Towards a Counter- Explosive Hazards Centre of Excellence focusing on the implementation of new mature Hardware and software Technologies

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FP7 TIRAMISU, D-BOX Projects

1. Introduction

The year 1994 may be considered as the first decisive year in the long struggle with the use and the removal of anti-personnel (AP) mines throughout the world, followed in 1999 with the Entry into force of the OTTAWA Treaty adopted on September 1997, the Convention on the Prohibition of the use, stockpiling, production and transfer of AP-mines and their destruction.
Not all Countries signed the Ottawa Treaty: a political problem and many Countries are still affected by unexploded remnants of War and Conflicts
March 2009 was also the first deadline for completing clearance by the mine affected countries that ratified the Ottawa Convention before March 1999. Unfortunately, two thirds of them have not met this deadline [Ms Agnès Marcaillou, Director of the United Nations Mine Action Service (UNMAS)]
March 2013, new countries have been affected by the plague of disseminated unexploded devices, landmines but also cluster munitions (now directly concerned by the OSLO treaty). New dangers arise in some North African Countries, Middle East, Asian and African Countries, called Improvised Explosive Devices and slowing the difficult tasks of Deminers.
The need for rapid land release for economical purposes (agricultural and grazing, among others), is thus pressing. If a change towards less costly and time-consuming Mine Action practices has always been desirable, **it has now become imperative.**

In 2011, the European Commission confirmed its continued support for achieving a mine-free world by making important financial contributions (to Demining operations AND to R&D in support of such operations). The Commission will continue to consider landmines and explosive remnants of war (ERW) within a broader context of humanitarian assistance as well as long-term and sustainable socio-economic development programs.
The EC recently decided to fund two large projects including about fifty European organizations, NGO, Universities, SME and industrial partners. The RMA coordinates one of both projects, called TIRAMISU, the second one being coordinated by Airbus Defence and Space SAS and called D-BOX.
The TIRAMISU (Figure 1) and D-BOX (Figure 2) projects aim at providing the foundation for a global toolbox that will cover the main Mine Action activities, from the survey of large areas to the actual disposal of explosive hazards, including Mine Risk Education and Training. Obviously, as underlined in the presentation of M. Andy Smith (Fields and R&D synergy) no 'silver bullet solution' has to be expected from the projects, but new technologies (hardware and software) with high potential are ready for experimental validations and implementations in a process that has already started in close cooperation with the CROMAC (Croatia), the BHMAC (Bosnia Herzegovina) and the CMAC (Cambodia).

The system engineering work carried out in D-BOX through the expertise of Airbus Defence and Space, the demining experience of BACTEC, and the contribution of research institutions with expertise in demining, like the Swedish FOI, has generated the idea of an information management system of new conception, that glue together Information, best practices & procedures, and detection tools in a unique platform, to give better awareness to the End Users and reduces the possibilities of errors. D-BOX mission is to support End Users in the Land Release Process because this is the core activities of deminers. New tools will be plugged into the platform as soon as they become operational. The outputs of new tools and existing tools will be merged together to improve the quality of information provided to End Users.

Figure 1 Tiramisu Toolbox Content

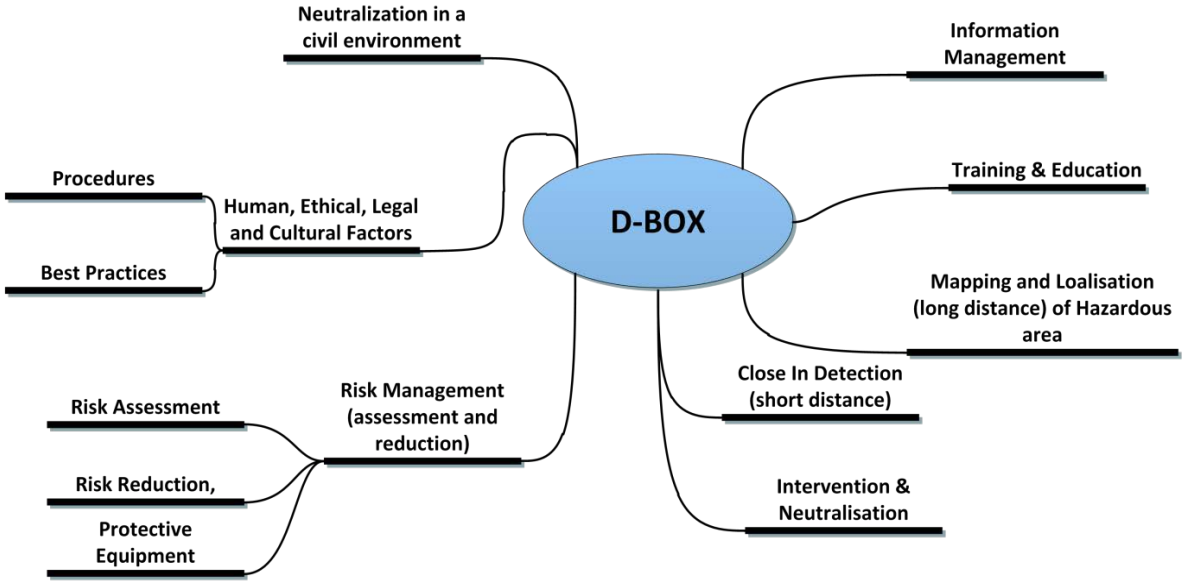

Figure 2.D-BOX Toolbox content

The development of our R&D is also supported by experienced De-mining services, some of them through Military Demining activities (the Swedish army, the Polish Military Engineering Centres), some of them active Members of International Centres of Excellence (the International Centre of Demining supported by the Spanish Ministry of Defence, the NATO-accredited Counter-Improvised Explosive Devices (C-IED) Centre of Excellence, the NATO EOD Centre of Excellence, the European Defence Agency).

Belgium has a long experience in the field: a lot of missions (Figure 3) have been entrusted to the Demining Service of the Belgian Defence. This experience has underlined the increasingly unsafe context of Mine Action in Countries affected by a periodic political, social and/or economic instability. Military Mine-clearing Actions often precede Humanitarian Demining activities entrusted to local entities or experienced Non-Governmental Bodies. Synergies with such Actions have to be improved as well

Figure 3. DOVO support in Humanitarian demining

2. Towards a European Counter-Explosive Hazards Centre of Excellence (C-EH CoE)

Our projects may not lead to successful results without the support of experts from the United Nations Services and the continuous cooperation of our consortiums with the Management System for Mine Action developed and maintained by the UNMAS and the GICHD since 1999.

From the GICHD point of view, the problems in HD will not be solved by the new technologies proposed in the FP7 TIRAMISU/D-BOX toolbox: technology is good enough, what is needed is capacity building (training), implementation support and appropriate prioritization. Nevertheless, the GICHD acknowledges the value of using images as an aid for the land release, but believes only low-cost solutions for image gathering should be envisaged.

The need to make a better use of existing tools is correct and understood; new tools and existing tools could be used together for improved efficiency and effectiveness of operations. Several of the solutions proposed in D-BOX and TIRAMISU do not require the user to enter physically in the Hazardous Area (0 risks for human life) and/or they allow scanning a large area in one shot. The real challenge will be to make the End User to recognize and use the technology in the most safe and proficient way. To achieve this goal the tools shall be integrated in the processes used by End Users.

The Information Management Concept developed in project D-BOX is perhaps an answer to the doubts raised by the GICHD. D-BOX Platform reproduces the main activities of the Land Release process; Functional Tool Chains (including existing and new tools) are linked to the process tasks to realize the different activities, possibly with an increased effectiveness. The platform provides the means to transform raw data from the tools into information useful for the End Users.

GICHD: 'The data collection phase is directly included in Non-Technical Survey so that LIS (Land Impact survey) is removed from the demining process cycle'.

Advanced General Survey, based on Satellite Imagery at Country/Regional level must take into account the Sensor technology evolution (higher accuracy) and allow for the importance of community knowledge and the local perception of the social and economic impact of mined areas within their livelihood when planning mine clearance actions. To achieve this the EU projects therefore combine the former (but renewed) Impact Survey with the Non-Technical survey (from aerial manned or unmanned flights at local level) to derive efficient tools focusing on(i) the collection of quality data, (ii) the accurate geo-referencing of information and (iii) the use of analytical tools and methods for priority setting through the software development of interactive tools starting from expert, geospatial and contextual information and their exploitation to an Advanced Intelligent Decision

support System optimizing the delineation of Suspected Hazardous Areas (SHA): tools that have been tested in close cooperation with End-Users.

The Information Management Concept developed in project D-BOX goes a long way towards answering the doubts raised by the GICHD. D-BOX Information Management reproduces the main activities of the Land Release process and implements Functional Tool Chains: the data provided by tools are elaborated, evaluated and merged with data provided by other tools to improve End User situational awareness.

The GICHD members were shocked to learn that the EU funded projects' efforts are focused mainly on the technological side, while from their point of view they should be on implementation.

Such implementation however requires technological R&D as well as study of the ethical and legal issues related to, for instance, unmanned flights. The GICHD has a global point of view: concerned by cost efficiency and by versatile applicability, so its focus is of course different from a research project funded by FP7. Moreover, the EU objectives are different from the objectives of the Centre. Referring to the Call for Security, TIRAMISU and D-BOX have to promote new technologies, ensuring dual use applications related to the whole program SECURITY of the Commission.

As a consequence, and taking the objectives of the European Union into account, it has been proposed to create a Centre of Excellence focusing on the exploitation of the toolboxes developed by the 50 partners of the FP7 Consortia, in close cooperation with existing Centres such as the GICHD, but also the NATO EOD Centre of Excellence, the NATO accredited C-IED Centre of Excellence, the International Centre of Demining located in Madrid, the International Centre of Humanitarian demining launched by Russia, the European Corporate of security Associations (ECSA), avoiding useless duplication and pursuing the HORIZON European objectives. The CoE HUDEM will differ from other R&D resources by retaining the degree of honest scientific objectivity required in an academic institution and by pursuing practical and effective end-results without being subject to undue commercial influence. To promote the pursuit of rapid solutions that are not delayed by misinformation, constructive criticism and common-sense honesty will be required features in all reports.

The following structure (Figure 4) will progressively be achieved by the end of the year, including four Technical Advisory Boards focusing on:

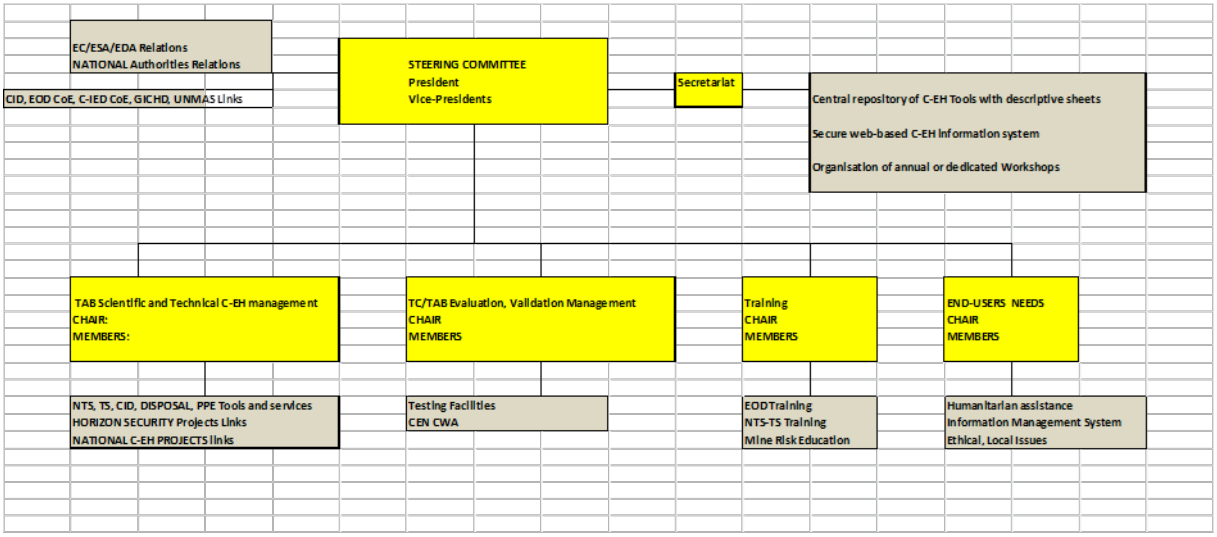

Figure 4. Intended C-EH-CoE Structure

3.1. R&D

It's essential to improve new technologies through a continuous exchange of R&D information and results among the scientific Community and through an adequate policy of Technology Transfer. The handover of all Mine Action activities to local entities who can perform the majority of the work and can gain skills while participating to the creation and maintenance of **new technology** for area reduction is desirable and necessary.

The following R&D areas, among others, have been identified as impacting the fast release of suspected areas:

- **Sensors**: Chemical sensors, Metal detector arrays, GPR arrays, in particular, could improve the efficiency of technical Survey and Quality Assurance. In TIRAMISU, such sensors have been mounted on remote controlled platforms (unmanned EOD-like ground vehicles figure 5) – agricultural machines (figure 6).

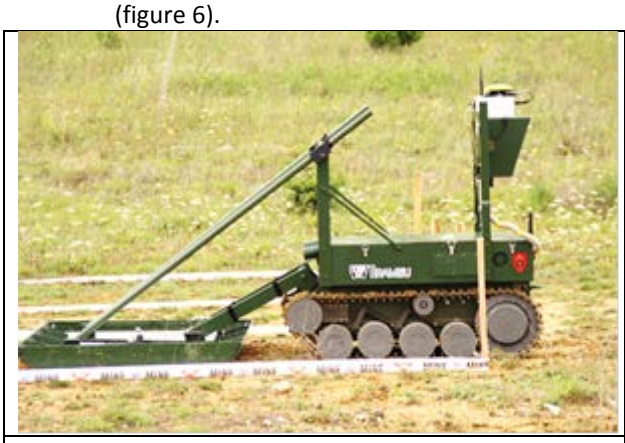

Figure 5. TeODOR – VALLON Metal Detector Array

Figure 6. LOCOSTRA V2- LUCIFER GPR Array

- **Remote Sensing** : **RPAS** (Remotely Piloted Aircraft Systems) can also carry sensors and provide information used in Non-Technical and Technical Survey. Hyperspectral Sensing has provided essential data on Croatian infested areas, while the use of a classical camera combined with a Near-Infrared Sensor considerably helped the BH MAC in a country heavily affected by the floods destabilizing Mine action activities in 2014 (figure 7)

Figure 7. Detection of mines and UXOs after heavy floodsin Bosnia Herzegovina (2014)

- **Disposal and Personnel Protective Equipment**. In TIRAMISU, a novel technique for testing protective materials against fragment impacts was presented. Three projectile impacts within close space and time proximity were incorporated in order to simulate the effects of multiple fragment impacts on protective structures. A roller and and a transport trailer together with blast container vessel have been designed and tested, that could equip resistant platforms such as the LOCOSTRA V2;

The sharing of Expertise through dedicated Scientific Workshops and bi(multi) lateral work-meetings, in close cooperation with the above mentioned Centers will promote the implementation of such tools and their dual use, in particular in the current context of 'Terroristic threats' in Europe (European Program HORIZON focusing on the Security: the IED and Counter IED techniques are particularly developed by the NATO C-IED Center of Excellence and could lead to R&D cooperation in the domains of Terahertz technology, C-RCIED, Radars based on SAR principles, Multispectral spectroscopy, Bio-inspired sensors, etc.)

3.2. Evaluation, validation, certification (CWA)

The Centre would involve a dedicated area of permanent lab-space for baseline testing of performance – detection in air, detection "halo", battery life, signal clarity, reliable replication of results, etc. As far as possible, this would lead to a series of quantifiable, comparable and replicable results that manufacturers could not reasonably question. A full test would also involve field testing in dedicated test areas (Support of the CID in Spain and the CTRO Test Facilities in Croatia) leading to results that were semi-quantitative but still meaningful because the test context was the same for each test (although weather variations, etc. would be noted). The field test would include a subjective assessment of ergonomics and ease of use for lengthy periods. The field results would not guarantee that the equipment would be suitable in the field in every country – but poor results would strongly imply that poor results might be expected elsewhere, which would be very useful to know when selecting equipment [2]
The Centre could thus re-initiate some activities of the former ITEP (International Test and Evaluation Program).

Between 2003 and 2008 several CEN Workshop Agreement were published and made available free-of-charge by CEN:

- CWA 14747 (2003):Testing Metal Detectors
- CWA 15044 (2004):Testing Demining Machines
- CWA 15464 (2005): Planning and Assessing EOD Competencies
- CWA 15832 (2008): Follow-on after Demining Machines
- CWA 15833 (2008): Quality management for mechanical demining
- CWA 15756 (2007):Testing PPE was initially published but was later withdrawn because some tests described in it were found out to be too demanding.

Four CWA were proposed by the Consortiums: (1) on 'PPE' (*The new CWA would* specify "*methods for the testing, evaluation, and acceptance of PPE for mine action against anti-personnel blast mines – this CWA is supported by the GICHD but complementary information has been requested by the CEN due to existing PPE standards in the context of dual Use of protective equipment (Fire-fighters, Police, etc.)*, (2) on ' better evaluation of mechanical assets for technical survey' (This CWA was not supported by the GICHD (IMAS Review Board) but fully supported by the CEN/BT – The GICHD supporting a TNMA[1]), (3) on 'ethical use of remotely piloted aircraft systems – also known as unmanned aerial vehicle (UAV) or miniature aerial photography plane (MAPP). This CWA was not supported by the GICHD (IMAS Review Board), but could become important in a near future because of privacy implications in RPAS operations as underlined by G.Voisin in [REF 3]: data protection where RPAS capture personal data, CCTV regulations where domestic law would regards video captured by RPAS as equivalent to CCTV, ad-hoc legislation regulating the use of specific instruments embedded in RPAS. (4) on Ethical Issues in humanitarian demining (D-BOX)

3.3. Training, Mine Risk education

During the project, E-tutors have been developed, currently evaluated by our Project advisory Boards, among which

- A E-tutor for Non-Technical Survey
- E-training tools for neutralization and clearance
- E-tutor for selection of protective equipment

With the progress of developments in information and communication technology, e-learning is emerging as a platform for modern education and training. E-learning is a general term referring to the use of digital technologies to support learning and teaching [4]. The Joint Information Systems Committee (JISC) defines e-learning as "learning facilitated and supported through the use of ICT".

[1] Technical Notes for Mine action

E-tutoring can be defined as teaching, supporting, managing and assessing students on programs of study that involve the significant use of online technologies. An e-tutor is the interface between the learner and the learning resources.
The main advantages of e-learning are the following:

- E-learning is more cost-effective for the learner than traditional teaching methods because less time and money is spent travelling and the trainees have are able to study anywhere and at any time.
- E-learning is flexible and can be customized to meet the individual needs of the learner.
- E-learning enables money and time to be saved as traditional courses require more administration, preparation and organization.
- E-learning means that learners can work at their own pace and allows flexible training hours.
- The contents of an e-tutor can be continuously (and economically) upgraded and updated.
- The efficiency of the e-learning method is well-documented.
- E-learning provides a consistent message and eliminates the problems associated with different instructors teaching slightly different material on the same subject.
- There is evidence that e-learning methods can lead to increased retention, since many elements are combined to reinforce educational messages, such as video, audio, simulations, quizzes, interaction.
- E-learning enables learners to revisit or replay sections of the training course that might not have been clear the first time around.

As the e-tutor can be CD-ROM-based, it can also be delivered in some of the less developed countries that lack ICT infrastructure or have limited internet access. The very varied educational background of trainees around the world makes e-learning fairer and more inclusive than traditional classroom courses because well designed e-learning elements level the playing field by allowing trainees to start where they are, work at their own pace, and repeat the course elements as often as necessary.

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In the last two years, CTDT (Croatian Partner of TIRAMISU) received about 35 requests for EOD Training I-V Level courses from several Countries in Europe, Asia and Africa, that also justify the development and validation of a EOD e-Tutor

Mine Risk education tools have also been developed and tested (TIRAMISU, in Cambodia and Western Sahara, among others) that could be added to the GICHD Risk education topics. We suggest improving such tools specifically for use in the Refugees Camps where a new need has arisen because of unstable and worrying situations in North Africa and the Middle East, and long term needs exist in places such as Myanmar/Thailand.

With the Psychological Guidance Service "Youth Center of Prevention and Psychotherapy MOP" of Warszawa, Poland, Psychological Guidelines for Assumptions on Educational Computer Games on Subject Matter of Mine Risk have been developed that could help to increase the use of computer games designed for use on Electronic Devices now accessible in all Countries.

3.4. End-Users Needs, Information Management Systems

One of the most important characteristics of both projects lies in the development and validation of efficient Information Management Systems that allow a comprehensive use of the developed Mine Action Tools. The figures 8 and 9 summarize these systems (introduced in other presentations of the 12th International Conference of BIOGRAD).
We are convinced that synergies have to be realized within a partnership of the Centers focusing on the Counter Explosive Hazards Actions, and that links could be improved between our Systems and Security challenges of the European Union (Surveillance of Borders, CBRN-E threats, Environmental Protection, etc.)

IMSMA provides a lot of domain knowledge, but the tool is obsolete with respect to the most recent web developments. IMSMA surely does not address the needs below and it is time to move on.

Information management should address two important needs of HD: the need to create and improve procedures, the need to provide the best information to all the chain of stakeholders of the domain, up to the United Nations and donors. One of the difficulties of the domain is to gather information from the field of operations and manage the quality of this information all along the decision chain.

Furthermore, conflicts that have generated the use of Anti-personnel mines, Sub-munitions and several kinds of explosive devices in the Countries affected by these plagues have dramatic consequences on the environment, and consequently on the health of the local population. Therefore it is important to ensure that the accumulation of explosive contaminants does not occur at levels that will result in adverse effects to the environment and the loss of the use of the range. In order to control these risks, it is important to know what kind of residues are released from different types of munitions and explosive devices, how the residues behave in the environment, and how they are distributed throughout the environment. This information will assist in calculating the environmental loads of constituents resulting from live-fire interventions.
In TIRAMISU, the spectral behavior of grass, and grassy types of the vegetation, the hyperspectral techniques for estimating grassland bio-physical variables have been analyzed, providing first satisfying background information that could be refined through continued hyperspectral survey of the grassy vegetation by ground based and airborne systems. As a consequence Humanitarian assistance (Health issues, among others) and Environmental Survey are still to be pursued.

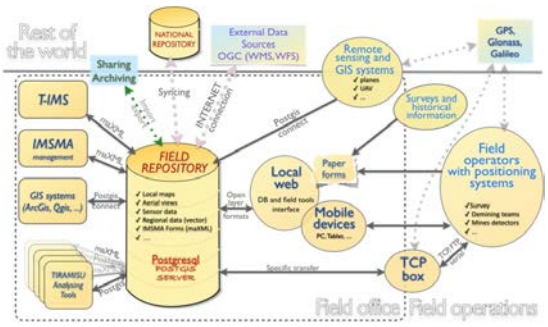

Figure 8. T-IMS and TRS TIRAMISU Management Information System

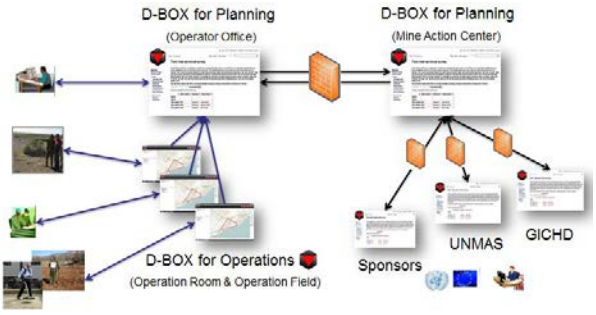

Figure 9.D-BOX Management Information System

4. Conclusions

The 'Humanitarian Demining projects have to reduce the lingering threat of landmines and cluster munitions for the population and would increase humanitarian security, while, at the same time, recreating an environment in which people can live safely, ensuring peace and stability, promoting a sustainable social and economic development and alleviating human suffering of affected victims and communities.
The handover of all Mine Action activities to local entities who can perform the majority of the work and can gain skills while participating in the creation and maintenance of new technologies for area reduction and all aspects of Land Release is desirable and necessary.
The objective assessment and certification of tools remains a necessity, including a transparent record of their limitations as well as their strengths.
The development and validation of innovative technologies ensuring an optimal interoperability through
Training related to the new technologies should replace the classical training courses with more accessible and appropriate training.
Also, taking full account of the opinions expressed by the GICHD which the project partners have assumed as a challenge, our efforts are now concentrating on selecting the most promising assets proposed in the two projects and then bringing them into use during operations.

REF:

[1] www.fp7-tiramisu.eu, www.d-boxproject.eu, , http://www.coec-ied.es/,www.GICHD.org, www.ecsa.org, https://www.eodcoe.org/

[2] Report Meeting TIRAMISU/D-BOX Project Advisory Board of 03 December 2014

[3] Gabriel Voisin, Bird&Bird (www.twobirds.com) 'Privacy Implications in Light of RPAS Operations (2014 RPAS Yearbook - &éth edition June 2014, page 123)

[4] Mellar, H., Kambouri, M., Logan, K., Betts, S., Nance, B. and Moriarty, V. (2007). Effective Teaching and Learning: Using ICT. London: NRDC