CLUSTER BOMBS

The military effectiveness and impact on civilians of cluster munitions

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landmine action
THE CAMPAIGN AGAINST LANDMINES

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> *I went with my cousins to see the place where NATO bombed. As we walked I saw something yellow – someone told us it was a cluster bomb. One of us took it and put it into a well. Nothing happened. Later I went back to the bomb and put it in this position [vertical]. We began talking about taking the bomb to play with and then I just put it somewhere and it exploded. The boy near me died and I was thrown a metre in the air. The boy who died was 14 – he had his head cut off. I was near him and another boy tried to help me.*
>
> 13-year-old boy in Pristina Hospital, having undergone a double leg amputation

Recently the use of cluster bombs by NATO forces during Operation 'Allied Force' in Kosovo focused the world's attention on the weapon. But cluster bombs have been used widely in the past 50 years, and have become part of a widely accepted military strategy and a growing source of revenue for many weapon manufacturers. Recognition has also grown of a characteristic of cluster bombs that makes them different to others; their propensity to cause post-conflict casualties among civilians. In Kosovo, NATO cluster bombs are estimated to have killed or injured more than 200 people in 12 months. But unlike landmines, cluster weapons are not designed to be long lasting or victim activated; it is their failure to always act as designed that leads to civilian casualties.

This UK Working Group on Landmines report assesses the military effectiveness of cluster bombs and their impact on civilians. It describes the types of cluster munitions and looks at their use and impact in a number of conflicts including Laos, the Gulf War and Kosovo. The report concludes by making recommendations about changes to international law to prevent future civilian casualties.

Types of cluster bombs and their uses

All cluster weapons consist of two primary elements: a container or dispenser; and submunitions, often called bomblets.

The container can be a purpose-constructed bomb casing released from an aircraft, missile, rocket or artillery projectile which carry submunitions towards the target area and incorporate a system to release them close to or above the target area. It may also be a re-useable dispenser attached to an aircraft and designed to release the submunitions close to or above the target area. These cluster weapons encompass the whole range of submunition types and, especially in the case of Multiple Launch Rocket Systems (MLRS), have the capacity to blanket large areas of territory with bomblets or mines from considerable distances.

Submunitions or bomblets are explosive projectiles, which normally incorporate some design feature allowing them to separate and spread as they are dispensed from the container/dispenser in order to achieve the optimum ground coverage. There are four main categories of submunition:

- **Anti-personnel:** normally a fragmentation bomblet with properties similar to a grenade.
- **Anti-tank/anti-materiel:** its effect is to kill or injure the tank crew, and cause the explosion of ammunition carried in the tank.
- **Combined Effects Munition (CEM):** a CEM submunition typically combines the properties of an anti-tank bomblet with the addition of an incendiary capacity to cover the impact area with burning fragments causing secondary fires especially where fuel is present.
- **Landmines:** submunitions may be anti-tank or anti-personnel mines.

Cluster bombs are one of the cheapest air-delivered weapons available. The cost per American BLU 97/B

bomblet is about US$60. By the end of the Vietnam War the cluster bomb was entrenched in western military thinking. This was despite the fact that the US was defeated and appeared to have achieved no sustainable battlefield advantages from using more than 350 million bomblets of many different designs. In the United Kingdom, Hunting Engineering began developing the BL755 cluster bomb during the mid-1960s (a variant of this, the RBL755, was used by the Royal Air Force in Kosovo). By the 1970s all the major international powers had introduced cluster bombs into their armouries. There is no doubt that the US and Russian Federation military and many other forces perceive this kind of weapon technology as central to their existing and future war-fighting strategy.

Failure rates

The failure of cluster bombs to function as designed is one of the central concerns surrounding the weapon-type. Submunitions are prone to failure for a number of reasons:

- **manufacture:** damaged or faulty parts being in either the dispenser or one or more bomblets.
- **movement and storage:** weapons spend long periods of their serviceable life in storage. Depending on the professionalism of the forces involved, stores will be subject to varying levels of care, preservation and servicing where errors may be made, leading to eventual failures in use. Transportation may result in damage.
- **loading, flight and landings:** in wartime, under the pressures of conflict, ground crews make mistakes and the mechanical stresses of flying in combat increase the potential for failure.
- **ground impact:** the environment is critical in determining the detonation as designed of all impact-initiated bomblets. The ground surface must offer sufficient resistance to impact or the bomblet will not detonate. Mud, snow, sand and surface water all lead to substantial numbers of duds and also result in bomblets penetrating ground cover and going sub-surface.

The reliability of cluster bombs is further affected by plant overgrowth and forest. Bomblets strike trees during descent and get caught up. Since there is no impact, the bomblet fails to function. Alternatively, branches and overgrowth reduce the speed of falling bomblets which then fail to detonate on impact.

Recent debate about failure rates of cluster bombs has often missed the point. The most common misunderstandings are due to political, military and manufacturer statements referring to an overall failure rate for cluster bombs generally or for specific weapon types. The most commonly quoted failure rate is five per cent. But in March 2000 the UN Mine Action Co-ordination Centre (UNMACC) in Pristina, Kosovo, had more details of estimated failure rates.

> *In Kosovo, preliminary statistics for the British RBL755 show that the failure rate is about 11-12 per cent. While the final figure will not be known until the last area has been cleared, it is highly likely that it will be at least 10 per cent, if not more.*

Moreover, the British Government has had evidence since the 1980s that the failure rate of the BL755 exceeds five per cent. On 28 May 2000 the Minister of State for Defence, John Spellar MP, wrote in response to a Parliamentary Question:

> *I am afraid that surviving records are a little inconsistent on the question of how many BL755s were dropped during the [Falklands] conflict. The number was either 106 or 107, we cannot be certain which. We do know, however, that 1,492 submunitions from these weapons were cleared from the Falkland Islands after the conflict.*

This amounts to a known failure rate of 9.6 per cent. It may be, however, that potential failure rates could be far higher, based on commercial and US military trials standards. On 20 March 2000 it was reported that the Sense and Destroy Armour (SADARM) manufactured by the US arms company Aerojet had successfully completed technical testing at the US Army Yuma Proving Grounds in Arizona. 'In all, 140 submunitions demonstrated 77 per cent reliability.' This indicates that a 20 per cent rate of submunition failure is acceptable to the US Department of Defense as long as the failures are on target.

However, it is the actual number of unexploded bomblets in a given situation that is of significance. For example, a BL755, assuming the accuracy of the UK MoD's expected failure rate of five per cent would result in approximately seven failed bomblets. Assuming a fairly standard strike of five bombs, the resulting 35 unexploded bomblets may have a post-conflict impact ranging from insignificant to devastating. Thirty-five bomblets spread across the agricultural and grazing land of a subsistence community could effectively destroy its future and force it to abandon its homes and land. It has no way of knowing that there are 'only' 35 bomblets present nor would it have any reasonable expectation of the land being cleared within a feasible timescale.

Perhaps the least meaningful calculation is the failure rate for a whole country or bombing campaign – a five per cent rate will not be an even spread across a war zone. To achieve that average rate of failure some dispensers will have failed totally, some will have had 50 per cent malfunctions, others 20 per cent and many will have had only one or two or no failed submunitions.

The use and impact of cluster bombs in three conflicts

When operating as designed, cluster bombs are capable of turning huge areas of territory into killing fields to achieve three primary objectives: causing immediate fatalities; causing disabling injuries; undermining the strategic objectives of enemy forces. The achievement of these primary aims has secondary effects: overloading medical evacuation and treatment facilities and diverting vehicles and manpower from other essential tasks; and undermining the morale of enemy forces through fear of the weapons' effects and being exposed to large numbers of casualties horrifically injured by bomb fragments.

Laos

It has been estimated that from 1964 to 1973 as part of it's strategy during the Vietnam War, the US dropped a planeload of bombs on the Lao people every eight minutes. The giant B52 planes that were principally used to bomb Laos were capable of carrying 30 tons of bombs. Many of these bombs did not detonate, with failure rates as high as 30 per cent. United Nations estimates put the amount of unexploded ordnance (UXO) still in the countryside in 1996 at about 500,000 tonnes. Much of this is cluster bombs and bomblets.

A 1995 study of two districts in Laos, Moung Pek and Moung Kham, with 24 villages and 56 villages respectively, found 1,153 UXO-related accidents recorded in a population of 97,562. Information was gathered on 66 such accidents during 1995 in these districts. Of the 66 victims, 36 were children under the age of 15. Thirty-two of them were boys. Of the 30 adults involved in accidents, 20 were men and 10 women. In total 14 people died and 52 were injured. The most common injury was severe shrapnel wounding to the body. The statistics from a group of subsistence farming villages show that at least 65 per cent of these incidents occur when the victims are engaged in essential daily tasks such as working in fields. These are not communities that have alternative lifestyles available to them.

The Gulf War: Operation 'Desert Storm'

The six-week air blitz that opened the Gulf War in 1991, employed similar methods – sustained air assault – and some of the same aircraft and weapons of the Vietnam War. Known US cluster bombs dropped during Operation Desert Storm amounted to 47,167 units containing 13,167,544 bomblets. Of these, more than nine million were of the type used by the US in Kosovo.

An official US government assessment of Operation Desert Storm found:

- unguided munitions including cluster bombs deployed at medium to high altitude were likely to miss the target and cause collateral damage.
- without radar, unguided bombing systems suffered from similar weather and environmental limitations as non-radar-guided munitions, especially at medium to high altitude.
- cluster bombs released at medium to high altitudes are very susceptible to wind.

It has been estimated that 30,000 tons of unexploded ordnance was scattered across Kuwait when the Gulf War ended. By February 1992 more than 1,400 Kuwaitis had been killed in incidents involving UXO and landmines. Among the most dangerous items were cluster bomblets.

Kosovo: Operation 'Allied Force'

In Kosovo in 1999, three different types of cluster bombs were deployed by NATO:

- BLU 87/B by US forces
- RBL755 by UK Royal Air Force (531 bombs, each containing 147 bomblets, of a total 1,011 aircraft munitions released)
- Mk 6/7 Rockeye by US forces.

Based on statements by senior military officers, the targets against which NATO approved the use of cluster bombs could be summarised as virtually anything other than runway cratering. The targets specifically recommended as being ideal for cluster bomb attacks included:

- aircraft and trucks on airfields
- main battle tanks and other heavy armour
- troops
- armoured personnel carriers
- artillery
- targets believed or reported to be hidden in wooded areas
- concealed targets which cannot be hit by precision weapons
- radio relay facilities/buildings.

Although it is difficult to assess the extent to which cluster bombs contributed to the psychological impact of the campaign, the intended targets of the cluster bombs are clear enough. The official figures for material targets destroyed during the bombing have been discredited by the recent release of details from the US Munitions Effects Assessment Team (MEAT) which conducted a comprehensive air and ground assessment in Kosovo immediately after the end of the campaign. This report was suppressed and replaced by an alternative written by the Chairman of the Joint Chiefs of Staff, General Henry Shelton, based largely on interviews with aircrews. The comparative findings included the following:

Tanks destroyed:	
Shelton – 140	MEAT – 14
Armoured personnel carriers destroyed:	
Shelton – 220	MEAT – 18
Artillery pieces destroyed:	
Shelton – 450	MEAT – 20

The MEAT Team found that of 744 'confirmed' NATO strikes, evidence could only be found of 58 successful strikes.

Impact on civilians

In the first four weeks after the end of the bombing campaign at least 150 Kosovars were killed and injured by landmines and unexploded ordnance. By June 2000 94 people had been killed and more than 400 injured. While the toll on the population has continued as the months have passed, most credible authorities agree that between 40 and 50 per cent of this total casualty rate can be attributed to cluster bombs. The key information required to speed bomb clearance is to know exactly where the bomblets are, where each bomb in each strike was delivered. But the UN mine-clearing operation, UNMACC, was denied access to the US MEA Team information, which included information that could have been life-saving.

Collateral damage is not time-limited – if a child finds and disturbs a bomblet six months after the bomb was dropped it is no less a measure of the impact of that attack than if the child had become a casualty after just one day. Despite knowledge of the dangers from previous combat experience particularly the Gulf War, cluster bombs were deployed from medium to high altitude during Operation Allied Force in Kosovo.

More than 50 people have been killed by NATO cluster submunitions since the end of Operation Allied Force. Given the true achievements of the bombings in Kosovo based on the US MEAT report, it seems clear that the

use of cluster bombs proved disproportionate to the military advantage gained. As time passes the bomblets become harder to locate and, often, increasingly unstable. Further civilian deaths and injuries will continue to illustrate the uncontrollable and disproportionate nature of cluster bombs.

Conclusions

It is clear that the lessons on the use of cluster bombs from the southeast Asian conflict and subsequently those of Operation Desert Storm and many smaller conflicts have not been learned, or at least have not led to a change of strategy. The continued use of cluster bombs has cost thousands of civilian lives, denied land to the poor and disenfranchised, and is now costing the international community millions in direct costs to eradicate the unexploded submunitions.

The legality of using weapons that have an unacceptable post-conflict impact on civilians and that act as a widely recognised obstacle to rehabilitation, resettlement, reconstruction and development, must be in doubt.

Governments have continued to insist that the failure rate, overall, of cluster bombs, is five per cent, and that this failure rate is 'acceptable'. To continue this distortion of the truth, while ignoring the advice of experts from the military and civilian mine-clearance community, is unforgivable.

Recommendations

New international law on the use of, and post-conflict responsibility for, cluster bombs is necessary. The use of cluster munitions must imply absolute accountability and responsibility. Any state that has used or uses cluster bombs should be:

i) required to implement full unexploded clearnace of munitions and supporting activities such as marking affected land immediately the territory is no longer subject to combat operations. Or, where that is not possible for any reason, the responsible party must be held financially responsible for full clearance and supporting operations under the auspices of the United Nations.

ii) held accountable for compensation to civilians and communities who suffer death, injury or economic disadvantage as a result of the explosion or presence of cluster bombs that do not explode on impact or within a short time thereafter.

iii) required to hand over to the United Nations full records of cluster bomb deployment and any additional information of use for the protection of civilians immediately after conflict ceases. In cases that are outstanding such as Laos, Kosovo, Chechnya and Yugoslavia this action must be undertaken without further delay.

Moratorium and review

As an immediate first step towards new international law on cluster munitions, there should be an in-depth review of this weapon type, encompassing use, impact and legality. This review should take place under the auspices of a recognised international body and should include input from civil society as well as the United Nations and the International Committee of the Red Cross and Red Crescent.

The review should be conducted during a global moratorium on the use, manufacture, sale and transfer of all cluster bombs.

Glossary

AT:	anti-tank
AP:	anti-personnel
APC:	Armoured Personnel Carrier
ATACMS:	Army Tactical Missile System
ATK:	Alliant Techsystems
APAM:	Anti-personnel/Anti-materiel
AVM:	Anti-vehicle mine
ATAP:	Anti-tank/Anti-personnel
AFB:	Air Force Base
BLU:	Bomb Live Unit
BAT:	bombes d'appui tactique
CEM:	Combined Effects Munition
CBU:	Cluster Bomb Unit
CEP:	Circular Error Probability
Dispenser:	Container or bomb from which submunitions are ejected.
DoD:	Department of Defense (US)
EOD:	Explosive Ordnance Disposal
FY:	Fiscal Year
Flak:	Anti-Aircraft Ground Fire
GAO:	General Accounting Office (US)
Howitzer:	Short-barrel/high-elevation gun
HIMARS:	High Mobility Artillery Rocket System
Hansard:	Official UK parliamentary records
ICRC:	International Committee of the Red Cross
IMSMA:	Information Management System for Mine Action
JSOW:	Joint Stand-off Weapon
KFOR:	NATO Kosovo Force
MAG:	Mines Advisory Group
MBT:	Main Battle Tank
MCC:	Mennonite Central Committee
MEAT:	Munitions Effects Assessment Team
MoD:	Ministry of Defence (UK)
Mortar:	Short large bore cannon for throwing shells at extreme elevations
MLRS:	Multiple Launch Rocket System
NFZ:	No Fly Zone (Iraq)
NATO:	North Atlantic Treaty Organisation
NOTS:	Naval Ordnance Test Station
RAF:	Royal Air Force
SADARM:	Sense and Destroy Armor (US)
SFW:	Sensor Fuzed Weapon
UXO:	Unexploded Ordnance
UNMACC:	United Nations Mine Action Co-ordination Centre (Kosovo)
WCMD:	Wind Corrected Munitions Dispenser

1 Introduction

Weapons of war are designed to kill and to maim – that is fact. History and common sense illustrate that, once a weapon is made available to a military force, it will be used to the limits of its destructive capabilities. But what practical controls exist once the military is involved in the process of fighting a war? Some restrictions do exist, in that military forces are bound by the international conventions to which their governments are party. The fact that the public now has access to images of the reality of war as it happens increases both their ability to judge and their duty to control; the practical question is how can that control be imposed in a way that reduces the burden on the soldier to make society's moral judgements under fire? One obvious way is to limit the weaponry placed at the disposal of the military to those weapons which cannot, by their design or common usage, result in damage that society finds unacceptable. There is precedent; the ban on chemical agents, laser-blinding weapons and, most recently, anti-personnel mines.

The key considerations for society are straightforward:

a) Which weapons are unacceptable by reason of their intended or actual impact?
b) What controls and limitations on the use of weapons considered to be acceptable must be placed on the military?

In order to make such judgments society must be informed. Unfortunately the political and military sectors in many countries have shown themselves unwilling to be the conduit for that information.

Cluster munitions

Probably the very first cluster bomb was a clumsy Swedish weapon made in the 1840s consisting of a bundle of grenades fired from a mortar.[1] Opinion varies regarding the first use of cluster munitions in modern times. One authoritative source[2] credits the British with the invention during World War I and cites their use, as incendiary weapons, by the United States and Britain in World War II against Japanese and European cities. The same source records the use of fragmentation bomblets by US forces against Japanese ground forces in the Pacific and the German dropping of 'butterfly' bombs on targets in Britain. But the Russians were also developing the cluster concept before and during World War II and used Il-2 Sturmovik bombers against German tanks by deploying large numbers of 1.5kg to 3kg anti-tank bomblets from their bomb bays. During the 1950s several cluster bomb models were developed by the Soviet Union to carry scatterable anti-personnel mines.

Recently the use of cluster bombs by NATO forces during Operation 'Allied Force' in Kosovo focused the world's attention on the weapon type. But cluster bombs have been used widely, albeit with less attention from the media, in the past 50 years, and have become part of a widely accepted military strategy and a growing source of revenue for many weapon manufacturers. Recognition has also grown of a characteristic of cluster weapons that makes them different to others; their propensity to cause post-conflict casualties among civilians. But unlike landmines, cluster weapons are not designed to be long lasting or victim activated; it is their failure to always act as designed which leads to civilian casualties.

Furthermore, international law on landmines does not appear to specifically deal with many cluster weapons. This report aims to address two key factors in an attempt to determine what might be done about a weapon that causes such post-conflict problems. The first is military effectiveness. In simple terms, is the weapon capable of achieving meaningful gains for the user force in combat? What strategies determine its successful deployment? What are the shortcomings of the weapon type and how do they influence its effectiveness? The second factor is proportionality. Is the use of cluster bombs legal under the laws of war (international humanitarian law)?

International law and cluster bombs

The central pillar of Additional Protocol I to the Geneva Conventions is clear:

> *In any armed conflict, the right of the Parties to the conflict to choose methods or means of warfare is not unlimited.*

The Protocol makes clear the general limitations on the effects of weaponry and the responsibility imposed on combatants to protect non-combatants.

> *It is prohibited to employ weapons, projectiles and material and methods of warfare of a nature to cause superfluous injury or unnecessary suffering.* [3]

Indiscriminate attacks are prohibited. Indiscriminate attacks are:

a) those which are not directed at a specific military objective;
b) those which employ a method or means of combat which cannot be directed at a specific military objective; or
c) those which employ a method or means of combat the effects of which cannot be limited as required by this Protocol; and consequently, in each such case, are of a nature to strike military objectives and civilians or civilian objects without distinction.[4]

Among others, the following types of attacks are to be considered as indiscriminate:

a) an attack by bombardment by any method or means which treats as a single military objective a number of clearly separated and distinct military objectives located in a city, town, village or other area containing a similar concentration of civilians or civilian objects; and
b) an attack which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated.[5]

The Protocol also lays down rules for the precautions that must be taken by those responsible for designating targets to protect the civilian population and property:

(ii) take all feasible precautions in the choice of means and methods of attack with a view to avoiding, and in any event minimising, incidental loss of civilian life, injury to civilians and damage to civilian objects;
(iii) refrain from deciding to launch any attack which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated.[6]

These are laws that should both limit and guide the military and the responsible political persons in their choice and approval of weaponry and in the subsequent targeting and use of those weapons.

There is also a body of international humanitarian law that prohibits the use of anti-personnel mines (the Ottawa Convention) and places restrictions on the use of landmines, including anti-personnel mines (the Convention on Conventional Weapons). According to the UK's Ministry of Defence:

> *Cluster bombs demonstrably do not fall within [the Ottawa Convention's] definition of an anti-personnel mine as they are indisputably designed to detonate on impact. In fact the use of cluster bombs is not specifically proscribed under any specific weapons convention.*[7]

It is clear from the general principles of humanitarian law set out above that, although cluster bombs do not appear to fall within the Ottawa Convention definition of an anti-personnel mine, the use of cluster bombs is not always legal. Furthermore this report shows that information available to NATO following the Falklands/Malvinas conflict and the Gulf War, along with the expertise of UK-based landmine clearance agencies, should in any case have been a cause for serious review of cluster bombs and the targeting strategies in force with the armed forces.

This report

This report seeks to examine the design, targeting, deployment and impact, both intentional and incidental, of cluster bombs against the principles of military utility and proportionality. Kosovo has been key to this evaluation of utility as it has for examining the proportional nature of cluster bombs primarily because of the nature of the conflict. Operation 'Allied Force' was what could be termed a 'best-case scenario' given the humanitarian justification for the bombing and the perception of NATO as an alliance of responsible forces with respect for human rights and the laws for the conduct of armed conflict. NATO was under pressure to fight a 'clean' war, a fact that was often emphasised by its spokesmen. The justification for the bombings was reports of genocide.

It is apparent that the NATO assumption, in mounting Operation 'Allied Force', that it represented both the United Nations and the 'international community' placed its command and forces under considerable pressure to transparently observe all the requirements of international humanitarian law (the laws of war). Since such emphasis was placed on humanitarian principles and transparency by NATO any negative properties of cluster bombs in Kosovo must be expected to be magnified considerably compared to any conflict with less humanitarian objectives.

Kosovo, though it is a key element of this report, is to some extent unrepresentative because the unusually large-scale response to the problems posed by unexploded ordnance and landmines so rapidly followed the end of the bombing campaign. Laos could be said to be at the other end of the response and severity scale; it was more than 20 years before organised clearance operations began, despite the fact that between the years 1964 to 1973 the United States dropped the equivalent of a planeload of bombs on Laos every eight minutes. In 1996 it was estimated that there were still 500,000 tonnes of unexploded ordnance in Laos.[8] Reference is also made in this report to other conflicts in which cluster bombs have been used. Sudan is an internal conflict where cluster munitions have been used by government forces against internal opposition; Chechnya has parallels with the Kosovo conflict. The Gulf War (Operation 'Desert Storm') provided an opportunity to evaluate the capacity of the military to learn lessons from 'lessons learned' exercises. Other areas of focus were Afghanistan and the North and South 'No Fly Zones' of Iraq.

Cluster munitions do not lend themselves to an all-encompassing definition. This report seeks to classify cluster munitions and submunitions in a way that will usefully inform the debate that surrounds the weapon type, and aims to cut through some of the confusion caused by the complex terminology employed by the manufacturers and, to a lesser extent, the military.

The arms trade is notoriously reticent regarding its development and marketing of lethal weaponry.[9] In addition to a review of promotional and technical materials produced by manufacturers of cluster munitions, interviews have been conducted with former employees, government and military specialists. This has enabled an accurate picture of development and production, and future planning, to be established.

The methodology of the study for this report has taken three approaches:

- Field studies – the direct assessment of the impact of cluster munitions.
- Interviews – to access the expertise, experience, opinions and recommendations of specialists in relevant fields.
- Literature review – a comprehensive review of available resources.

1 Lumsden, Dr M, Anti-personnel weapons, SIPRI Stockholm 1978.
2 Prokosch, Eric, CLUSTER WEAPONS, Essex University/Medico International 1995.
Eric Prokosch is probably the world's foremost expert on anti-personnel weapons. This meticulous research has made available an enormous body of information on the development, production and use of cluster munitions and other weapon systems.
3 Article 35.2, Additional Protocol I (1977) to the Geneva Conventions 1949.
4 Article 51.3, Additional Protocol I (1977) to the Geneva Conventions 1949.
5 Article 51.5, Additional Protocol I (1977) to the Geneva Conventions 1949.
6 Article 57.2 (ii) and (iii), Additional Protocol I (1977) to the Geneva Conventions 1949.
7 Letter dated 16.2.00 from John Spellar MP, UK Minister of State for the Armed Forces, to Julia Drown MP. MoD Ref: D/Min(AF)/JS 0153/00/M.
8 Curse of the Bombies: A Case Study of Saravan Province, Lao, Jim Monan, Oxfam Hong Kong 1998. More than 6,300,000 tons of bombs were dropped on Indochina during the Vietnam War of which 3.9 million tons fell on South Vietnam. 1,360,000 tons were dropped on Germany by all Allied planes during World War II.
9 Hunting Engineering agreed to meet researchers for this study but would only do so '...within security guidelines...' (letter dated 8.12.99) and would agree to the meeting on condition it was on an '...off the record...' basis (telephone discussion). Hunting Engineering and other manufacturers are less reticent in their advertising material, primarily produced for use at international arms fairs, and researchers have also been able to meet confidentially with individuals working within the industry and related fields. In the event it was decided that nothing further of substance could be gained from a meeting.

2 Cluster munitions defined

Generic cluster munition properties

All cluster munitions consist of two primary elements:

- A container or dispenser
- Submunitions

The container can be a purpose-constructed bomb casing released from an aircraft, missile or artillery projectile which carry submunitions towards the target area and incorporate a system to release them close to or above the target area. It may also be a re-useable dispenser attached to an aircraft and designed to release the submunitions close to or above the target area.

Submunitions are explosive projectiles, often called 'bomblets', which normally incorporate some design feature allowing them to separate and spread as they are dispensed from the container/dispenser in order to achieve the optimum ground coverage. The arming cycle of each submunition begins at some stage between ejection from the dispenser and striking the ground. Arming mechanisms vary widely and may, in some cases, only complete the arming cycle sometime after impact. Most, but not all, submunitions are designed to detonate on impact. Submunitions delivered by missile or artillery tend to be simpler in design than those dispensed from aircraft. The number of submunitions in each container ranges from tens to hundreds.

There are four main categories of submunition:

- **Anti-personnel:** normally a fragmentation bomblet with properties similar to a grenade.
- **Anti-tank/anti-materiel:** commonly contains a shaped explosive charge with a metal liner that, on detonation, becomes a molten jet capable of piercing armour. Its effect is to kill or injure the tank crew, often through splintering of the inner wall of the armour, and cause the explosion of ammunition carried in the tank. Most anti-tank submunitions have a secondary fragmentation effect caused by the disintegration of the bomblet casing into fragments driven outwards from the detonation at ballistic speeds.
- **Combined-effects Munition (CEM):** a CEM submunition typically combines the properties of an anti-tank bomblet with the addition of an incendiary capacity. This is commonly achieved through the incorporation of zirconium sponge that breaks up on detonation and covers the impact area with burning fragments causing secondary fires especially where fuel is present.
- **Landmines:** submunitions may be anti-tank or anti-personnel mines. These may be pressure or tripwire initiated, may include self-destruct mechanisms, and are deployed primarily in an area-denial role.

There are other categories of cluster munition which do not fall within the scope or concerns of this study such as fuel-air explosive and chemical warfare cluster bombs.

Air delivery – history

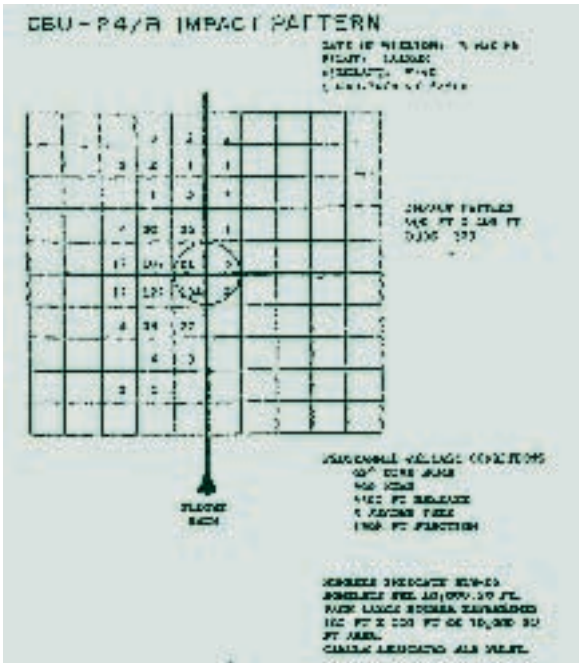
The development of cluster munitions has tended to focus on air-delivered systems over missile or artillery designs, although there are some signs that the balance may shift in the future. Development through two world wars and the Korean conflict was sporadic although considerable attention had been afforded to the design of fragmentation, armour-piercing technology and bomb design. But it was in the 1960s in the United States that support for the 'cluster bomb' concept accelerated. As each type was accepted into service, orders were placed in enormous numbers and manufacturers, most notably Honeywell Inc of Minneapolis, could hardly keep up with demand. In the years 1964 to 1971 the US Department of Defense procured 37 million BLU 3/B bomblets, while the respected Stockholm International Peace Research Institute (SIPRI) estimated, based on the number of carrier bombs purchased, that 275,500,000 BLU 59, BLU

36 and BLU 26 fragmentation submunitions were procured in the same period. The strategic thinking behind this massive commitment to a largely unproven weapon-type was best explained in a confidential report from the Naval Ordnance Test Station (NOTS) based at China Lake, California, in 1959:

> *... tanks are perplexing targets for aircraft, since they are small and hard targets, making both acquisition and kill very difficult... One way to solve the problem of a small target and large delivery error is to use a weapon consisting of a cluster of warheads. By this means the target can be attacked with a greater hope of success...* [10]

The above report resulted from a project on which NOTS and Honeywell worked in close co-operation, resulting in the design of the Rockeye II cluster bomb for which Honeywell became the main contractor with business worth in excess of US$100 million.

Figure 1: Nellis AFB trial of BLU 24/B 1966



Trials on this emerging group of weapons are worth reviewing in retrospect. The matrix at Figure 1 graphically illustrates the results of a trial deployment of a CBU 24/B cluster bomb by an F-4c aircraft at Nellis Air Force Base, Nevada, on 3 March 1966. [11]

The distance between each line represents 100 feet on the ground and each square represents a ground area of 10,000 square feet. The circle indicates the central target area and the cross-point at the circle's centre the mean point of aim. The total number of BLU 26 submunitions dropped is 663 of which 33.6 per cent (223 bomblets) impacted within the target area. In other words 440 BLU 26s, or 66.4 per cent, missed the main target area and covered an area of 320,000 square feet, more than eight times the size of the central target area.

The pilot was performing a textbook bomb delivery within the manufacturer's specified parameters and was under no threat from ground fire, missiles or enemy aircraft – this was therefore a 'best-case' deployment. The trial also reported that 173 bomblets failed to explode on impact, a dud rate of 26 per cent.

One attraction of cluster bombs was the comparatively low production cost that could be achieved through mass production. Prokosch states that Honeywell had so refined the production process that an impact fuze for the BLU 26 bomblet took only 48 seconds of direct labour and the remote fuze for the same submunition, which caused the BLU 26 to explode at random intervals after arming, was being produced for only $1.24.[12] Cluster bombs remain one of the cheapest air-delivered munitions available. The estimated unit cost per BLU 97/B submunition, based on a breakdown of the total munition cost for the CBU-87/B of US$13,941, would not exceed US$60. (The CBU-52 total cost is US$2,159). By comparison a US laser-guided GBU-27 unit cost is US$75,539 while the GBU-28 costs US$100,000. Maverick missile unit costs range from US$64,100 (AGM-65B) to US$269,000 (AGM-65G). [13]

The impact of American cluster bombs in southeast Asia is well documented but perhaps impossible to fully conceptualise. US Department of Defense statistics indicate that something like 285 million BLU 26 series submunitions were dropped on Vietnam, Cambodia and Laos which equates to seven bomblets for every man, woman and child in those three countries. The total number of submunitions dropped by US forces on south east Asia, including air-delivered mines, is estimated by credible sources to be as many as 360 million. [14]

The question clearly raised by usage on such scale is; what strategy was being served? One view is that the availability of the weapon dictated the strategy, a

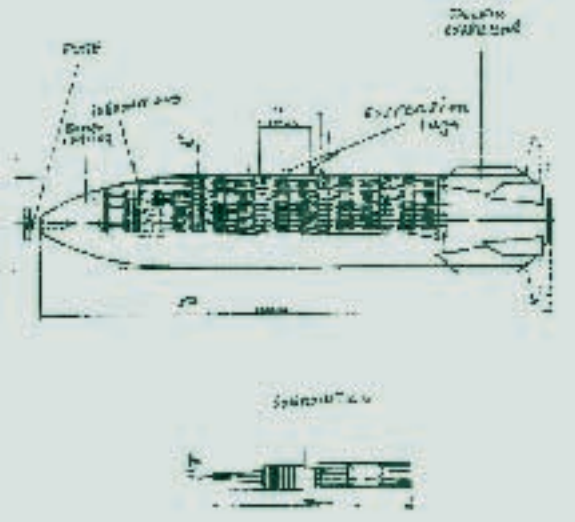
perception supported by Vice Admiral Lloyd M. Mustin, Director of Operations for the Joint Chiefs of Staff, in explaining why no political approval was sought before cluster bombs were used:

> *In our view, they were a purely conventional weapon, and we regarded them as available, and the less said, the better... We in J-3 (Directorate of Operations) had ways of exchanging information with our subordinate echelons all the way out to pilots on the line, and we just said, 'As far as we know, that's authorized to you, you've got 'em, use 'em when you want, and keep your mouth shut, or somebody will tell you that you can't'.* [15]

Cluster bombs were chosen to deny the Ho Chi Minh Trail in Laos to North Vietnamese forces. Despite bombardment on an unimaginable scale and continuous cluster bomb attacks using bomblets and mines, the Trail was never closed and, in fact, increased its capacity throughout the period of bombing.

By the end of the Vietnam War the cluster bomb was entrenched in western military thinking. Despite having used more than 350 million submunitions of many different designs, the United States was defeated and appeared to have achieved no sustainable battlefield advantages as a result of its tactical reliance on cluster bombs. In the United Kingdom Hunting Engineering began developing the BL755 cluster bomb during the mid-1960s while the German company Raketen Technik was concentrating on a multi-purpose system, the MW-1, which could be loaded with mixed configurations of bomblets and mines to suit differing targets. By the 1970s all the major international powers had introduced cluster bombs into their armouries.

Figure 2: Example of cluster bomb and Submunition (Chilean CB-500)



Air delivery – hardware

Cluster bombs are essentially a bomb casing containing submunitions. The bomb is usually attached to the plane by means of suspension lugs, of which there are three standard types referred to as NATO, Russian and British. After release from the plane the critical factor is achieving separation between plane and munition. There are a number of methods employed to achieve safe separation most based on the inclusion of a fuze time-delay allowing a safe distance before the submunition ejection sequence begins. Some bombs use a retard parachute to ensure fast separation by slowing the bomb on release. The bomb is commonly imparted spin by tail fins, the outer skin of the bomb is discarded, and the submunitions are ejected from the bomb, usually by centrifugal forces as a consequence of the spinning container. In order to achieve a more effective spread some bombs use different dispersal technology, for instance the UK-manufactured BL755 employs a gas-operated system which splits and ejects the twin outer casing then ejects the 147 submunitions in a staggered pattern at differing velocities. Table A1 in the Appendix, shows a sample of current cluster bombs.

Some cluster bomb systems, such as the German MW-1, employ re-usable dispensers that remain attached to the aircraft. The submunitions are typically dispensed vertically downwards or to left and right from a fuselage-mounted dispenser. The dispenser with the

most prolific dissemination capacity was the Hayes dispenser 16 used by US planes during the southeast Asian conflict. The most common version consisted of two segmented aluminium containers carried in the bomb bay of a B52 bomber which could drop 10,656 BLU 3 bomblets, 25,488 BLU 26 bomblets or 77,040 M40 fragmentation grenades in a single pass over the target area. The manufacturers, Hayes International Corporation, described this dispenser as being like:

> *…a Swiss watch in intricacy and complexity of parts, all designed with micrometric attention to exacting interface requirements aimed at providing our Air Force bomber/attack aircraft with the ultimate refinements of state of the munitions-dispensing art technology.* [17]

More recently, analysis of the performance of cluster bombs used in the Gulf War (Operation 'Desert Storm') by the United States showed that, when they were released at medium to high altitudes, the bombs were very susceptible to high wind. The US began developing the Wind Corrected Munitions Dispenser (WCMD) following the second Gulf War as a direct response to this problem. The most recent cluster bombs in the US armoury, CBU-78/B Gator, CBU-87/B CEM, CBU-89/B Gator and the CBU-97/B SFW, are designed for release at low altitudes, where the plane and crew are at greatest risk; the WCMD is designed to allow release at medium to high altitudes, reportedly up to 45,000 feet. It consists basically of a bolt-on replacement tail unit and guidance system capable of adjusting the flight of the bomb to maintain course trajectory on a target selected prior to launch over a maximum range of eight miles. The WCMD was accepted into service by US forces in February 1999; initial orders are for 40,000 kits at US$8,937. [18] The three versions of the WCMD will be designated CBU 103 (with BLU 97/B CEM), CBU 104 (with BLU 91 and BLU 92 mines) and BLU 105 (with BLU 108 SFW). [19]

Land-based cluster munition systems – hardware

The military also employ submunitions in self-propelled guns, howitzers[20] and missile and rocket systems. These cluster weapons encompass the whole range of submunition types and, especially in the case of Multiple Launch Rocket Systems (MLRS), have the capacity to blanket large areas of territory with bomblets or mines from considerable distances. Tables A2 and A3 in the Appendix list examples of rocket systems, artillery guns and howitzers that use cluster submunitions.

Submunitions – types and effects

Although reference is often made to cluster bombs or to missiles and projectiles, they are simply the means of delivering the submunitions to the target area – it is the submunitions that do the damage. The military and manufacturers use increasingly complex vocabulary to refer to the various systems, components and modifications. But the manufacturers' technical documentation issued with their weaponry and the training and operational pamphlets written and used by the military are presented in plain language and far easier to understand than the information generally accessible to the public.

There are four main categories of submunition:

- Anti-personnel
- Anti-tank
- Combined Effects Munition
- Landmines

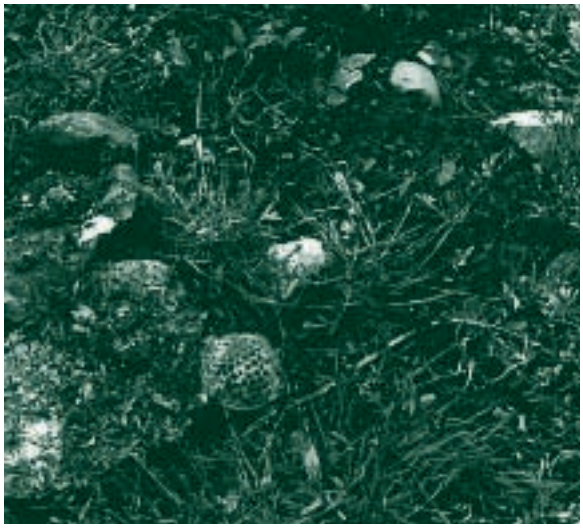
Anti-personnel submunitions

The lethal property of an anti-personnel submunition is normally fragmentation. The tactical concept involved is to cause maximum casualties among combatants in an enemy force, especially troops in the open. Although this category of submunition is often referred to as having an area-denial role, given that it is normally designed to explode on impact or soon after impact, this description is, at best, misleading.

A capability to deny territory implies presence of threat and could only be attributed to a weapon which has a considerable delay between dissemination and detonation or, as with landmines, is victim-initiated. Area denial could only be a valid strategy if the planners

or users were relying on a recognised propensity for malfunction and, if that were the case, the submunition would, since the malfunction is so common as to be considered a property of the weapon, be a de facto anti-personnel mine.

Photo 1: Unexploded BLU 26 anti-personnel fragmentation bomblet, Laos



When operating as designed, anti-personnel submunitions are capable of turning huge areas of territory into killing fields to achieve three primary objectives:

- Causing immediate fatalities.
- Causing disabling injuries.
- Undermining the strategic objectives of enemy forces.

The achievement of these primary aims has secondary effects:

- Overloading medical evacuation and treatment facilities, and diverting vehicles and manpower from other essential tasks to respond to evacuation priorities.
- Undermining the morale of enemy forces through fear of weapon effects and being exposed to large numbers of horrifically injured fragmentation casualties.

Weapons designers have expended considerable resources to understand and improve the impact of fragmentation on the human body. One of the most important studies was conducted by a group from Princeton University in the 1940s who saw their work as '...an attempt to place wound ballistics on a sound quantitative basis'. Other experts, placing bias on treating the casualty rather than improving the weapon, have documented the effect of fragmentation in some detail.

The fragmentation effect

All cluster submunitions are anti-personnel regardless of their prime design purpose. The reason for this is obvious and unavoidable, the human body is soft and easily penetrable in comparison with all other combat targets; if personnel are within range when a submunition of any type detonates there is a high likelihood they will become victims due to either design or secondary fragmentation.[21] The impact of fragmentation on the human body is explained in detail by the authors of a training resource for 'first-helpers' at village level:[22]

Fragment injuries to limbs

Although the inlet wound looks small, the damage inside can be massive. A stone hitting water makes waves. Our body is 70 per cent water. A fragment sends pressure waves into the tissues. The waves are very fast and hit the tissues like a blow. How the tissues are damaged depends on how elastic they are (how easily they stretch).

- *The skin is very elastic. It stretches when the fragment passes through then springs back without much damage.*
- *But muscle is not very elastic. The pressure waves tear a wide and ragged wound track through the muscle. Because muscles have a rich blood supply muscle wounds bleed a lot.*
- *Bones are not at all elastic. When a fragment hits bone, the fragment is suddenly brought to a complete stop. Exactly at that point a massive pressure wave is formed. The wave hits the surrounding tissue like the splash from a flat stone hitting water. All the force carried by the fragment becomes tissue damage.*

Artery injuries

Fragments... or pieces of bone may tear the wall of the artery. Small tears are plugged by platelets and don't bleed a lot. But note – the artery bleeding is hidden! Because the wound track is narrow you will seldom see blood pumping out through the limb wound. Still 1-2 litres of blood may collect inside the limb. Then – as a result of the blood loss – the blood stream inside the artery slows down. The platelets plug the artery tear and the bleeding temporarily stops. When you arrive at the site of the injury, the patient is not bleeding. This may fool you. If you start [intravenous] IV infusions without having packed the wound track with gauze or clothes, the blood clot in the artery will be flushed away when the blood pressure rises, and the wound will start bleeding heavily.

Fragment injuries to important organs

Injuries to the skull mean airway problems: as most victims with severe head injuries die within an hour in the field, we can do nothing to save them. For those who survive more than one hour, blocking of the airway is the main problem.

Injuries to the face mean airway problems: often there is associated brain damage, so the patient is weak and cannot cough properly. This is why blood or bone fragments may block the airway.

Injuries to the chest: most victims who are hit in the middle of the chest die within one hour from tears of the heart or major blood vessels. Most victims hit at the side of the chest survive if the life support is good and starts early. The main problem is not the lung injury itself: the lungs are very elastic and can take a fragment without much bleeding. The main problem is the fragment wound in the chest wall: blood from broken ribs and torn rib arteries collects between the lung and chest wall and compresses the lung. Air leaking from the lung and through the chest wall wound also makes the lung collapse. This causes poor breathing – and the body suffers from oxygen starvation.

Injuries to the abdomen: there are many blood-rich organs in the abdomen such as the liver, kidneys and spleen. The main signs of injury within the abdomen are the signs of blood loss: the victim's limbs are cool, the heart rate increases, the blood pressure falls and the victim becomes drowsy... The abdomen can collect 2-3 litres of blood without showing any swelling... Injuries to the abdominal organs block the movement of the diaphragm. This means the lung suction pump cannot work properly. So, besides having less blood circulating round the body, the blood also carries less oxygen due to shallow breathing.

The authors estimate that 30 per cent of fragmentation casualties will be fatal even with good life support available. It is valid to put this highly efficient wounding medium in perspective since there is a tendency to view fragmentation as an almost incidental weapon property. But weapon developers have placed great emphases on the improvement of fragmentation design as the following extract from a 1963 presentation at the American Ordnance Association seminar illustrates:

> *...initial feasibility studies established the high level of lethality associated with the cast pearlitic malleable iron. This was followed by extensive research and development activity during which nearly 20,000 (mortar) rounds were tested...* [23]

The outer casings of cluster submunitions are an integral design factor with pre-planned effects that are major 'selling points' for manufacturers. Hunting Engineering, the UK manufacturers of the BL755 cluster bomb, described this property as follows:

> *147 shaped-charge bomblets with fragmenting warhead casing ... the warhead produces a high-velocity jet and slug for armour piercing, while casing fragmentation is a secondary effect capable of defeating a wide range of battlefield targets.*[24]

Anti-tank, anti-armour and anti-materiel submunitions

Cluster weapons are especially designed and targeted at heavy and light armour, artillery and general vehicles and equipment. The primary design priority is to target Main Battle Tanks (MBTs); this requires a capacity to pierce armour in such a manner as to demobilise the

vehicle and/or its crew. This is most commonly achieved by a shaped charge.

Figure 3: Manufacturer's drawings of BL755 GP and AAA submunitions

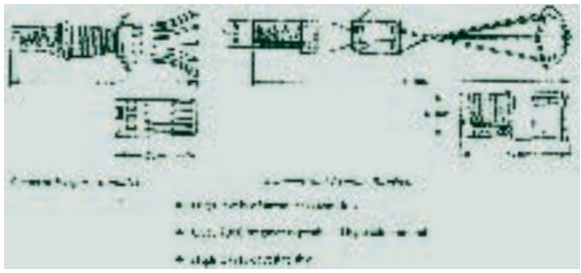


Photo 2: Unexploded BL755 bomblet

The British-made BL755 bomblet's primary function is to attack armour and other hard targets which is achieved through a series of technical functions which begin when it is ejected from the carrier bomb, as follows:

- Bomblets are ejected from the bomb by gas pressure
- The bomblet clears the carrier bomb and deploys its parachute retarder, the timer is initiated
- The probe is erected
- The detonator begins to be moved from the 'SAFE' to 'ARMED' position by the timer
- When the bomblet reaches a pre-determined critical airspeed the detonator moves to the fully armed position
- On impact at the target an electric charge ignites the detonator and initiates an explosive chain concluding with the firing of the main charge
- The shaped charge produces a plasma jet capable of penetrating 250mm of armour
- The notched steel wire which is wound around the outside of the casing is driven outwards at ballistic speed segmenting into more than 2,000 steel fragments.

In recent developments the approach has changed, with anti-tank submunitions taking on the 'smart' label. The CBU 105, a combination of the Wind Corrected Munitions Dispenser (WCMD) and the BLU 108/B, was recently certified for use on the F-16 aircraft.[25] The BLU 108/B sensor-fuzed 'skeet' submunition incorporates an infrared sensor that detects armoured targets. When the target is detected a rocket is fired which literally blasts the projectile into its top armour. If no target is detected within a pre-determined time, the projectiles are automatically fired 'causing damage to material and personnel'.[26]

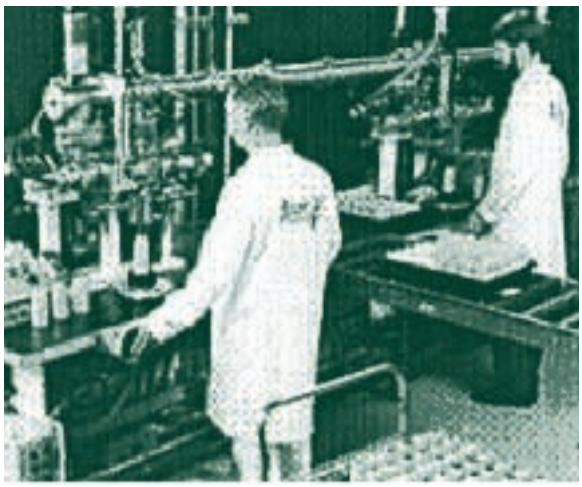
The Combined Effects Munition (CEM)

The BLU 97/B CEM submunition is designed with the primary objective of 'killing tanks', but with additional capabilities to kill and maim personnel while damaging and setting fire to anything else within the target area. The US Department of Defense describes them thus:

> *The BLU 97B and BLU 97A/B 27 bombs are small, aerially dispensed, decelerator stabilised, shaped charge, anti-material/antitank bombs.* [27]

The main body of the bomblet is yellow in colour. The drogue parachutes (either AID or RAD types 28) which deploy to arm and orientate the munition vary in colour and may be white, green or olive drab and possibly other colours. There is no standard chute type or chute colour to bomblet variant.

Photo 3: Loading and assembly of BLU 97 CEM bomblets for JSOW



Aerojet, the US company that assembles and loads the BLU 97 for the JSOW programme, developed special machinery to load each bomblet with PBXN-107 29 explosive. Four machines are used to load 3,000 bomblets in each batch. Aerojet estimates that one bomblet is loaded every 22 seconds. Two automated machines are used for final assembly of the submunitions.[30]

Figure 4: Diagram of CBU-87 dispensing BLU 97/B submunitions

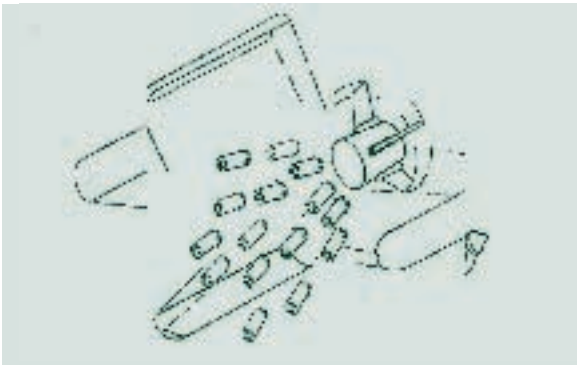
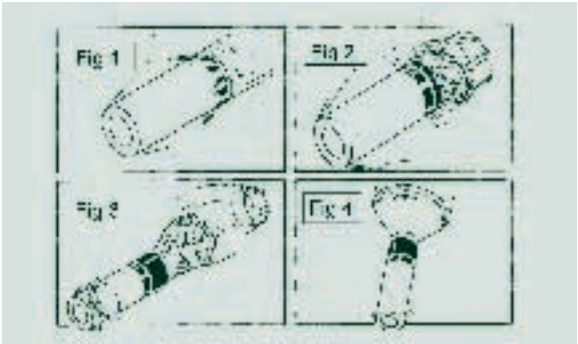


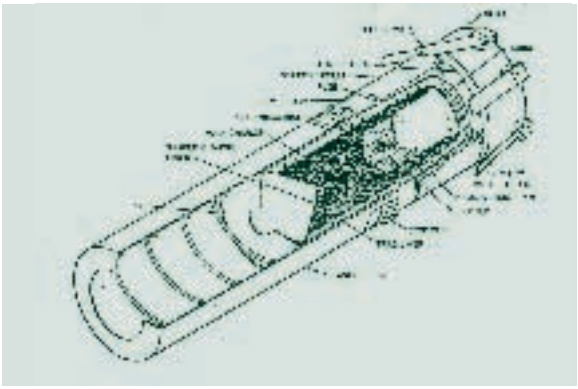
Figure 5: BLU 97/B functional sequence



As the BLU 97 is released from the dispenser and encounters airstream velocities of 175 knots or greater (Fig 1) the airflow acts on the wind tabs and begins releasing the cup assemblies and stand-off probe (Fig 2). The airstream then pulls the cup assembly rearward, discarding the cup and exposes the AID or RAD while the stand-off probe is extended under spring pressure and locked in position. As the stand-off probe extends, it allows the primary firing pin to rotate out of its recess and into the armed position (Fig 3). Ram air entering the inlet ports deploys the AID or RAD, which transmits load to the main shaft assembly in the fuze (Fig 4).

As the probe strikes the target, the stop clip is overcome driving the stand-off probe rearward, compressing the spring and driving the primary firing pin into the primary M55 detonator which initiates and crushes a piezoelectric crystal located in the detonator housing. This sends an electrical pulse to an electric detonator, which initiates the fuze, which then initiates a booster and detonates the main explosive charge of cyclotol or PBXN-107. The bomblet contains a back-up secondary firing pin and M55 detonator.

Figure 6: BLU 97B CEM submunition with standoff probe extended



The effect on detonation is threefold – the shaped charge pierces armour and causes fragmentation injuries to tank crews and severe damage to automotive, fighting and communications equipment. The scored steel bomblet casing breaks into 300 ingrain fragments effective against light armour and personnel, while the zirconium breaks up and scatters over a large area causing fires, especially where fuel is present.

Landmines

The deployment of anti-personnel and anti-tank landmines as submunitions with cluster systems presents all the problems of conventionally deployed landmines. Unlike other submunitions landmines are designed to be victim-initiated. Two aspects are of particular concern:

- The sheer number of mines which can be delivered, capable of constructing a minefield of considerable

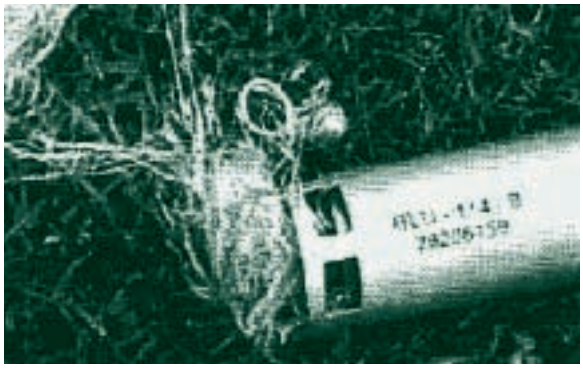
proportions within minutes and with no possibility of marking its perimeter. While the attacking force may retain records of the target area and number and type of mines disseminated there is no guarantee of that data being made available to authorities controlling the target area within a viable timescale or at all. Nor is there any effective possibility for the attacking force to evaluate the accuracy of its records. Multiple rocket systems are a particular concern because of the sheer number of landmines that can be laid from distances up to 300km.

- Some landmines used in cluster systems are fitted with self-destruct capabilities. It must be assumed that these mechanisms have, at least, the same weaknesses as those existing in conventionally laid landmines. Where the mines are anti-personnel they are subject to the prohibition imposed by the Ottawa Convention, although the most prolific users and developers of these cluster munitions, the United States, China and the Russian Federation are not signatories to the treaty.

Other submunitions

Cluster weapons are also used to disseminate non-explosive items. A recent example was the use of BLU-114/B on 2 and 7 May 1999 against Yugoslavia's national grid. It is probable that this submunition is part of JSOW and can be loaded on BLU 87/B in place of BLU 97/B CEM or in a mixed configuration with both submunitions. It is thought to have been deployed from a US F-117A Nighthawk Stealth aircraft.

Photo 4 Partially functioned BLU 114/B in Yugoslavia



The submunitions eject webs of ultra-conductive fine carbon threads which fall across power lines and switching stations causing system surges, a collapse of the power supply and costly damage. Even when the system is repaired engineers are forced to shut down the system whenever air attacks are expected to avoid damage and cannot return electrical supply until ground checks have been made. Similar attacks were launched against Iraq during Operation 'Desert Storm', probably from sea-launched cruise missiles.

NATO and US officials refused at the time to give details of the weaponry employed in Yugoslavia but claimed that power supply to 70 per cent of the country was lost following the attacks.[31]

Another use of cluster munitions is in fuel-air explosive weapons. For example, the US CBU 72 deploys three submunitions, which disseminate an aerosol fuel cloud over the target area. As the cloud descends it is ignited causing a downward pressure wave with devastating ground effects.

The Russian Federation is among the countries that use cluster bombs as chemical weapons dispensers. The AK-2 carries 240 chemical bomblets containing a mixture of mustard gas and Lewisite. The United States developed the BLU 80 Bigeye – a 500lb cluster bomb with two agents, Sulfur and QL, stable chemicals, carried in separate containers which are mixed by explosion to create a lethal VX-type agent.[32]

Future cluster munitions

There is no doubt that the US and Russian Federation military and many other forces perceive this kind of weapon technology as central to their existing and future war-fighting strategy. Cluster munitions are a key element of the United States' Joint Vision 2010.[33] The co-operation between the military and the manufacturers is close and the continued development of the Sensor Fuzed Weapon (SFW) is conducted by Textron Systems at Eglin US Air Force base in Florida. The BLU-108 is currently undergoing P31 testing.[34] A recent report, when the submunition passed its first test, said that accuracy was improved over the current version of SFW, hitting four times more targets and immobilising twice

as many. It also showed an improved footprint (area of impact) of approximately 30 acres, nearly twice the ground covered by the existing munition. The vice-president of Military Products at Textron Systems explained the development objectives:

> *The major objective of the P31 programme is to increase the number of kills per pass by improving performance against countermeasures, reducing sensor false alarms, optimising warhead aim point, and increasing target area coverage.* [35]

The cluster munition is seen as a cost-effective weapon with the great advantage that it does not require to strike a single point to be successful. A lot of emphasis is being placed on the development of warheads for missile systems especially in the United States and Europe where a new phase of Multiple Launch Rocket System (MLRS) is due to come into service in May 2001. The High Mobility Artillery Rocket System (HIMARS) was test-fired at White Sands Missile Range in New Mexico during April 2000 and is designed to carry the full range of MLRS and Army Tactical Missile System (ATACMS) munitions.

The Israeli mortar-based cluster munition is likely to become more widely accepted with the recent co-operation agreement between the manufacturers of the M971 120mm DPICM mortar cargo ammunition, Israel Military Industries Ltd (IMI) and the US arms manufacturing giant Alliant Techsystems (ATK). Both companies will manufacture the new round in their respective countries but ATK will serve 'as prime contractor for final systems integration and sales to the US military.'[36]

The Joint Stand Off Weapon is now advanced in development having had its first reported combat deployment during Operation 'Desert Fox'. In March 2000 it was tested on the B-2 Bomber. The USAF has plans to procure 3000 AGM-154As and 3100 AGM-154Bs for use on the B-2, B-52, B-1, F-16 and F-15E aircraft. It has been reported that the US Navy used 64 JSOWs in Kosovo and Iraq using F-18s.[37]

The commitment to, and investment in, cluster munitions appears to be based on their low cost and a perception that cluster bombs are effective where other weapons fail. The Financial Year 1999 US Department of Defense Procurement budget provides a high level of funding for ATACMAS-BAT, SADARM, SFW and JSOW – all cluster munition systems.

10 Prokosch, Eric, The technology of killing, Zed Books 1995.
11 Declassified USAF Tactical Air Command, Operational test and evaluation of CBU 24/B (Sadeye), Report TAC-TR-65-114, Annex C. Source: Prokosch, E, 1995.
12 Prokosch, E, 1995.
13 Munition unit costs source: US General Accounting Office, 1997.
14 Estimate based on US DoD procurement and re-supply/replacement records.
15 Prokosch, E, 1995.
16 Prokosch, E, 1995.
17 Hayes International Corp. Brochure quoted in Prokosch, E, 1995.
18 WCMD information USAF Airpower Journal International, August 1999, Jane's Air Launched Weapons 1999.
19 Source: Defence Systems Daily, 22.5.00.
20 Howitzer: a short or medium barrelled cannon with a low muzzle velocity and a steep angle of fire.
21 Secondary fragmentation is fragments, not part of the exploding munition, which are collected and accelerated by the blast wave. Typical secondary fragmentation consists of small stones, earth and other items situated close to the munition at the time of detonation.
22 Husum H, Gilbert M, Wisborg T, Save lives, save limbs: life support for victims of mines, wars and accidents, Third World Network 2000.
23 William C. Truckenmiller of the Albion Malleable Iron Company quoted in Prokosch, E, 1995.
24 Hunting Engineering Limited advertising brochure TP
25 Source: Defence Systems Daily, 22.5.00.
26 USGAO, 30.9.96, GAO/NSAID-96-192.
27 Ordatall v1.0, DoD St Naval EOD Technology Division.
28 AID: Air Inflatable Device; RAD: Ram Air Decelerator.
29 PBXN-107 has replaced Cyclotol which was originally used as the explosive charge in BLU 97 submunitions for the JSOW programme. According to some sources this bomblet is re-designated BLU 97B/B and incorporates an additional notch in the six rectangular recesses of the bomblet body into which the spring leaves of the spider cup assembly are clipped when the submunition is assembled.
30 Source: Aerojet advertising material 1998.
31 Supporting sources: www.beograd.com; Voice of America 4.5.99; FAS Military Analysis Network 7.5.99; New York Times 4.5.99.
32 Jane's Air Launched Weapons 1999.
33 Joint Vision 2010 is the joint forces programme based on the Rapid Decisive Operations concept. The Chairman of the US Joint Chiefs of Staff, General Henry Skelton, told the Senate Appropriations Committee on 26.4.00 that 'Rapid Decisive Operations emphasises critical functional concepts, including attack against critical, mobile targets, which focuses on near-simultaneous sensor-to-shooter data flow and high-speed long-range weapons'. The FY99 DoD budget contained substantial funding for ATACMS, SADARM, SFW and JSOW. The High Mobility Artillery Rocket System (HIMARS) is expected to be a key element in Joint Vision 2010.
34 P31 Testing is part of the acceptance into service process, its full title is pre-planned product improvement variant testing.
35 Defence Systems Daily 10.4.00.
36 Defence Systems Daily 21.6.00.
37 Defence Systems Daily 10.3.00.

3 Cluster munitions and failure rates

The failure of submunitions to function as designed is one of the central concerns surrounding the weapon type. Functional failure has been emphasised by manufacturers, military and politicians as a problem that exists but within acceptable margins of probability which do not justify any limitations on use.

Why submunitions are prone to failure

Every object with moving parts is subject to failure. Each pre-determined or pre-programmed action produces a critical juncture where failure is possible. Some failures are predictable, but the engineering solution to reduce that failure to a minimum may well introduce an additional potential for failure.

The critical junctures involved in deploying a submunition from a cluster bomb are considerable in number.

- **Manufacture:** the potential exists for damaged or faulty parts being incorporated into either the dispenser or one or more submunition. Incorrect assembly or damage to components during assembly that is overlooked during the quality assurance process is a common reason for faults in all manufacturing processes.
- **Movement and storage:** live ordnance spends long periods of its serviceable life in storage. And, depending on the professionalism of the forces involved, stores will be subject to varying levels of care, preservation and servicing. Essential though these procedures are, they are also critical junctures where errors may be made, leading to eventual failures in use. Transportation may result in damage.
- **Loading, flight and landings:** in wartime under the pressures of conflict ground crews make mistakes and the mechanical stresses of flying in combat increase the potential for failure. Bringing bombs back unused adds substantially to that risk; most bombs have limits on the number of landings allowed and pilots will jettison a bomb that they have been unable to drop on target. The bomb may require time-delay fusing to be pre-set.
- **Bomb release:** once the pilot reaches the target area he must release the bomb. On some high technology weapon systems the aircrew may pre-set fuzing time delays in flight prior to release. The bomb may 'hang' – a total release failure – this is a comparatively common failure. Following Operation 'Desert Storm' the official figure for bomb release failures for the F-117 bomber was 25.1 per cent.

Thus, based on the 'Desert Storm' experience, operational planners considering the use of the F-117 in a comparable scenario and environment would anticipate that the expected probability of a target's being damaged to the desired level would be based on the number of bombs tasked, reduced by the proven probability of bomb release (75 per cent), and reduced further by the demonstrated hit rate (between 55 and 80 per cent). [38]

Virtually all the safety features in a cluster bomb are concentrated on ensuring adequate separation between bomb and aircraft prior to ejection of the outer skin or submunitions. A premature ejection could result in the loss of plane and crew or, at best, expensive damage to the airframe. The mechanism for ensuring separation may be time- or altitude-linked or involve more complex technology. One common system is for a drogue parachute to open at the rear of the bomb on release that slows its flight, allowing fast separation. The parachute then maintains the munition in the correct trajectory for the ejection phase. A partial canopy deployment or complete drogue failure is an obvious critical juncture with major implications. Delivery from a height or at a speed or angle of attack outside the munition's design parameters may be critical and, a factor not always envisaged by the designers, is often due to enemy air or missile attack.

- **Submunition ejection, dispersal and arming**: the sequence varies considerably depending on bomb design. The cycle culminating in the ejection of the submunitions from the dispenser may require that spin is imparted to the bomb which provides the necessary momentum to expel the submunitions from the dispenser or, as in the case of the BL 755, the dispenser skin and submunitions may be ejected by a compressed-gas system. A malfunction at this stage will usually result in the bomb impacting with its full load of submunitions or only a partial submunition ejection being completed.
  As the bomblets are ejected they must disperse to ensure they cover the intended area of ground – manufacturers present this designed impact footprint as something of an exact science although the evidence of actual use in conflict indicates a more random and less predictable result.[39] One malfunction common to all cluster bombs with large numbers of submunitions is random in nature; the airborne collision of individual bomblets. This normally leads to the immediate detonation of one or more bomblets causing damage to others which may effect their operation on impact. Some bomblets are orientated and armed by small parachutes which, if they fail to fully inflate, will have a consequent effect on the design function – so the bomblet may fall erratically, striking others in flight, or simply fail to arm.

- **Ground impact**: the environment is critical in determining the detonation as designed of all impact-initiated bomblets. The ground surface must offer sufficient resistance to impact or the bomblet will not detonate. Mud, snow, sand and surface water all lead to substantial numbers of duds and also result in bomblets penetrating ground cover and, in the terminology of Explosive Ordnance Disposal technicians, going sub-surface.

  Sub-surface bomblets are a substantial post-conflict problem – following the Operation Allied Force all three submunitions – unexploded BL 755, BLU 97/B and Mk118 Rockeye – have been discovered below the ground in substantial numbers. The manager of United Nations mine clearance operations in Kosovo explains the complications of sub-surface bomblets:

  ... the failure rate figure is actually a distraction from the real problem ... that because of the characteristics of the weapon we have to search large areas of land in order to clear an area to the required humanitarian standards. Whether the failure rate is one per cent or 20 per cent we still have to search the entire area to clear all submunitions. Not only that, many of the (bomblets) that have failed to function are buried beneath the surface, in some cases up to 50cm deep, but in most cases about 10cm to 20cm.

  This is the problem. Unless we search the area with detectors to confirm that they are clear, submunitions will continue to be ploughed up by farmers and continue killing for years to come. [40]

The reliability of cluster submunitions is further affected by plant overgrowth and forest. Submunitions strike trees during descent often with one of the following consequences.

- The drogue parachute is caught up in tree canopy and, since there is no impact, the bomblet fails to function. This phenomenon was experienced in Kabul, Afghanistan, when rocket-fired bomblets became caught in trees. Later, when the population were not alerted to any threat of attack, high winds would shake the bomblets from the trees and, because arming was of the wind-off type, the cycle would often be completed as the munition fell to the ground causing detonation.[41] Reports from EOD specialists working in Kosovo following Operation 'Allied Force' have reported BLU 97/Bs, caught in coniferous tree branches on the retarder parachute, falling to the ground during controlled demolition of unexploded bomblets on the ground.[42] One specific example of this problem during bomblet clearance by members of the Royal Engineers was at a strike area to the west of the town of Stimlje (grid reference EM 02009855).

- Branches and overgrowth exert a braking effect on bomblets, reducing speed of descent to a sufficient extent to cause a failure to detonate on impact. This is by no means a new problem. The BLU 24/B submunition, nicknamed orange, was designed specifically to overcome this problem by the

incorporation of a spin-delay fuze to allow penetration of jungle canopy.[43] The BLU 24/B is a commonly encountered unexploded bomblet in southeast Asia today.

Manufacturers have attempted to overcome the problems of malfunctions by incorporating self-destruct mechanisms within each bomblet. This has produced its own problems.

- The self-destruct mechanism itself introduces one or more additional critical junctures into the chain.
- The introduction of a potential self-destruct failure adds considerably to the danger of the non-functioned submunition. Any secondary fuzing system, once failed, has a tendency to be especially sensitive to any disturbance or movement. This is a consideration for bomblet clearance teams and, in practical terms, a failed self-destruct mechanism can be considered an anti-disturbance/anti-handling device. This is emphasised in a restricted-circulation UK Ministry of Defence letter advising on clearance of BLU 97/B and BLU A/B by EOD teams.

> *Once dispensed from its carrier any submunition should be considered armed. Dispensed bomblets should not be manually moved.* [44]

Failure rates and proportionality

Recent debate about failure rates of cluster munitions has often missed the point. The most common misunderstandings are due to political, military and manufacturer statements referring to an overall failure rate for cluster munitions generally or for specific weapon types. The most commonly quoted figure is five per cent.

The UK's Ministry of Defence (MoD) gave Parliament an assessment of failure rates as follows:

> *Approximately 5 per cent of the bomblets within a cluster bomb fail to detonate when they impact. Regardless of the height from which they are dropped, this figure does not vary.* [45]

When asked what research the MoD has carried out into the failure rate of cluster bomb submunitions used by UK armed forces, the same Government Minister replied:

> *Information on the failure rate of cluster bomb cluster-munitions used by UK armed forces is collected during regular in-service trials and from field data. Recent statistics show a failure rate of approximately 5 per cent in line with expectations.*[46]

It appears that the UK Ministry of Defence, the US Department of Defense, NATO and manufacturers are perfectly aware of information that shows the five per cent figure is inaccurate. The manager of the UN Mine Action Co-ordination Centre (UNMACC) in Pristina expressed his frustration on the subject during November 1999:

> *As a military man I can understand why the military may have wanted to use cluster bombs. But the lesson is clear: if these things are going to be used, the military needs to recognise the penalties which come with their use. I am angry that KFOR keeps regurgitating this figure of five per cent failure rates; it is a distortion of the facts. If they said eight per cent to 10 per cent they would be closer to the mark and that's a big difference on the ground. In specific areas it is far higher than that.*[47]

By March 2000 UNMACC had more details of estimated failure rates.

> *In Kosovo, preliminary statistics for the British RBL 755 show that the failure rate is about 11-12 per cent (these figures are primarily provided by UK EOD teams). While the final figure will not be known until the last area has been cleared, it is highly likely that it will be at least 10 per cent, if not more.* [48]

Moreover, the British Government has had evidence since the 1980s that the failure rate of the BL755 considerably exceeds 5 per cent. On 28 May 2000 the Minister of State for Defence, John Spellar, wrote in response to a Parliamentary Question:

> *I undertook to write to you in my answer to your Parliamentary Question of 12 May, (Official Report,*

column 512W) about the use of BL755 cluster bombs in the Falklands conflict. I am afraid that surviving records are a little inconsistent on the question of how many BL755s were dropped during the conflict. The number was either 106 or 107, we cannot be certain which.

We do know, however, that 1,492 submunitions from these weapons were cleared from the Falkland Islands after the conflict. Moreover, all areas where BL755s were dropped have been completely cleared of explosive ordnance. We are confident, therefore, that no unexploded submunitions from the BL755 cluster bomb remain on the Islands. [49]

This shows that BL755 failure rates in the conflict were at least 9.5 per cent. This figure gives credibility to the UNMACC estimate in Kosovo. The government may wish to argue that this figure related to BL755 cluster bombs while the RAF used RBL755 clusters during Operation 'Allied Force' in Kosovo. But in the Falklands/Malvinas conflict the RAF was bombing from low level within the deployment envelope for the BL755. The modification that re-designated the weapon 'RBL' was to enable medium- to high-level deployment, effectively ensuring a delay in bomblet ejection until the same height as for the BL755. There would, therefore, be no increased reliability for the bombs in use during Operation 'Allied Force'.

It may be, however, that potential failure rates could be far higher based on commercial and US military trials standards. On 20 March 2000 it was reported that the Sense and Destroy Armour (SADARM) manufactured by the US arms company Aerojet had successfully completed Reliability Determination/Assurance Programme (RDAP) technical testing at the US Army Yuma Proving Grounds in Arizona.

The projectiles were fired throughout the design envelope at maximum charges to achieve ranges in excess of 19 kilometres ... In all, 140 submunitions demonstrated 77 per cent reliability during RDAP. The reliability in these tests fell 3 per cent short of the submunition 80 per cent requirement. However, viewed as a system, the submunition reliability, coupled with the high carrier reliability and SADARM's high rate of target hits, were sufficient to allow SADARM to go forward to the next stage, the Limited User Test (LUT) to be held in April and May. Aerojet believes its ongoing PI programme will provide the remaining reliability improvements necessary to pass the operational effectiveness requirements. [50]

This would indicate that a 20 per cent rate of submunition failure is acceptable to the US Department of Defense as long as the failures are on target. This possibility is supported by information from other reliable sources:

According to manufacturing requirements, the CBU 87 can have an acceptable dud rate of up to 12 per cent, but experience shows that it is actually between five per cent and seven per cent, said Frances Kosakowski, a spokesperson at the Ogden Air Logistics Center at Hill AFB, Utah. She said the rate could not be improved. [51]

However, regardless of the acceptable, estimated, or actual average failure rates, only the UN mine clearance programme manager in Kosovo among those quoted above touches on the real issue. It is the actual number of unexploded bomblets in a given situation that is of significance. For example, a BL755, assuming the accuracy of the UK MoD's expected failure rate of five per cent would result in approximately seven failed bomblets. Assuming a fairly standard strike of five bombs the resulting 35 unexploded bomblets may have a post-conflict impact ranging from insignificant to devastating. Thirty-five bomblets spread across the agricultural and grazing land of a subsistence community could effectively destroy its future and force it to abandon its homes and land. It has no way of knowing that there are 'only' 35 bomblets present nor would it have any reasonable expectation of the land being cleared within a feasible timescale (if it, in fact, knew that such a possibility existed at all).

Perhaps the least meaningful calculation is the failure rate for a whole country or bombing campaign - a five per cent rate will not be an even spread across a war zone. To achieve that average rate of failure some dispensers will have failed totally, some will have had 50 per cent malfunctions, others 20 per cent and many will have had only one or two or no failed submunitions.

The Nellis calculation

There is no recorded combat usage that would indicate a failure rate of five per cent and virtually all statistical and anecdotal evidence points to a far higher percentage failure rate.

However, Nellis Air Force Base in Nevada has undoubtedly experienced more peacetime cluster bomb strikes than any other location on earth. Nellis, according to the Base Chief of EOD, Chief Master Sergeant Ernie Lorelli, drops ' ...more than 90 per cent of the cluster bomb training units in the Air Force'. Nellis has a US$1 million Laser Neutralization System (LNS) mounted on an armoured personnel carrier with which to dispose of unexploded bomblets. [52]

Nellis uses approximately 2,000 cluster bombs per year with contents of between 200 and 700 bomblets. The base estimates an average of 20 bomblet failures per bomb. Taking an average bomb content of 450 submunitions this would indicate an overall failure rate of just below five per cent based on 2,000 bombs.

But Nellis differs from the 'real' world of cluster bomb impact.

- The bombs are dropped according to a test schedule with the pilot performing according to a planned approach; speed, altitude, rate of dive etc are all pre-determined. The aircrew is concentrating on the delivery of the bomb without the distractions of missile lock-on, flak, sharing crowded airspace, confusion over target identification, smoke from previous attacks and all the problems that face a pilot in combat.
- The environment at Nellis is devoid of forest and jungle. It is also devoid of irrigation ditches, paddy fields and the many environmental conditions that serve to increase the failure of submunitions in combat situations.
- A more realistic average submunition content of cluster bombs used at Nellis is probably lower than 450 which may considerably increase the actual percentage failure rate per annum under controlled conditions.

If the best failure rate that can be achieved in controlled circumstances is five per cent, it is reasonable to assume a greatly increased incidence of failure in combat conditions. Certainly, given the problems and dangers facing aircrews, an assumption of 10 per cent to 15 per cent failures would not be unreasonable. Account would then have to be taken of the known propensity of certain submunitions to fail in larger numbers based on munitions effects assessment data.

38 US GAO Desert Storm Analysis Appendix III.5.4. GAO/NSAID-97-134 Dated 6.12.97.
39 Most official ground-cover estimates refer to the mean area of impact rather than the total impact area. As the submunitions spread away from the mean point of impact, a greater distance separates each bomblet and the footprint borders become less defined. During survey and clearance operations the bomblets outside the mean area of impact are substantially more likely to be overlooked.
40 J. Flanagan, Programme Manager UNMACC. Email to R. McGrath.
41 Contemporary Halo Trust reports.
42 Interviews with former NATO (KFOR) EOD operatives.
43 SIPRI 1978.
44 UK MoD letter dated July 1999.
45 Hansard, 24 January 2000.
46 Hansard, 9 February 2000.
47 Interview, J. Flanagan, Programme Manager UNMACC, Pristina, Kosovo, 13.11.99.
48 J. Flanagan, Programme Manager UNMACC. Email to R. McGrath, 29.3.00.
49 Letter from John Spellar MP, Minister of State, to Harry Cohen MP dated 28 May 2000. MoD Ref: D/Min(AF)/JS PQ1886K/00/M.
50 Defence Systems Daily, 20 March 2000.
51 Defense Week, 1 June 1999.
52 Air Force News, 8 December 1997.

4 The use and impact of cluster munitions

Learning lessons

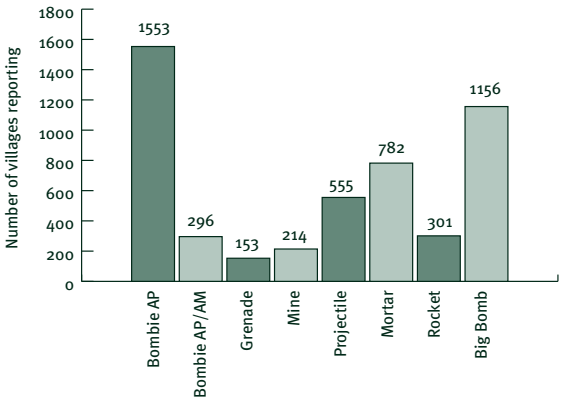
The 'lessons learned' concept is central to post-conflict action among NATO forces and within the United Nations which has a permanent Lessons Learned Unit. The resulting changes in military war-fighting policies are subject to secrecy, and the procurement and development of new weaponry is invariably subject to the strictures imposed by commercial confidentiality. The consequence is that public oversight is only possible in retrospect which, in military terms, means that deadly strategies and weapon systems are tested on real people.

It is the requirement for financial accountability that has led, almost incidentally, to public scrutiny of weapons effects and usage. The United States General Accounting Office (GAO) conducts analyses of the cost and benefits of warfare in much the same way as any departmental expenditure would be reviewed. For example, the GAO analysis of Operation 'Desert Storm' sought out, evaluated and published for public appraisal details of the air campaign. [53]

Laos

It has been estimated that from 1964 to 1973 the US dropped a planeload of bombs on the Lao people every eight minutes. The giant B52 planes that were principally used to bomb Laos were capable of carrying 30 tons of bombs. Many of these bombs did not detonate, with failure rates as high as 30 per cent. United Nations estimates put the amount of unexploded ordnance (UXO) still in the countryside in 1996 at about 500,000 tonnes.[54]

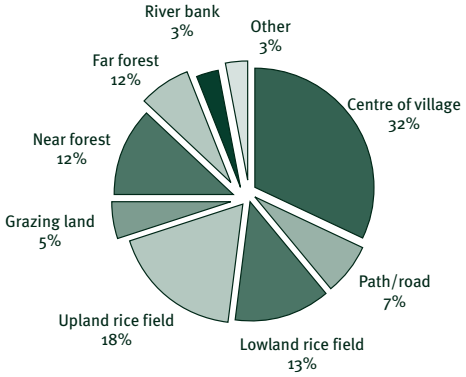
Figure 7: Data from the 1997 National UXO Survey of Laos [55]



Types of UXO present in Laos

A high percentage of the failed ordnance consists of cluster bombs and bomblets. This is not especially notable from a purely statistical viewpoint; a high percentage of the munitions deployed by the United States over Laos were cluster weapons. Statistics and direct observation indicate that at least 44 per cent of total UXO incidents causing death or injury are attributable to cluster munitions. [56]

Figure 8: Data from the 1997 National UXO Survey of Laos[57]



Location of UXO Accidents

It is difficult to estimate the actual number of submunitions dropped on the territory because so much of the bombing was conducted in secret and involved so many different governmental and quasi-governmental

agencies who were operating beyond normal oversight or control. One estimate, an extrapolation of US procurement figures for BLU 26 bomblets, assuming that something less than one-third of the total stock was dropped on Laos, would indicate a total of 90 million BLU 26 submunitions.[58] This would mean that there were probably in excess of nine million BLU 26 bomblets unexploded when organised clearance operations began in 1994. The BLU 26, while the most common of UXOs found in Laos, is only one of 12 submunition types encountered in large numbers.

A 1997 report from the Mines Advisory Group[59] details the most common submunitions in the most heavily populated areas of the northern province of Xieng Khouang as:

BLU 3/B	anti-material fragmentation bomblet – 250 steel pellets
BLU 24	anti-personnel fragmentation bomblet, spin-delay fuze for jungle penetration
BLU 26	APAM fragmentation bomblet – impact detonation, 300 steel pellets
BLU 42	anti-personnel spherical minelet with anti-disturbance and self-destruct
BLU 61	anti-material/incendiary bomblet – zirconium incendiary medium
BLU 63	APAM fragmentation bomblet (replacement for BLU 26 in 1971)
BLU 45	Anti-Vehicle Mine, shaped charge, timed self-destruct
BLU 49	Fragmentation bomblet
Mk 118	'Rockeye' AT/AP shaped charge/fragmentation bomblet

Figure 7 illustrates the extent to which the presence of unexploded ordnance, and particularly submunitions because of their small size and wide distribution, infiltrate every aspect of rural life. It is 27 years since the bombing of Laos ended and injuries and fatalities remain at a high level. The problem is beyond any community defence or avoidance mechanisms that may have developed over the years. In 1995 the Mines Advisory Group,[60] with clearance and risk education programmes in Xieng Khouang province, dispatched a data-gathering team to two districts, Moung Pek and Moung Kham, where it targeted 24 villages and 56 villages respectively.

To date, information on 1,153 UXO-related accidents has been recorded in a population of 97,562.

Accidents recorded in 1995

During 1995 the team gathered information on 66 UXO-related accidents in these districts. Of these 66 victims, 36 were children under the age of 15. Thirty-two of these were boys. Of the 30 adults involved in accidents, 20 were men and 10 women. In total 14 people died[61] and 52 were injured. The most common injury is severe shrapnel wounding to the body.

Reasons for UXO accidents

30 per cent	Playing with UXO[62]
21 per cent	Working in the fields, digging and hoeing
15 per cent	Cutting trees
10 per cent	Making fires in the garden
6 per cent	Looking for food
5 per cent	Grazing animals
13 per cent	Other, including bystanders[63]

These statistics from a group of subsistence farming villages show that at least 65 per cent of these incidents occur when the victims are engaged in essential daily tasks. These are not communities that have alternative lifestyles available to them. The report also examines land denial recorded as a result of UXO:

Villagers record the following land in Moung Pek and Moung Kham to be so heavily infested with UXO that they farm there at their peril.[64]

Lowland fields	169.75 hectares
Upland fields	187.77 hectares
Gardens	39.4 hectares
Grazing land	161 hectares

For more than 25 years the people of Laos have been exposed to long-term collateral damage caused by the mass dissemination of cluster munitions. This is reflected in some of the beliefs expressed by villagers who live in heavily affected areas:

Villager UXO beliefs: common beliefs expressed by villagers

Lack of direct experience of UXO explosive power and effect, combined with daily familiarity with bombs, has generated an apparently blasé attitude among some villagers. Alongside this apparently relaxed approach (and caused, again, by irregularity of past UXO experience), there is a kind of UXO sensationalism, which generates beliefs about UXO that are anecdotal, technically flawed, and actually tend to increase risk, and which amplifies the value of UXO among men as the index of Lao male bravery. These UXO beliefs and values exist in the villages today...

Corrosion: many villagers express the belief that the more corroded a piece of UXO, the less dangerous it is (hence practices such as pouring salt on UXO, urinating on it, or depositing it in water to accelerate decomposition). However, where corrosion has occurred, it will, in some cases, actually increase danger of functioning ...

Shelf life: the belief that UXO over 10 years old has ceased to be capable of function is not uncommon. Clearly, according to this criterion, all UXO (in Laos) is safe to handle.

Render safe: ... the most popular method believed to render items of ordnance safe is burning ... this ... process can, sometimes, increase risk where the item is partially burnt and becomes less stable, or where the casing and main explosive content are successfully burnt away giving the impression of safety, while the fuze has remained intact and capable of taking off fingers or a hand.

Lethal distance: on questioning, villagers have come up with a broad spectrum of UXO killing distances (this is largely in the case of bomblets). Estimations are generally low. Commonly the BLU 26 is thought to kill at between 10 and 15 metres (actual range, at the outside, is 150m). This misconception leads villagers to believe that UXO can be disposed of by throwing, unaware that they are not physically capable of throwing items beyond lethal range, and that the act of throwing itself (arm jerking back and then forwards) can exert enough force on an item's fuze to cause it to detonate. Further, while many villagers appear to understand the spin-arming of many bomblets, some do not link this with the possibility that spinning after being thrown away may complete the arming process on a bomblet only partially armed during the initial drop.

UXO moveability: based on their experience over the last quarter of a century, and their idea of spin-arming and impact detonation, villagers generally feel that bomblets can be moved relatively safely, as long as the item is picked up and carried without changing its orientation and without any violent movement.

Danger differentiation: ... historical experience of likelihood of detonation has varied between one type of ordnance and another. The BLU 24 with its cocked striker fuze, is generally considered to be least safe. The BLU 3/B is treated with particular caution by some, but considered by others – with its screw-top impact fuze unit – to be easy to dismantle.

Expertise: over time, and in a subsistence environment, food security issues, and aspirations to wealth or status, have forced or lured some male villagers into the business of dismantling UXO to use or sell parts ... Ironically these males build up an image in their villages (and in their own eyes) as especially skilled, the more they dismantle without getting blown up. Further, if several dismantlers are killed over a period of time in one village, the remaining dismantlers achieve even greater expert status by virtue of the fact that they are still alive.

The Gulf War: Operation 'Desert Storm'

Cluster bombs

Operation 'Desert Storm', the six-week air blitz that opened the Gulf War in 1991, employed similar methods – sustained air assault – and some of the same aircraft and weapons of the Vietnam War. It was in the heavy usage of cluster munitions where Operation 'Desert Storm' most resembled Vietnam. The following table gives estimates of US deployments based on post-war replenishment requests.[65]

Table 1: Known US Cluster Bombs dropped during Operation Desert Storm with types and numbers of submunitions per container and in total[66]

CBU Type	Estimated number of bombs dropped	Numbers of submunitions per container	Total submunitions
CBUs 52/58/71	7,831 total	CBU52: 254 x BLU 61 CBU58: 670 x BLU 63 CBU71: 650 x BLU APAM fragmentation	4,111,275 (Based on average of 525 bomblets per dispenser)
CBU 78 GATOR	209	45 x BLU 91/B AT mines 15 x BLU 92/B AP mines	9,405 3,135
CBU 87/B	10,035	202 x BLU 97/B CEM bomblets	2,027,070
CBU 89/B GATOR	1105	72 x BLU 91/B AT mines 22 x BLU 92/B AP mines	79,560 24,310
Rockeye (all variants)	27,987	247 x Mk 118 AP/AT bomblets	6,912,789
Total	47,167		13,167,544

The table shows only cluster bombs deployed from US aircraft, and it is probable that this is not a comprehensive record of even US totals.[67] Records also show that 254 CBU-72 Fuel Air Explosive cluster bombs were dropped, a total of 762 aerosol submunitions.

The US GAO report also analysed the performance of the F-117 Stealth bomber during 'Desert Storm'.

> *Stealth[68] was one of many options used to achieve portions of what was accomplished in the air campaign. It could not serve to achieve all objectives given its operational limitations. For example, it was not designed to, and in 'Desert Storm' it did not, engage targets (1) that were mobile and required searching , (2) that were large 'area targets' requiring coverage by dozens of bombs, or (3) that planners wanted to attack during the day. Most notably, the F-117's bomb hit rate was between 55 and 80 per cent, and equally important, its weapon release rate was only 75 per cent."[69]*

The miss rates of the F-117 must be viewed in the context of the data given in Table 1. A hit rate of 55 per cent is, by definition, a miss rate of 45 per cent. Even using the lower miss rate of 20 per cent this would mean that more than 2.6 million submunitions (or more than 5.9 million using the higher miss rate) were dropped in the wrong place.

While it may have been a 'target-rich environment' the problems of hitting targets during 'Desert Storm' were not confined to the limitations of certain aircraft types. After several weeks of bombing, intelligence analysts discovered that B-52s were consistently dropping bombs 120 to 200 metres short of their targets. The problem was traced to a compatibility conflict between the maps used for target allocation and those used to programme the B-52s' targeting system. This was resolved but the bombers accuracy still left a great deal to be desired. In the end, according to one source, 'the B-52 was primarily a means of terrorising the Iraqi ground troops, not killing them'.[70] The GAO report on 'Desert Storm' clearly identified accuracy as a factor of concern in regard to unguided bombs:

> *The accuracy problems encountered by unguided munitions were more difficult, if not impossible, to overcome. Pilots of virtually every type of aircraft remarked that they had little confidence in hitting*

point targets with consistent accuracy from high altitudes with unguided bombs.

As a result, pilots reported considerable difficulty attacking small, point targets, such as tanks, from high altitude with unguided bombs. Some expressed a high level of frustration in being assigned to do so and said that it was simply inappropriate, even 'ridiculous', to expect that unguided bombs were capable of hitting a target like a tank from high altitude with any consistency. It was also clear that such inaccuracy made unguided munitions inappropriate for use in inhabited areas, where civilian assets could be easily hit in error. [71]

The experiences of US Marine aircrews were illustrative of the fact that high technology equipment and highly trained combatants do not necessarily guarantee accuracy because both depend on receiving reliable targeting data. In a post-war analysis conducted by the Marine Corps Research Centre it was concluded that:

Target photos provided to the aircrew were days, weeks and many times months old. Without current aerial photos, it was extremely difficult for an aviator to find a target even in a totally permissive environment. Aircrews with dated intelligence were told to bomb point targets by latitude and longitude; an inherently inaccurate bombing technique. [72]

The Marines also reported problems with fuzing of the Rockeyes they dropped from high altitudes which, it must be assumed, combined with soft ground (sand), added to the normally expected failure rate for these weapons. This would be a considerable factor towards the overall total of failed submunitions since the US Marines expended more than 12,000 Rockeyes during 'Desert Storm', more than 4.5 million bomblets. If a failure rate figure of five per cent is accepted as a baseline and, say, a conservative estimate of a further two per cent due to faulty fuzing assumed, the Mk118 bomblets which failed to function as a result of US Marine operations alone would be in the region of 315,000. At some stage during 'Desert Storm' a new nose cone, designated FMU-140/M, was fitted to the Mk 7 Rockeye dispenser which could be set to open the dispenser at a pre-determined height of between 100 metres and 1,000 metres or at a pre-set time from release of between 1.2 seconds and 10 seconds. But the propensity of the Mk118 bomblet to fail should not have been an unknown or unconsidered factor since, both in Vietnam and Laos, it was a common item of unexploded ordnance.

During 'Desert Storm' the Royal Air Force was using JP233 90 and BL755 cluster munitions against a variety of targets. The first Tornado low-level airfield mission took off from Dhahran and Bahrain at 0130hrs local time on 17 February 1991 – one hour and 42 minutes before the expiry of the extended UN ultimatum. There were 12 Tornado GR Mk1s in total, equipped with long-range drop tank [73] and two JP233s giving each a take-off weight exceeding 30 tonnes. Their target was the Talil airfield in southeastern Iraq where each plane would approach the target at an altitude of 60 metres. One pilot, Flight Lieutenant Jerry Gegg, described the experience:

You're frightened of failure; you're frightened of dying. You're flying as low as you dare but high enough to get the weapon off. You put it as low as you can over the target – just to get away as fast as you can. [74]

Forty-four Tornado sorties with JP233 were flown within the first 24 hours of Operation 'Desert Storm'. Two planes were lost to enemy fire with two crew killed and two captured. The attrition rate soon became unacceptable, with a total of six planes lost, five crew killed and seven captured, and low-level attacks with JP233 were stopped. Before this, however, 100 of the bombs were used (21,500 x HB876 and 3,000 x SG 357 cluster munitions). The Tornados were later re-equipped with CBU-87/Bs on 28 February but, it is believed, none was used. RAF Jaguars GR Mk 1A of 6, 41 and 54 Squadrons dropped 393 cluster bombs of which only eight were BL755s (1,176 x BL755 bomblets) while 385 were CBU 87/Bs (77,770 x BLU 97/B CEM bomblets). The BL755, designed for low-altitude delivery was considered too high-risk when the threat of enemy ground fire existed.

French Jaguar As carried BLG 66 Belouga cluster bombs and flew 615 sorties but no information is available as to the number of these munitions deployed.

The military and manufacturers, especially in the United States, have concentrated in recent years on two key areas of design:

- successful low-level delivery
- improved accuracy from high altitude.

Design problems identified with cluster bombs during Operation 'Desert Storm' were an important factor in determining this user-led change in requirement. The GAO report confirms that unguided, or 'dumb' bombs, were used far in excess of expensive guided munitions.

> *It is evident ... that while the vast majority of the expended ordnance was unguided – 92.4 per cent – the inverse was true for cost. About 84 per cent of cost was accounted for by the 7.6 per cent of ordnance that was guided. If the 332 cruise missiles are excluded - with their extremely high unit costs – unguided ordnance still represented about 92.6 per cent of the total number expended, but the percentage of cost for ordnance that was guided decreases to 75.9 per cent.*[75]

Yet the GAO report also found that unguided weapons, including cluster bombs, had severe limitations. Table 2 summarises the GAO evaluation of the effectiveness of unguided munitions.

Table 2: Extract from GAO table comparing guided and unguided munitions[76]

Measure	Relative strengths	Relative limitations
Cost	Low unit cost; made up 92 per cent of the munitions used but only 16 per cent of the munitions cost	No cost disadvantages identified
Survivability	Permitted higher pilot situation awareness and more ready ability to manoeuvre to evade threats	Little or no stand-off capability from defences at target except for use at high altitude, which severely degraded accuracy
Operating characteristics	Exploited radar bombing systems impervious to weather but only for missions requiring limited accuracy	Non-radar unguided bombing systems had virtually as many limitations from weather, smoke, dust, and so on as guided munition sensors; accuracy severely degraded by winds, especially when used at medium-to-high altitude
Effectiveness	Of all munitions used, 92 per cent were unguided; unguided munition use was an essential part of the air campaign, especially against area targets and ground forces	Not accurate from medium-to-high altitude against point targets. Higher likelihood of collateral damage; no consistent relationship between use of unguided munitions and targets that were successfully destroyed

In summary, the main findings were:

- Using unguided munitions at low altitude placed aircraft and crews at high risk of succumbing to ground defences.
- Unguided munitions deployed at medium to high altitude were likely to miss the target and cause collateral damage.
- Without radar, unguided bombing systems suffered from similar weather and environmental limitations as non-radar guided munitions, especially at medium-to-high altitude.
- Cluster bombs released at medium-to-high altitudes are very susceptible to wind.

As noted above, the United States began developing the Wind Corrected Munitions Dispenser (WCMD) following the second Gulf War as a direct response to these problems. The most recent cluster bombs in the US armoury, CBU 78/B Gator, CBU 87/B CEM, CBU 89/B Gator and the CBU 97/B SFW, are designed for release at low altitudes, where the plane and crew are at greatest risk; the WCMD is designed to allow release at medium-to-high altitudes, reportedly up to 45,000 feet. It consists basically of a bolt-on replacement tail unit and guidance system capable of adjusting the flight of the bomb to maintain course trajectory on a target selected prior to launch over a maximum range of eight miles. The WCMD was accepted into service by US forces in February 1999; initial orders are for 40,000 kits at US$8,937. [77] The three versions of the WCMD will be designated CBU 103 (with BLU 97/B CEM), CBU 104 (with BLU 91 and BLU 92 mines) and BLU 105 (with BLU-108 SFW). [78]

Multiple Launch Rocket System (MLRS) and Army Tactical Missile System (ATACMS) munitions

The Gulf War was the first time that either MLRS or ATACMS had been fired in conflict. The US forces deployed more than 230 MLRS M270 launchers and 16 were deployed by the British army.

The MLRS was first fired in combat by 'A' Battery, 21st Field Artillery (1st Cavalry MLRS Battery) on the evening of 21 February 1991 at 1815hrs as part of a three-battery attack[79] against targets in southern Iraq under the overall command of 1st Cavalry Division Artillery. 'A' Battery's full complement of 10 launchers was lined along a 3km front. The three batteries fired 181 rockets at 15 targets at ranges of between 21 and 30 kilometres, the second 'ripple' engaged a further nine targets with 161 rockets. Total firing time was less than five minutes during which 220,248 x M77 submunitions had been fired.[80]

During 'Desert Storm', 17,286 MLRS rockets were fired at targets in Iraq and Kuwait, which equates to more than 11.13 million submunitions. US forces also deployed 105 ATACMS rounds of which 32 were fired. Each missile warhead contained 950 x M74 APAM bomblets giving a total of 30,400 submunitions.

Unexploded ordnance

It has been estimated that 30,000 tons of unexploded ordnance was scattered across Kuwait when the Gulf War ended. One observer wrote 'it is not hyperbole to describe parts of the Emirate as being carpeted in high explosives'.[81] Unlike Laos, Kuwait did not have to wait 20 years for an international response to this problem. A UK company, Royal Ordnance, better known for manufacturing ordnance than destroying it, became one of the main clearance contractors and had more than 500 personnel working in Kuwait by May 1991. Specialists involved in the clearance operations discovered that submunitions were no less likely to fail than landmines. In fact some estimates indicated that their likelihood to fail was actually far higher than normal for mines. One source reported:

> *... one third of submunitions failed to explode due to landing in soft sand.* [82]

By February 1992 more than 80 staff employed on the international clearance operation had been killed.[83] In the same period more than 1,400 Kuwaitis had been killed in incidents involving UXO and landmines. Among the most dangerous items were submunitions.

One document, including photographs of unexploded BLU 97/Bs taken during post-war bomb damage assessment missions by US Munition Effects Assessment Teams (MEAT), had comments added by Alliant Techsystems, the main contractors, showing seven specific, sometimes unexplained, malfunction conditions:

1. Drogue Chute Out and Body Extended – Failed to Function.
2. Fuze Primary Functioned
3. Fuze Secondary Failed to Function.
4. Fuze Primary Failed to Function – Physical Damage to Munition.
5. Missing Fuze.
6. Fuze Low Ordered – Expelled Booster
7. Fuze Escapement

The document, marked 'CUSTOMER ONLY', warns that a failed BLU 97/B bomblet should be treated as 'extremely dangerous'.[84] United States EOD agencies

involved in clearance of the BLU 97/B were warned to be ' ... particularly careful when dealing with these submunitions and do not conduct EOD operations to clear these bomblets if the meteorological conditions are windy, the threat being that the drogue chutes may catch the wind, move a bomblet and cause it to function'. (A British Ministry of Defence document, quoting this information, notes that the Queen's Gurkha Engineers personnel killed by unexploded ordnance in Kosovo on 14 June 1999 were '...dealing with these submunitions at the time of their deaths'.)

One of the most common reasons for bomblets not to function was simply that the ground did not afford sufficient resistance to initial impact. In the case of the BL755 a firm impact is required in order to crush the piezo-electric impact-sensing element; the ideal is a vertical impact. Angled impact or soft ground was a common reason for failure.

Unexploded BLU 97/B were common in Kuwait but not the most common. It may be that the huge scale of deployment tended to distort the overall failure rate of the weapon. The manufacturer's warning is, however, accurate and important – moving or striking the munition is especially dangerous because the detonator is stab-sensitive which stresses a piezo-electric crystal which fires the main detonator.[85] Rockeye II submunitions were widely recognised as being the most common item of UXO. Failures were especially numerous in soft ground. One specialist involved in the immediate post-conflict ordnance clearance of Kuwait and then later commercial operations to eradicate unexploded ordnance during the period 1994 to 1996 commented:

> *I would have to say that the worst [submunition] for failing was definitely the Mk 118 Rockeye and all the variants of the same munition. We cleared literally hundreds directly after the war, and even when I was working for Exploration Logistics in Kuwait, 1994 to 1996, we were still finding a large number of Rockeyes. There must have been a huge failure rate. You would like to think that when people design these weapons that they are trialed in all types of terrain, and if they were, then why drop them in obviously bad terrain? ... As for problems ... I would have to say that [the main problem found was] gaining information on the various submunitions i.e. from the Americans themselves. Another problem [with submunitions] is the fact that, to the layman, they don't actually look like a bomb and can look quite an attractive item, especially to children. [There have] been times I've had shepherds walking towards me carrying a couple of Rockeyes.*[86]

MLRS M77 submunitions, although comparatively simple in design and probably with a lower overall technical failure rate than bomb-delivered submunitions for that reason, do fail to function, and the sheer quantity of rockets fired ensures a high level of UXO contamination.[87] For example, even accepting a one per cent normal rate of failure, the first mission fired during 'Desert Storm', lasting less than five minutes, would have resulted in more than 2,200 unexploded M77 bomblets. However, there is every indication that failure rates are, in fact, quite substantial which makes this cluster weapon a major concern, given its capacity to fire such extreme quantities of munitions with very large footprint (bomb impact) areas and inherent problems of inaccuracy. The latest US Army MLRS Field Manual states:

> *Rockets are inherently less precise than cannon projectiles. They have a much larger CEP*[88] *[and] are therefore much less predictable...The MFOM*[89] *rockets are extremely sensitive to the low-level winds due to the relative low velocity of the rocket as it leaves the launch tube. The resulting effect produces a path heading error in the first few seconds of flight.*[90]

There is also some evidence that some batches of M77 bomblets may be more likely to fail than others, leading to changes in manufacturing specifications. However, the US army considers the cost of suspending high dud-rate batches of submunitions to be prohibitive and will not replace them, nor will those batches undergo modification to incorporate the new specifications. It is estimated that nearly half the remaining lots would result in a dud rate exceeding five per cent.[91]

The threat to civilians in Iraq and Kuwait as a result of failed submunitions from the Gulf conflict can be better understood when it is realised that the coalition forces themselves suffered a high attrition rate as a result of incidents involving UXO. Submunitions were confirmed

as responsible for the deaths of 25 US military personnel during 'Desert Storm', 16 of which were attributed to inappropriate handling of submunitions.

Sudan

The civil war in Sudan has continued for longer than any other internal conflict and has been estimated to have claimed the lives of nearly two million Sudanese during more than three decades of fighting. The Sudanese government forces have, over the years, used cluster bombs against targets in areas of southern Sudan occupied by opposition forces. This use of cluster bombs has been brought to the attention of the international community on many occasions, especially during the past five years. Reports have come mostly through relief agencies working in the 'liberated' zone in the south and often from NGOs operating within the United Nations Operation 'Lifeline'.

These reports almost without exception record the use of cluster bombs against hospitals, schools and churches, and individual incidents are often re-reported at regular intervals. Neither the government of Sudan nor its armed forces have responded to international criticism and appear to consider cluster bombs as a standard conventional weapon that can be used without restriction.

This use of cluster munitions is important because of its nature – a government using this type of weaponry against its own population – and also due to its divergence from international norms. Unlike landmines (which have been used widely and largely indiscriminately by all combatants during the Sudan conflict) cluster bombs are not used predominantly by the governments of developing countries and non-state actors, but by the major military powers. Unfortunately most of the reports of cluster bomb attacks by relief agencies are incomplete and sometimes conflicting. Much of the testimony available tends to indicate that the government of Sudan only uses cluster bombs against civilian, cultural, religious and medical targets, whereas this seems unlikely and it is more probable that it is on these occasions that the agencies involved are witness to, or are informed of, the bombing. The one organisation involved in landmine and ordnance clearance in Sudan, Operation Save Innocent Lives – Sudan (OSIL), an indigenous NGO operating in Sudan People's Liberation Army-controlled areas, confirms that the weapons are used more widely than internationally reported.[92] However, there is clear evidence that the Sudanese government are using cluster bombs and other weapons, specifically targeted at hospitals, internally displaced people (IDP) camps and targets of a non-military nature.

It is thought that the Sudanese air force has one cluster bomb type, either the Chilean-manufactured CB-130, CB-500 or CB-250-K, all products of Industrias Cardoen SA of Santiago. Most sources report that the weapon has been supplied to Sudan by Iraq.[93] All three dispensers have the appearance of a conventional bomb. The CB-130 contains 50 x PM-1 CEM bomblets, while the CB-500 and CB-250-K bombs carry 240 of the same submunition. The PM-1 has a similar appearance to the Mk118 Rockeye submunition.[94] The PM-1 incorporates anti-armour, anti-personnel and incendiary properties. The bomblet produces a hollow charge effect capable of penetrating 150mm of armour and has a pre-fragmented casing that results in anti-personnel fragmentation on detonation.

The reasons for failure of bomblets in Sudan appear to be threefold:

- delivery-related failures, when very few of the bomblets function
- soft ground
- bomblets slowed by forest overgrowth.

Examples of reported and verified attacks
June 17 1996: Chukudum

A total of 12 bombs was dropped, at least six of them cluster bombs. Reports indicate a high failure rate. Bomblets were found close to a primary school and a church. A local priest, Fr Maurice, said that this was the 17th time the village had been bombed since August 1993. A local Norwegian People's Aid (NPA) representative said that local people are frightened to cultivate their fields following bombings because of the danger from unexploded bomblets. The local SPLA Commander, Kuol Deim Kuol, surmised that the government was attempting to disrupt a peace

conference being held by local tribal chiefs to resolve cattle rustling in the area.

Mr Ali Sadiq of the Sudanese Embassy in Nairobi denied the use of cluster bombs against Chukudum which he said was an SPLA garrison and said that Christian Solidarity International (CSI), which had called the press conference, was using its NGO status to smuggle arms to the SPLA.[95]

Reported June 1999: Labone IDP Camp, Eastern Equatoria

A US Committee for Refugees press release[96] reported that Sudanese government Antonov bombers had overflown four times at night causing concern that government forces were preparing to bomb Labone Camp, home for 40,000 internally displaced people, again. The committee reported that government planes 'bomb the camp frequently' and that residents are woken and moved to shelters and foxholes whenever a bomber is heard. The planes use bombs, rockets and cluster bombs. The camp is said to have been hit at least a dozen times in the past four years according to community leaders. An attack in mid-1997 killed seven people, and one in September 1998 killed two residents. The Committee reported that cluster bombs and other weapons have been dropped on more than 100 villages by government planes during the previous five years. Pilots are also said to have bombed civilians fleeing along roads and footpaths.

28 September 1998: Yei, Eastern Equatoria

Norwegian People's Aid (NPA) reported that Yei hospital was again hit by cluster bombs dropped from an Antonov bomber by government forces at 1300hrs on 28 September 1998. The recovery ward was hit and badly damaged and one patient was seriously injured. Numerous unexploded bomblets were left in the vicinity of the hospital. This was the third time in three weeks that the hospital had been bombed and the seventh time that Yei and its surrounding area had been bombed during 1998.[97]

20 June 1999: Kajo Keji Hospital, children's playground, and Medecins Sans Frontieres (MSF) compound Kajo Keji

Two bombs were dropped on Kajo Keji hospital scattering 'more than 100' submunitions. Some weeks later, in July, several cluster bombs were dropped on a school playground and the MSF compound. Luckily the bomblets failed to explode. Specialists from OSIL destroyed the submunitions.[98]

Chechnya

Russian Federation forces launched a new assault against the Chechens in September 1999. Cluster bombs and scatterable mine systems are central to Russian war-fighting strategies. It was reported that Russian aircraft had 'littered the eastern border with cluster bombs'.[99] It seems likely that those submunitions were mines deployed to interdict forces attempting to cross between Dagestan and Chechnya rather than bomblets designed to explode on impact. During August the Russians had been forced to 'express sincere regret' and offer compensation after a Russian Federation aircraft dropped 'cluster bombs filled with landmines' on the Georgian village of Zemo Omalo.[100] A report in the Moscow Times during November focused on the Russian reliance on cluster munitions, referring to '...the relentless bombardment of residential areas in Chechnya, including the use of cluster warheads...' as a flagrant violation of the Geneva Convention.[101] Other reports have indicated that tactical battlefield missiles with cluster warheads have been used as well as multiple rocket-launched cluster munitions.

When the United States government raised concerns about the conduct of Russian Federation operations in Chechnya the Russian Deputy Foreign Minister, Yevgeniy Gusarov, was scathing, retorting that Washington '...should have remembered about the rules of conduct in war in March instead of dropping cluster bombs on Yugoslavia'.[102]

The Russian forces continued to use Tupelov heavy bombers to deploy tons of cluster bombs against the retreating Chechen fighters. Some more recent reports have strengthened the allegations that ballistic missiles

with cluster warheads, reportedly with a footprint of 3.5 to seven hectares, have been used by the Russian Federation against areas populated by civilians.[103]

Iraq

Iraq was heavily contaminated by cluster bombs during Operation 'Desert Storm'. Although the information available regarding the use and impact of cluster bombs is limited it is known to be of an extremely serious nature. Much of the cluster-type ordnance detailed in Table 2 fell on Iraq and one recent report quotes an Iraqi government source that:

> *...since the 30-state aggression against Iraq, the competent authorities have defuzed 8,450 cluster bombs...*[104]

That civilian deaths and injuries continue as a result of unexploded cluster munitions from the Gulf War is not in doubt. As recently as May 2000 three Iraqi civilians aged between 13 and 16 were reported killed by an unexploded bomblet while one was injured. In a separate incident three children were injured in a rural area 12 miles from the northern city of Mosul.[105]

In December 1998 US and British aircraft mounted Operation 'Desert Fox' which lasted for 70 hours and was reported to have destroyed up to 25 per cent of Iraq's air defence system, including missile sites, communications and radar facilities. During this action the United States used the Joint Stand Off Weapon (JSOW) for the first time.[106] It must be assumed from the stated targets that this was AGM 154A JSOW with 145 BLU 97/B submunitions rather than the Sensor Fuzed Weapon deployed as AGM 154B JSOW. No information is available as to how many JSOWs were deployed.

It is since Operation 'Desert Fox' that air activity in the two No Fly Zones (NFZ) in North and South Iraq[107] imposed after Operation 'Desert Storm' has become most intense. The Iraqi government claims that British and American aircraft have entered Iraqi airspace on more than 21,000 occasions since December 1998.[108] The UK Ministry of Defence has denied that British aircraft are using cluster bombs as part of these operations although it is confirmed that RAF planes had undertaken 200 operational sorties in a single period of four weeks during which six laser-guided bombs were dropped.[109]

There is no doubt, however, that US aircraft at least are dropping cluster bombs during missions in the Southern NFZs although reports are often non-specific referring only to 'ordnance' being dropped. Daily logs of missions in the Northern NFZ (Operation 'Northern Watch') record no cluster bomb use.[110] However the Turkish press has reported that US aircraft have been secretly using cluster bombs since September 1999. The Turkish Daily News states:

> *Turkish and US military authorities have been holding talks to address the sensitive issue of using cluster bombs against Iraqi forces during their reconnaissance flights in the US-Britain-imposed no-fly zone north of the 36th parallel over Iraq. Under the rules of engagement agreed upon between Turkey and the United States last year, the US should inform Turkey of the nature of the mission which US warplanes carry out on each flight taking off from the NATO Incirlik Air Base in southern Turkey to monitor the no-fly zone. However, the US fighter jets began to use the cluster bombs in question last September and continued to do so unnoticed.*[111]

The report goes on to say that the Turkish government has asked the Americans not to use cluster bombs against Iraq.

There is much more certain evidence of US aircraft deploying cluster bombs in the Southern NFZ. The Mennonite Central Committee retrieved tail cups from BLU 97/Bs reported to have been dropped on 18 July 1999 in Najaf.[112] The report that the US is using BLU 97/Bs in the southern NFZ is strengthened by a news piece released by the US Department of Defense during February 1998. Under a photograph of US airmen moving a cart containing two CBU-87/Bs the text reads:

> *Airman Rodriguez guides a cart of cluster bombs on the flight Deck of the USS Independence. Airman David Rodriguez (right) guides a cart of cluster bombs into the staging area for munitions on the flight deck of the USS Independence (CV 62) while the ship operates in the Persian Gulf on 11 February*

1998. Independence and its embarked Carrier Air Wing 5 are on station in the Persian Gulf in support of Operation Southern Watch which is the US and coalition enforcement of the no-fly-zone over Southern Iraq. Rodriguez is a Navy aviation ordnanceman.[113]

Eritrea-Ethiopia

Eritrea and Ethiopia went to war, nominally over a border dispute in the contested Badme border area, in May 1998. In the first raid of the war Ethiopia bombed the international airport in the Eritrean capital of Asmara, which shares its runways with the military air base. Eritrea responded with cluster bomb raids into Ethiopia which killed a reported 50 civilians in two towns. There followed a US-brokered moratorium on air attacks until 29 May 2000 when Ethiopian aircraft used cluster bombs against Asmara airport and the Eritrean ports of Massawa and Assab on the Red Sea coast.[114] One report described the Eritrean response, once more using cluster bombs, on the town of Mekele:

On Friday, there was nothing to protect the children when a small warplane from neighbouring Eritrea appeared over the eucalyptus trees near the elementary school and dropped a cluster bomb, only to return from the opposite direction and drop another one… The second bomb cut down the fathers and mothers and neighbours who had rushed to the playground upon hearing the children's screams. All told, 48 people were killed, including 10 children under 15. [115]

Sierra Leone

In Sierra Leone the Nigerian-led intervention force ECOMOG dropped three cluster bombs on the eastern town of Kenema from an Alpha jet aircraft. It was reported that 10 people were killed and a further 18 seriously injured. Several of the injured underwent amputations.[116] Some sources have alleged that the cluster bombs were British-manufactured BL755s and this may soon be possible to confirm since UN UXO specialists have recently reported finding unexploded 'air-delivered cluster bomblets' near Freetown.[117] It is worth noting that BL755s are now available on the open arms market and an attempt in 1999 by the Swiss arms supplier Aerotech to export US$9 million worth of the British-made cluster bombs to Zimbabwe was blocked when the Swiss government refuzed to issue an export licence in case the bombs were used to escalate the war in the Democratic Republic of Congo.[118]

53 Operation 'Desert Storm', Evaluation of the Air Campaign GAO/NSAID-97-134 June 1997.
54 Monan, Jim, Curse of the Bombies: A case study of Saravan Province, Laos Oxfam HK 1998.
55 National Survey on the Socio-Economic Impact of UXO in Lao PDR 1997, Lao UXO & Handicap Int.
56 Correspondence Sebastian Taylor/McGrath November 1999; National UXO Survey 1997; Mines Advisory Group, various reports and papers.
57 National Survey on the Socio-Economic Impact of UXO in Lao PDR 1997, Lao UXO & Handicap International.
58 Estimate by Don MacDonald, Programme Manager of the first wide-scale clearance initiative in Laos by the Mines Advisory Group which began in 1994.
59 Community Awareness 1996-97, MAG Lao August 1997, (Sebastian Taylor) unpublished.
60 The Mines Advisory Group (MAG) is a UK-based mine and UXO clearance NGO with wide experience of working with, and collecting data from, affected communities.
61 This is low compared with a national rate of 45 per cent deaths in UXO accidents.
62 Agencies operational in Lao including UXO Lao, HI, MAG and others recognise that many accidents are caused through children and teenagers playing with bomblets. One reason is thought to result from their wide presence and visibility, children literally grow up seeing bombies as part of the landscape.
63 Data Gathering Team Report for 1995, Moung Pek and Moung Kham, Xieng Khouang, Mines Advisory Group, 1995.
64 This indicates that cluster submunitions are the sole problem on the denied areas of land. Farmers in Laos do not normally perceive unexploded bombs as high-risk objects and would not stop using land as a result of their presence.
65 Baseline estimates from: Arkin W.M, Durrant D, Cherni M, On Impact: Modern Warfare and the Environment: A Case Study of the Gulf War. Greenpeace International May 1991.
66 Quantities used in this chart differ substantially from many previous estimates based on the (higher) figures used by Greenpeace in the immediate aftermath of the war which were based on the assumption that new procurements matched munitions expended. The quantities used here are based on US GAO statistics of actual items expended. See GAO/NSAID-97-134 Table IV.4.
67 SFW and JSOW, for instance, are reported to have been used for the first time during 'Desert Storm'.
68 In this document referring exclusively to the F-117 Stealth Bomber.
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70 Gordon, M.R., Taylor, General Bernard E., The General's War. Little, Brown & Co. 1995.
71 GAO/NSAID-97-134 Appendix IV:2.2.
72 Gordon, M.R., Taylor, B.E., 1995.
73 Fuel tanks are routinely discarded after use by military aircraft during operations.

74 Morse, Stan, Gulf Air War Debrief, Aerospace Publishing Ltd. 1991.
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76 US GAO Report 1997: Extract from Table IV.3.
77 WCMD information USAF Airpower Journal International August 1999, Jane's Air-Launched Weapons 1999.
78 Source: Defence Systems Daily 22.5.00.
79 The other two batteries were 'B' and 'C' Batteries of 27th Field Artillery.
80 Jensen, Major Mark S., MLRS in Operation 'Desert Storm', Field Artillery Magazine, August 1991; also Missile & rocket systems deployed to southwest Asia, Operation 'Desert Storm' Strategy http://www.redstone.army.mil/
81 Sibbald, Ray, The Gulf War Assessed, Chapter 11: The Gulf War and the Environment 1992.
82 Nash, Trevor, RO In Kuwait: the big clean-up, Military Technology, Miltech 1991 quoted by Mennonite Central Committee US information paper, June 2000.
83 It is now recognised that safety standards in Kuwait were far below those required in most armed forces and in the UN and NGO clearance initiatives which were operational at that time in Afghanistan. Many of those who died and were injured in Kuwait did so as a result of unacceptable clearance practices.
84 BLU97/Tech/R/68
85 Gravett, Bob, MAG.
86 Egan, Mark. Emailed letter 23.6.00.
87 Comment, C. King, Geneva 2.5.00.
88 CEP: Circular Error of Probability.
89 MFOM: MLRS Family of Munitions.
90 US Army Field Manual 6-60 Multiple Launch Rocket Systems (MLRS) Operations Draft 8.11.99. Quoted in Mennonite Central Committee US information paper June 2000.
91 US GAU Report Operation Desert Storm: Casualties caused by Improper Handling of Unexploded Submunitions. Quoted by MCC US June 2000.
92 In conversations with Aleu Ayieny Aleu, Director, OSIL-Sudan.
93 Jane's Air-Launched Weapons 1999 indicates that there are no known exports of CB-130, CB-500 or CB-250-K. However, examination of unexploded bomblets from Sudan indicate that they are PM-1, a submunition common to all three bombs.
94 The PM-1 has clear plastic fins, rather than the translucent white fins on the Mk118, and a longer distance to wind the arming cover.
95 Sources: CSI Switzerland 17.07.96, The 'Monitor' (Uganda) 15.7.96.
96 http://www.refugees.org/news/crisis/sudan_e040699.htm
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5 Kosovo: Operation 'Allied Force'

How much damage did we do? The short answer is 'enough'.

Kosovo – Lessons from the Crisis, UK Ministry of Defence, June 2000

Operation 'Allied Force' was mounted to achieve three objectives that were clarified by President Clinton on the day after the first air strikes by NATO planes:

- to demonstrate the seriousness of NATO's opposition to aggression and its support for peace.
- to deter President Milosevic from continuing and escalating his attacks on helpless civilians by imposing a price for those attacks.
- if necessary, to damage Serbia's capacity to wage war against Kosovo by diminishing its military capability. [119]

Those objectives were refined to encompass five demands of the alliance.

- An end to the killing (of ethnic Albanians and other groups in Kosovo)
- A withdrawal of troops from Kosovo by the Yugoslav government
- The establishment of an international peacekeeping force in Kosovo[120]
- To allow the refugees to return to Kosovo in safety
- The negotiation of a settlement.

Cluster munitions deployed in Kosovo

Three different cluster munition types were deployed by NATO:

- BLU 87/B by US forces
- RBL755 by UK Royal Air Force (531 bombs, each containing 147 bomblets, of a total 1,011 aircraft munitions released by the RAF)[121]
- Mk 6/7 Rockeye by US forces.

Serbian forces stockpiled BL755s in Kosovo but no verifiable details are available regarding total quantities.

Initially NATO avoided admitting the NATO use of cluster bombs. At a 14 April 1999 US Department of Defense briefing the use of BLU 87/B was announced by Kenneth Bacon, the Defense Department spokesman, after some initial uncertainty by Maj. Gen. Chuck Wald:

Q. Are you dropping cluster bombs?

Gen. Wald:

We haven't dropped any cluster bombs there. We're well within the confines of international law... [122]

Q. Can I follow up on one other thing you said? Senator Leahy, in a speech on the Senate floor today, said he'd received disturbing reports that US forces were dropping anti-personnel and anti-tank land mines from planes. Can you clarify that at all when you're talking about types of munitions that were dropped?[123]

Gen. Wald:

I can unequivocally say that we will not drop any weapons that are illegal. Maybe Mr. Bacon has more to offer there.

Mr. Kenneth Bacon:

We have not dropped these weapons. We have dropped, as General Wald said, cluster bombs,[124] *but we have not dropped the ones he was talking about, which are a combination of anti-tank and anti-personnel land mines. These are the self-destructing ones called 'Gator'. We have used CBU-87s, which are combined effects munitions, which are basically cluster bombs with bomblets, but we have not used Gator.*[125]

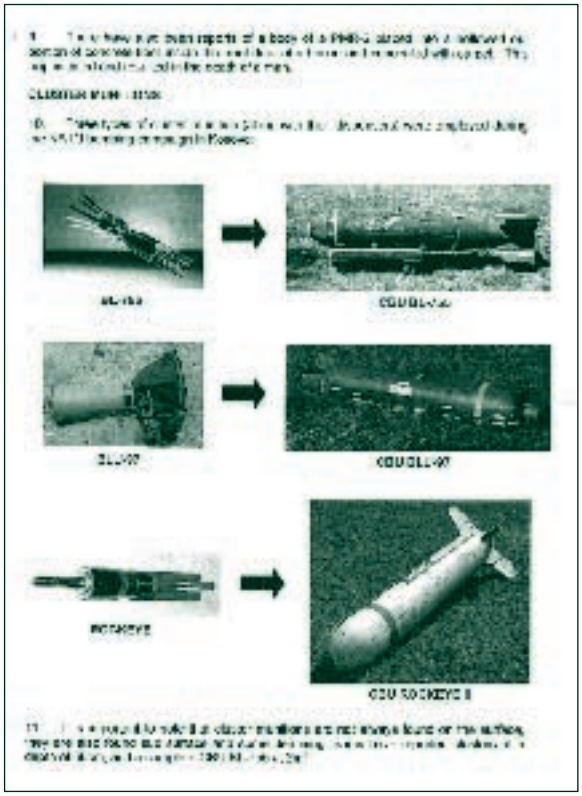
Photo 5 US Rockeye case from a bomb used against the Bulk Fuel Storage Depot near Ariljaca close to Pristina airport (Grid Reference DN 99651545).

There was similar official reticence regarding the use of Mk 6/7 Rockeye cluster bombs – reticence that lasted for a considerable time after the bombings had finished and ordnance clearance was being conducted. But Mk 118 bomblets had been illustrated on early NATO awareness material and been identified in several locations. In the event, research for this report investigated one NATO strike location close to Pristina Airfield, the village of Ariljaca and the Goles Communications site at Grid DN 99651545 where Rockeye, CBU-87 and laser-guided bombs had been dropped by US airplanes to destroy an underground fuel storage depot and surface soft targets. An interview with a member of the NATO EOD team that began clearance of the site in June 1999 confirmed the location of the Rockeye site. The bomb casing was photographed at the Royal Engineer base near Pristina, and the interviewee confirmed that this was brought from the fuel storage strike area.[126]

Targeting

In the case of Kosovo, the humanitarian objectives of the NATO action should have been an incentive to bomb with extreme care, and the principles of proportionality should have been a central consideration in targeting policy and every mission plan. According to a Special Report of the Civilian Affairs Committee of the NATO Parliamentary Assembly '... the fact that NATO was intervening in the name of human rights implied a perhaps heavier moral obligation to respect the rules of war than if the operation had been undertaken for purely economic, political or territorial objectives'.[127]

Figure 8 UNMACC threat factsheet No 1 October 1999 showing Rockeye submunition



The targeting policies for cluster bomb use were expressed as follows:

- **Area targets: Major General Jertz explained during May 1999 at a NATO Press Conference:**

  On cluster bombs, we do use [cluster] bombs against targets on which we think that cluster bombs will have the most effect, that is aerial targets. We never attack civilian targets and on aerial targets as we call it, we do use those bombs, however only when we can make sure that there is no collateral damage and they are not as accurate, as you said, but I just have to say so because I am a pilot myself, but cluster bombs in the way we are using them are pretty accurate. I know there are cases where it is of course a little difficult to really make sure that if one bomb goes astray it would not hit this target we were attacking but [it] is also within the law and it is legal in the international community to use cluster bombs, but once again only against aerial targets and that is where we use them. [128]

General Jertz was asked to clarify the meaning of the term 'aerial targets':

You could also call these cluster bombs 'combined effects munitions'. They are being used when talking about 'aerial targets' such as airfields so we use cluster bombs on soft targets like aircraft and trucks when they are on the airfield and we detect them, and when we can make sure there is no collateral damage, and we also use those cluster munitions in areas where we know there are valid military targets which we cannot see because they are under the wood. Of course we know where they are but they cannot be attacked accurately by precise weapons so we use cluster bombs against those targets.

General Jertz appears to argue that any target where cluster bombs will be effective and where there is a certainty that no collateral damage will result is a valid target. (The use of the word 'aerial' is obviously a translation error for 'area'.) He explains that cluster bombs can be deployed against targets where the targets cannot be seen but are known to be in a given area, once again where there is certainty that there will be no collateral damage. It is not clear how that could be known when the target area is invisible to attacking forces.

At a US DoD News Briefing, also in May 1999, Major General Chuck Wald expanded on the use of cluster bombs against concealed positions in response to a question about the military utility of the weapons:

For fielded forces it's very good, or for armor, or for things we know they're in a spot that could be camouflaged by trees, let's say. It's a very good weapon. As you can see from some of the weapons I showed you dropped here, you can't see through those trees necessarily with a laser, let's say. So in the case where there's a tank in trees, or troops, or vehicles, we know they're there from other sources, it's a very good way to destroy those type of targets.

Now these cluster bombs, you mentioned, I think, earlier to Mr Bacon, that there are some duds in there. Very few. But when they are, it's like any other unexploded ordnance. This is not a mine. There is no proximity on it where if you walk by or make the ground rumble or anything like that it's going to go off. So they're just like any other unexploded ordnance any place in the world. But they are not a mine. They have no timers on them whatsoever or anything like that. I think it's just like a 500-pound bomb, except there are several of them in a cluster. That's the way I'd characterize it.[129]

General Wald confirms that cluster bombs are perceived by NATO as weapons that can be used against targets which cannot be seen but which intelligence reports indicate are in the targeted area. He argues that unexploded cluster munitions are like other unexploded ordnance, despite the wealth of information available from previous conflicts to the contrary.

The same briefing continued to address the issue of cluster bombs.

Q. Do lawyers from the Joint Staff and CAOC[130] *review the target folders ahead of time for law of war considerations...*

Gen. Wald:
Most certainly.

Q. ...proportionality considerations?

Gen. Wald:
Most certainly, I've spent a lot of time with lawyers on this. When I was a planner with CAOC, we had a lawyer at the CAOC in 1994. In the Gulf War they had lawyers. Every target-set is reviewed for legal approval. So it's part of the process. And I'm pretty proud of our government, the fact that we do spend a lot of time checking the legality of all types of things we do, versus what Milosevic does. Once again, he is way outside anything legal.

Q. Have lawyers vetoed use of these – these military lawyers – have they vetoed occasionally the use of CBU 87s?

Gen. Wald:
Never. It's not illegal. It's totally within the law of armed conflict, and it's legal in the international community to use that weapon.

There are some points raised here by General Wald of considerable concern. If lawyers are included in the targeting process it is obvious that they must rely on information supplied by soldiers like General Wald for

the baseline information on which they must judge the legality of each target selection. If, for instance, a lawyer is told that the BLU 87/B very rarely fails and, when it does, is 'just like a 500-pound bomb except there are several of them in clusters' it would not be surprising that the use of the weapon was never vetoed. There is a suggestion also in General Wald's responses that the legality of an action in combat is subject to the level of legality displayed by the enemy. This would indicate that the laws for the conduct of war are a constantly adjusted scale, the balance of legality being matched to the excesses of the enemy.

The following day the US State Department Spokesman, James Rubin, addressed similar issues:

Q. ...going back to cluster bombs, there's been some criticism of the NATO and, I guess, US forces... Human Rights Watch and others ... for using cluster [sic] as an instrument of war, a weapon of war. I wonder if you have any comment on that?

Rubin:

I do not ... I will leave it to my Pentagon colleagues to explain why cluster bombs have been used for select military targets, including airfields and others. We're talking about risk to our pilots and then we are talking about why we are in this conflict in the first place. We don't accept any of the suggestions from any of the groups that there ought to be a moral equivalence between what the United States and NATO countries are doing on behalf of those suffering from war crimes, from crimes against humanity, from acts of genocide, and trying to reverse that evil. We have nothing to hide when it comes to our determined efforts to reverse that evil.

General Clark has made very, very clear that we go to extraordinary lengths and an incredible process of care is taken to try to minimize the damage to civilians in this conflict. We do not accept anybody's notion of proportionality, nor do we accept any of the human rights officials' suggestion that somehow there ought to be any comparison between the unintentional civilian casualties which have occurred from NATO bombing with the premeditated and systematic campaign of atrocities and ethnic cleansing committed by Serbian forces on civilians in Kosovo. [131]

These remarks go directly against the concept of belligerent equality in international law. Ironically one of the best summary interpretations of the doctrine of belligerent equality can be found at the beginning of the US Air Force Manual 1976:

The law of armed conflict applies equally to all parties to an armed conflict, whether or not the international community regards any participant as the 'aggressor or 'victim'... This principle is vitally necessary. [132]

Evidence of the thinking of UK officials emerged during March 2000 in London, when senior military figures and civil servants were called to give evidence before the House of Commons Defence Select Committee. [133]

Question 214:

Would you say that you were getting an accurate enough picture of what was really happening on the ground, particularly in Kosovo, with regard to what damage was being dished out? If a pilot came back through the system and found a target, who could actually give him a further right to engage that target? You talked about the right of engagement, if a pilot had seen a target, or you yourself had selected it as being a good operation for us, how much flexibility did you have?

Vice Admiral Sir Ian Garnett:

I did not personally authorise targets, that was not the way the process happened, it was part of a NATO operation. Air Commodore Morris has described to you how it actually happened in the theatre. If a United Kingdom pilot could not identify his target he was under strict instruction, which was always obeyed, to bring his weapon home. We were not going to take risks with people who thought it was the right target and dropped their weapon just in case. I was absolutely sure that any United Kingdom aircrew who could not positively identify the target, within the constraints that they had been given, would not attack outside their instruction. I was entirely confident of that.

This response implies that unexploded BL755 submunitions are the result of an intrinsic and unavoidable propensity for malfunction. If these most

responsible pilots can do nothing to limit the impact of the weapon, it follows that, in the hands of less scrupulously responsible aircrew the collateral cost of cluster bomb use would be dramatically worse.

Q. 220:

Air Commodore Morris, you said earlier that you could turn down target offers from NATO. Did you ever do so?

Air Commodore Morris:

Yes, I did.

Q. 221:

Would you like to tell us, or would you prefer to write to us and tell us the number of occasions and the grounds upon which you turned a request down?

Admiral Garnett:

We can certainly let you have a note on that.

Q. 222:

Or did you refer the request afterwards? Perhaps you could tell us?

Admiral Garnett:

There was constant discussion between Air Commodore Morris and Air Commodore Torpy about targets that, perhaps, led to some doubt about whether they would be valid United Kingdom targets, and as a result of that close and continuous liaison between my headquarters and Air Commodore Morris in theatre some targets were turned down.

Q.223:

Can you give us, in this meeting, the kind of grounds that might be used?

Admiral Garnett:

I suspect the targets with which we felt uncomfortable were targets that clearly we thought might lead to more collateral damage or civilian casualties, that I was under direction to avoid.

Q. 261:

Is there thought to be any political sensitivity about the use of ... cluster bombs ...?

Air Commodore Morris:

... As far as cluster bombs were concerned, everybody was well aware of cluster bombs, the nature of them and the possibility of unexploded ordnances. The same applies, of course, to conventional weapons as well, 1,000lb bombs, you can have some that fail to detonate, so we are extremely aware of that and none more so than the air crew who are asked to release them and to make sure that they always use the minimum number of weapons and only on the appropriate occasions.

This answer again shows an apparent lack of understanding of the important differences between failures of cluster bomblets and of 1,000lb bombs. On targeting, some detail was added to the general replies given above in a written answer to a Parliamentary Question:

This weapon is particularly effective against Serb forces deployed in the field in Kosovo, and targets have included main battle tanks, armoured personnel carriers, other military vehicles, artillery, field headquarters and troop concentrations. It is not designed as a runway-cratering weapon, and has not been used to attack runways; nor is it designed to impede damage repair.[134]

Finally, in June 2000 the UK Ministry of Defence published a lessons learned report:

Collateral damage is the term used to describe the unintended loss of civilian life, or injury to civilians, or the damage to civilian property, which is caused by attacks on military objectives. Accuracy in attack, and taking all feasible precautions with a view to avoiding, and in any event, minimising collateral damage, are important both politically and legally. [135]

The use of cluster bombs by UK armed forces during the Kosovo conflict has attracted adverse media comment. UK armed forces will always use the weapons systems judged most effective against a given target, taking into account the need to minimise collateral damage. The bomblets are designed to detonate on impact but, as with any similar munitions, a small percentage failed to do so. The manufacturer's estimated failure rate for the RBL755 cluster bomb used during the Kosovo conflict is approximately five per cent ... Cluster bombs are

an effective weapon against area targets such as a group of soft-skinned military vehicles. Nevertheless we have learned from the Kosovo campaign that it would be useful to have a capability to strike single vehicles more accurately, hence the trial of the Maverick missile. [136]

We have been criticised for continuing to use cluster bombs after the US had ceased to use them for safety reasons. The type of cluster bomb used by the US was discovered to have a fault and was temporarily withdrawn from service shortly thereafter for use until the end of the conflict. The UK uses a different type which continued to function normally, and there was thus no reason for it to be withdrawn. [137]

The targets specifically recommended as being ideal for cluster bomb attacks are:

- airfields
- aircraft and trucks on airfields
- fielded forces
- main battle tanks and other heavy armour
- troops
- vehicles
- armoured personnel carriers
- artillery
- field headquarters
- troop concentrations
- groups of soft-skinned vehicles
- targets believed or reported to be hidden in wooded areas
- concealed targets which cannot be hit by precision weapons
- radio relay facilities/buildings.[138]

Effectiveness against military targets

The UK MoD's overall assessment of the bombing campaign was that it was 'singularly effective'.

Well over 400 static targets were attacked. More than three-quarters suffered moderate to severe damage. There is also clear evidence that air strikes against Milosevic's field forces in Kosovo were successful in restricting their operations. The Supreme Allied Commander has published his battle damage assessment. Figures however cannot show the extent to which Yugoslav tanks and other assets had to remain immobile to avoid the onslaught. As they were immobile, they couldn't be used. If they broke cover, they could be attacked. And in the final analysis a successful military campaign is not just about material destruction or a numbers game. It is about the impact on the psychology of an aggressor. How much damage did we do? The answer has to be 'enough'. [139]

Although it is difficult to assess the extent to which cluster bombs contributed to the psychological impact of the campaign, the intended material targets of the cluster bombs are clear enough. The original official figures for material targets destroyed during the bombing have been discredited by the recent release of details from the US Munitions Effects Assessment Team (MEAT) which conducted a comprehensive air and ground assessment in Kosovo immediately after the end of the campaign. [140]

This report was suppressed and replaced by an alternative written by the Chairman of the Joint Chiefs of Staff, General Henry Shelton based largely on interviews with aircrews. This was presented as 're-analysing'. [141] The comparative findings included the following:

Tanks destroyed:
Shelton - 140 MEAT - 14
Armoured personnel carriers destroyed:
Shelton - 220 MEAT - 18
Artillery pieces destroyed:
Shelton - 450 MEAT - 20

The MEA Team found that of 744 'confirmed' NATO strikes, evidence could only be found of 58 successful strikes.

Impact on civilians

In the first four weeks after the end of the bombing campaign at least 150 Kosovars were killed and injured by landmines and unexploded ordnance. By June 2000 94 had been killed and more than 400 injured. The United Nations head of humanitarian assistance in Kosovo, Dennis McNamara, told the media that there were 15 casualties every month as people in the province tended their crops. He also stressed that children are particularly at risk from cluster submunitions: 'Kids are picking up the cluster bombs and getting blown up because the cluster bombs have bright canisters which are very attractive.'[142]

While the toll on the population has continued as the months have passed, most credible authorities agree that between 40 per cent and 50 per cent of the total casualty rate can be attributed to cluster submunitions. The notional failure rate of cluster bombs and the bomblets they contain is of little relevance to the related remedial tasks – survey, clearance, marking, community education and, of course, evacuating and treating the injured. The key information required to speed clearance is to know exactly where the bomblets are, where each bomb in each strike was delivered. But the UNMACC was denied access to the US MEA Team information, which included information that could have been life-saving.

Since NATO insisted that the bombing was a humanitarian action to save the lives of the people of Kosovo, it is difficult to see how it can now deny or unnecessarily delay information that will save the same population from death and injury. When the UN head of humanitarian assistance in Kosovo called on NATO to release information, the response was a bland assertion that ' ...NATO and the NATO-led peacekeeping force in Kosovo are providing all available information on location of the bombs to the UN team'.[143] Even if this was true it is difficult to understand why, after a year, that information is still in the process of being 'made available'. Collateral damage is not time-limited – if a child finds and disturbs a bomblet six months after the bomb was dropped, it is no less a measure of the proportionality of that attack than if the child had become a casualty after just one day.

Denial of land is a measure of proportionality as well, as is the continuing insecurity that results when communities are fearful of the land that provides their only income.

Senior officers responsible for targeting may feel that this makes the job impossible. But there is no shortage of information on past use of cluster bombs. For example, many of the failures in Kosovo have been caused by the bomblets failing to detonate on impact with soft ground and due to trees, yet these are both recurring themes throughout the history of cluster bomb use. Soft ground was a major reason for malfunction in Operation 'Desert Storm' and the Falklands. It appears that senior officers responsible for targeting and minimising collateral damage also approved the use of cluster bombs against concealed targets in forested areas, despite evidence that a common weakness of the weapon is an inability to penetrate overgrowth without a high percentage of malfunctions. That the United States, which deployed the great majority of the cluster bombs during Operation 'Allied Force', was aware of the potential for inaccurate bombing, is confirmed by its official justification for the continuing development of the Joint StandOff Weapon (JSOW) which says:

> *'Desert Storm' Lessons Learned highlighted our inability to accurately deliver ordnance from medium and high altitudes under adverse weather conditions.*[144]

Despite this knowledge, resulting from previous combat experience, the CBU 87/B and Rockeye were deployed from medium-to-high altitude during Operation 'Allied Force' in Kosovo.

Table 3: Random selection of cluster munition casualties from IMSMA Database, UNMACC/ICRC Kosovo

Date of incident	Place	Age	Sex	Area marked?	Casualty type
13.01.00	Junik, Decani	16	M	No	Injury – head/chest
13.01.00	Junik, Decani	18		No	Fatal
12.10.99	Hoc Zagradska	11	M	No	Fatal
12.10.99	Hoc Zagradska	8	M	No	Fatal
26.10.99	Dumos	13	M	No	Fatal
02.12.99	Srpska Babus	11	M	No	Fatal
15.12.99	Meja, Dakovica	29	M	Cluster bomb marked	Fatal
13.08.99	Bajgora	12	M	No	Fatal
13.08.99	Bajgora	36	M	No	Fatal
17.01.00	Ljubenic, Pec	27	F	No	Fatal
08.05.99	Ariljaca Kosovo	11	M	No	Fatal
11.07.99	Daovica	9	M	No	Fatal

BL755 strike. Target: fielded troops. Location: near Osmani, Mitrovica [145]

On 27 April 2000 after finishing school for the day, 10 children from the district of Xhafa were on their way home. One 15-year-old went into a field containing three unexploded bomblets and picked one of them up. He then ran back to his friends with the bomblet in his hand. They shouted to him that the bomblet was dangerous but he threw the submunition away from him. The children froze, expecting the worst, but nothing happened. The boy retrieved the bomblet and threw it again, nothing happened. Then he threw it at a tree – the bomblet exploded. The boy and his friends were lucky, he sustained minor head and arm injuries, and no one else was hurt.

Later investigation discovered a further 16 BL755 bomblets and a complete RBL 755 containing 147 bomblets.

BLU 97/B strike between the villages of Llpashtica and Obranc in the Municipality of Podujeve. Interview with a 13-year-old boy in Pristina Hospital who has recently undergone a double leg amputation, 26 August 1999.

I went with my cousins to see the place where NATO bombed. As we walked I saw something yellow – someone told us it was a cluster bomb. One of us took it and put it into a well. Nothing happened. Later I went back to the bomb and put it in this position [vertical]. We began talking about taking the bomb to play with and then I just put it somewhere and it exploded. The boy near me died and I was thrown a metre in the air. The boy who died was 14 – he had his head cut off. I was near him and another boy tried to help me…

There is a simple fact about both the incidents described on page 50: if the aircraft that dropped these cluster bombs had used unitary bombs or missiles, these accidents would not have happened, even if the alternative weapons had malfunctioned.

Having used the cluster bombs it was incumbent on NATO and especially the US and UK governments to give maximum support to the UNMACC clearance operations to remove the risk as quickly as possible.

More than 50 people have been killed by NATO cluster submunitions since the end of Operation 'Allied Force'. Given the true achievements of the bombings in Kosovo based on the MEAT Report it seems clear that the use of cluster bombs proved disproportionate to the military advantage gained. As time passes, the bomblets become harder to locate and, often, increasingly unstable. Further civilian deaths and injuries will continue to illustrate the uncontrollable and disproportionate nature of cluster munitions.

119 Televised address to the US, 25 March 1999.
120 It was always emphasised that this Force must include a NATO element.
121 The prefix RBL relates to a variation of the BL755 equipped with a radar proximity fuze which initiates the dispenser case ejection at a pre-set height to enable deployment from medium-to-high altitude. The bombs dropped by the RAF during Operation 'Allied Force' were said to be RBL755s although this has not been verified on the ground and some sources questioned whether sufficient RBL versions were held in stock to avoid resorting to BL755s which are optimised for low-altitude delivery.
122 It is not apparent what General Wald meant by this statement but it does raise questions as to whether he knew, at that time, whether the use of cluster bombs was legal.
123 BLU 91/92 Gators were not used in Kosovo and there has never been any serious or verified suggestion that they were deployed in Yugoslavia. However, the US reserved the right to deploy AP mines such as the BLU92/B. Such use would have placed NATO countries, which are parties to the Ottawa Convention, in a legally difficult position and was probably a major reason that the US decided against their use.
124 Note that General Wald specifically said: 'We haven't dropped any cluster bombs ...'
125 US Department of Defence Briefing, 14 April 1999.
126 Photo. ref. 3D BLU97/KOS/MILENG/31.
127 NATO Parliamentary Assembly Report as245cc(99)11e (Draft).
128 NATO Press Conference Brussels 14 May 1999.
129 US DoD News Briefing,13 May 1999.
130 CAOC: Combined Air Operations Centre; the NATO CAOC was based at Vicenza in Italy.
131 US State Department Noon Briefing, 14 May 1999.
132 Quoted in Best, Geoffrey, War & Law since 1945, Clarendon Press, 1994.
133 House of Commons Select Committee on Defence, extracts from Minutes of Evidence, March 2000.
134 Hansard, 18 May 1999.
135 UK MoD, Kosovo – lessons from the crisis, June 2000, Chapter 7.9.
136 UK MoD, Kosovo – lessons from the crisis, June 2000, Chapter 7.46.
137 UK MoD, Kosovo – lessons from the crisis, June 2000, Chapter 7.47.
138 General Wald, US DoD Briefing, 19.4.99.
139 Kosovo: an account of the crisis, Lord Robertson of Port Ellen, 14 October 1999.
140 Munitions Evaluation Assessment Teams (MEAT) are made up of highly trained military damage assessment and munitions experts.
141 Barry, John. Evan, Thomas, The Kosovo cover-up, Newsweek, 15 May 2000.
142 BBC World Service 16.6.00/Los Angeles Times 17.6.00. The BLU 97/B has a bright yellow casing and various colours of drogue parachute.
143 Associated Press report 16.6.00.
144 US Docs: WPNS103 - JSOWTAF MNS 401-91 Strike Capability Mission Need Statement Joint Standoff Weapon 1067. 'Issues' Para 3.
145 Information: Mines Advisory Group/UNICEF.

6 Conclusions

A major powers' weapon

The landmine has often been referred to as the weapon of poor countries, of guerrilla forces; and one of the arguments of major powers against a ban on landmines was that these countries could not be trusted to give them up. Cluster munitions are virtually the opposite — weapons of the major powers, and with the development of new, more complex and costly, versions they are becoming more exclusive. It will be interesting to observe whether, faced with the lessons of the past four decades, the major military powers will be as open to a review of this weapon type as many poorer countries have been with landmines.

Lessons learned

It is clear that the lessons of the southeast Asian conflict and subsequently those of Operation 'Desert Storm' and many smaller conflicts have not been learned, or at least have not led to a change of strategy. The continued use of cluster bombs has cost thousands of civilian lives, denied land to the poor and disenfranchised and is now costing the international community millions to eradicate the unexploded submunitions.

Military effectiveness

When the cluster munition works, it works. If it were possible to manufacture a variant with no propensity for failure and causing long-term danger, the military effectiveness of cluster munitions would not be in question. There would remain serious concerns about the use of cluster munitions, based on the irresponsible targeting strategies identified in this report, but these could be addressed through improved planning and discipline. However, there has never been a cluster munition that does not have a high failure rate, and therefore an in-built potential for collateral and post-conflict damage. Neither does its military effectiveness outweigh its non-military impact: cluster munitions have been shown to be disproportionate by effect. In none of the conflicts reviewed during this study could it be said that cluster munitions of any kind have been a critical positive combat factor for the user force.

Legality of use

The legality of using weapons known to have an unacceptable post-conflict impact on civilians and which act as a widely recognised obstacle to rehabilitation, resettlement, reconstruction and development, must be in doubt. Targeting strategies such as those described in this report are often such that the attacking force has no way to differentiate between the enemy and non-combatants. This is especially true when cluster bombs are used as an area bombardment weapon or when they are deployed against wooded locations where targets cannot be seen and the impact of submunitions cannot be assessed. If cluster munitions, using the strategies of most armed forces are, by common usage, indiscriminate then such use is in clear breach of international humanitarian law.

Manufacturers

The proliferation of weaponry requires the co-operation of arms manufacturers and governments and, whereas governments may benefit militarily, it is the manufacturers who profit. The companies who have profited from the sale of unreliable weaponry have a responsibility and should be required to contribute to the clearance of failed submunitions. They should expect to be held responsible for compensation where the intrinsic unreliability of their products has resulted in death, injury or loss.

Failure rates

Governments have continued to insist that the failure rate, overall, of cluster munitions, is five per cent, and that this failure rate is 'acceptable'. To continue this distortion of the truth, while ignoring the advice of experts from the military and civilian mine clearance community, is unforgivable. One British Parliamentarian summed this issue up as follows:

> *The difference between five per cent and seven per cent may not seem great, but the RAF used 531 BL 755s in the Kosovo operation. Each BL755 carries 147 submunitions. The extra two per cent would mean more than 1,500 extra unexploded bombs in Kosovo.*[146]

Command responsibility in future

In the light of the information now publicly available about cluster munitions, it will not in future be a defence to say 'I was following orders', it will not be a defence to say 'I did not know' when an individual is in a position of command with a duty to know. This applies equally to military officers and responsible politicians. In future, negligence will be the only reason for 'not knowing' that five per cent is an inaccurate estimate of the failures of cluster munitions, or for authorising the use of these weapons without taking full responsibility for the consequences.

146 Harry Cohen MP, Hansard, 20 February 2000, col. 106.

7 Recommendations

International humanitarian law

New international law on the use of, and post-conflict responsibility for, cluster munitions is necessary. The use of cluster munitions must imply absolute accountability and responsibility. Any state that has used or uses cluster munitions should be:

i) required to implement full unexploded munitions clearance and supporting activities such as marking affected land immediately the affected territory is no longer subject to combat operations. Or, where that is not possible for any reason, the responsible party must be held financially responsible for full clearance and supporting operations under the auspices of the United Nations.

ii) held accountable for compensation to non-combatants and communities suffering death, injury or economic disadvantage as a result of the explosion or presence of cluster munitions which do not explode on impact or within a short time thereafter.

iii) required to hand over to the United Nations full records of cluster bomb deployment and any additional information of use for the protection of civilians immediately after conflict ceases. In cases that are outstanding such as Laos, Kosovo, Chechnya and Yugoslavia this action must be undertaken without further delay.

Moratorium and review

As an immediate first step towards new international law on cluster munitions, there should be an in-depth review of this weapon type, encompassing use, impact and legality. This review should take place under the auspices of a recognised international body and should include input from civil society as well as the United Nations and the International Committee of the Red Cross and Red Crescent.

The review should be conducted during a global moratorium on the use, manufacture, sale and transfer of all cluster munitions.

Military responsibility

The confusion with which targeting appears to be conducted and the failure of many military personnel involved to fully understand the principles of humanitarian law is undoubtedly a cause of many unnecessary deaths and injuries among non-combatants. It is recommended that all national forces and regional alliances such as NATO should institute intensive training courses in co-operation with the legal department of the International Committee of the Red Cross and Red Crescent.

Appendix

Table A1. Sample listing of current cluster bombs

CB-500-K2	CB-500-K-2 CB with 400 CEM PM-1 bomblets (Chile)
AT CB	AT Cluster Bomb with 16 sensor-fuzed top-attack AT bomblets (China)
BLG 66	BLG66 Belouga Bomb with 151 BLG66 submunitions/grenades (France)
MW-1	MDS re-usable Dispenser with 4536 KB44 AT bomblets, 896 MIFF AT mines, 672 MUSA fragmentation bomblets, 672 MUSPA airfield denial mines or 200 STABO runway penetrator submunitions or a mixed-load configuration depending on target (Germany)
TAL 2	TAL 2 Cluster Bomb with 315 fragmentation submunitions (Israel)
PTAB-1M	KMG-U Dispenser with 248 PTAB-1M AT bomblets (Russian Federation)
RBK-500 BetAB	RBK Single-use Cassette with 12 BetAB runway cratering bomblets (Russian Federation)
CB 470	CB470 Cluster Bomb with 40 Alpha AP air-burst bomblets (South Africa)
BME 330 C	BM 330 Cluster Bomb with 180 CP AP Fragmentation, CH AT or SNA area denial
Multi Purpose	Bomblets or mixed configuration (Spain)
RBL 755	AWF Dispenser with 147 AT & Fragmentation bomblets (UK)
CBU 7/A	SUU-31/A Dispenser filled with 12 BLU18B delay-fuzed AP bomblets (USA)
CBU 24/A	SUU-14A Dispenser with unknown number of BLU24/B AP fragmentation bomblets (USA)
CBU 28	SUU-13/A Dispenser with 4800 BLU43/B short dragontooth AP minelets (USA)
CBU 33/A	SUU-36/A Dispenser with 30 BLU45/B shaped charge AT minelets (USA)
CBU 34/A	SUU-38/A Dispenser with 540 BLU41/B fragmentation delayed action minelets and BLU42/B fragmentation minelets with anti-handling device and self-destruct (USA)
CBU 37/A	SUU-13/A Dispenser with 4800 BLU44/B long dragontooth AP minelets (USA)
CBU 41/B	SUU-51 Dispenser with 18 BLU 53/B napalm-filled incendiary bomblets (USA)
CBU 51/A	SUU-13/A Dispenser with 40 BLU67/B anti-runway bomblets (USA)
CBU 52	SUU-30 with 254 BLU61 fragmentation/incendiary APAM bomblets (USA)
CBU 87/B CEM	SUU-65 /B TMD with 202 BLU97/B combined effects bomblets (USA)
CBU 97B SFW	SUU-64/B TMD with 10 BLU108/B submunitions which each contain 4 Skeet anti-armour projectile warheads (USA)
CBU 78/B	Mk7 or MK6 Rockeye II Dispenser with 45 AT Gator mines and 15 AP Gator mines (USA) [1]
CBU 89/B	SUU-64/B Dispenser with 72 AT Gator mines and 22 AP Gator mines (USA) [2]
Mk 20	Mk 7 Rockeye II Dispenser with 247 Mk118 AT shaped charge/fragmentation bomblets (USA)
CBU 59/B	Mk 7 Rockeye II Dispenser with 717 BLU77/B APAM bomblets (USA)
ISCB-1	Modified Mk 7 Rockeye II Dispenser with 160 pre-timed fragmentation mines and 65 dummy bomblets (USA)
AGM-154A JSOW	AGM 154 JSOW with 145 BLU97/B CEM bomblets (USA)
AGM-154B JSOW	AGM 154 JSOW with 6 BLU108/B (SFW) submunitions which each contain 4 Skeet anti-armour projectile warheads
KPT-150	KPT-150 Cluster Bomb with either 54 PTAB 1.5 HC AT bomblets, 44 RAB 2.5 fragmentation bomblets or 34 RAB 2.5 fragmentation bomblets (Yugoslavia/Serbia and Montenegro)

Notes to Table A1

1 The CBU 78/B is in use with US Navy aircraft

2 The CBU 89/B is in use with USAF aircraft

Sources include Jane's Air-Launched Weapons 1999, Lumsden Dr M, SIPRI 1978.

See Glossary p10 for abbreviations.

Table A2. Rocket-based cluster submunitions

Country	Designation	Cluster warhead options [1]
Belgium	70mm LAU97 MRLS[2]	Fires 40 rockets each containing 9 x 0.48kg AP/AT bomblets each with a lethal radius of 10.5 metres. The maximum range of the rockets is 7,900 metres with a saturation area at that range of 200m x 300m.
Brazil	ASTROS II [3] SS40/60/80	SS40: Fires 16 rockets each containing 20 x AT/AP bomblets with a range between 15km and 35km. SS60/80: Fires 4 rockets each containing 65 x AT/AP bomblets. The SS60 range is 20km to 60km, the SS80 22km to 90km. Three other warheads are also available, an ATAP incendiary bomblet, an AP/AT minelet and a runway cratering submunition.
China	NORINCO Type 79	305mm. Fires eight rockets each with 10 Type 69 plastic AT mines to cover an area 600m x 350m at a maximum range of 2,600m.
China	NORINCO Type 74	284mm. Fires 10 fin-stabilised rockets each with 10 x Type 69 or Type 72 plastic AT mines over a range of 1,500m. A salvo of four rockets has a footprint of 400m x 400m. Can also fire the type 85 rocket containing 10 x AT mines over a maximum range of 3,500m.
China	NORINCO WM-80 MRS	273mm multiple rocket system with a range of 34km to more than 80km. Fires eight rockets with 380 HEAT bomblets capable of piercing up to 100mm of armour plate.
China	NORINCO Type 89 SPMRS [4]	122mm system firing 40 rockets with a maximum range over 20km with a choice of three cluster warheads. The launcher carries a full reload of 40 rockets which are automatically reloaded. HE cargo: 39 x anti-armour bomblets lethal radius of 7 metres. Minelaying: 6 x AT mines or 96 x AP mines. Salvo footprint 900m x 800m. Type 84: 8 x AT mines or 128 AP mines. Salvo footprint 650m x 650m. All bomblets and mines are proximity fuzed.
China	NORINCO Rockets	122mm 30km rocket family: includes a cargo warhead with 39 x 42.2mm bomblets with a 9.3m lethal radius. Range 15km to 32km. A 15km-range rocket with 6 x AT mines. A 40km range cargo rocket with 44 bomblets.
China	NORINCO Type 84 Minelaying Rocket System	Fires 24 x 122mm rockets with 8 x AT mines or 128 AP mines over a maximum range of 7km. The salvo footprint over 6km is 650m x 450m. This system also fires the 122mm 30km and 40km 122mm cargo rockets.

Country	Designation	Cluster warhead options
Czech Republic and Slovakia	Krizna 122mm Cargo Rocket System	Krizna-R: With a range of 8km to 17km carries 4 x PTMi-D AT minelets. Krizna-S: 3km range with 4 x PTMi-D AT minelets. Kus: 3km range with 5 x PTMi-S1 AP minelets + 4 x decoy minelets [5] The Krizna-S and Kus can be fired from a man-portable three tube 122mm MV-3 rocket launcher fired from a tripod and capable of remotely laying a 100m x 100m minefield.
Czech Republic and Slovakia	122mm AGAT Cargo Warhead	Designed to replace warheads on existing 122mm rockets including the Russian BM-21. Fires 56 x ATAM bomblets.
Egypt	122mm SAKR-18 System	A maximum 20km range rocket with 72 x AP/AT bomblets.
Germany	KMW/GUF 110mm LARS [6]	A 36-tube truck-based system capable of firing a wide range of 110mm rockets including the DM-711 warhead with 5 x parachute-retarded 2.2kg AT2 anti-tank mines. Two further cargo warheads have been developed with 65 x M42 or M77 shaped-charge fragmentation submunitions.
Iran	122mm Fadjr 6 minelaying rocket	Designed for use with all standard 122mm rocket launcher systems the warhead carries eight parachute-retarded pressure AP/AT mines over a range of 3.5km to 6km.
Iraq	Abadeel 100 ARS [7]	400mm truck-mounted system with a maximum range of 100km with a cargo warhead that carries 300 x AP/AT bomblets or 25 AT mines. The latter have a magnetic influence fuzing system.
Israel	160mm LAR MRLS	Carries 13 LAR MkII rockets in each of two launch pods with a range of 12km to 35km each carrying 104 x CL-3022-S4 APAM submunitions. Each warhead has a footprint of 31,400 sq m. All 26 rockets can be fired within one minute and reloaded in less than 5 minutes.
Israel	MAR-350 medium artillery rocket system	A 350mm rocket system with a range of 30km to 100km carries 770 x CL-3022-S4 APAM submunitions.
Slovak Republic	RM-70 122mm Multiple Rocket Launcher/BM-21 Multiple Rocket Launcher/122mm ZV-3 man-portable rocket launcher	The two truck-mounted launcher systems are used to deploy the PTMi-D AT mine over ranges from 8km to 17km using the KRIZNA-R rocket rounds. Contains 4 x PTMi-D mines. The ZV-3 is mounted on a wheeled tripod and uses the KRIZNA-S rocket round over a range of 500m to 3000m. Both rocket types carry four mines and only differ in rocket motor and fuze type.

Country	Designation	Cluster warhead options
Russian Federation	FROG [8] 7b Cluster Warhead 9N18E	The FROG 7b rocket is 9.4m in length with a range from 15km to 70km. The warhead carries 42 x 9N22 AP bomblets each with 690 prefragmented splinters weighing between 1g and 4g. Each bomblet is impact-fuzed with a self-destruct backup function.
Russian Federation	Splav BM9A52 Smerch MRS	A 300mm 12-round launch system with a range from 20km to 70km. There are two cluster rockets available to the Smerch rocket: 9M55K: 72 x fin-stabilised AP/AV fragmentation submunitions 9M55K1: 5 x parachute-retarded top-attack AT 'smart' submunitions. A long-range version (70km to 90km) of the Smerch has been developed using a minelaying rocket with 25 x PTM-3M AT mines (Jane's notes that two MRS could lay a minefield 1km deep in one minute using this rocket). The long-range Smerch also has available a warhead with 646 x shaped-charge fragmentation APAM submunitions.
Russian Federation	Splav BM9P140 Uragan MRS	A 16-round system with a range from 10km to 35km with four cluster warheads available: 9N218K1 ICM with 30 x N9N210 APAM bomblets [9] 9N218K2 carrier warhead with 24 x PGMDM scatterable AT mines. 9N218K3 carrier warhead with 312 x PFM-1 'Butterfly' scatterable AP mines. 9M59 rocket with 9 x bottom-attack AT mines.
Spain	Santa Barbara 140mm Teruel MRLS	A 40-round truck-mounted system with a range from 6km to 28km. A 21kg cargo warhead is available in four versions: 42 x AP grenades either fragmentation or blast 28 x hollow charge anti-armour submunitions 6 x AT pressure mines with anti-disturbance device 14 x smoke grenades.
USA	Lockheed Martin Vought Systems 227mm MLRS Phase I	The MLRS first entered into service in the US in 1983 and is the most widely held multiple-rocket system. Based on the M270 and, from September 2001[10], the upgraded M270A1 12-round launchers and the M26 rocket[11] with the M77 DPICM[12] submunition. Each warhead carries 644 x M77 DIPCM which are shaped-charge blast fragmentation bomblets with an armour-piercing capacity up to 102mm. The rocket's maximum range is 31.6km. (See Operation 'Desert Storm' section for more information.) An extended range rocket, the XR-M77 has a maximum range of 45.5km carrying a reduced warhead load of 518 x M85 DPICM bomblets designed with a three to six minute self-destruct fuze to reduce dud rates.

Country	Designation	Cluster warhead options
UK and Germany	Phase II MLRS - AT2	The AT2 rocket and warhead has a maximum range of 40km. The warhead contains 7 x mine dispensers each with 4 x AT2 DM1399 parachute-stabilised AT mines. The DM1399 is a full-width bottom-attack mine with a self-destruct mechanism and an anti-handling device to disrupt mine-clearance operations. A full salvo of 12 rockets can lay a minefield 2km x 115 metres.
USA	Army Tactical Missile System (ATACMS)	The ATACMS uses the same launcher as MLRS and different models are categorised Block I, IA, II and IIA. The Block I missile delivers 950 x M74 APAM bomblets to a maximum range of 124km. The Block 1A missile uses the same submunitions but with a reduced load of 300 to achieve a maximum range exceeding 300km with increased accuracy due to GPS guidance[13]. The Block II delivers 13 x BAT smart submunitions to 140km[14]. The IIA version, due in service during 2004, will carry 6 x BAT over a range from 100km to 300km.
USA	Hydra 70 air-launched rocket system	A 70mm rocket system for use on a wide range of fixed-wing aircraft and helicopters. Of six operational rockets available, one, the M261 MPSM, has 9 x M73 AP/AT submunitions. This rocket was specifically designed for use from helicopters.
FR Yugoslavia Serbia and Montenegro[15]	LRSV M-87 'Orkan' MRLS	This truck-mounted 12-round 262mm system uses the M-87 rocket firing two types of cluster warhead over ranges from 24km to 50km. The 91kg cluster munition contains 288 x HEAT fragmentation ribbon-stabilised bomblets with a 10-metre lethal radius and an armour-piercing capability exceeding 60mm. The 83kg cluster munition carries 24 x KB-2 AT mines with an armour-piercing capability of 40mm.

Notes to Table A2

1 Most systems also have the options to fire a selection of non-cluster warheads which are not recorded for the purposes of this report. Warheads containing submunitions are known as cargo warheads.
2 MRLS: Multiple Rocket Launcher System.
3 ASTROS: Artillery Saturation Rocket System.
4 SPMRS: Self Propelled Multiple Rocket System.
5 The decoy minelets are inactive PPMi-S1s laid to confuze clearance operations.
6 LARS: Light Artillery Rocket System.
7 ARS: Artillery Rocket System.
8 FROG: Free Rocket Over Ground.
9 ICM: Improved Conventional Munition.
10 The M270A1 will begin service with the 2nd and 4th US Infantry Divisions and the 1st Cavalry Division in September 2001 subject to successful test and evaluation in May 2001.
11 The shelf life of the basic M26 rocket has been extended from 18 to 20 years. Source: http://mlrspmo.redstone.army.mil/newsletter/ (January 2000).
12 DPICM: Dual-purpose Improved Conventional Munition.
13 GPS: Global Positioning System.
14 BAT: Ballistic Aerial Target.
15 Also in service with Bosnian Serb Army and Croatian Army.

Sources: Jane's Information Group Publications; Mennonite Central Committee US; US Government declassified and unclassified documentation and reports; US 'Air Force News'; Defence Systems Daily; Konstructa Defence, a.s., Slovak Republic; Expomil.

Table A3: Examples of artillery guns and howitzers using cluster projectiles

Country	Designation	Details of submunitions available
China	Norinco D-30 Howitzer	Includes in its range of ammunition a cargo round containing six layers of HEAT Bomblets which can be fired over a range of up to 15km.
France	Giat 155mm Towed Gun TR	The TR can fire a wide range of French and NATO projectiles. The cluster munitions specifically allocated for firing by the TR are the Type H1 AT mine shell which contains 6 x AT mines and the OGRE 155 G1 Cargo projectile which contains 63 bomblets. The G1 can be fired to a maximum range of 28.5km.
Russian Federation	2S31 Vena SP Gun and Mortar System	This 120mm tracked self-propelled artillery system is in pre-production trials. It is expected to include a cargo round among the available projectiles that will carry 35 x high-explosive/armour-piercing submunitions capable of penetrating 100mm of steel. The projectile has a maximum range of 11km and an impact area of 10,000 sq m.
South Africa	LIW G6 155mm SP Gun-Howitzer	The G6 is a wheeled self-propelled gun-howitzer. A submunition round is standard ammunition for use with the G6 containing 42 x AP/AT bomblets.
USA	M110 series 203mm SP Howitzers	In service in at least 15 countries the M110 series is based on a tracked chassis and fires, among its available projectiles, the HE M509A1 Improved Conventional Munition carrying 180 x APAM grenade submunitions with a maximum range of nearly 23km.
USA	LP M109 series 155mm SP howitzer	The M109 tracked howitzer came into service in the early 1960s and more than 4,000 are in use by US forces, with thousands more in service with forces throughout the world. It has several cluster projectiles available for use: M449A1 which carries 60 x AP grenades M483A1 which carries 64 x M42 and 24 x M46 dual-purpose grenades M692 with 36 x AT mines M718/M741 with 9 x AT mines M731 with 36 x AP mines. All the above projectiles have a maximum range in the region of 14km. The M109A1 variant can fire all the above projectiles to an extended range exceeding 17km and in addition fires the following projectiles: M449A1 carrying 60 x AP mines to a range of 18.1km ADAM (Area Denial Artillery Munition) M692/M731 with 36 x self-destruct AP mines with a range of 17.7km AT RAAMS (Remote Anti-Armor Mine System) M718/M741 containing 9 x AT mines with a range of 17.7km.

Country	Designation	Details of submunitions available
USA	M108 105mm SP tracked Howitzer	The M108 is another standard piece of self-propelled artillery equipment with two available cluster projectiles: M444 carries 18 x M39 grenades to a maximum range of 11.5km M413 carries 18 x M35 grenades to a maximum range of 11.5km.
USA	105mm M101 Howitzer	The M101 is a towed howitzer developed from a pre-World War II artillery piece and is now in service with the forces of at least 59 countries. It has the capacity to fire the M444 (see entry above) over a range exceeding 11km.

Member Organisations

The UK Working Group on Landmines consists of the following co-operating organisations:

Action on Disability and Development
ActionAid
ACTSA Action for Southern Africa
Afghanaid
Amnesty International UK
Britain Vietnam Laos & Cambodia Association
Campaign Against Arms Trade
CAFOD
The Cambodia Trust
Child Advocacy International
Christian Aid
Comic Relief
Concern Worldwide
Disability Awareness in Action
Environmental Investigation Agency
Global Witness
Handicap International UK
Hope for Children
Human Rights Watch
International Alert
The Jaipur Limb Campaign
Jesuit Refugee Service UK
Mines Advisory Group
Medact
MERLIN (Medical Emergency Relief International)
The Medical Educational Trust
The Motivation Charitable Trust
Mozambique Angola Committee
Medical & Scientific Aid for Vietnam Laos & Cambodia
Medecins sans Frontieres (UK)
National Peace Council
Omega Foundation
One World Action
Oxfam GB
Pax Christi
Peace Pledge Union
People & Planet
POWER
Quaker Peace & Service
Refugee Council
Royal College of Paediatrics and Child Health
Saferworld
Save the Children Fund UK
Soroptimist International UK Programme Action Committee
Tearfund
United Nations Association of Great Britain and Northern Ireland
United Nations Children's Fund (UNICEF) UK Committee
VERTIC
Voluntary Service Overseas
War Child
War on Want
Welsh Centre for International Affairs
Women's International League for Peace and Freedom
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