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TIRAMISU PROJECT SUMMARY

(2012-2015) 
EC-REA Project Officer: Julien GIORDANI
Coordination – RMA: Yann Yvinec, Vinciane Lacroix, Yvan Baudoign

Clearing large civilian areas from anti-personnel landmines and cluster munitions is a difficult task because of the large variety of hazardous and explosive contamination areas. Since a single solution does not exist, many mine action actors have asked for a toolbox from which they could choose the tools which are most suitable for a given situation.

The TIRAMISU project aims 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, without omitting mine risk education. The toolbox produced by the project will provide mine action actors with a large set of tools, grouped into thematic modules, that will help them accomplish their job. These tools will be designed with the help of end-users and validated by them in mine-affected countries.

To reach the level of expertise needed, the TIRAMISU team includes organisations that were involved in some of the most important European and international research projects of the last fifteen years, in the field of mine action. The TIRAMISU partners will build the toolbox based on their past experience on this topic, as well as their collaboration history and the strong links they have forged over the years with mine action centres and authorities, demining companies and non-governmental organisations.

The final objective is to bring a toolbox that will represent a step forward in mine action by being the basis of a unifying, comprehensive and modular integrated solution for clearing large areas from explosive hazards. The toolbox is planned to comprise the following tools:

1. **Advanced General Survey**: tools enabling the most heavily mine-infested areas of a region to be prioritised and focusing on facilitating the efficient use of the other modules in a given situation.
2. **Non-Technical Survey**: tools to facilitate land release processes.
3. **Technical Survey**: tools to detect direct indicators of the likely presence of landmines/UXOs.
4. **Stand-off Detection**: tools to detect mines, submunitions or explosives at close range with remotely controlled Micro (Unmanned) Aerial Vehicles (MAV/UAV), remotely controlled ground platforms (UGV) or flying biosensors (honeybees).
5. **Ground-based Close-in Detection**: tools such as advanced metal detectors, Ground Penetrating Radars and novel chemical sensors.
6. **Disposal of Explosive Remnants of War (ERW)**: tools to protect deminers or vehicles against explosions.
7. **Mine Risk Education**: tools to assist in Mine Risk Education activities.
8. **Training**: tools aiming at facilitating capacity building and enabling the user uptake of the tools developed.
9. **Mine Action mission management**: tools to improve the planning and execution of Mine Action missions.
10. **Standards**: this module includes the current and in-progress or proposed CEN Workshop Agreements (CWA).

The TIRAMISU tools have already been used in real life situations over the past few years, encompassing assistance with relief operations after the floods that affected over 3 million people in Serbia and Bosnia in May 2014, mapping and vulnerability analysis of the Choam-Kravien and Ratanak-Mondo regions in Cambodia, as well as mapping and Hyperspectral survey of the Svilaja and Dinara mountains in Croatia and mine risk education activities in Algeria and Cambodia.

The TIRAMISU tools could be the key to accelerating the pace of demining without endangering operators’ lives and participating to the restoring economy of the infested areas.

For further information, please visit: http://www.fp7-tiramisu.eu
TIRAMISU PROJECT ADVISORY
BOARD (PAB) AND END-USER BOARD (EUB)

- Achercy, Marc – Professor, former Head of the RMA SIC, co-coordinator of EC funded HOPE and SMART projects. Expert in sensor systems, representative of RMA to the GICHID, UNMAS and former IETF meetings.
- Appelmanns, Roland – SGRS/MS, Security Adviser.
- Bach, Havard – Former GICHID member and member of Norwegian People Aid NPA. In charge of monitoring the compliance of the TIRAMISU with IMAS.
- Biagdien, Patrick Martin – Evaluator of donor-funded mine action programmes, Demining Policy Expert. In charge of monitoring the compliance of the project with the Ottawa and Oslo treaties.
- Brook, Anna – Dr. Ir., University of Haifa, Israel. Expert in hyperspectral data interpretation.
- Claes, Torn – Professor Dr. at the Center of Ethics and Value Inquiry, University of GENT, which is a founding member of the International Global Ethics Association (IGEA).
- Daniels, David J – CBE BSc MSc CEng FIEE FIEET, Chief Consultant Sensors, Cobham Technical Services.
- De Decker, Guy – Lt. Col., DOVO, Head of Demining service of Belgium, international on-the-field experienced, Mine Action Training Manager.
- Delisier, Emmanuel – UN Senior Adviser in Politics, and Socio-economic assessment for Humanitarian Demining actions. In charge of monitoring the compliance of the project with the UN directives.
- Dirick, Michel – Col. PhD, Royal Military Academy, Renaissance Brussells.
- Doroftei, Ioan – Professor Dr. Ir., Expert in Demining Robotics, Technical University of Iasi, Romania.
- Ishikawa, Jun, – Dr. Eng., Department of Robotics and Mechatronics School of Science and Technology for Future Life Tokyo Denki University.
- Laraher, Tim – Chief Technical Advisor to UNDO, employed by UNDP.
- Moerman, Luc – Lt Col, DOVO, Former Head of Demining service of Belgium, international on-the-field experienced, Mine Action Training Manager.
- Mytkiens, Vincent – previous Belgian member by the IMAS Review Board, Member of the Belgian Delegation to the European Commission for Security Matters.
- Najafi, Abinor – Professor, Robotics expert in Humanitarian demining, University of Pritina, Kosovo.
- Piotr, Jurgen – Maj, ECD, IEDD, MSMA expert, 2010-EU Investigation of Bosnian Ammunition deposits.
- Raux, Jean-Marc – Maj, expert in the fielding of specific GIS applications to support UAV Survey operations.
- Robe, Patrick – Camp de Marche-en-Famenne, Security Adviser.
- Sato, Motoyuki – Dr. Eng., Department of Engineering, University of Sheffield.
- Smith, Andy – Specialist in Humanitarian demining and PPE Expert.
- Tokhi, Daddy – Professor, Department of Automatic Control, University of Sheffield.
- Van Strythem, Michel – Lt Col., Member of the Belgian Chief of Defense Cabinet.

Team Composition:

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<thead>
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</table>

From December 2014, support from the ECD NATO Centre of Excellence, the C-IED NATO Accredited Centre of Excellence, the Spanish MOD International Centre for Demining, has been acquired, through the expertise of:

- Jimenez Sanchez, Rafael – Colonel Ingenieros, Former CID Director.
- Manolita Lopez, Juan M. – IED Tech - OF2 Spanish Marine Corps, Counter IED - Centre of Excellence.
- Mivan, Lubomir – Colonel, Slovakian Army.
- Zito, Sandor – Lieutenant Colonel, Hungarian Army, Head of Technologies Department.

From January 2012, partners with on-the-field experience have participated in the organisation of trials and validation tests including:

- Breikat, Mohammad – Director of the National Committee for Demining and Rehabilitation NCRD Jordan.
- Frison, Maite – APSO, Amis du Peuple Sahra Occidental.
- Jungwirth, Otto – Director of the Cluster for Humanitarian Demining.
- Mihaiclovic, Petar – Director of the Serbian Mine Action Centre.
- Miticlovic, Velimir – Regional Centre for Divers Training and Underwater Demining Montenegro.
- Ratana, Heng – Advisor to the Prime Minister, Director General of CMAC, Cambodia.
- Rezan, Milan – Director of the Bosnia-Hercegovina Mine action Centre.
- Ribic, Stepan – Regional Development Agency of Slavonia and Baranja Ltd for international and regional cooperation.
2. T-REX, T-IMAGE, T-MAP

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Team Description:
NOVELTIS is a French private company that was created in 1998. We perform innovative scientific engineering studies and implement customized end-user solutions in the fields of Space, Environment and Sustainable Development. NOVELTIS' staff has strong expertise in areas such as remote sensing data processing (satellite and aerial data), environmental modelling (fire, weather, vegetation and ocean), geographic information systems and integrated decision support systems.

NOVELTIS focuses its activities on innovation, in close relations with international research laboratories. Our company supplies end-to-end services to governmental bodies and industries, including risk management stakeholders. We also coordinate and participate in large-scale European and International projects.

NOVELTIS is certified to the ISO 9001(2008) / standards and has been granted “Confidential-Defence” status by the French Defence Ministry / French Ministry of Defence.

Team composition:

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<tr>
<th>NAME</th>
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3. T-REX, T-IMAGE, T-MAP

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Team Description:
PLUS-Z_GIS is concerned with semi-automated mapping of Indicators of Mine Presence (IMP). A theoretical risk and vulnerability framework, which serves as a guidance tool for making the social vulnerability to landmines/UXOs more conceptual, systematic and operational, is also being designed by the PLUS-Z_GIS team.

Team composition:

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</table>
4. T-IMAGE, T-MAP

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Team Description:
The DLR-IMF team contributes to the data provision in order to improve the potential for obtaining Indicators of Mine Presence (IMP) or Absence (IMA). The focus is on very-high resolution optical multi-spectral satellite data from modern sensors, such as WorldView2, being complemented with multi-spectral airborne data from the DLR 3K sensor. Digital surface models are also derived from Very High Resolution stereoscopic data, such as trenches and the calculation of slopes for trafficability, meant to improve the extraction of IMP. Besides the enhancement of algorithms developed in the SMART project, new spatial analysis methods are explored for combining information extracted from remote sensing and providing products focused on end-user requirements (e.g. maps combining IMP and IMA, damage assessment maps, trafficability maps, etc.).

Team composition:

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5. T-MAP

Name of team leader:  Vinciane LACROIX , Technical coordinator of the project TIRAMISU
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Team Description:
The Signal and Image Processing Unit of the CISS department contributed to the development of automatic algorithms for Indicators of Mine Presence (IMP) and the development of methods for Digital Surface Model (DSM) and Digital Terrain Model (DTM) generation using multi-view image analysis.

6. ADVANCED GENERAL SURVEY: T-REX, T-IMAGE, T-MAP AND T-PRIORITY

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Team Description:
The European Union Satellite Center (SatCen) was founded in 1992 and incorporated as an agency into the European Union on 1 January 2002. The Center supports, in agreement with the European Security Strategy, the decision making of the European Union in the field of the Common Foreign and Security Policy (CFSP), in particular of the Common Security and Defence Policy (CSDP), including European Union crisis management operations. The assistance consists in providing products resulting from the analysis of satellite imagery and collateral data, including aerial imagery, and related services.

Tool(s) Description:
EU SatCen is involved in the development of geospatial tools and the application of earth observations techniques for supporting the Advanced General Survey (AGS) and the Non-Technical Survey (NTS). In particular, SatCen has developed the Visibility and Trafficability Analysis as Indicators of Mine Presence (IMP) to be integrated into the vulnerability analysis and used as battleground reconstruction for validation purpose. Through a dedicated geoportal, users will have the chance to interact with the geospatial data and to launch some analysis processes. Furthermore, two or more self-explanatory posters will complement the information and introduce the rest of the tools.

Team composition:

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OPERATION AND VALIDATION TOOLS

1. VALIDATION

![Figure 1](image1.png)

**Figure 1.** a) LOCOSTRA was certified by CTDT and is under operational validation by CROMAC. b) RMA RPAS md4-1000 was used in an operational project and is under operational validation. c) T-IMS is under final testing by CROMAC waiting for the operational validation.

![Figure 2](image2.png)

**Figure 2.** CROMAC defined four regions of interest (Dinara Peruča, Svitaja, Čanak, Kapeia) for testing, evaluation and the operational validation of WP220 tools.

![Figure 3](image3.png)

**Figure 3.** Hyperspectral data have been collected over landmine test site c) Benkovac for operational validation of aerial systems a) on helicopter Bell-206 and b) on remotely piloted aircraft system. Besides Benkovac minefield, the minefield at location Murgići was also used for data collection / collecting data.

![Figure 4](image4.png)

**Figure 4.** a) The RGB visualization of acquired hyperspectral data over landmine test site Benkovac and b) corresponding reflectance spectra. Colours of samples are the same as colours of corresponding reflectance spectra. Note evident vegetation spectral difference between samples taken from inside (green) and outside (yellow) of the minefield.

![Figure 5](image5.png)

**Figure 5.** The hyperspectral ground vehicle based system for technical survey. a) Geometry of side – looking oblique mapping system, from different platforms, b) pickup truck, c) TIRAMISU LOCOSTRA.

![Figure 6](image6.png)

**Figure 6.** Average distribution of bees o in three time intervals over landmine and over control position a) in the test trench b) in open space of mine field Cerovac.

![Figure 7](image7.png)

**Figure 7.** Results of Multi-Criteria Analysis performed using PROMETHEE method. Presentation of results (ranked on map for each action).
Figure 8. Based on type of terrain and scope of the problem, different platforms are employed — helicopter and/or Remotely Piloted Aircraft System.

Figure 9. The landslide crosses the border of the SHA (red line) and endangers the residents.

Figure 10. a) Results of the semi-automatic interpretation of visible (red, green, blue) image of UXO scattered after the exploded ammunition depot Padjene. b) Spatial distribution of manually collected UXO.

Team Description:
CTDT was founded in 2003 by the Croatian Mine Action Centre (CROMAC). It is the leading institution for testing, evaluation, validation, deployment technologies and training in mine action and EOD domains, with worldwide references. It is accredited to conduct certification of demining machines, mine detection dogs and metal detectors, personal protective equipment and prodactes. The company also manages two mine testing sites. CTD is key organizer of the traditional annual Mine Action Symposium (12th edition in 2015), with typical international participants from 35 to 40 countries.

The company leads the validation in the TIRAMISU project, as well as taking care of research on hyperspectral survey in areas suspected to be mine-contaminated, airborne (helicopters, remotely piloted aircraft systems — RPAS), ground vehicle based, multi criteria prioritization, UXO survey after ammunition depot explosion and training biosensors (bees) to detect the explosive. CTDT benefits from a close and intensive cooperation with CROMAC, compliant with the TIRAMISU’s concepts, for evaluation, testing, certification and operational validation of several tools.


Team composition:

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2. T-AIDSS (MODULE FOR ANALYTICAL ASSESSMENT, MODULE FOR DATA ACQUISITION, MODULE FOR PRE-PROCESSING AND PROCESSING OF DATA, T-EXPL-UXO-DEPOT)

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Tool Description:
Chair of Photogrammetry and Remote Sensing Department — focus on Remote Sensing: T-AIDSS is an operational system that uses T-REX, T-IMAGE, T-MAP and T-SHA. A first version of the system (called AI DSS) is already in use and yielding good results in Croatia. It has also been successfully used in Bosnia and Herzegovina. T-AIDSS will benefit from the development of its components in TIRAMISU to fill gaps that were identified by the end-users and system operators. The objectives include increasing its robustness, decreasing the workload of the operator and improving the semi-automatic mapping of features of interest. T-AIDSS is a solution that will be proposed to the MACs worldwide for specific terrain and actions. A simplified version (without data acquisition) will also be developed, so it can be used in MACs for the support of the SHA assessment, reduction, re-categorisation and inclusion, only with Indicators of Mine Presence and Mine Absence derived from Management Information System (MIS) data. Services will be provided to ensure transfer of know-how and capacity building. T-AI-DSS will also focus on the problems generated by the possible explosion of Ammunition Depots.

Team composition:

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MANAGEMENT AND INTEGRATION TOOLS

1. INTEGRATION: DECISION SUPPORT CLIENT (DSC)

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Website:  www.dialogis.de

Tool Description:
The DIALOGIS R&D Team focuses on the development of Location Intelligence Solutions. Our tool is called “Decision Support Client” (DSC). It is a mobile ‘spatial management cockpit’, which integrates different sources of predominantly geo-related information and management information, in order to support the processes for land release planning and decision making in humanitarian demining. DSC is designed for mobile use on a tablet PC in the field. Beside functionalities supporting management and collaboration tasks, its main goal is to allow non-technical HD expert users to easily explore historical, as well as situational awareness information (i.e. reports, real-time tracking and sensor data) and other area-relevant data stored on the TIRAMISU Repository Service (TRS). Programmed as a HTML-5 client, the DSC runs on many different operating systems and devices. The map visualisation of the DSC is based on OpenLayers technology, which is an open source JavaScript library for displaying map data in web browsers. The DSC can load map data from any source providing Open Geospatial Consortium (OGC) standard interfaces like Web Mapping Service (WMS) or Web Feature Service (WFS). In combination with the GeoServer and PostGIS installation on the TRS server, the DSC provides access to several HD specific web-mapping features. Not all of the DSC features will be available if connected to the currently reduced version of the TRS-Demonstrator.

Team composition:

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2. **INTEGRATION: COMMUNICATION-POSITIONING-BOX (TCP_BOX) & DATA-REPOSITORY-SERVER (TRS)**

**Team Description:**
proTime is an engineering company which brings more than 18 years of experience in design and development of mobile applications using satellite-navigation and mobile data-communication. Our specific expertise consists of high precision SatNav using signals from all 3 systems (GPS, GLONASS and already GALILEO at the GATE testbed) – combined with sensors (acceleration, gyro, etc.) and integration through mobile data communication (GSM, WLAN, etc.) with web based location-aware servers and services.

**Tool Description:**
The TCPBox is the TIRAMISU tool for positioning and data communication at the field level, between other tools (like sensors) and the TRS data repository. It supports precise positioning using multiple GNSS systems and a field level ad-hoc network as an information infrastructure. Implemented on the RMA Teodor and connected to the Vallon MDA, TCPbox provides the Vallon MDA with positions and compass data. The TCP-Box sends sensor data to the Vallon, while Teodor sends track data to the TRS Field Server, both over the built up WLAN communication structure.

The TRS is the TIRAMISU data repository for storing and retrieving any sort of data and files during the demining process. It can be used as the ruggedized/enduring FieldServer device at field-level and also as a hosted system for office level.

The FieldServer is connected to the TCPbox WLAN-Mesh-Network and stores the retrieved sensor and positioning data into the TRS Database. The data can be displayed through the DSC tool and can also interact with the T-Rex and T-IMS.

**Team Composition:**

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<tr>
<th>NAME</th>
<th>FUNCTION</th>
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<tbody>
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3. **INTEGRATION : T-IMS, TIRAMISU INFORMATION MANAGEMENT SYSTEM**

**Team Description:**
Spinator is a software development company with more than 15 years of experience in developing applications for handheld devices, laptops etc. used in demining actions.

**Tool Description:**
T-IMS is a state of the art software application, primary for the deminers’ and the surveyors’ use out in the field. It is completely built on touch technology and can run on a Windows tablet without a mouse. T-IMS is very easy to interact with and use. With T-IMS, any kind of data and information from the field can easily be captured. This includes the marking of hazardous areas, the possibility to make map sketches, identification and positioning of landmines/UXOs and other findings, geo-referenced photos, interviews with voice recordings etc. T-IMS supports the use of all well-known map formats and layering of data. It supports the whole process of mine action from non-technical surveys, technical surveys, mine/UXO clearance, QA (quality assurance), to structured reporting and analyses. T-IMS is compliant and can exchange information with Information Management System for Mine Action (IMSMA) and uses the database Collaborative Ordnance Data (CORD) from Geneva International Centre for Humanitarian Demining/ James Madison University (GICHD/JMU) - for positive identification of UXOs.

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MINE RISK EDUCATION TOOLS AND SIMULATORS

1. CHILDREN MINE RISK EDUCATIONS: GREAT RALLY ON THE BACK OF ELECTRONIC TURTLES

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Fax: +48 22 629 92 70

Tool Description:
The “Great Rally on the back of electronic turtles” is a computer multiplayer board game destined for educating children about mine risk. The game is designed according to international Humanitarian Demining standards. It consists in rewarding the players, which are riding electronic turtles, with score points, according to their ability to avoid dangerous objects on the way. Since we are talking about an electronic board game, the players are represented by pawns. Score points are gained for correct observations of “terrain” and right answers in quizzes that can be taken in wayside Information Points. An original solution, not yet applied in board games, is substitution of randomness — realized by throwing the dice — by intentional actions of gamer. Namely, every step on the board involves the use of one “grain of movement” by the “electronic turtle”. The entire allocated reserve of grains is not sufficient for reaching the finish line and has to be replenished by gaining grains together with score points via apt observation and right answers in quizzes.

Team composition:

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<tr>
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</tbody>
</table>

2. SIMULATOR-TRAINER FOR ROBOTIC PLATFORMS OPERATORS IN DEMINING MISSIONS

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Tool(s) Description:
Simulator-trainers enable carrying out tasks typical for demining as, for example, detection of a mine covered with stones or uncovering of the mine with a robot’s arm. Computer reconfigurable models of robotic platforms are based on Vortex physical engine with rendering in Open Scene Graph (OSG). Environments’ models with possible simulation of weather conditions, such as illumination (day, night) or fog, are created with the use of by using an improved version of Mobile Spatial Assistance System. The simulators are developed in client-server architecture. All physics computations are done on a server, while all virtual robotic platforms are placed in the same virtual environment. Client applications (control console – cameras’ viewer and joystick) are connected to a server via Ethernet. Multi-robot simulators that allow interaction of several robots, thus enabling operators to perform tasks cooperatively, are also possible.

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</table>
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Tool(s) Description:
Simulator-trainers enable carrying out tasks typical for demining as for example detection of a mine covered with stones or uncovering of the mine with a robot’s arm. Computer reconfigurable models of robotic platforms are based on Vortex physical engine with rendering in Open Scene Graph (OSG). Environments’ models with possible simulation of weather conditions, such as illumination (day, night) or fog, are created with the use of / by using an improved version of Mobile Spatial Assistance System. The simulators are developed in client-server architecture. All physics computations are done on a server, while all virtual robotic platforms are placed in the same virtual environment. Client applications (control console – cameras’ viewer and joystick) are connected to a server via Ethernet. Multi-robot simulators that allow interaction of several robots, thus enabling operators to perform tasks cooperatively, are also possible.

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</table>

4. MINE RISK EDUCATION (MRE): BILLY GOAT RADIO

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Team Description:
The MRE team of Snail Aid is composed of a few key persons, namely Emanuela, Luisa and Silvia.

Tool(s) Description:
Our tool is called Billy Goat Radio. We started working in January 2013 and we already tested it in the field two times; the first time in the Saharawi refugee camps in South West of Algeria and the second time in Pailin region in Cambodia. The tool consists in a methodological kit aimed at enabling operators to create a short serial drama suited to the local context, both in terms of messages about risks posed by mines and UXOs and in terms of folkloristic appeal appeal. Operators are provided with a versatile system in the form of cards and/or simple software, with the script and a simple audio recording, as well as with a post-processing kit they can use to enact the script. Then, the scenario can be either broadcasted by radio or can be delivered by a mobile mine risk education team using any other form of simplified impromptu theatre in the villages at risk. Group discussions should follow every episode broadcast. The system also provides guidelines for carrying out these group discussions. After two in-field evaluations and the proceeding modifications, the tool is now ready to be used by field practitioners.

Team composition:

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</table>
CLOSE-IN-DETECTION, IDENTIFICATION AND TRAINING

1. CLOSE-IN-DETECTION AND TRAINING: INTELLIGENT PRODDER

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Team Description:
Several prototypes of service and mobile robots and innovative sensor systems have been designed and built by the DIEEI - UNICT. The group of DIEEI has carried out scientific research activity in the both mobile and industrial robotic and measurement and sensors sectors, within several national and international projects in cooperation with private companies and public research centres.

Our team designed, developed and tested an active prodder intended for the recognition of touched materials.

Tool(s) Description:
The conceived device is based on a piezoelectric actuating and sensing strategy; the elaboration of the obtained output signals is performed in the frequency domain. The smart prodder developed is also equipped with other sensors, such as a force sensor and an inclinometer to improve the reliability of the reading. A prototype was fabricated / built and successfully tested in laboratory, in a simulated outdoor minefield and in a realistic scenario (Benkovac, DOVO).

Team composition:

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</table>

2. TRAINING: INTELLIGENT FEEDBACK PRODDER

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Team Description:
In this consortium, CSIC is represented by the Centre for Automation and Robotics (CAR). CAR is a unique research and development centre that represents a joint task force, in the field of Automation and Robotics, of Universidad Politécnica de Madrid (UPM) and the CSIC. The major CAR objective is carrying out central applied research with the desire of providing society with valuable results. To accomplish that purpose, CAR is particularly well positioned to lead their ambitious work plan by using their excellent conceptual and instrumental resources, nurturing the studies in the fields of Automation and Robotics at its possible highest levels. CAR activities are organised around the key scientific-technical domains: Intelligent Supervision and Control, Artificial Perception and Intelligent Robots and Applied Robotics. CAR research groups have more than 30 years of experience in projects of applied investigation, in conjunction with public and private companies. In the area of applications, CAR has developed several systems for a wide-range of processes including perception, navigation, precise localization, transportation, robotic, manufacturing, agriculture, and bioengineering. CSIC-CAR has participated in about 40 EC projects and acted as coordinator of four EC research projects: INCO 960054, ESPRIT 02/76100, GRD1-1999-11153 and FP7-NMP2-VA-2010-245986

Tool(s) Description:
Our team has designed, developed and tested an intelligent feedback prodder for improving the training activities of demining operations carried out with prodders. The intelligent feedback prodder for training consists of a Human Machine Interface (HMI), an instrumented prodder, a data acquisition module and an electronic module for signals conditioning. All basic parts of the instrumented prodder are separable with the capability to replace different extensions in order to obtain different versions of the prodders, depending on the demining training needs. For the design of the instrumented prodder, two main types of sensors have been selected and evaluated: a load cell and an Inertial Measurement Unit (IMU). A prototype was fabricated and successfully tested in laboratory and in a simulated outdoor minefield.

Team composition:

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CLOSE-IN-DECTION, IDENTIFICATION AND NEUTRALISATION

ANTIPERSONNEL MINE-NEUTRALISATION SET (EXPLOSION METHOD) – AMNS-EM

ANTIPERSONNEL MINE-NEUTRALISATION SET (FIRE-SETTING METHOD) – AMNS-FMS

Team composition:

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<th>NAME</th>
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Tool(s) description:

The Organic Semiconductor Optoelectronic group at the University of St Andrews is an internationally-renowned group working at the forefront of organic semiconductor research for applications including chemical sensors, polymer lasers, solar cells, and smart lighting.

Team composition:

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PERSONNEL PROTECTIVE EQUIPMENT

TRIPLE LAUNCHER

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Tool Description:
The Department Weapon System focuses on Personnel Protective Equipment. Our tool is called the "Triple launcher". The development of the tool(s) system began in January 2012. A new triple launcher design was introduced, being able to launch NATO’s 5.56mm Fragment Simulating Projectiles (FSPs). These projectiles have standardised geometrical and material properties with extremely high tolerances, thus appropriate to be utilised in a standardised testing protocol. The NATO FSPs are widely acceptable in the area of ballistics and protective equipment industry, as they give repetitive and comparable results, narrowing down the otherwise probabilistic nature of impact engineering. Other modifications regarding the triple launcher were also implemented in order to form a robust, versatile and reliable tool.

Team composition:

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SUPPORT IN CLOSE-IN-DETECTION

ALIS SYSTEM

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Team Description:
Our research focuses on development and applications of radar technology using satellite microwave remotesensing (SAR), ground penetrating radar (GPR), electromagnetic methods, and other types of electromagnetic sensing to help humans utilize the environment with minimal adverse impact. We hope that the resulting technology can be applied to practical work in the field of international cooperation, particularly through joint international projects, to detect and remove land mines in Cambodia and Afghanistan or to measure groundwater in China, South Korea, Russia and Mongolia.

Tool(s) Description:
In order to contribute mine action, to help mine-affected countries, and to exercise our knowledge and experience on electromagnetic techniques, our team developed Advanced Landmine Imaging System (ALIS). ALIS is a hand-held dual sensor system, which consists of a metal detector and a ground-penetrating radar (GPR). The unique feature of ALIS is its visualisation function of the metal detector and GPR. Operators can easily identify buried mines based on the images extracted from the data. The system is based on a commercial metal detector, MIL-D1 (CEIA) and an impulse GPR. The full features of MIL-D1 are available, as for example the soil compensation function and the pinpointing capability. The GPR antennas are integrated into the search head together with the metal detector coils. The control unit holds all the electronics and a rechargeable battery and is designed to be worn on the shoulder. The colour LCD display provides the survey results both from the metal detector and the GPR as images. Audio alert is also available for the metal detector indication / warnings.

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TECHNICAL SURVEY AND CLOSE-IN-DETECTION SENSOR

GPR ARRAY

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Team Description:
IDS is an independent and privately owned commercial company providing products and services in four main areas: geophysical radar equipment, aeronautical engineering, air-navigation engineering, electromagnetic modeling and simulation. IDS has been involved in numerous demining projects ANGEL, DEMINE, DEMAND and TIRAMISU for the development of GPR arrays for humanitarian demining and Counter-IED applications.

Tool(s) Description:
Our tool is called ‘GPR array’ and it is an innovative multi-channel, densely-sampled Ground Penetrating Radar (GPR), based on arrays of air-launched antennas, with automatic detection capabilities. Two array prototypes suitable to different scenarios have been developed within the TIRAMISU project: a lower-frequency GPR array suitable for detecting larger, deeper targets (large AT/AP mines and UXOs) and a higher-frequency GPR array suitable for detecting smaller, shallower targets (small AT/AP mines). The new GPR array unifies the advantages of a hand held detector (ability to detect metallic and non-metallic mines, novel detection and classification algorithms to reduce the false alarm rate while keeping the probability of detection high) with the advantages of vehicle-mounted multi-channel systems (large detection footprint, high search speed). It is user-configurable in terms of data interfaces (differential GPS, TCP-box) and integration into multi-sensor systems, with metal detector, chemical sensors, etc.

Team composition:

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TECHNICAL SURVEY PLATFORM

TECHNICAL SURVEY: APT 796 (FORMERLY LOCOSTRA)

Names of team leaders:  Giovanni POLENTES
Matteo ZOPPI

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Team Description
PIERRE Trattori (company), DIME (university)
PIERRE Trattori: PIERRE has been producing agricultural technologies since 1883. The company is family-led and owns several patents in the agricultural domain.
DIME: The research group of DIME belongs to the PMAR Robotics Group (Laboratory of Design and Measurement for Automation and Robotics) of the University of Genoa, in Italy. The main research lines are on design and development of mechatronic and robotic systems for industrial and service applications, including systems for harsh environments, for rescue and security, and autonomous and tele-operated ground, alongside aerial and underwater systems.

Tool Description
The Area Preparation Tractor (APT) is a versatile platform designed to carry and power a wide range of tools that are used in area preparation during demining activities, as well as many other tools developed in TIRAMISU projects. An agricultural tractor with articulated chassis and conventional steering that gives outstanding maneuverability. APT can be controlled either by on-board driving or by using robust remote controls. With innovative blast resistant wheels and proven AP-mine armouring, the platform can carry (and power) detector arrays and a wide range of readily available agricultural implements. It can steer between mature trees and climb steep hills while working, and can be driven conventionally to the site by having road wheels fitted. With a high-power mulcher attachment it can clear dense undergrowth as shown in the photograph. This increases deminer safety by initiating (or breaking fuses from) fragmentation mines and may locate / detect lines of AP blast mines by detonating them harmlessly under its wheels. APT with the mulcher has been blast and field tested by CTRG CROMAC during the project. Training and service documentation is being finalised, alongside a final production model that incorporates all lessons learned in real use.

Team composition:

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**TECHNICAL SURVEY AND CLOSE-IN-DETECTION SENSOR**

TIRAMISAR EQUIPPED WITH A GROUND PENETRATING RADAR

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**Tool(s) Description:**
DLR Mine Hunter is developing a vehicle-based side-looking imaging sensor (TIRAMI-SAR) based on the synthetic aperture radar (SAR) principle for the medium-range detection of mines. This demining tool works in (Ultra High Frequency) UHF range and can be used to scan a wide strip on its side from a safe lane in order to provide indication of suspected items for other tools to investigate further. In this way the system serves as a very fast tool for inspected area reduction, diminishing a surface of hundreds of square meters of suspected land to a few spots requiring accurate close-in checks.

**Team composition:**

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**CLOSE-IN-DETECTION AND QUALITY ASSURANCE**

1. **SEMI-AUTONOMOUS DEMINING ROBOT HUSKY-ISR/UC (OUTDOOR DEMO)**

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**Team Description:**
The Institute of Systems and Robotics – University of Coimbra (ISR-UC) is a private non-profit research institution founded in 1992, having the global purpose of setting up a first class multi-disciplinary research team, able to carry out leading edge research in several important areas of science and technology, with a special emphasis in systems and robotics. ISR-UC promotes advanced multidisciplinary R&D in the areas Mobile Autonomous Robotics, Intelligent Transportation Systems, Search and Rescue Robotics, Robotic Manipulation, Computer Vision, Medical Robotics, Assistive Technologies, Biomedical Engineering, Advanced Industrial Automation Technologies and Intelligent Energy Systems. ISR-UC gives special attention to international scientific research cooperation with centres of excellence, as well as to advanced training and education initiatives. ISR has also developed strong research links with industry, either with existing national and international companies, or by promoting the creation of spin-offs. The capacity to attract funds is very high with more than half of the funding coming from international projects. The dissemination activities included the organisation of prestigious International Conferences, out of which we can mention IROS 2012, CLAWAR 2008, EEDAL 2013. ISR-UC has a strong international publication track-record in top journals and conferences. Following the institute’s evaluation, conducted by the National Science Foundation (FCT) with an international panel of scientists, concerning the period 2008-2013, ISR-UC was rated as Excellent.

**Tool(s) Description:**
Our team has designed, developed and tested a semi-autonomous demining robot with a two-degrees of freedom scanning arm. The arm contains a triple coil metal detector. The robot carries a sensor payload composed of video cameras, a 3D laser range finder, an inertial measuring unit (IMU) and a GPS receiver operating in real-time kinematics (RTK) mode. The robot is commanded and supervised from a remote base station or using a handheld remote with graphical user interface. The user specifies the boundaries of the area to be inspected and the robot covers the area autonomously, avoiding natural obstacles, like trees, bushes and large stones. All the suspicious objects found are localised on a map for subsequent inspection and removal.

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2. **TEODOR V-METAL DETECTOR D ARRAY (OUTDOOR DEMO)**

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**Team Description:**
VALLON GmbH is one of the worldwide leaders in the field of mine detectors and bomb locators and associated software.
RMA is a Belgium Defence University, with its Unmanned Vehicle Centre (UVC) focusing on the adaptive control of mobile robots.

**Tool(s) Description:**
Our tool is called "RMA TEODor-Vallon MCMD" and it is an innovative close-in detection tool composed of a mobile robot platform TEODor and a multi-channel metal detector MCMD. The TEODor mobile platform is upgraded by RMA with necessary electronics, sensors, computing power, motor control units and power sources in order to be able to execute remote controlled and semi-autonomous tasks. During many of the past field demonstration tests the TEODor platform has proven its usefulness in dealing with rough terrain, showing excellent maneuverability and good off-road performance. In addition, the rugged design of the platform makes it capable of handling unfriendly environmental conditions. One feature which is crucial for demining tasks. The Vallon MCMD is a flexible detector that allows up to 32 search coils in any configuration. A coil configuration with a ruggedized coil system is available for flat ground environments, while a flexible carpet-base variant was optimized for harder traversable grounds. Control and configuration is done with an easy to use web interface that incorporates all features usually known only on hand held detectors. The TCPbox (proTime) provides web connectivity and position reference data to the RMA TEODor-Vallon MCMD.

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