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Iran's 'Forward Defence' Doctrine

Missile and Space Programs

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Introduction

Since the 1979 revolution, the want of military wherewithal and fast-advancing technology has not been able to constrain Iran's ambitions. Driven by Imam Khomeini's dogma, the new dispensation strategized to export the revolution to Muslim countries. The Shah left a modern and well-trained military. Doubting their loyalty, the new rulers purged the armed forces of its foreign-trained, seasoned leadership, causing a serious blow to the institution. The war with Iraq proved to be costly for Iran as its arms stockpiles diminished and it lost fighter jets, helicopters and naval vessels. The spectacle of Iraqi missiles striking Iranian cities was etched into Iran's memory not just because of the human and financial losses incurred but also due to the psychological impact it generated. Moving on, sanctions on Iran increased and its deficiency in airpower became permanent. To make up for its inability to import spare parts for US-made military systems including F-14 Tomcats, Iran's military started cannibalizing its own stockpiles. For instance, the air force used half of the F-14 fleet for spare parts to keep the rest airworthy.

The government desperately attempted to acquire weapons from any available sources, nation-states and the black-market that had been thriving since the dismemberment of the Soviet Union and later the breakup of Yugoslavia. A variety of missiles were on sale, with different technologies, ranges, and delivery systems. The unmanned missiles were not only affordable but also easy to hide and improvise. No less significant is their addition to airpower when the air force is starved of fighter jets and the required munitions. In the years that followed, not only did Iran acquire entire missile systems but also their crucial subsystems and parts from across the world. From reverse-engineering to improvisation, the Islamic Revolutionary Guard Corps (IRGC) developed its military doctrine and strategy around unmanned aerial vehicles, ranging from ballistic and cruise missiles to armed and surveillance drones.

Iran's armed forces have the largest assortment of missiles, ranging from short- and medium-range ballistic to land-attack cruise missiles. It is believed that its missiles can deliver nuclear weapons as well, thus the Joint Comprehensive Plan of Action (JCPOA), commonly known as the nuclear deal, was intended to prevent Iran from possessing the capability to tip its missiles with a nuclear payload. Due to various obstacles, there are no indications yet that Tehran has acquired the expertise to alter the con-

ventional use of its sophisticated projectiles.

Even if the JCPOA survives the October test, Iran can produce hundreds of sophisticated, reverse-engineered improvised missiles. Through black-market or top-secret unannounced purchases, Tehran is suspected of building a missile force capable of evading the radars of its neighbors with speed and in-flight maneuverability. Considering the short flight duration between its adversaries, the threats from Iran's government to the region cannot diminish with the existing nuclear deal as it does not cover Iran's missile capability. Besides, Iran's lack of transparency and credibility along with a dubious military doctrine make its missile capability even harder to predict. As a result, neighboring states are likely to choose counter-measures on the basis of threat perception.

I- Vibrant Military Doctrine

Iran's strategic thinking has been unconventional compared to all its neighboring states. Post-revolution Iran has faced a unique set of security challenges. Despite its confrontational approach to regional security, Iran's theocracy has managed to keep its hold on power. Though Tehran's vision of its neighboring states and the big powers has not changed at all, its strategic doctrine to keep up with technological advances, geopolitical and internal dynamics has evolved into becoming much more complex and aggressive.

Iran carefully followed the Arab uprisings that began in 2011 and in two cases – Yemen and Syria – Iran intervened and tried to engineer the outcome. Tehran's strategic thinkers found the opportunity enticing with its rivals unable to either exploit or limit the change occurring after decades of stagnation in the Middle East. Though the Arab uprisings were facilitated by the Western world and aided by social media outlets and the likes of Al Jazeera, Iran placed its bet on the Arab protesters' ability to destabilize the Arab countries. Swift changes in Iran's strategic thinking led to the emergence of the so-called 'forward defense,' something already in practice vis-à-vis Iraq and Afghanistan.[1]

The 'forward-defense' thinking originates from Iran's acknowledgment of limitations in its conventional military capabilities. The strategy rests on an interplay between conventional deterrence and plausible deniability. Learning from its experience in Iraq and Afghanistan, Iran found great potential in projecting its influence and power through the use of non-state armed actors, civil society groups, emerging media platforms,

unmanned aerial vehicles and missile forces. From a purely militaristic viewpoint, the forward-defense doctrine rests on capitalizing on the weakness of its rivals by employing cost-effective solutions to protect/shield Iran from enemy attacks. As much as armed non-state actors pose a potent internal challenge to rivals, an advanced, diverse, and large missile force can keep them at bay from one's own borders. One may argue that Iran's missile force has been in existence since the 1980s, so what is new about it now? The answer lies in its prioritization as Iran's frontline military asset and the massive investment made in it to expand its range, from guided short-range missiles to an ambitious militarized space program.

A military doctrine defines the "fundamental principles by which the military forces guide their actions in support of objectives."[2] Chapman argues that "the military doctrine can and has been defined in_ many different ways in numerous countries. These varying definitions are affected by the security factors that face these countries, as well as existing and emerging technological trends and developments, internal political factors within the armed services such as inter-service competition and conflicting perspectives of civilian and military policymakers regarding critical national security priorities, and budgetary factors that may compel armed services to downsize their military objectives."[3] It is authoritative but requires judgment in application. It guides the identification of a potential enemy or threat, the crafting of a viable military strategy, its implementation, the arms required, and the requisite training for the troops or manpower involved. In this context, the term 'forward' can be broadly understood as 'offensive;' meaning to 'inflict damage on the enemy's military and vital assets in a pre-emptive manner."[4] Defensive doctrines deny an adversary an objective it seeks by "ruling out any initiation of hostilities and strictly confines one's combat to the defense of one's own territory."[5] Hence, Iran's 'forward-defense' doctrine is a clever interplay of both offensive and defensive doctrines while being based on the concept of conventional deterrence.

Iran's 'forward-defense' doctrine can also be called a hybrid doctrine, subtly blending all instruments of force and coercion by interplaying regular and irregular modes of war-fighting while keeping its own territory away from conflict.6 Iran's acknowledgment of its own state of weakness has led it to create a grey-zone area, allowing it to conduct operations to influence and gain an advantage without crossing the thresh-

old of war. However, Iran's reliance on its missile force makes it highly probable that it will face a high degree of escalation and pay severe retribution. It has successfully managed threats by deploying its missiles via its proxies in Lebanon, Iraq, and Yemen. However, plausible deniability has become too difficult to maintain.

Prior to the 'Arab Spring,' Iran was implementing its 'mosaic defense' doctrine conceived in 2005.[7] The previous stratagem was thoroughly defensive in nature and relied on naval and air-defense capabilities to disrupt the adversary's control of sea lanes and air space. Nonetheless, it did essentially rely upon an asymmetrical approach involving the mobilization of a large, dispersed militia force to inflict a war of attrition against its foe.[8]

The quest for a coherent and viable doctrine emerged during the war with Iraq. Until then, the supreme leader's laid-out principles of resistance were relied on to establish the parameters of the military's grand strategy. It was not until 1992 that the basic principles of Iranian strategy and doctrine were articulated systematically, keeping in mind the technological gulf, the military's human resources and its quality as well as the military geography. The revolutionary zeal and ultra-nationalist pride powered the evolving thinking but the approach was as pragmatic as possible. Keeping the ideology as a keystone for Iran's military doctrine, the regulations of the Iranian Armed Forces were codified in 1992.[9] Iran pursued a defensive policy that was primarily based on protecting the revolution, which made it unique and threatening for the state if it did not subscribe to Khomeini's version of Islam or did not adhere to the ethos of his dispensation. As systemic as it was, the evolving doctrine was anchored in loyalty to the concept of Velayat-e Faqih. By the mid-1990s, Iran's strategic thinking had shifted considerably towards concepts of deterrence and balance of power. The missile force started evolving and nuclear jargon started to become part of the rhetoric too. Iran's Minister of Defense Ali Shamkhani said in an interview that Iran's defense policy, military doctrine, training/education, structural organization, and defense industry "are dependent on our policy of détente." [10]

With the catastrophic events of 9/11, the advent of the US and allied troops in Afghanistan and later the Washington-led invasion of Iraq, Tehran found new opportunities in emerging volatility. The concept of relying on non-state actors, first successfully implemented in Lebanon, became a centerpiece of the doctrine, and became prominently evident

in the 'mosaic defence' doctrine unveiled in 2005.

Jack Snyder's theory argues that weak civilian control leads to 'offensive bias'[11] and this seems applicable to Iran as the IRGC has an upper hand in state policy. Thus, the existing 'forward defense' doctrine also provides an insight into Iran's internal political reality and the imbalance that exists between civil and military institutions in the country. The IRGC testing missile systems numerous times a year coupled with it holding elaborate military parades and wargames indicate its influence over decision-making in the country. For Iran's adversaries, the aforementioned indicate not only Iran's capability to use military force and launch missiles, but also diminish prospects of reconciliation between the IRGC and civilian institutions. The challenge for Iran's Foreign Minister Mohammad Javad Zarif was evident during the talks, which led to the signing of the Joint Comprehensive Plan of Action (JCPOA) on April 2, 2015. Since US President Donald Trump withdrew from the JCPOA, Iran's military has increased its projection of power via missile tests and launched a satellite into space on May 8, 2018.[12]

Though the notion of conventional deterrence remains at the core of Iran's missile force, all its ballistic and cruise missiles can carry nuclear warheads. The signaling from Iran's leader has been threatening. Ali Shamkhani, Iran's Minister of Defense, stated at the test firing of the Shahab-3 ballistic missile in 1998, "We have prepared ourselves to absorb the first strike so that it inflicts the least damage on us. We have, however, prepared a second strike which can decisively avenge the first one while preventing a third strike against us."[13]

Over the past four decades, Iran's doctrine became more sophisticated and systemic. However, the fundamental principles i.e. adherence and loyalty to velayat-e-faqih, protection of the revolution at home and expansion abroad always remained its foundational pillars. The most significant instrument was and remains the reliance on the radicalized Shiite outfit, whose arming depending on the strategic need and existing ground realities. Similarly, missiles were initially acquired, reverse-engineered and improvised on for protection of Iran's sovereign borders but were smuggled to Hezbollah, for instance, long before the 'mosaic defence' doctrine was envisaged and implemented in 2005. The evolution of Iran's military doctrine shows sophistication of articulation more than any signficant changes in tactics and instruments as the grand strategy or the revolution's goals have remained constant since 1979.

II- Missiles in Iran's Strategic Memory

None of the states possessing nuclear weapons today had a line-up of diverse ballistic and cruise missiles at hand before achieving the ultimate payload capability. Iran is quite unique as its wide-ranging consistently upgraded missiles are ready for the non-existent cargo (i.e. nuclear warhead option). While going through the painstaking and time-consuming process of keeping American-made fighter jets – especially F-14 Tomcats – supply planes and helicopters airborne and disassembling half of them to salvage much needed spare parts, Tehran has realized the difficulty of buying upgraded jets besides the challenging task of integrating and maintaining them. However, while this does not mean that Iran will not acquire modern fighter jets whenever an opportunity arises, it seemingly has found its stop-gap arrangement rather cost-beneficial and strategically and tactically effective. In Iran's 'forward-defense' doctrine fighter jets do not have a critical role, and, even if they did, they cannot provide the strategic advantage that missiles do. Drones have worked well for Iran, from Yemen to Iraq and Syria to Lebanon. A sanction-stricken country like Iran, without its many missiles and numerous drones, cannot project power and implement deterrence measures thousands of kilometers away.

On the one hand, missiles provide Iran with various options to confront the United States and its Arab allies, while on the other hand provide it with the ability to be self-reliant. In fact, self-reliance cannot define a country dependent on the black market and a handful of pariah nations for vital components and alloys. Nonetheless, the aforementioned might be slow and costly for Iran compared to acquiring weapons via normal channels. But they provide Iran with full freedom to use them and improvise and modify them as it pleases, something it would not be able to do with Western origin weapons.

President Trump's decision to withdraw from the JCPOA and impose wide-ranging sanctions on Iran only reinforced the historical distrust and the state of confrontation between the two countries. The IRGC is thus blame free in front of the Iranian people to continue its 'forward-defense strategy' while developing weapons with some key components acquired through the black-market or secret deals that violate UNSC sanctions.[14]

Without sanctions, a gas-rich strategically placed country such as Iran

with an ideologically-driven political set-up could have purchased virtually everything available. India and Egypt are two countries with the most diverse military equipment, especially their air forces and navies. However, they can never exploit a weapons system to its optimal level besides facing issues in regard to maintenance and integration while spending exorbitantly. Iran is constrained due to a limited military budget and faces isolation because of technology-related sanctions. Therefore, Iran has to optimally utilize its existing platforms or systems and also focus on indigenous production. The vast difference in defense spending between the GCC states and Iran is no secret. Hence, acquisition of Russian-origin Chinese and North Korean missiles and adjusting their fuel carrying capacity or payload deemed an advanced step to hit specific targets in the region. Exhaustive testing of these missiles has resulted in the development of an arsenal with a variety of ranges, payload capabilities, and slight design variations. Iran can amass these missiles to overwhelm the air defense systems of its enemies and make up for the lack of accuracy. Iran's short-range ballistic missiles have an impressive record of accuracy, but its medium range missiles are poor in precision targeting.

Missiles are a perfect weapon of choice for Iran as they suit its four dimensions of land, air, sea, and hybrid (militias). Besides, the experience in developing offensive missiles supplements Iran's ability to create its own air defense systems as well.

Missiles form part of Iran's most significant platform of conventional deterrence until it develops its own nuclear option. The concept of conventional deterrence in the Gulf has gained credibility in the aftermath of Ayatollah Khamenei's repeated threats, Tehran's firing of missiles on Iraqi bases targeting US troops after the killing of former IRGC Quds Force Commander Qassem Soleimani and the widespread presence of militias controlled by the IRGC.

III- Humble Beginnings of Iran's Missile Program

Since the beginning of the Cold War, Iran aligned itself with the US-led capitalist bloc. It joined the Baghdad Pact (later named the Central Treaty Organization, CENTO) along with bordering Iraq, Turkey, and Pakistan. Washington continued with its efforts to strengthen its relationship with Iran, especially on the military front by exporting new weaponry and holding joint military training.

A brief period of tension broke out when Mohammad Mossadegh was elected as prime minister in 1951. A few days after his appointment, legislation was passed to nationalize the Iranian oil industry. This move, led by Mossadegh, agitated Britain and the United States. Mossadegh had suceeded to pass a decree through the Parliament to curb the Shah's power. Shortly thereafter, in August 1953, he was deposed by the military and the Shah returned to power.[15]

Iran did not join the Saudi-led 1973 oil embargo, gaining the trust of the United States and other major Western capitals. The decision also resulted in revenues via oil exports, motivating Tehran to initiate missile and civilian nuclear programs in order to turn Iran into a regional power.[16]

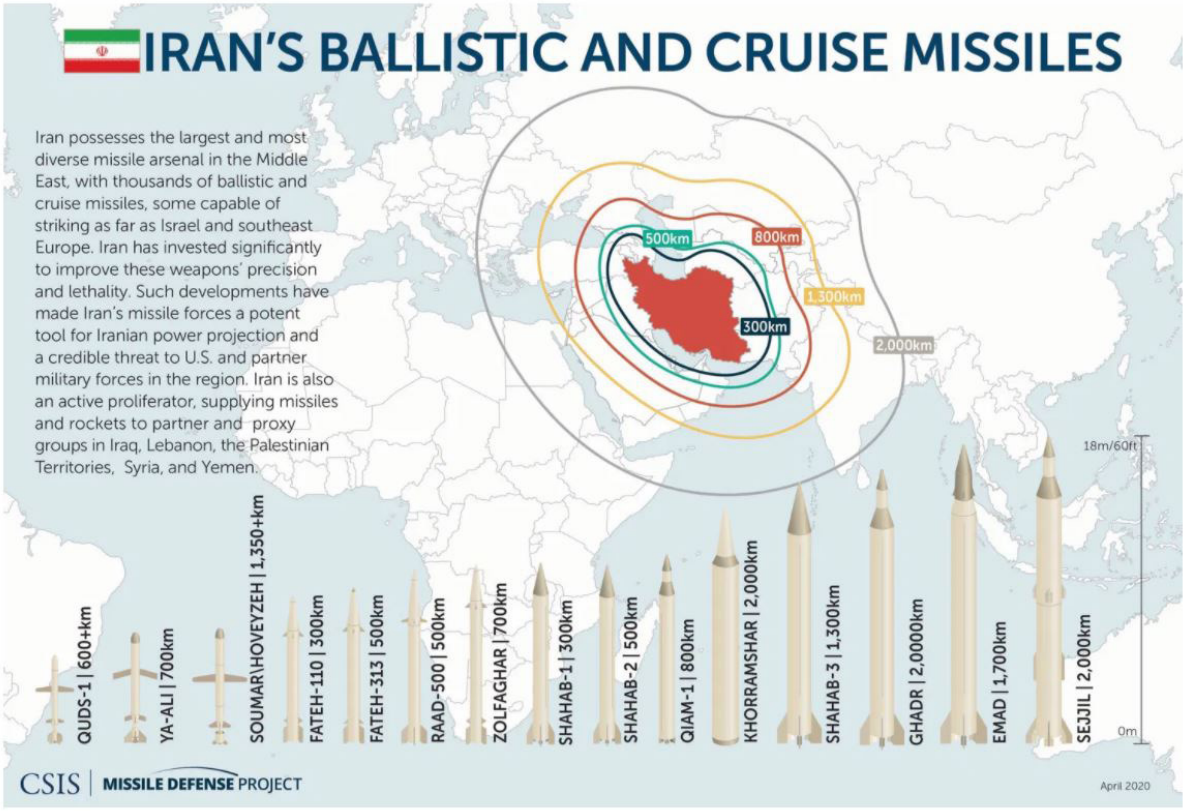
In 1974, the Defense Industries Organization under the Ministry of War produced the Arash, a short-range unguided rocket based on the Russian BM-11 that targets tanks and artillery guns.[17] In April 1977, under 'Project Flower,' Iran sought Israeli help to alter its advanced surface-to-surface missiles. The development work took place in Sirjan, central Iran, for a missile with a 482-kilometer range and a 750-kilogram payload but it was not completed during the reign of the Shah.[18] The 1979 revolution ended missile development programs that involved Western assistance.

From then to now, there has been a notable change. In February 2020, Iran displayed its Raad-500 short-range ballistic missile. A month earlier, Iran fired Fateh and Qiam ballistic missiles, approximately 16 in total, at two bases hosting US troops in Iraq.[19] Four missiles fell short of the target while six hit the target with a good degree of accuracy. Iran's missile inventory is stockpiled with missiles of a similar range, payload and even fuel type, leaving military analysts often perplexed due to this unusual practice. Slight modifications to a missile's payload either due to an increase in fuel capacity or a decrease in the deadly cargo on the front often results in Tehran renaming the missile. In August 2019, Iran unveiled three air-to-air missiles: the Yasin, the Balaban, and the Qiam.[20] The new missiles were the outcome of improvizations and changes made to existing missiles using recently acquired censors or design modifications at the Iran Electronics Industries (IEI). Similarly, the Iranian submarine-launched cruise missile during the 'Velayat 97' wargames in February 2019 was also an improvised Russian piece. While Iran keeps Zolfaghar ballistic missiles in its inventory, a modified

version was renamed Dezful with a range of 1,000 kilometers. During the same wargames, Tehran tested the Hoveizeh cruise missile able to hit around 1,200 km. The weapons system proudly displayed on the 40th anniversary of the 1979 revolution was a cheaper version of the Soviet-era nuclear-capable Kh-55 missile. It was unveiled along with the updated 2,000-kilometer range Khorramshahr 2 ballistic missile. The Sejil, Ghadir, and Khorramshahr missiles are thought to have been in mass production since March 2017. The other prominent missiles tested included the Shahab-3 medium-range ballistic missile, the Qiam short-range ballistic missile and the Zolfaghar (Zulfiqar) short-range ballistic missile. The Soumar (Sumar) cruise missile test flew approximately 600 kilometers in February 2017, but with a nuclear capable weapon it ranged between 2,000 kilometers to 3,000 kilometers depending on payload weight. In April 2016, the space launch vehicle (SLV) 'Simorgh,' based on North Korea's Unha rocket, was launched. Iran did not attempt to use solid fuel to launch Simorgh; instead it relied on liquid fuel at all stages of its launch. The Iranian Space Agency claimed that the SLV can launch a 100-kilogram payload into a 500 kilometer orbit. In response to Iraqi military attacks on Iranian cities, the late Ali Akbar Hashemi Rafsanjani, the then speaker of the Iranian Majlis, led a delegation in 1985 to Libya, Syria, North Korea, and China to acquire missiles.[21] During the same year Libya supplied Scud-Bs, and two years later China sold 'Silkworm' anti-ship cruise missiles to Iran. Tehran's project to reverse-engineer Russian-origin missiles was further boosted with the supply of North Korea's 100 Scud-Bs. The deal was reportedly a result of Tehran agreeing to finance Pyongyang's longer-range missile program in exchange for the transfer of technology. In 1988, Beijing agreed to share the technology it used to develop its own medium-range ballistic missiles. This was followed up by a 10-year scientific and technological agreement to develop military hardware.

Tehran showed off its first domestically produced short-range liquid-fueled missile Mushak-160 in 1988 with a range of 300 kilometers, derived from China's nuclear-capable DF-11A. Later, Iran developed a variant with an extended range or simply bought it from the original manufacturer. By 1996, Iran had the capability to assemble kits bought from China that included missile guidance systems, computerized tools and en-

gines to build its version of a C-802 surface-to-surface cruise missile. The Washington Times, quoting a Central Intelligence Agency (CIA) report at the time, stated that China had supplied Iran with missile technology, including gyroscopes and accelerometers, as well as test equipment and components for an advanced radar system. The development of its cruise missile continued and the IRGC improvised it by firing it from a Chinese-made patrol boat. The following year, Iran acquired air-launch cruise missile capability by firing Chinese-built C-801K missiles from its fighter jets. For domestic missile production, Iran faced the challenge of obtaining high-grade steel and other systems, three types of which were supplied by a Russian company in September 1997.[22] In January 1998, it became apparent that Iran was nearing completion of its Shahab-3 medium-range missile, which was tested months later. The nuclear-capable, liquid-fueled 16-meter long ballistic missile could initially carry a 1,000-kilogram payload up to 1,300 kilometers. Iran's investment in North Korea's medium-range missile program was paying off well and the Nodong missile would later become the basis for Iran's expanding missile arsenal. Coinciding with the testing of the Shahab-3, Washington imposed sanctions on seven Russian entities for involvement in missile proliferation activities.[23] One blacklisted company, INOR, was supplying special alloys for Iran's missile casings and alloy foil to shield missile guidance components. Rosvoorouzhenie, a state corporation for the export and import of armaments and military equipment, was accused of assisting in building a wind tunnel to test and design missile components. Crucially important help was provided by Russia's SHIG to develop solid rocket fuel technology and the design of guidance and propulsion systems. Such highly sophisticated technical assistance by Russian companies could not have occurred without the Kremlin's consent. More US sanctions targeted Russian tech giants as Iran displayed the Shahab-3 missile and three solid propellant surface-to-surface missiles Zelzal-2, Nazeat, and Shahin. In early 1999, US satellite imagery captured work in Iran on Soviet SS-4 missiles with a 2,000-kilometer range.[24]



Source: CSIS ,April.2020

Iran made its first sale of reverse-engineered or locally assembled missiles to the Congo ,then called Zaire [25].The number could not be determined but the presence of Iranian military advisers and engineers was proven. There has been no other declared customer but it is believed they have been smuggled to Hezbollah, the Houthis and Hamas for operations in sync with Iran's 'forward defense' doctrine. Not only did Iran procure a dozen or so Nodong missile engines for its Shahab-3 missiles but also a transporter-erector launcher (TEL) to reduce the pre-firing timeframe and enhance their masking before and after the mission. Iran's plan to become self-reliant was well-thought out as it never under-estimated or overlooked the need for high-grade metals and materials vital for the physical integrity of missiles. Large investments were made in 2000 to procure and produce vital elements for the production of solid-propellant rockets such as hydroxyl-terminated polybutadiene (HTPB) resin, aluminum powder, and potassium chlorite. During the 2000s, Iran exhausted domestic technical know-how and illicit international help to further refine its arsenal of Nodong missiles. There was a particular focus on their modernization, and the use of solid fuel as well as extending their range and payload capacity. The first half

of the decade was marked with the repetitive testing of Shahab variants and other missiles, albeit with mixed results.

In late 2004, Iran displayed the Zelzal, Nazeat, Shahab-2, and Shahab-3 missiles during a parade. The most striking were two Shahab-3 variants, featuring a triconic warhead with extended ranges of 1,500 kilometers and 2,000 kilometers beside a claimed improved circular error probable (CEP). Another interesting development was related to the Fateh 110, a single-stage, solid-fueled and short-range ballistic missile. It had a short range of 200 kilometers and was small in size but had high speed. It was envisaged as the frontline tactical weapon. Iran could not have developed it on its own, the United States imposed sanctions on two Moldovan companies – Cuanta S.A. and Computer and Communicatti SRL – for assisting Iran.[26] North Korea reportedly provided Iran in 2005 with 18 assembly kits of its BM-25 or Musudan missile, a modified version of Russia's naval SS-N-6 missile, which was a single-stage, liquid-fueled missile with a range varying between 2,400 kilometers to 3,000 kilometers. Like its previous acquisitions from North Korea, the medium-range missile would prove to be an important asset for Tehran.[27]

In December 2006, the UN Security Council passed resolution 1737 to prevent the transfer to Iran of materials, as well as technical or financial assistance, that might contribute to the development of Iran's nuclear and ballistic missile program.[28] Tehran deployed a set of experts to improve the prospects of producing domestically manufactured engines for liquid-propellant missiles. However, this attempt proved to be unsuccessful due to a lack of knowledge, experience, and facilities. In the public and private sectors, Russia and Ukraine were seen as likely providers of the power plants. Both upheld their commitment to the Missile Technology Control Regime (MTCR) by not officially exporting missiles with a range of more than 300 kilometers and with payloads less than 500 kilograms. While the black market in Eastern Europe and Central Asia could be of some help, Iran continued with its reverse engineering in parallel.

Table 1: Iran's Ballestic Missile Aresnal

Missile	Class	Range	News
Ya-Ali	Land-Attack Cruise Missile	700 km	Operational
Safir	SLV	350 km altitude	Operational
Khorramshahr	MRBM	2,000 km	In Development
Qiam-1	SRBM	700-800 km	Operational
Shahab-1	SRBM	285-330 km	Operational
Simorgh	SLV	500 km altitude	In Development
Koksan M1978	Artillery	40-60 km	Operational
Zolfaghar	SRBM	700 km	Operational
Emad (Shahab-3 Variant)	MRBM	1,700 km	In Development
Sejjil	MRBM	2,000 km	Operational
Shahab 2 (Scud C-Variant)	SRBM	500 km	Operational
Shahab-3	MRBM	1,300 km	Operational
Ghadr 1 (Shahab-3 Variant)	MRBM	1,950 km	In Development
Fateh-110	SRBM	200-300 km	Operational
Tondar 69	SRBM	150 km	Operational
Soumar	Cruise Missile	2,000-3,000 km	Operational (presumed)
Ra'ad	Antiship Cruise Missile	150 km	Operational
Fateh-313	SRBM	500 km	Operational

Source :CSIS.

In ,2008 Iran was focusing on solid-fuel powered missiles to reduce the preparation time and possibly extend their range .The Sejjil ballistic missile ,a solid-fueled and medium-range missile with a higher payload-range capacity, and the liquid-propelled Shahab-3 were tested. It marked a strategic shift in Iran's missile program, increasing its quest for chemicals vital for preparing solid fuel.

Iranian efforts to produce aluminum powder –used to produce solid fuel- reached a milestone in 2011 with the setting up of a small factory in the northeastern city of Jajram where one can find the country's largest deposit of bauxite.[29] Although a dual-use material consumed in paints, electronics and solar panels, aluminum powder is a key ingredient in solid-fuel propellants used to launch missiles. Iran's factory started the production of the vital black substance in 2015. This was an important step for Iran in order to gain greater control over the supply chain and to improve quality, as well as to reduce the launch time and extend the range of its missile force significantly. The documents relating to Iran's quest for solid-fuel propellants indicate that besides Chinese assistance, Japanese and German companies provided help, as well. Unsuspecting

foreign nationals and IRGC operatives were apprehended while trying to ship materials and technology vital to Iran's missile program including the production of solid fuel.[30]

IV.Missile Safety Anxiety and Nuclear Warhead Design

In Iran's psyche, missiles are its last and final option. In 2005, an intelligence agency leaked to the press that Tehran had built hardened silos to keep its missiles in launch-ready condition.[31] It took the Iranian government about six years to admit this. By October 2015, the IRGC released a video of its underground missile launch facility. Iranian media claimed that the military base was a half kilometer underground and "one of the hundreds located throughout the country."[32] Then again in May 2017, an IRGC commander claimed that Tehran had built three underground missile production facilities. The National Council of Resistance in Iran (NCRI), a Europe-based dissident group, claimed in June 2017 that the silos and the underground missile storage and firing facilities were constructed with the cooperation of North Korea. The NCRI claimed to have identified 42 missile sites, with a dozen not heard of previously.[33] If Iran intends to keep its missiles for conventional use, then what is the need for building silos and underground 'cities' besides revealing them in such a Hollywoodesque manner? The revelations when seen in parallel with Iranian attempts to acquire Western parts to improve precision and extend missile range, along with efforts to access nuclear cone designs, make it abundantly evident that Iran's eventual reliance on missiles is for their potential nuclear use. In February 2010, the IAEA complained that Tehran may have attempted to design a nuclear ballistic missile warhead. The UN watchdog went on to say that along with the aforementioned attempt, Tehran has likely tried to engineer a missile re-entry body and "design and computer modeling studies" focused on producing "a new design for the missile warhead."[34] The IAEA, in November of the following year, noted as per Iran's Project 111 (nuclear design program) that Tehran worked on deploying a new payload onto its mainstay Shahab-3 missile. The package also includes a high explosive and detonation package vital for an implosion device.[35]

V.Iran's Missile Arsenal and Conventional Deterrence

Assuming that Iran is not pursuing a nuclear weapons program, its missile force emerges as its frontline tool to project power and fight wars. A question arises about the effectiveness of Iran's conventional deter-

rence in response to any threats from the US-led coalition and a host of rival Arab Gulf nations. Iran's two rivals, the United States and Israel, not only possess nuclear weapons but have also signaled their potential use; Tel Aviv through its statements and Washington via its nuclear-armed weapons at bases in the Gulf and deployed on aircraft carrier groups sailing the narrow Strait of Hormuz as well as the Arabian Sea.

Over the decades, Iran's rhetoric about using force to defend its sovereignty has gained some credibility. By building silos and recently launching ballistic missiles hidden in the ground, it has also indicated its resilience to the enemy's first strike. Tehran's weakness is evident when looking at the multi-warfare domain such as its air force or sub-surface warfighting capability. Yet, its missile barrage will be accompanied by its proxies launching attacks against its foes. The narrow Strait of Hormuz dividing Iran from its Arab rivals is dominated by islands coupled with Tehran's cheap but numerous armed speedboats, swarms of armed drones and of course short-range, relatively more accurate ballistic and cruise missiles. Will Iran be able to command and control after the first strike? This remains an unknown. However, second-strike capability must not have been ignored during the various wargames Tehran conducts periodically.

Not only does Iran maintain its forces to fight in likely or expected battlefields but also its clerical leaders keep religious-nationalistic sentiments high to avenge enemy attacks. A missile force can most likely provide Tehran with wartime resilience in a conventional conflict, but domestic public opinion may turn against the government amidst intense attacks and losses on Iranian soil. To avert such a scenario, Iran will choose to create a domestic political crisis for its rivals by inflicting severe damage to oil, electricity, water, and coastal supply lines. To avert this Iran's Arab rivals must install superior missile defense batteries guarding their airspace against Iranian and Yemeni frontiers. The Gulf Arab states are likely in the process of replenishing their missile defense coverage after the attack on the Aramco oil facilities in Saudi Arabia.

Tehran's conventional warfighting approach through its missile force, particularly, can falter due to a miscalculation of the enemy's resolve and military capability. If hostilities break out, Iran's foes will seek the collapse of the state's writ and its military's command and control while Tehran's objectives of defending the country while inflicting heavy damage on its foes won't be easily achievable given the existing state of its

missile and air defense capabilities as well as the need to satisfy public opinion.

Iran's much-trumpeted coercive threat to blockade the Strait of Hormuz and its anti-ship capability can give it some strategic advantage but it is not punitive enough to deliver any political objectives it might hope to achieve. Another area where Iran severely lags behind is in the domain of electronic warfare. With the Cuban missile crisis being the textbook example of a blockade, Iran will be in an elevated state of danger, while being able to inflict tangible yet measured and largely reversible pain. However, it may not likely win any diplomatic advantage for such an aggressive act as it will potentially inflict harm to its allies such as China, India and Russia. The Gulf rim nations would not like to see Gulf waters becoming a victim of Iran's brinkmanship; hence Tehran must be defeated at any cost if it were to undertake such aggressive action.

The threat of asymmetrical warfare is Iran's best stratagem instead of an all-out conflict. The missile buildup increases strategic risks for its adversaries while restraining Iran from launching a war which it cannot win despite an assortment of militias and a wide variety of layered missile attack capabilities. Hence, if the arms embargo is lifted, Iran's arms shopping list will include missile defense systems, fighter jets and submarines, none of which can be delivered in less than a period of two to three years.

VI.Quest for Air Defense Capability

In August 2019, Iran unveiled the Bavar-373 air defense system, dubbed as being superior to Russia's S-300 and like the S-400 Triumf in some respects. The first version of the air defense system was tested in 2011. The Bavar-373 is powered by four rectangular container launchers, each carrying one Sayyad-4 missile and 24 missiles in one battery. Iran claims that the Sayyad-4 can hit an airborne object including ballistic missiles at the range of 300 kilometers and an altitude of 27 kilometers.[36] It is designed to intercept and destroy any type of aerial target as well as ballistic missiles. It is fair to say that the Sayyad-4 has an uncanny resemblance with Russia's 48N6E, which Tehran acquired in 2016. The maneuverable 48N6E is capable of accurately hitting the target in a clutter and jamming environment and is equipped with a semi-active radar guidance system.

With a range of 300 kilometers, the Bavar-373 can al-

legedly detect some 300 targets simultaneously, track 60 and engage six of them at an altitude of 26 kilometers.[37] Since the capture of the US drone RQ-170 on December 5, 2011, Iran has been aspiring to shoot down one of many foreign reconnaissance objects flying unscathed through its airspace. The crash of the RQ-170 drone not only perplexed the world but also raised the morale of the Iranian military as well as the Iranian people.[38] As a result, Tehran has been desperately strengthening and expanding its air defense capabilities. Its efforts have centered around enhancing detection, engaging, and destroying capabilities of imported and indigenous radar and missile systems. Iran claims that with the addition of a VHF radar, a Bavar-373 battery could effectively monitor the airspace of neighbors like the UAE, Kuwait, Iraq, and Qatar. Such an early-warning capability is fundamental for a pre-emptive strike advantage. Iranian analysts have been saying that four Bavar-373 batteries can make Tehran's airspace impregnable.[39] The reality is not as rosy. The capabilities of Iran's Bavar-373 are highly exaggerated, it is also still in early production runs, and thus has not been commissioned in large numbers so far. Besides, the S-300 is the preferred air defense system for sensitive installations.

Additionally, Tehran unveiled in 2019 its 'domestically-designed' Khordad 15 air defense missile system. Defense Minister Brigadier General Amir Hatami claimed that Sayyad 3 missiles can bring down fighter jets and unmanned aerial combat vehicles (UCAVs) at a range of 120 kilometers, a shorter-range version of the Sayyad 4.[40] As per the Khordad's claimed ability to track 'stealth objects,' it can trace them from a distance of 85 kilometers and engage them from 45 kilometers away. The system's deployment timeframe is claimed to be five minutes while it can engage six targets simultaneously. This surface-to-air missile system is a further development in Iran's Talash series.

"Iran will bolster its military capabilities to safeguard its national security and interests, and does not need permission from anyone," said Defence Minister Amir Hatami at the launch ceremony of the Khordad 15.[41] Various arms experts doubt Hatami's claim. Sayyad 3 missiles resemble the Hawk missiles imported from the United States during the Shah's reign. The Reagan administration also delivered some of these missiles during the Iran-Contra Affair.[42] Some modifications in the Hawk missile's launch system led the Iranian military to 'indigenize' the weapons system. The Sayyad 3 is not the only one to get such a superficial makeover

and rebranding.

Nonetheless, the on-ground threat perception puts Iran in a difficult situation, as its air force is obsolete, too small, and ill-equipped to support its air defense system. Technologically, its systems are inferior too. For the Sayyad missiles, anti-ship missiles and radar systems, Tehran owes a lot to Beijing. During the 1990s, China transferred technology and trained Iranians on reverse-engineering and military hardware production. The surface-to-air self-sufficiency story began with Iran copying China's HQ-2, which Beijing copied from the Soviet S-75 Dvina.[43]

There is no exit from its quagmire due to restrictions on arm imports, unless the US bid to extend the UN arms embargo fails, which is expected to expire in October. In light of the UNSC sanctions and now the nuclear deal, arms exporting countries are barred from selling modern military equipment including fighter jets and air defense systems to Iran. Its Gulf rivals are not only equipped with the latest fighter jets and missiles but also state-of-the-art air defense systems. In an all-out conflict, Iran's drones, its weapon of choice, won't stand a chance unlike in low-intensity conflicts. The very notion of plausible deniability will become irrelevant, as well. Any hostility will be attributed to the warring foe (i.e. Iran). Thus, Iran's best bet is to adopt a defensive posture while relying heavily on its missile arsenal and kamikaze boats. However, its missile silos need to be protected from enemy attacks. Hence, the significance of its air defense system cannot be overstated.

Tehran also claims to have developed a radar system - Arash 2 – which can locate small flying objects. In the words of Khatam al-Anbiya Air Defense Commander Brigadier General Farzad Esmaili, "One of these systems is a long-range space radar with combined frequencies and the capability of discovering small flying objects and cruise missiles."[44]

Iranian commanders have been vocal about deficiencies in the country's air defense systems. Brigadier General Alireza Sabahifard claimed that Iran's air defense covered only a handful of Air Force bases and cities prior to the revolution. However, the rude awakening of the Iran-Iraq war led to an expansion in Iran's air defense coverage, as Iraqi jets targeted sensitive and vital centers of the country.[45] The military claims that the air defense systems now cover over 3,600 sites including cities and sensitive installations. It boasts that 'indigenized' radar systems and a watchtower system have created an integrated air defense system with

day and night capability.

The Rassed 32 surveillance system is another domestically-developed tactical air defense system capable of aerial surveillance with a range of 15 kilometers.[46] There is also the indigenously-developed Ya Zahra AD missile system which is mobile like the Khordad 15 which also feeds into Iran's integrated air defense network. There is little indigenous about the system for it is a licensed copy of China's H-7, which itself is a copy of France's Crotale missile short-range air defense system.[47]

Two more radar systems – Moein 40 and Nasser 40 – also add to Iran's hostile object detection capability. The Nasser 40 is claimed to be a passive radar system capable of detecting targets in urban environments and can locate small flying objects and cruise missiles in urban centers. The Moein 40 has a declared detection range of 400 kilometers. It is meant for both civilian and military purposes.

For Coast Guard personnel, Iran declared in July 2017 to have developed and deployed the Afaq.[48] According to Iranian Defense Minister Brigadier General Amir Hatami, "The coast monitoring radar is capable of monitoring vessels within a range of 200 kilometers and it can also trace and hunt aerial targets." He also boasted that the mobile radar system (Afaq) is equipped with anti-electronic war capabilities and can trace and track 100 vessels at a time.[49]

Among the line-up of domestically designed and developed systems is the Nazir radar system, which can "detect radar-evading targets and survive electronic warfare." Fars News Agency quoted Esmaili as saying that "the radar system is specialized in detecting small flying objects and MQ1, RQ4 and U2 aircraft and can easily detect and trace ballistic and cruise missiles and, most importantly, radar-evading aircraft."[50] Back in 2014, Iranian military commanders claimed that the Nazir is more advanced than the Russian S-300 but now they only claim this about the Bavar-373.

"An air defense system more advanced than what they didn't supply to us due to their strategic interests went on display in the IRGC's recent exhibition," Brigadier-General Salami said in Tehran.[51]

Though each radar system or surface-to-air missile in Iran's arsenal is a copy of a foreign innovation, licensed or otherwise, it lacks effective capability to engage and destroy an incoming hostile object. As mentioned before, the range and capability parameters of defense systems remain

largely exaggerated in Iran. Thus, Tehran has keenly awaited Russia's delivery of its S-300 air defense system which was agreed upon in 2005 but later ditched by Moscow in 2010 as a result of UNSC sanctions against Iran.

After the signing of the Joint Comprehensive Plan of Action (JCPOA) in 2015, Iran revived the deal with Russia and the weapons system was finally delivered in July 2016. The Iranians can potentially negotiate an upgraded version of the system (S-300 PMU2), whose exact details remain guarded. After the imposition of fresh US sanctions on Iran, the Russians do not seem inclined to supplement Iran's war fighting capability. Yet, the S-300 system adds some sharp teeth to Tehran's bite. It has since claimed to have integrated the system with its other air defense capable platforms. It is quite likely that Iran's S-300PMU2 has a kill range of 200 kilometers and the radar's imagery spans over 300 kilometers.[52]

Russian technology allows Iran to not only defend itself against intruding aircraft, cruise and ballistic missiles as well as drones, but also allows it to monitor certain regions of Saudi Arabia and the UAE depending on where on the coastal frontier it is deployed. Placing it in Bushehr coastal city where Iran also has a nuclear reactor will provide Tehran with a picture of parts of Iraq, Kuwait, and Saudi Arabia. The system's deployment closer to the Strait of Hormuz bottleneck can give the military a clear view of air traffic in the skies of Saudi Arabia and Oman.

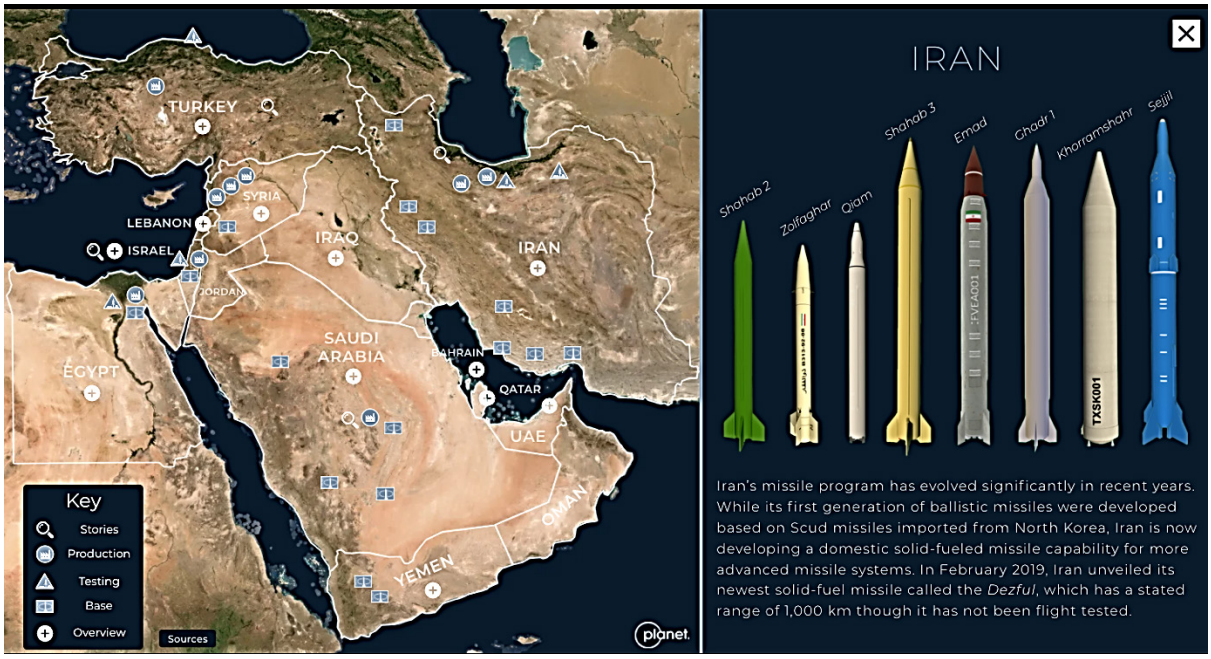
As much as Iran is vulnerable to foreign fighter jet and missile attacks, so are its foes across the Gulf. The flight time for a missile will be in the range of three to four minutes, depending on which part of the country the target is located. However, its Arab adversaries have multilayered defense arrangements against aerial objects. Their latest air defense systems are being tested day in and day out due to intruding Houthi missiles and drones.

Nonetheless, the Russian export of its S-300 missile defense system does change the threat-perception calculus of the Arab states as well as America. Unlike its adversaries, Iran's Russian air defense arsenal will be thinly spread due to the country's landmass and dispersal of military installations. Devoid of Russia's medium range Buk-M2 missile – one of which was used to shoot down flight MH17 – Tehran lacks the punch other operators of S-300 or S-400 have. However, it must have replaced the missing Buk-M2 with locally produced or reverse-engineered sur-

face-to-air-missiles. The rude reality-check, however, remains that older versions of the Russian system in Iran's armory will not be able to match the threat-level posed by newer jets and missiles. Besides, it also will not be able to develop a multi-layered defense shield.

Over the past decade, Tehran has placed an especially high premium on reverse-engineering or developing a drone force, missile cache and radar systems. If Gulf tensions reach the level of all-out conflict, Iran's heavy reliance on developing asymmetric capabilities to deter adversaries with vastly superior conventional military power will not be of much use. Its air defense system remains untested contrary to its key rival Saudi Arabia. Its four batteries of its Russian imported S-300 system will be too crammed with incoming hostile traffic. Except for Iran's handful of ageing yet capable F-14 Tomcats and MiG 29s, there is little punch it can throw against F-15s, F-16s, and Rafales to name a few (assuming that the USAF F-35s stay out of the equation).

Even if the United States does not participate in the conflict, Iran's posture in any conventional warfare will remain defensive. The Arab Gulf states may, however, utilize the opportunity to suppress Iranian offensive capabilities and annihilate early-warning systems as well as its air force assets. Yet, Tehran might not go down without inflicting its rival air forces with some losses. Much will depend on how effective and realistic Iran's personnel training and air defense integration has been.



Source: Planet

VII. Anti Access/Area Denial (A2/AD) Weapon System

The key component of Iran's military strategy is denial of access to the Strait of Hormuz, which remains a vital waterway for all its neighbors and rivals as well as for itself. Having a sizeable coastline along the northern Arabian Sea makes Tehran less vulnerable due to a blockade in the event of a war. However, the infrastructure on its Arabian Sea coastline is insufficient for large trucks and containers as well as for berthing facilities. Tehran's capability to deny any traffic in the narrow waterway passage is a vital element of its stratagem.

Currently, the military's arsenal for anti-access/area denial or anti-ship missiles has a range variation from 280 kilometers to a maximum range of 700 kilometers. Iran's variety of missiles can be launched from land and air or from both. However, the land-based anti-ship missiles have a shorter range and better accuracy. Though Tehran occasionally shows off its anti-access prowess by targeting mock models of US carriers and ships, there is still much left to do in order to achieve the desired results.

The high point for Iran's anti-access/area denial came when it shot down a US Global Hawk drone in mid-2019, using its medium-range Khordad-3 or Ra'ad system.[53]

Another professed locally made 'Ghadir' or 'Qadir' anti-ship missile is being projected to show Iran's growing expertise in developing weapons systems, especially missiles. The reality is a lot different though. Based on China's Silkworm missiles, which are replicas of Soviet-era Termit anti-ship missiles, the original 'Ghadir' or 'Qadir' missile systems were bought during the late 1980s. Tehran has made efforts to improvise the anti-ship missile by changing its subsystems or making certain changes in its appearance. Nonetheless, Chinese cooperation in regard to Iran's missile capability remains critical. Beijing sold Tehran HQ-2/2B SAMs (copies of the Soviet S-75 SAMs).

Iran's anti-access missile Khalij Fars – a version of the Fateh-110 – is itself a modification and upgrade of China's CSS-8 short-range missile, 200 of which were acquired in 1989. It is Iran's most potent anti-ship ballistic missile. It is a 'supersonic projectile,' capable of carrying a 650-kilogram warhead, which "is immune to interception and features high-precision systems."[54] It was first tested in 2011, and it is seen by Iran's military as being highly reliable and having exceptional accuracy. Interestingly, the Khalij Fars AShM is a solid-fuel propellant, has an inertial guidance sys-

tem and a long range.[55]

VIII.Dubious Space Program

The April 22 launch of the Noor-1 satellite was clearly neither an image-building exercise nor a manifestation of Iran's intent to use space for peaceful purposes. The SLV was based on a modified version of the Shahab-3 ballistic missile with a propagated range of 2,500 kilometers. In a departure from its signature policy of plausible deniability, like Iran's nuclear program, its space ambitions are not meant to serve peaceful purposes.

The Noor-1 is neither Iran's first nor its last object to orbit the planet. Iran had earlier sent four satellites, but the Noor-1 has gone the farthest i.e. over 425 kilometers. Since the previous ones did not last long in orbit, the IRGC put more effort into the serviceability of the Noor-1 than capability, meaning less-sophisticated censors and cameras and an overall smaller weight. Iran's satellite controls are vulnerable to hostile cyberattacks too. Laden with cameras, the Noor-1's purpose is military surveillance albeit with limited capability.

Iran's Noor-1 satellite flies freely numerous times a day over every part of the Earth in its non-sun-synchronous orbit inclined at 59.8 degrees to the equator at 427 x 435 kilometers while it does a repeating ground-track about every four days.[56] Each orbital rotation takes 90 minutes.[57]

The IRGC aspires to build and launch high-resolution reconnaissance satellites in the future disregarding any concerns about Iran's dual-use space program. The launch of the Noor-1 was extraordinary as it did not take place from the fixed-structure launch pad at the Imam Khomeini Spaceport but from a mobile transporter-erector launcher at the Shahroud missile test site.[58] Iran's previous launches could be tracked by satellite due to preparation activities at the Imam Khomeini spaceport but the one on April 22 came without warning. No satellite geospatial images could be taken nor was a hacking attack launched to thwart what was suspected as a test flight of Iran's intercontinental ballistic missile (ICBM) under the garb of the SLV. Iran's space agency has made 13 such attempts in the past. This time the IRGC took matters into its own hands and sent its own satellite riding an improvised three-stage solid and liquid ballistic missile. The satellite is lighter at 100 pounds compared to some previously attempted satellites the country developed and fired into the sky. It remains to be seen how safe the satellite is from signal

disruption or how long its battery lasts.

The satellite's telemetry signals are claimed to be strong at 401.5 MHz, consisting of regularly spaced data packets with one data packet sent each 10 seconds.[59] However, radio amateurs, reporting its data dumps near its ground stations, have pointed to the weakening or occasional absence of signals.[60]

Iran's once secret space program, now in the open, is working to send more capable satellites via solid-fueled SLVs, which might not happen during 2020.[61] The IRGC's parallel program was unveiled in 2011 when its first bid to develop an SLV on November 12 went into flames due to an explosion rocking the Shahid Modarres solid-fuel research facility. Among the 39 victims was the program's key architect Brigadier General Hassan Tehrani Moghaddam.[62] Until the unveiling of the Qased SLV – the second stage of which was powered by the IRGC solid-propellant motor Salman – the military side of Iran's space program was thought to have ended in 2011.[63] In September 1998, Iran first displayed its solid-propellant projectiles e.g. short-range surface-to-surface reverse-engineered missiles: the Zelzal-2, the Nazeat, and the Shahin.[64] The quest to master the use of solid-propellant projectiles was never realized at least since 2011.

Along with its solid-fuel stage, the other defining technological feats of the Qased SLV are its swivel nozzle for vital flight control and a lightweight carbon-fiber casing extending its range.[65] Black-marketeers in Russia, China and North Korea played a critical part in these vital twin improvements.[66]

The Qased SLV was a highly modified version of the Shahab 3 ballistic missile, which itself is based on North Korea's Nodong missile. Even the transporter-erector launcher can be traced back to Pyongyang, which Iran acquired in 1995, and went through modifications after locally-assembled copies were made including some reverse-engineered parts.[67] The Nodong missile and the transporter-erector launcher in essence both date back to the Soviet-era.

Though Iran's interest in space technology can be traced back to 1958 when it sat amongst the founding members of the UN Committee on the Peaceful Uses of Outer Space (COPOUS), it was in 1985 that the then speaker of the Iranian Majlis the late Ali Akbar Hashemi Rafsanjani led a high-level delegation to Libya, Syria, North Korea, and China to acquire

an assortment of missiles and rockets.[68] In 2004, the Iranian Space Agency (ISA) was formed under the Supreme Council of Space, chaired by the president, with a mandate to explore outer space and build, launch and deploy satellites in addition to seeking regional and international cooperation.[69] On October 27, 2005, Iran debuted its space journey by sending its Sina-1 satellite on a Cosmos 3M rocket from northern Russia.[70]

Along with the solid-fuel stage, the other defining technological feats of the Qased SLV are its swivel nozzle for vital flight control and a lightweight carbon-fiber casing extending its range. Black-marketeers in Russia, China, North Korea, and in eastern European states such as Moldova played a key role in these vital twin improvements. Nonetheless, Iran is fully cognizant that one successful launch into orbit does not mean success of future missions. However, the April 22 launch comes at a crucial time for the projection of Iran's defiance and technological gains.

The rationale for Iran's space research is evidently no different from its nuclear program. Both have a dominant military dimension, which Iran denies. The aims of Iran's space program are secure communication, surveillance, and reconnaissance.

The satellite launch ensures uninterrupted access to space and on-orbit operations, situational awareness of space and earth surveillance. More specifically, the launch provides the IRGC with command, control, and communication mechanisms via the satellite, which may later be transformed into a space-based defense of Iran's territory. Tehran, at some point, may like to arm the satellite to attack other similar objects of rival nations. The IRGC has an infatuation with such fantasy weapons. In 1974, Russia launched the Salyut 3 which was equipped with a 23-mm anti-aircraft cannon and which even fired at a plane.[71] Iran may also fancy downing rival satellites with direct-ascent anti-satellite missiles. The United States, China, Russia, and India have already tested weapons to shoot down satellites.[72]

The presence of orbiting satellites has monumental significance for Iran's ballistic and cruise missile guidance system and their deterrent capability. As much as SLV capability directly feeds into Iran's ballistic missile program, it also brings into the calculus and debate the militarization of space and the possible drafting of a corresponding defense policy.

For a climate-change affected and water-stressed country like Iran, space surveillance can also help with early warning of floods and droughts

besides providing data for efficient and environmental-friendly farming practices and town planning alike.[73] This, however, is subject to the IRGC's willingness to share data with the civilian government.

Iran's satellite development program seems a rather slow and less exciting project compared to the actual refinement of its ballistic missile program leading to the development of an ICBM. The space program provides the necessary knowledge and technical finesse to Iran's engineers to extend the ICBM's range and payload with greater accuracy. Iran's pursuit of a solid-fueled SLV, which does not entirely feed into its ballistic missile program, will bring invaluable insight into the complexities of projective velocity and metallurgy. If Iran has been active in the black market, its development of a solid-fueled SLV will be sooner rather than later.

The space program provides satellite communication (Satcom) capability, which is a pre-requisite for an effective drone-based war-fighting and surveillance network.

After back-to-back breaches of the nuclear deal, Iran has chosen to take the next defiant step of sending a military satellite into orbit riding on an improvised ballistic missile. The one-way trip to space is also a calculated violation of UN Security Council (UNSC) Resolution 2231 which states, "Iran is called upon not to undertake any activity related to ballistic missiles designed to be capable of delivering nuclear weapons."[74] This development undermines Tehran's argument that it is committed to international law.

Moreover, Iran has proven that it has the capability to hit the US mainland via its satellite launch, a leap in its strategic outreach. The White House warned Iran against such measures aiming to change the status quo. Of Washington's 12 conditions to lift sanctions, the fourth specifically demanded Iran end its proliferation of ballistic missiles and halt further launching or development of nuclear-capable missile systems.[75]

Iran may still stick to its argument that its space program is for peaceful purposes and SLV technology does not feed into developing a long-range ballistic missile. However, in principle, it has changed the rules of the game. The strategic calculus in the West has drastically changed and Iran's strike capability will provoke a multifaceted diplomatic, legal, and strategic response. Russia and China do not agree with the US interpretation of Iran's satellite launch, but the other three members of the nu-

clear deal are likely to.[76]

Alongside the United States, Germany, Britain, and France have criticized Iran's fresh leap into space. "Reports that Iran has carried out a satellite launch – using ballistic missile technology – are of significant concern and inconsistent with UN Security Council Resolution (UNSCR) 2231," commented a British Foreign Office spokesman.[77] He pointed out that "the UN has called upon Iran not to undertake any activity related to ballistic missiles designed to be capable of delivering nuclear weapons. Iran must abide by this."

France vehemently condemned the launch because it violated UNSCR 2231.[78] The French Foreign Ministry statement said, "Given that the technology used for space launches is very similar to that used for ballistic missile launches, this launch directly contributes to the extremely troubling progress made by Iran in its ballistic missile program. The role played by the Islamic Revolutionary Guards Corps Aerospace Force, an entity subject to EU sanctions, in this launch reflects the close link between these two programs."[79]

The German Foreign Ministry spokesman Christofer Burger warned that "the Iranian rocket program has a destabilizing effect on the region and is also unacceptable in view of our European security interests." The United States tabled a resolution before the UNSC, and it was vetoed by Russia.[80]

Not only for the United States but also for NATO as a strategic bloc, the IRGC's renewed and displayed capability must be alarming. Given the differences between Washington and the EU, NATO becomes relevant not only to calm US security concerns but also to highlight the importance of its own existence. However, there was no condemnation from the NATO spokesman or secretary-general.

For the United States, October 18, 2020, a date marking the scheduled expiration of an UN-imposed arms embargo on Iran as per the nuclear deal, has become ever more significant. The United States may start the dispute resolution mechanism (DRM) objecting to Iran's space launch and space program overall. Once the matter reaches the UNSC, Russia and China will not have the right to veto but the snapback clause will become applicable automatically after the DRM 30-day period to resolve the dispute expires.[81]

The text of resolution 2231 clearly states that Iran is to avoid "any activity related to ballistic missiles designed to be capable of delivering nuclear weapons."

The legality of Iran's space program remains contentious with many foreign political leaders debating whether the launch violated the Joint Comprehensive Plan of Action (JCPOA), UNSC Resolution 2231, and the provisions of the Outer Space Treaty (OST) on peaceful uses of outer space.[82]

Notwithstanding the fact that Iran's space vehicle launch capability enables it to send a nuclear weapon to a land target, it does need to master many technological challenges to make a deadly delivery possible to any designated target. Tehran's past failures have exposed the fact that its recent satellite launch was carried out by a parallel program run by its military.

Taking the objections point by point, UNSC Resolution 2231 reads, "Iran is called upon not to undertake any activity related to ballistic missiles designed to be capable of delivering nuclear weapons, including launches using such ballistic missile technology." No treaty or customary law bans any state from launching observatory satellites into space. Additionally, no UNSC resolution including resolution 2231 prohibits Iran specifically from reaching space and does not restrict Iran's right to explore space for peaceful purposes.

Iran's violations of the non-nuclear provisions of UNSC Resolution 2231, especially the test launch of the Simorgh on July 27, 2017, complicates matters. Barring China and Russia, all other JCPOA members protested to the UN Security Council terming the test launch "a threatening and provocative step" that is "inconsistent" with Iran's commitments. The United States and E3 were objecting to Iran's intent of use.

Besides the controversy over America's membership in the JCPOA, there are differing views on whether the West must insist on halting all testing and development of the MTCR Category 1 missiles.[83] Iran disagrees with Western nations that its ballistic missile and space programs are in violation of UNSCR 2231. The text of the resolution clearly states that Iran is to avoid "any activity related to ballistic missiles designed to be capable of delivering nuclear weapons."[84]

IX. The Ever-Present Transnational Black Market

On July 30, the United States blacklisted four Iranian companies and one German and three Emirati subsidiaries of Iran's steel giant for ties to Tehran's missile program.[85] Over the past two decades, Iran has paid special attention to steel production and other vital metals such as aluminum and iron.

The unilateral sanctions imposed on Iran by the United States and major powers like the EU and Britain are meant to alert and discourage traders from doing business with Iranian entities requiring export clearance. Though there is no clear and agreed upon determination about aluminum powder, the United States and its European allies see Iran's access to the material as a means to enhance the capability of its nuclear-capable ballistic missiles, making it inconsistent with UN Security Council Resolution 2231. Even prior to the JCPOA, UNSC Resolution 1929 passed in 2010 restricted Tehran's production of nuclear-capable ballistic missiles and prohibited other countries from supplying related technology.

Li Fangwei, a Chinese businessman, was indicted in 2009 by the United States for alleged sales of missile parts to Iran. Both he and his company have been blacklisted by the United States.[86] In September 2010, Singapore seized a shipment of 18 tons of aluminum powder en route to Iran, which could have resulted in the production of approximately 100 tons of rocket propellant to feed its Fateh, Zelzal or Sejjil missiles.[87] Then in March 2012, a 50-year-old Australian and his company ICM Components Inc. were indicted in the US District Court for the District of Columbia for illegally exporting VG-34 Series Miniature Vertical gyroscopes to control the pitch and roll of missiles and torpedoes to Iran.[88] In 2012-2013, a German-Iranian desperately attempted to procure dual-use solid-fuel related items for Iran's Shahid Bagheri Industrial Group (SBIG). The items were trans-shipped via the UAE for re-export to Iran.[89] In October 2013, the US Justice Department indicted Reza Olangian on charges of attempting to acquire and transfer surface-to-air missiles to Iran.[90]

Germany arrested a German-Iranian for providing the IRGC dual-use vacuum pumps and valves for its missile program worth nearly $315,000 in February 2014. Two Iranians were found trying to acquire US-origin military technology through a Malaysia-based company for Iran's missile program.[91]

The network in Germany, like in Malaysia, remains multilayered as yet another smuggling ring was busted in October 2017 when an intelligence report found 32 Iranian attempts in 2016 to procure ballistic missile-related technology from the state of North Rhine-Westphalia. Ukraine too has been an enticing source for Iran's smuggling of military technology. Glaringly in January 2018, Kiev arrested two Iranian nationals trying to buy components of the Ukrainian-made X-31 (Kh-31) anti-ship missile; one of them was Tehran's military attaché. The most broad-based single sweep of US sanctions came in February 2020 when 13 entities from Iraq, Turkey, Russia, and China were blacklisted as per the Iran, North Korea, and Syria Nonproliferation Act (INKSNA). Tehran's unflinching resolve to acquire missile technology ranging from engines to advanced gadgets for accuracy and solid-fuel production capability point to three primary motivations: to be able to hit targets on the US mainland, to ensure quick assembly and accurate delivery of nuclear-tipped ballistic missiles and to reach deeper space.

X. Is Countering Missile Proliferation Possible?

Arms and missiles symbolize strategic power and political capital at home for political leaderships. The significance of missiles in military logic is based on them being pilotless, and having extended range, lethality, and accuracy. Since the 1980s and 1990s, ballistic missiles remain the weapon of choice for the frontline defense of vulnerable states, which seek to reach a military balance of power with developed countries. This all stands true in the case of Iran.

The existing instruments of arms control and countering missile proliferation are inadequate and weak. The changing nature of the global system and balance of power is deepening disagreements and tensions between states.

The MTCR has been in dire need of reform to keep up with technological advancements. Envisaged in 1987 to curb the spread of unmanned aerial systems (UAS), the MTCR filled a void in the age of advanced military technology and sophisticated, lethal offensive systems. The MTCR addresses attempts to regulate and implement export controls among a select group of countries. It is handicapped by a limited number of members e.g. China is not a member; monumental changes in technology, making missile technology simpler, cheaper, and better as well as harder to contain due to dual-use; and commercial and geopolitical in-

terests of member states to restrict further regulations and restrictions.

Today, the MTCR is comprised of 35 members, the vast majority of which are Western countries, each of which must establish national export control policies for ballistic missiles, cruise missiles, unmanned aerial vehicles, space launch vehicles, and drones as listed on the MTCR's Material and Technology Annex.[92] Category I fixes the export limit on missile and rockets to a range of 300 kilometers and a payload of 500 kilograms. In addition, it also regulates the major sub-systems and production facilities of projectiles. Category II governs dual-use technologies and materials such as specialized chemicals, technologies, propellants, and sub-components for missiles and rockets.

The MTCR, which is a non-binding multilateral accord, led to the signing of the Hague Code of Conduct Against Ballistic Missile Proliferation which seeks greater restraint from its participants in the development of WMD-capable ballistic missiles and a reduction in existing missile arsenals.[93] Some 138 states annually exchange information on their ballistic missile and space launch vehicle programs besides giving advance notice of any test-fires or space launches. The Hague Code of Conduct has a much larger membership base but relies on normative principles to guide nonproliferation diplomacy.

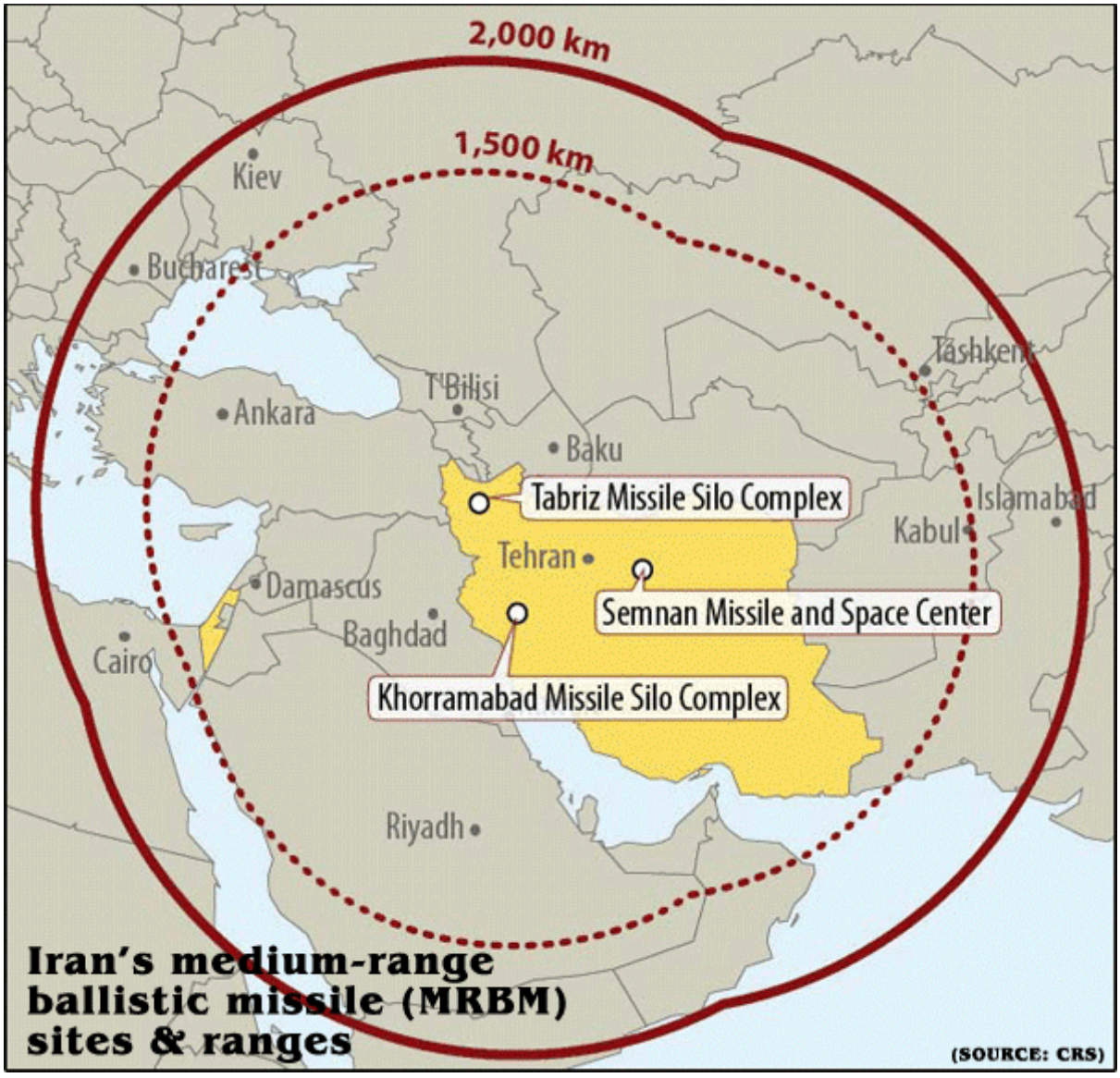
The UN Panel of Experts — which has been investigating Iran's use of ballistic missiles and drones despite the UN arms embargo imposed on Iran since 2015— is handicapped by challenges to form and implement a universal missile policy and decision-making through consensus instead of majority vote.

Today is, by far, the most challenging time to be optimistic about global arms control after the US withdrawal from the Intermediate-Range Nuclear Forces (INF) Treaty and Open Skies Treaty, two key instruments and confidence-building measures of the Cold War era. It is all about the inclusion of China in all global arms treaties. Ironically,

it was Washington which led the drive to reject Beijing's membership to the MTCR. China remains Iran's main ally and multifaceted future partner. Tehran and Beijing's bilateral diplomatic engagement can have implications for global arms control and the balance of power in the coming years. The Middle Eastern states will continue to pay the price by either amassing Western military hardware and missile defense systems while facing low-intensity conflict imposed by IRGC's proxy mili-

tias or by engaging in an armed clash.

There is no doubt that Iran's missile force does not make it invincible in a war against its rivals across the Gulf or their Western allies but it certainly deters them from initiating a war by increasing its costs, which will not only be financial but human too.



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