HANDBOOK

A Practical Guide to Life-cycle Management of Ammunition

Jovana Carapic, Eric J. Deschambault, Paul Holtom, and Benjamin King

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About the Small Arms Survey

The Small Arms Survey is a global centre of excellence whose mandate is to generate impartial, evidence-based, and policy-relevant knowledge on all aspects of small arms and armed violence. It is the principal international source of expertise, information, and analysis on small arms and armed violence issues, and acts as a resource for governments, policy-makers, researchers, and civil society. It is located in Geneva, Switzerland, and is a project of the Graduate Institute of International and Development Studies.

Established in 1999, the Survey is supported by the Swiss Federal Department of Foreign Affairs and current or recent contributions from the Governments of Australia, Belgium, Canada, Denmark, Finland, France, Germany, Japan, the Netherlands, New Zealand, Nigeria, Norway, Sweden, the United Kingdom, and the United States, as well as from the European Union. The centre is grateful for past support received from the Government of Spain, as well as from foundations and many bodies within the UN system.

The Survey has an international staff with expertise in security studies, political science, law, economics, development studies, sociology, and criminology, and collaborates with a network of researchers, partner institutions, non-governmental organizations, and governments in more than 50 countries.

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Preface

The Survey has long understood that improving the safety and security of ammunition stockpiles is critical to reducing the risk of diversion and unplanned explosions at munitions sites (UEMS). Global efforts to improve ammunition management practices picked up the pace in 2011, when the United Nations General Assembly welcomed the International Ammunition Technical Guidelines (IATG) of the UN Office for Disarmament Affairs (UNODA). This Handbook—*A Practical Guide to Life-cycle Management of Ammunition*—is intended to support UNODA's SaferGuard Programme, which promotes and disseminates the IATG.

The Small Arms Survey could not have developed the Handbook without the assistance of Germany, Switzerland, and the United States. Each of these governments provided flexible financial support for the production of the Handbook and was generous in contributing to its elaboration. The Survey collaborated with a large number of ammunition and subject-matter experts to ensure the guidance would be as accurate, comprehensive, and user-friendly as possible.

The Handbook complements existing technical guidance from the IATG, but also references other technical guidelines (such as those developed by NATO and the Organization for Security and Co-operation in Europe). In so doing, it elaborates an accessible, comprehensive life-cycle management of ammunition (LCMA) model, one that considers both the technical *and the political* aspects of ammunition management. The Survey's schematic of the model benefited significantly from the expertise of the like-minded countries that make up the Multinational Small Arms and Ammunition Group, known as MSAG. The dozen-plus countries that participate in the MSAG process meet formally twice a year and provide a platform for civil society organizations, such as the Survey, to discuss initiatives to improve stockpile management. The Handbook authors unpacked, developed, and refined the various components of the LCMA model in three formal MSAG symposia under the leadership of Berlin, Stockholm, and Washington. They took advantage of offers to attend MSAG courses, during which they had the opportunity to increase their understanding of LCMA policy and practice in discussions with military personnel, as well as other international experts.

The LCMA Handbook benefited from numerous additional initiatives and projects. The Swiss government, for example, created space for the Survey to promote the Handbook on the margins of its Safe and Secure Management of Ammunition meeting in Geneva in November 2016. The feedback we received from the side event, together with knowledge gained from earlier meetings that Switzerland hosted on conventional ammunition, provided many examples of good practice that found their way into, and enriched, the contents of the Handbook. The authors' participation in the UN Institute for Disarmament Research's Weapon and Ammunition Management Expert Group Meeting series in 2017 and early 2018 also contributed to their knowledge.

The Handbook takes advantage of lessons learned during an ambitious ammunition management programme in Bosnia and Herzegovina, which the European Union Force (EUFOR) Althea is backing. EUFOR and Bosnian government and armed forces officials in Sarajevo have been extremely generous with their time and expertise in support of our work. Indeed, the Survey's case study on LCMA in Bosnia and Herzegovina is a useful companion to the Handbook. It provides an overview of the country's LCMA challenges and accomplishments, as well as the role the international community has played in moving things forward.[1]

Numerous other partners aided in the research effort, including the Austrian Armed Forces Logistics School, the German Bundeswehr Verification Center, the Spanish Verification Unit, the Swiss Verification Unit, and EUFOR Mobile Training Team 2.1.6.1, as well as a host of organizations implementing ammunition management and research projects. This list includes Conflict Armament Research, the Geneva International Centre for Humanitarian Demining (GICHD), the HALO Trust, ITF Enhancing Human Security, the Mines Advisory Group (MAG), the NATO Support Agency, the South Eastern and Eastern Europe Clearinghouse for the Control of Small Arms and Light Weapons (SEESAC), the UN Development Programme in Bosnia and Herzegovina, and the UN Mine Action Programme in Libya.

Moving forward, we will work with MSAG members such as Spain, as well as EUFOR and the British Peace Support Team (Africa), to translate the Handbook, in particular Annexe 1—which provides user-friendly summaries of each of the 40-plus IATG modules—into languages other than English. We appreciate UNODA's

1 See Carapic and Holtom (2018).

willingness to host Annexe 1 on its SaferGuard website and to translate it into other official UN languages. As a participating member of the Strategic Coordination Group, we will continue to support SaferGuard's implementation efforts and the Technical Review Board. We will work with our strategic partners to provide assistance to the group of governmental experts on problems arising from the accumulation of conventional ammunition stockpiles in surplus. And of course we will continue to update our UEMS database, which has recorded more than 500 explosions since 1979 in more than 100 countries, underscoring safety and security concerns.

In closing, I extend warm thanks to the many governments and institutions that assisted the Survey in producing the LCMA Handbook, and that have agreed to help ensure the study has a wide distribution in many languages. We look forward to working with our partners closely in the months and years to come to advance the utility and implementation of the IATG, as well as other initiatives promoting life cycle management of ammunition.

—**Eric G. Berman**
Director, Small Arms Survey
Geneva, April 2018

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This Handbook is the result of extensive collaboration with individual practitioners, implementers, and experts working in this field. Without their enthusiasm, constructive criticism, and reassurances, the Handbook would not have evolved as it has. It is impossible to mention all of the individuals with whom we engaged. Those who were particularly generous with their time and expertise include: Franz Otto Baer, Samir Becirovic, Kerstin Bekaan, Slobodan Boskovic, Nick Bray, Prasenjit Chaudhuri, Vincent Choffat, Steve Costner, Ole Feurer, Israel Gallego Gallego, Paul Grimsley, Andrea Gruber, Christopher Heron, Etienne Huber, Luis Manuel Jimenez, Werner Kernmaier, Wolfram Albrecht Knabe, Chris Loughran, Juergen Marschnig, Lance Malin, Blaz Mihelic, Sho Morimoto, Robin Mossinkoff, Mihaela Osorio, Joe Palmer, Caroline Payne, Daniel Prins, Katherine Prizeman, Ethan Rinks, William Luke Robertson, Ian Ruddock, Alexander Savelyev, Moritz Schmid-Drechsler, Himayu Shiotani, Sezin Sinanoglu, Michael Tirre, David Towndrow, Martin Trachsler, Tarik Ucanbarlic, Nico Van Waes, Laurentius Wedeniwski, and Elizabeth Wilson.

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Bundeswehr Verification Center for contributing Annexe 2 in his capacity as German representative to the Technical Review Board of the IATG.

Many colleagues at the Survey contributed research support, useful reflections, and inputs to the Handbook. André Gsell undertook a thoughtful review. Claire Mc Evoy was involved at various stages of the drafting process, providing direction and making numerous useful suggestions and edits. Glenn McDonald edited Section 6 and oversaw the early development of the Handbook. Natacha Cornaz fact-checked the text. Olivia Denonville, Tania Inowlocki, Rick Jones, and Stephanie Huitson were invaluable to the production process.

—**Jovana Carapic, Eric J. Deschambault,**
Paul Holtom, and Benjamin King
Geneva, April 2018

Table of contents

List of boxes, figures, and tables

Boxes

Figures

Tables

List of acronyms and abbreviations

AASTP	Allied Ammunition Storage and Transport Publication
ATT	Arms Trade Treaty
DAER	Daily ammunition expenditure rate
DGOS	Directorate General of Ordnance Services
DoD	Department of defence
EOD	Explosive ordnance disposal
EUC	End-use(r) certificate
GGE	Group of governmental experts
HCC	Hazard classification code
IATG	International Ammunition Technical Guidelines
IRT	Incident Reporting Template
LCMA	Life-cycle management of ammunition
MHE	Mechanical-handling equipment
MoD	Ministry of defence
MSAG	Multinational Small Arms and Ammunition Group
NATO	North Atlantic Treaty Organization
NGO	Non-governmental organization
OB	Open burning
OD	Open detonation
OFB	Ordnance Factory Board
PfP	Partnership for Peace
R3	Recovery, recycling, and reuse
RASR	Regional Approach to Stockpile Reduction
RRPL	Risk reduction process levels
SCG	Strategic Coordination Group

SOP	Standard/standing operating procedure
SSOW	Safe systems of work
TRB	Technical Review Board
TRP	Technical Review Panel
UEMS	Unplanned explosions at munitions sites
UN	United Nations
UNGA	United Nations General Assembly
UNODA	United Nations Office for Disarmament Affairs
WAM	Weapons and ammunition management

Glossary

Unless noted otherwise, the following definitions describe terms as they relate to the life-cycle management of ammunition, in line with their use in this Handbook.

Ambient risk: Exposure to the chance of harm or damage caused by the surrounding environment (Haskins, 2006, sec. 5.6).

Ammunition: Based on the IATG definition, a complete device—such as a missile, shell, mine, or demolition store—that is charged with explosives; propellants; pyrotechnics; initiating composition; or nuclear, biological, or chemical material for use in connection with offence, or defence, or training, or non-operational purposes, including parts of weapons systems that contain explosives (UNODA, 2015, mod. 01.40, para. 3.8). This Handbook focuses on conventional ammunition (see Note on p. 26).

Demilitarization: The complete range of processes that render ammunition unfit for its original purpose, including related transport, storage, accounting, and pre-processing operations (UNODA, 2015, mod. 01.40, para. 3.69).

Destruction: The process of final conversion of ammunition into an inert state so that it can no longer function as designed (UNODA, 2015, mod. 01.40, para. 3.71).

Disposal: The removal of ammunition and explosives from a stockpile utilizing a variety of methods (that may not necessarily involve destruction) (UNODA, 2015, mod. 01.40, para. 3.84).

Diversion: The unauthorized transfer of arms and ammunition from a national security force or civilian stockpile to unauthorized end users. Diversion can also include the unauthorized use of arms and ammunition by authorized end users (Schroeder, Close, and Stevenson, 2008, p. 114).

Explosion safety case: A risk assessment to be compiled by an ammunition safety specialist when full compliance with quantity distances is not possible (UNODA, 2015, mod. 02.10, para. 13.4).

Explosives licence: The permitted amount of explosives at a potential explosion site (UNODA, 2015, mod. 01.40, para. 3.112).

Hazard: A potential source of harm (UNODA, 2015, mod. 01.40, para. 3.127).

Inventory management: The systems and processes that identify ammunition stockpile requirements, evaluate the condition of a stockpile, provide replenishment techniques, and report the actual and projected status of holdings (UNODA, 2015, mod. 01.40, para. 3.151).

Life-cycle management of ammunition (LCMA): A comprehensive set of integrated processes and activities that ensure sustainable and cost-effective management of ammunition, delivering a safe and secure stockpile that meets national strategic and operational needs.

Lot: A pre-determined quantity of ammunition that is as homogeneous as possible and may be expected to give uniform performance (UNODA, 2015, mod. 01.40, para. 3.160).

Lot number: A unique identifier allocated to a lot (UNODA, 2015, mod. 01.40, para. 3.161).

Milestone: A point at which a critical decision is made regarding ammunition management.

National ownership: The active exercise of a state's authority over the design, implementation, and monitoring of all LCMA-related processes and activities, based on clearly defined roles for political, military, logistics, procurement, and other relevant actors.

National stockpile: The full range of ammunition stockpiles under the control of separate state-run organizations such as the police, military forces (both active and reserve), border guards, and manufacturers, including all ammunition types, irrespective of classification (operational, training, or disposal-designated) (UNODA, 2015, mod. 01.40, para. 3.180).

Open storage: The use of a location that lacks an enclosed structure that is used to protect ammunition items from exposure to their surroundings and weather conditions (UNODA, 2015, mod. 04.10).

Physical capacity: The infrastructure and equipment used to implement and operate an ammunition management system.

Proof: The functional testing or firing of ammunition to ensure safety and stability in storage and intended use (UNODA, 2015, mod. 01.40, para. 3.204).

Propellant: A substance or mixture of substances used to propel projectiles and missiles, reduce the drag of projectiles, or generate gases for powering auxiliary devices. When ignited, propellants burn or deflagrate to produce quantities of gas capable of performing the intended task (NATO, 2009b, p. A-80).

Propellant surveillance: The periodical testing of propellants to monitor deterioration (UNODA, 2015, mod. 01.40, para. 3.208).

Quantity distance: The minimum amount of space required between a potential explosion site and an exposed site (UNODA, 2015, mod. 01.40, para. 3.222). See also 'Separation distance' below.

Recovery, recycling, and reuse (R3): Techniques used to break ammunition down into its basic component parts and compounds, which can then be sold to help offset demilitarization processing costs.

Risk: A combination of the probability of occurrence of harm and the severity of that harm (UNODA, 2015, mod. 01.40, para. 3.229).

Risk analysis: The systematic use of available information to identify and minimize the likelihood and degree of harm (UNODA, 2015, mod. 01.40, para. 3.230).

Risk management: The complete, risk-based decision-making process (UNODA, 2015, mod. 01.40, para. 3.233).

Safeguarding: The process of managing, protecting, and restricting the use of land within a quantity distance but beyond an ammunition site (UNODA, 2015, mod. 02.40, para. 3).

Safety and suitability for service (S3): A process designed to assess whether ammunition is acceptably free from hazards and meets specified requirements, not including operational effectiveness (NATO, 2009b, p. A-89).

Separation distance: The minimum permissible separation between a potential explosion site and an exposed site (UNODA, 2015, mod. 02.20, para. 13.2).

Standard/standing operating procedure (SOP): Instructions that define the preferred or currently established method of conducting an operational task or activity, with the aim of improving operational effectiveness and safety.

Standing order: A promulgated directive that remains in force until amended or cancelled.

Stockpile management: Procedures and activities involving safe and secure accounting, storage, transportation, handling, and disposal of conventional ammunition (UNODA, 2015, mod. 01.40, para. 3.275).

Stockpile safety: The result of measures taken to ensure minimal risk of accidents and hazards deriving from explosive ordnance to personnel working with arms and munitions as well as adjacent populations (UNODA, 2015, mod. 01.40, para. 3.276).

Stockpile security: The result of measures taken to prevent the theft of explosive ordnance, entry by unauthorized persons into explosives storage areas, and acts of malfeasance, such as sabotage (UNODA, 2015, mod. 01.40, para. 3.277).

Surveillance: A systematic method of evaluating the properties, characteristics, and performance capabilities of ammunition throughout its life cycle to assess the reliability, safety, and operational effectiveness of stocks and to provide data in support of life reassessment (UNODA, 2015, mod. 01.40, para. 3.285).

System-based approach: A paradigm or perspective involving a focus on the whole picture and not just a single element, awareness of the wider context, an appreciation for interactions among different elements, and trans-disciplinary thinking (Leischow and Milstein, 2006, p. 403).

Unplanned explosions at munitions sites (UEMS): Accidents that result in an explosion of abandoned, damaged, improperly stored, or properly stored stockpiles of munitions at a munitions site (Berman and Reina, 2014, p. 3).

SECTION 1

Introduction

1.1 Context

Ammunition is an expensive commodity and an essential resource for the implementation of a national defence and security policy. National ammunition stockpiles can also pose risks to national security and public safety. Poor accounting and inadequate physical security of storage facilities can facilitate the diversion of ammunition from the national stockpile to terrorists, criminals, and other armed groups, increasing insecurity and instability. Furthermore, the deterioration of munition components can contribute to unplanned explosions at munitions sites (UEMS), which can have significant negative socio-economic and political consequences for the public and national governments (Berman and Reina, 2014).

To mitigate these risks, ammunition management requires complex systems, which, in turn, present planning challenges and have significant budgetary implications for governments. A system-based approach to the life-cycle management of ammunition (LCMA)—and a long-term strategy to execute it—can help a state to address these challenges and, in particular, to mitigate diversion and UEMS risks. LCMA comprises:

> *a comprehensive set of integrated processes and activities that ensure sustainable and cost-effective management of ammunition, delivering a safe and secure stockpile that meets national strategic and operational needs* (see Box 1.1).

States that have developed and maintain LCMA systems typically exhibit a high degree of national ownership. National ownership entails an enabling environment with the necessary conditions for strategic planning—that is, adequate normative and organizational frameworks, infrastructure and equipment, and human

Box 1.1

LCMA: unpacking the Small Arms Survey definition

LCMA requires an enabling environment with a suitable normative and organizational framework, adequate infrastructure and equipment, and sufficient financial and human resources. States can attain an enabling environment incrementally, as they build up their capacity (see Section 3).

Once operationalized, the processes and activities that comprise LCMA are:

- comprehensive (by covering all aspects of ammunition management);
- part of an integrated system (within which all of the elements work together);
- sustainable (so that the system can be maintained); and
- cost-effective (yielding positive results in relation to its cost).

resources—as well as the predictable implementation of the programmes that flow from such planning. Many of the ammunition management practices of these states have informed the guidance provided by the International Ammunition Technical Guidelines (IATG), which assist states and other users in enhancing the safety and security of their ammunition (see Annexe 1; Section 3.3.1).

The international community welcomed the IATG in 2011, in an effort to improve ammunition stockpile management practices around the world (see Box 1.2). The IATG—which focus on the technical aspects of ammunition management—are an important part of the LCMA approach. This Handbook recognizes the importance of these technical guidelines for LCMA but also emphasizes that political and policy issues need to be addressed for the development and implementation of an LCMA approach. By examining both the technical characteristics and political implications of ammunition management, the Handbook aims to:

- situate the IATG clearly within the LCMA approach; and
- describe how a comprehensive LCMA system can be achieved.

Note This Handbook draws on the second edition of the IATG, which was released in 2015 by the United Nations Office for Disarmament Affairs (UNODA). Module and paragraph numbers are cited whenever relevant, as in: UNODA (2015, mod. 02.10, para. 6.1).

A growing number of states—particularly developing and conflict-affected states—are expressing an interest in establishing and implementing an LCMA system to mitigate the risks of UEMS and diversion. Many do not enjoy the high level of national ownership that can be found in states that already maintain LCMA systems. In this Handbook, the Small Arms Survey thus presents an LCMA model that can serve as the basis for the broader application of a system-based approach. Based on extensive research, interactions with ammunition experts and other specialists, and international guidance on ammunition management, the model provides a simplified yet comprehensive, integrated, sustainable, and cost-effective framework for ammunition management (see Box 1.1). An LCMA system comprises the following interconnected elements:

- a **structural element** (national ownership and its associated enabling conditions); and
- four **functional elements**—planning, procurement, stockpile management, and disposal.

Note While the authors defer to the IATG definition of ammunition, the focus of this Handbook is on the management of conventional ammunition.

The Handbook is focused on the management of complete ammunition, including its energetic component parts, such as a fuse, warhead, rocket motor, primer, propellants, and pyrotechnic and explosives materials, as well as similar items that present risks to life and property. The term 'ammunition' thus covers both the complete item and its explosives components; both are part of the stockpile and should be managed in the same manner.[2]

1.2 What is the purpose of the Handbook?

This Handbook provides a succinct and accessible introduction to the Small Arms Survey's LCMA model and describes the role of national ownership in creating an enabling environment in which states can establish and maintain an LCMA system. It unpacks the model's four functional elements with reference to relevant IATG modules and presents examples drawn from states' experience and practice to highlight the benefits of an LCMA system-based approach. In particular, the Handbook answers the following key questions:

- What are the necessary enabling conditions to establish and maintain an LCMA system?
- What are the key processes and activities in each of the four functional elements of an LCMA system?
- How do the functional elements of an LCMA system interact with each other?
- What is the relationship between the LCMA system-based approach and other technical guidance and standards, such as the IATG?

1.3 Who can benefit from the Handbook?

This Handbook is intended for use by:

- **senior government officials,** especially in ministries of defence (MoD), ministries of interior, and other security providers who are concerned with normative

2 In line with the IATG, this Handbook occasionally refers to 'explosives' and 'ammunition and explosives' (UNODA, 2015). See, in particular, Annexe 1.

development and strategic planning of ammunition management in states that are interested in establishing an LCMA system;

- **government officials responsible for overseeing assistance programmes to address the proliferation of ammunition**, in particular donors providing support for stockpile management projects and the development of LCMA systems in partner states;
- **individuals in international and regional organizations, as well as non-governmental organizations,** who are involved in assistance programmes to address the proliferation of ammunition and stockpile management activities in particular; and
- **practitioners working at the operational and technical levels of MoDs and armed forces**—including ammunition personnel—who will benefit from a concise and thorough overview of the different dimensions of LCMA. This Handbook will allow operational and technical ammunition personnel to place their specific expertise within the broader context of an LCMA system approach.

1.4 Contents of the Handbook

The Survey's LCMA model emphasizes the comprehensive and integrated nature of the key elements in an LCMA system. Readers who wish to gain a complete understanding of the LCMA approach are thus advised to read the Handbook in its entirety.

Sections 2 and 3 provide an overview of the Small Arms Survey's LCMA model and the structural element (national ownership):

- **Section 2 ('A comprehensive approach to ammunition management')** provides the rationale for and an overview of the Survey's LCMA model.
- **Section 3 ('National ownership')** discusses the structural element—national ownership—and associated enabling conditions in an LCMA system: normative and organizational frameworks, infrastructure and equipment, and human resources.

The following four sections unpack the model's functional elements:

- **Section 4 ('Planning')** explores the planning element, outlining the role of strategic planning and illustrating how strategic plans are implemented via LCMA processes and activities.

- **Section 5 ('Procurement')** discusses the procurement element, focusing on ammunition acquired for demonstration and evaluation purposes, the acquisition process (covering domestic production and imports), and entry into service.
- **Section 6 ('Stockpile management')** examines the basis for the stockpile management element of the model, as well as the core groups of activities and associated processes. It also addresses the importance of stockpile management processes that are key to ensuring the availability of operational ammunition, as well as its safety and security.
- **Section 7 ('Disposal')** reviews the disposal of stockpile ammunition, the various options available, the management of disposal-designated ammunition, and risk management related to demilitarization processes and facilities.

The final section focuses on the integration of the LCMA elements described in Sections 3–7:

- **Section 8 ('LCMA at a glance')** provides a summary reference table that lists the major activities for each of the LCMA model's elements and their interactions with other LCMA elements.

The Handbook features three annexes aimed at supporting the development and implementation of an LCMA system.

- **Annexe 1 ('The IATG and SaferGuard')** presents brief summaries of the 12 thematic IATG volumes and their 45 modules, as developed under the UN SaferGuard Programme.[3] The summaries describe each module's importance and benefits to a state in a way that is accessible and useful to both **technical and non-technical readers.**[4]
- **Annexe 2 ('LCMA in the context of the IATG')**, prepared by a contributor from Germany's Bundeswehr Verification Center, considers the relevance of the IATG to the LCMA elements detailed in the Handbook. This annexe provides a tool that can assist states in the application of the IATG in conjunction with Annexe 1.
- **Annexe 3 ('Information for exporting states: end-user certificates of importing states')** presents elements to be included in documentation for states that are

3 Managed by UNODA, SaferGuard is the knowledge management platform that oversees the maintenance and dissemination of the IATG.

4 Annexe D of UNODA (2015, mod. 01.10) also provides a breakdown of the 12 thematic volumes into modules and contents. By using Annexe D in conjunction with Annexe 1 of this Handbook, readers will have a good idea of where to find relevant guidance within the IATG.

Box 1.2

Introduction to the IATG

The 12 thematic IATG volumes and 45 modules provide practical guidance and requirements for stockpile-management-related activities and processes (see Annexe 1). Although the IATG are primarily focused on stockpile management, they also include guidance that is relevant to and spans across the other functional elements of LCMA (see Annexe 2). The 12 thematic volumes are:

- 01 Introduction and principles of ammunition management
- 02 Risk management
- 03 Ammunition accounting
- 04 Explosive facilities (storage) (field and temporary conditions)
- 05 Explosives facilities (storage) (infrastructure and equipment)
- 06 Explosive facilities (storage) (operations)
- 07 Ammunition processing
- 08 Transport of ammunition
- 09 Security of ammunition
- 10 Ammunition demilitarization and destruction
- 11 Ammunition accidents, reporting and investigation
- 12 Ammunition operational support

The IATG offer a framework for developing national policy documents, regulations, standards, operating procedures, capacities, and capabilities to ensure the adequacy, safety, and security of a country's strategic and operational ammunition stockpile. Ammunition risk management is integral to the application of the IATG. The guidelines identify three risk reduction process levels, which stakeholders can use to assess their risk management situation—taking into account available material, financial, and technical resources—and to reduce their level of ammunition-related risk (see Section 6.10.1).

In 2011, the United Nations General Assembly passed Resolution 66/42, which encourages states to develop their own standards and standard operating procedures for ammunition management. The resolution explicitly cites the IATG and its overarching SaferGuard Programme (UNGA, 2011, para. 7). To date, the IATG have been used in at least 86 states (UN SaferGuard, 2016).

Author: Paul Holtom

seeking to import ammunition. It emphasizes that importing states should provide information on intended end users and uses of the imported ammunition. Once the documentation is signed and authorized by a senior government official, it is submitted to the competent authorities in the state that will authorize or deny the export of the ammunition. This document is one source of information for the exporting state's risk assessment process.

SECTION 2

A comprehensive approach to ammunition management

2.1 Introduction

Ensuring safe and secure ammunition stockpiles is a complex and costly undertaking. It requires a comprehensive approach that takes into account the technical aspects of ammunition management that are often covered by stockpile management efforts, as well as related structural and political dynamics. Such an approach is accounted for by the Small Arms Survey's LCMA model, which consists of processes and activities that maintain the safety and security of ammunition stockpiles. When embedded in an enabling environment, these processes and activities form an integrated whole to ensure the sustainable and cost-effective management of ammunition in support of a state's strategic and operational needs.

This section explains the rationale for the LCMA approach and provides a brief overview of the Survey's LCMA model. Section 3 unpacks the role of national ownership in fostering an enabling environment for a LCMA system. Sections 4–7 elaborate on each of the model's four functional elements—planning, procurement, stockpile management, and disposal.

2.2 Defining the problem: inadequate ammunition management

Despite growing awareness of UEMS, diversion, and the risk of surplus accumulation, in many states ineffective management of ammunition stockpiles continues to be the norm. Most states have a wide range of ammunition types in their stockpiles, including for artillery, small arms and light weapons, cannon, and man-portable air defence systems, in addition to mines, pyrotechnics, and explosives (Bevan and Wilkinson, 2008, pp. 22–30). Ammunition systems tend to pose specific safety and security risks along all points of the national stockpile chain, as described in Figure 2.1.

Note 'Risk' refers to a combination of the probability of the occurrence of harm and the severity of that harm due to UEMS and diversion (UNODA, 2015, mod. 01.40, para. 3.229).

The Small Arms Survey's UEMS Database shows that more than 500 UEMS occurred in more than 100 countries between 1979 and February 2018, often with grave social, economic, and political consequences (Small Arms Survey, n.d.). In addition to fuelling crime and terrorism, ammunition that is diverted from state stockpiles can affect the duration and intensity of armed conflicts (CAR, 2017). The

An aerial view shows the territory of a military base following unplanned explosions at munitions sites in the Vynnytsya region. Ukraine, September 2017. Source: Maxym Marusenko/NurPhoto/AFP Photos

risk-reduction aims of stockpile management are thus twofold: minimizing the costs and consequences of UEMS, while also reducing the likelihood of ammunition diversion to unauthorized end users (see Section 6.4.1).

Another consequence of ineffective stockpile management is surplus accumulation. Regardless of whether states have the ability to identify surpluses, there is a tendency to retain ammunition stockpiles in excess of strategic and operational requirements, not least because states continue to view conventional ammunition stockpiles as assets rather than liabilities (see Section 6.4.1). Ineffective approaches to acquiring, maintaining, and disposing of ammunition lead to the accumulation of unsafe, unserviceable, and obsolete surpluses in the national stockpile. The result is a build-up of ammunition, and with it an increase in safety and security risks (Bevan, 2008b, pp. 2–3; UNGA, 2008a, paras. 14–15). Surplus accumulation also leads to a considerable financial burden for states, in terms of operational, maintenance, and destruction costs (Carapic, Wilkinson, and Ruddock, 2017).

Beyond ineffective technical management of stockpiles, states may also have inadequate policies and procedures in place to govern ammunition management more broadly (UNODA, 2015, mod. 01.40, p. iii). Safety and security incidents are

Box 2.1

Mortar accident in Mali: the consequences of improper ammunition management

On 6 July 2016, a 60 mm mortar bomb exploded in its mortar tube during an exercise conducted outside the Dutch UN Mission camp near Kidal, north-eastern Mali. Two Dutch soldiers lost their lives and another was seriously wounded.

An investigation by the Dutch Safety Board concluded that military personnel had been working with ammunition that suffered from weak technical design elements, which had not been properly tested for quality or safety. The closure plate on the mortar fuse that exploded was defective and failed to prevent an explosion while in safe mode. The reliability of the ammunition had been further impaired as a result of storage and usage in unfavourable conditions: the materiel had been exposed to both high temperatures and moisture. As a result, excessive sensitive explosive substances had formed in the mortar fuse; when combined with the shock from the launch of the mortar bomb, these substances produced the explosion.

The investigation also found that there was a lack of thorough ammunition testing and supervision by the Dutch ministry of defence. The mortar bombs had been procured in 2006 for a mission in Afghanistan (which lasted from 2006 to 2010), with the assistance of the US Department of Defense. Political and time pressure had led to the neglect of procedures and inspections related to quality and safety during the procurement process. Officials in the Dutch MoD decided to omit these tests on the assumption that the US Army was itself using the ammunition and that adequate safety tests had already been conducted. However, the purchasing contract explicitly stated that the US Army had not used the ammunition concerned and that the US government could not guarantee the ammunition's safety or quality. Furthermore, although there was sufficient time to conduct quality and safety checks on remaining ammunition once the Afghanistan mission had concluded in 2010, no such checks were performed before the ammunition was deployed for use in Mali in 2014. In light of the investigation, the Dutch minister of defence and chief of defence resigned from their positions.

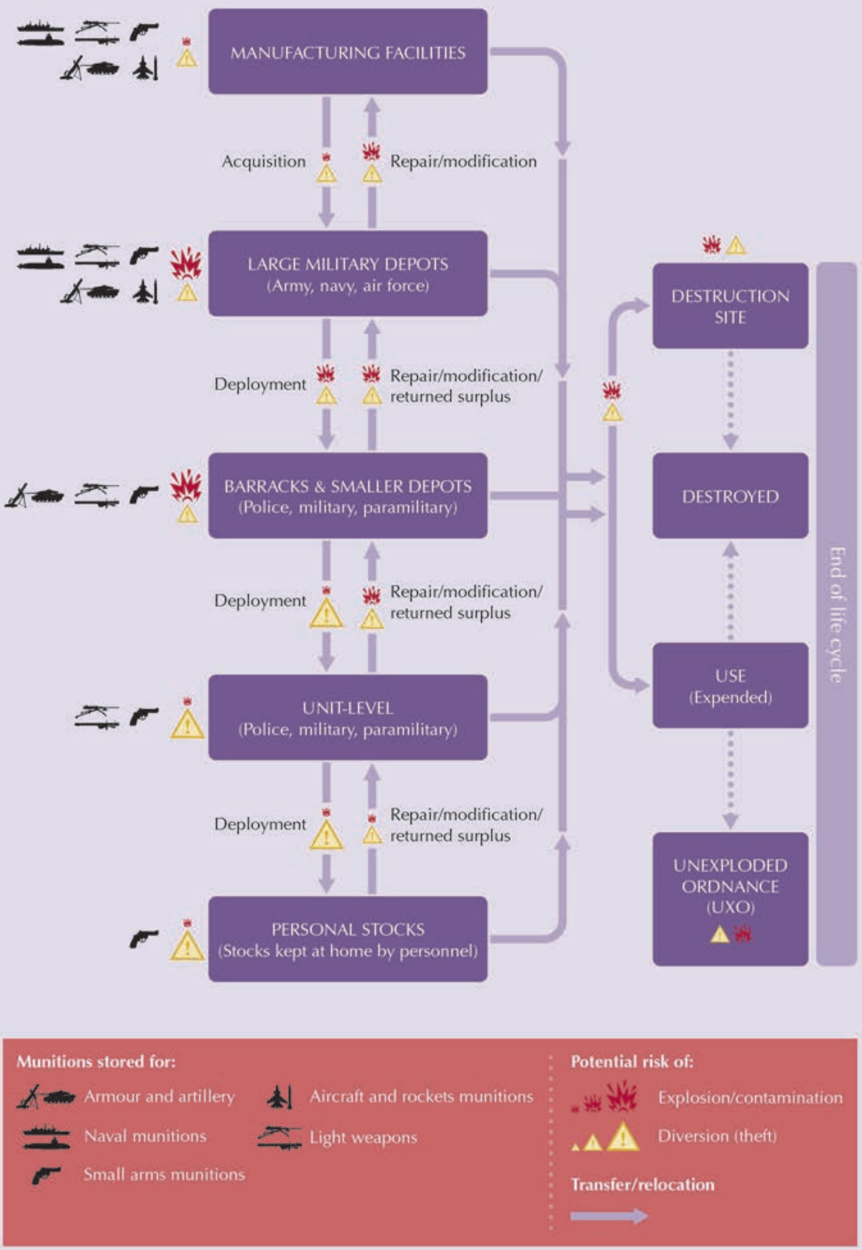
Sources: Dutch Safety Board (2017); Reuters (2017)

often the result of systemic failures in the management of the national stockpile. A recent accident that killed two Dutch soldiers during a mortar shell exercise in Mali is a telling example. It illustrates that technical challenges posed by inadequate management of ammunition stockpiles cannot be seen in isolation; structural deficiencies and politics can also affect ammunition management (see Box 2.1). In addition, it shows that senior officials can be held accountable for inadequate ammunition management.

2.3 A technical approach to managing risk

UEMS, diversion, and surplus accumulation occur primarily as a result of technical shortcomings. Historically, the attention of national authorities, international donors, and practitioners has thus been predominantly on technical approaches

Figure 2.1 The national stockpile: risks and hazards in the conventional ammunition life cycle



Source: Bevan (2008b, p. 8)

to managing related risks, with a particular focus on improving stockpile management practices as a means of managing the risk of UEMS and diversion.

The IATG defines risk management as a 'complete risk-based decision-making system' (UNODA, 2015, mod. 01.40, para. 3.233). It serves as 'a fundamental preventative measure to support safe conventional ammunition stockpile management' and as a means of minimizing the probability of UEMS and diversion (UNODA, 2015, mod. 02.10, p. v; see Section 4.3.2). The IATG advise national authorities to perform stockpile management at three progressive risk reduction process levels (RRPLs)—1 (basic), 2 (intermediate), and 3 (advanced)—depending on the infrastructure, equipment, and financial and technical resources at their disposal (see Section 6.10.1). They provide a technical frame of reference and step-by-step guidance—in addition to relevant tools—for stakeholders developing a risk management programme (UNODA, 2015, mod. 02.10, paras. 1, 6–6.2, 7–12; see Section 6.10).

Although the IATG risk management approach fulfils many of the requirements of a comprehensive risk management system, the guidelines focus primarily

Discarded and looted crates of ammunition in the Libyan desert. February 2014.
Source: UNMAS Libya, Arms and Ammunition Advisory Section

on stockpile management (UNODA, 2015, mod. 02.10, para. 6; see Section 6.10). While the guidelines offer practical steps for reducing risk through improvements in stockpile management, for example, they do not discuss how to identify risk stemming from the surrounding environment and what to do once a risk has been identified. Moreover, applying or implementing the IATG has proven especially difficult in conflict-affected settings or in contexts where the available funding, technical personnel, equipment, or physical infrastructure is not sufficient to undertake risk management. More guidance is needed to help states to address the implementation gap between what may be the 'reality on the ground' and the basic IATG level of conduct that is outlined in RRPL 1.

Technical approaches to risk reduction elaborated within the IATG can be cost-effective and help to mitigate the risk of UEMS and diversion by improving stockpile management practices. As outlined in Box 2.1, however, they may fail to take into account the broader environment—that is, the political or strategic decision-making context—within which ammunition management occurs. Despite their merits, therefore, such approaches do not constitute a comprehensive ammunition management system.

In contrast, LCMA takes a 'big picture' perspective. It takes a comprehensive approach and considers both technical and political aspects of ammunition management in order to meet a state's strategic needs and operational requirements. In accordance with a holistic risk management framework, LCMA considers how risks are distributed, transferred, and managed, allowing for an understanding and avoidance of such risks. Furthermore, LCMA involves taking an active and structured approach to anticipating negative outcomes of UEMS and diversion, and to responding to them if they occur. In so doing, it takes into account the ambient risk, defined as 'the risk caused by and created by the surrounding environment (ambience)' (Haskins, 2006, sec. 5.6).

Ultimately, the objective of risk management, as it relates to an LCMA system, is to allow national authorities to:

- **balance the allocation of resources** so that the minimum amount achieves the greatest risk-mitigation benefits; and
- **observe the external environment** so that they may act or react in ways that minimize the impact of ambient risk and nurture an enabling environment for ammunition management (see Section 3).

Note The IATG focus on stockpile management, which constitutes only one part of LCMA. This Handbook complements the IATG by elaborating on the processes and activities for ammunition management across the entire life cycle. The matrix in Annexe 2 provides an overview of how the 12 thematic volumes of the IATG correspond and overlap with the holistic LCMA approach proposed in this Handbook.

2.4 LCMA: a comprehensive means of ammunition management

LCMA comprises:

> *a comprehensive set of integrated processes and activities that ensure sustainable and cost-effective management of ammunition, delivering a safe and secure stockpile that meets national strategic and operational needs.*

The LCMA approach recognizes the importance of adequate technical capabilities but also emphasizes the political dimension of managing ammunition across its life cycle. LCMA is thus akin to the concept of 'through-life capability management' used by the United Kingdom's MoD. In this approach, 'every aspect of new and existing military capability is planned and managed coherently across all defence lines of development'—including training, equipment, personnel, infrastructure, concepts and doctrine, organization, information, and logistics (Tetlay, 2010, p. 4; Yue and Henshaw, 2009, p. 4).

LCMA demands that state actors at the strategic, operational, and tactical levels work together on multiple ammunition-related aspects to ensure cost-effective management of the national stockpile. Such a high degree of coordination calls for a major effort by relevant institutions and personnel, as well as an understanding that no single element-specific programme—such as procurement, stockpile management, or disposal—is able to address the wide range of capabilities needed

Note The political dimensions of LCMA are the processes necessary for the overall management of national ammunition stockpiles. These processes are the purview of state actors operating at the strategic level—both civilian and military. The political dimensions of LCMA fall into two categories: life-cycle processes and enabling processes. Life-cycle processes include the management of decisions, risk, and opportunities, as well as coordination and information (Haskins, 2006, sec. 5.1). Enabling processes are used to direct, control, and support LCMA and include the management of resources, the environment, and quality control (sec. 6.1).

to sustain a comprehensive ammunition management system (Costner, 2015). One of the main attributes of the approach is that it unifies all stakeholders in meeting strategic and operational needs, and in operating within the legal and technical frameworks that are required for ammunition management.

2.5 Origins of the LCMA concept

The view of LCMA presented in this Handbook is based on current practice among a number of states that participate in NATO's Partnership for Peace (PfP)[5] and other NATO partners[6] that are implementing comprehensive ammunition management systems (ISO/IEC, 2016; NATO, 2007). These states have well-developed militaries and a long history of ammunition management.

While national approaches may differ, one feature is central to all of them: the effectiveness of LCMA systems in these states is ensured by a high degree of national ownership (see Section 3.2). This feature guarantees an enabling environment, a prerequisite for sustainable ammunition management. The enabling environment also allows for the translation of long-term policies and plans into short-term, integrated, and coordinated programmes aimed at effectively managing the national stockpile and mitigating the risks posed by the ammunition.

NATO and its partner states have conducted a large amount of empirical research on the risks and consequences of inadequate ammunition management. This research has not only ensured international cooperation in ammunition management, but also shaped the way LCMA is understood globally. Indeed, the knowledge and research developed within these countries has been reflected in a number of international standards, guidelines, and best practices for ammunition management, such as:

- the IATG (UNODA, 2015);

5 The PfP is 'a programme of practical bilateral cooperation between individual Euro-Atlantic partner countries and NATO'. It allows partners to build up individual relationships with NATO while choosing their own priorities for cooperation. See NATO (2017b).

6 NATO works to promote security and project stability with more than 40 non-member countries, which stretch from Central and Eastern Europe to as far afield as the Asia–Pacific region. Many partners contribute actively to NATO-led operations and missions. Some aspire to join the Alliance. NATO also works with other international organizations, such as the European Union and the UN (NATO, 2015b).

- numerous NATO ammunition-related documents, including Allied Ammunition Storage and Transport Publications (AASTPs);[7] and
- the Organization for Security and Co-operation in Europe's *Handbook of Best Practices on Conventional Ammunition* (OSCE, 2008).

Similarly, these experiences of improving ammunition management—both domestically and internationally—have been shared through the activities of the Multinational Small Arms and Ammunition Group (MSAG),[8] whose members all belong to NATO or the PfP. For instance, since 2010, Austria, Sweden, and Switzerland have been providing ammunition-management-related capacity building and training to the armed forces of Bosnia and Herzegovina (Carapic, Chaudhuri, and Gobinet, 2016; Carapic and Holtom, 2018). This Handbook builds on such practical experiences to develop and elaborate the LCMA model.

2.6 Introduction to the Small Arms Survey's LCMA model

The LCMA model described in this Handbook was developed following an analysis of LCMA systems observed among NATO member states (including PfP states and MSAG participating states) and NATO partners, with reference to relevant international guidance on ammunition management, and in collaboration with ammunition specialists.

The model comprises:

- a structural element—national ownership and its associated enabling conditions (see Section 3); and

7 NATO has produced a number of AASTP guidelines, some of which are available at NATO (n.d.): *NATO Guidelines for the Storage of Military Ammunition and Explosives* (AASTP-1) (NATO, 2015c); *Explosives Safety Risk Analysis* (AASTP-4, Part 2 not available publicly) (NATO, 2016b); and *NATO Guidelines for the Storage, Maintenance and Transport of Ammunition on Deployed Missions or Operations* (AASTP-5) (NATO, 2016a). The *Manual of NATO Safety Principles for the Hazard* (AASTP-3) is currently unavailable. The previously available *Manual of NATO Safety Principles for the Transport of Military Ammunition and Explosives* (AASTP-2) has been replaced with the Allied Multi-Modal Transportation of Dangerous Goods Directive, an Allied Movement Publication (AMovP-6) that is not available publicly.

8 The aim of the MSAG is to enhance the capacity to undertake physical security and stockpile management, exchange best practices concerning small arms and light weapons, and orchestrate destruction and disposal in order to reduce accidents and the number of weapons in circulation. The MSAG describes itself as 'an apolitical, informal, multinational assembly of like-minded states'. See MSAG (2012).

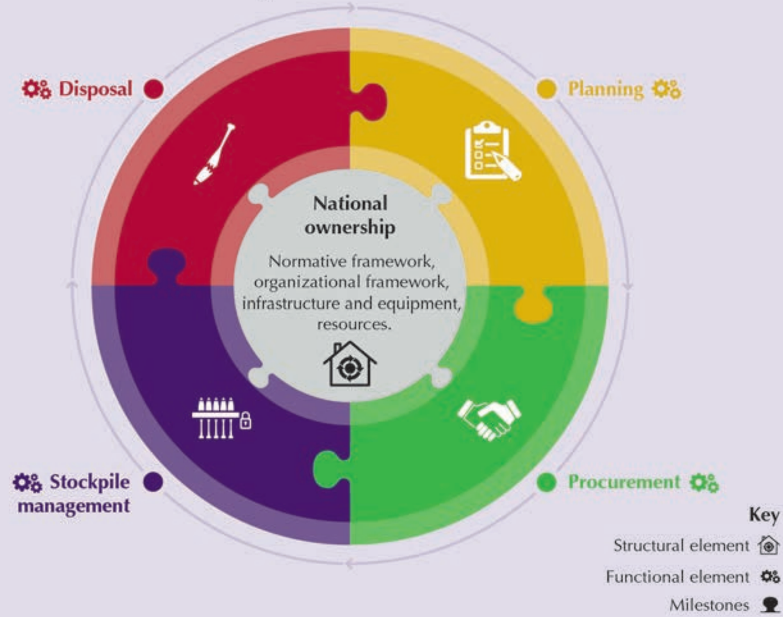
- four functional elements—planning, procurement, stockpile management, and disposal (see Sections 4–7).

To be effective, all elements of the LCMA system must function as a coherent, coordinated, and complementary whole (see Section 8).

Representations of LCMA models tend to be linear depictions that mask the degree of interaction and sequencing among the functional elements of the system. Such depictions also tend to omit the key role of national ownership, which complements and supports the functional elements and is critical to the overall integrity of an LCMA system. In contrast, Figure 2.2 highlights the interrelationships among the elements. It also stresses the importance of the two crucial aspects of ammunition management:

- the technical—the functional elements necessary for the management of ammunition across its life cycle; and
- the political—the structural element necessary for effectiveness of the functional elements.

Figure 2.2 The Small Arms Survey's LCMA model



2.6.1 The structural element: national ownership

National ownership is a prerequisite for an LCMA system and helps to ensure its sustainability. It creates an environment that complements and supports the management of ammunition across its life cycle—from planning and procurement, to stockpile management and disposal. National ownership implies that a state takes full responsibility for LCMA, as demonstrated by national authorities' active engagement in the development, implementation, and oversight of a system and the provision of adequate financial and other resources to support its implementation. National ownership is a precondition for, and is fostered by, a number of enabling conditions, which support LCMA (see Section 3.2.3 and 3.3). These are:

- **a normative framework** comprising laws, regulations, and standard operating procedures to govern the system;
- **an organizational framework** for coordination, oversight, and implementation of the system;
- **infrastructure and equipment** to operationalize the system; and
- **human resources** to implement and maintain related processes and activities.

2.6.2 The functional elements: planning, procurement, stockpile management, and disposal

The four functional elements of the LCMA model relate to the different stages of the ammunition life cycle. Each of the four involves tailor-made processes and activities that deliver concrete outputs. All of the elements have to be managed in order to ensure that they operate in a coherent, coordinated, and complementary manner and that the risk of UEMS and diversion is kept to a minimum. Each functional element is summarized below and discussed in greater detail in Sections 4–7:

- **Planning (Section 4):** Effective planning is fundamental to the overall management and functioning of national stockpiles. Planning is also crucial for the sustainability of the LCMA system. It covers the strategic, operational, and tactical levels and all aspects of ammunition management—procurement, stockpile management, and disposal. For military actors, planning involves understanding the demand for ammunition and ascertaining the capability of armed forces to meet this demand in a timely and cost-effective manner. This section focuses on strategic planning and planning for LCMA in the national stockpile.

- **Procurement (Section 5):** The procurement element ensures that the appropriate ammunition is available in the right quantity, at the right time, in the right place, at the right price, and in the right condition. This element begins once ammunition requirements are approved and ends when the ammunition is placed into service. Procurement involves a number of activities, from research into and development of ammunition, to production and purchase; it also refers to the acceptance of ammunition into service, and the provision of spares and post-design services throughout the life of the ammunition. In an effort to supplement the IATG, this section describes the following key aspects of the procurement element: ammunition acquired for demonstration and evaluation purposes, acquisition, and entry into service.
- **Stockpile management (Section 6):** Given the safety and security risks associated with improper management of ammunition stores, the stockpile management element is particularly important in the prevention of UEMS, diversion, and accumulation of surpluses. It may also be the most complex and technical aspect of LCMA, as it includes a variety of activities and processes that must be integrated to ensure that ammunition is safe, secure, operational, and available when needed. The management element is typically defined as beginning with the introduction of ammunition into service and ending when the ammunition is removed from the stockpile as a result of a disposal action. In practice, however, stockpile management needs to begin long before ammunition is introduced into the stockpile, as part of planning and procurement. This section discusses how the IATG form the basis for stockpile management, describes the six IATG core groups of stockpile management activities and processes, and highlights key processes that are integral to LCMA.
- **Disposal (Section 7):** The disposal element begins with the identification of ammunition for removal from the national stockpile, continues with its assignment to a disposal account, and ends with its removal from the stockpile as a result of a disposal action. In most countries, the allocation of ammunition for disposal and selection of disposal options are sensitive issues, constituting key milestones in the LCMA process. While international guidelines emphasize and encourage disposal through environmentally sound demilitarization, many states opt to dispose of their serviceable surplus stockpiles through exports (as sales or donations). Ideally, disposal considerations are part of ammunition planning and acquisition, in terms of identifying demilitarization options and

necessary resources. This section addresses the disposal options available to states and related stockpile management considerations, as well as the risk management of demilitarization processes and facilities used for disposal operations.

2.7 LCMA milestones

Throughout an LCMA system, decisions are made in order to mitigate the risk of UEMS, diversion, and surplus accumulation. While all LCMA-related decisions are made within the context of ensuring the safety and security of the stockpile as well as a state's strategic and operational needs, milestones are points in the life cycle at which the most critical decisions regarding the management of ammunition are made.

Milestones control the transition across the functional elements of LCMA and their related processes and activities (NATO, 2007, p. 34). Milestone decisions are defined and approved by relevant actors at the strategic level—both civilian and military. They are made based on information obtained from technical experts and analysis provided within the LCMA system—as part of planning, procurement, stockpile management, or disposal programmes (see Section 4.3). Milestone decisions are also affected by the degree of national ownership and associated enabling conditions (see Section 3). Milestones are thus highly political.

There are a number of milestones within any LCMA system. Examples include:

1. **planning to procurement:** development and approval of strategic plans and budgets for the acquisition and management of types and quantities of ammunition necessary for achieving defence goals and operational requirements;
2. **procurement to stockpile management:** procurement of ammunition based on confirmation that the items being acquired are safe and suitable for service (also known as an 'S3' process);
3. **stockpile management to disposal:** approval of disposal of ammunition following a national disposal review; and
4. **disposal to planning:** certification or confirmation of disposal activities.

Authorities may introduce other milestones to respond to their national needs. Milestones can be reviewed, updated, and adjusted as necessary to reflect strategic needs as items are added and removed from the national stockpile. They effectively drive LCMA by answering questions such as the following:

- Does the stockpile satisfy the national demand for ammunition?
- Do LCMA programmes exist for planning, procurement, stockpile management, and disposal? Are the acquired items safe and suitable for use?
- Are the expenditures associated with maintaining the ammunition stockpile sufficient and within the defined budget?
- What items need to be procured, when, and from where?
- Can the ammunition be stored in an accessible, safe, and secure manner?
- What items need to be disposed of, when, and in what way (sale, donation, demilitarization)?
- Did the relevant national authority certify the destruction of the ammunition?
- Are planning authorities taking disposal into account when they are developing programmes?

2.8 Conclusion

The challenges of UEMS, diversion, and the accumulation of unsafe, unserviceable, and obsolete surpluses are symptomatic of broader shortcomings regarding ammunition management. Activities aimed at improving stockpile management—and at bringing it in line with international best practice, such as the IATG—allow for mitigation of the safety and security risks associated with ammunition. This Handbook incorporates such activities in a comprehensive and integrated approach to ammunition management.

The LCMA model presented in this Handbook, comprising a structural and four functional elements, provides a holistic approach to ammunition management. National ownership, the structural element of the model, is a prerequisite for a comprehensive and sustainable system. Each of the four functional elements—planning, procurement, stockpile management, and disposal—is composed of tailor-made processes and activities that have to be planned and managed in order to ensure that they are carried out in a coherent, complementary manner.

Together, these elements comprise a comprehensive set of processes and activities that are embedded in an enabling environment and designed to facilitate technical and political decision-making with respect to the management of ammunition throughout its entire life cycle.

—Author: Jovana Carapic

SECTION 3

National ownership of LCMA

3.1 Introduction

As discussed in Section 2.6.1, national ownership is a prerequisite for a comprehensive LCMA system and serves as the structural element of the LCMA model. At its core, national ownership is grounded in the premise that states need to take responsibility for ammunition management and be actively engaged in ensuring the safety and security of their stockpiles. Until now, however, guidance on how to secure national ownership has been limited. After providing an overview of the concept of national ownership, this section discusses the enabling conditions for ammunition management in more detail.

3.2 The concept of national ownership

National ownership is central to ammunition management (Carapic, Chaudhuri, and Gobinet, 2016, pp. 41–43; Switzerland, 2017, pp. 3, 5). For the purposes of this Handbook, a state demonstrates national ownership if national actors—including relevant political decision-makers, armed forces planning and logistics staff, and procurement authorities—have clearly defined and active roles in designing, implementing, and monitoring all processes and activities across the ammunition life cycle:

- planning;
- procurement;
- stockpile management; and
- disposal.

Yet national ownership is not simply about 'political buy-in' for ammunition management. It is about states taking full responsibility for LCMA, including by:

- setting up and maintaining an ammunition management system;
- providing national financial resources for the system; and
- facilitating the establishment of the enabling conditions necessary for supporting the effective management of ammunition over its life cycle.

Note The concept of national ownership is built into the IATG, which state that 'the primary responsibility for conventional ammunition stockpile management shall rest with the Government of the state holding the ammunition' (UNODA, 2015, mod. 01.10, para. 6.1). Nevertheless, and despite increasing awareness of the risk of UEMS and diversion, national ownership for ammunition management is lacking in many states and needs to be facilitated and built up by national and international actors, in close cooperation with one another (see Box 3.1).

3.2.1 Setting up and maintaining an ammunition management system

To implement an LCMA system, national authorities must establish a set of effective life-cycle and enabling processes and then actively maintain them (see Note in Section 2.4). It is essential that relevant national stakeholders play a key role at all stages of LCMA, from planning to procurement, stockpile management, and disposal. States demonstrate that they are actively participating in maintaining an ammunition management system by taking milestone-relevant decisions (see Section 2.7) and by planning and implementing element-specific programmes (see Section 4.3).

3.2.2 Providing national financial resources

It is important that states commit financial resources to ammunition management to meet their medium- to long-term strategic needs and operational requirements. As discussed in Section 4.4, financial resources are required to cover both the cost of procurement and post-acquisition costs, such as those associated with storage, surveillance, transportation, maintenance, security, and disposal. The planning for, and allocation of, financial resources demonstrates both political commitment and national capability with regard to the implementation of an LCMA system. Even when donors provide international assistance for LCMA (see Box 3.1), it is important that states commit national resources to establish and maintain the system, so as to demonstrate—in concrete terms—their plans to ensure its sustainability.

3.2.3 Facilitating the necessary enabling conditions

There is a dynamic relationship between national ownership and the enabling conditions that make LCMA possible. For any state to exercise national ownership, it must facilitate the establishment of the conditions that support the effectiveness of the functional elements. In turn, these conditions foster national ownership for ammunition management and ensure the sustainability of the LCMA system as a whole. Section 3.3 presents the four enabling conditions in more detail.

Box 3.1

International assistance for building national ownership of ammunition management

National ownership is crucial for ensuring safe and secure ammunition stockpiles. In post-conflict and developing states, however, national actors may not be fully willing or able to manage their ammunition stockpiles effectively. In such contexts, authorities that are in charge of stockpile management, and of LCMA more broadly, can benefit from the support of the international community. The following good practices can be implemented to facilitate the process of developing national ownership:

- **Developing national technical regulations and standard operating procedures (SOPs):** In the absence of a comprehensive normative framework, a key step is aligning legally binding technical regulations and SOPs, which are not legally binding, with appropriate international ammunition management practices and standards. The development of technical regulations and SOPs should be based on national needs and priorities, which can vary widely across states. While the IATG offer guidance on developing technical directives and SOPs, they must be adapted to the local context. In the course of 2018, UNODA—with support from the Geneva International Centre for Humanitarian Demining (GICHD) and the Small Arms Survey—will be developing guidance on how to adapt the IATG to local contexts.
- **Fostering the development of a national organizational structure:** The development of an organizational structure capable of implementing an LCMA system often requires international assistance to support necessary long-term structural reforms. Relying on international staff, advisers, or consultants for the sake of efficiency or due to an absence of national capacity can have a detrimental effect on long-term capacity building and national ownership. While international actors can usefully support the development of national institutions needed to support LCMA in partner states, it is not advisable for them to adopt prominent long-term roles in strategic decision-making or project management (Donais, 2014, p. 6; OECD, 2011, p. 84). Finding the right balance is challenging but necessary for the sustainability of a national organizational structure.

Members of Bosnian Armed Forces, EUFOR, and the EU's Political and Security Committee visit an ammunition storage site in Krupa. Bosnia and Herzegovina, November 2014. Source: Sarajevo Times

- **Coordinating international assistance:** Given the significant resource demands associated with the implementation of LCMA, no single international actor or project can generally be relied upon to support the development and implementation of an entire LCMA system in another state. In some cases, it may be advisable for international actors to pool their resources and to coordinate their activities under a common initiative. Between 2013 and 2018, for instance, the international community coordinated activities in Bosnia and Herzegovina to introduce a sustainable LCMA system there (Carapic and Holtom, 2018).

  The need to coordinate assistance means that in addition to seeking the most common forms of international ammunition management assistance—such as improvements to physical infrastructure or the provision of equipment for security and stockpile management—it is important for national authorities to place emphasis on medium-term assistance programmes that allow them to foster their national ammunition management experts and knowledge about LCMA. These programmes can occur at different levels, including through tailor-made ammunition management courses, the development of national training curricula, and the establishment (or enabling) of dedicated training (Carapic, Chaudhuri, and Gobinet, 2016; Kahl, 2012, pp. 37–40).

3.3 Enabling conditions that support LCMA

As outlined in Section 2.6.1, four enabling conditions are necessary for national ownership of LCMA:

- **a normative framework** comprising laws, regulations, and standard operating procedures (SOPs) to govern the system;
- **an organizational framework** for coordination, oversight, and implementation of the system;
- **infrastructure and equipment** to operationalize the system; and
- **human resources** to implement and maintain related processes and activities.

3.3.1 Normative framework for ammunition management

All states have a national ammunition stockpile and therefore at least some rudimentary form of ammunition management in place. An LCMA system needs to be anchored in and informed by a normative framework that consists of country-specific policies, laws, regulations, technical directives, and SOPs that provide guidance on ammunition (and weapons) management at different operational levels (see Table 3.1). This normative framework informs the division of responsibilities, processes, and activities within the national LCMA system.

The development of an appropriate framework is a national responsibility and is based on national needs and priorities. These can vary widely across states.

For states without a normative framework in place, the IATG offer concrete guidance and tools for ammunition safety and security, as well as a model for effective stockpile management (see Box 1.2). They also provide advice on developing

Table 3.1 Sample components of a holistic normative framework for ammunition management

Management level	Actors	Policy focus	Legislation, regulations, and standards
Strategic (civilian)	Political decision-makers (members of parliament)	■ Formulation of national strategic and security interests and policy	■ National legislation regulating arms and ammunition control, budgeting, procurement, military installations, exports, environmental protection, safeguarding of ammunition storage sites, issuing of explosives licences ■ International commitments on arms control
Strategic (military)	Military decision-makers and ministers (minister of defence, chief of defence)	■ Concept of strategic defence ■ Defence planning directives ■ Strategic capabilities plans ■ Procurement programmes ■ Management programmes ■ Disposal programmes	■ Regulations and directives on arms and ammunition procurement, military installations, exports, environmental protection ■ Directives and legislation on the organization of the armed forces
Operational	High-ranking officials (joint staff, force command)	■ Executive policies for human resources, procurement, management, disposal ■ Training programmes ■ Joint service doctrines	■ Directives on the organization of branches of the armed forces and allocation of responsibilities for ammunition management across its life cycle ■ Regulations on operations management ■ Ammunition surveillance standards ■ Risk management standards
Tactical	Mid-ranking officials (commanders of military units)	■ Unit standing orders	■ Standing orders on ammunition usage and handling ■ Technical directives and SOPs on stockpile management

Source: Huber (2017, pp. 8–9)

technical directives for ammunition management and on the roles and competencies of ammunition specialists (UNODA, 2015, mod. 01.90). However, the IATG do not provide a template for the development of a holistic normative framework for ammunition management, nor is such guidance currently available from any other international organization.

Table 3.1 provides a sample framework for consideration. It is not intended as a template for a normative framework; rather, it aims to identify some of the components of a possible framework. In the absence of national legislation, regulations, and standards on ammunition management, a state will not be able to achieve long-term improvements in stockpile management. By extension, it will also be unable to maintain the integrity and sustainability of an LCMA system.

3.3.2 Organizational framework for coordination, oversight, and implementation

National ownership for ammunition management calls for context-specific organizational frameworks. In practice, requiring that relevant institutional and organizational

Box 3.2

Developing institutional structures for LCMA in Somalia

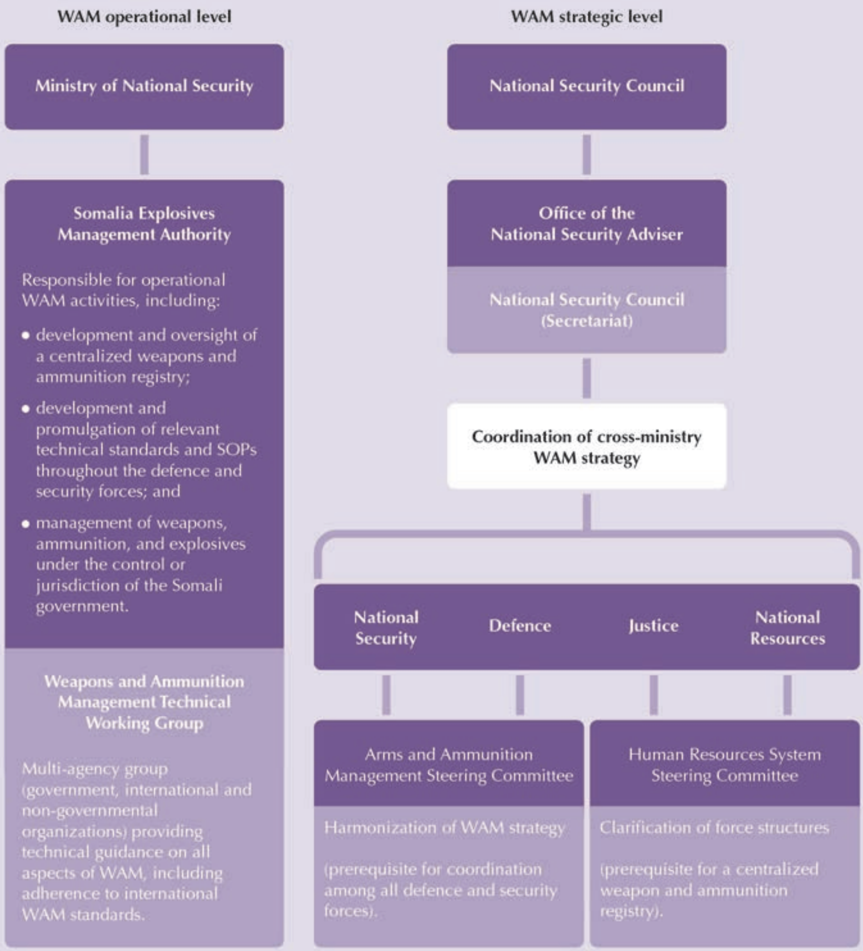
International guidelines emphasize that states should play an active rather than a reactive role in ensuring the safety and security of stockpiles to the highest possible standards, whatever the state of their institutions and capacity (UNODA, 2015, mod. 09.10, p. v). In 2014, the Somali government shared progress made with regard to its weapons and ammunition management (WAM) policies and practice, including the development of an organizational structure in charge of WAM. Somalia established its Arms and Ammunition Steering Committee in 2014 as a forum to bring together all relevant stakeholders—that is, the various security forces, implementers, and donors—to discuss WAM-related issues, including the drafting of new legislation and SOPs. Figure 3.1 provides an overview of Somalia's institutional WAM structures and indicates the specialized roles and responsibilities of various institutional bodies, with a focus on strategic and operational levels.

While the high level of institutional development for WAM issues can be seen as a success, international political analysts working in Somalia have expressed concern over the lack of coordination and information exchange among relevant agencies. For instance, at times security agencies make decisions unilaterally, without consulting or informing the Office of the National Security Adviser, which is meant to serve as the focal point for all WAM matters. This lack of coordination may be characteristic of nascent political institutions. Over time, as the institutional WAM structures consolidate, coordination and information exchange among the agencies is likely to improve.[9]

Source: Bevan, Leff, and Ruddock (2014, pp. 8–11)

9 Author correspondence with Jonah Leff, director of operations, Conflict Armament Research, 20 September 2017.

Figure 3.1 Institutional WAM structures in Somalia



Source: Bevan, Leff, and Ruddock (2014, pp. 8–11)

structures be both led and staffed by national personnel helps to ensure that ammunition management:

- applies national policies and legislation in the organization of security forces and responsibilities;
- is carried out with the support and continuous engagement of senior, national decision-makers, both civilian and military; and

- involves a national project management body that is in charge of coordinating, synchronizing, and prioritizing related processes and activities (see Box 3.2).

Only with such a framework in place can a state claim to have the capability to ensure the management, coordination, and oversight of its ammunition stockpile. Establishing a framework involves meeting a number preconditions:

- **A high level of institutional and organizational development**. An LCMA system demands a high level of institutional and organizational development, with clearly defined tasks, competencies, and responsibilities. In addition to having functioning governmental institutions and control over security forces, it is important for states to support their LCMA systems with an organizational structure devoted to the day-to-day management of ammunition stockpiles. Institutions with such a structure can ensure that stockpile management practices comply with national legislation; they can inform the development and implementation of normative frameworks and plans for ammunition management by providing technical expertise (see Section 4.2). Furthermore, they can constitute a 'regulatory and assurance' mechanism to demonstrate to a government that compliance with national legislation is taking place in practice.
- **A high level of flexibility**. The organizational structure needs to be flexible enough to deal with the complexities and changing demands of LCMA. In practice, this involves everything from being able to work with national and international firms when it comes to procurement and disposal of ammunition, to being able to design, implement, and adapt regulations and SOPs to the national context (see Box 3.2). The organizational structure must also be flexible enough to ensure that there is information exchange, coordination, and oversight among relevant stakeholders—both international and national—at different levels.

3.3.3 Infrastructure and equipment for LCMA

Physical capacity is essential for LCMA. For the purposes of this Handbook, the term 'physical capacity' relates to the ability to implement ammunition management processes and activities across the life cycle of the ammunition stockpile. More specifically, physical capacity comprises the following:

- **infrastructure,** including explosives storage houses, ammunition process buildings, destruction facilities, barricades, fences, gates, doors, and locks; and

Box 3.3

RASR: a regional approach to capacity maximization

States can enhance and develop their physical capacity by adopting a regional approach to aspects of LCMA, which allows them to share experiences and reduce costs. A prominent example is the Regional Approach to Stockpile Reduction (RASR) Initiative in South-east Europe. In recognition of the financial and logistical challenges faced by RASR members and donor countries, RASR states are increasingly adopting a collaborative approach, especially in relation to the destruction of ammunition. As part of this collaboration, Montenegrin anti-aircraft cannon ammunition was destroyed at the Mjekës factory in Albania in 2014 and Bosnian white phosphorus ammunition was demilitarized in Croatia in 2016 (Carapic, Wilkinson, and Ruddock, 2017; Gobinet and Carapic, 2015, p. 143).

- **equipment,** such as lightning rods, fire-fighting equipment, forklifts, vehicles, and intrusion detection systems.

Note Ammunition storage and processing infrastructure needs to be considered in terms of its proximity to local civilian settlements and inhabited buildings. In some instances of UEMS—such as explosions that occurred in 2002 in Lagos, Nigeria, and in 2012 in Brazzaville, Republic of Congo—inadequate separation distances between civilian dwellings and other infrastructure and ammunition depots led to significant loss of life (Berman and Reina, 2014, pp. 28, 32).

Infrastructure and equipment are essential to supporting the implementation of LCMA. A state cannot claim to have the capacity to ensure the safety and security of its stockpiles or the disposal of surplus stockpiles without them. For this reason, the last decade has seen a considerable increase in the number and scale of international assistance programmes related to capacity development (Parker and Rigual, 2015; see Box 3.1).

States that maintain an LCMA system address related financial and logistical challenges in different ways, including by adopting an incremental, priorities-oriented approach to physical capacity development. Such an approach requires relevant stakeholders to be able to identify, categorize, and rank infrastructure and equipment needs and to seek targeted international assistance, based on risk assessments (Kahl, 2012, pp. 31–35). States may also be able to enhance their national physical capacity by adopting a regional approach to LCMA (see Box 3.3).

3.3.4 Human resources for implementing and maintaining LCMA

The implementation and sustainability of an LCMA system depends on the availability of adequately trained personnel at all levels, including at the:

- **strategic level**—senior MoD and armed forces headquarters staff;
- **operational level**—managerial staff in the logistical command; and
- **tactical level**—technical staff working at storage facilities, processing plants, or demilitarization locations.

Adequate training on basic stockpile management activities—such as cleaning, storehouse maintenance and organization, inspection of ammunition, inventory management, and accounting—can help to reduce the probability of UEMS and diversion. By providing training that is firmly rooted in national and international ammunition management regulations and SOPs, external donors ensure that their support is responsive to the needs of a recipient state and relevant security forces. They also promote knowledge transfer and integration into a recipient state's institutions (see Box 3.1). Experience from Bosnia and Herzegovina indicates that training is key in fostering national ownership and that it is most effective when it is progressively transferred and systematically integrated into a recipient state's institutions (Carapic and Holtom, 2018).

LCMA also necessitates an effective personnel management system—one that allocates a sufficient number of adequately trained individuals with appropriate ammunition management roles and responsibilities. Career planning and development of career paths in technical and political spheres of ammunition management is integral to LCMA, as is making these careers and disciplines attractive to both civilian and military personnel. Professional development is especially important given the turnover of personnel as a result of rotations, retirement, or moves to the private sector.

In many countries, international actors play a key role in personnel turnover, including by hiring highly qualified national staff as translators, drivers, or administrative staff for higher salaries than they would otherwise earn (Donais, 2014, p. 6). This can be detrimental to national LCMA programmes and should be guarded against by both international and national actors.

3.4 Conclusion

The structural element (national ownership) and the conditions that create an enabling environment for LCMA—a normative framework, an organizational framework, adequate infrastructure and equipment, and sufficient human resources—are all essential components of the system. They support and facilitate behavioural and institutional change with a view to safer and more secure ammunition stockpiles at the national level. They also support the coordination of international assistance that may be supplied. Furthermore, they facilitate the four functional elements of an LCMA system—planning, procurement, stockpile management, and disposal—to ensure the safety and security of ammunition stockpiles and sustainability of the entire system.

—Author: Jovana Carapic

SECTION 4

Planning

4.1 Introduction

Planning is essential to the overall management of ammunition. It is also key to ensuring that all LCMA processes and activities are integrated into a comprehensive system. An LCMA system must be thoroughly planned from the outset, with dedicated resources and procedures put in place in advance of any new acquisitions or other alterations to the system. Direction is provided by a state's national defence policy, which is translated into a comprehensive and actionable strategy that typically determines requirements for: conventional ammunition; procurement, storage, and deployment; and disposal of ammunition (Wilkinson, 2008, p. 77). This tiered approach aims to ensure that any changes in national strategy are reflected throughout the entire ammunition management system.

This section examines two types of LCMA planning: strategic planning and planning for life-cycle management of ammunition in the national stockpile. It begins by describing how strategic 'big picture' defence policies are translated into required national ammunition stockpile levels. It then discusses data-driven assessments and planning for LCMA as part of procurement; stockpile management, including risk management; and disposal. Finally, it considers planning in relation to the prioritization of needs and assessment of the full cost of ammunition over its entire life cycle.

4.2 Strategic planning

Ammunition is an essential component of the state's defence capabilities; therefore, the national ammunition stockpile must reflect the security goals of the state. The aim is to ensure that the right type of ammunition, in the appropriate quantities, is ready when and where it is needed, both in the present and in the future.

Generally, the national defence (or security) policy, as developed by the MoD and approved by the head of state or national legislature, provides critical direction regarding national security threats and broader national strategic objectives. A defence policy is operationalized through a long-term defence strategy that is developed by high-level military planning personnel such as the chief of defence or joint chiefs of staff (NATO, 2003a; see Figure 4.1). Related guidance documents, which ensure consistency, provide planners with the necessary tools to prepare for potential security challenges.

Figure 4.1 Long-term defence planning

NATO defines long-term defence planning as:

> *a process that investigates possible future operating environments and develops a force structure development plan (SDP) to best adapt the defence organisation to those environments given a host of constraints—including financial ones* (NATO, 2003a, p. 3).

Long-term defence planning includes establishing a clear framework with both peacetime and wartime mobilization strategies and responsibilities clarified throughout the organizational structure of the military (Mawson, 1985, pp. 10–11; UNODA, 2015, mod. 01.30, para. 11.2; US Army, 2009, p. 1; see Section 3.3.2).

A primary milestone of the planning element is the development of a cohesive national ammunition stockpile plan that meets the long-term defence planning goals. Strategic planning for the national ammunition stockpile defines the appropriate types and quantities of ammunition necessary for achieving the goals and required capacities outlined in the national defence policy and related strategy documents. Such estimates take into account:

- the number and type of military units (the force structure);
- the number and type of weapons (the equipment levels); and
- the projected rate of expenditure (strategic deployment) (Wilkinson, 2008, p. 81).

Related calculations typically categorize ammunition in the national stockpile according to its three main strategic roles: operations, training, and war reserves (UNODA, 2015, mod. 03.10, para. 19.3.1; Wilkinson, 2008, p. 77).

- **Operations.** This ammunition is explicitly designated for operational deployment. The amount required can normally be determined using historical data from previous operations. Relevant data can be found in ammunition expenditure records that tend to be kept at the unit level and submitted to commanders according to a set schedule (US Navy, 2012, pp. 1–7).

- **Training.** Armed forces may issue guidelines on annual quantities of live-fire training ammunition required by individuals or units to ensure that they maintain an established proficiency level (US Army, 2001, sec. C-2). Planners ensure that the necessary quantities of ammunition are available for each unit so that the required level of capacity is maintained.
- **War reserves.** To calculate requirements for a war reserve, planners use forecasting methods that estimate the usage rates necessary to support potential wartime or 'worst-case' scenarios (Slak, 2012, p. 8; UNODA, 2015, mod. 03.10, para. 19.3; Wilkinson, 2008, p. 81). Forecasting takes into account the number of persons mobilized to respond to a given scenario and the likely intensity of the response, for a set period of time—typically 15–30 days—or before new procurements of ammunition can arrive (UNODA, 2015, mod. 03.10, para. 19.3.1; Wilkinson, 2008, p. 81). There are multiple methods for making these forecasts. NATO uses the level-of-effort[10] calculation, whereas the IATG recommend the daily ammunition expenditure rate (DAER) method (see Box 4.1).

When necessary, operational and training ammunition may be 'borrowed' from a war reserve, provided that the reserve is replenished.

Box 4.1

Calculating ammunition needs with DAER

The DAER method uses a simple formula to estimate ammunition requirements for security forces. Based on records of previous operations, planners assign DAER rates to each type of ammunition for an individual weapons system to estimate the average rounds expended during high- and low-intensity operations. The rate for a single weapons system is then extrapolated to calculate how many rounds would be required to sustain a particular level of fighting for every system firing that ammunition for an extended period (usually 15–30 days).

For example, planners may wish to calculate the required ammunition reserves for 10,000 assault rifles in their holdings. If regulations require 30 days of supplies and the military's historical data shows that a firearm is used to fire 200 rounds per day in high-intensity fighting, the DAER rate would be 200 and the calculation would be as follows:

10,000 (rifles) × 200 (ammunition rounds) x 30 (days) = 60,000,000 required rounds of ammunition

Source: UNODA (2015, mod. 03.10, para. 19.3.1)

10 Level-of-effort calculations are 'based on an expected daily expenditure rate, the number of combat days, and the attrition rate to counter targets of which the number is unknown' (NATO, 1997, para. 406.1).

4.3 Planning for life-cycle management of ammunition in the national stockpile

Strategic planning decisions that relate to the national ammunition stockpile reverberate throughout the entire LCMA system. It is essential to determine whether there is sufficient capacity to store, protect, monitor, and dispose of each item in the national stockpile. Since ammunition must be stored in safe and secure facilities, new acquisitions affect available storage space; likewise, newly defined surplus affects the system's disposal capacity. Meanwhile, the introduction of new weapons systems into service requires new rules and procedures, in addition to supplementary ammunition procurement to cover additional testing and training requirements (DND and CAF, 2004; Lewis and Roll, 1993, p. 3; US Army, 2015, p. 4). Similarly, if a weapons system is withdrawn from service, disposal of the outgoing ammunition must be planned.

It is incumbent on planners to understand all of the downstream ramifications of their stockpile-related decisions. For this to take place, an information management system has to be in place. Information management is vital to LCMA planning, as it enables planners to maintain oversight of the entire LCMA system. Comprehensive information management systems are essential to provide the data that planners need to make informed decisions. The following section discusses the data-driven needs assessments and planning that take place as part of procurement, stockpile management, and disposal so as to ensure the maintenance of an LCMA system. Sections 5–7 explore each of these functional elements in greater detail.

4.3.1 Planning for procurement

Planners identify procurement needs by comparing the target strategic holdings with the current ammunition stockpile and the anticipated ammunition expenditures. This comparison can reveal gaps that need to be filled to achieve the projected targets; that is, shortages reveal procurement needs. Similarly, surpluses should trigger disposal plans. Once identified, planners recommend solutions for resolving identified gaps through individual programmes (Butler et al., 2016, p. 49; US Army, 2009, pp. 13–15; see Box 4.2).

Data is a critical element of procurement planning. Planners need data on the current inventory records and yearly consumption estimates—that is, ammunition

Box 4.2

LCMA programmes

The implementation of LCMA plans occurs through programmes. Programmes turn identified needs into 'achievable packages recognizing fiscal and resource constraints' (US Navy, 2012, para. 8.5.3). Programmes consist of both investment and divestment plans and are designed to ensure the productive use and prioritization of available resources (OSCE, 2008, pp. 21–22; Sloan, 2006, pp. 22–23).

Ammunition programmes are designed by technical officials who rely on a high-level advisory board for strategic direction and oversight. Programmes typically seek to solve an issue that is related to one particular type of ammunition, such as the need for new supplies or increased capacity, but they also fit into the broader national strategy and take fiscal limitations into consideration. An appropriations committee in the national legislature decides whether to approve programmes linked to budgeted LCMA plans.

consumed during the course of operations, training exercises, and surveillance to make informed decisions on procurement needs.

While it is possible to estimate annual consumption rates, the allocation and consumption of ammunition can vary from year to year, for multiple reasons, including unplanned operations, procurement delays, and limitations on available ammunition (Persi Paoli, 2010, p. 70). The capacity to anticipate potential consumption fluctuations is important. Technological developments may also have an impact on plans, as they can lead to the introduction of new weapons systems and ammunition into the arsenal. Therefore, it is important for planners to consider how the status of ammunition may change over time.

4.3.2 Planning for stockpile management

Ammunition management covers a broad set of activities from its introduction into the national stockpile until its utilization or designation by the state for a disposal action (see Section 6.2). Stockpile management planning organizes the administration of the physical asset and manages all related risks, in line with policy and governing documents, training plans, and operating procedures.

Stockpile management planning requires accurate knowledge of management capacities. In general, this is achieved through analysis of 'assets', such as buildings suitable for safe and secure storage of ammunition, and vehicles and tools used for related transportation and handling, in addition to assessments of core staff capacities and skills. Since each of these assets is available in limited supply, the challenge is determining how to utilize them in the most efficient manner.

For example, planners are tasked with deciding where to store ammunition. Since operational readiness is a key priority, a primary goal is the safe and secure storage of ammunition in a location that allows it to meet its operational objectives (Clark, Barnhart, and Kolitz, 2004, p. 697). Storage capacity has physical and functional limitations, affecting both the volume and type of ammunition that can be stored safely (see Box 4.3). Storage plans, therefore, are based on the available infrastructure, as well as risk assessments and operating budgets. Such planning involves the consideration of a number of variables, including ones related to the storage location (such as the quantity distance), security provisions, the available space and building design, and storage capacity (see Box 4.3; Section 3.3.3).

As discussed in Section 2.3, risk management that is properly implemented across all LCMA and stockpile management activities can minimize the likelihood of UEMS or lessen the impact of an incident if an explosion does occur (see Section 6.10). To achieve these goals, planners must be aware of the hazards and threats facing the stockpile and proceed with a level of risk that is considered tolerable. This awareness encourages actions that reduce the probability or mitigate the impact of an ammunition accident.

Planning for risk relies on technical expertise. A risk assessment—conducted by trained personnel—sheds light on the risks involved at every stage of the ammunition life cycle. Analysis of this assessment feeds into the development of and planning for appropriate procedures, staffing and personnel training, the

Box 4.3

Standardizing the measurement of storage capacity

While the size of ammunition and its packaging varies by type, planners are able to estimate the quantity of ammunition that can fit in a store room, or a vehicle, by using the 'pallet' as a standardized unit of measurement (Johnson and Coryell, 2016). They are able to calculate the quantity of each type of ammunition that can safely fit on a pallet. The IATG suggest ways to calculate the volume and weight of palletized ammunition, advising non-NATO countries to equate a loaded pallet to 1 m^3 with an all-up weight of 1 tonne (UNODA, 2015, mod. 06.20, para. 4). By adjusting for IATG standards on pallet stacking (mod. 06.20), aisle, and other spacing requirements (mod. 02.30), planners can estimate how many pallets can be placed in a storage facility, and thus the quantity of ammunition that it can hold.

It should be noted that these calculations measure only the *physical storage capacity* of a given space. More often, the amount of ammunition that can be stored is limited not just by the storage capacity but also by the quantity distance (the minimum distance required between a potential explosion site and an exposed site) and explosives licence (the permitted amount of explosives at a potential explosion site) (UNODA, 2015, mod. 01.40, paras. 3.112, 3.222).

acquisition of facilities and equipment, and planning for risk mitigation and protection, as well as related spending and resource decisions.

The IATG provide guidance on the development of an integrated risk management programme, including risk mitigation planning and plan implementation (UNODA, 2015, mod. 02.10).

4.3.3 Planning for disposal

Unserviceable ammunition should be destroyed or demilitarized (UNODA, 2015, mod. 01.40, paras. 3.69, 3.71; see Section 7.3.2). Surplus—yet serviceable—ammunition can be sold, donated, destroyed, demilitarized, or used for training, all of which are internationally acceptable practices. However, multinational frameworks have consistently stated a preference for destruction (OSCE, 2011a; UNGA, 2001b, para. II.18).

Ammunition that requires disposal is identified during ongoing assessments and surveillance activities, as part of a national disposal review process (see Section 6.4.1). Since disposal capacity is limited and the logistical costs can be significant, it is important that planners consider how and when they will dispose of surplus ammunition as part of their planning. High-ranking officials may be reluctant to dispose of surplus ammunition because of the high cost of procurement, false expectations regarding its potential sales value, or a strong national identification with military arsenals that are viewed as a source of strength and pride. Indeed, faced with budget constraints and a lack of technical capacity, governments often seek to generate revenue by selling surplus materiel, rather than spending money on its demilitarization (Lazarević, 2012, p. 22). Political considerations may, therefore, override calls from technical experts to destroy surplus stocks. By establishing disposal criteria—covering both the disposal method and the point at which ammunition is no longer considered serviceable—planning authorities can seek to avoid such disagreement and delays.

Note Planning necessitates a realistic assessment of the state's disposal capacity. Demilitarization of the various items in the national ammunition stockpile requires machinery and expertise, which are likely to be available in limited quantities. Disposal methods also vary—depending on the type of ammunition—and should be clarified as part of the procurement process. With this information, planners can then seek to plan for and prioritize disposal activities (see Section 4.4).

Disposal programmes also require support capacities. For instance, transportation requirements can be significant, especially if a disposal facility is not located near storage facilities (Covert, 1985, p. 28). A facility may even be located in another country. Furthermore, all items awaiting disposal—including ammunition from sales, transfers, and donations—require safe and secure storage (UNODA, 2015, mod. 10.10; see Section 7.3).

4.4 Allocation of budgets and prioritization of needs

Allocation of budgets is another milestone within the planning element of LCMA. Budget constraints tend to limit the ability of armed forces to meet every strategic target: budget proposals for ammunition management are highly political since they have to compete with other requests (both civilian and military) for funding. Deciding on the best way to allocate available resources efficiently (that is, to cut costs where possible, and to avoid unnecessary expenses) is an important aspect of planning (OSCE, 2008, p. 22). This process involves prioritizing identified needs

Figure 4.2 The total cost of ammunition

Source: author's elaboration based on NATO (2012, p. 4) by establishing the relative importance of one requirement over another and by determining the best balance between the capabilities required to conduct known and potential operations and the associated risk and costs (US Army, 2009, p. 13).

Costs are not incurred only when ammunition is purchased; ammunition incurs costs throughout its entire life cycle (Gobinet and Van Beneden, 2012, p. 3). A calculation of the true cost of ammunition factors all of these indirect expenditures into the overall cost of procurement (US Army, 2009, p. 4). NATO describes these as life-cycle costs and notes that post-acquisition expenses—such as for storage, surveillance, transportation, maintenance, security, disposal, and support—can often be significantly greater than the initial procurement cost (NATO, 2012, p. 4; see Figure 4.2). If these indirect costs are not planned and budgeted for prior to procurement, available resources are likely to be insufficient for the subsequent management of life-cycle activities. Making financial resources available to cover post-acquisition expenses is a way for states to demonstrate national responsibility for ammunition management (see Section 3.2.2).

Life-cycle costs are calculated using a variety of different methodologies (NATO, 2003b, p. 1-1). Such costing is useful in that it requires planners and programme managers to measure the resources—both financial and in-kind, in the form of staff and infrastructure—needed to maintain an entire LCMA system. It also serves as a means of comparing the cost of current and future LCMA-related programmes (p. 10-1). Yet even for governments with reliable historical cost data, calculations tend to be estimates (NATO, 2012, p. 2).

4.5 Conclusion

Planning is fundamental to ammunition management and an essential part of LCMA. It encompasses the process of translating the national defence policy into a strategy and operational activities and ensuring that sufficient financial resources are available to meet these needs. The process begins by defining the nation's ammunition requirements and continues through the development of integrated programmes that are designed to address those needs in the most efficient way possible. The end goal is to ensure that plans are made for the management of all ammunition—throughout its entire life cycle—in both current and future national holdings.

—Author: Benjamin King

SECTION 5

Procurement

5.1 Introduction

The procurement element of LCMA deals with the mode and source of ammunition supply. An effective procurement process delivers ammunition that is suitable for the implementation of the national defence policy in a safe and secure manner (NATO, 2009a; UNGA, 2008a, para. 22; Wilkinson, 2008, p. 77). As noted in Section 4.2, the planning element of the LCMA model determines the general parameters for the quantity and type of ammunition to be procured. The procurement element begins with the approval of ammunition for acquisition and concludes with its entry into service, the two main milestones for this element. Procurement systems are expected to adhere to good governance principles and include robust anti-corruption provisions.

This section provides an overview of ammunition procurement, with a focus on three key aspects:

- ammunition acquired for demonstration and evaluation purposes;
- acquisition, via domestic production and imports; and
- entry into service.

Box 5.1 considers the two main modes of acquisition: procurement from national production and imports from foreign suppliers.

This section draws on NATO and UK standards for procurement processes but also provides an example from India to demonstrate the challenges involved in acquiring ammunition, even when planning and procurement systems are in place. Wherever relevant, it highlights connections with the stockpile management and disposal elements of the LCMA model, which are more closely examined in Sections 6 and 7, respectively.

5.2 Demonstration and evaluation prior to acquisition

Before an order is placed, it is useful to acquire a limited quantity of ammunition for testing ('demonstration and evaluation') purposes. NATO provides guidance on how to evaluate the safety and suitability of ammunition for service (known as an 'S3' process), including a questionnaire to help devise appropriate demonstration trials (NATO, 2009a, annexe A).

Note In determining whether to procure ammunition, it is never sufficient to rely on a supplier's test results and documentation (see Section 5.2).

Box 5.1

Modes of acquisition

States procure ammunition from two main sources:

- producers located within their national territory; and
- suppliers in other states.

Traditionally, states owned national ammunition production facilities, which prioritized the procurement needs of the national security forces. This arrangement has changed over time. While most ammunition can be produced with limited industrial capacity, the production of non-cartridge-based light weapons ammunition tends to be limited to industrialized states (King, 2010, pp. 19–20). Today, few states have the desire to produce ammunition—or are capable of doing so—to satisfy all of their needs. As a result, most states import ammunition (pp. 33–34).

States import new and surplus ammunition via commercial sales, government-to-government sales, or gifts. They may also acquire licences—or equipment and technology—to produce their own ammunition (UNODA, 2015, mod. 03.30, para. 4.2.3). The import of surplus ammunition is cost-effective if it is in good condition (UNGA, 2008a, para. 39). In such cases, it is often imported alongside weapons to 'reduce transport costs, minimize logistics, and maximize profitability' (Gobinet and Gramizzi, 2011, p. 11).

Surpluses may be new or from old ammunition stockpiles. Purchasing from old stockpiles can lead to 'controversial quality control, dubious traceability issues, and procurement fraud', however (Gobinet and Gramizzi, 2011, pp. 4–5; King, 2010, p. 40). For example, some of the surplus ammunition supplied by the United States to Afghan armed forces during 2007–08 were provided in mislabelled boxes that lacked the necessary paperwork to ensure safe handling; were transported in packaging that made the ammunition unsafe for transportation; and were simply 'unserviceable' (USHR, 2008, p. 1). Afghan security forces complained that the ammunition they had received was 'junk' (Chivers, 2008).

Boxes of ammunition are seen inside a Russian aircraft at the Hamid Karzai International Airport, Kabul. Afghanistan, February 2016. Source: Mohammad Ismail/Reuters

5.3 Acquisition

While the IATG do not have a module dedicated to the procurement process, they do provide guidance on managing the safety and security of ammunition during the acquisition process, with a focus on ensuring state control and oversight; comprehensive registration and record-keeping; and safe and secure transportation. The guidance focuses on:

- **Sample acquisition:** Once a decision to acquire ammunition has been made, it is advisable to also acquire ammunition items and any related components that may be necessary to support monitoring and testing activities associated with that ammunition item throughout its life cycle. Such activities might involve stockpile surveillance and propellant stability testing (see Box 6.1), in-service proofing, and energetic material ageing studies (generally associated with new propellants and explosive fills).

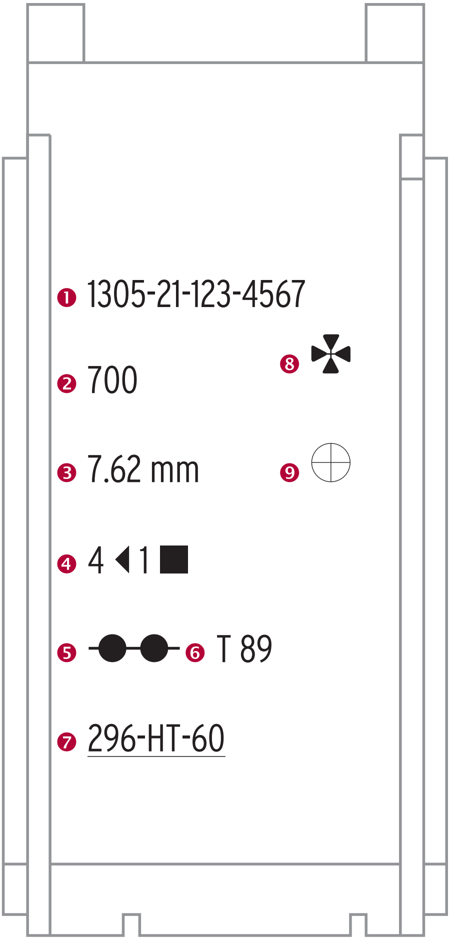
  A procurement agency can obtain test standards, results, and validation documentation from a producer to inform its assessment of whether the ammunition will be fit for the intended operational environments in which it is to be used (OSCE, 2008, p. 9). It is prudent to acquire detailed technical information, which might include operating manuals, ammunition hazard classification test results (combined with supporting documentation and videos), and propellant stabilizer level documentation. It is important for a stockpile assessment to be accomplished *before* the introduction of a new ammunition item into the stockpile and for all required technical data to be acquired at the same time as part of a package (see Section 6.2).
- **Hazard classification:** Ammunition should be given a UN hazard classification code (HCC) to indicate its hazard division in accordance with the Globally Harmonized System of Classification and Labelling of Chemicals and compatibility group (UN, 2017b; UNODA, 2015, mod. 01.50, para. 6).[11] The HCC ensures 'that standardized information on physical hazards and toxicity from chemicals is available in order to enhance the protection of human health and the environment during their handling, transportation and use' (UNGA, 2008a, para. 25; see Box 6.3).

11 The *UN Recommendations on the Transport of Dangerous Goods contain the UN Manual of Tests and Criteria*, which provides guidance on determining the HCC for ammunition (UN, 2015; 2017a).

- **Labelling and packaging:** Packaging for ammunition should be tested with a view to proving it is able to 'protect the contents from foreseeable hazards of physical damage and environmental deterioration throughout the envisaged life of the item' (UNODA, 2015, mod. 06.40, paras. 4, 4.1; UN, 2017a, ch. 6.1). The correct packaging and labelling can increase an ammunition item's life span, reduce maintenance costs, and assist with in-service surveillance by providing information on the quantity and nature of the ammunition (see photo below and Figure 5.1). In particular, labelling should indicate the HCC, UN serial number (a four-digit number that identifies dangerous goods and hazardous substances), a shipping name for the materials from the Dangerous Goods List, and approval granted by a national authority or the UN (UNODA, 2015, mod. 06.40, para. 4.7).
- **Ammunition marking:** The marking of conventional ammunition helps to prevent accidents and facilitates logistical and tactical operations. Marks provide information on the type, calibre, producer, age, production lot number, explosive material and propellants, and other hazard information to ensure that handling, transportation, storage, and surveillance are conducted in a manner that minimizes the risk of instability and explosions (OSCE, 2008, p. 5; UNGA, 2008a, para. 26).

A box of 7.62 × 51 mm cartridges. Source: Douglas Muth/Wikimedia Commons

Figure 5.1 Example of the layout of minimum package markings



1. NATO stock number: this is a 13-digit numeric code that standardizes the identification of supply items. Refer to STANAG 3150 and 3151 for further details.
2. Quantity of ammunition.
3. Calibre of ammunition.
4. Symbols representing the nature of the bullet as packed; in this case, the symbols mean four armour-piercing bullets and one tracer round.
5. Symbols for the type of pack; in this case, 'linked'.
6. Model of link.
7. Lot number: lot serial number, manufacturer initials, last two digits of the year of production.
8. NATO symbol of interchangeability (if applicable).
9. NATO design mark (if applicable).

Source: NATO (2008a)

- **Lotting:** The lot number should be agreed in consultation between a national producer and stockpile management authority when ammunition is procured from domestic sources. When procurement is from a foreign supplier, the lot number provided by the producer at the time of production is used. The lot number indicates the production date, producer, and production method. This is a key means by which a producer can convey information to support safe stockpile management and disposal (OSCE, 2008, pp. 5, 13; UNODA, 2015, mod. 03.20, paras. 4–7.4).

It is important to consider the two main modes of acquisition: domestic production and foreign supply.

5.3.1 Domestic production

States develop laws, regulations, and administrative procedures to control and regulate the production of ammunition, irrespective of whether the production facilities are owned by a commercial enterprise or the state itself (see Section 3.3.1). For example, a licensing system may be utilized to facilitate government control and oversight of ammunition producers. Many states have ammunition production facilities, but only a limited number can devote the significant level of funding necessary to maintain dedicated national research, design, and development programmes and facilities to meet their needs (see Box 5.2).

In the UK, a licence is granted to manufacture small arms ammunition if the following criteria are met:

- conditions are satisfied regarding the manufacturing site (for example, construction and siting complies with separation distances and security is adequate);
- the hazard type, description, and maximum amount of explosives to be used for the manufacture of small arms ammunition in any one place at one time are considered safe; and
- a register of the facility's safety and security provisions is maintained along with records of all items produced (UK, 2014a).

The UK Health and Safety Executive has provided two guidance booklets to support implementation of these regulations: one deals with safety, the other with security provisions (UK, 2014b; 2014c).

Box 5.2

Production: research, development, and 'design for demilitarization'

Ammunition research and development can be expensive. Before ammunition that is being developed can be issued to national forces, it undergoes extensive testing to ensure that it meets transport, storage, environmental, and operational requirements. Segregated storage may be necessary until long-term safety has been certified, after which the test materials must be discarded (UNODA, 2015, mod. 06.10, para. 11.6.2).

Some procurement agencies have called on manufacturers to develop ammunition that allows for 'improved recycling and more efficient, cheaper future ammunition destruction and demilitarization systems' (UNGA, 2008a, para. 45). For example, NATO guidance promotes design for demilitarization 'to facilitate demilitarization and disposal using processes that maximize safety and minimize health hazards, negative environmental impacts, and life cycle cost' (NATO, 2001, pp. 4–5). This approach aims to ensure that:

- components can be disassembled easily;
- energetic materials can be removed;
- demilitarization processes can be used efficiently;
- munitions are safe to handle by operators throughout demilitarization processing; and
- reusable or recyclable components or materials can be economically recovered (NATO, forthcoming).

The overall aim is to ensure minimal environmental impact. There may also be cost savings for future development programmes through the use of recovered components and materials (NATO, forthcoming). However, design for demilitarization is challenging and therefore it remains prudent to invest in both surveillance and modernization (such as upgrading and repairs), as well as cost-effective demilitarization (see Section 7.3.2).

Box 5.3

Ammunition acquisition challenges in India

The Comptroller and Auditor General of India recognizes the need for a system-based approach for ammunition management. The agency's review of the Indian Army's ammunition management in 2008–13 found that the procurement of 125 out of 170 types of ammunition—74 per cent of the total—did not meet the 'minimum acceptable risk level' requirements of the Indian Armed Forces (CAG, 2015, p. iv).

The findings, released in 2015, indicate that India's Ordnance Factory Board (OFB) factories did not deliver the quantity of ammunition agreed with the Directorate General of Ordnance Services (DGOS), which is responsible for ammunition management, including procurement arrangements from the OFB and foreign suppliers. DGOS procures the overwhelming majority of its ammunition from OFB factories, in line with India's long-standing preference for domestic arms and ammunition (MoD of India, 2016; Singh, 1998, pp. 56, 65–66). This meant that insufficient quantities of ammunition were being supplied to fulfil DAER requirements. Further, the Directorate General of Quality Assurance, which carries out 'final acceptance' inspections, found defects in 71 of 123 types of ammunition that had passed OFB quality assurance controls during the same period (CAG, 2015, pp. v, 11, 29, 45).

As part of the review, the Comptroller and Auditor General issued a series of recommendations to address concerns regarding ammunition procurement (CAG, 2015, pp. 46–47). By 2017, however, no signs of significant improvement had emerged, underscoring that putting theory into practice is not always straightforward (CAG, 2017, p. 44). In this case, the Indian government continued to use a preferred producer due to political considerations, but the OFB was unable to provide suitable ammunition in the required quantities. As a result, the Indian government is now also turning to private industry in India to meet its needs (FICCI and CENJOWS, 2018; MoD of India, 2017).

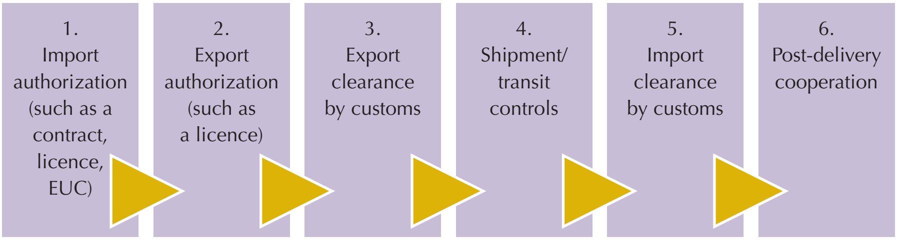
Oversight can help to ensure high standards during the production process (see Section 3.3.2). Box 5.3 illustrates how civilian oversight has led to the identification of deficiencies in India's acquisition of ammunition from domestic producers. It sheds light on the challenge of addressing known shortcomings, even when planning and procurement systems are in place.

5.3.2 Imports

States also develop laws, regulations, and administrative procedures to control and regulate the import, export, transit or transhipment, and brokering of military items and technologies, including ammunition (see Section 3.3.1).[12] To ensure tight control of the process, only a limited number of government agencies or ministries—and individuals—should be authorized to import ammunition (UNODA, 2015, mod. 03.30, para. 4.2.2; see Section 3.3.2). They are responsible for providing

12 The IATG provide guidance on 'effective and accountable controls' that govern international transfers of ammunition (UNODA, 2015, mod. 03.30, para. 1; mod. 03.40, para. 1).

Figure 5.2 Ammunition transfer control process



a written authorization to the exporter or exporting state for any imports. The authorization can take the form of a contract, licence, or end-user certificate, depending on the requirements of the exporting state (see Annexe 3). The competent authority in the exporting state can use the information provided by the importing state as part of the comprehensive risk assessment it conducts prior to authorizing or denying the ammunition export (Casey-Maslen, 2016, paras. 5.4–5.5; UNGA, 2013, arts. 6–7; see Box 7.2).

Once authorized for export, safe and secure transportation of ammunition is crucial (UNODA, 2015, mod. 08.10, paras. 5–8). The importing state can be asked to provide the exporting state with written confirmation of delivery—such as a delivery verification certificate—or to undertake other forms of post-delivery checks to demonstrate that the ammunition has not been re-exported or used in contravention of any provided assurances (mod. 03.40, para. 6.3). Figure 5.2 presents an overview of the stages in an ideal transfer control process.

Note It is essential that a competent authority keep a record of every stage of the transfer process and that ammunition packaging be marked clearly (mod. 03.10, para. 14.1; mod. 03.30, para. 12.8).

It is good practice for a designated procurement agency to liaise with agencies that are responsible for planning and stockpile management, as well as with the domestic producer or foreign supplier of ammunition.

5.4 Entry into service

Effective LCMA requires the registration and comprehensive record-keeping of ammunition throughout its life cycle—from research and development, through production, testing, shipment, and delivery, to utilization or disposal (OSCE, 2008,

p. 9). Accurate information on the type, nature, quantity, and condition of the ammunition procured, as well as where it is being kept at each stage in the procurement process, is important for safety and security (NATO, 2009a). This is particularly true at moments when the ammunition is susceptible to theft, loss, or an unplanned explosion.

As discussed, it is advisable for a state to test ammunition received from either domestic producers or foreign suppliers to ensure quality and functionality *before* its acquisition and entry into service. If the acquired ammunition is newly developed or has never been used by a state, it is likely that technical information will be required in addition to training on its use, storage, and surveillance. Such information can be part of a package provided by the producer or supplier. If the ammunition is already in use, a domestic training programme may already be in place.

5.5 Conclusion

This section highlights the importance of a robust normative framework to ensure safety and security at all stages of the procurement process, including appropriate demonstration and evaluation procedures to determine that ammunition is safe and suitable for service. To be able to test ammunition as part of life-cycle surveillance and in-service proofing (see Section 6.4.1), it is necessary to acquire samples, as well as the results of tests carried out by the producer. It is essential to keep a record of each stage of the acquisition process and of entry into service. Good cooperation between the national procurement agency and an ammunition supplier—whether domestic or foreign—in a range of areas including lotting, testing, and training helps to ensure safety and security.

—Author: Paul Holtom

SECTION 6

Stockpile management

6.1 Introduction

In order to meet operational and strategic requirements, as well as to ensure the safety and security of stored items, it is important that the national ammunition stockpile be properly managed. As this section explains, the comprehensive and sustainable management of the ammunition stockpile requires the development, implementation, coordination, and monitoring of a number of core functional activities and processes.

The stockpile management element of the Survey's LCMA model is based on the IATG—more specifically, the IATG 'core groups' of activities around which all stockpile management activities and processes are structured. This section describes each of these core groups (see Sections 6.4–6.9). It also highlights specific stockpile management processes, such as surveillance and in-service proofing (Section 6.4.1), inventory management (Section 6.6), and risk management (Section 6.10), all of which are critical to ensuring the availability of operational ammunition, as well as its safety and security.

As discussed in Section 3 of the Handbook, effective stockpile management hinges on the presence of an enabling environment. It also interacts with all of the other functional elements of LCMA, specifically planning, procurement, and disposal, which are discussed in greater detail in Sections 4, 5, and 7, respectively.

6.2 Delimiting stockpile management

Stockpile management begins when ammunition enters the stockpile and ends when it leaves, be it through:

- issuance (for training or operations);
- consumption (ammunition spent); or
- disposal (through exports or demilitarization).

Stockpile management also applies to:

- ammunition under development;
- ammunition acquired for demonstration and evaluation purposes (see Section 5.2); and
- the integration of new ammunition.

Note Prior to the integration of new ammunition, a stockpile management assessment is normally conducted to determine the adequacy of existing resources, activities, and processes, including from a safety and security perspective. In this way, the necessary resources can be mobilized in a timely fashion so that new infrastructure, equipment, procedures, staff, and training are in place before an item is introduced into the stockpile.

A number of milestone decisions need to be made—and reviewed and updated periodically—with regard to the adequacy of resources, infrastructure and equipment, and personnel to manage the existing stockpile. Similarly, a milestone decision will also need to be made regarding the introduction of new ammunition, with the goal of ensuring safe operations and the safety and security of the national stockpile.

6.3 The stockpile management 'core groups'

Stockpile management encompasses many complex and interrelated activities and processes. As noted, the stockpile management element of the LCMA model is based on the IATG, which consist of 45 modules that address all aspects of stockpile management, including associated activities and processes (see Box 1.2 and Annexe 1). The holistic approach of the IATG to stockpile management is consonant with the Survey's LCMA model.

The IATG identify six 'core groups' that comprise stockpile management, providing guidance on, and setting out detailed requirements for, activities and processes pertaining to them (UNODA, 2015, mod. 01.10, para. 4). To ensure effective stockpile management and reduce the risk of unplanned explosions and diversion, the core groups interact very closely, with individual activities depending on or influencing each other across group boundaries.

The six core groups are:

- ammunition storage;
- ammunition processing, maintenance, and repair;
- ammunition accounting;
- ammunition demilitarization and destruction;
- security of ammunition stockpiles; and
- transport of ammunition.

Sections 6.4 to 6.9 describe the core groups, offering a basic understanding of each and identifying key activities that affect multiple groups.

Note Destruction—the final conversion of weapons, ammunition, and explosives into an inert state—is a form of demilitarization, which refers to the range of processes that render ammunition unfit for purpose. Demilitarization is a form of disposal.

6.4 Ammunition storage

Much of the ammunition life cycle involves storage. It is important that ammunition be safely stored until it is needed to fulfil operational and strategic requirements. A wide range of activities and processes ensure that these objectives are met. Many IATG modules pertain to storage-related activities and processes, associated facilities, and supporting procedures that ensure that ammunition is kept operationally capable and safe. The IATG identify specific modules that are associated with ammunition storage (UNODA, 2015, mod. 01.30, para. 5).

Certain activities and processes involve monitoring the condition and safety of stockpile ammunition. Others relate to the availability of ammunition. Continuing vigilance in these areas, including with respect to the detection of ammunition-related losses, limitations, and restrictions, is essential—especially since the procurement of new ammunition is often a lengthy process. The following subsections discuss the main stockpile-management-related processes that can affect ammunition availability.

6.4.1 Surveillance and in-service proofing

Every ammunition item—and its packaging—has a finite life and naturally ages over time, potentially degrading both performance (operational effectiveness) and safety. The safety and stability of ammunition is established through a comprehensive 'ammunition surveillance' programme (UNODA, 2015, mod. 07.20, para. 4); meanwhile, its performance is assessed through in-service proofing (para. 7.2). Together, these two fundamental components of stockpile management ensure that the ammunition stockpile is both safe and operationally effective. The IATG provide guidance and set out the requirements for such surveillance and in-service proofing programmes (mod. 07.20).

Box 6.1

The importance of propellant stability testing

Nitrocellulose-based propellants pose a significant safety threat. The nitric ester constituents of all nitrocellulose-based propellants, such as nitroglycerin and nitrocellulose, slowly decompose even at moderate temperatures. The degradation products that are formed can reduce chemical stability to the point where the propellant can self-ignite. To reduce the probability of such adverse effects, small quantities of stabilizing compounds are added to propellant formulations during manufacture to react with propellant degradation products (NATO, 2008b, p. 1-1). The stabilizing compounds do not stop the degradation process, however. As the process continues, the stabilizing compounds become increasingly depleted. Once depleted beyond a certain point, the safety threat becomes dire, requiring immediate action.

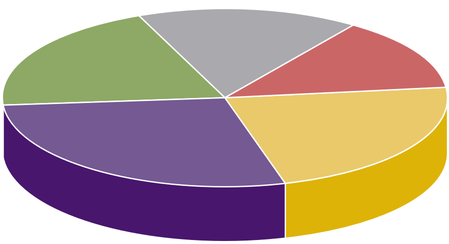
Stability testing is used to determine the stabilizer depletion level of a nitrocellulose-based propellant. Such testing assesses the amount of remaining stabilizer in the propellant and determines whether it has dropped below a safe level. Propellants that have been subjected to a prolonged storage at temperatures above ambient require additional attention and testing.

The mere physical presence of nitrocellulose-based propellant at a given location is often a source of concern. Artillery and small arms propellants rank among the most dangerous materials that national armed forces routinely handle and store. These propellants are often unpredictable, in some cases becoming unstable within four or five years of manufacture. Inadequate propellant safety programmes have contributed to several self-ignition incidents at US Army installations (DAC, 1998, p. 1-1).

Such testing can identify problems that affect the safety of certain ammunition or its suitability for intended uses. For example, surveillance can alert a state to abnormally low propellant stabilizer levels, which call for the immediate destruction of the affected lot (UNODA, 2015, mod. 07.20, para. 13). This aspect of ammunition surveillance is especially critical for ammunition containing nitrocellulose-based propellants, which is common throughout the world (see Box 6.1; Section 4.3.3).

The importance of surveillance and propellant stability testing is further illustrated by Figure 6.1, which identifies a ‘lack of surveillance’ as one of five main causes of documented UEMS incidents from 1979 to early 2018 (see Section 2.2).

Figure 6.1 UEMS root causes, 1979–February 2018



Legend

- Lack of surveillance
- Inappropriate storage systems and infrastructure
- Handling errors and inappropriate working practices
- Failure to take into account external, environmental influences and events
- Poor security

Source: Small Arms Survey (n.d.)

6.4.2 Bans and constraints

Issuing bans and constraints is another fundamental component of stockpile management. They ensure that a user receives ammunition that is safe to use and will perform according to agreed ballistic and performance criteria (UNODA, 2015, mod. 01.70, p. iv).

Bans and constraints can result from surveillance and in-service proofing (see Section 6.4.1), an accident (pending investigation), the results of an accident investigation (see Section 6.10.2), information received from an ammunition producer or another state, or other reasons. The IATG set out in some detail the various reasons for issuing bans and constraints (UNODA, 2015, mod. 01.70, paras. 6.1, 7.1).

6.4.3 Ammunition returning from training and operations

Ammunition that has been issued but not utilized during training and operations is sometimes exposed to unfavourable and damaging conditions, whether as a result of improper transport and handling or through environmental exposure.

US ammunition specialists comb through turn-ins to identify serviceable ammunition. Afghanistan, March 2013.
Source: Summer Barkley

Such ammunition is potentially unsafe or non-functional and requires rigorous inspection and possibly repairs. Only safe and functional ammunition is returned to storage, some of it with bans or constraints. Ammunition that is clearly unsafe, however, has to be discarded (see Section 2.2; Box 2.1).

Consistently large returns of issued ammunition may indicate the need to reassess issuance rates. Such returns are very inefficient from a stockpile management perspective and can have a significant impact on the availability of ammunition for training and operations, as well as on utilization rate planning and procurement. Ammunition that has been issued but not consumed is also at greater risk of diversion as it is not subject to the same security procedures that apply to stockpiled ammunition.

6.4.4 Ammunition designated for disposal

The national stockpile invariably includes ammunition that is designated for disposal, be it for sale, donation, or demilitarization. Such ammunition is allocated to stockpile 'disposal accounts', which are not available for operational purposes. Such accounts are often very large, primarily due to the difficulty of assembling the resources and means needed for demilitarization.

Disposal accounts require storage space, as well as resources for management and disposal. It is extremely risky to delay disposing of unsafe ammunition. The timely disposal of unsafe ammunition ensures it does not become a major problem and also reduces the potential for diversion. The longer unsafe ammunition remains in storage, the greater the likelihood of an unplanned explosion and of diversion.

6.5 Ammunition processing, maintenance, and repair

Efforts to assess and maintain the safety and functional capabilities of ammunition include the handling, inspection, processing, maintenance, and testing of ammunition and its packaging, as well as its occasional repair and upgrading. Ammunition under development and ammunition acquired for demonstration and evaluation purposes needs to be processed in the same manner, as does ammunition that is integrated into the stockpile for the first time.

This IATG core group covers all of the processes and supporting components needed to accomplish the above activities in a safe and secure manner. It includes ensuring that appropriate infrastructure and equipment, trained personnel, and adequate procedures and resources are in place.

A number of IATG modules address the development, coordination, management, and monitoring of ammunition-processing-related activities, including the facilities for such processing, as well as the supporting activities needed to keep ammunition fully operational, safe, and secure. The IATG identify the specific modules that are associated with ammunition processing (UNODA, 2015, mod. 01.30, para. 5).

6.6 Ammunition accounting

With respect to accounting, the IATG address:

- stockpile inventory management (see Box 6.2);
- lotting and batching;
- ammunition import and export;
- the end user and end use of internationally transferred ammunition; and
- ammunition tracing (UNODA, 2015, mods. 03.10–03.50).

Box 6.2

Inventory management

Inventory management is a key component of stockpile management. It is also central to the other functional elements of LCMA. Effective planning, procurement, and disposal, along with resource allocation more generally, depend on a state's awareness of what quantities of ammunition it has, the types and condition of that ammunition, and whether it can meet national strategic and operational requirements.

Information entered into the inventory management system is not only crucial in communicating the status of the ammunition stockpile. It also provides the ability to rapidly detect inaccurate records, loss, theft, leakage, and diversion from the national stockpile, thus enhancing overall control. Conversely, ineffective stockpile accounting systems significantly increase the risk of unplanned incidents and diversion (UNODA, 2015, mod. 03.10, p. v).

Inventory management refers to the systems and processes that specify stockpile requirements, assess the condition of a stockpile, identify replenishment options, and record the actual and projected status of the inventory (UNODA, 2015, mod. 01.40, para. 3.151). Proper inventory management ensures the safety of personnel working with and around ammunition, optimizes the use of stockpile ammunition (an expensive asset), controls the issuance and use of ammunition, and allows for the timely and reliable detection of losses and diversions (mod. 03.10, para. 4). The IATG provide further information on the concept of inventory management, the processes involved, and their contribution to effective stockpile management (mod. 03.10).

6.7 Ammunition disposal

Section 7 of the Handbook addresses the topic of ammunition disposal. Yet, until physically removed from the stockpile through a disposal action (such as an export or demilitarization), ammunition designated for disposal is managed in accordance with the same procedures that apply to other items in the stockpile (such as for storage, accounting, inspection, maintenance, surveillance—including propellant surveillance—and transport).

Once actual disposal starts, such ammunition is handled, prepared, and transported for shipment (in the case of a sale or donation), or handled, transported, and processed for disposal (in the case of demilitarization) in accordance with the stockpile management processes applicable to the five other core groups.

The IATG specifically address the safe planning and execution of ammunition destruction and other demilitarization activities in support of stockpile management (UNODA, 2015, mod. 10.10).

6.8 Stockpile security

Ammunition stockpile security measures are aimed, above all, at reducing the risk of diversion. In covering security principles and systems, the IATG provide guidance for the development and implementation of physical security systems, processes, and activities designed to ensure ammunition stockpile security (UNODA, 2015, mod. 09.10). They include a series of basic, practicable measures, such as security plans, the selection of reliable and trustworthy personnel, personnel training, security regulations and procedures, and access control. These measures are broadly achievable and help prevent theft, leakage, and proliferation of stored ammunition (p. v).

In this context, the IATG place an emphasis on infrastructure and systems that can help prevent, limit, and monitor unauthorized access, such as hardened storage facilities, perimeter fencing, intrusion detection systems, and cameras (UNODA, 2015, mod. 09.10). The aim is to deter or reduce unauthorized access by making breaches difficult. In the event such breaches do occur, the IATG seek to ensure their immediate detection and notification of appropriate security personnel.

Implementation of these basic measures, in conjunction with infrastructure and perimeter systems designed with physical security in mind, can be extremely effective in deterring unauthorized access to a stockpile. As noted in Box 6.2, inventory management also plays a key role in security as it provides for the timely and reliable detection of diversion.

6.9 Ammunition transport

The transport of ammunition involves:

- its preparation (including proper packaging);
- the marking of the packaging with basic information such as its contents and hazard classification;
- the securing of the shipment in its mode of transport (road, rail, sea, and air); and
- the actual movement of the ammunition.

It is crucial that all of these activities be conducted with safety and security in mind and in conformity with national and international regulations governing the movement of ammunition within a country and beyond its borders.

Instead of developing their own regulations for the in-country movement of ammunition, most states have adopted internationally accepted regulations for the movement of 'dangerous goods' (including ammunition) for both in-country and international ammunition shipments. This eliminates the need for a state to maintain two distinct sets of ammunition movement regulations and simplifies the movement of ammunition between states.

The IATG describes the international regulations that are applicable to the transport of dangerous goods, in particular the UN Globally Harmonized System of Classification and Labelling of Chemicals, which governs the classification and labelling of chemicals, along with other safety data. The system applies to both civilian and military ammunition, as well as all modes of transport (UN, 2017b; UNODA, 2015, mod. 08.10, para. 4; see Box 6.3).

The UN *Recommendations on the Transport of Dangerous Goods Model Regulations*, complementing the Globally Harmonized System, contain details of the hazard classifications, including applicable symbols (UN, 2015; UNODA, 2015, mod. 01.50, para. 4). Other international transport standards covering specific modes of transportation (road, rail, sea, and air) build on these two documents with more detailed, transport-mode-specific regulations and requirements.[13]

13 International transport standards include UNECE (2017) and ICAO (2011).

Box 6.3

Hazard classification

Ammunition imported into a state needs to be classified according to the principal hazard it presents, in line with applicable international regulations, as does ammunition exported from a state. Proper hazard classification of ammunition is a fundamental component of IATG-based stockpile management. The hazard classification assigned to an ammunition item (based on the testing of its packaged shipping configuration) allows risk to be managed to a tolerable level, whether through the application of quantity and separation distances or the conduct of risk assessments (UNODA, 2015, mods. 02.10, 02.20).

The IATG provide details on the UN hazard classification system and its application (UNODA, 2015, mod. 01.50).

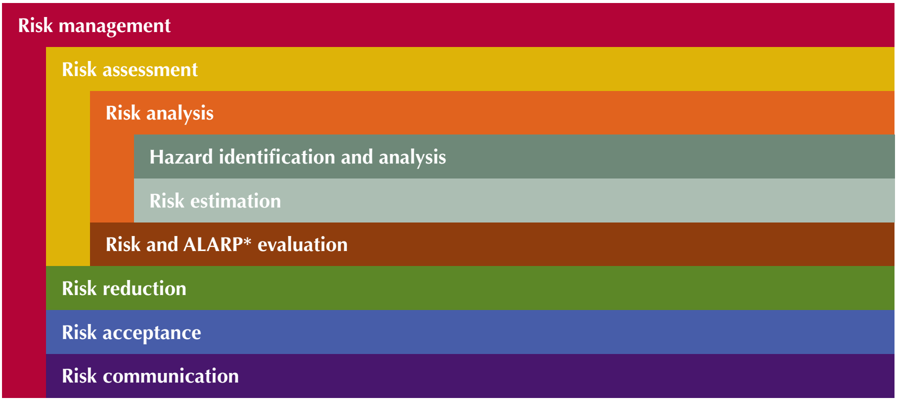
Example of a UN hazard classification sign.

A US soldier oversees the preparation of an ammunition transport mission. Afghanistan, March 2016. Source: US Army

6.10 Risk management in the context of stockpile management

The Small Arms Survey's UEMS database recorded more than 500 incidents for the period from 1979 to February 2018 (Small Arms Survey, n.d.). These resulted in nearly 29,000 casualties—an average of 50 casualties per incident. The incidents claimed military and civilian lives, caused injuries, and damaged and destroyed infrastructure, national assets, and private businesses and homes. These statistics clearly show that the threat from ammunition is real and exists wherever ammunition is located, especially if it is improperly managed and monitored.

Figure 6.2 IATG 'risk management matrix'



Note: * ALARP stands for 'as low as reasonably practicable', as determined using technical and explosive engineering judgement.
Source: UNODA (2015, mod. 02.10, para. 6.1)

Management of the risks inherent to ammunition storage is a fundamental component of stockpile management (see Section 2.3). Adherence to the IATG fulfils many of the requirements of an integrated risk management system (UNODA, 2015, mod. 02.10, p. v). The IATG introduce the concept of risk management and describe the activities accompanying the management of risks relating to the ammunition stockpile. Although their primary focus is on reducing storage-related risks to the civilian community, the IATG include risk estimation techniques that can be used for other aspects of stockpile management (UNODA, 2015, mod. 02.10, para. 1). Drawing on accepted scientific and engineering principles, risk management can both reduce the likelihood of unplanned explosions and mitigate the consequences of such an accident if one does occur.

Wherever adherence to minimum safety standards is not possible, authorities can turn to the IATG for step-by-step guidance regarding the conduct of a 'consequence analysis', an 'explosion safety case', or a risk assessment using SaferGuard Toolkit software tools and forms.[14] These risk-based assessment methodologies can help to identify—for the relevant authority—existing risks, as well as the means of reducing those risks to the maximum extent possible. Figure 6.2 outlines the overarching risk management approach of the IATG, in particular the relationship between the different components of risk management (UNODA, 2015, mod. 02.10,

14 Relevant forms are available at UN SaferGuard (n.d.c).

para. 6.1). The IATG also offer detailed explanations of each component of risk management and techniques for stockpile management (paras. 6–13).

6.10.1 IATG risk reduction process level approach

The IATG provide an ammunition security and safety framework that incorporates risk management. Based on this framework, individual states can establish their own programmes and develop their capabilities in line with national resources. As noted in Section 2.3, the IATG explain how to perform stockpile management at three progressive risk reduction process levels—RRPL 1 (basic), 2 (intermediate), and 3 (advanced)—depending on the infrastructure, equipment, and financial and technical resources at a state's disposal (UNODA, 2015, mod. 01.20). States are advised to:

> *maintain stockpile management processes at RRPL 1 as a minimum. This will often reduce risk significantly. Ongoing and gradual improvements could then be made to the stockpile management infrastructure and processes as staff development improves and further resources become available. These additional actions would equate to RRPLs 2 and 3* (UNODA, 2015, mod. 06.20, p. iii).

The IATG provide detailed guidance for achieving RRPLs 1, 2, and 3 (UNODA, 2015, mod. 01.10, p. iii, para. 6.5; mod. 01.20). As a first step, a country assesses its conformity with relevant IATG requirements and the RRPL associated with them. It then determines its priorities in moving towards compliance with such requirements, taking account of its capabilities and resources. As noted in the IATG, a country can progressively and incrementally reduce stockpile risk as a function of staff development and available resources.

6.10.2 Accident reporting and investigation

The reporting and investigation of accidents and other incidents involving the ammunition stockpile, as well as the actions taken in response to them, are key components of stockpile risk management. Although most accidents are preventable, perfect safety is unattainable; even the best processes and most highly trained personnel cannot ensure that accidents will never occur. Steps can be taken to reduce risk and improve safety generally, however. Accident reporting and investigation, in particular, can serve to determine the cause of an incident, identify

Box 6.4

The Small Arms Survey's Incident Reporting Template

The Small Arms Survey has developed an UEMS Incident Reporting Template (IRT) to standardize and encourage the collating of information in support of accident reporting and investigations. The IRT addresses six UEMS-related questions:

- When did the UEMS incident occur?
- Where did the UEMS incident occur?
- Who owns the site and the contents on it?
- Why did the UEMS incident occur?
- What happened as a result of the explosion?
- How did the state and the international community respond?

The IRT promotes accurate record keeping and the sharing of systematized data. It is available in Arabic, Bosnian-Croatian-Montenegrin-Serbian (BCMS), English, French, Portuguese, Russian, Spanish, and Swahili.

Source: Berman and Reina (2014)

what actions are needed to prevent similar future occurrences, and generate broad lessons learned. Such a process is aimed not at assigning blame, but at improving safety and reducing risk.

It is especially important that the stockpile management system include an accident reporting and investigation process that encourages the immediate reporting of an ammunition or ammunition-related accident, including any 'near misses' (see Box 6.4).[15] Follow-up investigations have consistently found that ammunition-related accidents and incidents rarely occur due to one isolated event, but are typically the result of successive, individual failures.

Examples of actions that might result from an investigation include new or revised processes and procedures, the retraining of personnel, the correction or improvement of ammunition designs or infrastructure, and the imposition of bans or constraints (see Section 6.4.2). Two IATG modules address ammunition accidents, reporting, and investigations, outlining the basic considerations applicable to these areas and providing a methodology for the conduct of an investigation (UNODA, 2015, mods. 11.10, 11.20).

15 A 'near miss' is an occurrence involving ammunition or an ammunition-related activity that only by chance did not result in an accident or incident. Examples might be an ammunition item that is dropped, a flash and smoke observed during a cleaning operation, the collapse of a stack of ammunition containers, or a forklift operator driving the lift forks into an ammunition container.

6.11 Conclusion

To meet operational and strategic requirements—and to ensure the safety and security of stored items—it is important that the national ammunition stockpile be properly managed. Comprehensive and sustainable stockpile management is thus a key component of LCMA.

The stockpile management approach described in this section of the Handbook is based on the six IATG 'core groups' of activities, each of which has a specific function or role to play in stockpile management. Other key stockpile management processes, such as surveillance and inventory management, underpin specific core groups and interact with others to ensure that ammunition is available to fulfil operational needs while remaining safe and secure.

Risk management is another critical stockpile management process. It is reflected in the RRPL approach adopted by the IATG, which helps a country manage risks relating to its ammunition stockpile in line with its capabilities and resources. Accident reporting and investigation help to bolster risk management and to reduce ammunition risks further, thereby improving the safety of the national stockpile.

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SECTION 7

Disposal

7.1 Introduction

Disposal is the removal of unsafe, unserviceable, obsolete, or excess ammunition from the national stockpile. A state's decision to dispose of ammunition, as part of a national disposal review, is the first step in the disposal process, and a number of factors can influence that decision. Disposal ends with the physical removal of disposal-designated ammunition from the stockpile as a result of a disposal action.

In the past, various disposal methods were available to a state. However, in the current environment, which is focused on reducing illicit ammunition activities and conducting disposal in an environmentally sound manner, only two internationally accepted disposal methods remain: exports (sales or donations) and demilitarization. Of these two, demilitarization—excluding open burning (OB) and open detonation (OD)—is preferred. A number of technologies are potentially available for demilitarization, each one with advantages and disadvantages. This section identifies some of the factors that need to be considered when selecting a suitable process.

Two important components of the disposal element are:

- stockpile management of disposal-designated ammunition; and
- risk management of the demilitarization process, associated facilities and locations, and related activities, including munitions emergency response and the decommissioning of sites.

This section addresses both components.

Note A national disposal review is a thorough, in-depth process designed to ensure that each disposal action is economically viable, suitable given the state of the ammunition and the amount to be disposed of, consistent with international agreements, and in line with applicable national safety, security, and environmental regulations.

7.2 Historical methods of disposal

Historically, the following six disposal methods were available to states:

- sales (exports);
- gifts or donations (exports);
- reallocation for training;

- deep-sea dumping;
- landfill; and
- demilitarization, including destruction (UNODA, 2015, mod. 10.10, para. 4).

Today, some of these methods are banned and others are highly discouraged.

One of the key LCMA-related milestones is the decision regarding when a state chooses to dispose of its ammunition. Once that decision is made, selecting the appropriate disposal method can be a complicated process—one that is influenced by many factors.

In recent times, environmental considerations have become critical to disposal decisions. Moreover, international treaties and other legal considerations may require intensive management of a demilitarization process (NATO, 2015a, p. 33).

Some of the disposal methods listed above are banned or discouraged, as follows:

- **Sea dumping** is *banned* by the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ('London Convention') and its 1996 'London Protocol' (IMO, 1972; 1996).
- **Dumping into lakes and burial in landfills** is *strongly discouraged* by the United Nations as both methods contribute to land and water contamination and simply pass on hazards, threats, and cleanup expenses (UNODA, 2015, mod. 10.10, para. 4).
- **Destruction involving OB and OD** is *increasingly discouraged* by states due to health concerns and environmental contamination of soil, groundwater, and air (NATO, 2001; see Box 7.1).

Although OB and OD are increasingly discouraged, the reality is that these methods will continue to be used for destruction of ammunition, including by many developing and conflict-affected states, for example, because they can be cost-effective and do not require sophisticated infrastructure and equipment. OB and OD may be the most expedient method of disposing of large quantities of surplus or unserviceable munitions when other risk factors are considered, such as diversion or UEMS. The need to balance the use of OB and OD against competing interests and requirements is part of a state's decision-making process (UNODA, 2015, mod. 10.10, p. vi, para. 9).

Due to environmental concerns, these methods will come under increased scrutiny, with a view to further reduction and elimination. Consequently, it is prudent to limit the use of OB and OD to unsafe ammunition disposal, when expedient destruction is deemed necessary and no other practical or feasible technology is available.

Box 7.1

OB and OD environmental hazards

A study from Canada concluded that activities involving ammunition and explosives—such as training, the destruction of small arms ammunition, and OB/OD operations—contaminate the area surrounding the activity with energetic materials, such as TNT, RDX, and nitrocellulose, and heavy metals such as lead and chromium.

The study recommends that demilitarization operations be conducted by controlled destruction in most cases, including for small arms ammunition. It suggests that OB and OD techniques be used only for unconfined bulk energetic materials and projectiles containing high explosives, and for dealing with misfired and dud ammunition items, including unexploded ordnance. It calls for the permanent banning of static furnaces. Furthermore, the study urges officials to review disposal-designated ammunition on a case-by-case basis.

Source: Boulay (2003, p. i)

Unserviceable ammunition is destroyed in a controlled open detonation in Afghanistan, October 2014.
Source: Alamy Stock Photography

7.3 Management of disposal-designated ammunition

Until it has been physically removed from the stockpile, disposal-designated ammunition is treated as part of the national stockpile (UNODA, 2015, mod. 01.30, para. 8; mod. 01.40, para. 3.180). As such, it is managed in accordance with the stockpile management requirements discussed in Section 6.

This section considers the management of disposal-designated ammunition with a focus on the two internationally acceptable methods of disposal. These are:

- exports (sales or donations); and
- demilitarization.

Note In an effort to prevent, combat, and eradicate the illicit trade in small arms and light weapons, the international community discourages the export of excess ammunition. Demilitarization is the preferred disposal option. If an export is pursued nonetheless, it should occur in accordance with international treaties, agreements, or instruments that govern a state's disposal decisions (OSCE, 2012, p. 10).

7.3.1 Exports: sales or donations

While international guidelines on best practice emphasize disposal through demilitarization, many states prefer to export ammunition to save on demilitarization costs or to generate income from earlier investments. Such sales or donations are only possible if a market exists for used and aged ammunition, which is rarely the case. Other considerations related to exports are the following:

- **National and international controls**. A number of international treaties and agreements include provisions on the export of ammunition, with a view to limiting illicit sales and preventing the sale of certain banned or restricted ammunition items, such as anti-personnel mines or cluster munitions (UNODA, 2015, mod. 10.10, para. 5). The IATG provide guidance on the development and implementation of effective and accountable national controls over international transfers of ammunition—covering imports, exports, transit, transhipments, and brokering—as well as issues related to enforcement, international cooperation, and public and parliamentary transparency (mod. 03.30, para. 1).
- **End use**. National controls are in place to ensure that international ammunition shipments are legally transferred to the declared end user for the declared end use. These controls are essential for any ammunition transfer control system

Box 7.2

ATT prohibitions and export risk assessment criteria

Article 6 of the ATT prohibits the authorization of a transfer of ammunition if it violates a UN arms embargo or relevant international agreement, or if the state party:

> has knowledge at the time of authorization that [the ammunition] would be used in the commission of genocide, crimes against humanity, grave breaches of the Geneva Conventions of 1949, attacks directed against civilian objects or civilians protected as such, or other war crimes as defined by international agreements to which it is a party (UNGA, 2013, art. 6).

Article 7 of the ATT outlines the process a state must undertake before authorizing the export of ammunition. It states that ATT states parties shall not authorize an export if there is an overriding risk that the ammunition would 'undermine peace and security' or that it could be used to commit or facilitate a violation of international humanitarian law or international human rights law, or to 'commit or facilitate an act constituting an offence under international conventions or protocols' relating to terrorism or transnational organized crime to which the exporting state is a party (UNGA, 2013, art. 7).

and are indispensable in combating and preventing diversion from the legal market (UNODA, 2015, mod. 03.40, p. v). States parties to the Arms Trade Treaty (ATT) are prohibited from supplying ammunition if authorizing the transfer would violate their international obligations; they are also obliged to conduct a risk assessment prior to authorizing any transfers (Casey-Maslen, 2016, pp. 55–70; UNGA, 2013; see Box 7.2).

- **Cross-border movements**. Cross-border movements of ammunition destined for demilitarization need to be managed and accounted for in accordance with the relevant provisions of the IATG, so as to ensure accountability and to prevent illicit activities and improper use (UNODA, 2015, mods. 03.20, 03.40). In addition, it is essential that all international transfers of ammunition comply with UN hazard classifications and international transport of dangerous goods regulations, as detailed in the IATG (mods. 01.50, 08.10; see Section 5.3).

7.3.2 Demilitarization

The purpose of demilitarization is to render ammunition unfit for its originally intended purpose. It requires significant financial resources (see Box 7.3). Ideally, demilitarization is considered early in an ammunition item's life cycle, as part of its design or procurement process (see Box 5.2). Such steps ensure that budgets can be allocated and procedures put in place before demilitarization occurs. Early planning is rare, however, and an appropriate demilitarization process is often

Box 7.3

Examples of disposal costs

Georgia. As part of a project conducted in Georgia in 2008, close to 9,000 missiles and rockets were destroyed. With a budget of EUR 478,000 (nearly USD 690,000), the project entailed the dismantling of 1,080 surface-to-air S-8 missiles, 5,724 Alazan rockets, and 1,976 Kristall anti-hail rockets (agricultural cloud seeding missiles) (NATO, 2008c).

Belarus. Belarus destroyed 3.4 million PFM-1 mines using a mobile plant with a cold detonation chamber (a thick-walled armoured kiln) at a cost of EUR 3.9 million (USD 5.4 million). The technology safely disposed of chemical components and remaining waste in an environmentally acceptable process that met the highest Belarusian and European environmental standards (APMBC ISU, 2017).

Serbia and Montenegro. In 2007, a project to destroy 1.4 million landmines at a cost of EUR 1.7 million (USD 2.3 million) was completed in Serbia and Montenegro. Under a project in 2003, 28,000 small arms and light weapons had been destroyed at a cost of EUR 375,000 (USD 424,000) (NATO, 2017a, p. 1).

United States. As of February 2015, the US conventional ammunition awaiting demilitarization and disposal was approximately 529,373 tons, which included 3,533 tons of serviceable small arms ammunition. The Department of Defense estimates that from fiscal year 2016 to 2020, it will add an additional 582,789 tons of conventional ammunition to this stockpile. In fiscal year 2015, it spent approximately USD 118 million on the demilitarization and disposal of conventional ammunition (GAO, 2016, p. 126).

identified—and resources for it allocated—after a disposal decision has been made (see Sections 3.2.2 and 4.4).

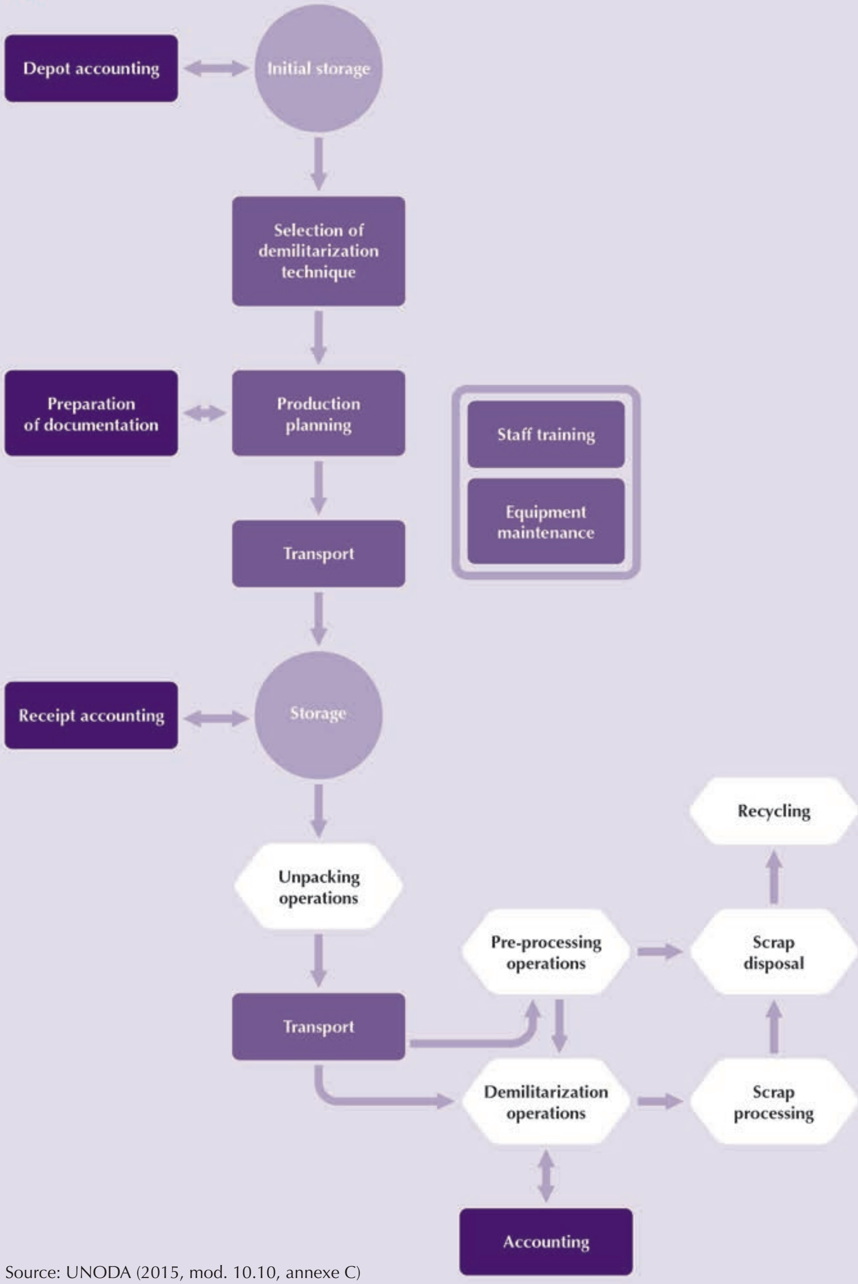
Figure 7.1 presents a typical demilitarization cycle, illustrating how complex, comprehensive, and wide-ranging the process can be. It shows that the physical demilitarization of ammunition is only one aspect of the cycle, which includes:

- transportation;
- storage;
- processing;
- operations;
- equipment maintenance;
- staff training; and
- accounting.

It is important that planners understand and fully assess the full range of processes in the cycle before opting for demilitarization as a disposal solution (UNODA, 2015, mod. 10.10, paras. 6–7; see Section 4).

A wide range of technical factors need to be considered as part of demilitarization plan development (UNODA, 2015, mod. 10.10, paras. 6–7). Many resources list available techniques and processes, including their advantages and disadvantages

Figure 7.1 The IATG demilitarization cycle

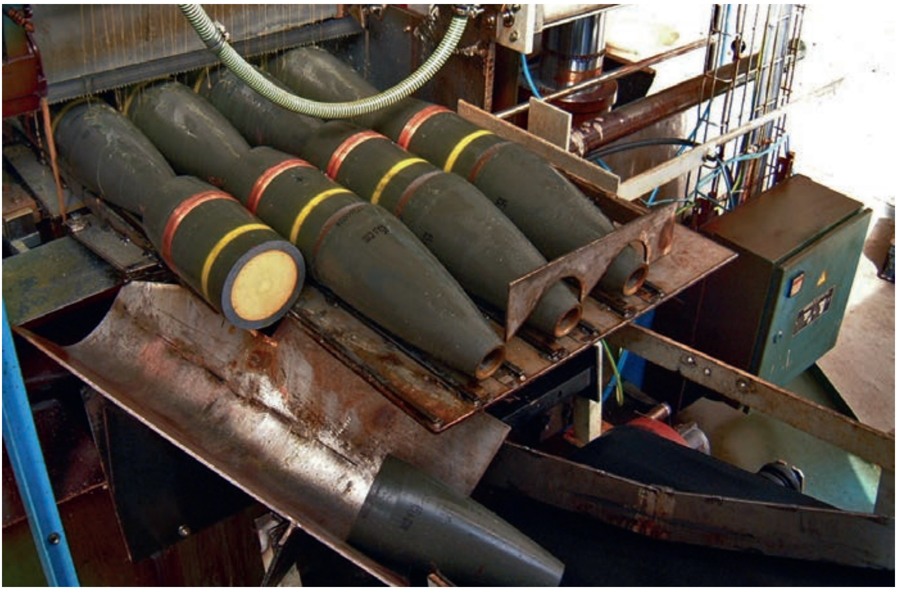


Source: UNODA (2015, mod. 10.10, annexe C) (see the 'Further reading' section). These can range from OB- and OD-based techniques to highly sophisticated industrial approaches. Generally speaking, the more ammunition is involved, the larger the economy of scale, and the greater the range of affordable and efficient technologies available. States can also consider cooperative approaches—such as a regional or alliance-based approach—to demilitarization (OSCE, 2008, p. 145; UNODA, 2015, mod. 10.10, para. 7.5; Box 3.3).

In summary, the selection of an appropriate demilitarization process is dependent on a wide range of factors (UNODA, 2015, mod. 10.10, para. 7). These include:

- available demilitarization options;
- available resources (such as funding, facilities, trained personnel, technology);
- physical conditions (whether the ammunition is safe to transport);
- the amount, type, and quantity of ammunition to be demilitarized;
- national capacity (to include the use of contractors);
- governing safety and environmental legislation; and
- international legislation, instruments, and agreements.

Demilitarization costs can potentially be offset through the recovery, recycling, and reuse—or 'R3'—of ammunition, as appropriate and feasible. Not all categories



The saw-cutting of high-explosive projectiles exposes their energetic content, after which the components travel on a conveyor belt to the next station to melt out the explosives. Lübben, Germany, 2012. Source: Spreewerk Lübben GmbH of ammunition can undergo such a process. R3 techniques break down munitions into their basic, recyclable component parts and compounds, which can then be sold to help offset demilitarization processing costs. Choosing such a technique involves selecting an appropriate process based on the availability of markets for alternative use, or sale, of process and waste materials, such as scrap metal,[16] explosives used in mining, or fertilizers.

If permitted by national regulations, surplus disposal methods—including resale and recycling—can offer greater rewards to states than the retention of unserviceable and aged surplus stockpiles. Experts estimate that R3 approaches can reduce demilitarization costs by 30 to 60 per cent or more (Lazarević, 2012, p. 30). Such savings do not imply that demilitarization is a highly profitable business, however:

> *Set-up and running costs are relatively high. In addition, while some scrap metals generate relatively high revenues, items such as missiles yield large quantities of non-recoverable materials such as glass fibre and electronics, which can increase disposal costs, instead of offsetting them* (Lazarević, 2012, p. 30).

Note At the international level, demilitarization has moved towards techniques that are environmentally acceptable, practical, physically safe, free from health hazards, cost-effective, and able to maximize the benefits of R3.

A number of milestones are related to disposal, including the decision to dispose of ammunition; the selection of a disposal method and process (in the case of demilitarization); the completion of disposal activities; and certification that ammunition has been disposed of properly and in accordance with a disposal decision. The details of such milestones should be recorded and reported to relevant personnel involved in all of the LCMA elements, so as to inform and facilitate planning, procurement, stockpile management, and further disposal activities, as well as the development of lessons learned.

7.4 Risk management for demilitarization

Section 6.10 addresses risk management from a stockpile management perspective. This subsection considers risk management in the context of demilitarization.

16 Scrap should be certified as free from explosive hazards prior to sale or use for other purposes.

Demilitarization can lead to significantly greater risks than those associated with new ammunition, including for the following reasons:

- **Age**. Ammunition due to be demilitarized is generally older and may have exceeded its shelf life.
- **Unclear history**. Storage and handling conditions may be unknown; the ammunition may never have been in surveillance or propellant stability programmes; and it may have been subjected to rough handling and be damaged internally, or have been exposed to adverse environmental conditions, which may have led to physical deterioration.
- **Damage**. Internal damage, corrosion, and other dangerous conditions may exist (such as exudation or crystallization).

Demilitarization operations can be conducted safely, provided that sufficient planning and effort goes into identifying and assessing risks, selecting the right demilitarization process and equipment, developing operating procedures (including consideration of all possible contingencies), and utilizing properly trained and qualified personnel.

As noted in Section 6.3, the IATG requirements establish a basic level of risk management for all six core groups, including ammunition demilitarization. Risk assessments of each demilitarization operation should be conducted in accordance with the IATG; the results can inform the development of both preventive and protective measures. As with any other operation involving ammunition, there may be specific risk management concerns and increased vigilance may be necessary during demilitarization operations (UNODA, 2015, mod. 02.10).

Advanced planning is key to fully addressing ammunition disposal methodologies and risks, with a focus on reducing costs and ensuring appropriate equipment and training for individuals assigned to accomplish safe and efficient disposal and decommissioning tasks (see Section 4.3.3).

As part of risk management for demilitarization, two important additional processes may be necessary:

- a munitions emergency response; and
- the decommissioning of contaminated sites.

Such responses require the participation of specially trained individuals, as discussed below.

7.4.1 Munitions emergency response

Even if the necessary precautions are in place, an unusual or unsafe situation may require explosive ordnance disposal (EOD) personnel to coordinate a munitions emergency response. Such situations can involve spilled or dropped ammunition or explosives, exudation or other unsafe conditions, or an accident. In such cases, only EOD personnel may assess and deal with the situation; all other personnel should be evacuated.

Another issue concerns the large quantities of unsafe excess ammunition in the stockpiles of many post-conflict, developing, and other countries. In these scenarios, an EOD clearance operation may be required to render relevant areas safe. The IATG address the management of, and techniques used in, such clearance operations, including following an unplanned explosive event. In this context, the IATG discourage the use of 'demining' standard operating procedures, which are not specific to post-explosive clearance and may thus not be safe or efficient. Post-explosive clearance operations require greater technical knowledge than that needed for mine or unexploded ordnance clearance (UNODA, 2015, mod. 11.30, p. iv).

40mm smoke rifle grenades found at the Car Dusan ammunition storage site in Rudo. Bosnia and Herzegovina, 2010.
Source: OSCE/EUFOR

7.4.2 Decommissioning of sites

Despite good maintenance practice, equipment, facilities, and land may become contaminated with propellants, explosives, and other contaminants during demilitarization activities. Until proven otherwise, all equipment, facilities, and areas used to store, handle, and process demilitarization activities should, therefore, be considered contaminated.

Upon completion of demilitarization activities and before use for other purposes, all the equipment, facilities, and land that were used should be inspected, decontaminated, and certified as free from explosive hazards. Decontamination plans and procedures are based on hazards identified by risk assessments. Clean-up and certification should be accomplished by qualified personnel familiar with the requisite processes and record-keeping, including certifications. The IATG provide guidance on related certification (UNODA, 2015, mod. 06.50, para. 7.2).

7.5 Conclusion

All national ammunition stockpiles contain ammunition that needs to be disposed of at some point. The disposal element, as part of LCMA, is critical for ensuring that unsafe, unserviceable, obsolete, and excess ammunition is properly identified, accounted for, and managed, and that required disposal is conducted in a timely manner. Disposal helps to ensure the safety of the national stockpile and to reduce the risk of unplanned incidents and diversion.

The disposal process begins when a decision is made to remove ammunition from the national stockpile. Exporting, although not encouraged, is possible if:

- the transaction is in accordance with relevant governing (national and international) frameworks;
- the ammunition is safe to transport in accordance with international dangerous goods transport requirements; and
- there is an interested recipient or buyer.

In all other circumstances, demilitarization is required.

Selection of the right demilitarization technique may provide opportunities for recouping some costs through R3 of demilitarization process materials and waste. R3 remains the internationally preferred approach for environmentally sound demilitarization. Obtaining ammunition that has been designed with demilitarization in mind as part of new procurements can help with planning for end-of-life disposal and the reduction of associated costs.

The completion of risk assessments can significantly lessen the probability of unplanned incidents and help to minimize the consequences if one does occur. Specialist EOD personnel may be required to deal with emergency situations or those that are out of the ordinary.

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SECTION 8

LCMA at a glance

8.1 Introduction

This Handbook introduces the Small Arms Survey's LCMA model, focusing on:

- the **structural element** (national ownership and its associated enabling conditions); and
- the four **functional elements**—planning, procurement, stockpile management, and disposal.

This section shows how all of the parts of the LCMA model—that is, the elements, enabling conditions, and major activities—fit together and interact.

8.2 LCMA elements and activities

As discussed in Sections 2 and 3, the LCMA model comprises the structural and functional LCMA elements and enabling conditions that ensure the sustainability of the entire LCMA system. It is virtually impossible for LCMA to exist in a state that lacks these essential elements and conditions. Each part of the puzzle works with the other parts to make the system function effectively, with appropriate milestone decisions taken as required. National ownership and an enabling environment facilitate the system, allowing states to develop LCMA processes and programmes that are comprehensive, integrated, sustainable, and cost-effective. The end result is an ammunition stockpile that is safe and secure, and that meets national strategic and operational needs.

Table 8.1 provides an overview of the LCMA model, including the elements and major associated activities. It identifies the interactions among the elements that are necessary to ensure a comprehensive and sustainable system.

8.3 Conclusion

The primary objective of LCMA is to give a state an ammunition stockpile that will meet its national and strategic needs while ensuring that the stockpile is safe and secure. Guidance to date has been complex, having been written for the technical reader. This Handbook aims to provide a non-technical audience with a basic understanding and overview of the scope and components of an LCMA system. It introduces the major LCMA elements (planning, procurement, stockpile management, and disposal), discusses their major processes and activities, and explains how they can only be fully effective when integrated in an enabling environment.

Table 8.1 LCMA enabling conditions, elements, activities, and interactions

LCMA elements	Major activities	Interaction with other LCMA elements			
		Planning	Procurement	Stockpile management	Disposal
Structural element—national ownership and its associated enabling conditions (Section 3)	Setting up and maintaining an ammunition management system	×	×	×	×
	Providing national financial resources for implementation	×	×	×	×
	Develops a normative framework (such as national policies, defence directives, standards)	×	×	×	×
	Develops an organizational framework for coordination, oversight, and implementation	×	×	×	×
	Establishes infrastructure and equipment to support coordination, oversight, and implementation	×	×	×	×
	Makes available human resources for implementation of processes and activities	×	×	×	×
Planning (Section 4)	Translates policy and national and strategic requirements into the necessary ammunition procurements and prioritizes needs		×		
	Is conducted before ammunition acquisitions		×		
	Complies with international treaties or other legal considerations				
	Assesses ammunition stockpile status (in terms of safety, surplus, obsolescence, restricted use) and acquisition needs against strategic requirements and mission to identify gaps		×	×	×
	Sets strategic procurement, management, and disposal goals			×	×
	Identifies required capacities and resources (such as facilities, trained personnel, infrastructure)			×	
	Considers ammunition risks, management, and disposal prior to procuring		×	×	×
	Develops short- and medium-term programmes to meet long-term goals				
	Ensures allocation of budgets and prioritization of needs		×	×	×

LCMA elements	Major activities	Interaction with other LCMA elements			
		Planning	Procurement	Stockpile management	Disposal
Procurement (Section 5)	Implements programmes to meet ammunition requirements and priorities as defined in planning	×			
	Includes the acquisition of materiel, training, and information for the life cycle of the ammunition (such as propellant stability information, extra propellant samples, testing information, hazard classification information, operating procedures, disposal procedures, technical ammunition details, test equipment, specialized training)			×	×
	Complies with international dangerous goods transport and storage requirements			×	
	Complies with international treaties and other legal considerations, including end-use and end-user requirements	×			
	Utilizes appropriate practices and available tools to acquire ammunition that is safe and suitable for service			×	
	Considers disposal as part of procurement actions				×
	Complies with national regulations for ammunition production	×			
Stockpile management (Section 6)	Establishes ammunition accountability systems	×	×		×
	Establishes inventory management systems (such as inventory by lot and batch, condition, and location) to ensure visibility of the various stockpiles—obsolete, excess, unsafe, banned or restricted use, training, war reserve	×	×		×
	Ensures security of ammunition and facilities (to prevent theft and illicit activity)	×			
	Ensures safety and functionality (via hazard classifications, surveillance and in-service proofing, propellant stability testing, bans and constraints)		×		×
	Maintains proper facilities, equipment, staffing, supervision	×			
	Manages risk (via site planning, maintenance of equipment and facilities, required testing, inspections and audits, application of quantity distances, assignment and monitoring of				

LCMA elements	Major activities	Interaction with other LCMA elements			
		Planning	Procurement	Stockpile management	Disposal
Stockpile management (Section 6)	explosives licences, training and certification of personnel, identification of deviations from criteria, risk assessments, handling and transport of explosives)	×			
	Reports on accidents, investigations, and related actions	×	×		×
Disposal (Section 7)	Conducts a comprehensive national disposal review and decision-making process	×	×	×	
	Ensures that disposal involving exports is compliant with national and international end use, end user, transport of dangerous goods requirements and other treaties, restrictions, and bans	×		×	
	Ensures that disposal involving demilitarization includes a comprehensive process for assessing the safest and best options, including best practice and best price	×		×	
	Considers international and national health and environmental requirements	×		×	
	Considers R3 to help offset costs	×		×	
	Establishes free-from-explosives process and certification for scrap materials prior to sale or donation			×	
	Ensures security of ammunition and components throughout demilitarization processes (to prevent theft, diversion, and illicit activities)	×		×	
	Includes safety and risk management (via operating procedures, trained personnel, equipment and facilities, personnel protection, high-risk operations, risk assessments, oversight, inspections, accident reporting and investigation)			×	
	Provides for emergency response			×	
	Conducts post-operations cleanup, deactivation, decommissioning, certifications			×	
	Provides certification of disposal activity completion records	×	×	×	
	Develops documentation that records life-cycle-related information and lessons learned on ammunition that has been disposed of	×	×	×	

Table 8.1 summarizes the contents of the Handbook, highlighting the major activities associated with LCMA and illustrating the important interactions within an effective LCMA system. This table is designed to allow states to:

- explain LCMA and promote LCMA awareness and education goals;
- identify programmatic gaps, weaknesses, and strengths in their LCMA programmes and planning; and
- develop LCMA-related milestones and budgets.

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ANNEXES

Annexe 1. The IATG and SaferGuard

Introduction

The UN's International Ammunition Technical Guidelines (IATG) provide states and other users with guidance on implementing a risk-based, multi-level, incremental life-cycle management of ammunition (LCMA) approach. They do so by providing practical and technical guidance that takes into account resource and capacity constraints, including limitations on the ground, such as inappropriate or inadequate facilities, unsafe working conditions, and the absence of personnel or technical capabilities. Since their inception, the IATG have enjoyed overwhelming international support, as evidenced by their extensive use in almost 90 countries and the growing number of international organizations and non-governmental entities engaged in ammunition stockpile management activities—including through the UN SaferGuard Programme.

The primary purpose of this annexe, prepared by Eric J. Deschambault, is awareness raising. It begins with background information on UN General Assembly (UNGA) Resolution 63/61, which mandated the development of international security and safety guidelines for ammunition stockpile management (UNGA, 2008b, para. 7). It then describes how that resolution resulted in the IATG and the UN SaferGuard Programme, and how these have been developed and implemented to date. The rest of the annexe summarizes each of the 45 modules that comprise the 12 IATG thematic volumes.

Importantly, the guidelines are not meant to be used as national standards themselves, but rather as a foundation and reference framework for national authorities responsible for LCMA-related activities. As such, the IATG are meant to assist authorities in establishing their own national policies, standards, and safety and security programmes.

Background

Inadequately managed conventional ammunition stockpiles have threatened public safety for many years. They are particularly vulnerable to unplanned explosions at munitions sites (UEMS) and the diversion to unauthorized users.

The mandate for the development of the IATG can be traced back to UNGA Resolution 61/72, which establishes a group of governmental experts (GGE) to consider 'further steps to enhance cooperation with regard to the issue of conventional ammunition stockpiles in surplus' (UNGA, 2006, para. 7). In a July 2008 report, the GGE noted the need to explore the problem of surplus ammunition stockpiles 'within the broader context of stockpile management' and recommended 'a "whole life management" approach to stockpile management' that would incorporate elements such as surplus identification, improved explosives safety standards, and increased stockpile security (UNGA, 2008a, paras. 2, 58).

The GGE report's key recommendation was the development of:

> *technical guidelines for the stockpile management of conventional ammunition [. . .] to assist States in improving their national stockpile management capacity, preventing the growth of conventional ammunition surpluses and addressing wider risk mitigation* (UNGA, 2008a, para. 72).

The UNGA's subsequent approval of this recommendation in Resolution 63/61 provided the mandate for the development of the IATG and the UN SaferGuard knowledge resource management programme, both of which would be overseen by the UN Office for Disarmament Affairs (UNODA) (UNGA, 2008b, para. 7).

IATG development

The initial modules for the guidelines were developed by UNODA with the support of a technical expert. As the draft modules were completed, they were provided to UNODA's Technical Review Panel (TRP)[17] for substantive review. In addition, the modules were validated in selected countries and were opened to a wider consultative and endorsement process involving interested UN member states and stakeholders. The TRP review and the external validation process identified a series of necessary clarifications, corrections, enhancements, and changes, as well as the need for two additional modules, namely Module 12.10 (*Ammunition on multi-national operations*) and Module 12.20 (*Small unit ammunition storage*).

The final draft of the first edition of the IATG was completed in early 2011. Later that same year, UNGA Resolution 66/42 welcomed its completion and encouraged

17 The TRP was established in 2008 by UNODA and consisted of experts from states selected on the basis of equitable geographical representation.

its use by states on a voluntary basis (UNGA, 2011, arts. 1, 7). Upon its publication in April 2012,[18] attention was directed towards the development of the UN SaferGuard Programme alongside IATG dissemination and implementation. As part of this effort, the TRP was restructured into a Technical Review Board (TRB). Concurrently, UNODA established a Strategic Coordination Group (SCG), of which the Survey is a member.[19] Consisting of non-governmental implementing partners, the SCG advises on SaferGuard implementation and provides feedback based on experiences associated with IATG implementation. The inaugural meetings of the TRB and SCG were held in April 2014 and resulted in the recommendation of a series of changes for the guidelines, including three additional modules. These subsequently became Modules 01.90 (*Ammunition management personnel competences*), 04.20 (*Temporary storage*), and 06.80 (*Inspection of ammunition*).

The IATG are considered 'living' documents and are kept current by UNODA with the support of UN SaferGuard, the TRB, and the SCG. Additional IATG modules will be developed, as required, to address emerging areas of need. In addition, the IATG are reviewed and updated at least every five years. Following one such review, the second edition was published on 1 February 2015 (UNODA, 2015). Many changes were made to the IATG as part of the second edition, the most significant of which are listed below:

- Module 01.50 (*UN explosive hazard classification system and codes*) introduces additional hazard classes and divisions for risk assessment and storage distance calculation purposes.
- Module 01.90 (*Ammunition management personnel competences*) is a new module.
- Module 02.10 (*Introduction to risk management principles and processes*) introduces new text on when and how to compile explosion safety cases (para. 13.4 and annexe G).
- Module 02.20 (*Quantity and separation distances*) introduces new quantity distances for small quantities (up to 500 kg) of Hazard Division 1.1 explosives.
- Text on temporary storage areas is relocated from Module 04.10 (*Field storage*) to the new Module 04.20 (*Temporary storage*).
- Module 04.20 (*Temporary storage*) is a new module.
- Module 06.80 (*Inspection of ammunition*) is a new module.

18 The first edition dated from October 2011 but was published on the UNODA website in April 2012.

19 The SCG is a group of experts engaged in worldwide stockpile management activities and IATG implementation.

IATG framework

LCMA authorities carry many responsibilities and obligations for stockpile safety and security. Taking these into account, the IATG framework is shaped by four fundamental guiding principles, which are elaborated in the summary of Module 01.10 (*Guide to the International Ammunition Technical Guidelines*).

The IATG provide states and other users with a risk-management framework for incrementally improving their LCMA-related activities. All IATG tasks and activities—identified as necessary for safe, efficient, and effective stockpile management—are assigned to one of three risk reduction process levels (RRPLs). RRPL 1 is the lowest level of compliance and RRPL 3 is the most complex and highest level of compliance.

At a minimum, IATG users are urged to strive to achieve RRPL 1 for each IATG requirement. Compliance with this most basic level can have an immediate positive impact on ammunition stockpile safety and security. The expectation is that users will continually strive to improve and develop further national capacity—resources permitting—to manage their ammunition stockpiles more effectively.

UN SaferGuard Programme development

Following completion of the first edition of the IATG, attention turned to providing tools and aides to support their implementation. To that end, the UN SaferGuard Programme was formally established in 2011 (UNGA, 2011, para. 7). Its overarching objectives are to:

- develop a website with IATG products and tools;
- develop IATG training materials;
- conduct IATG training courses;
- offer technical expertise on ammunition stockpile management to national authorities; and
- establish a resource documents repository.

The UN SaferGuard website provides the latest edition of the guidelines, as well as the online **IATG Implementation Support Toolkit**, which makes available software applications to support IATG implementation, among other resources (UN SaferGuard, n.d.a). These SaferGuard products and tools complement the use and implementation of the IATG and include forms and calculators for assessing and documenting risk, visualizing danger areas, and generating licences. To further support IATG users and enhance their knowledge, SaferGuard also features a **documents repository**, which contains most of the references listed in the IATG modules' annexes (UN SaferGuard, n.d.b).

In addition, the UN SaferGuard website offers a range of **training materials** (UNODA, n.d.).[20] Since 2014, UNODA has organized supplementary training courses and capacity building missions in various locations around the world—including in Kenya, Liberia, Nigeria, Paraguay, Peru, and the United Arab Emirates.

IATG module summaries

This section summarizes each of the 45 modules in the 12 thematic IATG volumes, with reference to LCMA. The information, guidance, and requirements provided in each module can be used to develop national policies, standards, and requirements. Reference documents identified in each module provide additional information.

Note This Annexe draws heavily on the IATG and reflects the language used therein. All citations should be based on the original IATG (UNODA, 2015).

Volume 01. *Introduction and principles of ammunition management*

Module 01.10. *Guide to the International Ammunition Technical Guidelines (IATG)*

This module introduces the six activity groups that encompass 'conventional ammunition stockpile management'. It also identifies the following IATG guiding principles:

- the right of national governments to apply national standards to their national stockpile;
- the need to protect those most at risk from unintended explosive events;
- the requirement to build a national capacity to develop, maintain, and apply appropriate standards for stockpile management; and
- the need to maintain consistency and compliance with other international norms, conventions, and agreements (UNODA, 2015, mod. 01.10, para. 6).

20 The SaferGuard training courses are designed to provide the information necessary for states and other users to move towards compliance with RRPL 1.

By applying the IATG risk management process in line with their capabilities and resources, states and other users are expected to secure immediate reductions in ammunition-related risk. More broadly, use of the IATG is designed to ensure consistency with international guidelines and compliance with relevant international regulations, conventions, and treaties.

Module 01.20. ***Index of risk reduction process levels (RRPL) within IATG***

The RRPLs lie at the heart of the IATG risk management process. Each required task and activity is assigned to one of three possible levels. As the level number increases, the risks decrease accordingly.

Under RRPL 1, basic stockpile safety and security precautions are in place and a minimal investment of resources[21] is required. The risk of UEMS remains, as does the concomitant likelihood of fatalities and injuries.

RRPL 2 is an improvement on RRPL 1 and requires medium-level investments. The risk of UEMS remains, but the likelihood of fatalities and injuries is reduced due to the use of basic separation distances.

RRPL 3 requires the greatest investment. The result is a relatively safe, secure, and efficient stockpile that is consistent with international best practice.

States that adopt the IATG risk management structure are able to adopt a simplified approach to LCMA as part of which they can develop, manage, and monitor their own efforts towards achieving self-identified RRPL goals. Using the tables presented in this module, a state can design its own comprehensive plan for achieving IATG compliance.[22]

Module 01.30. ***Policy development and advice***

A comprehensive national LCMA programme that ensures the safe and secure storage of ammunition requires top-level support for state policies that specify requirements for the system. Before basic LCMA policies can be established, policy developers and decision-makers must gain an understanding of the overarching philosophy and principles of safe, effective, and efficient ammunition storage, as well as the associated challenges. International agreements such as the following may have an impact on national policy and direction, and stockpile management:

21 These could include human and financial resources, technical equipment, and facilities.

22 These tables identify IATG activities (by IATG module and ‘clause’, or paragraph) associated with each RRPL.

- the Mine Ban Treaty (UNGA, 1997);
- the UN Firearms Protocol (UNGA, 2001a); and
- the London Protocol (IMO, 1996).

This module is designed to assist states as they develop strategic LCMA policy and requirements. It outlines important functional areas that need to be addressed by policy-makers and relevant organizations at all levels of national planning and operational activities.

Efficient stockpile management ensures the best 'value for money' from ammunition. Stockpile management is an effective mechanism for reducing security risks associated with loss, theft, leakage, and proliferation.

Module 01.40. ***Glossary of terms, definitions and abbreviations***

The IATG draw on a variety of international sources. To ensure a common understanding and consistency in interpretation and application, this module defines all key terms that are used in the IATG modules. In addition, it explains the top–down approach that was taken by IATG drafters in developing the IATG terms and definitions.

Module 01.50. ***UN explosive hazard classification system and codes***

The development of appropriate ammunition safety requirements calls for an understanding of the risks associated with each individual ammunition item. In general, a technical authority in the state where the ammunition is produced assigns an item's dangerous goods classification, using prescribed UN testing and assessment protocols (UN, 2017a). The classification identifies the item's hazard class, division, and storage compatibility code, all of which are necessary for shipping and storage purposes. With rare exceptions, purchased and shipped ammunition should be classified in accordance with the UN protocols described in this module. For storage purposes and to ensure the proper application of quantity distances,[23] a relevant technical authority may need to assign ammunition to a storage subdivision[24] and to further classify its predominant hazardous effects.

23 The quantity distance tables in Module 02.20 are based on the UN explosive hazard classification system described in Module 01.50. The tables provide the minimum distance required between a potential explosion site and an exposed site.

24 A storage subdivision is a subcategory designation that must be assigned to all Class 1 Division 2 and Class 1 Division 3 ammunition items (see Module 02.20).

Since the IATG risk management process and its safety requirements are based on UN hazard classifications, it is important for users to have a basic understanding of what these are, how they are derived, and how they should be applied. This module introduces and explains the UN system and related codes, identifies the tests that are performed to determine an appropriate hazard classification, and discusses the mixing of ammunition with different compatibility groups. It also covers the assignment of an appropriate storage subdivision.

National authorities can ensure the proper application of IATG requirements once they have integrated the UN hazard classification system into their LCMA processes.

Module 01.60. ***Ammunition faults and performance failures***

Despite efforts to promote stockpile safety, UEMS may still occur. Most of these events are preventable, however, and their impact can be reduced significantly if preventive LCMA safety measures are undertaken.

This module outlines what steps to take in the case of ammunition faults or performance failures. It explains the importance and benefits of reporting such problems, investigating them thoroughly, and taking prompt corrective action to prevent them from reoccurring.

The ability to manage ammunition faults and performance failures is an important part of ensuring the safety and security of a national stockpile. This module advises authorities on how to develop a national process for reporting, investigating, correcting, and managing these failures.

Module 01.70. ***Bans and constraints***

States should never permit the storage or use of ammunition that is dangerous or unsafe. Similarly, they should not use ammunition that does not meet minimum performance requirements or is in short supply.

This module provides guidance on the establishment of a formal system of bans and constraints. It also covers their application to ammunition use, storage, handling, transportation, and disposal. It explains why bans and constraints might be used, how to manage them, and how to make sure all relevant parties are aware of their existence and abide by them.

The ability to manage ammunition bans and constraints is an important part of LCMA. This module helps authorities to develop a national process for establishing, implementing, and managing them.

Module 01.80. ***Formulae for ammunition management***

Module 01.50 explains the UN hazard classification system and codes in the context of IATG risk management and safety requirements. It helps users to understand the hazardous effects of ammunition and explosives, as well as how to protect against them.

The type and extent of hazardous effects associated with UEMS is related to the kind and quantity of ammunition and explosives involved in an incident, as well as the location in which it occurs. Proper risk management calls for a solid understanding of all possible hazards.

This module is designed for technical officials who require an understanding of the effects and consequences of explosives and who need to undertake risk assessments, which are an RRPL 1 requirement. Risk assessments help to identify the potential impact of an unexpected event on surrounding areas and personnel. When minimum IATG separation distances cannot be met, risk assessments and risk analyses are also RRPL 2 and RRPL 3 requirements (see Module 2.20). By understanding hazardous effects, technical experts will be better able to advise decision-makers on available options for reducing, preventing, and even eliminating risk.

Module 01.90. ***Ammunition management personnel competences***

To assure the safety and security of a state's ammunition stockpile, personnel charged with handling and managing ammunition must be properly trained and demonstrate minimum competency levels.

As there are no international standards on the skill sets required for proper ammunition and risk management, this module provides an overview of the required basic competencies. It is focused on RRPL 2 and RRPL 3 of the IATG requirements.

The module describes three areas that are associated with personnel competencies: behavioural traits, technical skills, and the achievement of targets and objectives. It also identifies seven generic categories of ammunition-related personnel[25] and explains how to assess an individual's competency to perform assigned tasks. For each of the generic personnel categories, detailed annexes identify roles and responsibilities, competencies, and IATG tasks for which personnel must be able to demonstrate proficiency.

25 The seven categories of ammunition personnel are operator, processor, accountant, supervisor, manager, inspector, and regulator.

Ensuring that personnel are properly trained and competent is an important part of the LCMA system. This module assists authorities in developing a national training and competency programme for personnel involved in ammunition-related tasks and their management.

Volume 02. *Risk management*

Module 02.10. *Introduction to risk management principles and processes*

Based on their resources and capacities, states take various approaches to risk management, ranging from basic to extremely complex. For those with limited resources, capacity, and capabilities, even simple risk management techniques and tools can help to identify risks related to UEMS so that decision-makers clearly understand the risks they are accepting and the consequences of their decisions.

Implementation of a robust, effective, and integrated risk management process for achieving an 'acceptable' risk level for ammunition-related activities should be a fundamental part of a state's LCMA process.

This module discusses the concept, principles, activities, and techniques pertaining to risk management of ammunition storage, as well as available IATG tools (provided by SaferGuard) to support risk management efforts. Adherence to IATG requirements calls for the implementation of many components of an integrated risk management system. Although this module is primarily focused on risks to the local civilian population, it provides information that can be used to address risks involving all functional areas of ammunition stockpile management.

The module describes straightforward risk assessment techniques that can be used in a wide range of circumstances. It also provides references for more complex risk assessment and analysis.

Module 02.20. *Quantity and separation distances*

The use of separation distance—that is, quantity distance as detailed in this module—is the most effective way to protect people and structures from the impact of UEMS, which can produce weapon fragments, thermal radiation, and structural debris. Under ideal circumstances, a safe separation distance is determined and applied. In practice, this step is often skipped due to a lack of resources or capacity; in such cases, authorities make do with a distance that ensures an 'acceptable' level of risk.

This module underscores the importance and value of complying with IATG requirements in determining minimum quantity distances from ammunition locations. It provides pre-determined distances that are based on the exposed site, ammunition type and quantity, and storage sites—in the open air or within a structure.

Module 02.30. ***Licensing of explosive facilities***

How do workers and managers know what operations are permitted and what type and amount of ammunition are stored in a given facility? The answer is provided in the explosives licence granted by the national issuing authority for a particular facility.

This module addresses licensing for explosives facilities. It identifies issuing authorities, the various types of licences, the minimum content of such licences, and related management and oversight responsibilities to ensure that licensing requirements are met. The explosives allowance specified in a licence should be based on the results of a risk assessment or analysis and associated risk management decisions (see Module 02.10) or an approved site plan (see Module 05.10). The guidance provided in this module can assist authorities in developing a national licensing system for ammunition facilities and their management.

Module 02.40. ***Safeguarding of explosive facilities***

A guiding IATG principle is that national authorities have a responsibility to protect those most at risk from UEMS (see Module 01.10). One of the most effective ways of protecting the public from such an event is by using the quantity distances provided in Module 02.20.

All too often, these quantity distances extend beyond the boundaries of ammunition sites, including into areas that are not under the control of national authorities, such as private property. The process for managing, protecting, and restricting the use of such land is called 'safeguarding'. In the absence of a system for safeguarding land located within designated boundaries, the public can be at risk. Such cases contravene approved quantity distances or decisions on an 'acceptable' level of risk from explosive facilities (Module 02.10). A lack of safeguarding can have a significant impact on public safety as well as a state's ammunition capabilities and its stockpile.

This module discusses the concept of safeguarding and provides an approach for establishing, implementing, and managing a safeguarding system. Authorities can use this guidance to develop policy and requirements for safeguarding land surrounding ammunition stockpiles.

Module 02.50. ***Fire safety***

Fire presents a significant threat to ammunition stockpiles and is probably the most common cause of UEMS. In view of the inherent risks associated with ammunition, fire presents an immediate and high risk to life and property surrounding a stockpile.

For that reason, an aggressive and comprehensive fire prevention programme is essential to minimize the risk of fires in or near ammunition storage facilities. In addition, trained personnel, response processes, and equipment for fighting fires must be in place and readily available. Once a fire gets out of control and ammunition begins to react, the evacuation of all personnel to safe distances is generally required.

This module addresses the elements of a good fire safety and prevention programme for explosives facilities. It also outlines the basic principles underpinning fire fighting in such facilities and provides guidance on fire fighting equipment, systems, and procedures. It is not intended to help design fire fighting systems or responses, as these must be assessed on a case-by-case basis.

Volume 03. *Ammunition accounting*

Module 03.10. ***Inventory management***

Ammunition has a shelf life that is finite and controlled by a number of internal and external factors. Unmanaged and unmonitored ammunition can be stolen, damaged, or misused and can deteriorate to a point where it reacts in an unintended manner, as evidenced by the catastrophic UEMS that occur each year around the world.

To protect such a valuable commodity and provide a safe and secure environment a state must be able to account for—and effectively manage—its ammunition as part of an inventory management system. This module details the basic elements of such a system and how to incorporate it into an ammunition management programme. Failure to provide basic inventory management is almost a guarantee that ammunition will fail to function as designed, will become unsafe, or will be diverted.

An inventory management process can help a state to meet the IATG guiding principles by ensuring that only ammunition that is serviceable and safe to use is issued and by protecting the civilian population from hazards associated with unsafe ammunition (see Module 01.10). An effective inventory management system allows a state to identify inventory issues—including inaccuracy, loss, theft, and unsafe ammunition in the national stockpile.

Module 03.20. ***Lotting and batching***

Tracking lot and batch numbers on ammunition as part of the inventory management process supports a state's efforts towards efficient ammunition management. Lotting and batching distinguishes like stockpile items that were manufactured at the same time using the same or similar materials and processes, meaning that they are generally expected to have the same performance capacity and properties throughout their lifetime.

This module introduces the concept of lotting and batching, describes when lot and batch numbers should be used, how they are assigned, and what information can be derived from a lot or batch number. It also addresses the importance of knowing and tracking ammunition locations by lot and batch numbers. A primary benefit of recording and tracking such information, as well as ammunition locations (by lot and batch), is the ability to identify and locate unsafe or suspect ammunition so that appropriate action can be taken to manage risk (see Module 01.70).

Accounting for lotting and batching information as part of the national ammunition inventory management system is important for proper stockpile accounting and LCMA. These processes significantly improve a state's ability to keep ammunition safe and secure.

Module 03.30. ***International transfer of ammunition module***

This module provides guidance on the development and implementation of effective national controls over international ammunition transfers, including the import, export, transit, transhipment, and brokering of ammunition. It also addresses issues related to the transfer of man-portable air defence systems (MANPADS), the enforcement of controls, international cooperation and assistance, and public and parliamentary transparency. This module is of particular relevance to states that are significant exporters or importers of ammunition but that have little involvement in other aspects of the international arms trade. The module may also be of interest to legislators, ammunition manufacturers, non-governmental organizations (NGOs), and other stakeholders working to improve controls.

The module focuses on assisting government personnel, UN officials, and staff from other international and regional organizations that are developing and implementing ammunition transfer controls. It covers the development and strengthening of national controls to help prevent transfers that fuel armed conflict, facilitate abuses of human rights or violations of international humanitarian law, or risk being excessive or destabilizing to the recipient country. It also presents advice concerning the development of effective national measures to prosecute individuals who breach ammunition transfer norms.

Module 03.40. ***End-user and end-use of internationally transferred ammunition module***

This module provides guidance for the development and implementation of effective national controls over the end users and end uses of internationally transferred ammunition, specifically in order to prevent and combat its diversion from the legal market into the illicit sphere. Other aspects of the international transfer of ammunition are covered in Module 03.30.

This module covers legislative and other processes that can be used to control the end users and end uses of internationally transferred ammunition, including the assessment of diversion risks at the licensing stage; the establishment and use of end-use documentation; the authentication and verification of end-use documentation; and post-delivery monitoring of transferred ammunition. It also addresses enforcement mechanisms and international cooperation and assistance.

The primary targets of this module are national authorities responsible for devising and implementing ammunition transfer controls. This module is also relevant to legislators, ammunition manufacturers, NGOs, and other stakeholders working to improve controls. National controls of end users and end uses are part of a comprehensive system that encompasses all aspects of ammunition transfer. The basic characteristics of such a system are:

- legislation or a regulatory framework;
- procedures for the assessment of diversion risks at the licensing stage;
- end-user authentication;
- verification measures before, during, and after the transfer; and
- enforcement mechanisms.

Module 03.50. *Tracing of ammunition*

This module aims to build national capacity for the tracing of ammunition in order to identify and disrupt sources of illicit trade linked to armed conflict and criminal activity. Illicit ammunition—which tends to enter the illicit sphere following legal manufacture—fuels conflict and crime. Ammunition components are commonly used to produce improvised explosive devices.

Tracing is used to determine the point at which ammunition was diverted or became illicit. It involves the systematic tracking of items from the point of manufacture or import, through the supply chain, to the last legal owner. Lotting and batching help to ensure that ammunition is traceable (see Module 03.20).

This module covers areas such as the introduction of national points of contact, the establishment of a national tracing system, domestic and international tracing operations, responses to international tracing requests, and international cooperation and assistance—including the roles of INTERPOL, the UN, regional organizations, and NGOs.

Volume 04. *Explosive facilities (storage) (field and temporary conditions)*

Module 04.10. *Field storage*

During military operations, there is often a need to store ammunition in the field ('open storage') if proper storage facilities are unavailable at deployment locations. Ammunition in open storage can be kept safely, effectively, and efficiently as long as certain safety challenges are resolved.

This module addresses open storage of ammunition for periods of up to one year in support of military operations, describes the challenges associated with such 'short-term' storage, and details specific requirements for managing and monitoring the ammunition.

Open storage is associated with significant safety concerns, including the deteriorating effect of exposure to wind, water, sun, heat, humidity, sand, and dust, as well as the possibility that the service life of ammunition may be significantly reduced by the exposure. A surveillance and in-service test programme is required to ensure that ammunition performance and safety are not compromised during, or as a result of, short-term open storage (see Module 07.20).

This module assumes that deployment activities will end within one year and that ammunition deemed safe for transport will be returned to its originating state. Module 04.20 provides guidance for deployments that exceed one year and involve long-term open storage of ammunition.

Module 04.20. ***Temporary storage***

Long-term open storage may be required for up to five years if appropriate depot storage infrastructure is not available, or if available infrastructure cannot offer the necessary protection from the elements. This module assumes that the situation that led to the need for long-term open storage will be eliminated or resolved within five years, either because appropriate new infrastructure will become available or because the ammunition will have been used, relocated, or demilitarized.

Even under long-term open storage, it is possible for ammunition to be stored safely, effectively, and efficiently, as long as significant safety and security challenges are resolved.

This module describes these challenges and details specific requirements for managing and monitoring ammunition in this environment. Concerns regarding safety and reliability are further amplified for long-term open storage due to the increased exposure time. An effective surveillance and in-service test programme is the only way to ensure that ammunition performance and safety are not compromised during, or as a result of, long-term open storage (see Module 07.20).

Volume 05. *Explosives facilities (storage) (infrastructure and equipment)*

Module 05.10. ***Planning and siting of explosives facilities***

UEMS can have extremely dangerous effects on surrounding areas. Authorities must consider these potential effects as early as possible in the planning and design of an explosives facility of any size or capacity. They also need to factor them into their assessments of protection needs around these facilities, such as in relation to the public, roads, buildings, or other storage facilities.

Every existing or planned explosives facility must be carefully considered and evaluated to ensure that minimum quantity distances are applied (see Module 02.20). Whenever these cannot be applied, appropriate risk assessment and risk acceptance steps must be taken (see Module 02.10). These actions can be accomplished through the establishment of a formal national process to assess, site, and approve all existing and planned explosives facilities. The primary purpose of this process is to validate that each established and planned ammunition storage location meets IATG requirements in addition to providing minimum protection levels within quantity distances (see Module 02.20).

This module details general requirements and procedures for planning, siting, and approving planned and existing explosives facilities and for managing construction within quantity distances of these facilities.

Module 05.20. *Types of buildings for explosives facilities*

Many different types of buildings are used for the storage and handling of ammunition, but—from a safety or risk perspective—not all are appropriate for the ammunition-related activities conducted in them. The consequences of using unsuitable buildings can be serious. When planning the construction of a new explosives facility, decision-makers should consider a number of different building types and aspects of building construction.

This module details the general requirements for the design of explosives facilities. It discusses the effects of unplanned events, the hazards they introduce, the concept of explosives propagation (that is, a detonation reaction in which one ammunition stack causes an immediate detonation reaction of an adjacent stack), and the importance of protecting against the detonation of an adjacent stack in order to limit the size of any unplanned event. The module provides guidance on the types of buildings to be used as explosives facilities; possible scenarios and effects resulting from unplanned events and how different types of buildings respond to such events; design considerations; and the optimization of explosives facility design with quantity distances.

Explosives facilities are a hazard, including to personnel, the public, surrounding facilities, and other exposed locations. Appropriate building design, construction, and siting are of crucial importance in the application of IATG quantity distances, as detailed in Module 02.20.

Module 05.30. *Barricades*

A properly constructed barricade around an explosives facility is an extremely effective mitigation technique for intercepting low-angle fragments and debris resulting from an unplanned explosion. It is important to properly assess the placement of barricades so that they are constructed where they provide the most beneficial protection and are most cost-effective.

This module addresses the issues of barricade selection, design, construction, and siting. A proper barricade can benefit ammunition locations that contain small quantities of explosives (up to 500 kg), in particular by allowing the use of reduced quantity distances detailed in Module 02.20.

This module only applies to barricades used in permanent explosives storage facilities. Temporary barricades used as part of open storage are addressed in Modules 04.10 and 04.20.

Module 05.40. ***Safety standards for electrical installations***

The control of electrical and lightning-related hazards in explosives facilities is important because of the potential for transient electrical signals and surges, arcing, static discharge, and lightning strikes, as well as associated fires. Control measures for these hazards can vary significantly, depending on the ammunition-related operations being performed and the facility involved. Some measures may be very simple while others may require complex, integrated systems that must be collectively considered as part of the design of the building's electrical, grounding, bonding, and lightning protection systems, as well as their installation and maintenance.

A primary technique for managing electrical risks within an explosives facility is categorizing the facility by electrical hazard codes and zones. Such categories further define the levels of protection that are required to prevent an unplanned event.

This module helps users to understand the electrical hazard categorization process, as well as the protection systems that may be required to manage various electrical threats. It also details the requirements and standards for these systems, including testing, to demonstrate system effectiveness.

Module 05.50. ***Vehicles and mechanical handling equipment (MHE) in explosives facilities***

In the context of ammunition-related operations, unsuitable vehicles and mechanical handling equipment can present a fire or explosion risk. Vehicles and equipment, as well as ancillary items, should comply with the facility's or area's assigned electrical hazard categorization codes and zones (see Module 05.40).

This module addresses a broad range of vehicles and MHE that might be used in ammunition-related operations and provides corresponding risk reduction measures. It also reviews requirements for a management and control process for vehicle equipment design, modification, selection, approval, labelling, use, maintenance, and testing—to ensure the process is appropriate for all intended uses and that it is kept current with applicable standards.

Compliance with this module ensures that vehicles and MHE used to support ammunition-related operations are appropriate and safe for their intended use and environment, thereby reducing risk. The information contained in the module can be used to develop national procedures to govern this equipment.

Module 05.60. ***Radio frequency hazards***

Technological advances have resulted in the increased use of communications equipment operating on a host of different radio frequencies, as well as power outputs such as data loggers, mobile phones, pagers, two-way radios (hand-held, permanent, or vehicle-mounted), and high-power transmitters. This equipment generates electromagnetic radiation energy; if improperly used in the proximity of susceptible ammunition, the energy from an inadvertent transmission may cause an unplanned event or the degradation of an electronic system. The energy can also lead to arcing or sparking, both of which are potential fire hazards. These threats point to the need to consider, control, and manage the use of electronic communications equipment in the proximity of ammunition throughout the LCMA process.

This module explains why electromagnetic radiation energy is a hazard that needs to be addressed as part of ammunition management and details basic precautions that can be taken. It provides guidance on the requirements for developing a technical national authority and statutory regulations, in addition to establishing an assessment and approval process for the use of electronic communications equipment and transmitters.

Compliance with this module addresses a critical safety issue and helps prevent UEMS related to uncontrolled electromagnetic radiation energy.

Volume 06. *Explosive facilities (storage) (operations)*

Module 06.10. ***Control of explosives facilities***

The safe and efficient management of explosives facilities or operations—with their myriad hazards—entails the consideration of areas such as personnel training and qualifications, security and access controls, fire protection, real estate management and site planning, electronic equipment for communications, facilities, and licensing.

From a safety and security perspective, managers, supervisors, and ammunition-related personnel should prioritize the management and control of activities associated with the above areas.

This module introduces the basic principles for managing explosives operations. It lists the elements of a good control and management programme, identifying what is important about each and providing the requirements for the routine control of ammunition-related activities. The module covers some technical issues, including radio-frequency energy produced by transmitters,[26] MHE, and electrical installations. It cites references to other modules that have been developed to help manage these areas.

Module 06.20. ***Storage space requirements***

Both ammunition and storage facilities are expensive and should be managed not only to maximize storage facility use, but also to place as much ammunition as possible in the protective spaces of storage facilities. As Modules 04.10 and 04.20 indicate, covered storage is preferable to open storage for the protection of ammunition from the potentially damaging effects of environmental and other exposure.

This module helps users to plan for and optimize ammunition storage, thereby ensuring maximum cost efficiency and effective storage planning. It encourages the full use of available units of space in covered storage to reduce the need for open storage. Explosives limits[27] must not be exceeded in any storage facility.

This module provides guidance on storage space planning, taking into consideration the allowable explosives limits of storage facilities. This module is designed to help users align their storage facility space requirements more closely with their available stockpile needs, towards safer and more effective storage of ammunition.

Module 06.30. ***Storage and handling***

Improper storage and handling of ammunition increases the potential for damage, which may negatively impact its reliability and safety or lead to UEMS. Damaged ammunition has to be either repaired or destroyed and then replaced, which may result in significant financial cost. The protection of ammunition from such damage is one of the controls discussed in Module 06.10.

This module provides an overview of general practical considerations and requirements for the safe storage and handling of ammunition in facilities and for inter-facility transportation. It references related modules, all of which provide additional guidance and requirements for important aspects of safe ammunition storage, processing, and transport.

26 Radio-frequency energy can potentially ignite hazardous environments (such as flammable or explosive gas, dust, or vapours) or susceptible, electrically initiated devices.

27 Explosives limits identify the quantities and types of ammunition and explosives authorized by an explosives licence issued to an explosives location.

Module 06.40. *Ammunition packaging and marking*

The correct packaging of ammunition—which is designed and tested to demonstrate that it provides the required protection throughout its service life—is a key safety measure. Packaging is also designed to assist the processes of ammunition movement, storage, and handling. The removal of ammunition from its approved packaging exposes it to damage and other potential hazards, such as environmental effects, insects, dirt, and electromagnetic energy, which can have a serious impact on its safety and reliability. For that reason, ammunition should always be kept in its approved packaging until needed. In addition, taking ammunition out of UN-approved shipping packaging can affect its hazard classification (UN, 2017a).[28] Changes in classification must be accounted for as part of the management of explosives facilities (see Module 06.10). The UN hazard classification system is detailed in Module 01.50.

Proper markings, labels, and seals on ammunition and packaging communicate critical safety and security information, allowing for proper storage, handling, and transport of ammunition. Some are required by the UN hazard classification system, while others support management and control processes in facilities, as discussed in this module and Module 06.10.

This module provides general, practical information and basic requirements related to ammunition packaging and its markings, with the aim of raising user awareness on the many considerations involved.

Module 06.50. *Specific safety precautions (storage and operations)*

The chemicals that are used to manufacture ammunition are generally hazardous. They are toxic to humans, posing health risks through inhalation, ingestion, and absorption through both the skin and the eyes. Some ammunition items require additional safety consideration because they present unique risks. These must be considered and incorporated into management and control processes in explosives facilities (see Module 06.10).

The purpose of this module is to highlight additional safety precautions, basic requirements, and mitigation factors for ammunition in general, as well as for unique ammunition items and component materials, such as:

28 For example, a Hazard Division 1.2 item removed from its shipping package may have to be treated as Hazard Division 1.1.

- ammunition filled with dangerous substances, such as white or red phosphorus, which, if cracked or damaged, can leak and—upon contact with air—can spontaneously ignite;
- phosphide-filled ammunition, which is activated by water and, if cracked or damaged, can interact with water in any state and produce toxic and flammable phosphine gas;
- finely divided powdered metals (in bulk and in ammunition), which can generate hydrogen gas upon contact with water and form an explosive hydrogen–air mixture;
- ammunition or components recovered through explosive ordnance disposal (EOD), such as unexploded ordnance; and
- ammunition for museums, souvenirs, displays, training aids, or surplus products or salvageable leftover materials from manufacturing, demilitarization, or other similar processes.

Module 06.60. ***Works services (construction and repair)***

Contract personnel working in an area where explosives are stored, processed, or transported must be properly managed and monitored for their own safety and the safety of others. To minimize risks and ensure compliance with the necessary requirements, management and control measures must be implemented for any work involving—or carried out in the proximity of—an explosives facility. The measures are to be applied regardless of the scope of the work—be it major, minor, or routine—and irrespective of who is carrying it out (see Module 06.10).

This module describes the key roles and major responsibilities associated with explosives safety with respect to contractors, a visiting workforce, and explosives area support workers. It provides procedures and safety requirements for the control and management of such personnel, as well as the approval, monitoring, and management of work involving—or carried out in the proximity of—explosives facilities.

Module 06.70. ***Inspection of explosives facilities***

An important element of managing explosives facilities is the conduct of inspections by the establishment responsible for the facilities as well as by national authorities with oversight responsibilities. The absence of an inspection process or programme to address inspection faults can lead to unplanned explosions. For this reason, it is critical that national authorities require their explosives establishments to document and track periodic inspections of explosives facilities, inspection faults, and the status of fault corrections and repairs.

In addition, national authorities should monitor these establishments' processes and provide oversight to ensure compliance with the IATG and their own national processes.

This module explains the importance of having both a comprehensive inspection process and an aggressive fault correction system in place. It underscores the potential ramifications of being deficient in these areas. It also describes a recommended procedure for conducting inspections of explosives facilities, recommends timeframes for periodic inspections, provides a sample logbook that identifies areas in the explosives facility that should be inspected, and provides a sample format for recording inspections and faults. Users should adapt these as necessary for each of their explosives facilities. Lastly, this module addresses national authorities' oversight responsibilities and provides a checklist format for them to use when inspecting their explosives establishments.

Module 06.80. ***Inspection of ammunition***

Inspection of ammunition is necessary to ensure its safety, reliability, and performance. The level of inspection and complexity of the effort depends on the reason for the inspection. Some are basic external inspections of ammunition or its packaging, while others—such as surveillance breakdown of ammunition[29] and the collection of propellant or explosives samples (see Module 07.20)—are significantly more complex and require additional resources, training, and preparation time.

This module presents general information on ammunition safety and common inspection points. It provides guidance for the conduct of a basic risk assessment prior to any explosives processing operation (see Module 02.10); outlines three types of ammunition inspections—routine, technical, and safe to move; and offers advice on physical inspections, including for 25 generic types of ammunition.

The module is also designed to help users assign status codes and other markings to indicate the status of inspected ammunition: serviceable, unavailable, or banned.

29 Surveillance may require the breakdown of an ammunition item to allow for a proper assessment of its internal state or the collection of explosive or propellant samples for test purposes.

Volume 07. *Ammunition processing*

Module 07.10. ***Safety and risk reduction (ammunition processing operations)***

Any operation involving ammunition potentially increases the risk of UEMS. Explosions can be initiated by a multitude of external stimuli, and a minor event can quickly escalate into a major one. As a result, full consideration must be given to every explosives processing operation, regardless of the level of complexity involved, so as to assess all potential risks.

It is difficult to control and manage risks and develop a risk reduction strategy for an explosives operation if potential risks are unknown. For this reason, this module starts with general guidance on the conduct of a risk assessment (see Module 02.10). Users are then systematically guided on how to translate findings into safety measures, namely through the establishment and implementation of user-developed 'safe systems of work'. Such systems, guided by risk assessment results in conjunction with guidance and requirements from this module, should also address other areas that are part of the control and management of explosives facilities (see Module 06.10).

In addition, the module provides guidance on general safety aspects of ammunition and explosives processing.

Module 07.20. ***Surveillance and in-service proof***

Since ammunition deteriorates over time, it has a finite serviceable life. Surveillance and in-service proofs are used to monitor its condition and gauge any safety deterioration or performance degradation; these processes also fulfil the ammunition inspection requirements provided in Module 06.80. An accurate appraisal of an ammunition item's state and remaining lifespan is important to ensure both safety and cost-effectiveness. Such a determination ensures the most advantageous return on what can be a heavy investment.

This module explains both the rationale for, as well as the importance of, surveillance and in-service proof processes. In providing guidance and requirements that national authorities can use to develop their own processes, it serves to address areas such as national regulation, responsibilities, requirements for effective programmes, and the establishment and implementation of relevant processes, including the collection of baseline data, sample selection, scheduling, and documentation.

Also included is strong advice related to propellants, some of which can spontaneously ignite upon depletion of their stabilizer content[30] below minimum levels. This depletion process is unstoppable and irreversible and has resulted in many catastrophic UEMS. Once stabilizer content is depleted, the only safe solution is immediate isolation and disposal of the ammunition. With advance warning through a surveillance programme, such ammunition could possibly be used in training before it becomes unsafe to handle or store, which would allow an owner to optimize its use.

Volume 08. *Transport of ammunition*

Module 08.10. *Transport of ammunition*

International agreements and regulations[31] govern the transport of dangerous goods—including ammunition. Without them, and given that national transportation regulations vary greatly across states, the international movement of dangerous goods would be severely impeded, if not impossible.

These international regulations rely on the UN hazard classification system, which is almost universally accepted by states and which provides a common platform for safe transport (see Module 01.50). All other international transport agreements and regulations build on the UN system (UN, 2017a).

This module explains how the UN system is used by organizations responsible for developing international regulations for the safe transport of ammunition and explosives by truck, rail, air, and sea. It discusses each of these modes of transport and the international regulations and requirements that govern them.

The ammunition-related regulations on the transport of dangerous goods in these international agreements apply only if a national authority has adopted

30 Nitrocellulose-based propellants contain nitric ester constituents such as nitroglycerin and nitrocellulose and undergo a slow decomposition even at ambient temperatures. Unless removed, the degradation products that are formed can cause a reduction in chemical stability, which can lead to self-ignition due to the exothermic nature of the reactions involved. They can also 'lead to a loss of calorific value, changes in ballistic properties, and cracking in large diameter charges. Small amounts of stabilizing compounds are included in propellant formulations, either singly or as mixtures, in order to react with the degradation products, thus reducing the probability of the adverse effects noted above' (NATO, 2008b).

31 The agreements include the European Agreement concerning the International Carriage of Dangerous Goods by Road (UNECE, 2017); the Regulation concerning the International Carriage of Dangerous Goods by Rail (RID) (OTIF, 2017); and the Safe Transport of Dangerous Goods by Air, which is Annexe 18 to the Convention on International Civil Aviation (ICAO, 2011).

them for internal use. States that adopt them benefit from a harmonized and safe system for classifying and transporting ammunition. The quantity distances in Module 02.20 are based on the UN hazard classification system, an IATG RRPL 3 requirement.

Volume 09. *Security of ammunition*

Module 09.10. *Security principles and systems*

The physical security of ammunition stockpiles is an essential part of LCMA as it reduces the risk of loss, theft, leakage, and proliferation (collectively referred to as 'diversion') as well as acts of malfeasance, such as sabotage. Physical security is especially important in regions of instability and post-conflict environments, where basic security steps can have a very large impact in terms of preventing diversion.

When compared to the value of an ammunition stockpile, the financial costs associated with taking security precautions are minimal. Security costs should not be viewed simply as an expense; they should be balanced against the potential costs associated with poor security leading to UEMS. Effective and efficient physical security of a state's ammunition stockpile is consistent with IATG guiding principles (see Module 01.10). States are advised to adopt an active, rather than reactive, approach to accounting for and securing their ammunition (see Module 03.10).

This module is designed to help improve physical security standards for ammunition stockpiles. It establishes guiding principles for physical security, details the various elements of physical security, provides guidance and requirements for implementing these elements, defines the necessary procedures, and introduces technical security systems in support of LCMA.

Volume 10. *Ammunition demilitarization and destruction*

Module 10.10. *Demilitarization and destruction of conventional ammunition*

A number of IATG modules note that certain stockpile management activities can generate unsafe, damaged, or excess ammunition-related materials that may need to be demilitarized or destroyed. In addition, certain international treaties, agreements, and instruments refer to or require the destruction of ammunition.

States that intend to destroy ammunition can avail themselves of various techniques, ranging from relatively simple open burning and detonation to highly sophisticated industrial demilitarization processes. Each of these processes requires expert knowledge and carries a unique set of risks. States are advised to carry out comprehensive planning to be able to select the most appropriate and efficient process and to execute it safely.

This module provides general guidance on and introduces a technical methodology for the safe planning and execution of ammunition demilitarization and destruction activities in support of LCMA. It does not provide a template for demilitarization and destruction as there are many different factors to consider; instead, it focuses on core activities that are common to most destruction processes.

Volume 11. *Ammunition accidents, reporting and investigation*

Module 11.10. *Ammunition accidents: reporting and investigation*

Reporting and investigating ammunition accidents are fundamental, preventive safety measures. All accidents should be immediately reported and properly investigated so that appropriate action can be taken. Delays in reporting and responding, or the failure to conduct a proper investigation, may perpetuate a dangerous situation and increase the likelihood of an accident.

This module introduces the overall rationale behind accident reporting and investigation. It presents a classification system for accidents and provides guidance on actions that can be taken when an accident occurs; accident reporting procedures; and the related responsibilities of the established investigation authority and assigned technical investigator. National authorities that wish to develop requirements for accident reporting and investigation can use this module as well as Module 11.20, which covers a specific methodology for conducting an accident investigation.

Module 11.20. *Ammunition accidents: investigation methodology*

Reporting and investigating ammunition accidents is important to ensure that causes are identified and appropriate actions taken to prevent a reoccurrence or UEMS.

Conducting an investigation is never a simple matter. Accidents are not usually the result of a single failure, but rather result from a series of progressive and sequential events or failures that together eventually cause an accident. Determining the causes of an accident requires the application of a systematic and deliberate approach using a proven and agreed-upon methodology.

This module introduces and describes the basic elements of an accident investigation and provides a methodology for conducting one. It includes topics such as gaining assistance from other agencies and technical experts, gathering evidence, and interviewing witnesses. It provides a checklist that helps to guide and track investigation activities. In addition, it includes lists of generic questions, divided by major topics—such as ammunition, personnel qualifications, and procedures—that can be used by an investigator.

Module 11.30. ***Ammunition storage area explosions: EOD clearance***

Based on the number of UEMS that occur each year around the world, it is highly likely that some IATG users will need to oversee post-event explosive ordnance disposal clearance. As these situations are extremely dangerous, cleanup is best left to experienced and qualified organizations. An understanding of the consequences of UEMS and of the particulars of post-UEMS cleanups can underscore the need to maintain safe and secure ammunition stockpiles.

This module explains the extreme danger associated with post-event situations, during which ammunition and explosives—in a variety of hazardous conditions—may be scattered over large areas. It details the potential consequences of such an event on the surrounding people and areas, as well as the hazards that have to be addressed. It provides basic clearance principles and guidance on the development of a clearance methodology and the clearance operation itself. An example of an EOD clearance order is provided as an annexe to this module.

Implementation of basic RRPL 1 stockpile management requirements can help reduce risk significantly (see Module 01.20). These risks can be further reduced through continual improvements and as additional capabilities and capacities become available.

Volume 12. *Ammunition operational support*

Module 12.10. ***Ammunition on multi-national operations***

This module provides guidance on the storage, handling, and use of ammunition and explosives for personnel deployed in multinational operations.

It provides basic planning guidance for selecting appropriate locations for the safe storage of ammunition from troop-contributing nations, details key force-level explosives safety and risk management roles and responsibilities, and identifies the required competencies for a force explosives safety officer. It establishes the minimum safety requirements for unit personnel and the public; specifically, it features a table that refers to appropriate IATG modules and paragraphs, to meet RRPL 1 stockpile management requirements, at a minimum. A force's goal should be to strive for higher RRPLs to reduce risk.

The guidance in this module encourages all troop-contributing nations to certify[32] that ammunition deployed in support of multinational operations is 'safe to deploy' and is subject to surveillance and in-service proof programmes that are fully compliant with Module 07.20.

Module 12.20. ***Small unit ammunition storage***

Small unit organizations such as police or isolated military units—many of which operate in heavily populated urban areas—handle ammunition on an almost daily basis although they may not have received the necessary training to do so. Such a lack of training has led to deaths and injuries in a number of catastrophic UEMS.

This module provides guidance for individuals in small units who are responsible for ammunition handling, storage, and management. Since many basic safe handling and storage requirements in the IATG are also directly applicable to small units, this module provides a requirements checklist that points to appropriate IATG modules and paragraphs to meet RRPL 1 stockpile management requirements, at a minimum. As compliance may be difficult to achieve, this module offers advice on the use of a risk management approach (see Module 02.10) and the importance of communicating risks to all potentially affected parties, especially when compliance with the IATG cannot be achieved. Wherever possible, small units should apply quantity distances (see Module 02.20).

Small units may accumulate large amounts of ammunition whose safety status is unknown, including as part of criminal investigations. This module includes warnings and guidance on isolating or disposing of such dangerous materials as quickly as possible, in accordance with the governing national legal framework or protocol.

32 Annexe E to Module 12.10 and Annexe C to Module 04.10 provide a 'proof and surveillance compliance form' that can be used for this certification.

Annexe 2. The IATG in the context of LCMA

This matrix, prepared by a contributor from Germany's Bundeswehr Verification Center, considers the relevance of the IATG to the LCMA elements detailed in the Handbook. This annexe provides a tool that can assist states in the application of the IATG in conjunction with Annexe 1.

IATG thematic areas	IATG modules	LCMA elements				
		National ownership	Planning	Procurement	Stockpile management	Disposal
Relevance: ++ = strong, + = some, ◊ = limited						
01 Introduction and principles of ammunition management	01.10 Guide to the IATG	++	+	◊	+	◊
	01.20 Index of RRPL within IATG	++	◊	◊	++	+
	01.30 Policy development and advice	++	++	+	◊	◊
	01.40 Glossary of terms, definitions and abbreviations	+	+	+	+	+
	01.50 UN explosive hazard classification system and codes	◊	+	+	++	+
	01.60 Ammunition faults and performance failures	+	+	+	++	+
	01.70 Bans and constraints	+	◊	◊	++	+
	01.80 Formulae for ammunition management	+	+	◊	++	+
	01.90 Ammunition management personnel competences	++	+	+	++	+
02 Risk management	02.10 Introduction to risk management principles and processes	++	++	+	++	+
	02.20 Quantity and separation distances	+	+	◊	++	◊
	02.30 Licensing of explosive facilities	+	+	◊	++	◊

IATG thematic areas	IATG modules	LCMA elements				
		National ownership	Planning	Procurement	Stockpile management	Disposal
Relevance: ++ = strong, + = some, ◊ = limited						
02 Risk management	02.40 Safeguarding of explosive facilities	+	+	◊	++	◊
	02.50 Fire safety	+	+	◊	++	+
03 Ammunition accounting	03.10 Inventory management	+	++	◊	++	+
	03.20 Lotting and batching	◊	◊	◊	++	+
	03.30 International transfer of ammunition module	++	+	+	+	+
	03.40 End-user and end-use of internationally transferred ammunition module	++	+	+	++	◊
	03.50 Tracing of ammunition	++	◊	+	++	◊
04 Explosive facilities (storage) (field and temporary conditions)	04.10 Field storage	+	+	◊	++	◊
	04.20 Temporary storage	+	+	◊	++	◊
05 Explosives facilities (storage) (infrastructure and equipment)	05.10 Planning and siting of explosives facilities	+	+	◊	++	◊
	05.20 Types of buildings for explosives facilities	+	+	◊	++	◊
	05.30 Barricades	◊	+	◊	++	+
	05.40 Safety standards for electrical installations	+	+	+	++	◊
	05.50 Vehicles and mechanical handling equipment (MHE) in explosives facilities	+	+	+	++	+
	05.60 Radio frequency hazards	◊	+	+	+	+
06 Explosive facilities (storage) (operations)	06.10 Control of explosives facilities	+	+	◊	++	◊
	06.20 Storage space requirements	+	++	+	++	+

IATG thematic areas	IATG modules	LCMA elements				
		National ownership	Planning	Procurement	Stockpile management	Disposal
Relevance: ++ = strong, + = some, ◊ = limited						
06 Explosive facilities (storage) (operations)	06.30 Storage and handling	◊	◊	++	◊	+
	06.40 Ammunition packaging and marking	◊	◊	+	++	◊
	06.50 Specific safety precautions (storage and operations)	◊	+	+	++	◊
	06.60 Works services (construction and repair)	◊	+	+	++	◊
	06.70 Inspection of explosives facilities	+	+	◊	++	◊
	06.80 Inspection of ammunition	+	+	◊	++	+
07 Ammunition processing	07.10 Safety and risk reduction (ammunition processing operations)	◊	+	◊	++	+
	07.20 Surveillance and in-service proof	+	+	+	++	+
08 Transport of ammunition	08.10 Transport of ammunition	+	+	◊	++	+
09 Security of ammunition	09.10 Security principles and systems	++	+	◊	+	+
10 Ammunition demilitarization and destruction	10.10 Demilitarization and destruction of conventional ammunition	+	+	+	+	++
11 Ammunition accidents, reporting and investigation	11.10 Ammunition accidents: reporting and investigation	++	+	◊	+	+
	11.20 Ammunition accidents: investigation methodology	++	+	◊	+	+
	11.30 Ammunition storage area explosions: EOD clearance	++	+	◊	+	++
12 Ammunition operational support	12.10 Ammunition on multi-national operations	+	+	◊	++	+
	12.20 Small unit ammunition storage	+	+	◊	++	◊

Note: The relevance assessments presented in this table reflect the author's personal experience and may not be consistent with other experts' views.

Source: Bernd Kaltenborn, ammunition technical officer and arms control officer, Bundeswehr Verification Center, Germany

Annexe 3. Information for exporting states: end-user certificates of importing states

Module 3.40 of the IATG states that 'an end-user certificate (EUC) shall be required prior to the approval of any ammunition export licence' (UNODA, 2015, mod. 03.40, para. 4.2). It recommends that EUCs include information about the entities involved in the transfer, items to be transferred, and assurances regarding the end user and end use, as follows:

An end-user certificate for transfer to state entities *shall* contain the following elements:

a) the date of issue;
b) a detailed description of the ammunition to be exported: 1) type, 2) model, 3) calibre, 4) quantity, 5) lot or batch numbers, and 6) value;
c) whenever available, the contract number (or the order reference) and the date of its issuance;
d) the country of final destination of the goods to be exported;
e) the description of the end use of the goods to be exported;
f) assurances that the ammunition will be used only by the end user;
g) assurances that the ammunition will be used only for the stated end use;
h) assurances that re-export of imported ammunition can only take place after receiving a written authorization from the exporting country, unless the exporting country decides to transfer that authority to the export licencing authorities of the importing country;
i) the details of the exporter, including name, position, business name, address, phone, fax, e-mail, and website (if available);
j) information about the end user, including name, position, institution/organization, address, phone, fax, e-mail, and website (if available);
k) the original signature of the end user (or a representative of the end user). A legally certified signature may be used when using an electronically issued EUC;
l) a certification by the relevant governmental authorities, according to national practice, as to the authenticity of the end user, including the date, name, position,

institution/organization, address, phone, fax, e-mail, website (if available), and original signature of the authorizing official (a legally certified signature may be used when using an electronically issued EUC); and

m) a unique register number and the duration of the end-user certificate.

An end-user certificate for transfer to state entities *should* contain the following elements:

n) information on other parties (intermediate consignees/purchasers, brokers, transport agents) involved in the transaction, as may be required, including name, position, business name, address, phone, fax, e-mail, and website (if available);
o) information on transit points (if any). If these elements are not known at the time of the EUC development, they should be notified prior to the export;
p) a commitment by the end user and/or the importing state to provide the exporting state a delivery verification certificate (DVC); and
q) a clause allowing the exporting state to carry out, upon its request, on-site inspections of the transferred ammunition, particularly in the case of production capacity transfers.

An end-user certificate for transfer to state entities *may* contain the following elements:

r) the place of issue; and
s) the location of the end use of the goods to be exported.

Regarding re-export, the exporting state may require more stringent requirements, such as:

t) assurances that re-export of imported ammunition can only take place after receiving a written authorization from the exporting state;
u) assurances that the imported ammunition will not be re-exported; or
v) assurances that the imported ammunition will not be diverted or relocated to another destination or location in the importing state.

Source: UNODA (2015, mod. 03.40, para. 5.2.3.1)

Further reading

Section 2

Bevan, James, ed. 2008a. *Conventional Ammunition in Surplus: A Reference Guide.* Geneva: Small Arms Survey.

Kahl, Marius. 2012. *Towards Strong Arms and Ammunition Management Practices. Starter Guide.* Bonn: Bonn International Center for Conversion. December.

Tetlay, Abideen. 2010. 'Through Life Capability Management Perspective for Framework Development for Assessing and Measuring System Maturity, System Readiness and Capability Readiness using Architecture Frameworks.' Paper presented at the 5th IEEE International Conference on Systems of System Engineering. Loughborough University, UK, June.

Yue, Yi and Michael Henshaw. 2009. 'An Holistic View of UK Military Capability Development.' *Defense & Security Analysis*, Vol. 25, No. 1. May, pp. 53–67.

Section 3

Carapic, Jovana and Paul Holtom. 2018. *Life-cycle Management of Ammunition: Lessons from Bosnia and Herzegovina*. Briefing Paper. Geneva: Small Arms Survey.

Donais, Timothy. 2012. *Peacebuilding and Local Ownership: Post-Conflict Consensus Building.* Abingdon, UK: Routledge.

Sigri, Unsal and Başar Ufuk. 2015. 'Assessing the Quality of Training: The Case of EUFOR Operation Althea.' *Journal of International Peacekeeping*, Vol. 19, Nos. 3–4, pp. 274–86.

Section 4

Covert, Harold Duane. 1985. *An Analysis of the Navy Conventional Gun Ammunition Inventory Management System.* Monterey, CA: Naval Postgraduate School. June.

Gobinet, Pierre and Tom Van Beneden. 2012. *Buy and Burn: Factoring Demilitarization into Ammunition Procurement.* RASR Issue Brief No. 2. Geneva: Small Arms Survey. April.

NATO (North Atlantic Treaty Organization). 2003a. *Handbook on Long Term Defence Planning.* RTO Technical Report 69. SAS-025. AC/323/(SAS-025)TP/41. Brussels: NATO. April.

Slak, Robert. 2012. *A Study of Slovenian Armed Forces Ammunition Forecasting Methodology.* Fort Leavenworth, KS: United States Army Command and General Staff College. 14 December.

US Navy (United States Navy). 2012. *The Naval Ordnance Management Policy (NOMP) Manual, Volume 1: Ordnance Concepts, Objectives, Policies, Organizations, and Responsibilities*. OPNAV M-8000.16, Change 3, 18 May 2016. Washington, DC: Office of the Chief of Naval Operations.

Section 5

Bevan, James, ed. 2008a. *Conventional Ammunition in Surplus: A Reference Guide.* Geneva: Small Arms Survey.

King, Benjamin, ed. 2010. *Surveying Europe's Production and Procurement of Small Arms and Light Weapons Ammunition: The Cases of Italy, France, and the Russian Federation.* Working Paper No. 10. Geneva: Small Arms Survey.

NATO (North Atlantic Treaty Organization). 2009a. *Guidance on the Assessment of the Safety and Suitability for Service of Non-Nuclear Munitions for NATO Armed Forces, 3rd edn.* AOP-15. Brussels: NATO. April.

Section 6

NATO (North Atlantic Treaty Organization). 2017c. *In-Service Surveillance of Munitions General Guidance, Edition A, Version 1.* AOP-62. Brussels: NATO Standardization Organization. February.

—. 2017d. *In-Service Surveillance of Munitions Sampling and Test Procedures, Edition A, Version 1.* AOP-63. Brussels: NATO Standardization Organization. February.

—. 2017e. *In-Service Surveillance of Munitions Condition Monitoring of Energetic Materials, Edition A, Version 1.* AOP-64. Brussels: NATO Standardization Organization. February.

OSCE (Organization for Security and Co-operation in Europe). 2008. *OSCE Handbook of Best Practices on Conventional Ammunition, Decision 6/08*. Vienna: OSCE. 15 September.

—. 2011b. *OSCE Document on Stockpiles of Conventional Ammunition.* FSC.DOC/1/03/Rev.1 of 23 March. Vienna: OSCE.

Section 7

Alverbro, Karin, et al. 2009. 'A Life Cycle Assessment of Destruction of Ammunition.' *Journal of Hazardous Materials,* Vol. 170, Nos. 2–3. 30 October, pp. 1101–09.

GAO (United States Government Accountability Office). 2015. *Improved Data and Information Sharing Could Aid in DOD's Management of Ammunition Categorized for Disposal.* GAO-15.538. Washington, DC: GAO.

Gullett, Brian, Johanna Aurell, and Ryan Williams. 2016. *Characterization of Air Emissions from Open Burning and Open Detonation of Gun Propellants and Ammunition.* Washington, DC: United States Environmental Protection Agency, 7 November.

Poulin, Isabelle. 2010. *Literature Review on Demilitarization of Munitions. Technical Memorandum (TM) 2010-213.* Valcartier, Canada: Defence Research and Development Canada. November.

RASR (Regional Approach to Stockpile Reduction). n.d. Website.

Wilkinson, Josh and Duncan Watt. 2006. *Review of Demilitarisation and Disposal Techniques for Munitions and Related Materials.* Report L-118. Brussels: North Atlantic Treaty Organization Munitions Safety Information Analysis Center.

Bibliography

Alverbro, Karin et al. 2009. 'A Life Cycle Assessment of Destruction of Ammunition.' *Journal of Hazardous Materials*, Vol. 170, Nos. 2–3. 30 October, pp. 1101–09.

APMBC ISU (Anti-Personnel Mine Ban Convention Implementation Support Unit). 2017. 'Belarus Destroys over Three Million Hazardous Landmines Fulfilling Its Ottawa Convention Obligations; Over 50 million Landmines Have Now Been Destroyed.' *Press release.* 7 April.

Berman, Eric, Benjamin King, and Pilar Reina. 2014. *The UEMS Incident Reporting Template (IRT).* Research Note No. 40. Geneva: Small Arms Survey.

— and Pilar Reina, eds. 2014. *Unplanned Explosions at Munitions Sites (UEMS): Excess Stockpiles as Liabilities rather than Assets.* Handbook. Geneva: Small Arms Survey. June.

Bevan, James, ed. 2008a. *Conventional Ammunition in Surplus: A Reference Guide.* Geneva: Small Arms Survey.

—. 2008b. 'Introduction: Conventional Ammunition in Surplus.' In James Bevan, pp. 1–11.

—, Jonah Leff, and Ian Ruddock. 2014. *Weapons and Ammunition Management in the Federal Republic of Somalia.* Geneva: United Nations Institute for Disarmament Research.

— and Adrian Wilkinson. 2008. 'Generic Types of Conventional Ammunition.' In James Bevan, pp. 22–30.

Boulay, Rodrigue. 2003. *Demilitarization of Ammunition and Explosives.* Canadian Department of National Defence Report 11300-28 (DAPM 4-4-6). 15 August.

Butler, Dwayne, et al. 2016. *Identifying Efficiencies in the Supply Chain for Training Ammunition: Methods, Models, and Recommendations.* Research Report RR-952-A. Santa Monica, CA: RAND Corporation.

CAG (Comptroller and Auditor General of India). 2015. *Ammunition Management in the Army for the Year Ended March 2013.* Union Government (Defence Services) Army and Ordnance Factories. No. PA 19 of 2015. New Delhi: CAG.

—. 2017. *Report of the Comptroller and Auditor General of India for the Year Ended March 2016.* Union Government (Defence Services) Army and Ordnance Factories. Report No. 15 of 2017. New Delhi: CAG.

CAR (Conflict Armament Research). 2017. *Sudanese Stockpiles and Regional Weapon Diversion: An Analysis of Captured Equipment in the Possession of the Sudan People's Liberation Army-North in the Nuba Mountains.* London: CAR. May.

Carapic, Jovana, Prasenjit Chaudhuri, and Pierre Gobinet. 2016. *Sustainable Stockpile Management in Bosnia and Herzegovina: The Role of EUFOR Mobile Training Team for Weapons and Ammunition Management*. Working Paper No. 24. Geneva: Small Arms Survey. October.

— and Paul Holtom. 2018. *Life-cycle Management of Ammunition: Lessons from Bosnia and Herzegovina*. Briefing Paper. Geneva: Small Arms Survey.

—, Adrian Wilkinson, and Ian Ruddock. 2017. 'Deliverable 1: Cost-benefit Analysis of Stockpiles Surplus Storage versus Destruction.' In *Mechanisms for Control and Reduction of Stockpiles in Bosnia and Herzegovina: Options for Disposal and Improving Safety and Security.* Unpublished background paper. Geneva: United Nations Development Programme and Small Arms Survey.

Casey-Maslen, Stuart. 2016. 'Export Controls.' In Sarah Parker, ed. *The Arms Trade Treaty: A Practical Guide to National Implementation.* Handbook. Geneva: Small Arms Survey, pp. 49–71.

Chivers, C.J. 2008. 'Supplier under Scrutiny on Arms for Afghans.' *New York Times.* 27 March.

Clark, S.J., Cynthia Barnhart, and Stephan Kolitz. 2004. 'Large-Scale Optimization Planning Methods for the Distribution of United States Army Munitions.' *Mathematical and Computer Modelling*, Vol. 39, Nos. 6–8. March, pp. 697–714.

Costner, Steven. 2015. 'Life Cycle Management of Conventional Ammunition.' Unpublished presentation given at the 22nd Symposium of the Multinational Small Arms and Ammunition Group. Geneva, 16 November.

Covert, Harold Duane. 1985. *An Analysis of the Navy Conventional Gun Ammunition Inventory Management System.* Monterey, CA: Naval Postgraduate School. June.

DAC (United States Army Defense Ammunition Center). 1998. *Propellant Management Guide.* Savanna, IL: Logistics Review and Technical Assistance Office. June.

DND and CAF (Department of National Defence and Canadian Armed Forces). 2004. 'DAOD 3002-0, Ammunition and Explosives.' Last modified 24 August 2016. Accessed January 2018.

Donais, Timothy. 2012. *Peacebuilding and Local Ownership: Post-Conflict Consensus Building.* Abingdon, UK: Routledge.

—. 2014. 'National Ownership and Post-Conflict Peacebuilding: From Principle to Practice.' Policy Brief No. 43. Waterloo, Canada: Centre for International Governance Innovation.

Dutch Safety Board. 2017. 'Mortar Accident Mali.' The Hague: Dutch Safety Board. 21 December.

FICCI (Federation of Indian Chambers of Commerce and Industry) and CENJOWS (Centre for Joint Warfare Studies). 2018. *Ammunition Manufacturing in India: Road to Self-Reliance*. New Delhi: FICCI. 12 March.

GAO (United States Government Accountability Office). 2016. *2016 Annual Report: Additional Opportunities to Reduce Fragmentation, Overlap, and Duplication and Achieve Other Financial Benefits*. GAO-16-375SP. Washington, DC: GAO. April.

—. 2015. *Improved Data and Information Sharing Could Aid in DOD's Management of Ammunition Categorized for Disposal.* GAO-15.538. Washington, DC: GAO.

Gobinet, Pierre and Jovana Carapic. 2015. "Less 'Bang' for the Buck: Stockpile Management in South-east Europe." In Small Arms Survey. *Small Arms Survey 2015: Weapons and the World*. Cambridge: Cambridge University Press, pp. 125–55.

— and Claudio Gramizzi. 2011. *Scraping the Barrel: The Trade in Surplus Ammunition*. Issue Brief No. 2. Geneva: Small Arms Survey. April.

— and Tom Van Beneden. 2012. *Buy and Burn: Factoring Demilitarization into Ammunition Procurement*. RASR Issue Brief No. 2. Geneva: Small Arms Survey. April.

Gullett, Brian, Johanna Aurell, and Ryan Williams. 2016. *Characterization of Air Emissions from Open Burning and Open Detonation of Gun Propellants and Ammunition*. Washington, DC: United States Environmental Protection Agency. 7 November.

Haskins, Cecilia, ed. 2006. *Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities.* Version 3. San Diego: International Council on Systems Engineering. June.

Huber, Etienne. 2017. 'Organizational Framework of Ammo Management.' Unpublished presentation given at the 2017 Multinational Small Arms and Ammunition Group (MSAG) Ammunition and Staff Assessment Visit Course. Thun, Switzerland, 25 September.

ICAO (International Civil Aviation Organization). 2011. Convention on International Civil Aviation Annex 18: The Safe Transport of Dangerous Goods by Air, 4th edn. July.

IMO (International Maritime Organization). 1972. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. Adopted 29 December.

—. 1996. Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ('London Protocol'). Adopted 17 November 1996, as amended 2006.

ISO/IEC (International Organization for Standardization/International Electrotechnical Commission). 2016. 'Systems and Software Engineering: Life Cycle Management—Part 1: Guidelines for Life Cycle Management.' ISO/IEC TS 24748-1:2016.

Johnson, Michael and Brent Coryell. 2016. 'Logistics Forecasting and Estimates in the Brigade Combat Team.' *Army Sustainment Magazine*. November–December.

Kahl, Marius. 2012. *Towards Strong Arms and Ammunition Management Practices. Starter Guide.* Bonn: Bonn International Center for Conversion. December.

King, Benjamin, ed. 2010. *Surveying Europe's Production and Procurement of Small Arms and Light Weapons Ammunition: The Cases of Italy, France, and the Russian Federation*. Working Paper No. 10. Geneva: Small Arms Survey.

Lazarević, Jasna. 2012. *Costs and Consequences: Unplanned Explosions and Demilitarization in South-east Europe*. Special Report No. 18. Geneva: Small Arms Survey. November.

Leischow, Scott J., and Bobby Milstein. 2006. 'Systems Thinking and Modelling for Public Health Practice.' *American Journal of Public Health*, Vol. 96, No. 3. March, pp. 403–05. Washington, DC: American Public Health Association.

Lewis, Leslie and Charles Robert Roll Jr. 1993. *Strategy-to-Tasks: A Methodology for Resource Allocation and Management*. P-7839. Santa Monica, CA: Rand Corporation.

Mawson, John III. 1985. *The Conventional Ammunition Requirements Determination Process of the U.S. Navy*. Monterey, CA: Naval Postgraduate School. December.

MoD (Ministry of Defence) of India. 2016. *Defence Procurement Procedure 2016: Capital Procurement*. New Delhi: Government of India.

—. 2017. 'Manufacturing of Ammunition for Indian Army by Indian Industry.' New Delhi: Press Information Bureau. 20 December.

MSAG (Multinational Small Arms and Ammunition Group). 2012. 'About MSAG: Objectives of MSAG.' 10 February. Accessed January 2018.

NATO (North Atlantic Treaty Organization). 1997. *NATO Logistics Handbook: Senior NATO Logisticians' Conference Secretariat, 3rd edn.* Brussels: NATO Headquarters.

—. 2001. *Safe Disposal of Munitions, Design Principles and Requirements, and Safety Assessment*. STANAG 4518. Brussels: NATO. 8 October.

—. 2003a. *Handbook on Long Term Defence Planning*. RTO Technical Report 69. SAS-025. AC/323/(SAS-025) TP/41. Brussels: NATO. April.

—. 2003b. *Cost Structure and Life Cycle Costs for Military Systems*. AC/323(SAS-028)TP/37. Brussels: NATO. September.

—. 2007. *NATO System Life Cycle Stages and Processes*. AAP-48, 1st edn. Brussels: NATO. February.

—. 2008a. *Allied Ordnance Publication (AOP) – 2(c): The Identification of Ammunition*.

—. 2008b. *Explosives, Nitrocellulose-Based Propellants, Stability Test Procedures and Requirements Using Stabilizer Depletion, 2nd edn*. AOP-48. 3 October.

—. 2008c. 'NATO to Help Georgia Destroy More Missiles.' 20 August.

—. 2009a. *Guidance on the Assessment of the Safety and Suitability for Service of Non-Nuclear Munitions for NATO Armed Forces, 3rd edn*. AOP-15. Brussels: NATO. April.

—. 2009b. *Glossary of Terms and Definitions Concerning the Safety and Suitability for Service of Munitions, Explosives and Related Products, 5 edn*. AOP-38. October.

—. 2012. *NATO Independent Cost Estimating and the Role of Life Cycle Cost Analysis in Managing the Defence Enterprise*. SAS-076. Brussels: NATO. August.

—. 2015a. *NATO Programme Management Framework (NATO Life Cycle Model)*, edn. C, version 1. AAP-20. Brussels: NATO Standardization Organization. October.

—. 2015b. 'Partners.' Updated 11 November. Brussels: NATO. Accessed January 2018.

—. 2015c. *NATO Guidelines for the Storage of Military Ammunition and Explosives*, 2nd edn. AASTP-1. NSO/1582(2015)CASG/4440. Brussels: NATO.

—. 2016a. *NATO Guidelines for the Storage, Maintenance and Transport of Ammunition on Deployed Missions or Operations*, 1st edn., version 3. AASTP-5. Brussels: NATO.

—. 2016b. *Explosive Safety Risk Analysis Part 1: Guidelines for Risk-Based Decisions*, 1st edn., version 4. AASTP-4. Brussels: NATO.

—. 2017a. 'Fact Sheet: Montenegro.' January. Luxembourg: NATO Support and Procurement Agency.

—. 2017b. 'Partnership for Peace Programme.' Updated 7 June. Brussels: NATO. Accessed January 2018.

—. 2017c. *In-Service Surveillance of Munitions General Guidance*, edn. A, version 1. APO-62. Brussels: NATO Standardization Organization. February.

—. 2017d. *In-Service Surveillance of Munitions Sampling and Test Procedures*, edn. A, version 1. APO-63. Brussels: NATO Standardization Organization. February.

—. 2017e. *In-Service Surveillance of Munitions Condition Monitoring of Energetic Materials*, edn. A, version 1. AOP-64. Brussels: NATO Standardization Organization. February.

—. n.d. 'NATO Standardization Document Database.' Accessed January 2018. Brussels: NATO.

—. Forthcoming. *Safe Disposal of Munitions, Design Principles and Requirements, and Safety Assessment*, edn. A, version 2. AOP-4518. Brussels: NATO.

OECD (Organisation for Economic Co-operation and Development). 2011. *Supporting Statebuilding in Situations of Conflict and Fragility*. Paris: OECD.

OSCE (Organization for Security and Co-operation in Europe). 2008. *OSCE Handbook of Best Practices on Conventional Ammunition*. Decision 6/08. Vienna: OSCE. 15 September.

—. 2011a. Decision No. 3/11: Destruction of Conventional Ammunition. FSC.DEC/3/11 of 23 March. Vienna: OSCE.

—. 2011b. *OSCE Document on Stockpiles of Conventional Ammunition*. FSC.DOC/1/03/Rev.1 of 23 March. Vienna: OSCE.

—. 2012. *OSCE Document on Small Arms and Light Weapons*. FSC.DOC/1/00/Rev.1 of 20 June. Vienna: OSCE.

OTIF (Intergovernmental Organisation for International Carriage by Rail). 2017. Regulation concerning the International Carriage of Dangerous Goods by Rail (RID). Appendix C to the Convention concerning International Carriage by Rail (COTIF).

Parker, Sarah and Christelle Rigual. 2015. *What the National Reports Reveal: Trends in UN PoA and ITI Reporting*. Issue Brief No. 13. Geneva: Small Arms Survey. June.

Persi Paoli, Giacomo. 2010. 'Italian Procurement, Exports, and Consumption of Small- and Large-calibre Ammunition and Munitions.' In Benjamin King, pp. 54–84.

Poulin, Isabelle. 2010. *Literature Review on Demilitarization of Munitions.* Technical Memorandum (TM) 2010-213. Valcartier, Canada: Defence Research and Development Canada. November.

RASR (Regional Approach to Stockpile Reduction). n.d. Website.

Reuters. 2017. 'Dutch Defense Minister Resigns over Peacekeepers' Deaths in Mali.' 3 October.

Schroeder, Matt, Helen Close, and Chris Stevenson. 2008. 'Deadly Deception: Arms Transfer Diversion.' In Small Arms Survey, *Small Arms Survey 2008: Risk and Resilience.* Cambridge: Cambridge University Press, pp. 113–153.

Sigri, Unsal, and Başar Ufuk. 2015. 'Assessing the Quality of Training: The Case of EUFOR Operation Althea.' *Journal of International Peacekeeping*, Vol. 19, Nos. 3–4, pp. 274–86.

Singh, Ravinder Pal, ed. 1998. *Arms Procurement Decision Making—Volume I: China, India, Israel, Japan, South Korea and Thailand*. Oxford: Oxford University Press and Stockholm International Peace Research Institute.

Slak, Robert. 2012. *A Study of Slovenian Armed Forces Ammunition Forecasting Methodology*. Fort Leavenworth, KS: United States Army Command and General Staff College. 14 December.

Sloan, Elinor. 2006. *The Strategic Capability Investment Plan: Origins, Evolution and Future Prospects.* Ottawa: Canadian Defence and Foreign Affairs Institute. March.

Small Arms Survey. n.d. Unexpected Explosions at Munition Sites (UEMS) Database. Accessed February 2018.

Switzerland. 2017. 'Chair's Summary.' International Workshop on the Safe and Secure Management of Ammunition, 8–9 December 2016. Geneva: Government of Switzerland. Unpublished document. 14 February.

Tetlay, Abideen. 2010. 'Through Life Capability Management Perspective for Framework Development for Assessing and Measuring System Maturity, System Readiness and Capability Readiness using Architecture Frameworks.' Paper presented at the 5th IEEE International Conference on Systems of System Engineering. Loughborough University, UK, June.

UK (United Kingdom). 2014a. The Explosive Regulations 2014. No. 1638.

—. 2014b. *Explosives Regulations 2014: Safety Provisions. Guidance on Regulations, L150*. London: Health and Safety Executive.

—. 2014c. *Explosives Regulations 2014: Security Provisions. Guidance on Regulations, L151*. London: Health and Safety Executive.

UN (United Nations). 2015. *Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria*, 6th revised edn. ST/SG/AC.10/11/Rev.6. New York and Geneva: UN. 6 December.

—. 2017a. *Recommendations on the Transport of Dangerous Goods: Model Regulations*, 20th revised edn. ST/SG/AC.10/1/Rev.20. New York and Geneva: UN. June.

—. 2017b. *Globally Harmonized System of Classification and Labelling of Chemicals (GHS)*, 7th revised edn. ST/SG/AC.10/30/Rev.7. New York and Geneva: UN. July.

UNECE (United Nations Economic Commission for Europe). 2017. European Agreement concerning the International Carriage of Dangerous Goods by Road. ECE/TRANS/257 (Vols. I and II). As amended 1 January 2017.

UNGA (United Nations General Assembly). 1997. Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction ('Mine Ban Treaty'). Adopted 18 September.

—. 2001a. Protocol against the Illicit Manufacturing of and Trafficking in Firearms, Their Parts and Components and Ammunition, Supplementing the United Nations Convention against Transnational Organized Crime ('Firearms Protocol'). Adopted 31 May. A/RES/55/255 of 8 June.

—. 2001b. Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All Its Aspects. Adopted 21 July. A/CONF.192/15 of 20 July.

—. 2006. Resolution 61/72. Adopted 6 December. A/RES/61/72 of 3 January 2007.

—. 2008a. Resolution 63/182. A/63/182 of 28 July.

—. 2008b. Resolution 63/61. Adopted 2 December. A/RES/63/61 of 12 January 2009.

—. 2011. Resolution 66/42, adopted 2 December. A/RES/66/42 of 12 January 2012.

—. 2013. The Arms Trade Treaty, adopted 2 April. Resolution 67/234B, adopted 2 April. A/RES/67/234B of 11 June 2013.

UNODA (United Nations Office for Disarmament Affairs). 2015. *International Ammunition Technical Guidelines*, 2nd edn. New York: UNODA. 1 February.

—. n.d. 'UN SaferGuard Programme Training Courses on the IATG.' Accessed January 2018.

UN SaferGuard. 2016. 'UN SaferGuard: International Ammunition Technical Guidelines: Who Is Using the International Ammunition Technical Guidelines?' New York: UNODA. Accessed January 2018.

—. n.d.a. 'IATG Implementation Support Toolkit.' Accessed January 2018.

—. n.d.b. 'IATG – References.' Accessed January 2018.

—. n.d.c. 'IATG Forms.' Accessed January 2018.

US Army (United States Army). 2001. *Ammunition Handbook: Tactics, Techniques, and Procedures for Munitions Handlers.* Field Manual 4-30.14, FM (9-13). Washington, DC: Department of the Army. 1 March.

—. 2009. *Management: Total Army Munitions Requirements Process and Prioritization System*. Army Regulation 5-13. Washington, DC: Department of the Army. 17 December.

—. 2015. *Worldwide Ammunition Logistics and Explosives Safety Review and Technical Assistance Program (AR 700-13): Annual Digest.* FY2015 Program. McAlester, OK: Defense Ammunition Center.

USHR (United States House of Representatives). 2008. 'Examination of AEY Contracts with the U.S. Government.' Hearing before the Committee on Oversight and Government Reform House of Representatives, 110th Congress, 2nd Session, Serial No. 110-119. 24. June.

US Navy (United States Navy). 2012. *The Naval Ordnance Management Policy (NOMP) Manual, Volume 1: Ordnance Concepts, Objectives, Policies, Organizations, and Responsibilities*. OPNAV M-8000.16, Change 3, 18 May 2016. Washington, DC: Office of the Chief of Naval Operations.

Wilkinson, Adrian. 2008. 'Stockpile Management: Planning.' In James Bevan, pp. 76–84.

Wilkinson, Josh and Duncan Watt. 2006. *Review of Demilitarisation and Disposal Techniques for Munitions and Related Materials*. Report L-118. Brussels: North Atlantic Treaty Organization Munitions Safety Information Analysis Center.

Yue, Yi, and Michael Henshaw. 2009. 'An Holistic View of UK Military Capability Development.' *Defense & Security Analysis*, Vol. 25, No. 1. May, pp. 53–67.