

RESEARCHERS, TRAINERS AND FIRST RESPONDERS: A SYNERGY FOR AN IMPROVED PREVENTION OF CHEMICAL, BIOLOGICAL, RADIOLOGICAL AND NUCLEAR RISKS IN SOUTH-EAST ASIAN COUNTRIES

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Sommario

Una serie di ricercatori e scienziati attivi in istituzioni italiane accademiche e di ricerca collaborano dal 2013, sotto l'egida del EU Chemical, Biological, Radiological and Nuclear (CBRN) Risk Mitigation Centres of Excellence, con rappresentanze governative ed enti tecnici in nove nazioni del Sud Est Asiatico, per rafforzare le competenze locali esistenti per prevenire, controllare e mitigare gli effetti di incidenti CBRN dovuti a cause intenzionali, accidentali o naturali. Le attività hanno riguardato corsi di formazione, lezioni, simulazioni dal vivo, esercitazioni e sessioni interattive 'train-the-trainer', alla presenza di formatori europei e di esperti locali, con competenze interdisciplinari nel campo della chimica, biologia, tossicologia, medicina ingegneria, giurisprudenza e diritto internazionale.

Abstract

Italian scientists active in national research and academic institutions have been collaborating since 2013, under the aegis of the EU Chemical, Biological, Radiological and Nuclear (CBRN) Risk Mitigation Centres of Excellence, with governmental stakeholders and technical partners, in nine countries of South-East Asia, in order to enhance the local capabilities in preventing, monitoring and responding to CBRN incidents due to intentional, accidental or natural causes. The initiatives implied training courses, didactical sessions, live simulations, table-top exercises and interactive train-the-trainer sessions, in the presence of European and local experts, with trans-disciplinary competences covering areas such as chemistry, biology, toxicology, medicine, engineering, law and international right.

Keywords

Emerging threats, chemical biological radiological and nuclear risk, South-East Asian countries, training courses, first responders.

Introduction

Along the history of humankind, every new scientific or technological finding has presented the risk of a *dual use*, for either peaceful or criminal purposes. This is valid for every branch of science and notable examples can be found since the discovery of fire (with the myth of Prometheus), passing through the preparation of dynamite by Alfred Nobel, the synthesis of ammonium nitrate (useful fertiliser for agricultural applications, but powerful explosive, at the same time), the use of nuclear fission reaction (for energy production or for warfare), up to the recent frontiers of information technologies, biotechnologies or advanced sciences (with a non-negligible potential of unexpected risks to human health and environment) (Trapp 2008).

If one considers the field of non-conventional chemical-biological-radiological-nuclear (CBRN) warfare agents, the recent rapid development of scientific and technological disciplines is leading not only to the development of new risks (*e.g.*, chemicals and pathogens with a unpredictable effects on humans, clandestine production of weapons at small scale, new high-potential explosives, etc.), but also to novel and effective methods for the control, mitigation and, in some cases, the neutralization of these threats (Gatti et al. 2008; Guidotti et al. 2010; Tucker 2010). Scientists and engineers are indeed focusing an ever-increasing attention to the design, production and development of tools and instruments for the rapid detection, identification, monitoring, protection, mitigation, decontamination and abatement of CBRN agents (Reynolds et al. 2004; Singh et al. 2016; Singh 2016; Rowland et al. 2016).

During the 20th century, in warfare scenarios, the onset of efficient and available countermeasures to minimize or eliminate the negative effects of a deliberate use of chemical or biological weapons, reduced the vulnerability of fighters and contributed to decrease (or even eradicate) the extended use of C and B agents in armed conflicts (Pitschmann 2014). In fact, thanks to the gradual development of protection devices, such as active-carbon-based gas masks, hybrid polymer-containing protective suits or ready-to-use decontamination solutions or powders, the tactical advantage of the use in battlefield of chemical and/or biological weapons has been far reduced. For these reasons, after the dramatic use of chemical warfare agents during WWI, the good technological development level attained by protection devices acted as a real deterrent and discouraged the use of non-conventional C and B weapons during WWII and later, at least in Western countries (Bismuth et al. 2004).

Nevertheless, since the beginning of 21st century, new global equilibria and the growing threat of terrorism prompted institutions and research agencies to devote special efforts in the search for novel enhanced methods of prevention, protection and defence against attacks perpetrated by means of non-conventional weapons. In particular, nanosciences, nanotechnologies and biotechnologies are disciplines which can lead to optimised methods, tools and equipment to counteract efficiently and effectively CBRN threats. In fact, the higher the level of development of protection/defence techniques, the lower is the risk of non-conventional weapons in a warfare or terrorist scenario and the lower is the vulnerability of population, rescuers, first responders and military personnel.

Along with the risk of use of CBRN agents for criminal purposes, the possible occurrence of technogenic unintentional incidents caused by the presence, release or mishandling of chemical, biological and radiological hazardous materials is a theme attracting a relevant attention at global level too. There is indeed no need to recall the impressive impact, also at psychological level (Guidotti et al. 2007), on the public opinion by major disaster events, such as Seveso (C event, Italy, 1976), Bhopal (C event, India, 1984), influenza pandemics (B events, e.g. Sars, 2003, swine flu, 2009, from Far East worldwide), Chernobyl (R event, former Ussr, 1986), Fukushima (R event, Japan, 2011).

In these scenarios, aiming at a good risk management, an efficient prevention and an effective response, only a thorough knowledge of the threat and of the available countermeasures can lead to a lower vulnerability and to fewer final damages. In addition, only an adequate formation and training in the field of prevention, defence and management of emergency events involving hazardous materials can help in getting rid of widely-diffused misconceptions and false commonplaces linked to the idea of non-conventional warfare (Gundry 2007; Guidotti et al. 2015). Actually, an improved knowledge helps in lowering the feeling of powerlessness experienced by many people when talking about mass destruction weapons. It also undoubtedly helps emergency professionals and experts in achieving an enhanced level of preparedness and capacity to response to major emergency situations.

Initiatives in South-East Asia involving researchers, trainers and first responders

The European Union CBRN Risk Mitigation Centres of Excellence (CBRN CoE) is an initiative of the European Union launched in 2010 and addresses the mitigation of and preparedness against

risks related to hazardous CBRN material and agents, working in 54 non-Eu countries spanning from Eastern Europe to Asia and Africa (<http://www.cbrn-coe.eu/> last access: 01/01/2018).

The proliferation by either states, or terrorist groups, of weapons of mass destruction was identified in the European Security Strategy as ‘potentially the greatest threat to EU security’. According to this point of view, by enhancing the security at local scale, the global security will be enhanced at worldwide level as well.

Existing international and national strategies in non-proliferation issues acknowledge the importance of developing a comprehensive approach, but tend to implement isolated activities perpetuated by the traditional divisional structuring of chemical or biological or radiological or nuclear sectors. Therefore, the CBRN issue is often fragmented into pieces, which are thus studied according to their own characteristics, but without a true holistic approach and a research for synergies. This might be counterproductive, since no single organisation possesses all necessary resources, expertise and statutory power to face all possible aspects of the problem.

In the framework of CBRN CoE, a series of initiatives was launched in response to the need to strengthen the institutional capacity of countries outside the Eu to tackle and mitigate non-conventional risks due to the use, misuse or intentional, accidental or natural release of chemical, biological and/or radiological hazardous materials. Risk mitigation comprises prevention, preparedness and post-crisis management.

The ultimate goal of these actions is indeed to improve the preparedness, resilience and recovery capability of the broad community of the partner countries before, during and after a non-conventional CBRN event occurs. Such target can be achieved by enhancing the local capabilities in preventing, monitoring and responding to CBRN incidents.

Enhancement of CBRN capacities in South-East Asian countries

In particular, the present report describes the Project no. 46 of the initiative, named “Enhancement of CBRN capacities of South East Asia in addressing CBRN risk mitigation concerning CBRN first response, biosafety and biosecurity, awareness raising and legal framework”, which started in June 2015, for a period of 3 years.

In the first part of this Project, a team of Italian scientists active in national research and academic institutions have been collaborating, under the coordination of Fondazione Formit (Italian non-profit foundation promoting institutional projects linked to innovation and technology transfer), with governmental stakeholders, national agencies and technical partners in seven countries of South-East Asia (Sea), namely: Lao, Cambodia, Viet Nam, Myanmar, Brunei Darussalam, Malaysia and Philippines (Figure 1).



Figure 1 - Countries of South-East Asia region involved in European Union CBRN Risk Mitigation Centres of Excellence Project no. 46 initiative: Lao, Cambodia, Viet Nam, Myanmar, Brunei Darussalam, Malaysia and the Philippines

The Italian experts focused their efforts on the enhancement of the capacity of local first responders (fire brigade, ambulance services, HazMat teams, law enforcement agencies, armed forces, on-field analytical laboratories, etc.) in the management of crises and emergency situations in which CBRN hazardous materials are involved.

The cooperation activity implied the delivery of a one-week long training session for multi-agency CBRN incident commanders in each Sea country in the period between October 2016 and May 2017 (Figure 2).

The training was composed of modules, didactical sections, live simulations, table-top exercises and interactive train-the-trainer sessions, with the help of experts featuring trans-disciplinary competences and covering areas such as chemistry, biology, toxicology, medicine, engineering, law and international right.

A working group of some 20 to 30 professionals selected from local agencies with institutional roles as strategic-level coordinators / commanders in CBRN incidents was the ideal target audience for such training programme.

In order to gather the broadest information as possible about needs and priorities and to meet at best the requests by each country, a preliminary series of fact-finding missions has been performed on site, during which the potential points of weakness and the main gaps in preparedness against CBRN incidents have been evidenced and pointed out.

Then, especially in those countries in which a response capability in major CBRN events was already present or well established, the Project leaders have designed and tailored a syllabus for the training activities in collaboration with the representatives of the most relevant local governmental agencies.



Figure 2 - CBRN incident command course training sessions in Cambodia (top left), Lao (top right), the Philippines (bottom left) and Malaysia (bottom right). Training module on electronic and web-based resources for CBRN first responders and incident commanders (top centre).

Tailoring a training course programme for CBRN Incident Commanders

In general, the leading topics touched during the training sessions for CBRN incident commanders can be summarised as follows:

- definition of chemical, biological, radiological and nuclear risk
- risk assessment
- civil protection doctrine
- detection, protection and decontamination of CBRN hazardous materials
- legal framework at national, regional and supranational level
- health and medical aspects in CBRN emergencies
- decision-making processes
- handling, transportation and management of hazardous agents; disposal of toxic wastes
- roles and responsibilities in a response to a major CBRN event
- multi-agency coordination in major non-conventional emergency events
- use of electronic and web-based resources as tools for CBRN incident commanders.

Some training modules, such as those related to misconceptions and common places on CBRN agents and threats or a critical review on detection, protection and decontamination techniques available at prototypal and commercial level, have been designed in collaboration with a trans-disciplinary pool of experts, so that the trainees could get familiar not only with ‘one’ unique correct approach to a response to a CBRN incident, but, rather, with a multi-faceted point of view, obtained from a comprehensive survey of the current standards, protocols, rules and guidelines at worldwide level. This wide-ranging approach is particularly relevant when different legal frameworks and regulations are compared and, therefore, various approaches to the management, transportation or disposal of hazardous materials and dangerous waste, such as the European, North-American, Japanese, Australian, etc. ones, have to be taken into account.

The leading idea underlying the training programme, indeed, is to provide the delegates taking part into the didactical sessions with the key information and tools to build up and/or strengthen a national response capability against natural or man-made CBRN disasters, following tailored self-established guidelines that best fit the national situation. This approach is to be preferred to the

mere application of external ready-to-use protocols, designed for Western countries, which can be rarely adapted to the Sea scenarios without significant ameliorations and modifications.

It is, however, worth highlighting that in none of these activities the transfer of information and know-how was in one direction only. On the contrary, thanks to the active participation and the designation of technical experts from the partner countries, the Italian team experienced a continuous bilateral sharing of information, which facilitated the development and the implementation of the project in the region and allowed the European delegates to acquire a broader insight onto the on-site already existing capabilities.

In all cases, a special emphasis was devoted to adult-learning principles and teaching skills in order to provide the participants with the skills necessary to cascade the training programme to their colleagues. This ‘train-the-trainer’ approach formed a key element of each training programme and it was particularly appreciated in the largest countries of the Sea region (like Philippines, Malaysia or Myanmar), where a programme of training courses can be now organised by newly-formed local trainers in other parts of the partner countries, for operators working in remote provinces and poorly accessible areas.

Furthermore, a special attention was also paid to language issues, for those countries in which the use of English is not adequately spread across professionals of the CBRN emergency mitigation sector. In several cases, the presence of native-tongue technical interpreters was a key factor to encourage the interactive (and sometimes proactive) participation of experts with well-established local skills, although with a less evident international expertise.

The possibility to exchange and transfer know-how, expertise and good practices, at technical level, not only across participating nations, but also across participating local agencies was another main achievement of the training activities along the project. These training sessions were often, in fact, an ideal occasion to stimulate inter-agency discussions within the hosting countries, encouraging novel and effective collaborations among entities who seldom work together.

Three main classes of actors have been evidenced in almost all of the Sea countries, namely:

- 1) governmental researchers and academic experts, who are at the forefront of the scientific and technological advancements;

2) institutional and/or governmental representatives, who are active at the regulatory, policy and decision-making level;

3) first responders, who eventually operate at the incident site, either as non-specialised or as CBRN expert units (typically HazMat teams of the Fire Protection Services or special Eod military units).

In several cases, indeed, the one-week training activity has been the first effective occasion of working together, even though on simulated hand-on situations only, for delegates of institutions from different ministries of the same nation.

Involving governmental stakeholders and decision-makers in training initiatives for CBRN Responders

The participation of institutional delegates from Sea countries to the training courses is summarised in Table 1 and Figure 3. Among the most relevant agencies and governmental institutions involved, it is worth mentioning: national ministries of Home Affairs, National Security, Defence, Health, Education; Fire Services, Fire and Rescue Departments, Civil Protection, Police Forces, Ambulance Forces, Hospitals, national Red Cross committees, Customs and Immigration Offices, Coast Guards, State Universities.

Table 1 - Number of individuals and agencies involved in the CBRN incident command course training in South-East Asian countries in the framework of EU CBRN Risk Mitigation CoE Project 46. October 2016 – May 2017.

Countries	Individuals	Agencies				
	Participants	Ministries	LEAs	Defence	Hospitals	Universities
Brunei	18	1	5	1	0	0
Cambodia	21	5	1	1	0	0
Lao	33	5	1	0	4	1
Philippines	33	2	8	1	0	0
Viet Nam	15	4	4	2	0	0
Malaysia	33	4	7	1	0	0
Myanmar	23	8	2	0	0	1
TOTAL	176	29	28	6	4	2



Figure 3 - Percentage of involved stakeholders in the CBRN incident command training course in seven Sea countries. LEAs: Law-Enforcement Agencies.

During the interactive table-top exercises and the hands-on simulation sessions, it has been possible to perform a general survey and analysis on the points of strength and weakness of the local situation in the field of CBRN inter-agency strategic response preparedness and capabilities.

Some important key concepts, valid for the entire South-East Asia region, have been pointed out:

- Interoperability is an essential factor for a successful response to a major emergency event. This means not only having an efficient inter-communication across agencies and professionals at the incident scene, but also (and in particular) planning and setting up common command structures, defining joint standard operating procedures, sharing information and intelligence and homogenising decision-making models.

- Only a limited set of rules and regulations involving production, management and control of highly hazardous CBRN materials are currently valid at worldwide level. It is the case, for instance, of the Un Global Harmonised System (Ghs) for the identification and transportation of dangerous goods (United Nations 2015), the Cwc or the Btw conventions for the ban and control of chemical and biological warfare agents, respectively (Opcw 2005; Btw 1975). On the other hand, many other guidelines are valid on a national or regional basis only, such as the Reach regulation (<https://echa.europa.eu/regulations/reach>), the Fda standards (<https://www.fda.gov/food/guidanceregulation/>) or the Protocol Dangerous Goods (<http://asean.org/>), which are valid at Eu, Usa or Asean level only, respectively. Therefore, harmonised common protocols are a goal to be reached by working together on a model which all

can adopt, without imposing one model on another. This is also possible by merging the best guidelines at international level (Eu, North America, Japan, Australia, Asean countries, etc.) and adapting them to the local situation (Cavallini et al. 2014).

- The most advanced scientific outcomes of sustainable development can represent a powerful tool and a competitive advantage to overcome technical and/or economical limitations found in some partner countries.

For instance, by adopting the principles of the Green and Sustainable Chemistry for a cleaner, safer and environmentally-friendly production of chemical substances, it is possible to avoid (or, at least, minimise) the side production of large amounts of hazardous waste, remarkably reducing the problems of waste disposal (Anastas and Warner 1998; Matlack 2010). Analogously, innovative technological solutions in the field of detection, protection and decontamination of CBRN hazardous materials can help in circumventing the lack of classical stockpiles of protective and detection equipment. Indeed, miniaturised detection devices based on the latest technologies or novel decontamination formulations obtained from simple and cheap chemical components can be a viable and suitable alternative to the conventional approach to CBRN countermeasures based on large-scale facility and costly equipment (see, for instance, Lee et al. 2012). This is particularly true when the involved agencies have a limited budget for CBRN prevention / mitigation, small institutions (sometimes, non-governmental organisations) are involved and there is a discontinuous availability of funds for pieces of equipment requiring periodical maintenance and reparations.

Such an approach may allow the partner countries to exploit at best the existing resources and capabilities, building up new trans-disciplinary networks of expertise and know-how among local experts and professionals.

At the end of each training session in the beneficiary countries, in order to assess the effectiveness and the degree of success of the activity carried out by the team of Italian experts, a feedback evaluation questionnaire was circulated across the trainees. In detail, the participants were asked to evaluate the quality of the training sessions, the future impact (if any) of the course on their professional work and the usefulness of the treated topics for an enhanced inter-agency CBRN response. The delegates felt a significant improvement of their skills and knowledge with regard to all of the proposed training themes, but the most positive feedback was obtained in the training

modules dealing with the CBRN Risk Assessment (Figure 4, left) and the Adult Learning Principles and Presentational Skills (Figure 4, right).

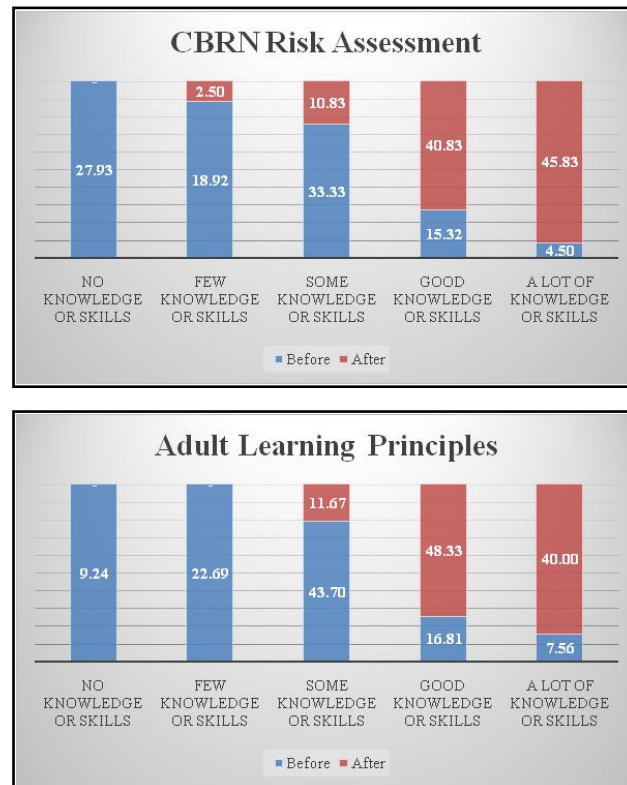


Figure 4 - Feedback evaluation questionnaire at the end of the CBRN incident command training course in seven Sea countries. Self-assessment of trainees’ knowledge and skills on CBRN Risk Assessment (left) and Adult Learning Principles and Presentational Skills (right) before (blue bars) and after (red bars) the training session.

In these cases, a substantial improvement of the awareness and preparedness on these key topics was highlighted by comparing the situation before and after the delivery of the training course. In fact, while the trainees felt an average to modest level of knowledge before the training with percentage values as high as 75 % – 80 % of the total audience, they acknowledged a considerable improvement of their awareness level, with a fraction of 40-45% of the participants, after the one week-long training session (Figure 4).

Conclusions

In the framework of the European Union CBRN Risk Mitigation Centres of Excellence initiative, a series of training courses for multi-agency incident commanders have been carried out in seven South-East Asian countries. The training activity saw an innovative synergistic and multi-disciplinary interaction among academic researchers, trainers and professionals from Italian institutions and Asian first responders' agencies.

The fruitful information and the positive feedback results collected during the training campaign across Sea countries from October 2016 to May 2017 confirm that the merging of conventional didactical modules with interactive table-top exercises and train-the-trainer sessions can be a viable approach for the successful implementation of cooperation programmes aiming at strengthening the regional capacity in non-EU countries to respond to non-conventional risks and threats linked to criminal or non-intentional release of chemical, biological and/or radiological hazardous materials.

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Nomenclature

Asean	Association of Southeast Asian Nations
Btw	Biological and Toxin Weapons convention
CoE	Centres of Excellence

CBRN	Chemical, Biological, Radiological, Nuclear
Cwc	Chemical Weapons Convention
Eod	Explosive Ordnance Disposal
Eu	European Union
Fda	United States Food and Drug Administration
Formit	Fondazione per la Ricerca sulla Migrazione e Integrazione delle
Tecnologie	<i>(Foundation for the Research on Technology Migration and</i>
<i>Integration)</i>	
Ghs	Global Harmonised System
HazMat	Hazardous Materials
LEAs	Law Enforcement Agencies
Reach	Registration, Evaluation, Authorisation and restriction of CHemicals
Sars	Severe Acute Respiratory Syndrome
Sea	South-East Asia
Un	United Nations
Usa	United States of America
WWI	World War One
WWII	World War Two