founding of the Iran Space Industries Group as a subordinated entity to IEI was announced on the occasion of the launch on February 4, 2008 of the Kavoshgar-1 rocket.⁵⁸

Shiraz Electronics Industries (SEI)

Shiraz Electronics Industries is a firm that has been professionally engaged in electronic products and projects since 1973. Combining highly skilled personnel with advanced equipment and an abundance of motivation has produced a powerful technological industrial group focused on electronic warfare, control and automation, radar and microwaves, weapon electronics, avionics, computers and electro-optics applications.⁵⁹

Iran Communication Industries (ICI)

Iran Communication Industries, known as Sanaye-e Mokhaberat-e Iran in the Persian language, is the country's leading manufacturer of military and civil communication equipment and systems. Based in Tehran, it has more than 75 products in the field of tactical communications and encryption systems to meet a wide range of military requirements.⁶⁰

Information Systems of Iran (ISIRAN)

Information Systems of Iran located in Tehran is a state-owned company founded in 1971. It is one of the largest and most experienced information companies in the country, and is reportedly the leading information technology company in terms of revenue, market share, and the variety and quality of its products and services. It assists and provides its clients with state-of-the-art information systems.⁶¹

Electronic Components Industries (ECI)

Electronic Components Industries was founded in 1976 and has two facilities, one in Shiraz and the other in Tehran. Its activities include the design and manufacturing of semiconductor devices, quartz crystal, multilayer printed circuit boards, and thick film hybrid, infantry field wire, optical cable and access systems.⁶²

Isfahan Optics Industries (IOI)

Isfahan Optics Industries was founded in 1987 to create a vigorous and modern optics industry. The employment of highly qualified engineers and state-of-the-art equipment has made it one of the most capable industries in Iran. It has designed and manufactured complex lenses and prisms, multilayer coatings, a wide range of daylight sights, and various types of aircraft windshields.⁶³

Iran Electronics Research Center (IERC)

The Iran Electronics Research Center was founded in 1997 as a scientific, educational and research institute. It has research teams active in the fields of electronics, communications, microprocessors, microelectronics, optics, electro-optics and radars. It is capable of handling the multiple technology range of large products.⁶⁴

Shahid Bagheri Industrial Group (SBIG)

The Shahid Bagheri Industrial Group, also known as the Iran Technical Organization (IRTO), is part of the Defense Industries Organization (DIO) based in Tehran. It reportedly cooperated with Russia's Baltic State Technical University and the Sanam Industries Group to create the Persepolis (Takht-e Jamshid) joint missile education center in Iran which transfers missile technology from the Russian Federation to Iran.⁶⁵

Iran Telecommunication Manufacturing Company (ITMC)

Iran Telecommunication Manufacturing Company was created in 1967 to produce systems for high capacity telecommunications centers and on-the-table telephones. It operates factories in Tehran and Shiraz. The present stockholders are MCIT (45%), the Mine and Industry Bank of Iran (35%), and Siemens (20%). As the largest manufacturer of telephone high capacity centers in Iran, by the end of 2001 it had produced ten million fixed telephone lines and nearly 500,000 mobile telephone lines, covering 80% of the fixed and 20% of the mobile telephones in the country. In recent years, these factories received an ISO 9001 certification which resulted in \$850,000 of exports to other countries. The principal capabilities of the company includes the design, production and installation of mobile telephone centers, and the design and production of fixed high capacity switches for local, mobile, urban and STD (standard) systems. The company has currently more than 1,000 employees.⁶⁶

Telecommunication Company of Iran (TCI)

The Telecommunication Company of Iran is subordinate to the Ministry of Communications and Information Technology and has branches in almost every province. Its chief responsibility is the development and management of the country's communications infrastructure, particularly using satellite-based and ground-based telecommunications.⁶⁷

Security of Telecommunications and Information Technology (STI)

The Tehran-based Security of Telecommunications and Information Technology (STI) is supervised by Iran Electronics Industries (IEI/SAIran).⁶⁸ It utilizes a wide variety of security systems designed and produced by IEI for Security of Communications and Information Technology.⁶⁹

National Cartographic Center (NCC)

Established in 1953 in Tehran, the National Cartographic Center is the principal authority for the production of maps and spatial information under the IR Iran President's Deputy

for Planning and Strategic Supervision. Having 800 highly experienced personnel, NCC undertakes supervision and technical control of mapping and spatial information projects that are carried out by NCC itself, by other governmental organizations, and by private mapping companies. It has been responsible for creating the base map of the country and appropriate marine charts, the design and establishment of National Geodetic Control and geodynamical networks, the establishment of national, regional, and urban spatial topographic databases, and the production of small-scale base maps and national atlases. The expertise gained during the course of half a century enables NCC to undertake and supervise all manner of mapping and spatial information projects at the national and international levels.⁷⁰

Research Institute of Space Science and Technology (RISST), Amir-Kabir University of Technology

The Research Institute of Space Science and Technology was created at the Amir-Kabir University of Technology (AUT) to meet Iran's needs in designing, manufacturing and applying space products and space-related projects as approved by the Council of Higher Education Development with the support of the Iranian Space Agency.

Shahid Rezaie Research Institute (SRRI), Sharif University of Technology

The Shahid Rezaie Research Institute was affiliated with the Sharif University of Technology (SUT) in 1999 to undertake research designed to enable the country to achieve technological self-sufficiency in a variety of fields, including aerospace, and facilitate the entry of an educated young workforce to the work environment.

Space Research Center (SRC) of Iran

With the annexation of the Iranian Space Agency to the Presidential Institution in 2010, the Aerospace Research Institute (ARI) and the Agricultural Engineering Research Institute (AERI), the latter more usually called the Engineering Research Institute (ERI), came under the umbrella of the space agency and, together with the Space Research Institute (SRI) of ISA, formed the Space Research Center. The Aerospace Research Institute of Iran was renamed the Astronautics Research Institute (ARI), but still follows its former functions when working under the Ministry of Science, Research and Technology. ARI was established in 2000 to conduct research into aerospace. It has pursued a range of activities in order to achieve the research needs of the country and to establish connections with related industries:

- Recognition and introduction of aerospace technologies, and cooperation with related entities and organizations in order to acquire the latest aerospace technologies.
- Development and expansion of research in the aerospace field in order to meet the research needs of the country.
- Cooperation with research and educational organizations of the country in order to improve the quality of related research activities.

Located in Tehran, ARI has expanded research facilities and established an environment that is conducive for research. Its facilities include a parallel processing laboratory, an electronics laboratory, a virtual reality laboratory and an Information Technology

Center. In addition it has construction and assembly plants and a library.⁷¹ In line with the plan of the country to send astronauts into space by 2021, ARI has been conducting practical experiments on life in space by developing a space bio-capsule.⁷² It was the principal contributor to the development of the capsule in which a monkey was launched by a Kavoshgar rocket to an altitude of 120km on January 29, 2013, marking the first time that Iran sent a primate into space.⁷³

The Space Research Institute (SRI) of the Iranian Space Agency was established in Tehran under the authorization of the Council of Higher Education Development in 2007 with the goal of meeting the research needs of the nation's space technology industry. It is mainly in charge of developing the Masbah-2 satellite project.

2-2-3 Non-governmental organizations and private firms

The contribution and involvement of non-governmental organizations as well as the private sector in the development of aerospace activities, services and industries is significant. Moreover, NGOs are involved in policy-making in the nation's space endeavor. Because aerospace is a research-intensive industry that requires major capital outlays for research and development before production can start, only a small number of private technological firms operate in Iran. Their contribution is primarily in the aeronautical sector of aerospace. Activity in the aeronautical sector requires greater investment, knowledge, and highly developed skills and expertise. Some of the active NGOs and private firms in the aerospace domain are given below.

Iran Aviation and Space Industries Association (IASIA)

The Iran Aviation and Space Industries Association is a non-governmental entity with 27 participating companies that are active in the aerospace industry. It was established in 2007 and has its secretariat in Tehran.

Iranian Aerospace Society (IAS)

The Iranian Aerospace Society is engaged in activities relating to scientific development, research, and specialized technical aspects of aerospace for peaceful purposes. It was established in 1993 and has its secretariat in Tehran.^{74,75}

Andisheh Barta Company (ABC)

The Andisheh Barta Company is a private center pursuing industrial studies that relate to air traffic, particularly in ultra-light unmanned aircraft. The company is the first specialized center for recruiting, training on the construction and operation of model aircraft and the sale of spare parts. It is located in Isfahan.⁷⁶

Aram Azmoon Company (AAC)

The Aram Azmoon Company Aviation Non-Destructive Testing (NDT) Services and Training Center was established in 1996 with the aim of providing aerospace engineering and consulting services and training. It is the only center approved by the Iranian Civil Aviation Organization to offer all the NDT services and training in aviation in accordance with common global standards. The company benefits from the high expertise of its inspectors in providing the services to its customers.⁷⁷

Arya-Tech International Company (ATIC)

The Arya-Tech International Company is a private firm established in 2003. Based in Tehran, it was mainly founded with the aim of generating rapid prototypes in the industrial field. Over the course of the years, it has gained experience in 3D scanning, rapid modeling, replica building, rapid prototype molding, and piece building. It has excelled in aerospace, with its artisans and experts contributing to and expediting the evolution of research by constructing visual and conceptual models.^{78,79}

Dorna Aerospace Company (DAC)

The Dorna Aerospace Company is a private joint-stock venture which specializes in designing and manufacturing lightweight aircraft covering EASA (European Aviation Safety Agency), CS-VLA (Certification Specification for Very Light Aircraft), ASTM LSA (American Society for Testing and Materials- Light Sport Aircraft), and FAR Part-23 (Federal Aviation Regulations Part-23) categories. Located in Tehran, it was established in 1988 by a group of aerospace engineers and technicians and has received the Design Organization Approval Certificate, Type Certificate and Production Approval Certificate qualifications for its two-seat aircraft called Blue Bird and the UL/LSA (Ultra-Light/Light Sport Aircraft) aircraft called Free Bird. Its main objectives include the design and manufacturing of lightweight aircraft in the JAR-VLA (Joint Aviation Regulations-Very Light Airplane) category and JAR23 by implementing projects using composite materials instead of metals.⁸⁰

Energy Systems Planners Company (ESPC)

The Energy Systems Planners Company, known as the Tadbir-garan Industrial Research Center, is a private venture founded in 2005. Based in Tehran, it undertakes activities in the four fields of energy, computational mechanics, aerospace, and management. The company holds the accreditations of the Ministry of Science, Research and Technology and of the Ministry of Industry, Mines and Trade. In 2007 it was chosen as the Excellent Industrial Research Center by the then-Ministry of Industry and Mines. Its aerospace section carries out projects related to the analysis, design and manufacturing of aircraft and air/space systems, along with their associated subsystems.⁸¹

Raha Institute (RI)

The Raha Institute is one of the country's leading private aerospace entities. Located in Tehran, it was created in January 2004 to develop the aerospace industry in the private sector in Iran and its activities include aircraft manufacturing, airline and airport industries, air traffic control, and avionics systems. It also provides management consultation, engineering and technical services, and cultural activities. RI is also the main sponsor of avia.ir, the first Iranian Aerospace News Agency.⁸²

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