Since the beginning of the offensive aimed at retaking Mosul, Iraq's second city, in October 2016 the Islamic State has found itself increasingly cornered in its former stronghold. Besieged and under constant air and artillery strikes, as of mid-June 2017 the remaining Islamic State contingent is now in control of the Old City area of western Mosul.

The Islamic State has conducted a large number of suicide vehicle-borne improvised explosive device (SVBIED) attacks during the battle of Mosul, claiming in mid-June to have conducted more than 460 such attacks, an unparalleled number by the group. In an attempt to slow down Iraqi advances and make the battle as costly as possible, the Islamic State has launched continuous waves of SVBIEDs toward Iraqi positions. As the battle for Mosul has progressed, a new type of SVBIED has emerged.

Designed to deceive, confuse, and counteract the tactics employed by Iraqi forces and the United States-led coalition, it is a hybrid between the classic covert SVBIED and the up-armoured SVBIED. This new form of SVBIED has been field-tested for several months over the course of the battle, resulting in three separate 'stages', with each one innovating from the previous.

The danger posed by SVBIED attacks has been a recurring feature of operations against the Islamic State, particularly in Iraq, but there has been little attention paid to the group's design of such weapons and the evolution that has taken place. The Islamic State has a profound attention to detail when constructing SVBIEDs, tailoring them to specific threats and environments along with different vehicles, types of armour, explosive charges, paint jobs, and general design. This report will mainly focus on the emergence of what will be referred to as 'camouflaged' SVBIEDs, but will also include an overview of SVBIED design, construction, and tactics in the battle for Mosul.

To better understand camouflaged SVBIEDs, it is important to know how Islamic State-made SVBIEDs have been designed and used in the past, as well as what lead to the introduction of this new type. The core tenet of SVBIED design, construction, and employment has always been to ensure its survival up to the intended target, without it detonating prematurely. There are different ways the Islamic State goes about this, including but not limited to a variety of armour designs, different types of explosives, and support teams assisting the driver. However, it has previously been possible to divide all Islamic State SVBIEDs into two broad categories: covert and up-armoured.
A covert SVBIED is an unmodified civilian vehicle fitted with a hidden explosive payload. This design allows the SVBIED driver to blend in with civilian traffic and get as close as possible to the intended target before detonating. Typically used in areas where the Islamic State maintains little to no territorial control, this stealth-oriented design has also been used in limited numbers by the Islamic State in the preceding three years to strike behind enemy lines. As of early-to-mid 2017, though, the use of such SVBIEDs is mostly a recurring feature of the group’s asymmetric campaign against civilians in areas of Syria and Iraq under the control of an opposing force.

An up-armoured SVBIED is any vehicle fitted with improvised armour plating. This design saw very limited usage by the Islamic State’s predecessor organisations during the wider insurgency against United States-led forces in Iraq between 2003 and 2011, but has become the standard SVBIED design used by the Islamic State ever since it launched territorial campaigns across Syria and Iraq in 2013-14. While the covert SVBIED prioritises stealth, it became practically useless when deployed by the Islamic State in an area where it held a fixed front line with an opposing force. As stealth was no longer a priority, the group started welding improvised armour onto its SVBIEDs in order to lower the risk of incoming fire causing a premature detonation.

The up-armoured SVBIEDs used by the Islamic State are constructed by a network of workshops tasked with overhauling vehicles into rolling bombs. This has resulted in a variety of different designs, but most have a few key components in common. In general the front, sides, and wheels are the most heavily armoured areas. The frontal steel plates are commonly mounted at an angle to increase the effective thickness of the armour and to increase the chance of incoming small arms fire ricocheting. A small rectangular hole is cut out of the windshield armour, allowing the suicide bombers to see where they are driving, in addition to there
frequently also being a grille cut out of the armour to serve as an air intake for the engine, as well as headlights to facilitate driving at night.

The camouflaged SVBIED

There are three separate stages of the camouflaged SVBIED, all originating from the battle for Mosul. Consequently, it is important to examine the battle itself in order to understand what prompted the introduction of this new variant.

Up-armoured, tan-coloured, SUV-based SVBIED used on the outskirts of Mosul.

When the Iraqi Security Forces (ISF) offensive aimed at recapturing Mosul began on 16 October 2016, the fighting was taking place in and around the villages and towns in the Ninawa plains surrounding Mosul city proper. The SVBIEDs used by the Islamic State at this stage were often forced to drive across open terrain that offered little to no cover, something that made countering them easier for the ISF.

With this in mind, the Islamic State mostly deployed up-armoured SUV and pick-up truck SVBIEDs painted in a tan colour, matching the surrounding natural environment. These often featured frontal slat (or cage) armour, an improvised metal grid fitted on top of the steel plating with some spacing. Taking cues from conventional armoured vehicle manufacturers, this type of armour is designed to negatively affect any potential anti-tank munition's penetration capability, should it hit the SVBIED. However, the tan-coloured SUV is not a new SVBIED design, having been used consistently in Ninawa and surrounding Wilayat Jazira and Wilayat Dijla.

All-white, up-armoured, SUV-based SVBIED in Mosul city.

Stage 1

[Continued in full version...]
This was the first stage of the camouflaged SVBIED. While white SVBIEDs were the most common, some pick-up trucks and SUVs also started appearing with grey and black paint jobs. Painting the armour in these colours was a deliberate attempt to blend in with the civilian vehicles already present in the city.

By masking the improvised armour, the Islamic State was attempting to deceive and confuse the ISF as well as US-led coalition aircraft into thinking that this type of SVBIED was actually an unmodified civilian vehicle. A key factor supporting this theory is the lack of frontal slat armour on the overwhelming majority of all camouflaged SVBIEDs. While slat armour would offer an increased defensive capability, it would also negate the efforts to make the SVBIED look like a civilian vehicle by obscuring key features.

The change from tan to stage 1 camouflaged SVBIEDs was mostly a product of changing environmental factors, and is a continuation of the same logic that led to the production of tan-coloured SVBIEDs. Both are attempts at blending in with the corresponding surroundings, the difference lying in what they are emulating.

Footage from an SVBIED workshop in Mosul shows a member of the group adding a layer of white paint.

When ISF personnel identify an SVBIED driving towards them, they have a very limited amount of time to fire at it in the hopes of achieving a premature detonation. Disguising the up-armoured SVBIEDs as civilian vehicles could potentially decrease the risk of them being identified as quickly and thereafter targeted, both from the air and ground, increasing the chances of a successful detonation. It also potentially raises the risk of the ISF inadvertently targeting civilian vehicles during the operation, which would play into the narrative being advanced by the Islamic State that it represents the only defence for Sunni Muslims in Iraq.

A yellow, up-armored, SUV-based SVBIED prior to deployment in Mosul.
While SVBIEDs are restricted to roads and have fewer attack routes in a densely populated city like Mosul, large-scale urban fighting typically favours an irregular defending force, such as the Islamic State, which is well-versed in such fighting. The ISF usually only has a clear line of sight down a single road, and is often unable to disable incoming SVBIEDs before they get too close. The same shift from tan to stage 1 camouflaged SVBIEDs also took place when the offensive to retake western Mosul began in February 2017. The Islamic State used tan up-armoured SVBIEDs in small numbers, before replacing them with the stage 1 camouflaged SVBIEDs when fighting penetrated the city limits.

A composite of different coloured SVBIEDs deployed by the Islamic State in Mosul in 2017.

After a short period of time, Islamic State SVBIED workshops started experimenting with other colours, and there soon appeared up-armoured SVBIEDs painted in dark red and light blue, before even bright yellow SVBIEDs were deployed.

On first consideration, using very bright coloured vehicles that noticeably stand out in comparison to white, grey, or black vehicles may seem counter-intuitive from a camouflage perspective. However, most of these colours are also some of the most common ones used on civilian cars in Mosul, especially yellow. The use of these colours expanded once fighting started in western Mosul, with SVBIEDs in bright green, blue, red, and yellow being deployed on a more regular basis. Again the Islamic State is potentially seeking to blur any readily apparent visual distinction between SVBIEDs and civilian vehicles fleeing areas controlled by the group in an attempt to compromise counter-SVBIED efforts.

A stage 1 camouflaged SVBIED with only the improvised armor painted yellow.

Diversifying the number of different exterior designs on existing camouflaged SVBIEDs by utilising a wide range of colours was an attempt to make it more difficult for the ISF to recognise the SVBIED threat and counter it in sufficient time. This represented a tactical innovation, and underlined the extent to which the Islamic State is continually attempting to stay one step ahead of threat mitigation efforts by the ISF. Even if
The camouflage on the improvised armour only reduces the reaction times of ISF or coalition aircraft by a few seconds, it could have devastating effects. The more time an SVBIED is allowed to drive toward ISF positions without being fired on, the more likely it is to succeed. In these situations mere seconds can be the difference between life and death.

[Continued in full version...]

**Stage 2**

On 21 December 2016, a peculiar SVBIED was featured in an Islamic State video from eastern Mosul. While the majority of the armour was painted white, the windshield was painted in all black.

![An early version of a stage 2 camouflaged SVBIED, featured in a December 2016 video from eastern Mosul.](image1)

Although massively unrefined, this was the first example of a stage 2 camouflaged SVBIED. However, it is the only example recorded in eastern Mosul. After embedding with the ISF just southwest of western Mosul on 24 February 2017, freelance journalist Warzer Jaff managed to photograph an up-armoured SVBIED racing towards the convoy he was travelling in.

![Stage 2 camouflaged SVBIED, with fake windscreen and grille, pictured in official Islamic State media.](image2)

The photograph clearly showed a stage 2 camouflaged SVBIED with a fake windshield and grille painted onto the improvised armour in black paint. Footage released by the Islamic State several days later showed a pickup truck SVBIED in western Mosul that utilised the exact same armour kit and paint job.
From the above image it is possible to see that even the improvised wheel and side window armour have been painted black in an attempt to disguise the armour. The stage 2 camouflaged SVBIED represents a drastic improvement to the stage 1 camouflaged SVBIED, and is also a testament to the lengths that the Islamic State is going to in order to improve and refine its SVBIED designs. Key features like the ones enhanced by the black paint in the above picture give the SVBIED an authentic ‘civilian’ look at a distance, both horizontally and vertically, again aiming to increase detection and response time by security forces.

Stage 3

On 8 November 2016, three weeks into the offensive to retake eastern Mosul, another odd SVBIED design was featured. While unrefined, it looked unlike any other SVBIED.

For this type of SVBIED, the windshield armour was mounted on the interior of the vehicle, while the armour shielding the engine block was exterior, albeit with a large piece of cloth masking it.
The SVBIED represented the only recorded use of a stage 3 camouflaged SVBIED during the battle for Mosul to date, but in late March 2017 the design re-emerged in the eastern Aleppo countryside in northern Syria. Since then, there have been a further 12 recorded instances of stage 3 SVBIEDs in Aleppo and Raqqa.

The SVBIED captured by pro-government forces in Aleppo in March showed remarkable improvements and refinements in comparison to the first example recorded in Mosul in November 2016. This time, all of the improvised armour was mounted on the interior. The wheel armour, interior side door armour, and likely also the interior windshield armour was painted black to blend in with and look like the standard features on the vehicle. A metal plate was also placed under the hood in front of the engine block.

![Stage 3 camouflaged SVBIED used east of Tabqa in Raqqa governorate in April 2017.](image)

On 6 April 2017, another example of the stage 3 camouflaged SVBIED was featured, this time east of Tabqa city in Raqqa governorate. At a first glance, the armour kit mounted on the SVBIED looks almost identical to the one captured in Aleppo in March. On closer inspection, though, there seems to be one exception. Instead of inserting a metal sheet under the hood, the Islamic State seemingly removed the entire front of the vehicle’s exterior. A metal plate covering the entire engine block and other vital systems was attached, before the removed section was re-attached over the metal plate. The metal piece that attaches to the right frontal wheel armour and the gap stretching across the front of the vehicle are both indicators as to this modification.

Even though most SVBIEDs used in Mosul have had the improvised armour mounted on the exterior, the armour itself has been shaped to fit the profile of the original vehicle. Stage 3 camouflaged SVBIEDs go far beyond that, but the increased stealth might come at the price of a reduced defensive capability compared to SVBIEDs carrying exterior armour. Nonetheless, it’s a remarkable and fascinating innovation.
Stage 2 camouflaged SVBIED captured by Kurdish-led forces in Raqqa city in June 2017.

Out of the at least 15 recorded examples of stage 3 camouflaged SVBIEDs to date, one was in Mosul, four were in Aleppo, and 10 were in Raqqa. Considering that SVBIED workshops in and around Raqqa have previously supplemented SVBIED operations in surrounding wilayaat, it is likely that those deployed in Aleppo were also produced in Raqqa. As of mid-June 2017, the battle for Raqqa city has begun in earnest, as US-backed, Kurdish-led forces have penetrated the city limits and engaged in urban combat with Islamic State fighters.

Statistics

In order to analyse SVBIED usage during the battle for Mosul up to the end of June 2017, every official Islamic State video relating to the ongoing offensive was examined. Including documented examples of SVBIEDs that were captured or disabled, there was documentary evidence of at least 189 separate Islamic State SVBIEDs in Mosul as of late June. It is worth highlighting that the group itself claimed in mid-June 2017 to have conducted more than 460 suicide attacks during the battle, although the Islamic State did not likely record and publish every single SVBIED attack – and also may well have inflated the figures. Nonetheless, the collected dataset represents what can be considered a reasonably representative sample of overall SVBIED usage. Additionally, while not all suicide attacks include the use of SVBIEDs, practically all suicide attacks in Mosul have been conducted with SVBIEDs. The dataset only includes examples where it was possible to visually confirm what type of SVBIED was used. Of those 189 SVBIEDs recorded, 35 were captured intact and seven were disabled during fighting.

The frequency of SVBIED usage has declined considerably as the offensive has progressed and the ISF has recaptured more and more areas of Mosul. Claimed SVBIED attacks decreased from 124 in the first month of the fighting, for instance, to 19 by the eighth month. While the Islamic State has manufactured SVBIEDs on an industrial scale, the group’s resources are not unlimited when subjected to an impenetrable siege, and territory lost has likely included some of the facilities used to manufacture SVBIEDs. As territorial losses continue in Mosul, the use of SVBIEDs will likely also continue to decrease.

In terms of vehicle types, SUVs were featured the most prominently, representing 129 of the vehicles used in the 189 recorded attacks. Pick-up trucks were utilised 21 times, heavy trucks 18 times, tractors nine times, front-end loaders four times, vans four times, and an HMMWV, an ILAV Badger armoured personnel carrier an improvised troop transport vehicle, and a covert SVBIED were used one time each. While SVBIEDs based on military vehicles comprised approximately 17% of all SVBIEDs featured in Islamic State videos between July 2015 and January 2017, only two such SVBIED featured in this data set - this is largely a consequence of the group’s ongoing attempts to make most SVBIEDs appear as civilian vehicles.
While SUVs were the most prominent vehicle recorded in the dataset, this is a relatively recent development. Pick-up trucks used to be the most widely-used SVBIED vehicle in Syria and Iraq, appearing more than twice as often as SUVs in all Islamic State videos released between July 2015 and January 2017. The shift seemingly took place at some point in mid-2016 across the territories controlled by the group in Syria and Iraq. The heavy reliance on SUVs in Mosul city can be explained by the superior speed and responsiveness they offer compared to pick-up trucks or larger vehicles in an urban environment. Furthermore, overhauling identical or similar vehicle models facilitates and speeds up the manufacturing of SVBIED armour kits through standardisation. SUVs were not the only vehicles that receive identical armour kits however. Out of the 17 heavy trucks featured in the dataset, five tanker truck SVBIEDs with identical armour kits were deployed in a three week span across April 2017.

Innovation

Out of the 189 SVBIEDs recorded during the battle for Mosul up to late June, at least seven were two-man SVBIEDs. These are SVBIEDs that include both a driver and a rooftop gunner.

The gunner's job is to suppress the target while the SVBIED approaches, effectively increasing the survivability of the SVBIED up until the desired point of detonation. These are typically used on particularly difficult or hard targets, sometimes as an initial strike in conjunction with one or multiple other SVBIEDs. In Mosul, three of the seven recorded such SVBIEDs have been up-armoured front-end loaders. The conversion of heavy construction vehicles into heavily-armoured SVBIEDs allows them to remove obstacles
and break through complex enemy fortifications and subsequently detonate a sizable payload on target, striking where a normal up-armoured SVBIED would not be able to. On the extreme end of the spectrum of both two-man and heavy construction vehicle-based SVBIEDs there are the mining haul trucks that the Islamic State has weaponised.

These massive 60-ton SVBIEDs are extremely rarely utilised, with the one pictured above deployed in western Mosul being only the third ever to have been documented. This particular example was heavily armoured on the front, with sloped armor and a machine gun nest parallel to the driver’s set. In addition, the Islamic State actually removed large chunks of metal from the sides of the haul bed in an attempt to prevent it from absorbing too much of the payload’s explosive energy.

A further example of Islamic State SVBIED innovation came on 20 April 2017, when the Islamic State released a short video, detailing an improvement to existing suppression-based SVBIEDs. The video, titled “A new innovation enters the battlefield in Mosul”, showed a stage 1 camouflaged SVBIED fitted with five rocket pods on the roof.

As shown in the image below, a firing mechanism with a safety and five separate firing switches gives the SVBIED driver the ability to launch five projectiles, possibly 73mm recoilless rifle rounds, toward ISF positions before detonating the main payload.

This SVBIED type constitutes a considerable advancement from two-man SVBIEDs, as it offers the same potential suppression effect while only needing a single operator. Eleven examples have been documented to date, with some exhibiting a degree of innovation within this SVBIED type. For example, one had 4 rocket pods mounted close together right on top of the driver’s seat, allowing the driver to aim better when launching the rockets. Another example based on a tanker truck had 10 rocket pods mounted on the roof.
Another recurring feature of Islamic State videos from Mosul has been SVBIEDs driven by handicapped suicide bombers. Militants using crutches, as well as wheelchair-bound paraplegics and double leg amputees have been seen driving off in up-armoured SVBIEDs. An Islamic State video released in early April 2017 briefly displayed how a simple modification has allowed militants with limited or non-existent leg mobility the ability to operate the vehicle.

Explosives

The payload of an average up-armoured SVBIED usually consists of a series of daisy-chained improvised explosive devices (IED) - typically constructed from barrels or containers filled with homemade explosives, and boosted with military-grade high explosives, mines, and gas tanks – wired to a trigger mechanism.

The Islamic State has innovated in this area as well, as during the battle for Mosul it introduced shaped charge explosives in its SVBIED payloads. There are at least five documented instances where the group mounted multiple anti-tank mines to the driver and passenger doors of an SVBIED in an attempt to direct the explosive energy of the SVBIED to the sides.

A similar design feature has also been observed on front-end loader SVBIEDs. The example in the image below included two plastic-covered IEDs mounted facing outward to the sides on top of each wheelhouse.
The Islamic State has also started experimenting with explosively-formed penetrators (EFP) on its SVBIEDs. In a video released on 14 November 2016, one of the tan up-armoured SVBIEDs included an interesting feature. What appeared to be two pairs of headlights on the front of the vehicle actually turned out to be four front-facing EFPs disguised as headlights.

This example of SVBIED design and innovation was subsequently confirmed with the capture of a similar SVBIED by pro-government Shia Muslim militiamen in the Tal Afar area, west of Mosul.

This type of SVBIED is remarkable. Anti-tank mines mounted to the windshield and both side doors on the interior, plus four EFPs hidden as mock-up headlights on the front of the vehicle clearly shows their intention of directing as much of the explosive force as possible forward and to the sides. Such a design further underlines the Islamic State’s knowledge and understanding of how explosive forces act, and how it is seeking to apply this in its evolving SVBIED designs.
An up-armoured tan SVBIED with four headlight EFPs.

While this variant of SVBIED has not been widely utilised to date – potentially due to the comparatively more complicated design – it remains a very noticeable shift in terms of payload design in comparison to prior to the Mosul offensive beginning.

Trigger mechanisms

When constructing SVBIEDs, the Islamic State also goes to great lengths to ensure that the driver is able to detonate the vehicle once they reach the intended detonation point. Trigger mechanisms normally include a number of redundancies, ensuring a detonation occurs even if one firing circuit is disabled by faulty wiring.
An Islamic State SVBIED fitted with a trigger mechanism with multiple redundancies.

The example in the image above includes a main trigger mechanism with two sets of safeties and firing switches on separate firing circuits. Each safety needs to be pressed before the corresponding firing switch is activated, so as to prevent an accidental premature detonation. The trigger mechanism also includes two redundancies, one of them based on a grenade fuse.

[Continued in full version...]

Operational practices

After construction, Islamic State SVBIEDs are moved to forward hide sites in residential areas close to the frontline. The group reportedly spray-painted red circles on potential SVBIED hide sites, thereby guiding in drivers ferrying SVBIEDs forward from production sites. SVBIEDs were typically covered with tarpaulin and stored in garages or under covered driveways in an attempt to prevent them from being discovered by US-led coalition aircraft.
A stage 2 camouflaged SVBIED found hidden under tarpaulin in western Mosul.

Behind every SVBIED there is also a support team with the task of making sure the driver knows where he is supposed to detonate his vehicle and to increase the chances of that happening. As part of that, the urban fighting in Mosul has seen a dramatic increase in the group’s usage of commercial quad-copter unmanned aerial vehicles (UAV). Before conducting an SVBIED attack, the chosen driver is usually briefed on the target and shown either UAV reconnaissance footage or satellite imagery of the target area.

An Islamic State video shows a future suicide bomber reviewing UAV footage of the planned target area.

The SVBIED drivers are often unfamiliar with the area, and are sometimes guided out from the forward hide sites to the frontline by local Islamic State militants on motorcycle.

In addition to conducting reconnaissance and attacks, the Islamic State has started using commercial UAVs en masse in order to guide SVBIEDs to their targets in real time. By using UAVs, they are able to follow the driver's progress on live video feed and give instructions by radio. This allows the observers to make on the spot judgements and corrections, and to direct the SVBIEDs away from threats or toward new targets, adding another level of mobility.
Motorcycle-riding Islamic State militant guides an SVBIED to the frontline.

This is quite obvious in a lot of the UAV footage released by the Islamic State from Mosul, much of which is utilised to record and publicise SVBIED attacks. More often than not the SVBIED drivers make multiple turns, zigzagging through dense residential neighbourhoods, before ramming into their targets. In one such case an SVBIED even took a shortcut through a courtyard, intentionally avoiding the blocked main road, in order to surprise the column of ISF vehicles on the other side. As a general rule of thumb, an SVBIED seemingly always chooses the path of least resistance when it is being recorded via UAV, an indication that the driver is likely in contact with whoever is monitoring the live feeds.

This becomes even more apparent when SVBIEDs attack ISF forward operating bases in Mosul. When the ISF sets up temporary bases in civilian compounds in areas of Mosul recently captured, they often resort to hot-wiring civilian vehicles and placing them in the middle of the roads surrounding its bases as a form of improvised roadblock.

In theory it should work fairly well, but multiple recorded instances show the attacking SVBIEDs choosing the route of approach with the least number of vehicles blocking the road, often driving around or pushing them aside before detonating right next to the ISF columns. In many cases the SVBIED drivers also appear to be surgical in their approach, driving past the closest ISF vehicles in favour of hitting a larger concentration of vehicles further up the road.
The view from an Islamic State UAV as an SVBIED (red) navigates vehicle roadblocks (blue) to approach and target a temporary ISF forward operating base (green).

The ISF is a lot more vulnerable to SVBIED attacks inside Mosul than on the plains outside the city itself, and the group is all too aware of this. By using commercial UAVs to survey, plan, and support SVBIED operations, the Islamic State has managed to continuously catch the ISF by surprise in devastating attacks.

[Continued in full version...]

**Countermeasures**

When fighting was taking place in eastern Mosul, coalition aircraft bombed all bridges connecting the two halves of the city, severely limiting the flow of SVBIEDs as well as logistics and fighters across the Tigris river. In an effort to further constrict the movement of SVBIEDs, the coalition has also repeatedly struck roads in Mosul with airstrikes, intentionally cratering the most obvious SVBIED attack routes.

Airstrikes conducted by the coalition have been a constant feature of the Mosul offensive, frequently targeting SVBIED manufacturing workshops and forward hide sites, as well as the SVBIEDs themselves. While airstrikes are an important tool in this regard, it is not always feasible to request close air support when the target is an SVBIED racing towards an ISF contingent. The problem with defending against SVBIEDs in a populated urban centre is that there is no sound tactic that efficiently deals with the threat. Although that is usually the case with irregular threats, there are few factors that work in the ISF’s favor in Mosul. When examining how well ISF ground personnel have been able to defend themselves against SVBIED attacks, it’s important to distinguish between static and mobile defences.

Islamic State UAV footage illustrates how covert SVBIEDs hidden in garages/covered driveways can strike without warning.

The ISF was best equipped to deal with incoming SVBIEDs on the plains outside of Mosul. There, employment of ATGMs and main battle tanks (MBTs) proved effective at countering the threat. The high visibility and unobstructed view meant that the ISF had no issues spotting incoming SVBIEDs from far away
and engaging them at a safe distance. Inside Mosul, the far closer urban environment and resultant low visibility has meant that SVBIEDs often appear suddenly from around corners that were ‘cleared’ just minutes before. ISF contingents are often only given a clear line of sight down a single street, and the sprawling networks of intersecting roads makes it difficult to maintain a coherent perimeter defence.

Although the low visibility has dramatically reduced the ISF’s reaction times and ability to engage incoming SVBIEDs with heavier weapons, they can still be utilised to some degree in a static defence of an improvised forward operating base in the city. By using dirt berms instead of, or in combination with car roadblocks, rooftop ATGM positions, and MBTs positioned at intersections, the chances of stopping incoming SVBIEDs are raised substantially. However, the quality of defensive structures is a matter of how much time is spent constructing them, and in the end requires continuous manning and UAV monitoring for it to be efficient.

The ISF is the most vulnerable when advancing into Islamic State-held areas of Mosul in convoys. Such ground forces are not able to rely on MBTs to react fast enough and hit incoming SVBIEDs, and setting up an ATGM is unviable except for when mounted on HMMWVs. This often results in a heavy reliance on less effective close-range AT-4 rockets and rocket-propelled grenade (RPG) variants. However, these weapons are not guaranteed to stop an SVBIED. Depending on where it hits, up-armoured Islamic State SVBIEDs have been reported in some instances to have taken direct hits from AT-4/RPG munitions without prematurely detonating. The most vulnerable part of an up-armoured SVBIED is the driver's viewing port in the windshield armour, as well as the wheels. The driver’s viewing port is usually fitted with reinforced glass, sometimes taken from armoured vehicle doors. The most common way of disabling an up-armoured SVBIED without detonating it in the process is by targeting this area and killing the driver – although this is no mean feat in a situation where there is rarely a substantial amount of time to react and respond to an imminent SVBIED threat.

Another problem with countering SVBIEDs inside Mosul is a lack of mobility. When on the offensive inside Mosul, the ISF usually advances in convoys of HMMWVs, M1 Abrams MBTs, and BMP-1 armoured personnel carriers (APC), all spearheaded by bulldozers tasked with removing obstacles and bearing the brunt of Islamic State resistance. These convoys have practically no way of moving away from a potential advancing SVBIED in an effective manner, as the vehicles are typically boxed in by either the streets and buildings or the other vehicles in the convoy.

Conclusion

While an interesting and telling development, the emergence of camouflaged SVBIEDs in Mosul and later Raqqa is in line with past strategic and tactical changes to SVBIED design and employment. All SVBIED designs follow the ground rule of manufacturing and use by attempting to ensure its survival up until the intended detonation point. Beyond that, SVBIED usage is intimately linked to territorial control at the strategic level. Covert SVBIEDs are for the most part used in areas where the Islamic State has little territorial control, while up-armoured SVBIEDs are strictly limited for use at frontlines in areas where the group has at least an element of territorial control.

The Islamic State has shifted from using a majority of either type since the beginning of the insurgency in Iraq to flexible response and adaptation that has been evident in Syria and Iraq since 2013-14, and there is nothing to stop the group from reverting to using covert SVBIEDs en masse again once it loses its current territorial holdings. This strategic development has already been witnessed in urban centres recaptured from the Islamic State by the ISF, such as Falluja, as well as in areas of northern Syria recaptured by Turkish and Turkish-backed forces.

On the tactical level, innovations and variations in up-armoured SVBIED design are typically responses linked to changing environmental factors and rising threats that may negatively affect the SVBIED’s success rate on the battlefield. The logic that the Islamic State used when switching from using covert to up-armoured SVBIEDs in 2013-14 was that since the opposing force already knew the SVBIEDs were coming due to a shared and fixed frontline, it would be a waste not to armour them and provide a measure of protection against defensive fire. The problem that emerged out of that decision was that crudely-armoured SVBIEDs with rusty steel plates stood out noticeably and were easily identifiable by opposing forces. This combined with the additional loss of offensive momentum and continuous aerial attacks helped spur innovations to up-armoured SVBIED designs.

Looking at the exterior, SVBIEDs have previously mostly received paint jobs as an aesthetic feature, with the exception of up-armoured tan SVBIEDs that have been deployed around Mosul from early 2016 at the latest. On the other hand, though, camouflaged SVBIEDs were designed to emulate civilian vehicles just like covert SVBIEDs, while still offering the same defensive capabilities as an up-armoured SVBIED. They represent an especially interesting SVBIED variant, as the entire development, field-testing, and refinement process has
been documented in Islamic State propaganda - from plain white up-armoured SVBIEDs (stage 1), to fake windows/wheels (stage 2), and eventually interior armour (stage 3).

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