

Emergency personnel at the United Nations offices which were devastated by a bomb blast in Abuja, Nigeria, August 2011. © Afolabi Sodtunde/Reuters



'Infernal Machines'

IMPROVISED EXPLOSIVE DEVICES

INTRODUCTION

Shortly after 6 p.m. on 17 February 1880, Stepan Khalturin lit a fuse in the cellar of the Russian tsar's Winter Palace in St Petersburg. Around 15 minutes later, the fuse initiated 145 kg of explosives that the carpenter had smuggled into the palace on behalf of the revolutionary group, The People's Will. The resulting explosion killed and injured around 50 people, many of them servants.

The People's Will was well aware that the bombing would endanger ordinary workers—the very people the group professed to be trying to liberate—but deemed the casualties acceptable if Tsar Alexander II was killed. 'It will kill 50 without a doubt', said one of the plotters. 'It is better to put in more dynamite so they don't die in vain, so it definitely gets him.' The sacrifice was futile, though, as the Russian monarch was not in the dining hall when the bomb exploded because his guest was late for dinner (Radzinskii, 2005).

This was the first mass-casualty attack carried out using high explosives and detonators, technology that had only been invented around a decade earlier by Alfred Nobel. The Swedish industrialist had devised a way to stabilize nitroglycerine in the form of dynamite and to detonate it using small charges of less stable explosives. These technological breakthroughs had incalculable benefits for the mining and construction industries, but also put hitherto unimaginable destructive power in the hands of small groups and individuals. Fin-de-siècle anarchists seized on this democratization of violence, using the power of high explosives to carry out spectacular bombings with the aim of intimidating their enemies and inspiring followers.¹

In the days of the anarchists, bombs were referred to as 'infernal machines'; now they are less colourfully known as improvised explosive devices (IEDs). With the addition of various prefixes, this term covers an extremely wide range of explosive devices, from letter bombs to suicide vests, as well as trucks and boats laden with explosives. IEDs have become the principal weapon for insurgents who are fighting superior military forces. They have also become a significant cause of civilian casualties.

This chapter surveys the range of IEDs utilized today, the tactics used to deploy them, the resulting civilian casualties, and efforts to mitigate the threat. Its key findings are:

- IEDs killed and injured at least 13,000 civilians in 44 countries in 2011, according to open-source reporting. The actual toll is probably higher and more research is needed to assess the overall impact that IEDs have on communities, development, and governance.
- Globally, the ratio of non-fatal civilian IED injuries to deaths was approximately 3:1 in 2011.
- The vast majority of civilian IED casualties occurred in Afghanistan, Iraq, and Pakistan in 2011.
- It is possible to make it harder for militants to source the materials most commonly used to make the large IEDs that are responsible for the majority of civilian casualties, but such measures are difficult to implement, especially in the worst-affected countries.

- Militant Sunni Islamist groups are responsible for the overwhelming majority of civilian casualties inflicted in IED attacks. This is largely attributable to their use of large IEDs and indiscriminate tactics.

The chapter begins by providing an overview of the various types of IEDs and the contexts in which they are used. It then examines the available information on the impact of IEDs on civilians and assesses the types of weapons and tactics that are responsible for the majority of casualties. It continues by looking at efforts to mitigate the threat of IEDs with a particular focus on counter-proliferation, and concludes with reflections on the current challenges facing efforts to reduce IED proliferation.

A TYPOLOGY OF IEDS

Militant Sunni Islamists are responsible for most civilian casualties in IED attacks. By definition, all IEDs contain a main charge of explosives. Much like military and commercial explosive specialists, improvised-bomb makers typically use a relatively inert explosive that can be handled safely for their main charge. These are initiated by a small charge of a more sensitive primary explosive that detonates readily. The most common type of detonator (also known as blasting cap) consists of a small metal tube filled with a primary explosive, such as mercury fulminate, which is initiated by an electrical charge. IEDs that use such detonators require one or more batteries to supply the necessary power. The activation mechanisms (switches or triggers) on these IEDs consequently involve various ways of completing an electrical circuit.

The complexity of IEDs increases with size. A larger device requires multiple detonators or detonating cord to ensure the whole of the main charge—which is generally divided into multiple sub-charges—detonates simultaneously. Also known as det/primer cord, detonating cord consists of a flexible, plastic tube that wraps around a core of high explosive and can be cut to length as required. High-explosive booster charges are needed in IEDs whose main charges cannot be initiated by detonators (such charges are known as ‘cap-insensitive’). Bomb makers often add fragmentation (commonly referred to as shrapnel) such as ball bearings, nails, and bolts to their devices to increase lethality. The typology presented here classifies IEDs according to their switch or activation system.²

Time-delayed

Time bombs remain a staple IED due to their simplicity. These can be as crude as a burning fuse that gives the bomber time to reach safety. While this might seem old-fashioned, the system is still used. For example, Norwegian right-wing extremist Anders Breivik used a cannon (or visco) fuse to initiate a vehicle bomb containing 950 kg of explosives in Oslo on 22 July 2011. Used in commercial fireworks displays, cannon fuses consist of a core of black powder wrapped in layers of string and nitrocellulose, a combination that burns at around 1 cm per second. They are considered ineffective for many types of IED as they burn with a visible flame and emit smoke. Nevertheless, they are often used in improvised hand grenades and pipe bombs, which are employed in significant numbers in some areas, notably northern Nigeria.

The next level of sophistication involves the use of an analogue clock or kitchen timer. A metal contact is attached to a clock hand or a timer’s rotating mechanism, so that it will eventually reach another contact, thus completing a circuit and activating the device. Digital clocks and timers are also used, including the clock or countdown functions on mobile telephones. Tapping into the device’s circuit board requires a degree of electrical proficiency.

Victim-operated

Victim-activated or -operated IEDs (VOIEDs) include a range of devices, such as mail bombs that function when opened, improvised mines that explode when someone steps on them, and booby traps that are activated by other means. In their simplest and most common form, VOIEDs are activated when a person, vehicle, or animal applies sufficient pressure to push together two metal contacts or to press a button that allows an electrical current to flow to a detonator embedded in a main charge of explosives. Such devices are known as pressure-plate IEDs.

Pressure-release IEDs or explosive booby traps are typically similar in their operation: by removing weight from the device, a victim causes two metal contacts to come together, thereby completing an electrical circuit. For example, bombers set devices with one contact weighed down by an object that a victim might be tempted to pick up.

VOIEDs can also be initiated by tripwires. These can be as basic as using a clothes peg on the end of a wire to hold electrical contacts apart. When the victim pulls the wire, the clothes peg snaps shut, completing the circuit. More sophisticated VOIEDs include tilt switches or other forms of anti-tampering mechanisms. These can involve a metal ball bearing that rolls down a plastic tube when it is tilted and then completes a circuit. Passive infrared sensors are another sophisticated way of triggering VOIEDs.

Command-operated

IEDs that are operated from a distance are generally known as command-operated IEDs (COIEDs). They are often used in ambushes since they allow militants to detonate a pre-emplaced device at the precise time a target moves into the target area. At their simplest level, these can be the same as tripwire devices, but with the bombers pulling the wire when they want to detonate the device. Electrical cables can be used to the same effect, with the bomber completing the circuit from a distance. Both types are known as command-wire IEDs.

IEDs operated from a distance are known as command-operated IEDs (COIEDs).

Radio- or remote-control devices are another common form of COIED. Car alarms, garage door openers, remote control toys, mobile telephones, and two-way radios have been adapted to this purpose. This type of IED is vulnerable to electronic countermeasure systems that prevent initiation signals from reaching the device; when effective, these systems can force the insurgents to revert to more primitive types of initiation, including command wires or victim-operated systems.

Suicide bomber-operated

The IEDs used in suicide bombings are forms of command-operated devices as bombers initiate them at a time of their choosing, generally using a switch that completes an electrical circuit. These IEDs sometimes involve switches designed to actuate the device if the bomber is killed by defensive counter-fire. This is done with some form of 'dead man's switch' or a remote-control trigger operated by a handler with visual oversight of the attack. The latter system can also be used to activate the device if the bomber has second thoughts about completing the mission.

The devices used in suicide bombings are typically referred to as body- or person-borne IEDs (PBIEDs) when used by bombers who approach their targets on foot. Suicide vehicle-borne IEDs (SVBIEDs) involve a driver who steers a vehicle laden with explosives towards a target; this approach tends to utilize civilian cars, minibuses, and trucks, but boats have also been used.

PBIEDs usually consist of a vest containing one or more high-explosive charges covered in outward-facing fragmentation. While these devices are generally worn inconspicuously under normal clothing, some bombers have responded



A policeman examines the remains of a vehicle used in a suicide bomb attack on the home of a colleague in Quetta, Pakistan, April 2011.
© Naseer Ahmed/Reuters

to improved security by developing new ways of concealing PBIEDs. In 2011, for example, a series of Afghan officials were assassinated by suicide bombers who had concealed IEDs in their turbans, knowing their headwear would not be searched. Similarly, female and child suicide bombers are widely presumed to have been used in Iraq because they attracted less suspicion and, in the case of women, because they were less likely to be searched by members of the security forces, who are predominantly men (Rubin, 2009).

Al Qaeda and its affiliates have developed IEDs that are specifically designed to pass undetected through airport security, disguised as shoes and various carry-on items such as beverages and disposable cameras. More recently, the Yemen-based affiliate Al Qaeda in the Arabian Peninsula managed to get an IED on board an airliner in the underwear of a would-be suicide bomber and on cargo aircraft inside the toner cartridges of printers (BBC News, 2010). None of these efforts have been successful.

SVBIEDs allow for the covert delivery of larger charges into a target area as the explosives can be concealed in the vehicle. Covertness is often a secondary consideration when SVBIEDs are used to attack well-defended targets. In such cases, the vehicles tend to be laden with explosives and driven as fast as possible towards the objective. Gunmen are sometimes tasked with overwhelming or distracting security personnel so the SVBIED can get closer to the primary target.

Improved explosive projectiles

Although not classified by their activation mechanism, improvised explosive projectiles are an important category of IED. They consist of any improvised standoff weapon that fires an explosive charge towards a target. They include direct-fire weapons such as improvised shoulder-launched rockets and rifle grenades, but more commonly take the form of indirect-fire (parabolic-trajectory) weapons, specifically improvised mortars and artillery rockets. Such weapons are generally directed against targets that are far away or in well-defended positions that cannot be effectively engaged with direct fire.

The Provisional Irish Republican Army (PIRA) used improvised mortars against security forces facilities in Northern Ireland, where the weapons were sometimes referred to as 'barrack busters'. A multiple-launch version was also used to bring down military helicopters (Geraghty, 1998). More recently, Palestinian militants based in the Gaza Strip regularly fired improvised artillery rockets known as 'Qassams' (after a militant cleric) into Israel. Videos released by militants in Iraq and Syria show that they have fabricated similar weapons (Ansar al-Islam, 2011; Stratfor Global Intelligence, 2012).

The effectiveness of improvised rockets is limited as they typically have less powerful motors and warheads than military equivalents and are significantly less accurate. Palestinian militants have fired several thousand Qassams into Israel since 2001, killing 15 civilians up until the end of September 2012, according to the Israeli government (Israel MFA, n.d.).

While militants favour factory-produced artillery rockets over their home-made counterparts, there is still an improvised element in most of the militant attacks involving the former, which are designed to be launched in barrages by vehicle-mounted launchers. Militant groups rarely have military launchers and thus improvise their own. This can be as crude as laying the rocket on a suitably inclined piece of ground, a procedure that does nothing to improve accuracy and heightens the danger to civilians in the vicinity of the target. To mitigate the threat of a rapid military response, militants often use time-delay mechanisms so that they can leave the scene before the rockets are launched.

Among the most effective improvised indirect-fire weapons deployed to date are improvised rocket-assisted mortars or munitions (IRAMs), which the US military has described as a signature weapon of Iranian-backed Iraqi militant groups (JIJEDDO, n.d.b). Sometimes referred to as 'flying IEDs', these are cylinders filled with approximately 100 kg of explosives and attached to 107 mm artillery rocket motors. Starting in November 2007, they were periodically fired in intense barrages from the back of civilian trucks over short ranges at US bases in Iraq. While IRAMs were exclusively used against US military targets in Iraq and no attacks have been recorded in that country since US forces withdrew at the end of 2011, they could potentially cause high civilian casualties if used against populated areas. This may have happened in Syria in early 2013, where government forces used similar weapons (Chivers, 2012a).

Other characteristics

IEDs can also be defined by other characteristics, including the type of target they are designed to engage. Anti-personnel IEDs are generally comparatively small and/or contain fragmentation; anti-armour IEDs are either large or focus their energy. The latter include shaped charges, platter charges, and explosively formed projectiles or penetrators, all of which fire metal liners towards their target from varying standoff distances. These are all directional IEDs that are not designed to be buried in the ground. Anti-personnel IEDs can also be directional. These tend to consist of a metal box filled with explosives and a layer of fragmentation on the open side, which is placed facing the target. They are sometimes referred to as improvised claymores, after the US military's M18 directional anti-personnel mine. Both anti-armour and anti-personnel IEDs can be either VOIEDs or COIEDs.

IRAMs are among the most effective improvised indirect-fire weapons deployed to date.

THE IMPACT OF IEDS

Weapons of asymmetric war

The term 'IED' was popularized by the use of vast numbers of improvised explosive devices during the recent conflicts in Iraq and Afghanistan. IEDs became the primary weapon for insurgents in these conflicts due to the asymmetric nature of the battle between irregular forces and the world's best-equipped and most technologically advanced militaries. All the same, IEDs are not new and are used by most insurgent groups currently operating around the world. Open-source reporting suggests that around 60 per cent of violent actions by non-state actors involve IEDs (AOAV, 2012, p. 24).

IEDs are used by most insurgent groups operating around the world.

Cheap and easy to construct, IEDs allow lightly armed and barely trained militants to engage far better-equipped security forces. They help tip the balance in an asymmetric conflict by enabling insurgents to inflict casualties without exposing themselves. IEDs also hamper the mobility of security forces as they have to conduct time-consuming sweeps for concealed devices and are weighed down with equipment such as metal detectors, electronic countermeasure systems, and robots. In addition, the security forces may have to use more heavily armoured vehicles with limited off-road capabilities, thereby restricting their ability to patrol rural areas and allowing the insurgents to establish and maintain control over territory.³

The shadowy nature of IED warfare can sap the morale of security forces far more effectively than conventional fighting. Soldiers operating in high-threat environments have to bear the strain of knowing they could be attacked at any moment. They face sudden death or life-changing injuries, with limb amputations being a particularly common result of IED attacks. Security forces that suffer casualties and are unable to engage their elusive adversaries have been known to vent their frustrations on local civilians, thereby undermining efforts to engage communities in the counter-insurgency effort. While this is more often a problem among ill-disciplined forces, even highly trained NATO soldiers have been known to fire randomly when attacked (Meo, 2008; Will, 2012). The threat from suicide bombers can also limit interaction between security forces and locals.

IEDs are the primary tool for strategic attacks on critical infrastructure. Oil and gas pipelines are particularly vulnerable and carry a key source of foreign revenue for many states. Insurgents looking to put pressure on governments also target mobile telephone networks, railway lines, bridges, electricity grids, and tourist resorts. Such actions disrupt commerce, limit communication, and undermine confidence in the authorities.

Civilian casualties

While many insurgent groups claim to target only combatants, civilians are often the victims of their IEDs. There is no single body of definitive figures of civilian casualties caused by IEDs around the world. That said, the NGO Action on Armed Violence has set up the Explosive Violence Monitoring Project (EVMP) to track civilian casualties caused by IEDs and explosive military ordnance around the world. The EVMP stresses that its database is populated using English-language media reporting and offers a useful indicator of the scale and pattern of explosive violence, rather than a comprehensive survey of all such incidents.⁴

It is also particularly difficult to assess injuries caused by IEDs as the figures reported by the media are often vague and do not detail the severity of the wounds, which can range from relatively minor lacerations to life-changing disfigurement and disability. More serious injuries have a considerable impact on societies, as caring for the victims can put a significant strain on families and health systems. Modern prosthetic limbs, for example, cost thousands of

dollars. In 2012, the Iraqi Ministry of Health estimated that the annual demand for new prosthetic limbs hovered around 20,000 and that more than 72,750 had been distributed over an unspecified timeframe. These figures include demand from people who have suffered amputations due to all causes, not just IEDs (Al-Shumosi, 2012).

There has been increased reporting on traumatic brain injuries resulting from IED blasts. Medical research has also found that large numbers of IED survivors could suffer from an Alzheimer's-like condition called chronic traumatic encephalopathy later in life (Mooney, 2012). While the condition is normally associated with athletes who have received repeated head injuries, it can be caused by a single IED blast. The psychological trauma of IED attacks is even harder to gauge but is likely to be considerable.⁵

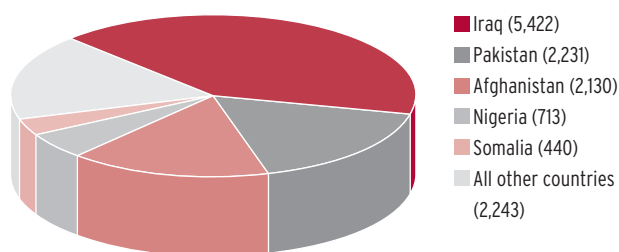
The EVMP data shows that 3,352 civilians were killed and another 9,827 injured by IEDs in 44 countries in 2011. According to the data, the ratio of non-fatal injuries to deaths for that year is approximately 3:1 globally, with variations by context. In Afghanistan, the fatality rate was higher, with 1,301 non-fatal injuries and 829 deaths, yielding a ratio of about 3:2; in Iraq, there were 4,295 non-fatal injuries and 1,127 deaths, or a ratio of roughly 4:1. With more than 5,400 casualties in 2011, Iraq has been the worst-affected country in recent years, according to EVMP data. The US military has estimated that 21,000 civilians were killed and 68,000 injured by IEDs in Iraq from 2005 to 2010 (Vanden Brook, 2011).

After Iraq, the countries where civilians have been most heavily affected by IED usage in recent years are Afghanistan and Pakistan. IED attacks in these three countries accounted for 74 per cent of the total number of civilian



A technician works at a prosthetics factory in Baghdad, Iraq, where the numerous war-related injuries have created a high demand for the aids, December 2011.
© Mario Tama/Getty Images

Figure 10.1 **EVMP record of IED casualties (injured and killed) by country, 2011**



Source: EVMP 2011 dataset provided to the authors by Action on Armed Violence, 2012

every day, often in remote and dangerous areas. The Afghan figures, for example, can be compared to those released by the United Nations Assistance Mission in Afghanistan (UNAMA), which is more systematically gathering data on civilian casualties through an extensive network of sources (UNAMA, 2012). It reported that 967 civilians were killed and 1,586 injured by IEDs in 2011. Even though these figures do not include the casualties caused by IEDs used in suicide attacks, they are around 20 per cent higher than the EVMP's figures of 829 killed and 1,301 injured. Another 431 civilians were killed in suicide attacks, according to UNAMA, although not all by IEDs as the perpetrators sometimes used firearms as well as bombs.⁶

The IED toll may be even higher than UNAMA's reporting suggests. According to declassified military statistics, 3,843 civilians were killed or injured in IED attacks carried out by anti-government elements in Afghanistan in 2011. This figure is 80 per cent higher than the one recorded by the EVMP using open sources.⁷ By comparison, 252 Coalition military personnel were killed by IEDs in Afghanistan in 2011, accounting for slightly more than half of all hostile deaths of those forces (iCasualties.org, n.d.).⁸

IEDs also have a wider socio-economic impact on communities. Normal life in parts of Afghanistan has been significantly disrupted, with locals unable to tend their fields and orchards or travel on roads, which consequently cuts them off from schools, medical facilities, and markets (see Box 10.1). The same threat deters investment and aid projects, while greatly increasing the expense of any development work that is undertaken as aid workers and officials have to take restrictive and expensive security precautions.

Some militant groups deliberately try to restrict the development of communities, thus making them less supportive of the government and more vulnerable to subversion. The most striking example of this was a series of attacks on the international community and NGOs in Iraq starting in 2003. The first attack came in Baghdad on 19 August 2003, when an SVBIED targeted the Canal Hotel, which had been converted into the United Nations headquarters, killing more than 20 people, including Special Envoy Sergio Vieira de Mello (Power, 2008). While one of the key figures behind the bombing later testified that it was revenge for the UN Security Council's imposition of sanctions on Iraq during the 1990s and for the special envoy's role in the secession of East Timor and Bosnia and Herzegovina, it was part of a wider pattern of attacks that appeared to be designed to intimidate the international community and aid groups. Further attacks on the UN and the International Committee of the Red Cross persuaded both organizations to pull their foreign personnel out of Iraq by the end of October 2003, depriving the country of their resources and expertise.

casualties recorded by the EVMP in 2011 (see Figure 10.1). The fourth and fifth worst-affected countries are Somalia and Nigeria, which together suffered 9 per cent of total casualties. In all the top five countries, militant Sunni Islamist groups are either the only or primary users of IEDs.

These figures reflect a degree of under-reporting, especially in intense conflict zones where researchers and journalists struggle to record all the IED attacks that take place

Box 10.1 Life in the IED zone

The most prolific IED usage in Afghanistan has occurred in parts of Helmand and the agricultural districts of western Kandahar. Kandahar city, the former Taliban locus of control, is targeted with suicide attacks in addition to IEDs. Sixty per cent of the 20,866 IEDs encountered in Afghanistan in 2011 were in Helmand and Kandahar.⁹ Interviews conducted for the Small Arms Survey in Helmand and Kandahar with a Taliban commander, tribal elders, farmers, law enforcement personnel, and a female activist confirmed IEDs as the most hazardous insurgent weapon, particularly because strikes often resulted in multiple casualties. Interviewees described the day-to-day IED threat as greater in volatile rural areas, particularly on unpaved roads, although they also noted the unpredictability and severity of suicide attacks in urban areas.

The chances of survival are reduced for victims of multiple-casualty incidents as health care facilities are overwhelmed by both the number of wounded and the serious nature of their injuries. A doctor working in Kandahar said that the hospital did not have sufficient beds to handle the casualties caused by major IED attacks, such that some victims had to be accommodated on the floor. He added that people in rural areas risked dying of blood loss because of a lack of local first-aid facilities.

IEDs can have a devastating impact on Afghan families, especially if multiple family members are killed or injured in a single incident. A female activist described how more than 20 women and children were killed and injured when a bus carrying her relatives to a wedding struck an IED. A tribal elder recalled an incident in which a family was killed when their vehicle hit an IED and then relatives travelling to pay respects were killed and injured in precisely the same way.

Locals said that moving from rural areas to district centres or provincial capitals placed them at the greatest risk of triggering an IED. Facilities in villages are often non-existent, so the associated reluctance of rural people to travel restricts their access to health care, education, and government. Pointing out that the threat of an attack was greatest around military convoys and government facilities, locals reported that they avoided government facilities. Feelings of insecurity were also reported in markets and other public spaces, particularly in those close to government facilities. Farmers and elders complained that IEDs restricted access to agricultural land and markets and that grazing livestock were also at risk.

A local policeman noted that the insurgents warned people not to travel at night, left indicators such as circles of stones, or blocked access to alert locals as to the presence of IEDs. Yet, as an elder stated, the number of IEDs and the wide area in which they are planted mean that locals are still at risk, as are outsiders who visit the area. Insurgents sometimes trigger IEDs unintentionally, underlining the irresponsible deployment of the weapons.

A police chief reported that, despite the fears of IED explosions, some local people were involved in IED fabrication and placement, for example by smuggling fertilizer from Pakistan to Afghanistan. One doctor recounted that he had treated bomb setters who were injured during a premature detonation, saying they were naïve and inexperienced locals who had been recruited by the Taliban. Other interviewees affirmed that the Taliban recruited youths to plant IEDs.

The Taliban commander interviewed refused to take responsibility for civilian casualties inflicted by IEDs. Although he acknowledged that some civilians had been killed, he suggested this was their own fault as they had ignored warnings about the placement of IEDs on certain roads. He said the Taliban's top-level religious guidance committee had issued a *fatwa* (ruling) allowing the use of VOIEDs, but that Taliban leader Mullah Mohammed Omar had also issued directives to avoid harming civilians with the devices. He added that no attempts to negotiate an end to IED usage could take place while the Coalition forces had freedom of movement.

A tribal elder underscored that residents were afraid to demonstrate against IED usage as this would imply that they were protesting against the Taliban and cooperating with the government. He said that locals who expressed such dissent could be added to insurgent hit lists.

Indiscriminate weapons and tactics

The likelihood of civilian casualties is greatly increased by the use of indiscriminate types of IEDs as well as disregard for civilians on the part of the bombers. All IEDs represent potential threats to civilian life and livelihoods, but some types are fundamentally more dangerous than others. COIEDs are among the least indiscriminate as they are designed to be triggered only when the intended target is in the target area and attacks can be aborted if civilians are at risk.

Time-delay IEDs are less precise weapons than COIEDs. A bomb may have been planted to target a specific individual who is normally in a certain place at a certain time, but a slight change in routine can mean the explosion

misses the intended victim and inflicts unintended casualties. Some militants plant time-delay IEDs and then provide a warning so that the authorities can evacuate the threatened area, thereby demonstrating their capabilities, causing disruption, and damaging property. It also means the militants will be taken seriously when they call in future warnings, even if they have not planted a device.

However, this tactic can go wrong. One notorious example is the vehicle-borne IED (VBIED) that was set to detonate in the Northern Irish village of Omagh on 15 August 1998. The militant Irish nationalists responsible for the device telephoned warnings to journalists from around 40 minutes before the device was set to explode, but the wrong area was evacuated and 29 people were killed (BBC News, n.d.b).

Most VOIEDs are even less discriminating. While various militant groups around the world have deployed VOIEDs, they have been used on an unprecedented scale in the current conflict in Afghanistan (see Figure 10.2). In its mid-year 2011 report, UNAMA noted that 13,000 of the 20,000 IEDs cleared over a 12-month period had been analysed and 69 per cent (8,970) were VOIEDs, with 90 per cent of those (8,073) involving pressure plates (UNAMA, 2011, p. 2). Extrapolating this ratio to the entire sample would suggest that, of the 20,000 IEDs deployed by insurgents, at least 12,000 were pressure-plate VOIEDs. UNAMA also found that most pressure-plate IEDs contain approximately 20 kg of explosives, meaning the victims have little chance of survival, and the majority that had been analysed by the UK's Defence Exploitation Facility would be activated by 10 kg of pressure, the weight of very young child (UNAMA, 2011, pp. 2, 16).

Afghan insurgents have at times tried to mitigate the threat to civilians by advising locals to avoid areas where IEDs have been emplaced, typically by distributing 'night letters' around communities. These might inform locals of areas to avoid or warn them against travelling at night. A UN Mine Action Service (UNMAS) official told the Small Arms Survey that there was considerable regional variation in the extent to which insurgents were trying to mitigate civilian casualties, which probably reflected the varying levels of interaction between local insurgent groups and communities.¹⁰

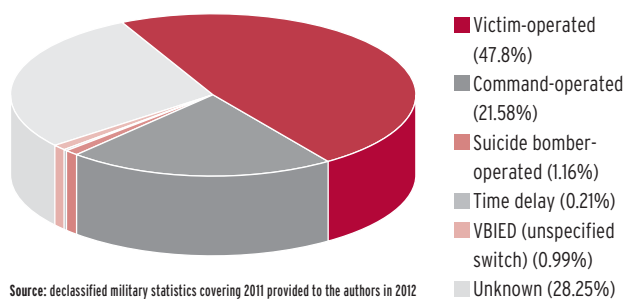
Sometimes Afghan insurgents use arming devices that allow them to switch pressure plates on only when targets are in the area. Some VOIEDs also incorporate simple ways to regulate the amount of pressure required to activate them so they will only detonate when a Western soldier weighed down with equipment steps on them—as opposed to lighter locals.¹¹ Nevertheless, Coalition counter-IED officers told the Small Arms Survey that they are not seeing a significant increase in attempts to reduce civilian casualties through the use of safety devices on VOIEDs.¹²

UNAMA has repeatedly stated that it considers pressure-plate IEDs equivalent to military landmines as they are equally indiscriminate. Nevertheless, there are significant differences between Afghan VOIEDs and landmines. The former represent a less persistent threat as most are made using home-made explosives, which are rendered inert as they

degrade over time; they also are generally triggered by electrical circuits that rely on batteries, which run out of power.¹³ In contrast, modern anti-personnel landmines have non-electrical initiation mechanisms and more stable, factory-made explosives that ensure they continue to function for years.

The widespread use of batteries and other metal components also makes IEDs easier to find than modern military landmines, which

Figure 10.2 IEDs in Afghanistan by switch type, 2011

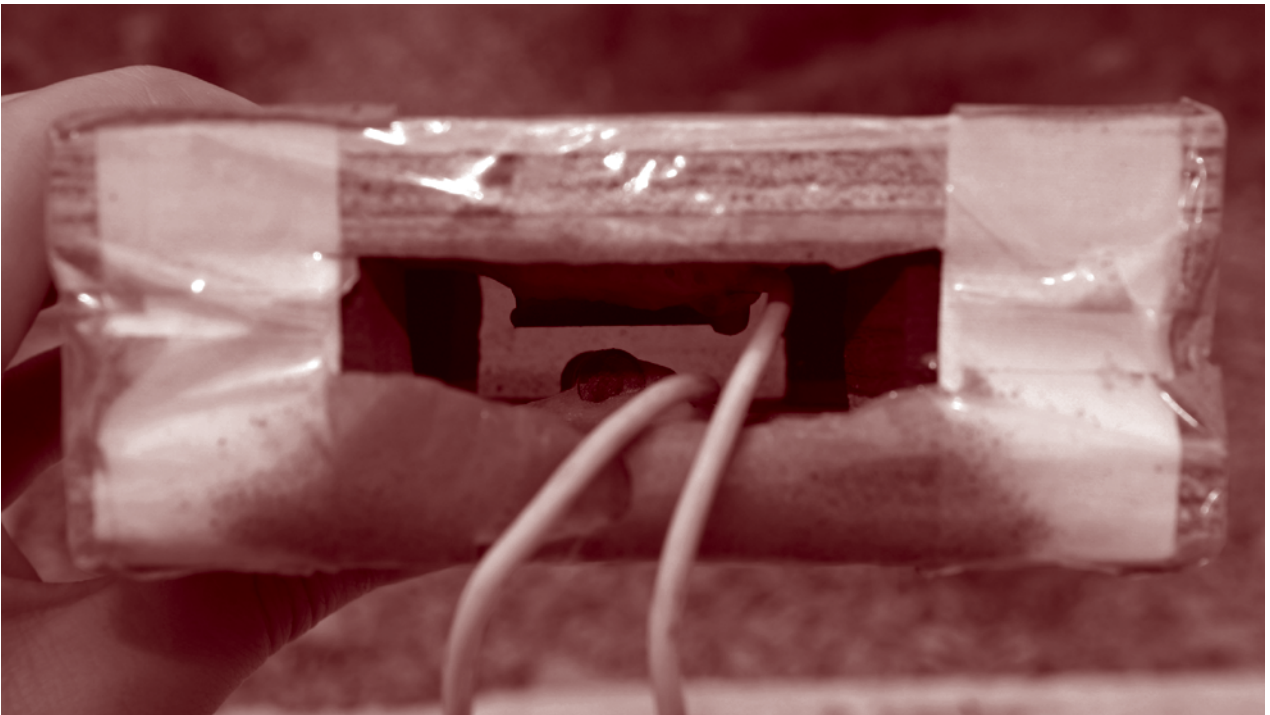


are usually made with as few metal parts as possible to make them more difficult to detect. However, in response to the increased use of metal detectors by foreign military forces, Afghan insurgents have developed ways of reducing the metal content in their IEDs. For example, some now use carbon rods taken from inside batteries as their electrical contacts. These conduct electricity but do not have a metal signature (JIEDDO, 2011). IED emplacers also bury the batteries to make them harder to detect.

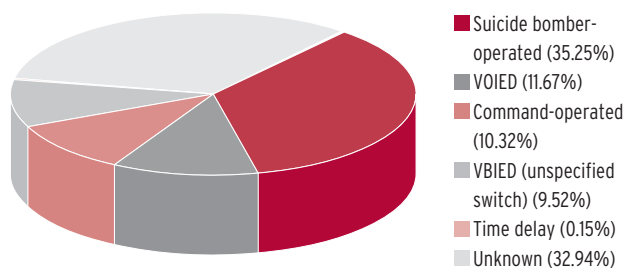
A more sophisticated solution began to emerge in southern Afghanistan in 2010, in the form of copies of the Soviet PMN anti-personnel landmine. The casings for these IEDs were made using a plastic extrusion machine. Like the real PMN, they have no electrical components and thus represent a more persistent threat than most pressure-plate IEDs; unlike military mines, the copies do not have arming mechanisms, making them more dangerous to transport, handle, and neutralize (Wright and Binnie, 2010).

While the deployment of minimal- and no-metal VOIEDs makes them as hard to find as military landmines, if not harder, the process of clearing IEDs is also complicated by their irregular nature. Explosive ordnance disposal technicians know at what depth they will encounter military landmines and how to disarm the mass-produced weapons. Under international law, they should only be buried in clearly marked areas. In contrast, every IED potentially represents a unique challenge that can be more dangerous and time-consuming to disarm.¹⁴ The dangers are also greatly increased by the practice of adding additional anti-tampering mechanisms to IEDs, such as pressure-release, photo-sensitive, and tilt switches that activate the devices when they are moved.

Like command-operated devices, suicide IEDs ostensibly give their operators an opportunity to abandon their attacks if they cannot reach their intended targets or if they risk inflicting undesired casualties. Indeed, some groups have described suicide bombers as their equivalent of military precision-guided munitions, with the human operator



A pressure plate initiator, recovered in Kandahar, 2012. Carbon rods from batteries are used to prevent the device from being located by metal detectors.
© Joanna Wright

Figure 10.3 **Civilian IED casualties in Afghanistan, by switch type, 2011**

Source: declassified military statistics covering 2011 provided to the authors in 2012

According to the declassified military statistics, PBIEDs and SVBIEDs accounted for 35 per cent of civilian casualties in Afghanistan in 2011. In contrast, VOIEDs accounted for just 12 per cent of civilian casualties (see Figure 10.3).¹⁶

The risk of civilian casualties in suicide IED attacks is heightened by their use in busy places, where bombers typically have a better chance of closing on their targets by blending in with locals. The risk of civilian casualties is also elevated in such attacks because of the use of larger amounts of explosives; this threat is particularly associated with the use of VBIEDs and SVBIEDs, which are usually designed to deliver large quantities of explosive to a target. The EVMP data shows that in 2011 vehicle bombs were most frequently used to target military and security forces facilities, but civilians represented 67 per cent of the resulting casualties. It also shows that vehicle bombs inflicted nearly ten times the number of civilian casualties as roadside IEDs and attributes that rate both to the relatively large amount of explosives they carry and to their frequent use in populated areas (AOAV, 2012, p. 25). Declassified military statistics reveal that, in Afghanistan, VBIEDs and SVBIEDs were used in just over 1 per cent of attacks but caused 25 per cent of civilian IED casualties in 2011.¹⁷

While there are no available figures showing a clear trend towards larger VBIEDs, it is likely that militants are using more explosives in an attempt to overcome defensive measures adopted by their targets. Such measures include the use of more heavily armoured vehicles and the erection of blast barriers around facilities. What is clear is that the use of indiscriminate IEDs and tactics are responsible for the overwhelming majority of civilian casualties. EVMP data indicates that around 26 per cent of the 13,179 civilian IED casualties in 2011 were inflicted in incidents in which the military, security forces, or non-state armed groups were the intended targets. At the same time, 35 per cent of civilian IED casualties were caused by attacks that deliberately targeted civilians (the intended targets of the remaining 39 per cent were not reported).¹⁸

Targeting civilians

Non-state armed groups routinely target civilians. Most see political leaders, civilian officials, and informers who are involved in efforts to suppress their activities as legitimate targets. They also typically try to silence other types of civilians whom they perceive to be a threat—including critics in their own communities—using violence or intimidation. While such attacks are often highly targeted, they can cause high casualty rates when IEDs are used. The most devastating such attack was the attempt to assassinate Benazir Bhutto when she returned from self-imposed exile to Pakistan on 18 October 2007. A suicide bomber killed at least 130 people and injured more than 400 by detonating his explosives during her procession through Karachi that day. Two months later, more than 20 people died in the suicide bombing that killed her on 27 December 2007 (BBC News, 2007).

replacing the sophisticated guidance technology.¹⁵ Such arguments belie the unreliability of suicide bombers, who are often under considerable psychological strain and frequently make mistakes, such as initiating their devices too early or in the vicinity of civilians.

The unreliability of suicide bombings is reflected in the civilian casualties they inflict in Afghanistan, where attacks that deliberately target ordinary civilians are relatively rare.

Lower-level IED attacks on civilian opponents happen frequently in Pakistan, with tribal elders being popular targets as the militants attempt to supplant traditional forms of social organization with their own Islamist system. For example, there have been a series of suicide bombings at *jirgas*, the councils of Pashtun tribal leaders. The targeted tribal groups were attempting to mobilize resistance to the militants, knowing that attacks that deter them from holding *jirgas* threaten their system of social and political organization.¹⁹

There are also extremist groups and individuals who deliberately target ordinary civilians who have no involvement in countering militancy. IEDs—especially large ones—are the ideal weapons for carrying out these types of indiscriminate attacks. Such actions are generally intended to draw attention to the bombers' cause, avenge a perceived injustice, instil fear in the targeted population, undermine confidence in the security forces, influence government policy, or provoke retaliatory action that helps mobilize a certain community. Sometimes the motive is unclear. Members of the right-wing group Nuclei Armati Rivoluzionari were convicted of the 2 August 1980 bombing at the main railway station in Bologna, Italy, in which 85 people died, but it was never established what they hoped to achieve by killing civilians (BBC News, n.d.a). Similarly, the motive behind the 11 April 2011 bombing of the Minsk Metro in Belarus remains unclear (Sweeney, 2012).

Mass-casualty attacks have been carried out by actors with various cultural, religious, and political backgrounds. Norwegian right-wing extremist Anders Breivik, for example, stated that he carried out his VBIED and shooting attack in Norway in an attempt to publicize his anti-immigration ideology and inspire others to take up the cause (Breivik, 2011). Timothy McVeigh claimed he was avenging the bungled 1993 assault on the Branch Davidians (a sect with which he was not affiliated) when he detonated a VBIED that killed 168 people in Oklahoma City on 19 April 1995 (BBC News, 2001).

Criminals generally use IEDs to attack rivals or law enforcement officials.

Criminals who use IEDs generally employ them in highly targeted attacks to kill rivals or law enforcement officials, but there have been instances of them carrying out mass-casualty incidents. The Colombian drug lord Pablo Escobar is suspected of ordering the bombing of an airliner on 27 November 1989, which killed 110 people. A few days later, on 6 December 1989, a VBIED killed 52 people when it detonated outside the Administrative Department of Security headquarters in Bogotá, Colombia (Bowden, 2001).

While criminals and right-wing extremists have sporadically carried out mass-casualty bombings targeting civilians, militant Sunni Islamists have been overwhelmingly responsible for such attacks in recent years. The worst-affected countries are Iraq and Pakistan. According to the EVMP dataset, 462 (or 41 per cent) of the 1,127 fatalities caused by IEDs in Iraq in 2011 occurred as a result of attacks that deliberately targeted civilians. In Pakistan, the figure was 233 (or 39 per cent) of the 604 killed by IEDs (AOAV, 2012). While the EVMP does not attribute responsibility for attacks, a Small Arms Survey review of the incidents shows that militant Sunni Islamist groups either claimed or were held responsible for all the attacks that deliberately targeted civilians in Iraq.

The picture in Pakistan is complicated by the presence of both ethnic Balochi and Sunni Islamist groups that have claimed or been held responsible for attacks on civilians. The close correlations between Pakistan's religious and ethnic identities and political allegiances can also make it difficult to determine the motives behind attacks. Nevertheless, the EVMP recorded only 13 fatalities in attacks targeting civilians in Balochistan province; 11 of these victims died in an SVBIED attack that was probably carried out by Sunni extremists. Pakistan also has a long history of sectarian violence, which has claimed more lives in recent years as extremists have increasingly turned to mass-casualty IED tactics.²⁰

Militant Sunni Islamists were also responsible for at least 86 per cent of the fatalities caused by IED attacks that targeted civilians in countries other than Iraq and Pakistan (AOAV, 2012). Some of the attacks were primarily aimed at

non-Muslims, such as the suicide bombings at a Coptic church in Egypt on 1 January 2011 and Moscow's Domodedovo airport on 24 January 2011. Nevertheless, in most incidents Muslims—often members of non-Sunni sects—were targeted. It is consequently clear that the overwhelming majority of civilian IED casualties—whether intentional or otherwise—are being inflicted by militant Sunni Islamists and the majority of the victims are Muslims.²¹

SOURCES OF IED COMPONENTS AND CONTROLS

Bomb makers are hindered when acquiring materials becomes harder, riskier, and costlier. It is extremely difficult to prevent insurgents from making and deploying IEDs because explosives can be synthesized from everyday materials that are difficult to control. However, it is possible to increase the logistical burden on bomb makers by forcing them to shift to materials that are harder, riskier, and more expensive to acquire, or that have to be transported over longer distances and in smaller batches, that require more complex processing, or that are less powerful when they are turned into explosives.

It stands to reason that, if deprived of resources, insurgents and terrorists would be limited to building fewer or smaller IEDs. They would thus produce fewer large devices—which are among the primary causes of civilian casualties—and instead be forced to adopt more discriminating targeting methods. This section looks at the various sources of explosives and efforts to control them.

Military explosives and recycled ordnance

IED makers have made extensive use of military explosives, whether in the form of plastic explosives such as Composition-4 (C-4), which consists of RDX explosive combined with a plasticizing agent, or munitions that are adapted for use in IEDs. Military-grade plastic explosives are desirable weapons for insurgents and terrorists as they are designed to be safe to handle, easy to use, and highly adaptable. They are also tightly controlled, so one of the primary ways they have traditionally found their way to non-state actors is through state sponsorship.

State sponsorship

The best-recorded example of a state supplying militants with plastic explosives was the provision of Czechoslovakian SEMTEX to the PIRA by Col. Muammar Qaddafi's Libya. Used sparingly to make booster charges and small IEDs for targeted assassinations, this explosive greatly increased the capabilities of PIRA bombers. Although more than 25 years old, small amounts of SEMTEX continue to be used in bombings carried out by the militant Irish nationalist groups that reject the peace process that ended the PIRA's campaign of violence (IMC, 2009).

Iran has also been accused of providing explosives to various militants, including the Shia radicals responsible for a series of mass-casualty SVBIED attacks in Lebanon in 1982 and 1983 (Crist, 2012). These militants were subsequently incorporated into Hezbollah, which remains the world's most powerful non-state armed group thanks largely to continued Iranian support.

Iran tried to replicate its success in Lebanon by arming Shia militants in Iraq after the US-led invasion in 2003. US forces found large quantities of Iranian weaponry in caches used by groups such as Asaib Ahl al-Haq and Kataib Hezbollah, including Iranian-made C-4. The United States holds the Qods Force—the external operations arm of the Islamic Revolution Guards Corps—responsible for arming and training these groups (Schroeder and King, 2012; USDOT, 2008a; 2008b; 2009). Tehran also appears to see IED attacks as a deniable way of striking back at its adversaries.

In 2011–12, Iranian and allied Hezbollah agents were accused of involvement in bombing conspiracies in Azerbaijan, Bulgaria, Cyprus, Georgia, India, Kenya, Thailand, and the United States (Levin, 2012).

The Pakistani military's Directorate of Inter-Services Intelligence (ISI) is another organization that is regularly accused of supporting non-state armed groups in an effort to weaken regional rival India and establish a friendly regime in neighbouring Afghanistan. In India, the use of RDX is widely seen as evidence that the ISI supported the perpetrators, on the basis that they could not have obtained the military explosive from other sources (Ghosh, 2000). In the most notable incident, the Indian authorities claimed ISI-trained militants used RDX that had been smuggled into India from Pakistan in the 11 July 2006 Mumbai train bombings, which killed more than 180 people (BBC News, 2006). India has not, however, released compelling evidence of official Pakistani involvement and Islamabad denies the allegations.

The international community has responded to the plastic explosive threat with the 1991 Convention on the Marking of Plastic Explosives for the Purpose of Detection, which has been signed by 147 states (UNGA, 1991). This dictates that all plastic explosives made in signatory states must include detection taggants—volatile chemicals that slowly evaporate from the explosive and can be detected by either trained sniffer dogs or specialized air-sampling machines. This makes it far harder for terrorists to use powerful plastic explosives to bomb targets that have these types of security measures in place, most notably airliners. Iran remains a conspicuous non-signatory state, meaning that its domestically produced explosives need not include taggants, making them more of a threat to international security if they proliferate.

Pakistan's ISI is regularly accused of supporting non-state armed groups.

States have also sought to use diplomatic pressure to curb state-sponsorship of non-state actors. Probably the most prominent diplomatic effort is the US State Department's list of state sponsors of terrorism. Designated states are subject to US sanctions that include a ban on arms exports and controls on the export of dual-use items that could significantly enhance their military capability or the ability to support terrorism. But Pakistan has not been blacklisted by the United States and Iran has shown no sign of changing its policies even though it has been on the list since 1984 (Bozorgmehr, 2012). The international community has only sanctioned one state—Libya, from 1992 to 1999—for its involvement in terrorism.

Looting arsenals

State sponsorship is not the only way for militants to source military explosives; they also take advantage of the looting of arsenals after the collapse of a state's military structures and recycle explosive ordnance that has proliferated through other means. There have been two major proliferation events, in the last decade in Iraq and Libya, and a third is in progress in Syria. In 2003 the Iraqi military essentially disintegrated after it was defeated by US-led forces, leaving many arms storage facilities unguarded and vulnerable to looting. Coalition forces proved incapable of securing, destroying, and recovering much of this weaponry, which fuelled the resulting insurgency that continues today (Center for Public Integrity, 2008).

In one of the most significant proliferation incidents, 342 tonnes of HMX, RDX, and PETN high explosives disappeared from the Al-Qaqaa weapons facility south of Baghdad, according to the International Atomic Energy Agency, which had inspected and sealed the site shortly before the invasion (UNSC, 2004). Iraqi insurgents have testified that the looted explosives were used to increase the power of IEDs and the area around the Al-Qaqaa facility became a stronghold for militant Sunni Islamists known as the 'Triangle of Death' (Streatfeild, 2011). A similar proliferation event took place in Libya in 2011, when the existing military structures collapsed during the conflict that led to the overthrow and death of Qaddafi (Daragahi, 2011).

Weaponry was flowing out of Libya even before Qaddafi's demise. Nigerian soldiers intercepted an arms-smuggling convoy on 12 June 2011 and seized 640 kg of SEMTEX and 435 detonators, as well as firearms, although two of the vehicles escaped (Tele Sahel, 2011). The Nigerian authorities suspected that the arms had been destined for Al Qaeda in the Islamic Maghreb, which has long maintained a presence in northern Mali (RFI, 2011). An Algerian newspaper reported in June 2012 that soldiers in Mauritania had captured 300 kg of explosives and detonators smuggled in from Libya after a clash with suspected militants of the same group (Echourouk El Youmi, 2012). The Algerian authorities seized more than a tonne of explosives between July 2011 and February 2012 (UNSC, 2012, p. 20).

While plastic explosives are particularly useful IED components, bomb makers operating in conflict zones also recycle all sorts of explosive ordnance to make their weapons. This can be done either by extracting the explosives from munitions and repackaging them or by replacing the fuses in munitions so their contents can be detonated as part of an IED. In the wake of the invasion of Iraq, one of the most common types of IED used by insurgents consisted of an artillery shell with its fuse removed and replaced with a detonator attached to some form of activation mechanism. Military munitions were so plentiful that VBIEDs were made by loading vehicles with artillery shells, tank rounds, mortar bombs, and rocket warheads.

**Bomb makers
operating in conflict
zones recycle
explosive ordnance
to make weapons.**

Military landmines require no alteration to be turned into effective victim-operated weapons. Insurgents, however, often modify them with new activation mechanisms to allow them to be command-operated, either for discriminating roadside IEDs attacks or as part of an SVBIED. They are also sometimes rigged with an offset pressure plate that is activated by the wheel of a vehicle, which triggers a mine emplaced so that it will explode under the vehicle's crew compartment. While anti-personnel landmines contain only small amounts of explosive, which makes them of little use as a source of explosives, insurgents use them as a way of initiating larger VOIEDs.

Islamist militants also take fuses from hand grenades and use them to initiate suicide bombs by attaching them to a length of detonating cord leading to the main charge. Once the safety pin is removed, these operate as 'dead man's' switches that can activate the IED even if the suicide bomber is killed by security forces.

Military munitions have been adapted in the same way in Afghanistan, where the various armed factions that have been fighting since the late 1970s have been supplied with vast quantities of weaponry by the Soviet Union, the United States, Pakistan, and other states. While much of this ordnance is so old and degraded that it can no longer be used reliably as its designers intended, some of its parts can still be of some use as IED components. Videos released by militant Sunni Islamist groups show them extracting the explosive from shells and replacing it with home-made explosive, probably in the belief that the fragmentation from the shells will make the resulting IED more lethal (Jundullah Studio, 2009).

Arms caches are not the only source of military munitions that can be used in IEDs. Militants will recycle explosive remnants of war such as unexploded artillery shells and landmines. One of the legacies of the extensive use of artillery by Soviet counter-insurgency operations in Afghanistan in the 1980s is that unexploded shells continue to be salvaged by locals and sold to insurgents.²² There have been claims that militants have been able to recycle munitions dating back to the early 1970s. Egypt's Interior Ministry released a statement saying that some of the explosives used in a series of bombings that targeted tourists in the Sinai Peninsula on 7 October 2004 had been recovered from military ordnance left over from the country's wars with Israel, the last of which took place in 1973 (Nasrawi, 2004).

The only way to reduce the threat of old military ordnance being reused in IEDs is a concerted effort to identify and clear arms caches and explosive remnants of war. Such an approach showed signs of success in Iraq by 2008, when insurgents were making more use of home-made explosives. The scale of this cottage industry was demonstrated

when a militant explosive factory blew up in Mosul in January 2008, levelling a block of the northern city. Towards the end of 2011 the militant Iraqi Sunni Islamist group Ansar al-Islam released a video called *Inexhaustible Weapons*, which shows how the group was overcoming its growing difficulties in sourcing arms by fabricating its own (Ansar al-Islam, 2011).

Commercial explosives

When military explosives are unavailable, commercial explosives are a viable substitute for IED makers as they are similarly reliable, powerful, and safe to handle. Used for mining, road construction, and demolition, these types of explosives are generally subject to strict government regulation. Nevertheless, insurgents and terrorists have managed to source them in significant quantities.

Commercial detonators make it easy to construct IEDs that are activated by an electrical circuit, while detonating cord is particularly suited for the construction of large devices, such as VBIEDs, whose multiple sub-charges must explode simultaneously. Other types of commercial explosive are also used as booster charges to detonate large quantities of comparatively inert home-made explosives. Like military plastic explosives, some forms of commercial explosives are particularly suitable for making suicide-bombing vests, as the resulting devices are powerful yet small enough to conceal under an individual's clothes.

Militants sometimes steal commercial explosives. The Basque separatist group Euskadi Ta Askatasuna (ETA) has carried out some of the most high-profile explosives heists. In September 1999, it stole more than eight tonnes of Titadyn (a type of dynamite used in mining) as well as detonators and detonating cord from a factory in Brittany, France (Expatica, 2005). ETA members stole



BIAFO detonating cord packaging (without lot or batch number) recovered from an IED in Khowst province, Afghanistan, 2010. © Joanna Wright

another 1.6 tonnes of Titadyn from an explosives factory near Grenoble, France, in March 2001 (Tremlett and Goldenberg, 2001).

While the ETA threat has led Spain to introduce some of the tightest controls on explosives in Europe, militant Sunni Islamists were still able to obtain a sufficient amount of stolen mining explosive to build ten bombs that they left on trains heading into central Madrid on 11 March 2004. The subsequent explosions killed 191 people (Tremlett, 2004). They also had enough left over to blow themselves up as the police raided their safe house.

The Goma-2 ECO explosives and detonators used to make these devices came from a former miner in the north-western region of Asturias. While it is unclear precisely how he managed to obtain the explosive from supposedly secure facilities, Spanish Civil Guard officers later told a parliamentary inquiry that small quantities of explosives are regularly stolen in Asturias, where it was generally used for illegal land development (Giles, 2004).

For many countries, the diversion of commercial explosives is a very serious problem.

Other countries have a far more serious problem with the diversion of commercial explosives. Indian government documents obtained by the *Sunday Express* in 2007 show that 86,899 detonators, 52,740 m of detonating cord, 419 kg of gelatin sticks, and 20,150 kg of slurry explosives were stolen in 2004–06 (Sarin, 2007b). In October 2011, the *Indian Express* cited government documents as saying that 218,624 detonators, 3,500 m of detonating cord, 1,907 kg of ammonium nitrate-based explosives, and 16.58 tonnes of emulsion matrix (a slurry that needs to be sensitized before it can be detonated) had been stolen from the beginning of 2010 until July 2011 (Sarin, 2011). These quantities suggested widespread corruption in the supply chain.

While Indian officials believe much of the stolen material was channelled to illegal mining operations, they said some of it could have been acquired by militant groups, including the Maoist militants who operate in several Indian states (Sarin, 2011). The commercial explosive Neo Gel 90 has also been used in mass-casualty attacks, including the multiple bombings in Jaipur on 13 May 2008, which killed more than 70 people and were claimed in the name of the Indian Mujahideen (Rediff, 2008). Large quantities were also diverted to the Liberation Tigers of Tamil Eelam in Sri Lanka. In a particularly notable haul, the Sri Lanka Navy intercepted a boat carrying 61,000 detonators that had been made in Hyderabad in January 2006 (Sarin, 2007a).

Pakistan appears to have similar issues with the diversion of commercial explosives. While it is difficult to assess the scale of the problem, it is clear that militants operating in Pakistan's tribal areas and neighbouring Afghanistan have access to large quantities of commercial detonators, which are used in a significant proportion of the thousands of IEDs deployed every year. They also have access to substantial quantities of detonating cord. Videos released by Al Qaeda and other militant Sunni Islamist groups based in Pakistan's tribal areas have shown large quantities being used in the construction of IEDs. One video released by the Pakistani Taliban shows two alleged informers being wrapped in detonating cord and blown up—an unusual execution method that suggests the militants had an ample supply of the material (JTSM, 2010).

Afghanistan has no explosives manufacturers and has regulations to control the importation and distribution of explosives. These regulations are, however, so complicated and difficult to enforce that they encourage users who could legitimately obtain explosives to turn to the black market to avoid the corruption of the official system.²³

Nevertheless, there are suspicions that many of the detonators used in IEDs are coming from Pakistan, which has two explosives manufacturers: Biafo Industries and the Wah Nobel Group of Companies (Cahn, 2009). Militants have been able to obtain products made by both companies. A significant quantity of plastic explosive wrapped in Wah Nobel packaging can be seen in an Afghan Taliban video released in 2012 (Al-Emarah Jihadi Studio, 2012). Emmulite and Wabox explosives made by Wah Nobel have also been recovered in Afghanistan (JIEDDO, 2011).

A roll of Biafo detonating cord can be seen in an Islamic Movement of Uzbekistan video showing the construction of an SVBIED that was used to attack a security forces checkpoint in Pakistan's tribal areas on 18 August 2009. The packaging of a used roll of Biafo detonating cord was also found in an IED that failed to function in Afghanistan. The roll did not have the requisite lot number, date of manufacture, or foreman's signature, suggesting it was either produced before Pakistan tightened explosives controls or had not been subject to the standard monitoring process at the Biafo factory.

Both Biafo and Wah Nobel insist they adhere closely to Pakistan's tight rules governing the production, storage, sale, and transportation of explosives. Nonetheless, both have been implicated in cases where these rules have been flouted. A senior Pakistani police officer told journalists in March 2010 that two men had been arrested in possession of 260 kg of Wah Nobel explosives that they were smuggling from the company's factory to militants in the Northwest Frontier Province (now called Khyber Pakhtunkhwa Province), who intended to use it to make suicide-bombing devices. As is often the case in Pakistan, it is unclear if the investigation made any progress (APP, 2010).

Authorities temporarily suspended Biafo's licence and shut down its factory in November 2009, after police intercepted a consignment of 58.5 tonnes of explosives that was being illegally shipped to a mine in Pakistan's Balochistan Province (Abbasi, 2009b; Khan, 2009). The company was allowed to resume operations the following month, after paying a fine (Khan, n.d.). Yet the police reportedly stopped another consignment of Biafo explosives that was being illegally transported to another mine in Balochistan in August 2011 (Ismaeel, 2011).

Pakistani newspaper reports published after the November 2009 seizure suggested the illegal transfer of commercial explosives was commonplace in the country, but the authorities were doing little to counter it (Abbasi, 2009a; Khan, 2009). As in India, a strong demand for explosives from unlicensed mining operations apparently exists in Pakistan, creating a black market that militants can tap into to source IED materials. These explosive-trafficking networks may also supply Afghanistan's illegal mining sector, aspects of which are tied to militants based in Pakistan's tribal areas (DuPee, 2012).

Commercial explosives products also appear to be widely available in the Middle East. Syrian insurgents have said that detonators generally cost them around USD 2, making IEDs cost-effective weapons as the price of black market small arms ammunition soared due to demand (Chivers, 2012b).

While there appears to be a strong correlation between illegal mining, the diversion of commercial explosives, and their use in IEDs, there are significant challenges in regulating the informal mining sector. This is especially the case in Afghanistan and Pakistan, where small mining operations are scattered over vast and remote areas that often lack infrastructure and government control (World Bank, 2003).

Home-made explosives

When insurgents and terrorists are unable to source sufficient quantities of military or commercial explosives, they turn to home-made explosive (HME), which can be synthesized from a wide range of precursors.

High explosives

The most sophisticated bomb makers with access to the right chemicals are capable of making military- or commercial-grade explosives. For example, Al Qaeda bomb makers have synthesized PETN, which is used in a variety of explosives and munitions. The main charge in the shoe bomb that Richard Reid attempted to detonate on a transatlantic flight on 22 December 2001 was made from PETN (Belluck and Chang, 2001). The Yemen-based Al Qaeda in the Arabian Peninsula has also used PETN in IEDs that were specifically designed to be undetectable by airport security, including

Demand for explosives from unlicensed mining operations creates black markets that can be used by militants.

the one that Umar Farouk Abdulmutallab smuggled on to a transatlantic airliner in his underwear on 25 December 2009 (USDC, 2010). The device failed to function as intended.

Al Qaeda has also used hydrogen peroxide to make explosives. While there are numerous examples of militants using peroxide-based explosives such as TATP for improvised detonators, Al Qaeda operatives in Europe and the United States began using hydrogen peroxide to make the main charges in their IEDs from 2005. The only attacks successfully carried out with peroxide-based main charges were the 7 July 2005 London suicide bombings, which killed 52 people and the four bombers (BBC News, 2011). Hydrogen peroxide was the intended main IED precursor in bombing conspiracies thwarted in Germany in September 2007, the UK in August 2006, and the United States in September 2009.²⁴

These and other conspiracies have prompted calls for further restrictions to be placed on the concentration of hydrogen peroxide that can be sold to the general public (Esposito and Sandholm, 2009; *Metro*, 2011). So far, the response has been limited to a ban on passengers carrying liquids through airport security and awareness campaigns to educate vendors about the risks of hydrogen peroxide and other HME precursors, to urge them to 'know their customers', and to encourage them to report suspicious behaviour (DHS, n.d.; Home Office, 2012). However, the European Union (EU) is working on regulations to control common HME precursors. Under the proposed legislation, a licence would be needed to buy hydrogen peroxide with a concentration of more than 12 per cent (EC, 2010).

Ammonium nitrate fertilizer

By far the most common precursor used to make IEDs around the world is ammonium nitrate-based fertilizer, although other substances can be used as well (see Box 10.2). This is readily available in large quantities, affordable, and generally easier to process into explosives than other types of fertilizer, making it an attractive option for bomb makers who are looking to construct numerous or large IEDs.

Various measures have been introduced in an attempt to control access to detonable ammonium nitrate fertilizer. In the early 1970s, the extensive use of the substance in militant Irish nationalist IEDs prompted the UK government to introduce new regulations under which only vetted licence holders may purchase fertilizers containing more than 79 per cent ammonium nitrate in Northern Ireland (Hansard, 1972).

Box 10.2 The Haqqani Network and potassium chlorate

Potassium chlorate is relatively easy to turn into a main-charge explosive but is only used to make a small percentage of the IEDs deployed in Afghanistan. Nevertheless, it should be given more consideration than the usage statistics suggest because it is used by the Afghan militant faction known as the Haqqani Network (JTSM, 2010). Together with foreign allies such as the Islamic Jihad Union, the Haqqani Network is responsible for a large number of suicide bombings—often involving very large SVBIEDs—that cause civilian casualties.

For example, the Islamic Jihad Union claimed responsibility for an SVBIED attack in Khowst on 28 December 2008, saying it had killed many foreign soldiers. Footage from a security camera shows that the bomber actually triggered his device as a group of school children was walking past; 14 of the children died (JTSM, 2009).

The Haqqani Network is based in the Pakistani tribal area of North Waziristan and operates mainly in Paktia, Paktika, and Khowst provinces on the Afghan side of the border. It has also been held responsible for many of the suicide bombings in Kabul, which accounted for more than 93 per cent of civilian casualties in the capital in 2011.²⁵

There is no industrial requirement for potassium chlorate in Afghanistan, so Coalition officers presume the Haqqani Network sources it in Pakistan, where it is used in match factories.

The Joint IED Defeat Organization (JIEDDO) responded to the threat from potassium chlorate-based HME in July 2012, when it called on the private sector to submit proposals on ways to make it harder to turn the compound into explosives. It also asked for improved ways of detecting and neutralizing potassium chlorate-based HME (FBO, 2012).

Tighter regulations were imposed on ammonium nitrate in England, Wales, and Scotland in 2003. Because the UK agricultural sector is one of the most intensive users of ammonium nitrate fertilizers in the world, a licensing regime was deemed undesirable (NaCTSO, n.d.). Instead, every batch of fertilizer with more than 80 per cent ammonium nitrate (28 per cent nitrogen by weight) has to pass a detonation resistance test, after which it can be sold without restriction (OPSI, 2003).

The EU introduced stricter controls in June 2009. The legislation bans the sale of ammonium nitrate containing more than 28 per cent nitrogen that had not been specifically formulated to make it harder to turn into explosives and subject to detonation resistance tests. It also stipulated that only registered farmers and other legitimate downstream users could purchase ammonium nitrate with a nitrogen content of more than 16 per cent (EC, 2009). These regulations raise significant barriers to would-be terrorists, but enhanced monitoring is needed, as the case of Anders Breivik shows (see Box 10.3).

One initiative that could help address the problems with IED precursors is Program Global Shield. The pilot scheme began in November 2010, with more than 70 countries participating, and the World Customs Organization approved it as a long-term programme in June 2011. Participating governments share information to identify illegal shipments of materials that could be used to make IEDs. By June 2012, the initiative had prompted 41 seizures of chemical precursors, totalling more than 126 tonnes (DHS, 2012).

However, imposing restrictions on who can purchase ammonium nitrate fertilizer is completely unworkable in developing countries whose governments do not have the resources to monitor and regulate their large agricultural sectors effectively. Some states that are facing a significant threat from IEDs have instead decided to completely ban the sale of ammonium nitrate-based fertilizers.

Box 10.3 Raising barriers: lessons from the Breivik case

Although Norway typically adopts EU legislation even though it is not a member state, it did not pass the new regulations regarding ammonium nitrate into law until November 2011 (DSB, 2012). However, Anders Breivik appears to have been under the impression that the regulations had already been adopted when he began his preparations to build a VBIED a year earlier.

According to his own account, he rented a farm so that he could register as an agricultural business and obtain a farmer identification number that would allow him to purchase calcium ammonium nitrate fertilizer with a nitrogen content of 27 per cent (CAN-27), which he believed was the most suitable precursor available to him. In fact, these steps were unnecessary and, as he subsequently realized, he could have obtained ammonium nitrate fertilizer with a nitrogen content of 34 per cent in Norway at that time. Nevertheless, he purchased 3,000 kg of CAN-27 and used it to make the 950 kg of explosives that he loaded into a rented van to create the VBIED that he detonated in Oslo on 22 July 2011 (Breivik, 2011).

Breivik's success in turning CAN-27 into explosives does not mean that reducing the nitrogen content of ammonium nitrate is futile. His misapprehension about the ease with which he could obtain suitable fertilizer in Norway at that time increased the logistical and financial burden on his project. He rented a farm and acquired the additional equipment and chemicals he required to process and sensitize his CAN-27 and to make another type of explosive for the booster charges he needed to ensure his relatively stable main charge would detonate. According to his own account, it took him around 80 days to make his explosives and the processes he used exposed him to more personal danger and risk of exposure than if he had worked with a higher concentration of ammonium nitrate.

Breivik's case also demonstrates that the regulation of HME precursors would be more effective if they were supported by a vigorous monitoring regime. He ordered a significant quantity of aluminium powder from an online chemist based in Poland, claiming he would use it in boat paint. The Norwegian Customs Service informed the Norwegian Police Security Service (PST) about the purchase on 3 December 2010, but no further action was taken (Brenna, Grøttum, and Ravndal, 2012). If this information had been cross-checked with his large fertilizer order it should have raised suspicion as aluminium powder is a well-known ammonium nitrate sensitizer. According to the PST report on whether it could have prevented Breivik's attack, the security service was not tracking fertilizer purchases at that time. Even if it had known about the fertilizer, the PST would have been unable to cross-check his December 2010 aluminium powder and May 2011 CAN-27 purchases because it does not keep records for more than four months.

For example, Afghanistan's government introduced a ban on ammonium nitrate fertilizer in January 2010. It soon became apparent, however, that Afghanistan's porous borders were seriously limiting the ban's effectiveness. Security forces began intercepting large shipments of ammonium nitrate that were being smuggled into the country; 435 tonnes were seized in the first seven months of 2012 (Jaffe, 2012). In one of the largest reported seizures, 10 tonnes of ammonium nitrate were found in Kabul in April 2012 (Al Jazeera, 2012).

A Pakistani smuggler told a reporter in May 2010 that he was part of an operation that was bribing officials to send convoys carrying up to 85 tonnes of ammonium nitrate fertilizer into Afghanistan twice per week (Rodriguez, 2010). If this was the case, it would suggest there is strong demand for Pakistani fertilizer from Afghan farmers, as estimates have put the annual amount of fertilizer used in Afghan IEDs at around 200 tonnes (Jaffe, 2011). Indeed, large quantities of fertilizer were being imported into Afghanistan before the ban because the country could not meet domestic demand. Pakistani fertilizer has long been a popular option as it is subsidized, meaning that traffickers can make higher profits by selling it in Afghanistan (Emerging Asia, 2009). The director of JIEDDO, Lt. Gen. Michael Barbero, said in December 2012 that more than 85 per cent of IEDs used against Coalition forces in Afghanistan contained HME, and that about 70 per cent of those (60 per cent of the total) were made from ammonium nitrate fertilizer coming in from Pakistan (Garamone, 2012).

**Of Afghan IEDs,
85 per cent
contain home-
made explosives.**

Pakistani officials have disputed these claims, saying that Afghanistan's other neighbours produce large quantities of fertilizer, some of it easier to turn into explosives than the Pakistani equivalent, which is calcium ammonium nitrate fertilizer with a nitrogen content of 26 per cent (CAN-26) (Fatima Group, n.d.). Produced in two factories, Pakistani CAN-26 is generally freely traded in the country but was banned in November 2009 in certain parts of Khyber Pakhtunkhwa to prevent militants from using it (Shah, 2011).

Pakistani security forces have also tried to prevent ammonium nitrate fertilizer from being moved into the militant stronghold of North Waziristan and other tribal areas since 2009. This has proved problematic as it is difficult to distinguish between different types of fertilizer, which has led security forces to seize them all, alienating farmers in the process (Abbot, 2012; Yusufzai, 2012).

While US officials concede that only around 0.5 per cent of Pakistan's CAN-26 output is diverted to produce IEDs in Afghanistan, they have been pushing Islamabad to do more to control ammonium nitrate fertilizer, with Congress threatening to freeze USD 700 million in aid unless Islamabad took more action in December 2011 (Anthony and Nauman, 2011; JIEDDO, n.d.a). The United States has offered to pay Pakistan's factories to include a dye in their CAN-26. This would make it easier for security forces to distinguish the dangerous fertilizer from more inert types. The Fatima Group, which operates both of Pakistan's CAN-26 factories, said it was prepared to introduce this initiative in December 2011 (Hasan, 2011). Nevertheless, in congressional testimony on 20 September 2012, Lt. Gen. Barbero confirmed that this had not happened (NewsStand, 2012).

Some figures suggest that, in the absence of Pakistani cooperation, the ammonium nitrate fertilizer ban in Afghanistan has had no impact on the insurgency. Figures released by JIEDDO show that Afghan and foreign security forces encountered 16,600 IEDs in the first seven months of 2012, a slight increase compared to the same period in 2011 (Jaffe, 2012). While this increase suggests the fertilizer ban has had no impact, it is probably costing the insurgents more money to maintain this level of IED usage. Anecdotal evidence suggests the price of ammonium nitrate has increased in Pakistan's tribal areas where it has been banned; this hike would presumably be passed on to Afghan consumers. According to one Pakistani report, a bag of CAN-26 cost PKR 1,400 (USD 15) in Bannu in Khyber Pakhtunkhwa, but PKR 2,400 (USD 25) in neighbouring North Waziristan due to the expense of smuggling—a difference of more than 70 per cent (Yusufzai, 2012).

Nevertheless, many officials have concluded that the efforts to reduce insurgent access to ammonium nitrate in Afghanistan have had limited results. Former JIEDDO director Lt. Gen. Michael L. Oates said the ammonium nitrate ban 'has had little to no impact on the flow of precursor materials'.²⁶ Having initially called on Pakistan to follow Afghanistan's example and ban ammonium nitrate fertilizer, the team that monitors the UN sanctions on Al Qaeda and the Taliban concluded in its October 2012 report that this would not be feasible (UNSC, 2012).

Knowledge proliferation

There is a debate surrounding the threat posed by the proliferation of IED knowledge. On the one hand, there is evidence to suggest that some groups and even individuals can acquire the knowledge needed to make and deploy IEDs successfully without any coaching. On the other hand, this process can be accelerated by direct instruction from external experts and the proliferation of information.

The PIRA provides a clear example of self-acquired IED knowledge. It began building simple IEDs in the early 1970s, but gradually developed increasingly sophisticated devices over the following decades with little or no external training. This was an evolutionary process in which the militants and security forces were constantly trying to develop new ways of countering one another.

The same process has been seen in more recent conflicts, with IED cells in Afghanistan developing ways to overcome the latest countermeasures. This can be an extremely localized process as a cell adjusts to the different procedures



Syrian brothers making home-made explosives for the Free Syrian Army in Ma'ar Shamarine village, near Idlib, Syria, January 2013. © Chaith Taha/Reuters

followed by a new foreign military unit that has rotated into its area. It can involve adopting less sophisticated technology. For example, if the security forces operating in a certain area have been equipped with effective electronic countermeasure systems, then the local IED cell might start using command wires or pressure plates rather than radio-control devices. An UNMAS official described Afghan IEDs as living organisms that were constantly adapting to their environment.²⁷

The IEDs typically encountered by Coalition forces in Iraq were more advanced than the ones seen in Afghanistan. This has been attributed to the Arab country's better-educated population and access to more sophisticated technology. Many Iraqis also had appropriate skills, having spent years repairing and improvising electrical and mechanical equipment in the face of shortages experienced during years of UN sanctions.²⁸

Afghan IEDs have been described as living organisms, constantly adapting to their environment.

While IED cells evolve their devices and procedures according to environmental demands, there is some evidence that militant groups are passing on their knowledge. The PIRA, for example, supposedly trained ETA bomb-makers (Cragin et al., 2007, p. 71). Three Northern Irish men were arrested in Colombia in 2001 on suspicion that they were former PIRA members who had been hired to train rebels from the Revolutionary Armed Forces of Colombia (FARC) to make and use improvised mortars.²⁹ A former member of Al Qaeda has claimed that Hezbollah trained some of the Al Qaeda operatives who were involved in the 7 August 1998 attacks on the US embassies in Kenya and Tanzania (NYT, 2000). The militant Sunni Islamist training camps that were established in Afghanistan under Taliban rule in the 1990s attracted individuals from numerous countries and militant groups, some of whom would return home to pass on the lessons they had learned.

There has also been a history of militaries and intelligence agencies training allied militant groups. Various Arab states supported the Palestinian groups that carried out airliner hijackings and other attacks in the 1970s.³⁰ Western intelligence agencies supported Pakistan's efforts to train Afghan insurgents in the 1980s. The Pakistani military continued this policy into the 1990s to support militants who were fighting Indian security forces in Kashmir. The Iraqi insurgency may have benefited from some of the training that Saddam Hussein's intelligence services provided to non-state actors before the US-led invasion in 2003 (Jehl, 2004). It seems likely that members of Iraq's subsequently disbanded intelligence service joined the insurgency and passed on relevant skills, although the extent of their influence remains unclear. At the same time, Iranian and Hezbollah operatives were passing on skills as well as weaponry to Iraq's militant Shia groups.

There is also a debate surrounding the role of the Internet in the proliferation of IED knowledge. Much of the information available on the Internet is amateurish or rehashed versions of documents that have been available for years, such as the *Anarchist Cookbook*. In recent years Al Qaeda and its affiliates have put more sophisticated IED manuals and video tutorials online to encourage their followers to carry out independent attacks. At the same time, sympathizers are compiling multiple sources into online encyclopaedia collections that are updated as more information becomes available. There are also Internet forums where would-be bomb makers can ask apparently more-experienced individuals direct questions (UNSC, 2011, paras. 67–70).

Nevertheless, experts are still generally sceptical about the effectiveness of online IED training because even the most thorough and accurate instruction materials typically need to be supported by practical training or experimentation. This view has been corroborated by Syrian insurgents who have said they found some useful IED-related information on the Internet, but that it took time to perfect the techniques and adapt them to the environment (Chivers, 2012b). In its April 2011 report, the team that monitors the UN sanctions on Al Qaeda and the Taliban noted that it knew of 'no successful attack by perpetrators trained only online' (UNSC, 2011, para. 68).

This situation soon changed. On 28 April 2011, two IEDs exploded in a tourist café in Marrakesh, Morocco, killing 17 people. The authorities identified the bomber as a man who used the Internet to learn how to build explosive devices after his attempts to join militant Sunni Islamists in Iraq and Chechnya failed (Morocco News Board, 2011). Less than two months later, Anders Breivik detonated his VBIED in Oslo. According to Breivik's account, he received no external instruction, but instead undertook considerable Internet research. He stated that he found much of the available material to be unhelpful and even misleading, but by filtering the available information he nevertheless managed to acquire the knowledge he needed to build a viable VBIED.

CONCLUSION

This chapter has established that VOIEDs with no arming mechanisms represent a significant threat to civilians as they are indiscriminate weapons. The threat is especially great in Afghanistan, where these types of IEDs are used most prolifically. However, their usage will probably decline after the withdrawal of foreign forces in 2014.³¹

The IEDs that are responsible for the most civilian casualties around the world are the ones that deliberately target civilians in mass-casualty attacks, as well as VBIEDs that are used in areas frequented by civilians. An obvious way to reduce this threat is to restrict access to the materials commonly used in the more dangerous types of IEDs. Such measures include the disposal of military ordnance and the regulation of commercial explosives that can be used to make powerful, yet concealable, suicide bombing vests and booster charges for large VBIEDS made using HME.

These measures, however, cannot be effectively enforced in the countries that suffer most from IEDs due to corruption, lack of capacity, and porous borders. More research is needed to find out if overly complicated regulations and the practice of bribing officials to obtain licences are fuelling black market demand. If so, it may be possible to improve licensing systems so that it is easier for legitimate users to obtain explosives legally. While this may seem counter-intuitive, it would shrink the black market and improve oversight, thereby restricting militant access to explosives.

Limiting access to common HME precursors can help increase the logistical burden on bomb makers, but such measures have to be weighed against the cost of regulation and the impact they have on agriculture, commerce, and industry. Such measures are significantly less practical in developing countries with agrarian societies.

Nevertheless, there is still scope for more international cooperation on monitoring HME precursors and other potential IED components. More countries could join Program Global Shield and Pakistan could accept the US offer to finance the dying of its CAN-26 to make it easier for security forces on both sides of the border to identify it, thereby allowing less dangerous fertilizer to reach farmers.

Given that the greatest IED threat to civilians comes from militant Sunni Islamists, a campaign to raise awareness in Muslim countries could have merit, especially if supported by respected Islamic scholars and clerics. This would highlight the impact that militant Sunni Islamist IED attacks are having on civilians and condemn the use of indiscriminate weapons and tactics. It would be more successful if it were supported by a concerted effort to gather more definitive data on civilian IED casualties, while the identification of the perpetrators of attacks through transparent investigations would undermine the conspiracy theories behind which militant Sunni Islamist groups hide.

If the long-running campaign to stigmatize land mines and cluster munitions has been the most effective way of reducing their usage—as claimed by the NGOs involved—then the stigmatization of mass-casualty weapons and tactics may also prove to be the most practical way of reducing civilian IED casualties. ■

LIST OF ABBREVIATIONS

C-4	Composition-4
CAN	Calcium ammonium nitrate
CJTF	Combined Joint Task Force
COIED	Command-operated improvised explosive device
ETA	Euskadi Ta Askatasuna
EU	European Union
EVMP	Explosive Violence Monitoring Project
FARC	Revolutionary Armed Forces of Colombia
HME	Home-made explosive
IED	Improvised explosive device
IRAM	Improvised rocket-assisted mortar/munitions
ISI	Inter-Services Intelligence (Pakistan)
JIEDDO	Joint Improvised Explosive Device Defeat Organization
MRAP	Mine-resistant ambush-protected
NGO	Non-governmental organization
PBIED	Person-borne improvised explosive device
PIRA	Provisional Irish Republican Army
PKR	Pakistani rupee
PST	Police Security Service (Norway)
SVBIED	Suicide vehicle-borne improvised explosive device
UNAMA	United Nations Assistance Mission in Afghanistan
UNMAS	United Nations Mine Action Service
VBIED	Vehicle-borne improvised explosive device
VOIED	Victim-operated improvised explosive device

ENDNOTES

- 1 Militant anarchists carried out numerous bombings in various European countries and, to a lesser extent, the United States in the late 19th and early 20th century.
- 2 See, for example, Multi-National Corps–Iraq (2008).
- 3 The US Department of Defense, for example, procured thousands of mine-resistant ambush-protected (MRAP) vehicles of various types to safeguard its soldiers in Iraq. However, these vehicles lacked the mobility needed for Afghanistan's rough roads, so the Department issued a requirement for an MRAP all-terrain vehicle in 2008 (FBO, 2008). The competition was won by Oshkosh, which has since delivered more than 6,000 such vehicles at a unit cost of up to USD 500,000 (Clark, 2009).
- 4 EVMP 2011 dataset provided to the authors by Action on Armed Violence, 2012.
- 5 The US Health Services Research and Development Service has noted that—due to their exposure to IEDs—veterans of the conflicts in Afghanistan and Iraq suffer higher rates of post-traumatic stress disorder, traumatic brain injury, and other forms of trauma than veterans of previous conflicts (HSR&D, 2009). The authors were unable to find any research on the psychological impact of IEDs on civilians.
- 6 Suicide attacks involving both firearms and explosives have been carried out in Afghanistan since the 14 January 2008 attack on the Serena Hotel in Kabul.
- 7 Declassified military statistics covering 2011 provided to the authors in 2012.
- 8 These casualties include foreign military personnel participating in Operation Enduring Freedom Afghanistan, but not Afghan security forces.
- 9 Declassified military statistics covering 2011 provided to the authors in 2012.
- 10 Author interview with UNMAS official, New York, 27 September 2012.
- 11 Author interview with Combined Joint Task Force (CJTF) Paladin officer, Kandahar, September 2012.
- 12 Author interviews with commander and deputy operations officer, CJTF Paladin, Bagram, September 2012.
- 13 Author interview with deputy commander, CJTF Paladin, Bagram, September 2012.
- 14 Author interview with the deputy commander of CJTF Paladin, Bagram, September 2012.

- 15 This analogy is made in a Taliban document on suicide bombing titled *Omar's Missiles*, a reference to the movement's leader, Mullah Mohammed Omar (Taliban–Islamic Emirate of Afghanistan, n.d.).
- 16 It is likely that VOIEDs caused more than 12 per cent of the casualties as pressure-plate devices probably accounted for a proportion of the fatalities in the 'unknown' category.
- 17 Declassified military statistics covering 2011 provided to the authors in 2012.
- 18 The percentage was arguably slightly higher as the EVMP recorded a suicide bombing outside an Iraqi police station on 18 January 2011 as an attack on combatants even though it is highly likely that the prospective recruits who were queuing outside the facility were the intended targets. The explosion inflicted 217 civilian and no police casualties.
- 19 Author interview with a senior member of the Analytical Support and Sanctions Monitoring Team established to support UN Security Council Resolution 1267 concerning Al Qaeda and the Taliban, New York, 28 September 2012.
- 20 This is reflected in the trajectory of the Sunni extremist group Lashkar-e-Jhangvi, which primarily carried out firearms attacks after its formation in the mid-1990s, but has been held responsible for a number of mass-casualty suicide bombings since 2005, including an attack on Bareilvi Muslims in Karachi's Nishtar Park on 11 April 2006, which killed more than 50 people (Rana, 2009).
- 21 The regular IED attacks on Shia Muslims in Iraq are presumed to be part of Al Qaeda in Iraq's strategy of inciting retaliatory violence against Sunni Muslims in the hope of mobilizing support for its cause. This view has been expressed by numerous US officers. Author telephone interview with Lt. Gen. Michael L. Oates (ret.), former director of the US military's Joint IED Defeat Organization (JIEDDO), October 2012.
- 22 Author interview with deputy commander, CJTF Paladin, Bagram, September 2012.
- 23 Author interview with a member of the Analytical Support and Sanctions Monitoring Team established to support UN Security Council Resolution 1267 concerning Al Qaeda and the Taliban, New York, 28 September 2012.
- 24 News coverage provides details of the 2007 Sauerland Cell case, the 2006 plot to blow up an airliner with chemicals such as hydrogen peroxide, and a 2009 plot in the United States to detonate hydrogen peroxide bombs (Musharbash, 2009; BBC News, 2009; Meyer and Susman, 2009).
- 25 Declassified military statistics covering 2011 provided to the authors in 2012.
- 26 Author interview with Lt. Gen. Michael L. Oates (ret.), former director of JIEDDO, New York, 2 October 2012.
- 27 Author interview with an UNMAS official, New York, 27 September 2012.
- 28 Author interview with the deputy commander, CJTF Paladin, Bagram, September 2012.
- 29 The men were known associates of the PIRA and two were suspected members of the group's 'engineering division'. They were convicted for travelling on false passports and it was not proved in court that they were training the FARC.
- 30 Libya, Iraq, South Yemen, and Syria were the first to be designated by the United States as state sponsors of terrorism in 1979 for their support of Palestinian militant groups.
- 31 Author interview with Lt. Gen. Michael L. Oates (ret.), former director of JIEDDO, New York, 2 October 2012. Oates also noted that IEDs would continue to be used against Afghan security forces, which are more vulnerable than Coalition forces.

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