

**THE QUALITY MANAGEMENT SYSTEM IN
THE GERMAN EXPLOSIVE ORDNANCE
DISPOSAL PROGRAMME**

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GLOSSARY OF ABBREVIATIONS

AH-KMR	Arbeitshilfen Kampfmittelräumung (technical operations support documents EOD)	LISA	Liegenschaftsinformationssystem Außenanlagen (federal property information system)
BAM	Bundesanstalt für Materialprüfung (federal institution for tests of materials)	MoI	Ministry of Interior
BTU	Brandenburgische Technische Universität Cottbus	NRW	Nordrhein-Westfalen
DIN	Deutsches Institut für Normung (German Institute for Standardisation)	NVA	Nationale Volksarmee (National People's Army)
DLR	Deutsche Luft-und Raumfahrt Gesellschaft (German society for space and aviation)	OFD	Oberfinanzdirektion Niedersachsen (higher financial authority Niedersachsen)
EOD	Explosive Ordnance Disposal	QA	Quality Assurance
ERW	Explosive Remnants of War	QC	Quality Control
FRG	Federal Republic of Germany, West Germany, until re-unification 1990	QM	Quality Management
GDR	German Democratic Republic, East Germany, until re-unification 1990	RSP	Render Safe Procedures
GIS	Geographic Information System	PTB	Physikalisch-Technische Bundesanstalt (federal institution for physical-technical issues)
GKD	Güteschutzgemeinschaft Kampfmittelräumung (association for maintaining standards in EOD)	SHA	Suspected Hazardous Area
GPS	Global Positioning System	SOP	Standard Operating Procedures
HTF	Hilfstruppführer (Deputy troop leader)	SprengG	Sprengstoffgesetz (law about explosives)
ISO	International Organization for Standardization	TF	Truppführer (Troop leader)
KMBD	Kampfmittelbeseitigungsdienst (Lander EOD service, usually under the police)	UXO	Unexploded Ordnance

1. INTRODUCTION

Germany is a federal country, consisting of 16 states called ‘Bundesländer’ which are generally referred to as ‘Land’ or ‘Länder’.¹ It is one of the few countries in the world where Explosive Ordnance Disposal (EOD) to protect civilians and property alike has been carried out since the days of the Second World War until today, without pause.

Civil and military roles and responsibilities, risk management responses and quality management concepts and practice have all developed over time. Germany also has a range of management systems across its different regional governments (‘Länder’). This study looks at quality management in Germany and at the lessons learnt through the application of continual improvement processes².

Since 1946, non-military EOD in Germany has been carried out by the police as part of their tasks to protect the public from threats, and in this case specifically threats stemming from explosive ordnance. Police work and threat protection falls under the authority of each Land,³ meaning that the primary non-military EOD response in Germany rests with the police.

2. SCOPE AND HISTORY OF THE PROBLEM

Germany is contaminated with explosive remnants of war (ERW) that stems from both internal and external causes. During the 20th century, three German Armed Forces were disbanded on German soil: the Imperial German Forces in 1918, the ‘Wehrmacht’ in 1945 and the National People’s Army (‘Nationale Volksarmee’, NVA) in 1990. Almost a dozen different military forces, German and Allies alike, left behind enormous quantities of land service and naval ammunition at military installations. In 1989, 970,000 hectares of land (almost the size of Lebanon) was exclusively used and occupied by military forces.⁴

During WWII, there were 20 explosives factories and 3,240 ammunition factories in the country;⁵ many of their sites still represent a significant threat to public health and safety. Germany suffered intense bombardment during the war, both from the air and ground. Huge quantities of bombs, rockets, projectiles, mortars, grenades, landmines and cluster bombs were left in cities, the countryside and in rivers, lakes and seas. Around two million tonnes of ordnance was air dropped on the country during allied bombing campaigns.⁶ Rigorously collected figures are hard to find, but the consensus among historical researchers and clearance operators is that as many as 20 per cent of the weapons failed to function.⁷

Immediately after the war, the allied forces disposed of huge stockpiles of ERW and whole ammunition factories by detonation, creating in the process some no-go areas that still require clearance today. Significant quantities of the stockpiled ordnance, mixed with surplus chemical

¹ As of 1990 the reunified Germany is referred to simply as Germany.

² Main sources, and an outline of the methodology used in this case study can be found in Annex B.

³ Arbeitshilfen Kampfmittelräumung (AH-KMR), OFD Niedersachsen, 2007, p. 11 (AH-KMR).

⁴ G. Möschwitzer, R. Haas, Militärische Altlasten und ihre Folgen, <http://www.r-haas.de/V15.html>

⁵ Piper, BITS.

⁶ A study of policy and practice in relation to residual World War 2 Unexploded Ordnance in Germany and the UK, GICHD, Geneva, August 2013 (GICHD-WWII Study).

⁷ Ibid.

ammunition of German and Allied origin⁸ were also disposed of by dumping – in the North and Baltic Seas.

Germany was also significantly contaminated with landmines. During WWII, large minefields were laid in the east and west of the country to delay the advancement of allied troops. Those minefields were mostly cleared in the 1940s and 1950s, however landmines of wartime origin are still occasionally found. Most infamous is the ‘Riegelmine’ (bar mine, AT), which has caused many accidents; the last one being several self-detonations in the winter of 2011/12 in Brandenburg.

After fortifying its border with the west, East Germany laid anti-personnel minefields there during the 1960s and 1970s. These were later cleared in the 1980s and 1990s, however, a residual risk from landmines still exists.⁹

3. HISTORY OF EOD IN GERMANY AFTER WWII

Germany had a centralised administration from 1933 until 1945. It was not a federal state. Immediately after the war, Germany as a State ceased to exist. It was split into ‘zones’ by the four occupation forces. A short while later, the ‘Länder’ were set up by the allied occupation authorities, which then tried to cope with the aftermath of the war within their respective geographical regions. EOD as a means to remove and mitigate the risk to the public stemming from ERW was set up within the system of police response in most Länder.

Germany never had an institution comparable to a modern-day national mine action centre. Although the problem of ERW was a national one, the response was left to the Länder to deal with, with the only exception that costs for the response were to be split between federal and non-federal property and, for the latter, between German and Allied Ammunition.¹⁰ This split of responsibilities continues today.

The Federal Republic of Germany (FRG) was founded in 1951; about five years later the first Länder EOD services (‘Kampfmittelbeseitigungsdienste’, KMBDs) were set up.

3.1 THE END OF THE WAR AND AFTERMATH IN THE WESTERN ZONES

During the war the EOD response was risk-based and carried out under intense pressure. Towards the end of the war the workload became so overwhelming that only bombs with time delay fuses were defused or neutralised straight away. Other bombs and Unexploded Ordnance (UXO) were left to be dealt with at a later date. It is clear that the quality management (QM) of activities was not considered important and typically reflected a trial and error experience.

However, efforts were made to publish information on how to deal with certain types of bombs, including the tools used. Technical drawings of newly discovered bomb fuses were made onsite, tools and methods were documented, replicated and used elsewhere in similar situations. Information about render safe procedures (RSP) that failed was spread among bomb technicians

⁸ Der Munitionsräumdienst des Landes Schleswig-Holstein, Reg.Dir. a.D. Claus Kinder, Kiel, 1984 (Kinder, 1984).

⁹ <http://www.tagesspiegel.de/weltspiegel/die-scharfen-minen-der-ddr/6560838.html> (read 06.09.2013)

¹⁰ Artikel 120, Absatz 1, Grundgesetz and §19, Absatz 2, Nr 1 AKG (General Law about war liabilities).

as quickly as the difficult circumstances would allow.¹¹

At the end of the war, the responsibility for dealing with UXO lay with the allied forces. In response to an increasing number of ordnance-related accidents, units to dispose of the threat of ERW were established in 1946. Those units were formed and administratively structured by different individuals within the respective allied occupation authorities. As such, the size, structure and administrative links of the newly-founded units varied significantly across Germany:

- the KMBDs in the Schleswig-Holstein and Nordrhein-Westfalen were to be integrated into their Lander-Firefighting Authorities within the Ministry of Interior;
- in Niedersachsen, the KMBD was under the authority of the police; and
- in Hamburg, the KMBD was put under the local authority for construction.

All four Lander were within the British Zone¹². All Lander-KMBDs were set up in Federal German Lander, except Bavaria,¹³ where the response to the ERW problem resulted in the funding of a private (commercial) entity in August 1946. The company “GER” was set up with permission from the American occupation authority and was overseen by the Bavarian Ministry for Economy. Shareholders of this company were the states of Bavaria, Hessen, Wuerttemberg-Baden and later Bremen. The idea of the company from the start was to combine risk-mitigation and response with the utilisation and exploitation of the commercial value of ERW (eg, scrap metal, wooden packaging, etc).¹⁴ To this day, the EOD response in Bavaria is provided through a commercial company and is overseen by the Bavarian State Ministry of Interior.

Conditions for an EOD response at the beginning were very poor, as there was almost no equipment or funding available. Salaries were sometimes paid in instalments or only after extended delays; equipment was supplied by former EOD technicians or salvaged from ruins. Specialised equipment, such as for deep excavations, were almost impossible to come by.¹⁵

As the state EOD services developed and economic conditions improved, more personnel were employed. The employment figures peaked at the beginning of the 1960s, but began to decrease again from the mid-1960s. Employees were mostly former EOD technicians and other military personnel.

In the early phase, KMBDs covered all tasks from search, recovery and RSP through to transport, storage and disposal. Over time their focus changed to today’s more limited functions described below.

3.2 THE AFTERMATH IN THE RUSSIAN ZONE

From 1950 the Russian Zone (later to become East Germany or the German Democratic Republic, ‘GDR’) saw the KMBDs joining the police administration within the Ministry of the Interior directly. Six units were set up for the six (then) Lander in the east (including East Berlin).

¹¹ Sprengkommandos, Geschichte der Blindgängerbeseitigung, Manfred Rauschert, Motorbuch-Verlag, Stuttgart 1980 (Rauschert).

¹² Kinder, 1984.

¹³ Lehrmaterial Sprengschule Dresden, Kampfmittelbeseitigung in der BRD, Günter Fricke, 1999 (Fricke, 1999).

¹⁴ “Zwischen Berufung und strenger Pflicht“, Geschichte des Feuerwerkswesens in Deutschland, Rainer Lambrecht, Knotenpunkt-Verlag, Potsdam, p. 395 (Lambrecht).

¹⁵ Kinder, 1984.

These units were organised as a form of commercial entity ('Regiebetrieb Abrüstung') within the police structure. In 1957, those units had about 400 employees across East Germany, with their leaders being active-duty police officers, serving in plain clothes. The approach here was centralised in nature. It is also of note that in the 1980s there was an all-female EOD unit within the KMBD Magdeburg.¹⁶

The system continued until German re-unification in 1990, during which East Germany was organised into the same five Lander of the period from 1945 -1952 (not including Berlin). The formerly centralised EOD units were disbanded and integrated into the newly formed KMBD, following the West German example. The new Lander were each supported by a 'parent-land' from the west; hence, their respective EOD response systems were adopted in the new Lander as well, effectively ending a period of centralised EOD response in the east.

3.3 THE SCALE OF EOD IN GERMANY TODAY

Although the Second World War ended almost 70 years ago, EOD is still a very important task in Germany and will continue to be so for decades to come:

- The Berlin EOD service disposed of more than 6,642 tonnes of ERW between 1947 and 2011 (excluding East Berlin between 1950 and 1990), from an area of 891.8 km².¹⁷ This is about 0.25 per cent of German territory today.
- The KMBD Nordrhein-Westfalen (NRW) recovered and disposed of 114 tonnes of ERW in 2011 alone, including 247 bombs weighing more than 50 kg. In the same area, 14,743 requests for risk assessments (analysis of aerial photography) and subsequent land release were submitted in 2011.¹⁸ NRW is 34,084 km² in size, which is about 10.5 per cent of Germany's territory.
- The Land Brandenburg considers about 800 km² of its territory as suspected hazardous areas (SHA), even no go areas. This is 2.71 per cent of the area of Brandenburg, which is 29,477 km² in size and covers 8.25 per cent of Germany's territory.

4. POLICY, LEADERSHIP AND STANDARDS

There is no federal legislation for non-military-EOD, which defines responsibilities, financing and liability or material requirements for EOD. Instead, the respective legal sources are spread over different federal and Lander laws. The fundamental sharing of responsibilities and costs can be drawn from the 'Grundgesetz' (German equivalent to constitution). Details regarding state EOD services are defined in the respective Lander regulations.¹⁹

4.1 FEDERAL REGULATIONS

Some federal laws are fundamental to the sector of non-military-EOD even though they were not specifically designed for it. The most fundamental federal law is the 'Sprengstoffgesetz' or 'SprengG', which is a law about explosives. The following are exempt from the SprengG:

¹⁶ Ibid.

¹⁷ Figures from PTU (KMBD) Berlin, Presentation Engin Laumer, police officer.

¹⁸ Gefahrenabwehr in Nordrhein-Westfalen, Jahresbericht 2011, p. 93-96.

¹⁹ AH-KMR, p. 11.

KMBDs, the Bundeswehr, foreign military forces in Germany, Lander and federal police and the border customs authorities²⁰. However, some military regulations, such as the *BesAnSchAufg 34/100-III-0001*, do explicitly refer to the SprengG to be observed in the general sense of the law.²¹

The SprengG, among other regulations, distinguishes between *permission* to run an EOD company as a business and the state-acknowledged *certificate of proof of ability* to carry out physical tasks of EOD, such as detection, recovery, onsite transportation etc. A permission holder is not allowed to carry out physical EOD jobs without the certified proof of ability, which includes the required relevant knowledge.²²

The permit to run an EOD business is not time-limited (but is rendered void if the business activities do not start within a year of permission being given, or are not carried out for more than two years in a row). The permit may also be withdrawn if the reliability of the permit holder is considered insufficient by the authorities. Other federal laws with varying applicability to non-military EOD are listed in Annex A.

4.2 LANDER REGULATIONS AND STANDARDS

Specific tasks and responsibilities, the organisation of the state EOD services, among other, more general aspects of health, safety and environmental matters which are common to all work in Germany are defined in different Lander-laws across the 16 states.²³

Depending on the Land where a company or an employee works, a mix of certain federal requirements and some specific to the Land must be satisfied. Lander requirements are usually divided into an official Lander government order regarding EOD (‘Kampfmittelverordnung’), and a technical document from the respective KMBD, describing how EOD activities are to be conducted in that state. The latter can be seen as the definition of the required Quality Standards within the Land. The documents vary considerably in size, content and details. For example, Hamburg’s has 12 pages, NRW’s has 109 pages.²⁴

The number of laws, rules, conditions, directives, procedures and orders from various federal or Lander government authorities, from legal bodies and from professional associations is considerable. Identifying, and complying with applicable laws so that a uniform quality standard can be established and sustained for non-military EOD activities across Germany is difficult.

In light of that difficulty, a number of professional associations, in cooperation with federal and Lander bodies, took the initiative and attempted to create a set of minimum universal norms for non-military EOD in Germany. Although these norms do not reach the level of a federal law; they may still be used at a national level and, as such, they do provide a common framework that can be used in quality management. A list of applicable legal and professional norms is laid out as per Annex A.

²⁰ SprengG, §1, Abs4 Pkt1.

²¹ Durchführungsbestimmungen für Erwerb, Erhalt, Einschränkung, Ruhen, Entzug, und Nachweis der Berechtigungen für den Umgang mit Munition (Fachkunde Munition) BesAnSchAufg 34/100-III-0001, Anlage 5/1.

²² SprengG, §§ 7 and 20.

²³ AH-KMR p.11.

²⁴ See *JA-KRD Hamburg* <http://www.hamburg.de/contentblob/3967266/data/ta-krd-hamburg-2013.pdf> and *TV-KMB-NRW* http://www.mik.nrw.de/fileadmin/user_upload/editors/import/sch/doks/tvkampfmittelbes.pdf for details.

5. ROLES AND RESPONSIBILITIES

5.1 FEDERAL MINISTRIES

Federal Ministries such as the Ministry of Finance, the Ministry of Defence and the Ministry of Traffic, Construction and City Development, are considered key stakeholders for non-military EOD at the federal level, however, they have no legal authority to rule the various KMBDs directly. Instead, they act as initiators and financial donors to initiatives that were set up with the aim of national standardisation in EOD. Key organisations and professional bodies who took part in this process are listed in the sections below.

5.2 OBERFINANZDIREKTION NIEDERSACHSEN (HIGHER FINANCIAL AUTHORITY NIEDERSACHSEN, OFD)

The OFD Niedersachsen is the lead OFD in Germany in regard to comprehensive support in the areas of wastewater facilities, ground and groundwater protection and a federal property information system ('Liegenschaftsinformationssystem Außenanlagen', LISA).²⁵

As such, the OFD was tasked in 2007 by the Ministry of Defence and the Ministry of Traffic, Construction and City Development and in coordination with the Ministry of Finance to develop the technical operations support documents EOD ('Arbeitshilfen Kampfmittelräumung', AH-KMR). This was achieved with support from various KMBDs, EOD companies, supervising and planning engineering firms and contracting authorities.

The AH-KMR are based on the practical experience of years of EOD response in Germany. Structured in four phases (A, B, C1, C2), they contain information and details regarding the planning and execution of clearance tasks, from the initial assessments until the final documentation.²⁶

This includes legal and technical definitions, the specifics of geophysics, risk and clearance concepts and contracting. A large part explains the working structures and principles of the various KMBDs. The AH-KMR also try to define and clarify the terminology of 'Stand der Technik' (current level of technology) and variations of the term, which are fundamental to the quality expectations in terms of clearance requirements during EOD operations in Germany.

However, the AH-KMR are only valid on federal property for clearance of conventional ERW (chemical ordnance is excluded). The authority of the various Lander to regulate EOD is not touched. Implementing the AH-KMR outside of federal property is voluntary for clients or contractors, although highly welcomed by the OFD.²⁷ Nevertheless, a growing number of engineering firms are using the AH-KMR, which, because of their detailed and standardised approach, are receiving a growing acceptance even among clients outside of federal tenders.

Lately, the AH-KMR have been utilised by others to further promote and develop attempts to reach a higher level of national standardisation at all levels of non-military EOD. This is laid out in 'GKD' below.

²⁵ http://www.ofd.niedersachsen.de/portal/live.php?navigation_id=17503&article_id=66683&psmand=110

²⁶ http://www.ofd-hannover.de/KMR/KMRDocs/Downloads/Arbeitshilfen_KMR/AH-KMR_071031.pdf, p. 19.

²⁷ Ibid, p. 3.

5.3 MILITARY

The German army or ‘Wehrmacht’ ceased to exist with the unconditional surrender of Germany on May 8, 1945. As such, there was no military response to the EOD problem in Germany after this date, apart from allied EOD technicians and engineers, until the various KMBD assumed full responsibility.

National military forces were set up again in West Germany in 1955 and in East Germany in 1956. Those included an EOD capacity which dealt with the respective military in-service ordnance (as the police are responsible for non-military EOD).

5.4 NATIONAL STANDARDS AND ACCREDITATION BODIES

5.4.1 RAL

RAL is a German institution that acknowledges ‘Gütegemeinschaften’ (quality associations in form of registered associations), which in turn may award marks of quality to their members, following a thorough process of certification (see ‘GKD’ below). RAL defines the requirements for the mark of quality, according to the specifics of the respective product or service. The process involves a wide array of contributing stakeholders. Quality criteria related to product and performance include all aspects important for the use of the product. Criteria are published and remain in the public domain. RAL is the only institution in Germany awarding marks of quality; currently 160 marks of quality have been awarded.²⁸

5.4.2 DIN

An equally important factor within the quality management of German EOD is the use of DIN norms. The remit of DIN (‘Deutsches Institut für Normung’ – the German Institute for Standardisation) is to encourage, organise, steer and moderate standardisation and specification activities in systematic and transparent procedures for the benefit of society as a whole, while safeguarding the public interest. DIN's work serves to: advance innovation, safety and communication among industry and research organisations, the public sector and society as a whole; and to support quality assurance, rationalisation, occupational health and safety, as well as environmental and consumer protection. DIN publishes its work results and promotes the implementation of these results. Some 30,000 experts contribute their skills and experience to the standardisation process, which is managed and coordinated by a DIN staff of around 400. By agreement with the German Federal Government, DIN is the acknowledged national standards body that represents German interests in European and international standards organisations. Ninety per cent of the work on standards now carried out by DIN is international in nature. A registered non-profit association, DIN has been based in Berlin since 1917.²⁹

²⁸ <http://www.ral-guetezeichen.de>

²⁹ <http://www.din.de>

5.5 EOD INDUSTRY STANDARD SETTING

5.5.1 GKD

The GKD (‘Güteschutzgemeinschaft Kampfmittelräumung’ – the association for maintaining standards in EOD) is a registered association, funded in 1997. Its members cover the whole bandwidth of EOD, from commercial clearance over training, supervision and detector manufacturing to business-specific insurance solutions.

The aim of the GKD is to protect public and clearance personnel alike from the hazards of ERW. This aim is achieved through the setting of quality standards for its members and the continuous supervision thereof (details below). The quality standards are based on quality and test definitions as per DIN 18200, which is a universal standard in Germany.

The quality standards are considered a living document which is subject to routine improvement, the last of which took place in 2006. As such, these standards are a defined process in itself. In connection with European standards for the awarding of contracts, these standards ensure the highest level of safety for all stakeholders involved (customers, planners, executing companies, clearance and supervisory personnel, bystanders onsite).

In addition, GKD cooperated with the professional associations on the publication of a comprehensive information booklet ‘EOD’ in 2007, providing a support document for EOD companies (see ‘BG BAU’ below). The GKD was also a contributor to the AH-KMR.

Last, but not least, the GKD took part in the development of the ‘Technische Vertragsbedingungen für Kampfmittelräumarbeiten’ (technical terms and conditions for EOD contracting), ‘DIN ATV 18323’. The ATV 18323 aims to support the client in terms of defining the terms and conditions of a clearance or clearance-related contract. This is achieved through:

- a precise description of the expected performance delivery, enabling the bidder to undertake a thorough calculation, leaving no room for speculations;
- the provision of planning security with regards to costs; and
- the execution of services within the agreed limits of safety and costs.³⁰

The GKD also published a commentary about the topic, promoting standardisation even on the planning level, forcing planners and clients to define specifically the required clearance depth and quality. This ensures a document (contract) against which the contractor can be specifically measured.³¹

5.5.2 BG BAU

The professional construction association (BG Bau) developed the BG Information ‘EOD’ (BGI 833) in 2007. It is published in the form of an information booklet and has been developed with contributions from various stakeholders, who are almost identical with the stakeholders developing the AH-KMR (above).

The BGI 833 gives guidance for activities from initial assessments over risk assessments to clearance plan and clearance and handover procedures for ERW. It also includes transport and disposal (relevant for KMBD mainly), but excludes biological ordnance. The BGI 833 provides

³⁰ Kommentar zur ATV DIN 18323 Kampfmittelräumarbeiten, Dr. Rainald Haerber, Presentation, Dresden, 2013.

³¹ Interview Mr. Rosenwald, GKD and advertisement prospect GKD.

no guidelines for planning (other than for the clearance plan) and final documentation.

It is a practical 57-page booklet, providing relevant information and guidance covering the whole width of non-military EOD in a handy and comprehensible format. As such it offers an easily accessible aide to standardised procedures at a national level and complements the AH-KMR.

5.6 CERTIFICATION AND LICENSING

5.6.1 INDIVIDUAL CERTIFICATION

The individual proof of ability certificate is acquired by passing a state- exam at a licensed school. Before requesting a certificate in accordance with the SprengG, applicants must pass a number of courses (proof of ability), undergo a police background check, show political reliability (abstain from extremism etc) as well as personal suitability (for the permit and the certificate). Failing to meet these criteria may lead to the authorities rejecting the request.

The certificate for proof of ability must be renewed every five years. This can only be achieved through participation in a refresher course or in another EOD course leading to a state-acknowledged exam.³²

5.6.2 ORGANISATIONAL CERTIFICATION

5.6.2.1 GKD-certification

The body of documentation relating to requests from GKD members applying for the award of the mark of quality RAL-GZ 901 (equivalent to a quality certification) is extensive. GKD's authority to award the quality seal to its complying members was first awarded to the GKD by the RAL institution. It covers the following main areas:

- legal requirements – presence of holders of permission as well as holders of certified proof of ability;
- accident and other relevant insurances covers for death, invalidity and damage;
- medical and protective requirements;
- requirements for the archiving of documents and data (timespan);
- availability of a technical library;
- minimum requirements for the training and qualification of **all** staff on a site – including leased labour;
- requirements for professional development and regular specific safety briefings;
- specific qualifications for specific jobs (eg, divers, chemical ammunition);
- minimum ratio clearance workers to supervisor;
- requirements for surveying (minimum one Global Positioning System (GPS)-trained operator or contractor, Geographic Information System (GIS) workstation);
- minimum requirements for numbers and categories of general and special equipment (heavy equipment, detectors, computers, kit for bomb recovery, underwater clearance etc);

³² Ibid, §§ 8 and 11.

- maintenance and daily (or regular) checks of operability for equipment and appliances;
- clearance plans;
- regular internal/external supervision and inherent accreditation through awarding of quality seal; and
- procedures for the failing of accreditation or supervision.

Assessment for the mark of quality is carried out at four levels:

- An initial check is carried out by GKD itself, and includes reviews of the applicant company's internal documentation and internal audits/evaluations.
- The second level is carried out internally by a qualified and designated senior manager and is provided to external assessors if requested.
- The third level is an external assessment, carried out separately from the internal processes. The GKD quality commission nominates an external assessor, typically an engineering firm or independent consultant. External assessors do not apply for such roles, but are approached by the commission. External assessors cannot be internal assessors of another company (to avoid accusations of commercial conflicts of interest, or unfair advantage).
- After the mark of quality has been awarded, companies are re-visited twice a year by external assessors.

5.6.2.2 'Verein für die Präqualifikation von Bauunternehmen' e.V. (registered association for the pre-qualification of building contractors)

In order to receive public contracts, this association promotes the introduction and further development of a pre-qualification system for building contractors. Building contractors who wish to take part in a public tendering process must submit to the relevant authorities all data documenting their technical ability and reliability prior to each tendering process. The authorities must check the data for each bidder on each project.

The association strives to rationalise the process of public tendering by presenting a list to the authorities with contractors pre-qualified to take part in public tendering. Prior to any tendering process, the association carries out a thorough process of checking that the respective contractor meets the required criteria and compiles a list of pre-qualified bidders. As such, the authorities do not need to carry out the complete pre-qualification procedure by themselves. The aim is that the system should increase efficiency and decrease costs.³³ The process is based on a federal guideline from the Ministry for Traffic, Construction and City Development for conducting a pre-qualification process, dated 25.10.2012.³⁴

Currently all members of the GKD who hold a mark of quality are also certified as pre-qualified building contractors. Although there is no requirement for this to be the case, holding both the quality mark and the building certification is seen as strong evidence that all aspects of the company's documentation and systems are in good order.

³³ <http://www.pq-verein.de>

³⁴ <http://www.pq-verein.de/anlage150366binary>

5.7 OVERSIGHT AND MONITORING

5.7.1 KMBD

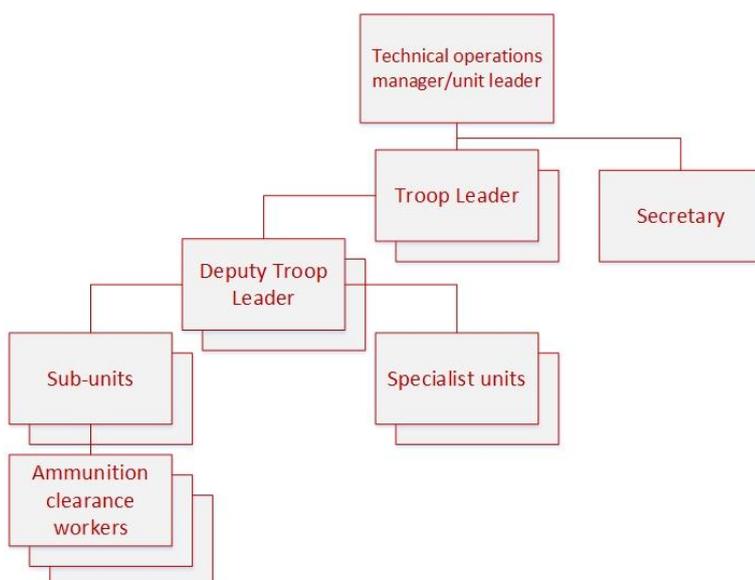
Each Land (including three city-states), has its own KMBD, governed by a mix of federal and Land-specific laws, rules and regulations. In 14 states, the KMBD is attached directly to the police or another public service (such as the fire-fighters) under the Ministry of Interior (MoI); in two Lander a private company is currently entrusted with full authority (under the control of one or two civil servants within the respective Lander Ministry).

In the past the KMBDs dealt with the full range of EOD tasks, but this has changed over time and now mainly covers the following areas:

- technical support to the Legislature by writing and implementing technical standards within their respective Lander;
- contribution/cooperation to developing tendering documents for public (commercial) tenders;
- technical supervision of commercial clearance companies' activities (Quality assurance (QA) and Quality control (QC));
- search, recovery, RSP and disposal of unexploded bombs, including risk analysis using aerial photography and historical research;
- transportation and storage of ERW;
- disposal of ERW either in-situ or bulk disposal in specific disposal areas³⁵.

The basic layout of a KMBD in general is:

Figure 1: Typical KMBD organisation



³⁵ Fricke, 1999.

The technical operations manager/unit leader and a secretary run operations in the Land. Troop leaders ('Truppführer', TF) run a troop, which can have multiple subunits or specialist units, such as a underwater clearance diver unit. A deputy troop leader ('Hilfstruppführer', HTF) runs a subunit and can stand in for the troop leader if required. Ammunition clearance workers are hired as required to satisfy ongoing demands.

The individual structure of a state EOD service and the number of personnel is defined by its specific tasks and varies from state to state.³⁶ EOD response is seen as a police task and the more classic tasks that are carried out by regular police officers when ERW are found are:

- a first response to reports from the public;
- securing the location and providing situations reports; and
- possible criminal investigations.

To enhance their knowledge of ERW, some KMBDs undertake basic ID and awareness lessons for police officers.³⁷ In Bavaria and Thuringia the authority of the KMBD was delegated to a commercial company. This company, however, also works as a common commercial company in other Lander of Germany, where it has to fulfil all the normal respective requirements and conditions.

5.8 EOD OPERATIONS

Commercial clearance activities were allowed early on in the west. In 1946 Paul-Heinz Roehll founded the 'Bohr-und Sprenggesellschaft P.H. Roehll KG' (Drilling and Demolition ltd) in Berlin. This was the first commercial company in Europe for EOD services and disposal of environmentally dangerous substances.³⁸ First contracts for recovery of submerged ERW were awarded in the 1950s in Schleswig-Holstein, although they were later revoked because of safety concerns following accidental detonations during transport and recycling.³⁹ It is worth noting that as early as the 1950s, safety concerns were already being taken seriously and companies not complying with basic safety rules were disqualified and removed from the market, so that other, better qualified companies, could take their place.

With the change in tasks for KMBDs over the years, the bulk of the efforts to search for, excavate and recover ERW nowadays rest with commercial companies.

Any company wishing to work in commercial EOD must satisfy the strict legal and licensing requirements described above. An unofficial list (dated 2011) shows 84 different companies working in Germany. Their size varies from one person (with or without specialised tools) to large companies with several hundred employees and a range of heavy equipment at their disposal. The size of companies often varies from season to season and as more or less funding is available.

The law distinguishes between qualified and certified personnel (with different degrees of qualification) and uncertified (unskilled) labourers. Companies may use leased unskilled labourers for basic clearance work, however, specific requirements for qualification and

³⁶ Ibid.

³⁷ Interview with Th. Lange, Technical Operations Manager KMBD Saxonia, July 2013.

³⁸ Lambrecht, p. 375.

³⁹ Kinder, 1984.

certification for them may vary in different companies or Lander.

Companies may engage in all sorts of activities within the limited range open to commercial operators within a given Land. Their main areas of activity are:

- manual surface search;
- computer-assisted surface search;
- borehole detection;
- underwater (offshore and onshore) search;
- EOD qualified visual supervision of excavation activities;
- sifting of ERW-contaminated soil; and
- preparation for in-situ disposal of ERW and support of demolitions (under state supervision).

If requested, companies may bid for clearance of chemical ammunition. If selected, they must meet additional requirements and demonstrate exceptionally high standards in safety and equipment. Authority to conduct bulk disposal of ERW at a central disposal site may also be given to a commercial company, following a tendering process.

5.9 USE OF ISO 9001:2008

ISO (International Organization for Standardization) 9001:2008 specifies requirements for a quality management system. These include the need for an organisation to demonstrate its ability to:

- consistently provide products that meet customer, as well as applicable statutory and regulatory requirements;
- enhance customer satisfaction through the effective application of the system, including processes for its continual improvement and the assurance of conformity to customer as well as applicable statutory and regulatory requirements.

All requirements of ISO 9001:2008 are generic and are intended to be applicable to all organisations, regardless of type, size and product provided.

In the German EOD market, mainly large, well-established companies and engineering firms as well as the four detector-manufacturing companies hold ISO 9001-2008 certification. Smaller companies do not always see a clear benefit from ISO certification. In some cases, in a highly competitive and volatile market, it is seen as a financial and administrative burden that does not support the position of smaller companies in the market.

Large projects or public tenders, which traditionally are in the field of large companies, require an ISO certification from the company to be able to tender. This ability comes from the assurance of certain standardised services, products and procedures documented by an ISO certification. ISO certifications are awarded by a variety of institutions or companies. The best known, and also internationally operating, are the DEKRA, TÜV Rheinland and TÜV Nord, among others. ISO, however, is not the only quality standard used by German EOD companies – the RAL system is equally important.

6. COMPETENCE, TRAINING, EQUIPMENT AND RESOURCES

6.1 TRAINING

Training in West Germany was for a long time carried out within the respective companies or institutions. As most operators had already been trained during the war, there was no need for standardised training. Instead an informal system was used – more experienced workers trained newcomers to the required levels of professionalism.⁴⁰

The quality of the internal training at these times depended on the quality of the respective instructor. There was considerable variation across the industry – examples are known of written exams from one institution containing 145 questions, whereas in another, only 20 questions (to be answered in bullet points) was considered sufficient for proof of knowledge.⁴¹

As a reaction, during the 1960s, a central, standardised training system was developed by conducting courses and state-acknowledged exams at the KMBD of Nordrhein-Westfalen, West Germany. Personnel were sent from commercial companies to the courses. The best participants were often recruited by the KMBDs to ensure that they had the best available personnel.⁴²

The system in East Germany was centralised, with the first manuals for training and handling in connection with ERW, written and published as early as 1950, within the structure of the MoI.⁴³ After German reunification, a central German training institution was established at the ‘Sprengschule Dresden’ in 1992. The school had previously taught general and special demolition techniques to a variety of civilian and commercial students in the GDR. It adopted and further developed the curriculum from the school in NRW.

Additional commercial EOD schools were founded in the following years – now, three commercial schools compete in the market. Their EOD training does not follow a single central federal curriculum. Instead, their individual curricula were acknowledged at the federal level following a process known as ‘Länderanhörung’ (Lander Consultation).

During the process, each school presents its curriculum to the responsible Ministry of the Land where the school is located. After the Ministry has checked the curriculum, it then sends it to the other 15 Lander for consideration. If there is no negative reply from another Land after a set time, the curriculum is confirmed and the school is licensed to conduct state-acknowledged exams for students. The resulting certificates allow individuals to work everywhere in Germany, but within any limitations set by the respective Land they may be working in⁴⁴.

Topics covered at the German (commercial) schools are:

- basics of technical drawings;
- basics of surveying;
- basics of ammunition technology;
- scientific basics (chemistry, physics, ballistics);

⁴⁰ Fricke, 1999.

⁴¹ Lambrecht, p. 254.

⁴² Telephone interview R. Gierke, Senior EOD supervisor.

⁴³ <http://de.wikipedia.org/wiki/Kampfmittelbeseitigung>

⁴⁴ For instance, even though a deputy team leader may have the necessary technical qualification to defuse a bomb, commercial companies are generally not allowed to do so.

- laws and regulations including for transport;
- planning and operating ERW clearance sites;
- identification of fuses and items of ERW;
- neutralisation and RSPs;
- special ammunition (eg chemical ammunition);
- clearance technologies including different methods of detection;
- earth moving, earth-moving machinery;
- basic demolition skills; and
- demolition of UXO in situ⁴⁵.

Although the different topics may be covered with different emphasis and levels of detail at each school, there is at least some sort of homogenous approach in that almost all topics are covered at all schools, therefore ensuring a relatively consistent approach across the country. However, some topics may be part of the standard core curriculum at one school, whereas they may be only part of an additional, special course at another school.

Rules for the exams as well as the composition of the examination committee are specific to each Land, although they do follow basic federal requirements associated with the Länderanhörung process of acquiring the state's permission to conduct courses.

Certificates are usually awarded on three different levels:

- proof of successful completion of a course (may be basic or special course);
- HTF which entitles the holder to supervise a limited group of clearance workers (troop) in the field; and
- TF, this entitles the holder to supervise a number of troops under their respective HTF, to manage a clearance site and, if applicable, to render safe and dispose of ERW.

In the fifth year after the award, the holder of the certificate must attend a refresher course to maintain certification.

A problem for a standardised training throughout Germany is the definition of 'Stand der Technik' (current level of technology). As there are no explicit federal rules about what this is, it is difficult for any school to teach a uniform standard of quality or technology to achieve the required level of quality at a given clearance site.

All representatives of commercial EOD schools interviewed for this case study stated that a standardised approach to training throughout Germany would allow for a better comparison of training quality and performance.⁴⁶

6.2 MILITARY EOD TRAINING

The system of military EOD training in Germany differs from commercial training in two respects. Firstly, the military background requires an almost entirely different technical training, and secondly, it uses national Standard Operating Procedures (SOP) for training and exams, only

⁴⁵ Emails to the author from DFAB, GfKB, Sprengschule Dresden, July 2013.

⁴⁶ Emails to the author from DFAB, GfKB, Sprengschule Dresden, July 2013.

divided into sections for different job groups or duties. The SOP also makes professional development as well as the keeping abreast of the latest technical developments a routine requirement for license holders. The performance of license holders is regularly reviewed within their specific areas of duty. In addition, they have to pass a refresher course every five years.⁴⁷

6.3 DETECTORS

Immediately after the war only a very small number of detection systems were available to the non-military EOD services. They were either German or allied metal detectors, mainly used for mines detection. Detectors able to find deep-buried, large metal items, such as bombs, were either unavailable or available in insufficient numbers.

However, some German companies developed magnetic locators:

- **Foerster** – research carried out since 1937, first company founded in 1948;
- **Vallon** – founded 1965;
- **Ebinger** – founded 1969; and
- **Sensys** – founded 1990.

All are still key players in the international market today and all are certified to ISO 9001-2008. They provide research and development in a wide field of electromagnetic detection, not limited to the detection of deep-buried ERW. Some of their products are state of the art and drive improvement processes in detection, enabling the operators to detect bombs in the most difficult environments – under railway tracks, next to iron walls, pipes, etc.

6.4 QUALITY OF DETECTION AND CLEARANCE

As Professor Spyra from the Brandenburgische Technische Universität (BTU) Cottbus (below) found out during research in 2006/07, technology and training have developed significantly over time, but the clearance result is still at times unacceptable. Re-clearance of previously cleared areas has revealed that, in some cases, up to 47 per cent of the area still contained ERW or parts thereof.

The reasons for the faulty detection are manifold, and occur depending on the situation, the detection technology and the human operator.⁴⁸ The detection of deep-buried ERW depends on a range of factors so complex that it cannot be evaluated or compared to in the field. To specifically compare the performances of various geo-physical measurements, a test field with simple and constant test conditions, is required.⁴⁹

6.4.1 BTU COTTBUS

Such a test field was set up by the BTU Cottbus in 2006 on an area measuring 1,800 m² in the Land Brandenburg, where various items of ERW (free from explosives) were buried in various

⁴⁷ BesAnSchAufg 34/100-III-0001, Anlage 5/1.

⁴⁸ Testfeld GEOMIL-Qualitätsmanagement in der Kampfmittelbergung, Erste Erfahrungen bei der Zertifizierung von Messtrupps, Prof. Dr.-Ing. Spyra, Vortrag, März 2007, Dresden (Spyra, Presentation).

⁴⁹ Ibid.

locations and positions in the previously cleared field. All items were first measured and the physical parameters, including location in the ground, were recorded for later reference and use in complex scientific models. Some items were placed in a way that they could not be detected with contemporary technology/detection systems.

The test field was intended to become a place where detector operators, technology and manufacturers alike could be tested and certified under constant test conditions. The aim was to integrate the results from the test field into the quality management system of any given EOD company. With this, a client would have been able to compare statistical data documenting the performance of various competitors, before awarding a contract.

In 2006, 11 detection crews were tested, with very different results. Some of the variations could easily be explained, for others more measurements would have been necessary. The exercise clearly demonstrated that quality across EOD companies in Germany is not on an equal level.⁵⁰ A number of other companies have undergone detection trials at the test field since 2007, however, the results did not change significantly. Some test results were good; some were not.

Tests are voluntary. Companies cannot be forced to undergo such a standardised test, as there is no federal rule to do so, although there are clear benefits in terms of a standardised level of detection quality. The test field is an important step towards the desired high level of standardisation, although much work still needs to be done. Military users request access to the test field from time to time.⁵¹

7. CONTINUAL IMPROVEMENT

Only the national military EOD SOP contains a formal requirement for continual improvement. However the requirement is equally important in the commercial sector, as it comprises a wide range of technological, financial and legal challenges. Although not written down in a national non-military document, the requirement for continual improvement is evident in a range of documents, such as the requirements for award of the quality seal from the GKD. It is also specified in the ISO 9001 standard, widely used within the German EOD industry. The requirement is further addressed by regular meetings and conferences at informal, Lander and federal levels ('Arbeitskreis', 'Fachtagung' below). There is a strong interactivity between all stakeholders in the sector, as the competitive environment in Germany drives research and development, resulting in new solutions requiring continual improvement from all stakeholders.

7.1 'ARBEITSKREIS DER LEITER DER KAMPFMITTELRÄUMDIENSTE' (WORKING GROUP OF JOINT CHIEFS OF KMBD)

The working group meets once a year in a different state under a rotating chair. States where authority is delegated to commercial companies send the relevant responsible ministerial civil servants. No commercial company is present at the meetings. Delegates from the Bundeswehr and from the national EOD services from Switzerland, Denmark, France, Austria and the Netherlands are also present. The delegates exchange information about relevant events, developments, initiatives and news from the previous 12 months.

⁵⁰ Spyra, Presentation.

⁵¹ Ibid.

Recommendations for technologies, guidelines or statements may be made. They are usually informal in character. Members are nominated to collaborate in working groups, focused on research and development in the field of EOD. Guest speakers may be invited for subjects of high importance.⁵²

7.2 'FACHTAGUNG KAMPFMITTELRÄUMUNG' (TECHNICAL CONFERENCE EOD)

In recent years two competing EOD schools have each held an annual EOD technical conference. Commercial companies, engineering firms, Lander representatives, suppliers, manufacturers and developers meet once a year to discuss technology, standardisation, quality, events of interest, legal and regulations problems etc. The competition between the two events ensures that the conferences offer a high level of quality and content.

7.3 UNIVERSITIES/RESEARCH FACILITIES

Apart from the BTU, some other institutions occasionally attempt to contribute to EOD through scientific research, specifically in relation to detection and its standardisation.

A project between the Physikalisch-Technische Bundesanstalt (PTB – federal institution for physical-technical issues) and one detector manufacturer is ongoing, subject to publication in 2014. The project deals with a model resembling an ideal bomb as a physical issue.

The Bundesanstalt für Materialprüfung (BAM – federal institution for tests of materials) has been involved in research activities. On another occasion it was the Deutsche Luft-und Raumfahrt Gesellschaft (DLR – German society for space and aviation). Both have dealt with improving existing metal detectors, with a focus on mine clearance.⁵³

When research facilities get involved, they usually seek support from highly experienced field operators to combine operators' and scientists' views of the problem. This is still one of the challenges on the way to develop a uniform standard for detection in German EOD, as sufficient buy-in from the operators is the first step to standardisation.

8. PRACTICAL QUALITY MANAGEMENT

8.1 QUALITY MANAGEMENT FROM AN ENGINEERING FIRM'S POINT OF VIEW

The following case study is based on a presentation given by the director of an engineering firm that was entrusted with the supervision of non-military EOD activities over a period of 12 years on a military training site. Those 12 years saw significant developments in QM and the standardisation of EOD activities in Germany, to some of which the engineering firm

⁵² Email from Thomas Lange, Technical Operations Manager state EOD service Sachsen, July 2013.

⁵³ Cooperation of the author with BAM and DLR in the past.

significantly contributed. Based on the example of the task, the presentation showed the evolution of QM, the relations between different stakeholders committed to quality management and the link between price and quality.

The engineering firm based their work on the following basic points, which are laid out in the AH-KMR:

QA means to ensure that all applicable laws, regulations and other requirements, as required by the specific activity, are met. QA is the contractor's duty. The contractor has to document all steps of QA taken, so that those steps can be fully audited.

QC checks that the contractually agreed clearance target was met, and it checks the type, dimension and adherence to the defined as well as the required QA measures. QC is the client's duty.⁵⁴

Over the course of time, and due to the continuous supervision of the task, the approach to QA and QC was altered multiple times in pursuit of more effective and efficient work for all parties involved. For example, the specific approach when conducting QC visits on cleared areas was changed three times following a constantly evolving technique.

One of the problems on this task was the partial lack of sufficient monitoring of the clearance process by the contractor, which leads to time delays and financial problems. The firm then promoted the increased introduction of electronic data processing systems into the clearance process. As such, the selected system (SEDAT) was capable of automatically monitoring the clearance results in relation to the clearance targets, thereby warning the user when targets were going to be significantly off the expected value at a given time.

QC was also carried out using computer-based data loggers (eg MAGNETO), producing maps of the checked areas showing any missed magnetic anomalies. By design, the initial recorded data cannot be manipulated. As such, this system provides a strong audit trail.

During the assignment, the firm produced a list of mistakes that had an influence on overall quality, and attributed those mistakes to both the client and the contractor, as applicable. The mistakes were divided into phases; planning, surveying, clearance concept and technology. This then led to suggestions on how to avoid those mistakes in future (continual improvement).

One of the suggested (and later implemented) changes was the introduction of test fields. The fields were defined based on specific features of an area (either random or systematic coverage of an SHA) and then investigated by a clearance company under supervision of an engineering firm. The company managing the test field probing was identified following a regular tendering process. All finds were documented, including ground conditions, density of anomalies, position of anomalies in the ground, etc and then made available in the tendering document. As such, the bidding parties were able to calculate their price with much higher confidence about the expected effort and technology required.

The firm was also able to identify a significant relationship between quality, qualification of personnel and price on clearance sites. Between 2004 and 2006, companies with and without internal QM systems were working on the site. In 2004, an average total of 2.8 per cent of cleared

⁵⁴ Dipl.-Ing. A. Doering, Kampfmittelräumung auf dem Tr.Ueb.Pl. Altmark, Eine Nachbetrachtung aus Sicht eines Ingenieurbüros zu Fragen der Qualitätssicherung, Presentation, Dresden, 2007 (Doering, 2007).

land was rejected during QC and had to be re-cleared by the contractor. In 2006, the average rejection rate was at 4.5 per cent.

However, out of the totals the companies with a QM system had a rejection rate of 2.13 per cent in 2004 and of only 0.4 per cent in 2006, whereas companies without a QM-system had a rejection rate of 3.24 per cent in 2004 and of 5.16 per cent in 2006.

Seeing the steep increase of rejected areas in 2006, it should be noted that companies onsite utilised two ways of recruiting – permanent and leased personnel. Companies with permanent staff had a rejection rate of 0.4 per cent, whereas the companies using leased labour had a rejection rate of 5.6 per cent. For the latter, failure rates were low at the beginning of the year (0.98 per cent) but very high at the end of the year, towards the end of employment (12 per cent).⁵⁵

As the deployment of unskilled, leased EOD labourers onsite is based on their lower cost, the example above clearly documents the relation between quality, qualification and price. This is why the German approach follows the principle not always of the cheapest but of the most efficient and comprehensible bid. The public client is required to select the company which makes the bid offering the best price in relation to the required results and quality. In doing so, cheap bids not reaching the required level of quality are excluded. This and other results from 12 years of collected statistics made significant contributions overall to QM documents and standards in German EOD.

9. SUMMARY AND CONCLUSIONS

German non-military EOD has evolved into a complex system over the past 70 years. This has meant the involvement of many experienced and professional stakeholders, each carrying decades of experience in its own area of expertise. As such, the German EOD system offers a high level of experience in physical clearance matters and at the levels of:

- interdisciplinary networking;
- scientific research and development; and
- the professional organisation of non-military EOD in an environment that turned from post-crisis to a major industrial state.

However, applied federalism, despite its many advantages, sometimes creates a challenging environment for attempted standardisation of EOD in Germany, in that the bureaucracy in some cases has had a detrimental effect on efficiency. Nevertheless, the system that is currently in place, despite some shortcomings, clearly shows that QMS can contribute significantly to safety, quality and better prices. This is because high quality work carried out to high-safety standards always leads to projects being completed in time, for the agreed price to the agreed quality standards.

⁵⁵ Ibid.

10. OUTLOOK

The increased adoption of quasi-federal rules and guidelines in the EOD market suggests that Germany is ready for more national standardisation, where it is reasonable, useful and sensible. A standardised QM system across the board would reduce the administrative effort, which currently makes effective and efficient working QM systems a challenge for operators as well as for quality inspectors.

The very high standard of German non-military EOD operations that has been reached already should be considered as a possible option for countries in the process of setting up or re-organising their national EOD response from the level of post-crisis operations to the level of operations within a functioning and developed society.

ANNEX A: LIST OF APPLICABLE LAWS, RULES, REGULATIONS, NORMS AND COMMENTS

Please note that the titles were only superficially translated for ease of comprehensibility.

FEDERAL AND LANDER LAWS AND REGULATIONS

- Grundgesetz (GG) (substitute for constitution)
- Kriegswaffenkontrollgesetz KWKG (*control of weapons of war*)
- Waffengesetz WaffG (*weapons, general*)
- OWiG (violations of public order)
- Polizei- und Ordnungsrecht (POR) (police-and public order law, NOTE: Lander law for Lander police, federal law for federal police)
- Sprengstoffgesetz SprengG (*explosives*)
- Bauordnungsrechtliche Vorschriften der Lander (Lander regulations for constructional activities)
- Chemikaliengesetz (ChemG) und Gefahrstoffverordnung (GefStoffV) (*chemicals, dangerous substances*)
- Gesetz über die Beförderung gefährlicher Güter und GefahrgutVO (*transportation of dangerous substances and goods*)
- Strafgesetzbuch (StGB) (*criminal code*)
- Umweltrecht (environmental laws)
- Gewerbeordnung (GewO) (*business rules*)
- Arbeitsschutzgesetz (ArbschG) (*work site safety*)
- Jugendarbeitsschutzgesetz (JArbschG) (*work site safety for the youth*)
- Arbeitssicherheitsgesetz (AsiG) (*work safety*)
- Arbeitsstättenverordnung (ArbStättV) (*workplaces*)
- Baustellenverordnung (constructional sites)
- Betriebssicherheitsverordnung (BetrSichV) (*safety rules for companies*)
- Ordnungsbehördliche Verordnung über die Abwehr von Gefahren durch Kampfmittel der einzelnen Bundesländer (*individual Lander orders for risk reduction from ERW*)
- Technische Regeln zu den Verordnungen (TRGS, TRBS, RAB) (technical rules and explanations to the individual orders above, also individual for each Land, published and enforced by KMBD)

BG⁵⁶ RULES, REGULATIONS AND INFORMATION

- BGV A1, Grundsätze der Prävention (*basics of prevention*)
- BGV A2, Unfallverhütungsvorschrift Betriebsärzte und Fachkräfte für Arbeitssicherheit (*accident prevention, medical and SHEF staff*)
- BGV A3, elektrische Anlagen und Betriebsmittel (*electrical appliances and tools*)
- BGV A4, Arbeitsmedizinische Vorsorge (*work-medical prevention*)
- BGV A5, Explosivstoffe, allgemein (*explosives, general*)
- BGV A8, Sicherheits- und Gesundheitsschutzkennzeichnung am Arbeitsplatz (*health-and safety markings at work*)
- BGV B1, Umgang mit Gefahrstoffen (handling of dangerous substances)

⁵⁶ BG ('Berufsgenossenschaft', professional or trade association).

- BGV C 22, Bauarbeiten (*constructions*)
- BGV C 23, Taucherarbeiten (*diving*)
- BGV C 24, allgemeine Sprengarbeiten (*demolitions, general*)
- BGV D 23, Sprengkörper und Hohlkörper im Schrott (*explosive- and hollow items within scrap metal*)
- BGV D 44, Munition (*ammunition*)
- BGR 114, Explosivstoff-Zerlege-oder Vernichteregeln (*dismantling and disposal*)
- BGR 123, Einsatz von Fahrzeugen in Explosivstoffbetrieben (*vehicle operations in explosives companies*)
- BGR 128, Arbeiten in kontaminierten Bereichen (*working in contaminated areas*)
- BGR 133, Ausstattung von Arbeitsstätten mit Feuerlöschern (*fire extinguishers at work sites*)
- BGR 176, Grabenverbaugeräte (*trenching*)
- BGR 178, Vermessungsarbeiten (*surveying*)
- BGR 189, Einsatz von Schutzkleidung (*PPE*)
- BGR 190, Einsatz von Atemschutzgeräten (*breathing apparatus's*)
- VBG 40, Erdbaumaschinen (*earth diggers*)
- BGI 833 Kampfmittelräumung (*EOD*)
- BGI 581 Fahrerinnen mit Anlagen zur Atemluftversorgung auf Erdbaumaschinen und Spezialbaumaschinen des Tiefbaues (*earth-moving machinery driver-cabins with breathing apparatus*)
- BGI 504, Arbeitsmedizinische Vorsorge (*medical prevention*)
- BGI 508, Übertragung von Unternehmerpflichten (*delegation of entrepreneurial duties*)
- BGI 608, Auswahl und Betrieb elektrischer Anlagen (*selection and operation of electrical appliances*)
- BGI 660, Allgemeine Arbeitsschutzmassnahmen für den Umgang mit Gefahrstoffen (*general work site safety for handling dangerous substances*)

DIN NORMS AND COMMENTS

- DIN EN 1063 Glas im Bauwesen, Sicherheitssonderverglasungen, Widerstand gegen Beschuss (*bulletproof glass*)
- DIN EN 13541 Glas im Bauwesen, Sicherheitssonderverglasungen, Widerstand gegen Sprengwirkung (*blastproof glass*)
- DIN 4124 Baugruben und Gräben, Böschungen, Verbau, Arbeitsraumbreiten (*excavations, trenches, berms, blocks, etc*)
- ATV DIN 18323 VOB Teil C, Allgemeine technische Vertragsbedingungen für die Kampfmittelräumung (*general contractual obligations for non-military EOD*)
- ATV DIN 18300 VOB Teil C, Allgemeine technische Vertragsbedingungen für Bauleistungen (ATV), Erdarbeiten (*general contractual obligations for earth moving*)
- DIN 54154 Teile 1 und 2, Zerstörungsfreie Prüfung — Elektromagnetische Detektionsverfahren (*non-destructive testing, electro-magnetic detection*)
- Für Wasserbergung: Attest der Schiffsuntersuchungskommission „SUK“ und der Binnenschiffahrtsberufsgenossenschaft „BSBG“ (*„fit for work“ certificates for water vehicles during underwater EOD*)
- Güte- und Prüfbestimmungen Kampfmittelräumung, Dokument zur Gütesicherung, RAL-GZ 901
- Kommentar Kampfmittelräumarbeiten (*commentary to DIN ATV 18323*)

ANNEX B: METHODOLOGY

The current study is based on preliminary research activities that were initiated by Vera Bohle, GICHD, in 2011. Frank Masche, a consultant to the GICHD, continued research in 2013, including document review, telephone interviews and meetings with representatives of professional organisations and bodies.

The following main sources of information were utilised:

- meetings with:
 - quality management organisation (GKD) representative;
 - representative of engineering firm in the EOD sector; and
 - technical operations manager of KMBD (Lander EOD service) Saxonia.
- Telephone and email conversations with:
 - representatives of three commercial schools and one Lander EOD school;
 - representatives of different engineering firms;
 - representative of BTU Cottbus;
 - representatives of two detector manufacturers; and
 - representative of the German Armed Forces (Bundeswehr).
- Staatsbibliothek Berlin (Central Library Berlin);
- information material from various professional organisations;
- ‘Arbeitshilfen Kampfmittelräumung’ (AH-KMR); and
- internet research