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IED Threat Consistency and Predictability in Fallujah: A 'Simple' Model for Clearance

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A ‘SIMPLE’ MODEL FOR CLEARANCE

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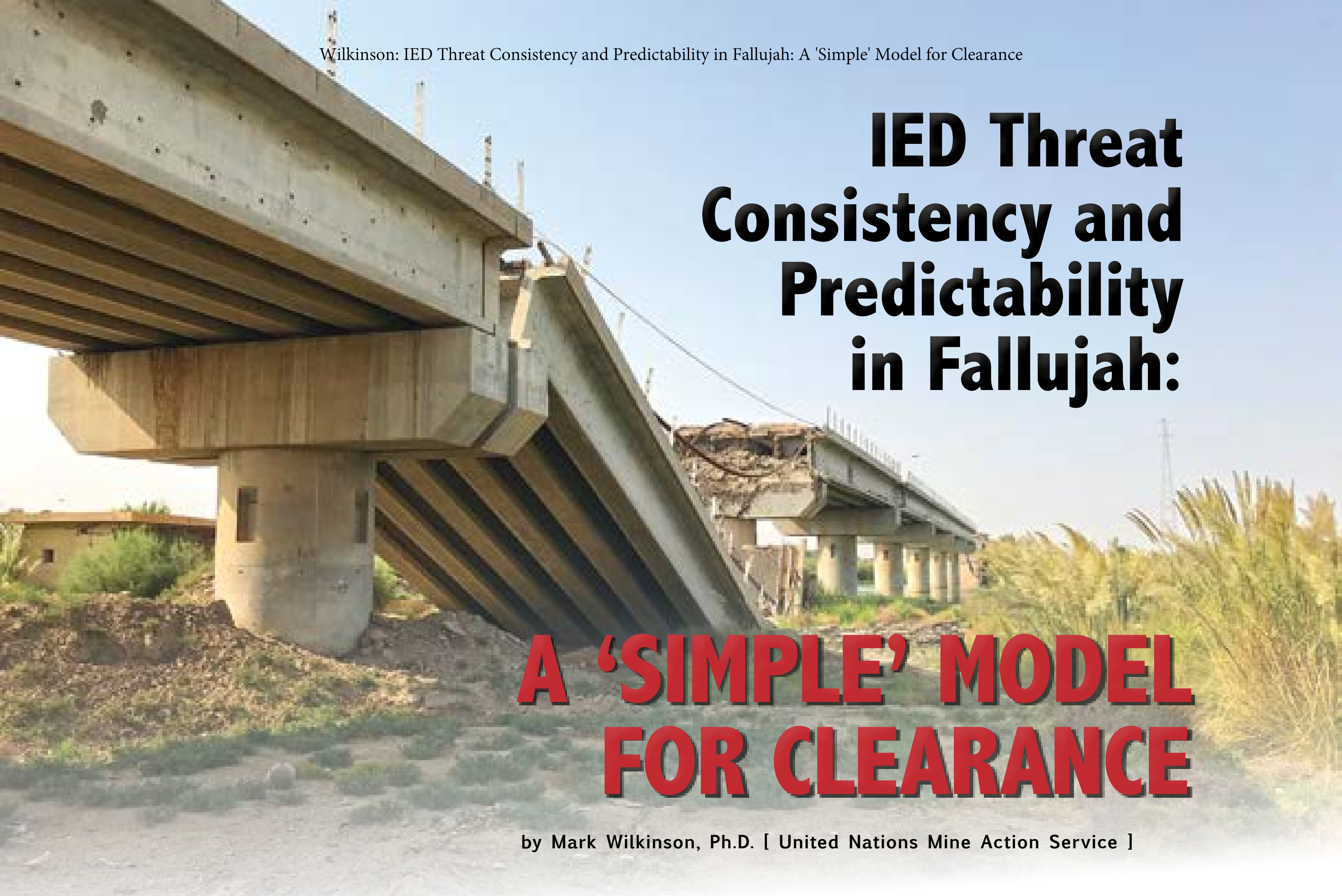


Image 1. A bridge over the Tigris River, 6 km north of Fallujah. ISIS destroyed the bridge to prevent civilians fleeing the city when the Iraqi Security Forces offensive began.
Image courtesy of UNMAS Iraq.

When in control of the area of Iraq north of Baghdad, including the city of Fallujah, ISIS prepared to defend its position from inevitable government counterattack through the widespread use of improvised explosive devices (IEDs) laid as defensive obstacles in patterns similar to conventional minefields.[1] The subsequent destruction of bridges over the Tigris River further strengthened the ability of ISIS to defend the city and prevent the civilians trapped within from escaping.

Although the Iraqi Security Forces (ISF) liberated Fallujah in May 2016, explosive hazards (EH), most significantly IEDs that lie as “weapons in wait,” continue the conflict today by depriving the Fallujah economy and society of a full recovery. For example, only after the removal of two submerged IEDs in August 2018, was the notorious Iron Bridge reopened to traffic after which a two-hour detour once again became a five-minute trip for many accessing a nearby maternity hospital.

Tasks. The bridge restoration is typical of so-called stabilization tasks in Fallujah that focus on EH clearance needed prior to restoration of essential public services and light infrastructure.[2] In addition, so-called humanitarian tasks focus on clearance of IED belts composed of victim-operated IEDs (VOIEDs).

Recovery. Following clearance by the United Nations Mine Action Service (UNMAS) Iraq, from 1 October 2016 through 22 January 2019, the United Nations Development Programme (UNDP) completed 199 stabilization tasks in Fallujah and surrounding areas. These tasks were managed by the UNDP and assigned in cooperation with the Government of Iraq through the Funding Facility for Stability (FFS)—effectively a clearing house to assign and prioritize clearance tasks so as to restore key infrastructure. In addition, in cooperation with other organizations, UNMAS completed 119 humanitarian tasks.

Mandate. Gradual progress may not be progress enough, however, when considered from a public and political perspective leading to the urgency of a “sooner-than-later” mandate for those organizations including UNMAS Iraq responsible for EH clearance. Arguably, this is the critical first step toward follow-on timely repair of infrastructure and

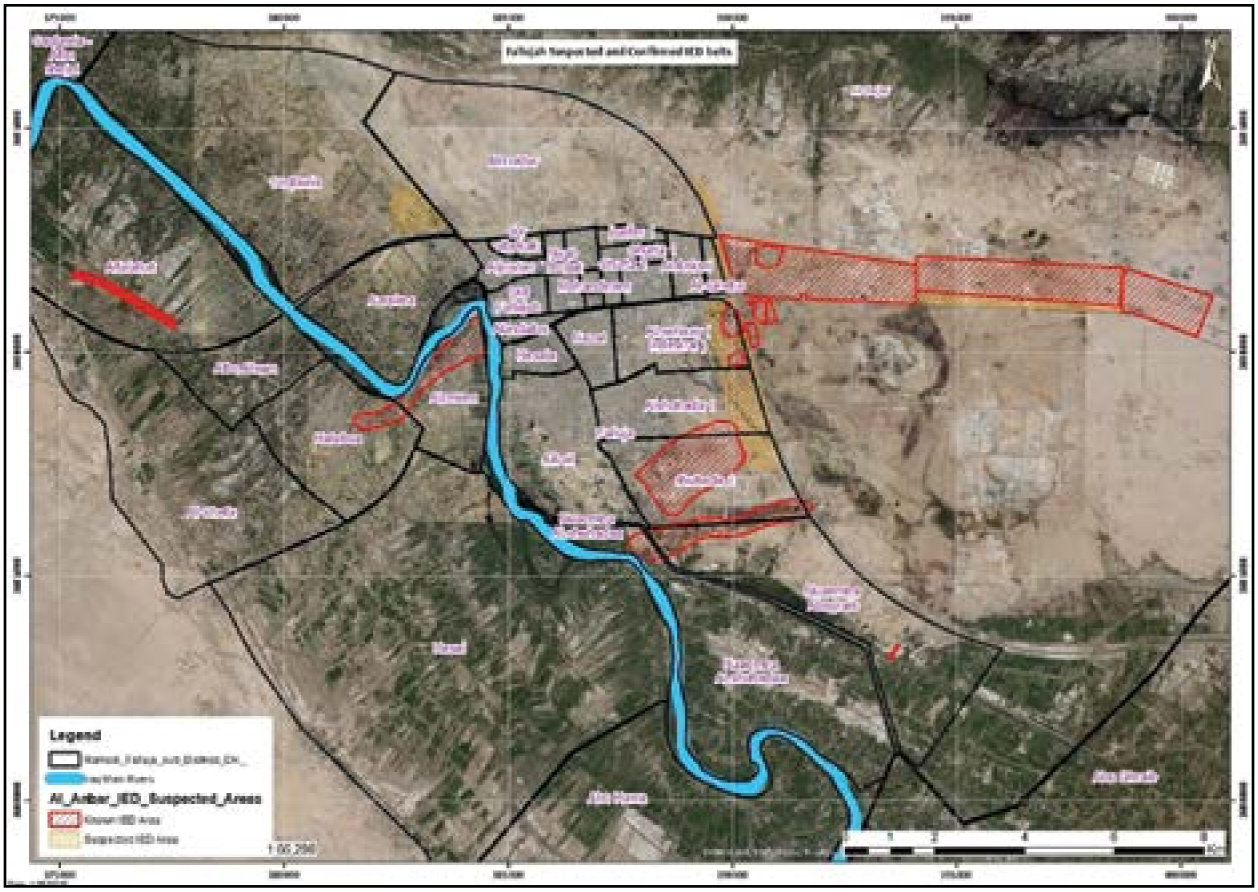


Figure 1. Known and suspected IED contamination around Fallujah (as of January 2019).
Figure courtesy of UNMAS Iraq.

ultimately the safe return home for the 1.8 million Iraqis still internally displaced, many living in camps. Such a mandate immediately leads to practical problems insofar as IED disposal (IEDD) operators need to understand the threats faced from two aspects: type and environment.

Implications. IEDD operators must identify and classify threats, consolidate and interpret related data, and thereby assess the threat environment. The more effectively the IEDD operators can draw practical conclusions about both the threats and the threat environments, the sooner they can safely commence clearance activities. Moreover, the IEDD community can then learn how to optimize clearance assets. This then leads to two questions concerning EH clearance in Fallujah:

1. What can the data tell us about the extent and type of IEDs encountered?[3]
2. What might the data contribute to the threat environment model?

Findings. UNMAS Iraq clearance data compiled during activities in Fallujah leads to three conclusions key to assessing

Images 2 and 3. Typical plastic (left) and "speed bump" (right) main charge containers in Fallujah.
Images courtesy of UNMAS Iraq.

Image 4. A typical IED obstacle belt on the outskirts of Fallujah.
Image courtesy of UNMAS Iraq.

and managing on-going clearance tasks and deployment of clearance assets in Fallujah:[4,5]

1. **Technical.** Most IEDs found in Fallujah have been victim-operated (high-metal content pressure plate) devices, only occasionally fitted with anti-lift devices.
2. **Threat.** The EH environment can be defined as relatively simple when compared to other areas of Iraq (see accompanying article, page 13).
3. **Coverage.** The amount and extent of contamination remains the biggest clearance problem.

Basis. EH clearance tasks completed by UNMAS Iraq since October 2016 provide a basis for the conclusions drawn regarding threat type, environment, and coverage. UNMAS Iraq operators cleared a total of 568 complete IEDs along with 1,139 other explosive remnants of war (ERW) from a coverage area of 2,586,546 sq m and safely removed another 4,384 IED main charges and components from this same area. In addition, UNMAS Iraq rendered safe and handed over to ISF nearly 10,000 kg of IED explosive content for destruction.

Components. Almost without exception, the IEDs recovered in Fallujah are victim-operated (VO) and crudely manufactured, but effective. The most common type uses a plastic container such as a commercial jerry can filled with 10–20 kg of ammonium nitrate and aluminum-based homemade explosive (HME), high-metal contract pressure plate(s), a 9-volt battery, detonating cord of varying length, and a commercially-manufactured electrical detonator. A common variant uses a crudely–fabricated, low-grade, steel-flattened box (colloquially known as an "explosive speed bump") for the main charge filled with the same weight and types of explosive. In the explosive speed bump variant, the explosive is often wrapped in a plastic bag to protect against weathering.

In most known cases, these devices are laid in large numbers in linear patterns of 5-to-10 m spacing, in some cases extending 10 km, and sometimes adding multiple rows for density. A location in the al-Shuhada area of Fallujah (see Image 4) illustrates a two-row deep pattern with five plastic jerry can type main charges visible (shown with red circles to the right) representing the first row and a single main charge (to the left) representing part of a second row. The presence of buildings in the background (indicated by the black arrow) illustrates the proximity of EH contamination to residential areas.

Switches. Nearly all VOIEDs recovered in Fallujah are triggered by pressure plates made from two flexible steel strips, averaging 60 cm in length, 3 cm in width, and 4 mm thickness. The two strips are normally separated by a spacer such as a piece of wood, leaving a distance of around 1.5 cm between the steel strips to be closed for the switch to function. Most recovered pressure plates have been wrapped in black rubber such as an inner tube from a vehicle tire or plastic for weatherproofing. There is usually little attempt to camouflage the switches other than to bury them, normally to a depth of 5 cm beneath the surface. Sometimes several pressure plates will be discovered in close proximity wrapped in the same color plastic and type suggesting a bulk manufacturing process.

Some VOIEDs feature an additional VO switch often called a *crush wire contact* or "rosary beads." The beads

Image 5. A pressure plate wrapped in orange plastic discovered in Fallujah.
Image courtesy of UNMAS Iraq.

refer to tiny open switches spaced at 10–30 cm intervals along lacquered wire insulated by clear plastic tubing. The entire switch can exceed 10 m in length. While more prevalent in complex and urban environments, they account for roughly five percent of switches used on VOIEDS recovered from Fallujah's contaminated areas to date, according to knowledgeable operators' anecdotal reports. To the untrained person, these can be difficult to locate visually or with a metal detector (see Image 5).

Image 6. A typical crush wire contact. Several dozen switches like this may be present on lengths of lacquered wire up to 10 m in length.[7]
Image courtesy of www.iedawareness.com.

Batteries are occasionally found as the spacer inside pressure plates but more often are simply wrapped in tape for weatherproofing and lie close to the main charge, again subsurface. Voltage checks on a small number of recovered batteries have revealed charges of a full 9-volts present, suggesting that most IEDs present are likely viable devices.

Main charges are usually buried separated from the battery by a distance of up to 2 m, again at a depth of around 5 cm. Some devices have been recovered with double pressure plates to a single main charge, others with double main charges from the same pressure plate. Whatever the variant, devices tend to be found in groups of identical devices and similarly spaced to those as already described. Operators in Fallujah have found and neutralized a number of VOIEDs equipped with anti-handling devices of three types.

Type 1 is fabricated from a plastic electrical box approximately 10 cm squared and 5 cm deep with a rocker-type switch protruding from one face and laid subsurface typically 20 cm from the main charge. When set, the switch is held down by a brick or rock that, in most cases, is obviously and clearly out of place. The switch can be closed by removing the brick or rock, as well as stepping on the pressure plate, probably targeting a tendency of novice operators to clear the area around a suspected IED before beginning render safe procedures (RSPs).

Type 2 uses the same pressure release mechanism but situates the switch underneath the main charge container. This method, recovered from several neutralized IEDs in Fallujah, targets an IED operator or virtually anyone else discovering and lifting the main charge from the ground. While the switch is easily discovered by a trained IED operator, for the less experienced or untrained person it can exploit actions that might lead them to believe a device is safe when it is not—for example, by severing the physical link to the switch.

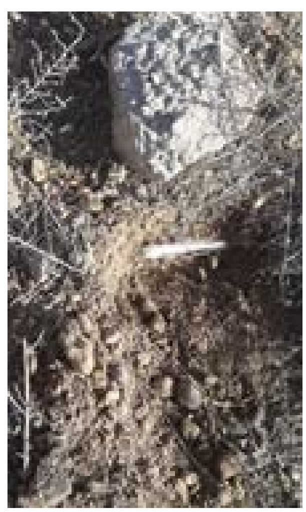
Type 3, a rarely used variant, configures the pressure plate vertically. This type has been used to target mechanical assets and their operators, in particular bulldozers that have been used to breach IED belts. These pressure plates are similar to but much smaller than (no more than 30 cm in length) Types 1 and 2. Type 3 variants are also buried much deeper (normally 10–15 cm). Setting them in a vertical plane and placed in locations where ISIS anticipated bulldozers might be used to move earth (for example, in tracks) allows for the targeting of valuable mechanical assets, initiating the IED when they are pushed aside with earth. While the main charges recovered in Fallujah are not large enough to destroy armored vehicles, they can cause extensive damage.

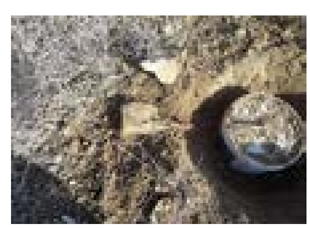
Although currently there is no accurate data on the precise numbers of anti-lift switches recovered, anecdotal evidence from interviews with international IEDD operators suggests that less than 10 percent of IEDs recovered to date are fitted with these devices.

Consistency. There is certainly sufficient evidence from an analysis of the 568 IEDs recovered to date from Fallujah by UNMAS Iraq operators to draw a number of conclusions, all relating to consistencies.

First, the design of pressure plates and main charges (either plastic or the explosive speed bump variant) is normally the same. This suggests that a deliberate and well-planned production facility existed and was capable of manufacturing a large number of pressure plates and main charges with a relatively high standard of design and reliability.

Second, the configuration of the device in the ground is normally similar enough to be predictable. In a given line of IEDs, it is extremely unusual to find a device where the switch, main charge, and power source are not located in the same layout. This suggests that these IEDs are probably laid by relatively unskilled persons taught to emplace the IEDs through a series of steps or rules as a drill.





Images 7 and 8. An in-place anti-lift switch. Note the presence of the rock on the anti-handling switch and the proximity of that switch to the main charge.
Images courtesy of UNMAS Iraq.

Third, the IED belts in Fallujah reveal a remarkable consistency in their pattern not unlike Warsaw Pact tactics for establishing defensive minefields. Given the quantities and types of Soviet equipment used by Saddam's Iraqi Army, it is reasonable to assume some individuals trained in conventional methods for laying minefields later offered their services to ISIS.

Implications. What might the community conclude from the data related to the work done in Fallujah concerning the types and locations of IEDs rendered safe? To answer this question, operators need to evaluate their findings relative to the environment and RSPs. On that basis, the findings related to work in Fallujah show consistent and predictable patterns useful in planning, conducting clearance operations, and managing clearance assets efficiently.

Model. These consistent and predictable qualities argue for and help to define what the community might term a simple model. Several factors support this argument:

1. **Location.** IEDs were deployed in belts by ISIS on the periphery of Fallujah for a clear purpose, namely to stall any ISF assault. In these mostly rural areas, the ground could be dug easily and quickly for emplacement purposes.
2. **Clutter.** Although the defensive belts often cut through open ground adjacent to residential and other built-up areas, they otherwise tend to be relatively clean, with little surface or subsurface metallic contamination present other than occasional items of unexploded ordnance (UXO) and associated scrap metal such as mortar-tail sections.
3. **Dimension.** Except on rare occasions—classified as the Type 3 IED that uses a vertical pressure plate switch and thereby could be viewed as a three-dimensional threat—almost all IEDs in Fallujah are two-dimensional threats located either at the surface or subsurface with clear implications for RSPs.
4. **Degradation.** IEDs are susceptible to degradation for reason of seasonal variations in weather, in particular the cumulative effect of repeated heavy rainfall and flooding. The impact of weathering is especially noticeable on ammonium nitrate-based explosives. Numerous main charges recovered have shown both plastic and metal casings shattered by explosives expanding as they absorb water. Type 2 IEDs' (explosive speed bumps) main charges are also susceptible to rapid oxidation of the casings with many severely corroded.
5. **Exposure.** IED pressure plates often can be found in the open and on the surface due to the action of rain water washing away less compacted earth covering them.
6. **Human.** Local residents who either have witnessed, have roles in setting IEDs, or have knowledge of their existence have proven to be a significant source of information concerning details on locations and emplacement methods, contributing to Non-technical Surveys as well as subsequent clearance operations.
7. **Render Safe.** In terms of neutralization and RSPs, analysis of recovered IEDs strengthens an argument that this is a simple environment for three reasons.
   - » **Easy to locate.** Standard metal detection equipment can identify extremely strong metal signatures from the ubiquitous high-metal content pressure plate
   - » **Signature.** Detector heads can localize and define the size of the signature, often defining the pressure plate before any manual intervention takes place
   - » **Visual.** Even the crush wire contact switch has proved relatively easy to detect by trained personnel, firstly by using the naked eye and secondly by detecting a strong signature via the Minelab F3 Compact used by the majority of UNMAS High Risk Search Teams in Fallujah.[7]

Given the relatively "clean" environment these IEDs exist within, as well as the identification and cancellation of spurious contacts (including UXO scrap such as shrapnel), RSPs are normally a relatively simple and quick process.

Conclusion

In summary, consistency and relative simplicity of device design and layout as described greatly facilitate RSPs in Fallujah. Where an IED operator is working within an established IED belt, the consistency of the device's linear pattern, regular spacing, and makeup is usually obvious. This then gives search teams, team leaders, and IED operators a degree of confidence in planning and conducting clearance activities.

Exceptions. Where secondary switches are incorporated into devices, their presence so far has been obvious. For switches utilizing a brick or rock to encourage pressure release, a pair of wires can easily be located running from the suspected switch location toward the main charge. For pressure release switches, the careful fingertip exploration of the area around the suspected main charge normally identifies wires running from the detonator (always found on the top of the main charges) to the underside of the main charge container. Regardless of the presence of anti-handling switches, RSPs remain relatively easy. IED operators identify the location of the IED's component parts and then take semi-remote action against either the power source or the detonator. A careful fingertip isolation of the switch, main charge, and any other suspected component easily allows them to

Image 9. Four complete VOIEDs neutralized by a local national IED operator in the al Shuhada district of Fallujah on 24 January 2019.
Image courtesy of UNMAS.

Image 10. A local national IEDD operator shows the results of his day's work in Fallujah.
Image courtesy of UNMAS.

negate the presence of additional detonators or power sources prior to semi-remotely breaking the circuit. Hook-and-line procedures further reduce any residual risk to search teams in completing the neutralization of devices.

Skills. The simple environment model has implications for operations transferred to local national personnel when appropriately trained. Based on collected data and UNMAS-documented operations, and the types of devices encountered, both search and RSPs can be broken down into simple, basic drills that can be taught, practiced, and assessed for relatively inexperienced personnel. According to a year-long pilot study, after a six-week training course led by experienced international technical advisors, a cadre of predominantly former-ISF, IED-operator recruits deployed as members of two Rapid Response Teams to Fallujah where their work was monitored and found successful in terms of IEDs located and rendered safe.

Variables. An assessment of UNMAS data compiled from Fallujah suggests three variables define a simple environment model for conducting IED clearance both there and in similar environments. Moreover, it suggests a simple environment model could benefit from a second order analysis and evaluation of data related to interaction of these three variables.

Caveat. The simple environment model, like all models, depends upon assumptions and conditions continuing without change, which may not be the case for at least two reasons. First, the ISF previously conducted render-safe clearance of some IED belts near Fallujah according to military standards and under combat conditions, which necessitates an approach different from humanitarian standards. In many cases, these military RSPs require only the removal of detonators, probably by hand, while leaving the charge in place, which, within the context of humanitarian clearance standards constitutes a potential threat. Second, evidence suggests that Iraq is not yet a fully post-conflict environment insofar as IEDs continue to be placed by ISIS operatives. Such old and new threats make continuing threat assessments necessary to ensure that processes in use are not likely to be exploited by any belligerent forces.

Applicability. EH clearance operations, particularly in high-threat and IED-laden contexts containing complex environments such as in Mosul (see companion article, page 13) are, by definition, extremely expensive compared to relatively simple environments such as Fallujah. Given the number of IEDs, the worldwide effort to address clearance in a timely, cost-effective way while protecting operators has become a matter for further data analysis and revised models. Effective business plans need to start with solid, applicable field experience quantified by data and driving an operational concept. To date, the UNMAS Iraq experience in Fallujah says this is possible even in the short term and is already being tried and has proven to be a working concept.

See endnotes page 60

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