Gulf Security after 2020

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Diplomatic efforts to reach a comprehensive, definitive and long-term solution to the Iranian nuclear issue culminated in the Joint Comprehensive Plan of Action (JCPOA), concluded on 14 July 2015 by China, the European Union, France, Germany, Russia, the United Kingdom and the United States, with the Islamic Republic of Iran. On 20 July 2015, the United Nations Security Council endorsed the JCPOA by unanimously adopting Resolution 2231. The resolution provides for the termination of the provisions of previous Security Council resolutions on the Iranian nuclear issue and establishes specific restrictions on military trade with Iran that apply to all states, without exception. As per the agreement, the JCPOA became effective on 18 October 2015, 'Adoption Day'. In accordance with paragraph 5 of Annex B of Resolution 2231, restrictions on arms-related transfers to Iran will be lifted five years after this date.

The International Institute for Strategic Studies convened a group of experts for a series of workshops in 2017 to discuss the future of Gulf security after the expiration of Resolution 2231. Participants examined the types of weapons Iran is likely to procure and their potential effects on Iran's military doctrine, force structure and capabilities. In general, the group concluded that Iran's military doctrine, way of war and emphasis on asymmetric tactics is likely to persist, with few exceptions. However, Iran will also seek to modernize its military and fill capability gaps through prioritized acquisitions of advanced weaponry. The need to address social and economic shortfalls caused by mismanagement and sanctions will likely constrain Iran's military modernization efforts. The collection of papers that follow focus on various aspects of Iran's modernization effort. Key takeaways are as follows:

- Since the Iran–Iraq War (1980–88), most of the Iranian leadership's military investments have been in the asymmetric-warfare capabilities of the Islamic Revolutionary Guard Corps (IRGC), the ballistic-missile program and anti-access/area-denial systems to address the perceived US and Israeli threat. However, these capabilities are unsuited to addressing contemporary challenges posed by regional insurgencies, failing states and extremism.
- Iran will fill capability gaps, selectively modernize its military and rebalance its conventional forces to reflect lessons learned in Syria. To this end, Iran will try to purchase the kinds of major weapons systems that it has been unable to produce domestically, such as surface-to-air missiles, advanced fighter aircraft, tanks, advanced mines, and anti-ship cruise missiles. However, Tehran's acquisition of these weapon systems will be limited by their high cost. Weapons procurements that include licensed- or co-production rights will take priority.
- Iran's way of war is unlikely to change significantly. The country may partially rebalance its force structure to strengthen air and ground defenses, and may improve the expeditionary capability of its Shia

foreign legion. But its modus operandi will continue to focus on indirection, ambiguity and patience – while relying on proxies to maintain a degree of deniability.

- The sale or deployment by Russia of the *Yakhont* anti-ship cruise missile to Iran would be a game-changing development for the region, drastically altering the considerations of US and coalition maritime commanders. Whether Moscow is willing to sell such advanced and potentially destabilizing weapons to Tehran without attempting to retain some control over their operational employment remains unclear, and this prospect is somewhat limited by the necessity of Russian troops on the ground in Iran such control would require (the presence of foreign troops on Iranian soil is forbidden by the country's constitution).
- Iran's air force is in dire need of modernization. The cost of a full makeover is prohibitive. Iran will likely prioritize the purchase of fighter aircraft and air-to-air missiles in an effort to strengthen its air defenses. The right to co-produce aircraft domestically will be an important factor as Iran decides which systems to acquire.
- Iran will continue to emphasize the development and acquisition of ballistic missiles. Improved missile accuracy will take priority over increased range. Iran's missile doctrine is evolving from one that relies solely on punishing would-be attackers by striking highly-valued, large-area targets, such as cities, to a strategy that also strives to deny potential foes their military objectives.
- Unmanned systems represent a relatively low-cost addition to Iran's arsenal, and Tehran has invested in a number of aerial and maritime drones for strike and reconnaissance missions (although the actual capabilities of many of these systems are suspect). A limited communications infrastructure and an inadequate indigenous defense-industrial base will restrict Iran's use of drones moving forward, and developments in these areas will signal Tehran's priorities while giving the US and its Gulf allies time to respond.
- In the medium to long term, emerging technologies, such as artificial intelligence-enabled swarming, could enhance Iran's ability to wage war asymmetrically.

The Strategic Foundations of Iran's Military Doctrine

Matthew McInnis

Iran's military posture and approach to warfare are changing in several potentially significant ways, as the country adapts to the implementation of the Joint Comprehensive Plan of Action (JCPOA), the civil wars in Syria and Yemen, and the international campaign against the Islamic State, also known as ISIS or ISIL. To anticipate Tehran's policies and actions – and deter or counter them – US policymakers will need to comprehend the drivers and characteristics of Iranian military thinking. How Iran uses military power to achieve its strategic goals is, at heart, an issue of doctrine. This paper provides an analytic framework for understanding the nature of this doctrine and how it may be changing.[1]

Historical evolution and key characteristics of Iranian doctrine

Tradition, historical memory, religious ideals, ideological concerns and enduring strategic goals all shape – but do not necessarily determine – Iran's military thinking. Iran's armed forces struggled to modernize in the two centuries prior to the 1979 Iranian Revolution, under the Western-dominated and enfeebled Qajar and Pahlavi dynasties. Many of these insecurities and unresolved issues carried over into the post-revolutionary era, even as new ideological concepts became dominant and Iran faced two external existential threats to its survival, the United States and Saddam Hussein's Iraq. Iran's split military structure – divided between the legacy conventional army, the Artesh, and the heavily ideological Islamic Revolutionary Guard Corps (IRGC) – is arguably a reaction to these overlapping factors, as is the country's preference for military thinking that focuses on defense and asymmetric warfare.

It is hard to overstate the importance of the 1980–88 Iran–Iraq War in shaping Iran's approach to warfare. The conflict cemented Iran's doctrinal focus around three main axes – proxy warfare, asymmetric warfare (especially in naval defense) and ballistic missiles – in addition to internal defense and regime preservation. The Iran–Iraq War, as well as Tehran's desire to challenge Israel's intervention in the Lebanese civil war, drove the IRGC to find new ways to fight more powerful conventional foes and promulgate its ideological mission to export the Iranian revolution to the rest of the Islamic world. Tehran gained a significant capability to project power with its creation, in the early 1980s, of proxy groups such as Hizbullah in Lebanon and the Badr Corps in Iraq from local Shia groups. The IRGC's use of small boats, mines and anti-ship cruise missiles to confront the US during the 1984–88 Tanker War (part of the Iran–Iraq War) placed asymmetric-warfare concepts at the center of Iran's offensive and deterrence doctrine. Due to the psychological effects of Iraq's use of missiles on urban areas in Iran during the conflict, Tehran has maintained a missile program as the centerpiece of its deterrence and broader military doctrine.

For Iranian military thinkers, the 1991 Gulf War and *Operation Iraqi Freedom*, the 2003 US-led invasion of Iraq, underscored the supremacy of US conventional power

and the need to develop doctrines that could deter, defend against and undermine America's overwhelming military strength. The most significant of these doctrines are passive defense, developed after the 1991 Gulf War to prevent US aircraft and missiles from identifying and destroying critical Iranian targets; Mosaic Defense, formulated after the 2003 US-led invasion of Iraq to withstand foreign interventions and, failing that, mobilize a large, dispersed guerrilla force to retake lost territory; and what American strategists often refer to as 'anti-access/area denial', under which the IRGC Navy has focused on extending the range of its missiles and submarines to further threaten US maritime operations in the Persian Gulf, the Gulf of Oman and the Arabian Sea.

Combined with evidence from publicly available Iranian doctrinal material, statements by senior Iranian leaders, and major Iranian military exercises conducted over the past five years, these historical factors suggest that modern Iranian doctrine has several broad characteristics:

- *Iranian military doctrine does not generally descend from Islamic teachings and Iranian revolutionary ideology per se.* Instead, doctrine appears to draw mostly on military lessons learned, to find effective, pragmatic solutions to Tehran's security challenges within the framework of the state's ideological and strategic objectives. Ideology does, at a minimum, shape the organizational structure and mission of the IRGC, especially the Quds Force. Other exceptions may include concepts linked to Shia martyrdom, the medieval Assassins or *fedayeen* ('those willing to sacrifice themselves for God') and the mujahideen ('those who wage jihad'). All of these factors have likely influenced the IRGC's approach to proxy guerrilla warfare and terrorism, as well as internal-defense strategies such as the Mosaic Doctrine.
- *Iranian military doctrine tends to be ad hoc, reflecting the legacy of the Iran–Iraq War*. But there has been an overall increase in the formality and complexity of Iran's system for strategy development. As it had no doctrinal traditions when the war broke out, the IRGC acquired basic offensive and defensive tactics through trial and error. Although the Artesh had absorbed training and doctrine from the US and other Western powers over several decades, the force was being purged and relegated under the newly formed IRGC when Iraqi President Saddam Hussein invaded Iran.
- *Iranian military doctrine explicitly incorporates foreign military thinking and capabilities, especially those of the US*. However, this process requires *ex post facto* ideological and Islamic moral justification from the supreme leader. Similarly, there is little restriction on employing effective foreign military technologies in war-fighting concepts. This trend follows the Qajar and Pahlavi dynasties' tradition of sanctioning the adoption and subsequent 'Iranianization' of anything proven to be effective in war.
- *The Artesh and the IRGC's competing military structures will remain an inherent feature of Iranian doctrine and strategy, even as the Iranian leadership appears to desire greater interoperability between the forces*. Distrust between the two services remains relatively strong. The IRGC will likely take on more conventional war-fighting responsibilities over time; the Artesh will continue to be the subordinate force.
- *The Iranian armed forces appear hesitant to go beyond defense, deterrence and asymmetric warfare in most circumstances*. For example, Islamic teachings on retaliation limit the Iranian leadership's willingness to employ force in a manner that it considers to be disproportionate – at least in its use of missiles and other conventional power, as well as cyber capabilities.[2] Nonetheless, as seen in their deployment of unmanned aerial vehicles, Iranian forces in Syria increasingly engage in operations with conventional offensive characteristics.
- *Iran also sees war in 360 degrees.* As a revolutionary state, Iran constantly worries about potential instability and counter-revolution triggered by its adversaries during conflict. Tehran's doctrines reflect this porousness across the spectrum of offensive and defensive operations, where an external Artesh campaign may need to quickly transition into an internal

one, or where an IRGC operation may need to move from regime defense to deterrence to power projection and then back to deterrence – or attempt to achieve all three objectives simultaneously.

An analytic framework

These factors can help in the process of categorizing Iran's doctrines. They demonstrate how these doctrines align with Tehran's defensive and offensive goals, indicating areas of particular strength or weakness while pointing to the ways in which the Iranian armed forces may develop. The Iranian military is still dominated by defensive doctrines oriented around four primary objectives: securing the regime (or protecting the government from subversion and instability); territorial defense; demonstrative deterrence (or displays of force); and retaliatory deterrence (or a 'threat in response to threat').[3] The centerpiece of Iran's deterrence strategy, retaliatory deterrence, aims to convince an adversary to refrain from or quickly de-escalate conflict through the threat of retaliatory action, such as terrorist, missile or cyber attacks.

Iran's offensive doctrines are designed primarily around exporting the revolution and promoting Iranian influence abroad while creating and maintaining proxy forces such as Hizbullah, which are capable of employing retaliatory deterrence against opponents. These doctrines have notably remained almost entirely unconventional. Iran continues to lack, in general, classic offensive doctrines to project conventional military power that can coerce an opponent; seize ground, air or maritime space; or defeat or destroy an enemy's forces. However, in the Syrian and Iraqi conflicts, the IRGC has increasingly integrated conventional capabilities and war-fighting concepts into its unconventional campaigns.

A changing Iranian military

The wars in Syria and Iraq are the primary drivers of recent changes in Iranian doctrine. The challenge Iran faces in preserving allied regimes in Damascus and Baghdad demonstrates the inadequacy of the Iranian military's doctrine and capabilities. Since the Iran–Iraq War, most of the Iranian leadership's military investments have been in the IRGC's asymmetric-warfare capabilities, the ballistic-missile program and anti-access/area-denial systems to address the US and Israeli threat. However, these capabilities are unsuited to addressing contemporary challenges posed by regional insurgencies, failing states and extremism.

Tehran continues to escalate its involvement, and deepen the complexity of its force presence, in several Middle Eastern wars – particularly that in Syria – because it cannot afford to lose. Given the stakes for Iran, the Iranian military will expand and improve this emerging form of hybrid and expeditionary unconventional warfare, combining increasing conventional elements and Artesh involvement, regardless of whether new resources and potential strategic directions are available due to the JCPOA. The Iranian military's cooperation with Russian forces in Syria is also likely to have lasting effect on Iranian doctrine, as they learn from each other's offensive tactics and approaches to hybrid operations.[4] The Iranian military's embarrassment at its dependence on Russian and US close air support, in Syria and Iraq respectively, has pushed it to explore ways of rapidly improving its long-range fixed- and rotary-wing capabilities.

American policymakers should keep in mind the dominant role US intentions and military capacity play in Iran's long-term calculations. Iran built its unique configuration of security forces as a means to target US weaknesses and deter US actions through fear of painful retaliation. The form of the modern Iranian military is arguably the product of rational choices by the leadership in Tehran, given Iran's limited resources and ideological commitment to opposing the US.

The future of Iran's armed forces

As the JCPOA eases restrictions on Iran's access to weapons and other technology, the degree to which the country acquires a more balanced, or conventional, military will be determined by the size of the defense budget; the military leadership's trust of, and integration into, the Artesh; the regime's ideological hesitation to appear 'imperialistic'; and, perhaps most importantly, a shift in Iranian threat perceptions away from asymmetric defense

against the US and toward competition and confrontation with other regional rivals.

During the next 10–15 years, an improvement in capabilities – facilitated by an anticipated increase in resources – and evolving threat perceptions will likely cause Iranian war-fighting doctrines to become more offensive and conventional. However, this will not lead to a wholesale shift to a more classic military posture typical of major Middle Eastern powers.

Beyond Iran's deployment of the Artesh to Syria and its use of conventional weapons there, several other signs suggest that a more conventional Iranian force is emerging. Tehran's July 2016 decision to reshuffle the leadership of the Armed Forces General Staff (AFGS) involved the most significant change in Iranian military personnel since the end of the Iran–Iraq War. The new chief of the AFGS, Major-General Mohammad Baqeri, is widely considered to be the godfather of IRGC intelligence. His appointment likely represents a move towards more professional, integrated and interoperable armed forces.[5] His early priorities appear to be furthering the capabilities of the Basij, the Quds Force and cyber units while increasing intelligence operations and extending Iran's naval reach into the Indian Ocean.[6] Baqeri's emphasis on areas such as cyber capabilities and conventional blue-water naval power may indicate that the Iranian military is prepared to pursue new goals, albeit without undergoing a full transformation. The Khatam al-Anbiya Central Headquarters, which was established during the AFGS reshuffle to coordinate operations between the IRGC and the Artesh, may play an important role in supporting Tehran's military campaigns abroad.

Perhaps most significantly, Iran's rhetoric about its military capabilities has begun to change. Supreme Leader Ayatollah Sayyid Ali Khamenei stated in September 2016 that Iran's development of defensive and offensive capabilities is 'an unalienable and clear right'.[7] Historically, Iran's leadership has shown a distinct aversion to describing the military as oriented toward offense. As several military, security and religious leaders have echoed Khamenei's statement, the new rhetoric likely reflects a genuine shift in approach.[8] The most significant drivers of this change are Iran's changing threat perceptions; the inadequacies that the IRGC and its proxies have demonstrated in fighting in the region; and, perhaps, Tehran's diminishing need to react to US military power in coming years.

Iran's current asymmetric military and proxy armies already create significant challenges for the US and its allies. For Washington, Iran's acquisition of traditional capabilities will compound the regional security challenge, but there may be an upside: American planners may find a more familiar military threat easier to predict and deter.

At the same time, there are additional risks for the US if Iran takes a more conventional military path. Increased capabilities in air, missile, naval and ground power projection may diminish the strong deterrent effect of the US military in the Middle East and embolden Iran to employ force there, especially against American allies. Given that Iran is likely to develop a military with a broader mixture of conventional and unconventional capabilities, the US will need to develop an even more tailored and nuanced approach to deterrence in the Gulf. Only strategies that address the factors underpinning Tehran's decision-making and military doctrines can successfully meet this challenge.

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Notes

1 Significant portions of this piece were previously published in J. Matthew McInnis, *The Future of Iran's Security Policy: Inside Tehran's Strategic Thinking* (Washington DC: American Enterprise Institute, 2017).

2 For an example of strategic analysis of the moral side of retaliation, see Asghar Eftekhari and Fatallah Kalantari, 'Evaluating and Defining the "Threat in Response to Threat" Strategy in Iran's Defense Policy', *Journal of Defense Policy*, vol. 22, no. 88, Autumn 2014.

3 *Ibid*.

4 Iran's involvement in the Russian-sponsored International Army Games in July 2001 may reflect the doctrinal exchange that accompanies ongoing Russian–Iranian military cooperation. See American Enterprise Institute, 'Iran News Round Up', 22 July 2016, https://www.criticalthreats.org/briefs/iran-news-round-up/iran-news-round-up-july-22-2016; and Michael Rubin, 'Iran's Revolutionary Guards in Russian Military Games', American Enterprise Institute, 1 September 2016, http://www.aei.org/publication/irans-revolutionary-guards-in-russian-military-games.

5 See American Enterprise Institute, 'Iran News Round Up', 5 July 2016, http://www.irantracker.org/iran-news-round-july-05-2016; Farzin Nadimi, 'Who Is Iran's New Armed Forces Chief of Staff?', Washington Institute for Near East Policy, 5 July 2016, http://www.washingtoninstitute.org/policy-analysis/view/who-is-irans-new-armed-forces-chief-of-staff.

6 http://bit.ly/2hFcH2i.

7 Marie Donovan, Paul Bucala, and Caitlin Shayda Pendleton, 'Iran News Round Up', American Enterprise Institute, 31 August 2016, https://www.criticalthreats.org/briefs/iran-news-round-up/iran-news-round-up-august-31-2016.

8 To date, Brigadier-General Abdolrahim Mousavi and Rear Admiral Ali Fadavi, commanders of Iran's army and the IRGC Navy respectively, have adopted Khamenei's rhetoric on offensive capabilities. See Marie Donovan, Paul Bucala, and Caitlin Shayda Pendleton, 'Iran News Round Up', American Enterprise Institute, 21 September 2016, https://www.criticalthreats.org/briefs/iran-news-round-up/iran-news-round-up-september-21-2016; and Marie Donovan, Paul Bucala, and Caitlin Shayda Pendleton, 'Iran News Round Up', American Enterprise Institute, 23 September 2016, https://www.criticalthreats.org/briefs/iran-news-round-up/iran-news-round-up-september-23-2016.

Iran after Sanctions: Military Procurement and Force-Structure Decisions

Michael Eisenstadt

Since the 1979 Islamic Revolution in Iran, US diplomacy and sanctions, along with more recent UN Security Council Resolutions, have greatly constrained Tehran's ability to acquire arms.[1] However, by 2020, the ban on arms transfers to Iran will have been lifted in accordance with UN Security Council Resolution 2231, which gave international legal force to the Joint Comprehensive Plan of Action (JCPOA). (By 2023, a similar ban on aiding Iran's missile programs will have been lifted.) With Iran's economy slowly recovering from the effects of sanctions and its parliament voting to increase the defense budget, the country will soon have more funding available for arms purchases than at any time in the recent past. This paper analyzes the factors that may shape Iran's procurement and force-building decisions, and how these decisions may advance its goal of becoming the Middle East's dominant power.

Back to the future

To understand Iran's future procurement and force-building options, it is important to examine its past choices.[2] It is unclear whether Iran purposefully designed the overall contours of its unique, unbalanced force structure – comprising ground and air forces that are fairly modest relative to the country's size; a highly capable guerilla navy;[3] a massive missile stockpile; and large proxy forces – or has been forced to accept this structure due to procurement constraints. Likewise, it is difficult to determine whether Iran adopted an asymmetric approach to war fighting to compensate for its conventional weakness or because this approach reflected a uniquely Iranian way of war.[4]

Iran reportedly tried to buy massive quantities of surplus Eastern Bloc weapons shortly after the end of the Cold War, when they became available at low cost. At this point, with the 1980–88 Iran–Iraq War fresh in their minds, Iranian leaders may have been trying to build the type of large conventional military Iran would have needed for a rerun of the conflict – even after Iraq's defeat in the 1991 Gulf War.[5] Tehran reportedly sought to purchase hundreds of combat aircraft and thousands of armored vehicles, among other systems.[6] However, US pressure and a lack of funding apparently thwarted these attempts to establish a large conventional military. As a result, Iran opted for a very different kind of military than the one it may have tried to create in the early 1990s.

Yet even if Iran had succeeded in purchasing large numbers of conventional arms, it would still have pursued the asymmetric approach behind its guerilla navy, missile force and proxies. After all, the Islamic Revolutionary Guard Corps (IRGC), which has traditionally eschewed conventional approaches to warfare in favor of a revolutionary Islamic approach, controls these forces.[7]

Ways of war and lessons learned

Iran's preferred way of war is to deter major conventional conflicts – which in its experience have tended to be bloody, costly and protracted – while shaping the regional environment using proxies and information warfare.

Thus, Iran's military posture emphasizes deterrence and defense, as it pursues a national-security strategy designed to change the regional status quo by expanding its influence at the expense of Israel, Gulf Arab countries and the United States.

This approach reflects Tehran's assumptions about the way the world works, how best to employ the instruments of national power and the lessons of conflict since the 1980s – particularly those of the Iran–Iraq War. Tehran believes that:

- Proxy operations ousted US and Israeli forces from Lebanon in 1983 and 2000 respectively, ejected US forces from Iraq in 2011 and defeated rebel groups battling Bashar al-Assad's regime in Syria in 2015 and after.
- Clashes between the US Navy and its Iranian counterparts in the Gulf during the latter phases of the Iran–Iraq War showed that the former is ill-equipped to deal with the IRGC's guerilla navy, with its small boats and fast attack craft.[8]
- Iraqi missile strikes during the Iran–Iraq War, which devastated Iranian morale, demonstrated the need for a strategic bombardment capability of its own to counter that of enemies.[9]

Acting on these beliefs, Tehran has sought to fill critical capability gaps and selectively modernize its military. It has built up its proxy capabilities by creating a Shia foreign legion that has fought in Syria and Iraq. It has bolstered its guerilla navy through the acquisition of modern mines and anti-ship missiles, as well as large numbers of small boats, fast attack craft and midget submarines. It has built a massive rocket and missile force while supplying rockets to Hizbullah, Hamas and, to a lesser extent, the Houthis. And it recently acquired a modern air-defense system – the S-300 *Favorit* surface-to-air missile system.

Yet major gaps remain. Iran's ground forces lack large numbers of modern tanks and infantry fighting vehicles; its air force lacks modern fighters and ground-attack aircraft; and its ground-based air defenses are relatively weak, relying mostly on dated or obsolete systems.

Guns or butter?

Tehran has long faced a dilemma in balancing investment in social-welfare programs with military spending – each of which is important to a different aspect of regime security. As revolutionaries, Iran's leaders fear nothing more than a counter-revolution. Many of them see the food and fuel subsidies that have long been a central feature of the Iranian economy as a means to not only help the poor and create a just society but also to prevent economic conditions from becoming so dire as to foment another revolution. As the middle class and the wealthy also benefit greatly from the subsidies, Iran has spent several years attempting to rationalize the economy by replacing them with cash payments targeted at those in need – albeit with only limited success. These outlays remain a national-security priority and will continue to compete with defense spending to some extent.

Syria: an inflection point?

For Tehran, the Syrian conflict, like the Iran–Iraq War, is an 'imposed' war. Many in Tehran saw the uprising against the Assad regime as part of a US–Saudi–Israeli conspiracy to undermine the 'Axis of Resistance', whose core members are Iran, Hizbullah and Syria. The war threatened both the survival of the Assad regime and Tehran's air bridge to Hizbullah in Lebanon, which runs through Damascus International Airport.

In responding to this crisis, Iran built on existing capabilities and approaches. The country created an expeditionary Shia foreign legion consisting of fighters from Hizbullah, Syria, Iraq, Afghanistan and Pakistan to fight in the conflict. It also augmented its IRGC–Quds Force advisors with IRGC ground forces, as well as personnel from the Basij and the Artesh, the IRGC's militia and Iran's conventional army respectively.[10] In doing so, Iran followed much the same path taken by the US since 9/11, whereby the latter's special forces became more 'conventional' and its conventional forces became more 'special' as the result of more than a decade of combat in Iraq and Afghanistan.

Throughout the Syrian war, Iran has deployed as few ground forces as possible to protect the Syrian regime.

Indeed, Iran reportedly has around 1,500 troops in Syria – far less than 1% of its 100,000-man IRGC ground forces and 350,000-man Artesh combined. By comparison, there were times during the last decade when the US had deployed around one-third of its ground forces to Iraq and Afghanistan. Iran has tried to offload as much risk and as much of the war fighting burden as possible onto its Shia foreign legion and Russia, which has provided critical air and heavy fire support to the effort.

This is not the behavior of a military seeking to become a major military power, with a concomitant readiness to wage conventional war. Iran knows – based on bitter experience and observation of US campaigns in Iraq and Afghanistan – how costly and difficult it can be to end a war. As a consequence, Tehran seeks to avoid conventional wars at almost any cost.

Looking ahead

Iran's leaders likely feel that events since the end of the Iran–Iraq War have vindicated their approach to force building and the use of the military. Iran has received a high return on relatively modest defense investments. It has acquired impressive capabilities, using them judiciously and effectively to gain leverage over adversaries, shape regional developments, and project influence while avoiding a major war. As part of this approach, Iranian military officials have warned that an attack on Iran would lead to a war that would spill over its borders, and would prompt a crushing response.[11] American military officials have warned that an attack on Iran's nuclear facilities would destabilize the region.[12]

Iran already has an effective deterrent. In the hands of Tehran's proxies and partners, Iranian-supplied rockets and missiles can threaten America's foremost regional allies, Israel and Saudi Arabia. Iran's missile force has the range to strike targets across most of the region. Tehran can disrupt traffic through the region's two major maritime chokepoints: the Strait of Hormuz and the Bab al-Mandeb Strait. And its proxies can subvert neighboring countries, project Iranian influence throughout much of the region and conduct terrorist attacks on several continents.

Therefore, Iran is likely to broadly maintain its approach after the bans on arms transfers to it and, subsequently, on support for its missile program are lifted. Furthermore, it will fill capability gaps, selectively modernize its military and rebalance its conventional forces to reflect lessons learned in Syria. To this end, Iran will try to purchase the kinds of major weapons systems that it has been unable to produce domestically, such as surface-to-air missiles,[13] advanced fighter aircraft, tanks, infantry fighting vehicles and light armored vehicles.[14] Indeed, media reports indicate that Iran has already approached Russia about buying Su-30 fighter aircraft, S-400 surface-to-air missile systems, T-90 tanks, modern artillery systems and *Yakhont* anti-ship cruise missiles.[15] Iran is also likely to continue strengthening its guerilla navy by seeking advanced mines, torpedoes, anti-ship cruise missiles and anti-ship ballistic missiles. It will seek technology to improve the accuracy of domestically produced ballistic and cruise missiles, and to manufacture countermeasures and penetration aids.[16] The country will also likely seek materiel for its Shia foreign legion – including light armored vehicles, fixed- and rotary-wing close air support aircraft, transport helicopters, and intelligence, surveillance and reconnaissance technology – so that its proxies can conduct sustained operations abroad, independent of Russian air and fire support.

However, Iran is unlikely to buy large numbers of fighter aircraft or armored vehicles due to the high cost of doing so. For instance, initial outlays for a single squadron of fighter aircraft could exceed US$2 billion. The process of recapitalizing the air force could cost significantly more than US$100bn, as it would require the Iranian military to buy modern aircraft; stockpile munitions and spare parts; modernize and harden air bases and maintenance facilities; and expand command, control, communications and intelligence networks. As Iran will also continue to emphasize self-reliance and domestic production of weapons wherever possible, arms sales will likely involve technology transfers.

In addition, Iran is likely to continue to emphasize the development of cyber capabilities,[17] which are emerging

as a fourth leg of its current deterrent/war fighting triad. The legs of this triad consist of: the anti-access/area-denial capabilities of the IRGC's guerilla navy; the long-range strike capabilities of the IRGC's rocket and missile forces; and the proxy forces overseen by the Quds Force. Using the triad, Iran can conduct acts of subversion and terrorism, as well as irregular and conventional military operations.

Finally, Iran will continue work on developing more efficient gas centrifuges[18] and will try to acquire nuclear-research reactors. It will do so to resume its march toward threshold nuclear status – and perhaps beyond – in around ten years, when the foreign powers lift or ease the constraints on its nuclear program.[19]

Iran's way of war is unlikely to change significantly. The country may partially rebalance its force structure to strengthen air and ground defenses, and may improve the expeditionary capability of its Shia foreign legion. But its modus operandi will continue to focus on *indirection, ambiguity* and *patience* – while relying on proxies to provide stand-off and, to a lesser extent, a degree of deniability. This allows Iran to manage risk and limit the potential for escalation, as it implements an anti-status quo strategy that will inevitably bring it into conflict with foreign powers that aim to maintain the regional status quo.[20]

Shaping Iranian choices

The US may be able to shape Iranian procurement decisions to some extent, by influencing Tehran's threat perceptions and desire to mitigate certain vulnerabilities or exploit those of its adversaries. This could involve forcing Iran to invest scarce resources in capabilities to which the US already has a response, or to divert resources away from systems that would present a significant challenge to American forces. Washington could also present Tehran with multiple dilemmas, prompting the latter to overextend itself by attempting to develop a diverse and costly mixture of capabilities.[21] Through procurement decisions, military presence, force posture, covert operations and information campaigns, Washington may be able to spur Tehran to:

- Allocate even more resources to its development of missiles (while taking steps to disrupt this process), because the US has invested heavily in missile defense.
- Continue investing in its guerilla navy, because this threat is largely limited to the Gulf and the US Navy can counter it, albeit at a price.
- Continue transforming its Shia foreign legion into quasi-regular military organizations, because the US may be able to target these groups more easily than lightly armed militias that can blend into a civilian population.
- Focus on the development of internal-security and conventional ground forces, because this would divert resources away from Iran's development of expeditionary capabilities and a land bridge to the Mediterranean.

By presenting Iran with multiple dilemmas, Washington may also be able to prevent the country from significantly modernizing and thickening its air defenses, thereby reducing the potential cost of a US or Israeli pre-emptive strike on Iranian nuclear facilities.

A last word

Iranian procurement and force-building decisions in coming years are almost certain to alter the Middle East balance of power to the detriment of the US and its partners. The factors that will influence this process the most are whether:

- The US will remain engaged as a security provider in the region and will act in a way that projects an image of competence and resolve.
- Gulf Arab states can transcend their political differences and function as an effective coalition to more fully realize, with US help, their collective potential.[22]
- Iran can consolidate its 'arc of influence' in the Middle East by strengthening its position in Iraq, Syria, Lebanon and Yemen, as well as by forging its Shia foreign legion into an expeditionary force capable of sustained independent operations throughout the region.

The US and its Gulf Arab partners should be able to meet the first two conditions, but they have failed to do so in recent years. If they are to effectively counter a resurgent Iran, they must do better, while hindering Iran's efforts to close capability gaps, selectively modernize its military and develop its Shia foreign legion into a more effective expeditionary force. Finally, the US should work with allies to hold Iran to its commitments under the JCPOA while fixing shortcomings in the agreement, so that the Islamic Republic does not eventually emerge as a nuclear threshold state. The future peace and security of the region may depend on it.

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Iranian Maritime Improvements: Challenges and Opportunities

John Miller

The sanctions relief brought about by the Joint Comprehensive Plan of Action (JCPOA) potentially provides Iranian maritime forces with an opportunity to expand and modernize. The regular Islamic Republic of Iran Navy (IRIN) needs a major overhaul, having undergone no significant process of modernization since the country's 1979 revolution. The Islamic Revolutionary Guard Corps Navy (IRGCN) has a long history of using any funding it receives efficiently. The first indicator of how the Iranian military intends to use at least some of the funding provided by sanctions relief under the JCPOA came in July 2015, when Major-General Qassem Soleimani, commander of the IRGC's Quds Force, visited Moscow to finalize the delivery of the S-300 air-defense system to Iran.[1] Conducted in violation of UN sanctions, his trip likely established the conditions for Russia's eventual intervention in the Syrian conflict – which changed the course of war while greatly enhancing Moscow's influence in the Middle East. The visit also secured the first delivery of a major weapons system to Iran since the revolution (Iraqi Air Force planes fleeing to Iran in advance of *Operation Desert Storm* in 1991 notwithstanding). When the international community has lifted nearly all international sanctions on Iran – which could happen as soon as 2020 – the country will likely pursue other conventional-weapons upgrades, perhaps through the acquisition of the Su-30 multi-role fighter and the *Yakhont* anti-ship cruise missile.[2] Both systems could have a significant impact on the strategic environment in the Middle East, especially the Gulf region, by altering the considerations of US and coalition maritime commanders.

Iran's strategic goals and the role of its maritime forces

Tehran entered into the JCPOA because the agreement gave Iran a place at the table with major world powers, virtually guaranteeing the survival of the regime and its revolution.[3] In this sense, the move accorded with the Iranian constitution, which 'provides the necessary basis for ensuring the continuation of the Revolution at home and abroad'. The extent to which Iran can fulfill its hegemonic regional ambitions remains unclear given the sheer number of Sunni Arabs in the Middle East, as well as the size and quality of recent weapons purchases by members of the Gulf Cooperation Council (GCC). However, there is substantial evidence that Tehran continues to destabilize Yemen, Syria, Iraq, Lebanon and Bahrain.[4]

Like all Gulf nations involved in the export of hydrocarbons, Iran has a keen interest in maintaining its ability to influence the maritime environment. To this end, the IRGCN has invested significantly in asymmetric capabilities, including hundreds of lethal small craft and a network of coastal-defense cruise missiles, as well as unmanned aerial vehicles (UAVs) that can potentially support the accurate targeting of adversary naval forces. These capabilities allow Tehran to exert sufficient influence in the Gulf – especially in the Strait of Hormuz – to protect its interests and threaten those of other nations.

The IRGCN is responsible for maritime operations in the Gulf and shares responsibility for such activities with the IRIN in the Strait of Hormuz. The IRIN is responsible for maritime operations outside the Strait of Hormuz.[5] Although the IRIN has often deployed to the Somali Basin in support of counter-piracy operations, and has roamed as far as China and South Africa, it is not a blue-water navy. Moreover, it is difficult to envision how the acquisition of what would likely be a relatively modest modernized blue-water capability would fit the Iranian regime's strategic goals.

The IRGCN has been built specifically for its primary purpose: protecting the regime.[6] The force has achieved most regime goals effectively and at relatively low cost by mass producing small, fast craft. These vessels can be used to swarm larger boats, deploy small numbers of troops ashore and to oil platforms (as occurred during the Iran–Iraq War), plant mines, patrol the Strait of Hormuz and harass commercial ships.[7]

With their current mixture of assets, the IRGCN and the IRIN are capable of protecting the homeland and the regime (absent an all-out force-on-force effort against them); acting as a combat presence strong enough to influence the flow of commercial traffic in the Strait of Hormuz (by limiting or denying access); protecting vital Iranian economic interests in the Gulf; and supporting the export of the revolution to countries such as Yemen, Syria, Iraq, Lebanon and, to a lesser extent, Bahrain.[8]

Yemen has become a kind of testing ground for Iranian equipment, as Houthi insurgents there have used weapons supplied by Iran to attack merchant ships – as well as Emirati, Saudi and US military vessels – in and around the Bab el-Mandeb Strait.[9] The Houthis have also allegedly laid mines, reportedly supplied by Iran, in and around the strait.[10]

Options for Iranian maritime forces after conventional-weapon sanctions

Iran has already received significant monetary relief with the enactment of the JCPOA; further sanctions relief will likely improve the country's economic circumstances and thereby increase its discretionary budgets. Although social pressure will probably spur Tehran to spend a larger amount on financial relief for poor Iranians, the military will almost certainly receive additional funding.

As most of the IRIN's ships are at least 38 years old, it is likely that much of the force is obsolete. If the IRIN is to remain a credible force, it will need to undertake at least some modernization. Iran is indigenously producing the *Mowj*-class frigate using a design based on the *Alvand*-class light frigate, and has produced two ships since 2006, when construction began.[11] The ships are equipped with SM-1 anti-aircraft missiles; *Noor* anti-ship missiles; torpedoes and a helicopter for anti-submarine warfare; a 76mm multi-purpose gun; and several smaller caliber guns for point defense. The ships' ability to operate helicopters suggests that they are also able to operate UAVs for intelligence, surveillance and reconnaissance (ISR), as well as over-the-horizon targeting.[12]

Given the ships' mature technology and limited capability, as well as the length of time it has taken Iran to bring two ships up to operational capability, the modernization of the IRIN into a more useful blue-water navy will likely require greater investment in indigenous capacity, and capability, than the country can afford. Likewise, Tehran is unlikely to be able to afford to purchase enough ships outright to modernize the force. Willing arms sellers such as Russia and China would view sales to an economically resurgent Iran as an opportunity to turn a profit, and thus would likely demand purchase terms beyond Tehran's means.

Despite the practical limitations on its ability to build a robust blue-water navy, Iran continues to publicly announce lofty objectives. For instance, Tehran recently declared that the construction of an aircraft carrier remained 'among the goals' of the Iranian navy.[13] In July 2017, President Hassan Rouhani signed an order that allowed the Iranian Atomic Energy Organization to begin testing nuclear-power systems for Iranian submarines.[14] While these projects may seem highly aspirational, they indicate Iran's ongoing desire to build a capable blue-water navy.

The IRIN may also attempt to modernize by partnering with a willing nation to build foreign-designed warships

in Iran. Although this approach would be expensive, it would give Tehran access to advanced technology that could replace outdated infrastructure and create much-needed employment. Iran is unlikely to establish a large naval force, but could pursue its strategic interests – defending the homeland and creating instability throughout the Middle East – with a force that maintains its participation in counter-piracy activities in the Somali Basin, and shows the flag from the Mediterranean to at least as far east as Sri Lanka and as far south as Kenya. Given the transactional nature of Russian–Iranian relations and aggressive Chinese port-building activity in the region, Moscow and Beijing are both potential partners in a joint ship-building effort in Iran.[15]

Ongoing IRGCN support for the Houthi rebels in Yemen indicates the direction Tehran could take if empowered by greater access to resources.[16] With more funding, Iran will almost certainly be able to enhance its destabilizing regional influence.

Additional resources and sanctions relief will allow the IRGCN to increase in size and, more importantly, adopt new technologies. Unmanned surface attacks using very fast bomb-laden craft, perhaps guided by ISR from UAVs, are assessed to have already been used by the Houthis against a Saudi frigate.[17] Technologically advanced mines that are deliverable without advance warning could be capable of creating chaos in the confined waters of the Gulf. Advanced coastal-defense cruise missiles that are difficult to detect and defend against, and are capable of covering the entire Gulf, could replace Iran's current legacy systems. Tehran's continued development of a new class of mini-submarines could further complicate the multidimensional threat.[18]

This is not to suggest that an IRGCN under reduced conventional-weapons sanctions will suddenly become far more capable, but simply to acknowledge that the force will do what it has always done: make the best out of the situation at hand. Given only slightly greater monetary and technological resources, the IRGCN will grow, gain tactical advantages and advance regime goals. The force will focus on obtaining the capacity and capability not so much to prevail in a direct force-on-force confrontation with the US Navy as to deter Washington from engaging in such a confrontation.

Russia's role in Iranian maritime modernization

Russia and Iran currently 'enjoy' a transactional relationship that both find useful. Russian support for Iran's effort in Syria means Moscow has gained a level of access to the region that it has not had in decades, and Iran's positive response to Russian outreach has provided access to a weapons market that it has not had since the revolution. This relationship, however, could turn out to be more of an impediment than an empowerment for Iran in the long term.

When the Iranian regime allowed Russia access to Hamadan airfield in the summer of 2016, it potentially violated the Iranian constitution (or at least conducted a procedural foul in failing to gain parliamentary approval in advance). A permanent presence of Russian troops or the establishment of a Russian base – clear violations of the Iranian constitution, although potentially necessary, for the introduction of advanced systems such as the S-400 anti-air missile-system and the *Yakhont* anti-ship missile-system would be problematic.[19]

Russia has deployed the S-400 and the *Yakhont* in Syria.[20] While Syria is likely to accept Russian assistance under any terms, Iran has constitutional obligations that could limit how it modernizes its forces and integrates with allies. The acquisition of both systems would complicate the maritime environment, but the addition of the *Yakhont* would be especially troublesome to coalition maritime commanders as the system would provide anti-ship coverage over the entire Gulf.[21]

Whether Russia is willing to sell the S-400, *Yakhont* or other advanced weapon systems to the Iranians – without attempting to retain some control over their operational employment – remains unclear. Such an arrangement would require Russian troops on the ground in Iran after the delivery of these complex, highly capable weapon systems; however, the Iranian constitution prohibits the presence of foreign forces on its soil – a measure inserted to counter the former Shah's fondness for the presence of foreign forces.[22]

The Iranian way forward

Freedom of action in the maritime environment – especially in the Gulf – will remain a priority for the Iranian regime. The IRGCN will retain primary responsibility for ensuring the regime attains its strategic goals in this environment. Economic growth, which is central to these goals, demands the capability protect vital economic infrastructure in the Gulf and to ensure that Iranian commerce can freely transit the Strait of Hormuz.[23]

With greater resources and access to modern technology under reduced sanctions, Iran will almost certainly dedicate some additional funds to increasing the size of the IRGCN and improving its technological capability. It is possible, if not likely, that Iran will gain access to unmanned, high-speed, explosive-laden surface craft supported by armed UAVs that provide over-the-horizon targeting and ISR. The country may also acquire modern smart mines that can be covertly deployed – and whose deployment only becomes known when a ship strikes one. Iran has taken delivery of advanced anti-air missiles, and may also receive the kind of advanced anti-ship cruise missiles that are in Syria. Once it is freed from conventional-weapons sanctions, the IRGCN can further complicate the maritime environment in the Gulf without an enormous investment of resources.

As it faces a more difficult challenge than the IRGCN, the IRIN needs to look to partner with willing nations to revitalize and modernize Iran's shipbuilding industry. The country does not necessarily require a robust blue-water navy to meet its strategic goals, but appreciates the strategic messaging that a limited blue-water navy produces.[24] A limited IRIN will give Iran the global prestige it desires, and it is likely that Iranian leaders will continue to pursue one through a partnership in Iran, in which they can improve local infrastructure, import technology, create jobs and indigenously produce ships.

The challenge for coalition forces

Absent an unlikely decline in the influence of hardliners in Tehran, an Iran that is no longer under UN conventional-weapons sanctions will pose a greater threat to its neighbors and to the US–GCC-led coalition that supports them. This is not an unsolvable problem, but one that will require a cooperative, concentrated and cohesive response.

Task Force 152 provides maritime security in the Gulf for the US Fifth Fleet; GCC states envision Task Force 81 as accomplishing the same task for their navies.[25] These task forces will need to work together closely to ensure that Iranian maritime activity is known, tracked, understood and, if necessary, countered effectively. The containment of destabilizing Iranian operations should be a priority for GCC and allied forces. As this will require cooperation at every level, GCC and coalition maritime leaders should actively seek avenues of interoperability, operational engagement and security cooperation, to ensure that every GCC partner and member of the combined maritime force is fully engaged with – and committed to – ensuring maritime security and stability in the Middle East.

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Iran and the Challenge of Combat-Aircraft Recapitalization

Douglas Barrie

There is perhaps no better example of Iran's capacity to make do and mend than its air force, which consists primarily of aircraft designed by the United States in the 1960s and 1970s, leavened by a smaller number of 1970s and 1980s Soviet aircraft. Though outmatched significantly by the Gulf's two main air powers, Saudi Arabia and the United Arab Emirates (UAE), Tehran continues to field an air force that has some operational utility – an achievement in itself, given the constraints under which the regime has had to operate. Should the Joint Comprehensive Plan of Action (JCPOA) – better known as the Iran nuclear deal – hold, then from 2020 Iran's air force will be in a position to begin recapitalizing its aging combat aircraft and weapons inventory once restrictions of arms-related transfers to Iran are lifted. This would have significant regional security implications.

While Iran's military posture is mostly defensive, it has and continues to pursue an assertive and sometimes aggressive foreign policy, which includes providing support to non-state actors across the Middle East as part of its wider security strategy. The Iranian military's involvement in Syria – where it is operating alongside Russian and regime forces – is providing valuable combat experience.

In keeping with Iran's fundamentally defensive orientation, the Iranian Air Force's (IRIAF) primary role is air defense, with a secondary attack role against land or maritime targets. It also provides intra-theatre fixed-wing airlift capacity and in-theatre rotary lift. Iran's old and increasingly obsolescent aircraft types struggle to meet these combat roles. Such aircraft types are of limited combat utility against modern Western designs, and support and maintenance of these aging aircraft fleets are also increasingly demanding.

The IRIAF was arguably most capable shortly before the outbreak of the Iran–Iraq War (1980–88). The service benefitted from the patronage of Iran's Shah, who saw the air force as prestigious and insisted that it was suitably equipped. The involvement of senior air-force officers in the abortive 1980 coup resulted in a long-lasting legacy of mutual distrust between the revolutionary theocracy and the IRIAF.

Although the air force and Iran's domestic-industrial base have done well to maintain some semblance of operational utility with an aging inventory, modernization over the coming decade is now essential for the IRIAF to retain any credible capability in its primary roles. If the country's domestic defense and aerospace industry has mostly met the challenge of sustaining its combat aircraft well beyond their average service life, it has, unsurprisingly, been less successful in establishing an indigenous-design development and manufacturing capacity, regardless of the regime's bombast over the nation's military prowess.

A good example of Iran's proclivity to exaggerate its capabilities is the *Qaher*-313. First shown in 2013, Tehran touted it as an Iranian 'stealth' combat aircraft. This effort would appear to be little more than domestic propaganda: the development of a real combat aircraft in this class

would require at least two decades and billions of dollars in investment, in addition to an advanced defense and aerospace industrial base akin to those of China, Russia or the US, especially in key-technology areas such as radar and infrared signature management, materials, sensors technology, avionics, propulsion and internal-weapon carriage. Iran's aerospace industry has shown commendable ingenuity, but it seems unlikely that it has been able to bend the 'laws' of aircraft design and development.

The needs of the IRIAF

The IRIAF comprises some 15 combat-aircraft squadrons, five fighter units and ten fighter ground-attack units, supplemented by five transport squadrons and a tanker-transport unit. It totals around 18,000 personnel. While the Islamic Revolutionary Guard Corps (IRGC) also has an aerospace force equipped with ballistic missiles, this is unlike the IRGC Navy, which is a parallel force to that of the regular service.

IRIAF fighter squadrons are equipped with various aircraft types sourced from China, Russia and the US. It has one unit of the Chinese F-7M *Airguard* in service, along with two squadrons of Russian MiG-29A *Fulcrum*s and two squadrons of US F-14A *Tomcat*s. None of these aircraft are state of the art. While the MiG-29A is the most modern of the three designs, the version in service with the IRIAF is an early one. Consequently, most of the avionics are obsolescent when compared with more recent versions. The F-7M is based on the Soviet MiG-21 *Fishbed* (which was designed in the 1950s), while Iran acquired the F-14As in the latter half of the 1970s.

The air-to-air weapons inventory complementing these types is also aging. The F-14A was originally supplied with the AIM-54A *Phoenix*, a world-class missile when it was introduced into service. However, any of the original stock left in the IRIAF inventory would now be around 40 years old, well beyond the missiles' original design life. Iran has claimed to have designed and produced its own version of the AIM-54, dubbed the *Fakkur*, but as with many of the regime's claims, this may be propaganda.

The IRIAF MiG-29s carry two types of medium-range missiles: the R-27R (AA-10A *Alamo*) semi-active radar-guided missile and the R-27T (AA-10B *Alamo*) infrared-guided medium-range missile. Design of both types of missile began in the 1970s. The semi-active radar-guided R-27s are less capable than the American AIM-120C Advanced Medium-Range Air-to-Air Missile (AMRAAM), which is in service with Saudi Arabia and the UAE, and will be further outclassed with the arrival of the European *Meteor* extended-range air-to-air missiles, currently on order for the Royal Saudi Air Force.

There are two main types of aircraft in the attack role: the US-manufactured F-4D/E *Phantom* II and the Russian Su-24MK *Fencer*. Five squadrons of the F-4D/E are still in service, alongside a single remaining Su-24MK. These are supplemented by a small number of Su-22 *Fitter*s that have been brought into service with the IRGC. While the F-4D/E is obsolescent, it is the most numerous type used in the air-to-ground role, and it can carry a substantial weapons load. Its effectiveness in the role, however, is limited by a lack of modern air-to-surface munitions. There is little evidence to support the regime's claims that the IRIAF is equipped with modern precision-guided weapons. The available imagery of Iran's F-4s shows that they most often carry US AGM-65A *Maverick* electro-optically guided missiles that date from the 1970s, and unguided free-fall bombs. The F-4s are also earmarked for the maritime-strike role, and have been displayed with a variety of short- and medium-range Chinese-designed anti-ship missiles, at least some of which have been integrated with the aircraft.

The Su-24MK is the IRIAF's most potent ground-attack aircraft, providing the service with a long-range tactical bomber. The air force can also operate the Su-24MK in the refueling role, extending the combat radius of the aircraft. Moreover, the Su-24MK arguably has the most effective weapons in the air force's inventory. The IRIAF inventory also appears to include the Russian-sourced Kh-25ML (AS-10 *Karen*) and Kh-29L (AS-14 *Kedge*) laser-guided missiles, as well as the Kh-29T (also AS-14 *Kedge*) TV-guided version of the AS-14 and the Kh-58 (AS-11 *Kilter*) anti-radiation missile. While these weapons were designed in the 1970s and 1980s, they continue to provide operational utility.

Capability gaps and equipment options

Most of the IRIAF's combat aircraft and their weapons are obsolescent. Furthermore, the air force also lacks adequate aircraft in key enabling roles, such as intelligence, surveillance and reconnaissance (ISR), airborne early warning and control, and electronic warfare. Assuming that new combat-aircraft types are introduced into service, the air force will also need to revamp both the aircraft and the syllabus it uses in training.

Once the conventional-arms embargo ends in October 2020, China and Russia are the states most likely to sell modern combat aircraft to Tehran. One effect of the involvement of the Russian Aerospace Forces in Syria has been to provide Iran with a close-up view of the kinds of aircraft and weaponry it could acquire after this date.

Iran's combat-aircraft recapitalization options

Current Inventory	Expected Investment	High-Investment Option
Fighter		
F-14A *Tomcat*	Su-30SM *Flanker*	Su-30SM *Flanker*/Su-35 *Flanker*
MiG-29 *Fulcrum*	Midlife upgrade	MiG-29M/J-10 *Firebird*
F-7M *Airguard*	JF-17 *Thunder*	MiG-29M/J-10 *Firebird*
Fighter Ground-Attack		
F-4D/E *Phantom*	Su-30SM *Flanker*	Su-30SM *Flanker*
Su-24MK *Fencer*	Midlife upgrade	Su-30SM *Flanker*/Su-34 *Fullback*
F-5B *Freedom Fighter*	JF-17 *Thunder*	MiG-29M/J-10 *Firebird*
Mirage F-1		Su-30SM *Flanker*
Su-22 *Fitter*		MiG-29M2/J-10 *Firebird*/ JF-17 *Thunder*
Su-25 *Frogfoot*	Midlife upgrade	Midlife upgrade/Yak-130 *Mitten*

Note: It is unlikely that Iran will opt for the 'high-investment' recapitalization options, given that it will need to balance its spending between socio-economic programs and military capabilities.

The extent and pace of Iran's equipment recapitalization will be determined in part by available funding, but also by the air force's ability to absorb new aircraft, and to introduce them into service. Given the age of the F-14As and the F-4s, replacing these platforms may be a priority for Iran, while the MiG-29s and the Su-24MK could be the subject of modest upgrades to improve their combat utility and further extend their service life.

There have been numerous reports of Iran and Russia holding discussions about the possibility of the former purchasing of a version of the two-seat Su-30SM *Flanker*. This would provide the IRIAF with a multi-role combat aircraft capable of performing both air-to-air and air-to-surface roles. Other Russian combat aircraft that might also form part of the IRIAF's equipment recapitalization include the MiG-35 *Fulcrum* variant of the MiG-29, and the Su-35 *Flanker*.

The IRIAF will more than likely acquire at least two new combat-aircraft types during the 2020s or the early 2030s. It may not be able to afford enough of an aircraft in the class of the Su-30SM or the Su-35 to meet its fleet-replacement needs, and may also look to acquire a light-to-medium weight multi-role aircraft. While the MiG-35 could fulfill this role, Tehran may also look to China as a possible source for a second fighter. The lowest-cost option would be a version of the JF-17 *Thunder* designed by China and now co-produced with Pakistan. A more capable – and more costly – option would be a version of the Chinese J-10 *Firebird* multi-role fighter. Sourcing key combat-aircraft types from China and Russia would provide Iran with a hedge, were its partnership with one of these powers to sour.

In deciding its procurement priorities, Tehran will favor acquisitions that include technology transfer and licensed production in Iran. Establishing indigenous-manufacturing capabilities will reduce the overall purchase price of aircraft and provide high-technology jobs for Iran's underemployed youth. It would also satisfy Iran's strategic desire to be more self-reliant: the flight of foreign experts after the Iranian Revolution in 1979, and the difficulties involved in procuring spare parts and maintaining aircraft during the Iran–Iraq War in the 1980s remain fresh in the minds of Iran's leaders. The technology transfer requirement will likely lead Iran to focus on the procurement of the Su-30SM, or Chinese aircraft.

The acquisition of new combat aircraft will also provide Iran with the opportunity to recapitalize air-to-air and air-to-surface weapon inventories. Russia is now offering to export a version of the R-77-1 (AA-12B *Adder*) medium-range active radar-guided air-to-air missile. Known as

the RVV-SD, this weapon would likely become the main beyond-visual-range air-to-air missile in Iran's inventory, should Tehran proceed with the acquisition of combat aircraft from Moscow. The RVV-SD has a performance similar to, or better than, the US AIM-120C AMRAAM. Russia is working on further iterations of the R-77 with greater range and improved overall performance, and it is reasonable to assume that over time, export variants of these would also become available. The introduction of the R-77-1 would be a marked improvement over the medium-range air-to-air missiles the IRIAF currently operates.

China has been investing heavily in air-to-air missile development and is arguably able to offer more capable systems for export than Russia. The Chinese equivalent of the AA-12 is the PL-12 medium-range active-radar-guided air-to-air missile. China is also finalizing development of the PL-15, an extended-range active-radar guided air-to-air missile, that may enter service in the coming year. The PL-15 – at least on paper – will be a pacing threat when it is brought into service. While Russia continues to offer a version of the R-73 (AA-11 *Archer*) as its main short-range air-to-air missile for export, this weapon is only fitted with an infrared seeker. By comparison, China is now marketing the PL-10 short-range air-to-air missile, which is fitted with a more capable and countermeasure-resistant infrared imaging seeker. China has already integrated the PL-10 into some of its own Russian-designed combat aircraft and could provide an alternative to Russian short-range air-to-air missiles. The PL-10 began to enter service in China in 2015–16.

A variety of short-, medium- and long-range air-to-surface weapons would also be available to equip any combat aircraft Iran might purchase from either Russia or China. Both countries could offer a variety of tactical air-to-surface weapons, including systems that provide a 200km stand-off capability. The addition of this class of system to the IRIAF inventory would provide it with a greater offensive capability.

As well as combat aircraft, Russia and China would also be in a position to offer a range of transport, ISR and special-mission aircraft to help address other capability gaps. China could also offer a range of armed unmanned aerial vehicle (UAV) designs, already in operation in several countries, or license production of one of its larger UAVs.

The IRIAF stands to benefit considerably from the end of the sanctions regime and the opportunity in the 2020s to recapitalize its inventory of aging equipment. Given the need to replace at least the majority of its combat-aircraft types by the end of the 2020s, Tehran is likely to purchase from Russia, China or conceivably both. If the IRIAF became able to field a multi-role fighter in the class of the Su-30SM in reasonable numbers by the mid-to-late 2020s, this would represent a notable improvement in capability.

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Iran's Missile Priorities after the Nuclear Deal

Michael Elleman

Ballistic missiles are central to the Islamic Republic of Iran's defense and deterrence strategy, and will remain so for the foreseeable future. The size and scope of its arsenal – the largest and most diverse in the Middle East – reflects the priority the country assigns to ballistic missiles. Iran is therefore highly unlikely to surrender its current systems. Ballistic missiles will continue to play a prominent role in its force structure, even as it begins procuring advanced military aircraft.

Background

Tehran's pursuit of missiles and long-range artillery rockets began soon after Iraq's invasion of Iran in 1980. During the Iran–Iraq War, Iraq repeatedly attacked Iranian cities, petroleum facilities and other strategic assets with Soviet-supplied aircraft and *Scud*-B missiles. Lacking reliable access to the skilled technicians and spare parts needed to maintain and operate its Western-supplied aircraft, Tehran had limited capacity to respond to the increasing pace of Iraqi assaults on its population centers.

The need for enhanced counter-strike capabilities therefore drove Iran's post-revolution regime to acquire missiles and rockets from willing suppliers. In 1985, in response to yet another barrage of Iraqi missiles, Iran retaliated with *Scud*-B attacks, which shocked the Iraqi regime and large portions of its populace. Saddam Hussein promptly agreed to suspend his missile attacks against Iranian cities if Tehran demonstrated similar restraint. Although the ceasefire did not last, Iran's firing of *Scud*-Bs fundamentally altered Saddam's strategic calculus and demonstrated that ballistic missiles are a powerful deterrent and vital to the defense of the Islamic Republic. Missiles have remained a cornerstone of Iran's deterrence and defense posture ever since.

After the war ended in 1988, missile acquisition remained a regime priority. Tehran turned primarily to North Korea for its more immediate needs, but also to China in order to support its longer-term requirement of self-sufficiency. It purchased 200–300 *Scud*-B and -C missiles, the latter having a long enough range to threaten the Gulf's Arab monarchies and the US forces stationed in the region. In the mid-to-late 1990s, Tehran began purchasing medium-range *Nodong*s from Pyongyang, allowing it to target Israel, Turkey and western Saudi Arabia. Flight tests of the missile (rebranded the *Shahab*-3) revealed that its range was limited to about 1,000 kilometers and it could therefore only reach Israel when fired from positions near Iran's western border, leaving launch crews vulnerable to interdiction by US forces stationed in Iraq. Iranian engineers overhauled the *Nodong*/*Shahab*-3 in the mid-2000s, replacing the original steel airframe with a lighter-weight aluminum alloy, lengthening the propellant tanks and incorporating other minor modifications. The modifications increased the range to about 1,600km. Iran completed testing of the modified *Shahab*-3, now called the *Ghadr*, by around 2007, and deployed the missiles, which can be used to threaten, intimidate, deter and retaliate against any of its regional adversaries, including Israel.

The Islamic Republic also operates an ambitious space program, which in 2009 lofted a small satellite into orbit using the two-stage *Safir* rocket. Iran has attempted at least eight launches since 2009, with only three or possibly four successful. A second-generation launcher, the *Simorgh*, is designed to boost larger satellites into space. The *Simorgh* may have been launched unsuccessfully on two occasions, once in 2016 and again in 2017. The *Safir* and *Simorgh* could, in principle, be altered for use as ballistic missiles, though flight testing as a missile would be needed to confirm the viability of the necessary modifications. No country has converted a satellite launcher into a missile, though ballistic missiles have often been used to launch satellites into orbit.

Iran's (and North Korea's) capacity to independently produce the engines that power the liquid-fueled *Scud* and *Nodong/Shahab-3/Ghadr* missiles is a hotly debated issue among analysts of ballistic-missile proliferation. Evidence indicates that Iran must import the liquid-propellant engines that power its missiles, leaving it vulnerable to the whims of potential suppliers. Creating an indigenous missile-production capacity, therefore, has long been an aim of the Islamic Republic.

Tehran procured industrial infrastructure and technical know-how from China in the 1990s and 2000s for the manufacture of solid-propellant artillery rockets in an attempt to achieve greater self-sufficiency. It leveraged the experience accrued while producing large artillery rockets to develop and manufacture bigger solid-propellant rocket motors. In 2008, Iran began flight testing a two-stage, medium-range ballistic missile based on solid fuel. The *Sajjil*-2 missile remains under development, though its existence illustrates Iran's resolve to become less reliant on imported technologies for its key strategic capabilities. Iran is the only country to have developed a missile with a 2,000-km range without having first acquired a nuclear weapon.

Limited military utility of Iran's missiles

The military utility of Iran's current missile stockpile is severely limited by the poor accuracy of its most-advanced systems. For instance, its *Shahab*-1 missiles (*Scud*-Bs) carry one-ton high-explosive warheads and have an estimated accuracy of around 800–1,000 meters circular error probable (CEP). CEP is defined as the radius of a circle, within which one-half of the warheads are expected to land. For the *Shahab*-1, this means the probability of mission success is between one in 100 and one in 1,000 for a soft target, such as unprotected humans or exposed aircraft. For hardened targets, the probability drops to as low as one in 10,000.[1] From the perspective of military planners, to destroy with moderate confidence a single, fixed-point military target, Iran would have to allocate a large percentage, if not all, of its missile inventory to one specific mission.

Against large-area military targets, such as an airfield or seaport, Iran could conduct harassment attacks aimed at disrupting operations or causing damage, but such missile attacks are not capable of halting critical military activities. Missile defenses arrayed across the Arabian Peninsula, Israel and Turkey, along with offensive operations designed to destroy missiles prior to launch and cyber operations, would further attenuate the disruptive effects of Iranian missile assaults against military bases and key logistics hubs.

Iran's ballistic missiles could be used to wage a terror campaign against adversary cities and industrial targets. Such attacks might trigger fear within the target population and erode the strategic resolve of some leaders, but the expected death toll, based on Germany's V-2 attacks on London during the Second World War, would likely be fewer than five per missile. Missile- and civil-defense measures would further minimize casualties.

Given the limited military utility of its missiles, Iran has historically viewed them as a tool for deterring attack by threatening to punish an adversary's population and civilian infrastructure, as it did during the war with Iraq.[2] Such threats extend to allies of the US in the Gulf region, particularly those that might support American military operations against Iran. Indeed, certain Iranian officials have been explicit about the role ballistic missiles play, such as Brigadier General Hossein Dehqan, who stated that 'Iran's missile capacity is defensive, conventional and deterrent.'[3]

Table 1 **Iran's rocket and ballistic-missile capability**

Missile	Range	Payload	Fuel	Mission	Note
***Zelzal*-2**	200 km	600 kg	Solid	Battlefield	Unguided
***Fateh*-110**	200-225 km	450 kg	Solid	Battlefield	Guided
Khalij Fars	200-225 km	450 kg	Solid	Anti-ship	Limited Capability
***Hormuz*-1/-2**	200-225 km	450 kg	Solid	Anti-radar	Limited Capability
***Fateh*-313**	300-325 km	350 kg	Solid	Battlefield?	Deployed??
Sajjil	2,000 km	700 kg	Solid	Strategic	Deployed??
***Shahab*-1**	300 km	1,000 kg	Liquid	Airfields, Military Bases	*Scud*-B
***Shahab*-2**	500 km	720 kg	Liquid	Airfields, Military Bases	*Scud*-C
Qiam	~700 km	500 kg	Liquid	Airfields, Military Bases	Modified *Scud*-C
***Shahab*-3**	800-1,000 km	~1,000 kg	Liquid	Strategic	*Nodong*
Ghadr	1,600 km	700 kg	Liquid	Strategic	Modified *Nodong*
Emad	1,600 km	700 kg	Liquid	Strategic	Modified *Ghadr*
Khorramshahr	2,000 km	~ 1,500 kg	Liquid	Strategic	*Development*

Table 1 - Iran has the largest, most diverse rocket and ballistic-missile arsenal in the Middle East. The missiles highlighted in red exceed the Missile Technology Control Regime's thresholds of 300-km range, 500-kg payload, and are generally considered to be capable of delivering a nuclear warhead. Iran does not currently possess nuclear weapons, and is verifiably prevented from acquiring them, per the Joint Comprehensive Plan of Action, or JCPOA.

In pursuit of greater precision

Iranian decision-makers also recognize that deterring attack by threatening to punish potential adversaries and their supporters may not be sufficient. The acquisition of missile defenses by Gulf states will undoubtedly amplify Tehran's worries. Consequently, Iran has spent the past decade refocusing its missile-development efforts away from increasing range to enhancing the precision and lethality of its missiles.

This pursuit of greater precision is best evidenced by the evolution of the *Zelzal* (Earthquake) artillery rocket. The first-generation *Zelzal* is unguided and terribly inaccurate, with half of the rockets missing their intended target by more than three kilometers. Spin-stabilizing the rocket only resulted in modest improvements to *Zelzal*'s accuracy.

Iran began developing the *Fateh*-110, a semi-guided rocket, more than 12 years ago. The designers appear to have incorporated a simple navigation and guidance system, and four aerodynamic-control surfaces mounted just below the rocket's warhead section. The navigation unit, which senses deviations in the rocket's pitch and yaw, are likely used to maintain a preprogrammed orientation (i.e. angle of attack) during the boost and ascent phases of flight. If implemented effectively, the flight stabilization system should significantly reduce the *Fateh*-110's lateral dispersion; range dispersion, while improved, is still affected by inconsistencies in the rocket motor's performance. The first generation of the *Fateh*-110 still lacks the precision needed to reliably strike military targets despite representing a significant improvement in accuracy.

In principle, Iranian engineers could enhance the navigation, guidance and control system of the *Fateh*-110 so that it continuously corrects deviations along its full trajectory, including the final approach to the target. The missile would necessarily have to fly within the atmosphere to maintain positive aerodynamic control over its entire path to the target. Thus, the *Fateh*-110, like other missiles of this type, including Russia's *Tochka* (SS-21) and the US *ATACMS* systems, cannot exceed an altitude of 35–40km if it is to achieve a high level of accuracy, a constraint that limits its achievable range to 200–250km. Only Kuwait, portions of Iraq and the eastern emirates of the UAE are within the *Fateh*-110's range. Iran's later development, the *Fateh*-313, with a maximum range of about 300km, cannot reach most targets in Bahrain, Qatar, Saudi Arabia and western UAE, including Dubai and Abu Dhabi, unless launched from islands in the Gulf.

Despite working for more than a decade to improve the *Fateh*-110's accuracy, progress has been limited. During the *Great Prophet-7* war games in 2012, for example, Iranian forces launched more than a dozen rockets and missiles towards a mock airfield. Most of the missiles fired were *Fateh*-110s, though a few were *Shahab*-1s (*Scud*-B). Iranian television showed the warheads impacting the intended target. A few months later, *Jane's Defence Weekly* published a report that included satellite imagery of craters distributed throughout a mock airfield and outside its imaginary boundaries.[4] The location of some of the craters in the satellite imagery corresponded with the impacts shown in the televised video, suggesting that the *Jane's* information accurately reflected events during the war game. Assuming the *Fateh*-110s were aiming for the center of the airfield, the spatial distribution of the impacts indicates a CEP of 800–1,100 meters, depending on the calculation method employed. Assuming an aim point at another location within the airfield boundaries does not improve the calculated CEP estimate. Not surprisingly, perhaps, the CEP value for the *Fateh*-110 is reasonably consistent with the theoretical predictions based on manufacturing deviations and other contributors to inaccuracy.

The *Fateh*-110's CEP of 800–1,000 meters is on a par with that of the *Shahab*-1 missile. The lethal effects of a missile warhead weighing 500–1,000 kilograms is limited to about 50 meters, making it easy to understand why the missile is not expected to land close enough to kill or destroy a specific target. As with the *Shahab*-1, the *Fateh*-110 is unlikely to succeed, unless the target is very large, like an airfield or military base. Iran will likely need many more years and scores of flight tests to reduce the CEP to below 200 meters, the minimum accuracy requirement for a missile to have a reasonable chance of destroying a specific military target.

Nonetheless, development of the *Fateh*-110 family of missiles, including the optically guided anti-ship *Khalij Fars* and the anti-radar *Hormuz* systems, as well as the *Fateh*-313, suggests that Iran seeks to produce and field highly accurate missiles capable of shaping the outcome of future military conflicts. The test launch of the medium-range *Emad* missile in 2015 provided additional evidence of Iran's desire to enhance missile accuracy. The *Emad*, which appears to be a *Ghadr* missile with a separating warhead capable of steering itself towards a target after it re-enters the atmosphere, is in its first phase of development. It will require very different technologies to the *Fateh*-110 to achieve the design objectives. Adding a Global Positioning System (GPS) receiver, or the Russian, French or Chinese equivalents, to the inertial navigation system to provide precise updates will only improve *Emad*'s accuracy by about 20–25%, not enough to alter its military utility. To achieve the precision needed to destroy military targets consistently and reliably, Iran must develop a post-boost control system and terminal guidance capabilities. With terminal guidance and control, missile warheads can be maneuvered to the target just before impact. Based on the time other countries took to develop precision-guided ballistic missiles with a range greater than 300km, Iran is not expected to possess an arsenal of accurate medium-range missiles before 2025. Extensive foreign assistance from China or Russia could shorten the timeline to a few years, however.

Iran has also made substantial strides in developing the near-real-time targeting and prompt post-strike assessment capacities needed to support ballistic-missile operations. This nascent, but rapidly improving, capability was demonstrated in June 2017 when Tehran launched seven *Zolfaqar* missiles against the Islamic State, also known as ISIS or ISIL, in Syria. The attacks largely failed, with only two of the missiles landing within the suspected target area.[5] Despite the poor performance of the *Zolfaqar*, which is derived from the *Fateh*-110, Iran demonstrated its ability to fly surveillance drones above the suspected target and relay the information to launch crews hundreds of kilometers away. The targeting information for the missiles was presumably derived from the drone's surveillance of the area, though it is too soon to draw specific conclusions. Video from the drone shows at least one, if not two missiles striking buildings, indicating that Iran has the capacity to conduct real-time damage assessments under certain conditions.[6]

Iran's targeting and damage-assessment capabilities are limited, however. For now, Iran lacks the communications

infrastructure needed to operate its drones more than a few hundred kilometers beyond the territory it occupies and controls. Ground-based controllers need to have line-of-sight access to the drones, as do the surveillance-data receivers. Operating beyond the line of sight requires communication linkages through high-flying aircraft or satellites.

Iran's evolving missile doctrine

A continuing pattern of prioritizing improved precision over increased range would mark a discernable shift in Iran's missile doctrine, from one that relies solely on punishing would-be attackers by striking highly valued targets, such as cities, to a strategy that strives also to deny potential foes their military objectives. Such a doctrinal evolution is consistent with Iran's overarching military strategy, which is primarily defensive.[7]

The 'mosaic defense' strategy, authored by Major-General Mohammad Ali Jafari, commander of Iran's Islamic Revolutionary Guard Corps (IRGC), establishes three asymmetric operational tactics to impede conventional military advances by an attacker: proxies provide a forward-based fighting force; guerrilla warfare at sea threatens enemies and impedes a navy-supported invasion; and the implicit threat of extraterritorial attacks with ballistic missiles deters adversaries.[8]

An arsenal of accurate, highly lethal ballistic missiles supports all three elements of this asymmetric approach to warfare. Heavy-artillery rockets and short-range missiles, if they can delivery ordnance precisely, are capable of denying an enemy access to territory along Iran's borders, or raise the cost of massing an invading army in a neighboring country. Short- and medium-range missiles threaten key ports that service the navies of the Arab Gulf states and external powers, including the US, UK and France, and can harass ships deployed within Gulf waters. Ballistic missiles striking airfields with precision could disrupt, if not halt, the sortie generation rate so vital to US and Arab Gulf state fighting strategies. Finally, missiles accurate enough to avoid potential collateral damage could be used to strike key military and civilian infrastructure with less risk of backlash from the international community. All these capabilities assume that Iran succeeds in developing highly accurate missiles.

Evidence to date suggests that Iran is improving the precision of its missiles, though not enough to generate the desired military outcomes. This will undoubtedly change as Tehran continues to master the technologies and operational tactics needed to achieve greater missile accuracy, as well as the critical enabling technologies, such as real-time targeting and damage-assessment capabilities. While it will take Iran a long time to establish an arsenal of militarily decisive missiles (at least five and perhaps ten years), the US and its Gulf partners must now begin identifying and developing a means to mitigate their impact.

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Notes

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5 Russ Read, 'Iran's Missile Strike On ISIS Was A Massive Failure', *National Interest*, 20 June 2017, http://nationalinterest.org/blog/the-buzz/irans-missile-strike-isis-was-massive-failure-21253.

6 Artemis Moshtaghian, 'Iran launches missiles into eastern Syria, targets ISIS', CNN, 19 June 2017, http://www.cnn.com/2017/06/18/middleeast/iran-launches-missiles-into-syria/index.html.

7 For a more in-depth discussion, see Matthew McInnis and Michael Eisenstadt's papers in this collection.

8 For a more in-depth discussion, see Michael Eisenstadt's paper in this collection.

Iranian Unmanned Systems

John Drennan

A handful of high-profile incidents over the past year illustrate Iran's burgeoning capacity to develop and operate unmanned systems. In June 2017, a US F-15 shot down an armed Iranian-made *Shahed*-129 drone in southeast Syria after it displayed hostile intent.[1] That same month, a Pakistani JF-17 *Thunder* downed an unarmed drone believed to be on a spying mission 'deep inside Pakistani airspace'.[2] Meanwhile, the Iranian Revolutionary Guard Corps Navy (IRGCN) has reportedly been working to incorporate unmanned systems into its forces.[3] An Iranian-operated unmanned aerial vehicle (UAV) on a reconnaissance mission recently beamed to ground stations video of a US aircraft carrier as it flew over the ship. In the near term, Iran will likely expand its arsenal of UAVs to collect intelligence, identify fixed-location and mobile targets, and threaten ships in the Gulf. Over the next decade, drones could be programmed to swarm and attack key maritime and land-based targets, and possibly pose a credible threat to commercial and military vessels throughout the Middle East; in the Gulf, the Red Sea, and the coastal waters south of Yemen and Iran. Iran has already provided unmanned systems to its proxies fighting in the Middle East: Hizbullah, for example, released a video reportedly depicting an Iranian UAV tracking a US military drone in Syria, apparently undetected.[4]

These incidents suggest that Iran is deploying drones to support a number of missions, particularly strikes and intelligence, reconnaissance and surveillance (ISR) operations. In addition, Iran could use its UAVs – either those that are already active or those in development – for targeting purposes, swarming at sea and to assess damage after a strike. Drones offer a relatively low-cost addition to Iran's arsenal but could have security implications for the United States and its allies in the Middle East.

Iran's unmanned aerial systems

Iran's use of unmanned systems dates back to the Iran–Iraq War (1980–88). Since the 1979 revolution in Iran, as Ariane Tabatabai explains, the country's 'defense doctrine has led it to develop low-risk, relatively low-cost tools, including missiles and UAVs, which afford it the ability to tackle threats at a distance without putting Iranian lives on the line'.[5] Iranian officials have stressed that unmanned systems are being incorporated into all branches of the Iranian military. In 2012, Brigadier-General Masoud Jazayeri, deputy chief of staff of Iran's armed forces, said that Iran's 'ground, naval and air divisions are using [unmanned systems] and we think that the higher Iran's defensive power and capability in this ground grows, the more it will contribute to our deterrence'.[6]

Despite – or perhaps as a result of – the strict international sanctions regime against Iran, Tehran has developed a domestic-production base for a variety of unmanned aerial vehicles with short- and long-range strike and reconnaissance capabilities. These include

the *Ababil*, *Fotros*, H-110 *Sarir*, *Hamaseh*, the *Hazem* series, *Hodhod*-3, *Karrar*, *Mohajem*-92, the *Mohajer*/*Dorna* series, *Nazer*, *Raad*-85, *Roham*, *Sadeq*, *Saeqeh*, *Shahed*-129, and *Yasir* systems.[7] These systems, however, face limitations, in particular Iran's limited communications infrastructure and its small indigenous defense-industrial base.

Dual-capable surveillance and strike UAVs

Developed in the late 1980s, the *Ababil* and its variants possess either strike or ISR capabilities, and can operate at a range of 100–150 kilometers. Hamas have operated the *Ababil* during a parade in Gaza, and Houthi rebels in Yemen have used a modified version for kamikaze missions.[8] Iran supports both groups.

The *Fotros*, unveiled in 2013, is one of the largest drones Iran operates – its size falling somewhere between the United States' *Predator* and *Reaper* drones. It has a range of 2,000km, flies up to 25,000ft and can stay airborne for 16–30 hours. The *Fotros* can be equipped for ISR or with air-to-surface missiles for strike missions.[9]

Although unverified, Tehran has claimed that its H-110 *Sarir* (first shown in April 2013) is a long-range drone equipped to avoid radar, conduct ISR missions and carry air-to-air missiles.[10]

During a May 2013 ceremony, then Iranian defense minister Ahmad Vahidi claimed that the new *Hamaseh* model was 'simultaneously capable of surveillance, reconnaissance and missile and rocket attacks', and that the 'aircraft with its stealth quality can avoid detection by the enemy'.[11] Experts were quick to point out, however, that the aircraft's non-retractable landing gear, push propeller and external missiles would make it visible to radar.[12]

Iran's *Hazem*-1, -2, and -3 are, respectively, long-, medium- and short-range UAVs, capable of conducting both strike and reconnaissance missions.

Unveiled in 2010, the *Karrar* was Iran's first long-range strike drone, and then-president Mahmoud Ahmadinejad described it as a 'messenger of glory and salvation for humanity', adding that to Iran's enemies, it was an 'ambassador of death'. It is likely derived from the US MQM-107 *Streaker* target drone designed in the 1970s and exported to Iran before the revolution. However, it appears that in creating the *Karrar*, Iran has incorporated some modifications to the *Streaker*.[13] In terms of capabilities, it can also conduct reconnaissance missions, with a range of up to 1,000km, and is reportedly able to operate using a waypoint-based autopilot when flying outside its ground station's range.[14]

In September 2012, the IRGC demonstrated the medium-altitude, long-endurance *Shahed*-129. Similar to the American MQ-1 *Predator*, the *Shahed*-129 has a range between 1,700km and 2,700km, and can fly for up to 24 hours on either strike or reconnaissance missions. It can carry up to eight bombs or smart missiles, although armed variants were not spotted in combat until fairly recently.[15] Similar to the *Karrar*, it can reportedly operate beyond the range of its ground station by using waypoint-based autopilot.[16]

Strike UAVs

The *Raad*-85, first demonstrated in 2013, is a remotely piloted kamikaze UAV. Iranian officials have said that the *Raad*-85 'can be used for hitting aerial and ground targets and can carry out an attack when it identifies a suspicious target'. It has a range of roughly 100km.[17]

Iran's *Sadeq* (sometimes transliterated as '*Sadegh*') drone is a high-speed unmanned system with a maximum altitude of 25,000ft, equipped with air-to-air missiles.[18] In August 2017, the US Navy reported that one of these vehicles nearly collided with an F/A-18E *Super Hornet* as the drone was circling the USS *Nimitz* in the Gulf.[19]

After capturing an American RQ-170 *Sentinel* UAV in December 2011, Tehran claimed to have developed a copy. Named the *Saeqeh*, Iran's putative copy surfaced in 2016. Although Iran has yet to demonstrate its capabilities, the commander of the IRGC's aerospace forces, Amir Ali Hajizadeh, stated that 'this long-range drone is capable of hitting four targets with smart precision-guided bombs with high accuracy'.[20] Iran has provided no evidence to suggest that this so-called copy has capabilities equivalent to those of the RQ-170.

Surveillance UAVs

The *Hodhod*-3 is reportedly a vertical take-off and landing multirotor UAV that can carry a three-kilogram sensor suite for reconnaissance and monitoring missions.[21]

Revealed in September 2015, the *Mohajem*-92 has a range of 500km and is reportedly intended for reconnaissance missions of up to six hours.[22]

The *Mohajer* series is primarily used for ISR purposes; Hizbullah has used models from this series during its 2006 war with Israel and in the ongoing conflict in Syria. President Bashar al-Assad's forces have also deployed them in Syria.[23]

The *Nazer* UAV is a small helicopter drone, used for reconnaissance and patrol, particularly to track drug-traffickers in Iran's border regions.[24]

The *Roham*, like the *Hodhod*-3, is a vertical take-off and landing drone used for reconnaissance missions. It is primarily intended for mapping, as it is capable of generating three-dimensional topographic maps.[25]

In 2012, the IRGC reported the capture of three US *ScanEagle* UAVs (a claim which the US denied at the time, saying it could account for all of its drones).[26] But, by September the following year, Iran had unveiled a slightly modified variant of the *ScanEagle*, dubbed *Yasir*.[27] Like the *ScanEagle*, the *Yasir* is thought to be capable of conducting ISR missions for long periods. However, its real performance is not publicly known.

Iran's unmanned naval systems

Iran's unmanned naval systems remain largely at an embryonic stage, with the possible exception of the *Ya Mahdi* unmanned surface craft. This system first made an appearance in 2010 and is reportedly a high-speed system capable of radar evasion.[28] Houthi rebels in Yemen reportedly deployed a *Ya Mahdi* system (or a variant thereof) for the first time in January 2017, when a remote-controlled suicide craft hit a Saudi frigate in the Red Sea. According to the US Navy, Iran likely supplied the boat to the Houthis.[29]

Although unmanned systems like *Ya Mahdi* are relatively new, Iran has been using swarms of manned fast-attack crafts to target and disrupt operations of the US and its allies in the Gulf. In the first half of 2016, US Navy officers noted a twofold increase in the number of 'unsafe, unprofessional interactions' involving Iranian fast-attack crafts, compared to the same period in 2015; groups of these small ships harassed US ships five times in September 2016 alone.[30]

Should Iran pair these tactics with unmanned crafts armed with explosives, their potential lethality increases, and several factors complicate defense against such an attack. According to Jeremy Vaughan, 'swarming technologies … provide asymmetric capabilities for weaker states and non-state actors. Correspondingly, defense against maritime drones is complicated because of the constraints of international law, the difficulty in determining hostile intent, and an inefficient kill chain or means of response.'[31]

Limitations facing Iran's unmanned systems

A number of issues limit Iran's unmanned systems, which stem mostly from Iran's limited communications infrastructure and inadequate indigenous defense-industrial base. Currently, Iran lacks satellite-navigation-enabled targeting or control links; without such capabilities, there are severe limitations on both the range and persistence with which Iranian drones can operate. Although Iranian state media lauded the launch of the *Simorgh* rocket in July 2017 as a significant step towards placing satellites in space, Tehran still controls no space assets.[32] Moreover, even when Iran acquires the capability to put communications satellites into orbit, it will take time before it is able to put enough into space to support a drone program.

Another limitation is Tehran's inability to produce small, efficient and reliable turbojet or turbofan engines. As a result, it must rely on imports to power its more capable UAV variants. This is likely to remain the case for the foreseeable future because the Missile Technology Control Regime (MTCR), a multilateral export-control initiative aimed at preventing missile and UAV proliferation, limits transfers, and North Korea – Iran's favored supplier of illegal goods – does not produce such engines. If other potential suppliers (such as China or Russia) adhere

to the MTCR and other export controls, growth in Iran's capabilities will be limited.

Implications for the US and its allies in the Gulf

Despite weaknesses in Iran's technical and industrial infrastructure that will limit its ability to substantially improve the performance of its UAVs, its relatively low-cost unmanned systems will help to partially offset the country's meager air force. Iran is also likely to continue exporting and providing its proxies with new capabilities as and when they are developed.

The strike and reconnaissance capabilities discussed above offer Iran a number of benefits. Drones will enhance Iran's short-range (up to 300km) ISR abilities, and offer limited real-time targeting and bomb-damage assessment (as shown in Syria, when Iran used ballistic missiles to target elements of the Islamic State, also known as ISIS or ISIL, in 2017). These UAVs are difficult to find, track, and eventually destroy; this problem is particularly acute when drones fly at low altitudes. Their small size and slow speed present challenges to detection by radar. In addition, international law is yet to coherently define the legal issues associated with firing on UAVs during peacetime, so countries such as the US face risks in taking action against Iranian UAVs outside of conflict zones.

Real-time communication and control issues could be addressed, at least in part, by erecting ground-based communication links on islands in the Gulf, and perhaps also in Syria and elsewhere in the Middle East. Doing so, however, would offer the US and its allies a warning that Iran would soon possess longer-range, real-time ISR.

In the medium to long term, the emergence of new technologies, such as autonomous swarming, has serious implications. Should Iran acquire such a capability, it could, for example, arm a swarm of drones with explosives to overwhelm US defenses or oversaturate sensors, offsetting the United States' conventional advantage.[33]

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Iran: Prospective, Rapid Technological Breakthroughs

Jeremy Vaughan

An Iranian animated film released in February 2017 depicts Iran using sophisticated technology to win an asymmetric battle against the United States.[1] In the film, Iran's military uses surface-to-surface missiles, remote-controlled mini-tanks and ballistic missiles to destroy US Navy ships and special forces. In reality, Iran has developed rudimentary versions of these weapons, including a relatively accurate replication of the movie's remote-controlled tank, and provided them to its proxies in the greater Middle East.[2]

Citing US sanctions (enacted prior to the signing of the Joint Comprehensive Plan of Action or JCPOA), Apple banned Iranian apps from its App Store in August 2017, causing large disruption to the nation's burgeoning technology start-up culture.[3] However, as Iran continues its current path of normalization with the international community, it will increasingly have access to new civilian technologies. Moreover, once the arms restrictions specified in the UN Security Council Resolution 2231 ease in 2020, Iran will be able to purchase advanced military technology. Without targeted sanctions or other alternative measures, advances in autonomy and artificial intelligence (AI) will eventually provide Iran and its proxies with new ways to quickly advance their military capabilities, potentially reshaping the region without tripping traditional counter-proliferation alarms.

Technology as a weapon

The neutralization of an adversary's superior military force through the use of technology is not a new strategy for either the United States or Iran. During the early years of the Cold War, the US offset the Soviet Union's formidable conventional force, first by developing small-yield battlefield tactical nuclear weapons, and then precision-guided munitions. Ballooning weapons costs, budget constraints and emerging peer adversaries are driving the United States to pursue the latest 'third offset' strategy by developing and exploiting AI and autonomous systems.[4]

Along somewhat similar lines, Iran's heavy investment in cyber technology in the 2000s highlights the country's early-adopter mindset, and offers insight into how it might exploit technology to gain an advantage in the future. While Iranian cyber activity was initially limited to website defacement, it became much more advanced after the 2007 Stuxnet attack infected its uranium-enrichment infrastructure.[5] Following its successful and sophisticated attacks on American and Saudi Arabian infrastructure, Iran – along with North Korea – is often considered to possess capabilities just below those of the United States, Russia, China and Israel.[6]

Autonomy is coming to Iran

Large commercial investments in unmanned autonomous systems – those 'that can change their behavior in response to unanticipated events' – have significantly increased in recent years, and such systems are quickly growing in capability.[7] Companies like Amazon and Google are pushing the boundaries of adaptable

guidance through the development of self-driving cars and autonomous-drone package delivery. In 2016, Waymo – spun off from Google's self-driving car project by parent company Alphabet – drove autonomously for over 2.3 million miles, and Amazon's drone service delivered its first packages in the UK.[8] It's not just corporations that are using this technology: an American software engineer built a surprisingly capable self-driving car in his garage by incorporating computer and sensing systems with an algorithm.[9] Iran already possesses a diverse ecosystem of locally produced unmanned aerial vehicles, and the engineering techniques necessary to develop autonomous systems are not beyond Iranian capabilities. Updating Iranian systems to operate autonomously could be as simple as cobbling together additional hardware, and installing acquired algorithms. By doing so, Iran could engineer package drones – like those developed by Amazon – autonomously guided to deliver explosives to designated targets. Such a development could prove to be the precision-guided munitions windfall that has so far eluded Iran and its proxies.

Swarming – a tactic that seeks to overwhelm an adversary through sheer numbers and that is used heavily in Iranian naval doctrine – could also be automated. Such a capability would have substantial potential for asymmetric warfare. While current Iranian capabilities rely on piloted boats, autonomous swarming would require mastery of sensing systems, computer networks and sophisticated algorithms to keep a large number of unmanned boats, drones, tanks or robots in coordinated motion. Though smaller drones individually pack less of a punch than manned combat aircraft, a herd of drones operating as one offers an asymmetric means for targeting an adversary's critical assets or capabilities. A single drone can cause significant disruption through a kamikaze attack on a sensitive target. With the addition of explosives or other payloads, a relatively small swarm of drones could offset a large US conventional military advantage by destroying fragile air- and missile-defense radars, overwhelming point defenses or simply saturating sensing systems.[10] Rapid advances in the group control of drones and swarming techniques, together with cyber capabilities and Iran's burgeoning relationship with China – which involves significant transfer of technology to Iran – could pave the way for Iranian combat capabilities in beyond-line-of-sight drone systems, swarming control and multi-domain (air, surface and underwater) unmanned systems.[11]

Artificial intelligence expands cyber reach

Artificial intelligence – the simulation of intelligent, human behavior in computers – uses very large amounts of data, specialized processing chips and heavily engineered algorithms to change and inform how computers solve complex problems. Computing power and techniques have developed from the earlier use of brute-force processes, to more human-like processes, wherein the system is exposed to a large database of information and uses algorithms and neural networks to improve its decision-making.[12] Apple's newly released iPhone X provides an example of the latter's use in a commercial context. The beating heart of this device is its AI chip, which enables facial recognition of the user to unlock the phone – an industry first – and can make over 600 billion calculations per second. The fact that these capabilities are included in a cellphone developed by the private sector, rather than the US military, should give operational and tactical planners pause for thought, to reflect on how adversaries such as Iran could adapt or acquire such technologies.[13] State actors are already using analogous cyber capabilities to probe and shore up defensive gaps, and to find new ways to access target systems. Gaining access to advanced AI algorithms through theft or open-source codes could provide Iran with cyber capabilities that could further unbalance the region.

Can Iran achieve advanced technological breakthroughs?

Despite Iran's rising military budgets, recognized scientific talent and asymmetric mindset, skeptics argue that rapid technological breakthroughs are beyond its capability.[14] At first glance, such doubts appear justified, given that Iran includes among its advertised maritime-weapons forces jet-skiers wielding rocket-propelled grenades.[15]

Operational problems will likely not prove too difficult for Iran to surmount. Iran has continued an old Persian tradition of emphasizing mathematics and science in education. Iranian students finish well in mathematics competitions – its team finished fifth in the 2017 International Mathematics Olympiad, behind South Korea, China, Vietnam and the United States. The best Iranian mathematician in the competition tied for first in the world. In the last decade, Iran has finished tenth or better six times, winning 14 individual gold medals.[16] While many of the country's brightest minds have historically left Iran, years of sanctions are slowing this brain drain by restricting access to foreign schools and feeding them back into Iran's highly subsidized engineering fields.[17]

While some argue that the arms embargo has successfully stopped Iran's technological advancement, Iran has found ways to improve its capabilities despite the sanctions.[18] While Iran lacks the industrial infrastructure to produce advanced fighter aircraft, it has been an innovator in the development and use of unmanned aircraft since the 1980s.[19] Despite international embargoes, export laws and treaties restricting Iran's access to light turbofan and turbojet engines, and other key aviation components, Iranian drone technicians have continued to acquire the necessary parts – either through local manufacture or on the black market.[20] While it is true that no drone can match American airpower, asymmetric tactics and the deployment of technologies like swarming, miniature submarines, mines and salvos of anti-ship cruise missiles would be a significant challenge for any military force.[21] Marginal improvements in autonomous drone control alone could significantly raise the cost of future combat for Iran's adversaries. More importantly, Iranian technological improvements tend to immediately trickle down for use in proxy warfare. In the last decade alone, Iranian proxies have critically damaged an Israeli patrol boat and nearly sunk an Emirati warship, using anti-ship cruise missiles in both cases. Elsewhere, a remote-controlled tank has been deployed in battle by the Iranian-backed Iraqi Popular Mobilization Units against the Islamic State, also known as ISIS or ISIL. In Yemen, Houthi rebels successfully guided a small, unmanned boat laden with explosives – likely an Iranian innovation – into a Saudi Arabian frigate. Although Saudi Arabia and other Gulf countries outspend Iran on defense by a ratio of more than five to one, advances in artificial intelligence and autonomy could eventually offset this disparity and destabilize the region.

Planning for the future

Iran will undoubtedly continue to improve its asymmetric military capabilities through leveraging technology. However, the risk of technological breakthroughs can be mitigated if the US, its allies and partners, and the wider international community take immediate and decisive action.

Existing non-proliferation tools like the Missile Technology Control Regime (MTCR) are not likely to impede Iran's efforts to develop the algorithms which will enable autonomous swarming and other tactics. The MTCR will, however, make it more difficult for Iran to access small, efficient propulsion systems for its drones. Executive orders by the US that sanctions against those who carry out technology transfers to Iran have greater efficacy than multilateral control mechanisms. The US Treasury's Office of Foreign Assets Control's (OFAC) designation of 16 entities in 2017 for technological support to Iran shows that such action is possible.[22] The creation of a 'Countering Technology Threat' (CTT) program, based on extant and effective Countering Terrorist Financing (CTF) programs, would use these same mechanisms while providing more focus on the illegal transfer of technology. CTF programs are powerful, because financial transactions denominated in US dollars must go through American exchanges and are therefore subject to American law. Similarly, as many of the technological advances are being made in the United States, a CTT program could greatly expand the use of US export laws focused on restricting and prosecuting illegal software proliferation, protecting the homeland and American businesses.

Despite concern about the risks of artificial intelligence by field leaders like Tesla and SpaceX CEO Elon Musk, advanced AI code is freely available for use and is circulated globally.[23] Iran has proved willing to steal technology it cannot access for free, permitted by the often

porous information systems used in the commercial sector.[24] Corporations could secure their systems, maximize their research potential and perhaps gain some say in how new technologies are used in warfare, through integrating their AI development with that of the US government in joint public-private ventures.[25] Intel's collaboration with the Defense Advanced Research Projects Agency (DARPA) on the Hierarchal Identity Verify and Exploit (HIVE) AI system shows how fruitful such partnerships can be.[26]

Hardware alignment in unmanned systems must be tracked to adequately warn military planners before new capability leaps mature. Much as an old flip-front cellphone cannot become the latest iPhone by just downloading new software, sudden capability shifts cannot happen by stealing new operating-system code. Similarly, an Android mobile device cannot be updated through an Apple software download, because the operating systems are so different. However, if hardware and software are aligned, greatly improved capability could be just a download away. DJI, the world leader in consumer unmanned aerial vehicles, required all owners to download software that prohibited their devices flying in certain areas, after the company received withering criticism following use of their products by extremists.[27] While these downloads restricted capability, the opposite is also possible. Drone hardware aligned sufficiently with third-party control software could potentially transform an airspace hazard into a swarming nightmare overnight.

The US and its allies must plan now to meet a more advanced adversary, before a technological leap in Iran's capabilities occurs. The military-acquisition system must begin to develop weapons able to counter emerging technologies. For AI, the development of cyber techniques to corrupt databases necessary for machine learning could neutralize a system before it can be used.[28] In order to combat autonomous weapons systems, directed-energy weapons could disable swarming threats without depleting conventional ammunition. In all cases, military lawyers must determine how the laws of armed conflict will apply to new technologies and produce rules of engagement that will enable military commanders to defeat robotic systems.[29]

Superpowers will not enjoy monopolies on any future technological leaps, and the advantages afforded by any such leaps might prove short-lived. The trickle down of advanced capability, however diluted, means that they will in some form eventually be used by Iranian proxies, which will increase the cost of intervention and change the regional balance of power. If the US and its international partners take action now to more carefully monitor the development of Iran's military systems, and to slow the transfer of technology to the country, they can forestall the unwelcome scenario of dramatic improvements to its capabilities.

Cmdr Jeremy Vaughan, US Navy, is a former Federal Executive Fellow at The Washington Institute who has completed multiple deployments to the Persian Gulf. The views expressed herein are those of the author and do not reflect the official policy or position of the US Navy, US Department of Defense, or US government.

Notes

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