ALADDIN Training Platform Based in Blend Learning for Security Training

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Abstract— In this paper, we describe a proposed training program based in blended learning, for security education (ALADDIN technical platform). Specifically, we present a training program and platform by using Moodle. The educational methodology of this training program and platform follows the Experiential Theory of David Kolb. Experiential learning is an engaged learning process whereby students "learn by doing" and by reflecting on the experience.

Keywords— Security education; blended learning; e-learning; learning management systems (LMS); Moodle; critical infrastructure protection

I. INTRODUCTION (*Heading 1*)

One of the innovative forms of education is blended learning & e-learning. It is a modern form of education that is often used at vocational training of security personnel in external, distant form of college education, as well as in the courses of lifelong learning. It is the most modern way of teaching with the usage of information technologies and it represents the implementation of information technologies into development, distribution and management of education or training. In this paper, we present a proposed blended learning training program based in an e-learning system, for security education (ALADDIN technical platform).

II. BACKGROUND

A. Blended Learning

The Blended Learning (BL) course consists of an association of computer-based teaching and face-to-face lectures [1]. Specifically, BL is an approach that has increasingly been adopted by universities due to its perceived effectiveness in providing timely, continuous, and flexible learning. It is often identified as a mix of teaching methods and materials that "can be placed somewhere on a continuum, between fully online and fully face to face courses" [2].

Numerous researchers define blended learning as "a training method that combines the benefits of in-class learning and e-learning" [3]. The term BL combines the elements of face-to-face teaching, including personalized learning, social interaction and direct contact with the language, allowing greater variety and flexibility than traditional learning [4]. Torrisi-Steele's (2011) definition of BL is "enriched, student-centered learning experiences made possible by the harmonious integration of various strategies, achieved by combining face to face interaction with ICT (Information Communication Technology)." This definition highlights that focusing on students' learning needs is an important aspect of blended learning, offering new opportunities but also new challenges in a changing learning environment [5].

BL has numerous advantages in comparison to traditional learning courses. One of the advantages of BL is that it is easily adaptable to learners' needs. The adaptability comes from the different ways that online resources can be used. The most important component of BL is its flexible course. If the educator notices any problems that the learners have while studying the course, he/she can immediately solve these problems by changing the material and learning activities. Learners' individual needs should be taken into consideration, otherwise even well-designed courses can fail. If the course is flexible it contributes to raising learners' motivation. Another benefit is that learners, being involved in planning the course can successfully develop creative and critical thinking. Moreover, BL allows students to be independent by studying outside the classroom any time they have opportunities and willingness to learn. Independent learning provides constant feedback without the educator's assistance. Students can easily find their

results and see their progress. So, the educator's role is changing from that of a lecturer to a facilitator who helps to monitor and assess learners' progress, giving them an opportunity to study independently. Moreover, the learner's role is also changing. The great advantage is that learners become active participants of the studying process. The involvement of the learner in planning his/her own learning is feasible and important [4],[6].

The design of blended learning environments brings with it four key challenges [7]:

- incorporating flexibility (BL is more effective pedagogy, or enhanced cost-effectiveness, combining face-to-face with online instruction is increased flexibility for learners) [8],[9],[10],

- stimulating interaction (increases social interaction, enables both verbal and non-verbal communication during certain parts of the course) [11],[12],

- facilitating students' learning processes, due to the increased flexibility and autonomy of learners in blended learning environments, self-regulation becomes a

- critical factor for success, within self-regulation skills like as: organization, discipline, time management, skill in using technology to support learning, and self-efficacy to exercise control over their own learning processes [14],[15], and

- fostering an affective learning climate (offers motivating, concentrating and exerting effort, attributing and judging oneself, appraising, and dealing with emotions) [16].

Finally, challenges to the use of blended learning come from several areas. One of these are the expectations created by the label 'blended' [2]. Gregory and Lodge (2015) found that it is not uncommon for academics to feel that technology puts the onus onto teachers to provide all materials online. They identified perceptions that traditional face to face methods work well and are not transferable to online offerings [17]. This is echoed by Partridge et al. (2011), who also pointed out that the reduction in face to face student-teacher encounters means there is an increased need for self-motivation, good time management and knowledge of sophisticated learning technologies. This is of interest for the current research as 'self-motivation' must be considered an important element, particularly for international students from collective cultures [18].

The next figure shows the BL concepts according the literature review.
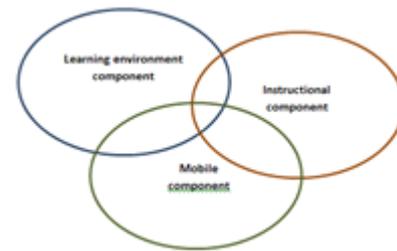
Fig. 1. *The BL concept*

Summarizing, in the BL, the degree of integration is based upon evaluating each component's specific attributes, resulting in the most appropriate blend to ensure attainment of the overall instructional goal. The majority of the literature evaluating blended learning has used a combination of author-designed questionnaires and course outcomes data. Learners' opinions and experiences are often prioritized over those of teaching staff, and researchers have more often used questionnaires than interviews and focus groups. Several authors have created instruments for this purpose. These are typically either Learner questionnaires or rubric-based frameworks for evaluation by a researcher. Due to the diversity of methods and evaluation frameworks utilized in the literature, there is no particular instrument that is seen to be the most effective for evaluating blended learning. The next figure shows a new framework of BL evaluating [19].

Fig. 2. *The Conceptual framework for evaluating blended learning*

B. E-Learning

E-learning systems are widely used from academia to industry. The usage of e-learning systems raises new research contexts. Multiple collaborative learning systems were implemented to improve people interaction, communication, working, coordinating activities, socializing and learning. E-learning systems play a significant role in the learning activities [20]. E-Learning is learning utilizing electronic technologies to access educational curriculum outside of a traditional classroom. In most cases, it refers to a course, program or degree delivered completely online. Oxford presents the concept of e-learning as being a type of "learning conducted via electronic media, typically on the Internet". In the Canadian Council on Learning's recent report was stated that e-learning is "the

development of knowledge and skills through the use of information and communication technologies (ICTs), particularly to support interactions for learning – interactions with content, with learning activities and tools, and with other people". This definition focuses on the idea of "interaction" as a key feature of e-learning and it is close to acknowledging the key role pedagogy plays in effective learning [21],[22].

E-learning has become of increasing importance for various reasons, such as the rise of information and global economy and the emergence of a consumer culture. Learners of the 21st century demand a flexible structure that allows them to study, work and participate in family life at the same time. This flexibility is reflected in alternative delivery methods that include Internet use. People have also become more sensitive to cultural and gender differences, and to the learning needs of the challenged, needs that might be addressed by e-learning [21],[23].

The use of e-learning has provided huge opportunities in an era where learners are "no longer the people our educational system was designed to teach". Harmonizing diverse teaching and learning needs of individuals born before and after the introduction of digital technology, while remaining focused on the learning outcomes, remains a great challenge. The current generation of learners often referred to as 'digital natives' are immersed in sophisticated technologies and are unprepared for the traditional teaching methods [24],[25].

The delivery of e-learning content can either be synchronous or asynchronous. Specifically (Fig.3) [26]:

- Synchronous delivery refers to real time learning where the instructor and learners communicate or acquire information simultaneously. Examples include teleconferencing (audio, video or both), instant messaging and chat forums. Synchronous learning using teleconferencing and chat forums offer an effective means of developing learning communities by increasing social interactions.

- Asynchronous delivery, the transmission and reception of information does not take place simultaneously and the instructor and learner communicate in their own time. Asynchronous communication plays a significant role when the educator and learner find face to face communication difficult, due to time constraints or complex geographical dispersal of the learners [28],[30],[31],[32].
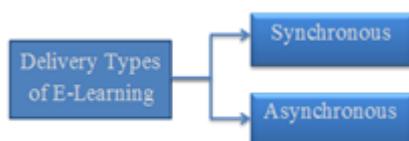
Fig. 3. *The delivery types of E-Learning systems*

According the Tirziu and Vrabie (2015), the main Inhibiting and facilitating factors for e-learning are [21]:

- learners (motivation, conflicting priorities, academic/technological confidence, learning style, gender, age),

- educator (technological confidence, new learning style, motivation and commitment),

- technology (access, software and interface, design, costs),

- support (pedagogical and infrastructure),

- course (content, pedagogical model, flexibility, localization, availability of educational resources, curriculum design),

- institution (staff, infrastructure, management),

- total costs,

- society.

According Khan (2016), e-learning contains eight dimensions which can be used to 'provide guidance in the design, development, delivery and evaluation of open and distributed learning environments' [19]:

Fig. 4. *E-Learning framework [33]*

Formative evaluation and summative evaluation are two common methods for evaluating e-learning course effectiveness in recent decades. Formative evaluation is used at the onset of new instructional program implementation to assess the needs and learning goals of an organization, or for program evaluation following training to revise existing programs. Several familiar formative evaluation models prescribe a four-part evaluation procedure employing expert reviews, one-to-one evaluations, small group evaluation, and field trials [34]. On other hand, Summative evaluation, one of the most popular methods focused on outcomes and used in classroom education. Summative evaluation models lack consideration of other factors, such as individual characteristics, e-learning interface design, instructional system design, and course design, which may influence e-learning effectiveness [35].

Most evaluation models, however, do not measure e-learning effectiveness from an overall perspective and ignore the interrelation among criteria. Typically, e-learning program effectiveness is evaluated by multiple intertwined and interaffected criteria, and the

perceptions of utility for learners are not monotonic. Establishing a model to evaluate all available criteria and to determine central criteria, learner utility perception about these criteria, and the future improvement direction for the programs is necessary [36-40].

C. Learning Management Systems (LMS)

LMS are enterprise-wide and Web-based systems, such as WebCT, Blackboard or Moodle, that integrate a wide range of pedagogical and course administration tools. These systems have the capacity to create virtual learning environments and are even being used to develop fully online virtual universities or e-training programs. They are becoming ubiquitous at universities around the world, adding a virtual dimension to even the most traditional campus-based institutions [41].

The various types of LMSs could be split in three main families and these families are [41]:

- open-source LMSs,
- proprietary LMSs, and
- cloud-based LMSs.

Also, the market offers four main categories of LMSs, as follows [41]:

- Proprietary LMSs (or commercial LMSs),
- Open-source LMSs,
- Cloud-based LMSs,
- Hybrid LMSs (usually developed in house).

The main characteristics of LMSs are [40],[41]:

- asynchronous and synchronous communication (announcement areas, e-mail, chat, list servers, instant messaging and discussion forums);
- content development and delivery (learning resources, development of learning object repositories and links to internet resources);
- formative and summative assessment (submission, multiple choice testing, collaborative work and feedback); and
- class and user management (registering, enrolling, displaying timetables, managing student activities and electronic office hours).

D. Security Training

Security is becoming the latest strategic and socio-economic role, but also to ensure its reliable functioning of any organization that has an objective of the environment and sustainable development in existing conditions. Safety occupies a large area of human needs; therefore it is important to recognize its important role. For that it is necessary to take into account the existing potential threats to human life [43].

The basis of security education consists in analytical work which is aimed at averting or minimizing safety risks of different forms and their causes. Security education should be directed towards the formation of a professional. A professional with extended competences. A professional active in the working process. A professional creating values for other people. Education of security managers should be implemented in conjunction with the principles of praxeology, which emphasizes the need to consider the learning objectives. The educational process should rely on the considerations of rationality. The aim and task of security education should be demonstrating the constantly changing world and the need for the security managers to adapt to this reality. Organized activity of teaching staff, subject to the objectives and tasks of the teaching process, has a significant impact on the development of plans and programmes, improving the methodological work, the qualifications of teaching staff, organization, management and evaluation of education and training of specialists. The objectives and tasks of the teaching process help create optimal conditions for the conscious and positive activity of well-educated and skilled security managers of different specializations [43-45].

The aim of education is to prepare a group of experts for the management of security institutions of different sizes and varying degrees of complexity. Deficiencies emerging in security education prevent the effective investigation of professional and societal aspects of security problems, by which the basic cognitive element for the effective management of security systems is limited. It is necessary to deal with deficiencies arising in this education and it is also necessary to examine and remove them [43],[46].

III. PROPOSED FRAMEWORK

Concepts

ALADDIN 's research program main objective is to study and develop a state-of-the-art, global, and extensible platform to detect, localize, classify, and neutralize suspicious, and potentially multiple, light UAVs over restricted areas. This platform will be tailored to operational constraints such as easiness of use and deployment, quality of detection, or safety, in order to deliver unprecedented tools for operational support, including investigations, and training. It will also assess relevant technologies, threat trends, regulations, and other important issues such as societal, ethical, and legal (SoEL) frameworks in order to develop new knowledge made available to LEAs and infrastructure designers, constructors, and operators through innovative curricula .

For the needs of ALADDIN project, an e-course is designed, developed and will be implemented. There are various environments where this training could take place but after research, the most adequate tool for this e-course is decided to be the online learning environment Moodle. Everything done on the Moodle platform is designed based on the adult learning theory

of Experiential Learning and on every one of its phases.

The proposed ALADIN training platform was based on an educational program (based in BL) for security training (ALADDIN technical platform). This includes (Fig.5):

- Theoretical training (theoretical background, standards, regulations, legal & ethical considerations, relative technologies, ALADDIN platform, concepts of operation etc.).

- Practical training (simulations & on fact).

Fig. 5. *The structure of Educational program, based on BL for ALADDIN technical platform*

One of the main ALADDIN'S objectives is to increase the end-user diversity, as they all face different kinds of threats and work within different regulatory frameworks.

The target audience of this educational program consists of two major end-user groups (Fig.6):

- Law Enforcement Agencies & Competent Authorities, and

- The Critical Infrastructure security planners and operators.
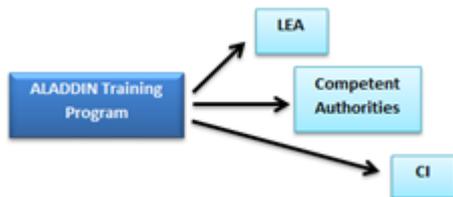
Fig. 6. *The target audience for ALADDIN training program*

Pedagogical Foundation

When designing a learning course, it is necessary to set the learning objectives, to choose a learning theory which will help plan the course during conception, development, and execution, in a way that will facilitate the learning process, and to apply certain evaluation techniques, in order to measure if the desired goals are achieved.

For ALADIN training platform, the adult learning theory applied is the Experiential Theory of David Kolb (Fig.7) [47-49]. Experiential learning is an engaged learning process whereby students "learn by doing" and by reflecting on the experience. Kolb supports that the learning abilities needed for successful adult learning are:

- Concrete experience (awakening)

- Reflective observation (observing)

- Abstract conceptualization (practicing)

- Active experimentation (applying)
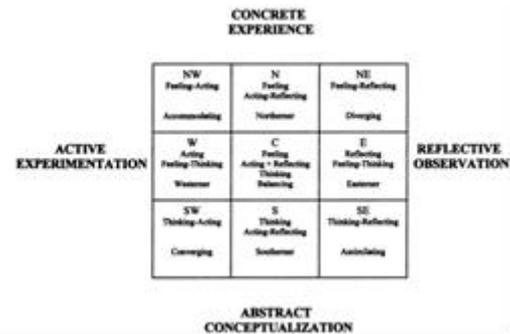
Fig. 7. *Kolb's nine-region learning styles Grid [47]*

In ALADDIN's case, the training procedure has been designed according to the Experiential Learning Theory as depicted in Fig.8, 9 and Fig.10. Every step of the learning theory is matched to a specific training objective and every activity serves one or more objective(s). The evaluation process takes place as both formative and summative assessment. The following learning process occurs in a linear order and evolves step by step. The main roles are the course creator, the course administrator, the trainers and the end-users. The end-users make up the participants which are Law Enforcement Agencies (LEAs) and Competent Authorities and the Critical Infrastructure security planners and operators.



Fig. 8. *The Experimental Cycle by D. Kolb*
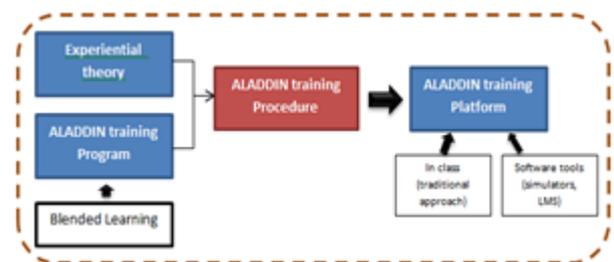
Fig. 9. *The total philosophy of ALADDIN training platform*
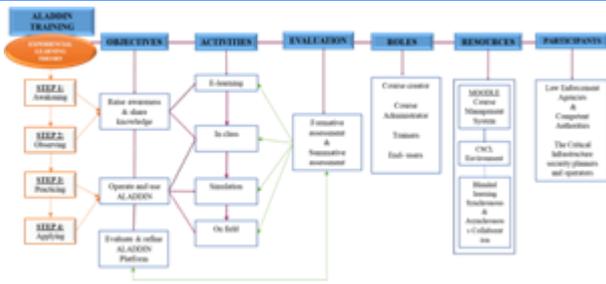
Fig. 10.   *ALADDIN training procedure based the Experiential Learning Theory*

Finally, for the educational needs of ALADDIN training program (and platform), the Experiential Learning Theory includes the following learning strategies: games, scaffolding, multiple choice exercises, matching exercises, fill-in the gaps, simulation practice, studio performances, field exercises and more.

Pedagogical Evaluation

In ALADDIN training program & platform, the evaluation will proceed as formative assessment (on-going evaluation, during each phase of the training procedure) and as summative assessment (final evaluation, at the end of the entire learning procedure) [50],[51]. For the formative assessment, certain types of exercises (multiple choice, matching, short quizzes, activities etc.) will be used. For the summative assessment, a final evaluation test will take place. In the end, all of the scores of each learner will sum up to make their final grade. More specifically, in order to measure the performance of the learners, the learning outcome, and the learning satisfaction level, the forms of evaluation will be broken down into the three main categories and the scoring methodology for each one of them will be analysed as we proceed.

For the needs of ALADDIN training program & platform, the pedagogical evaluation that takes place is organized in three levels (Fig.11) as follows:

- First Level of Evaluation \(FLA)
  - Theoretical Training (e-Learning courses, in-Class)
  - Practical Training (simulation, on field)
- Second Level of Evaluation
  - Theoretical evaluation (TE)
  - Practical Evaluation (PE)

- Third Level Evaluation (total Evaluation Calculation)
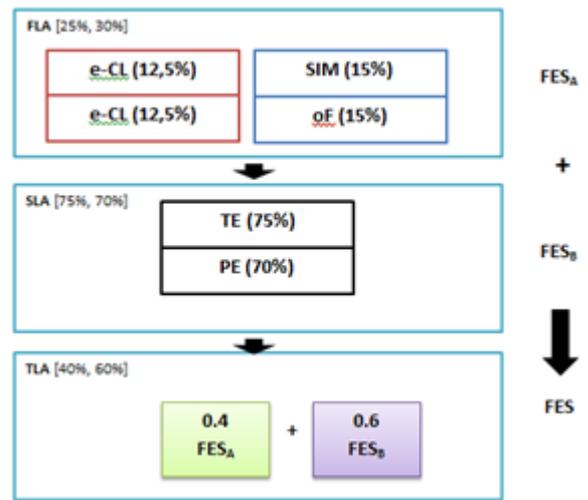
Fig. 11.   *Pedagogical Evaluation Methodology*

The pedagogical evaluation involves two tests of knowledge and skills assessment (pre-test and after-test) to study learning outcomes. Specifically, the methodology is:

- Pre-Test (before the ALADDIN educational program).

- Final Test (after the completion of ALADDIN educational program).

This test has a similar structure, like as:

Theoretical section-TS (it contains questions about the modules of e-learning context and in class context): UAs concepts, technologies & applications, threat analysis & assessment, standards & regulations, legal & ethical considerations, ALADDIN platform etc.

- Practical section –PS (it contains questions about the modules of simulation & on field)

The computation of score of tests is:

$$\text{Pre-Test} \mid \text{after Test} = 0.4 * TS + 0{,}6 * PS \qquad (1)$$

The results of the two tests are compared to draw useful conclusions for the ALADDIN Educational program. Additionally, in ALADDIN case, we use a learning satisfaction evaluation about the software tools and overall platform. Specifically, after the completion of ALADDIN educational program, some questions (open type) are used for trainees. This is done in order to test the level of satisfaction of the learners and evaluate the training program in a way.

These evaluation questions are:

1) What is the level of interactivity between the tutors, the students and the content?

2) How did the knowledge, skills and attitudes of the learners change by the training?

3) What level of satisfaction do the learners express about the training program?

4) What are tutors' reactions to blended learning program?

5) *How does blended e-learning training reduce workers' time away from workstation?*

6) *How reliable was the ICT infrastructure?*

Educational Tool

In ALADDIN case we use the Moodle tool. It is a learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalized learning environments. It is free and open-source software learning management system written in PHP and distributed under the GNU General Public License [52].

With customizable management features, it is used to create private websites with online courses for educators and trainers to achieve learning goals.) allows for extending and tailoring learning environments using community-sourced plugins [52-54].

The stated philosophy of Moodle includes a constructivist and social constructionist approach to education, emphasizing that learners (and not just teachers) can contribute to the educational experience. Using these pedagogical principles, Moodle provides an environment for learning communities [52-54].

In addition, the platform gives the opportunity to the instructional designer to implement it in ways that will give certain access to each student according to his or her role and to the appropriate level of difficulty for each one. In this application, the Moodle is the educational tool for ALADDIN training platform. All the educational material on theoretical training and evaluation is uploaded onto it (Fig.12).
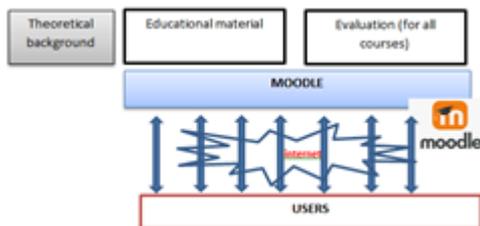

Fig. 12.   *ALADDIN platform based in Moodle*

The next figures show print screens of the e-learning courses form ALADDIN platform (based in Moodle):
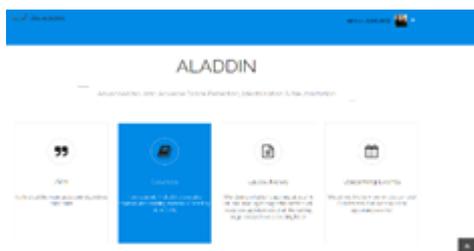
Fig. 13.   *Screenshot of Frontpage of e-learning course*
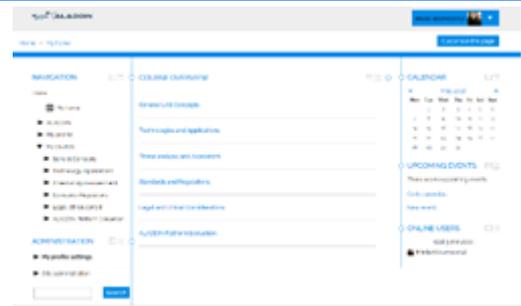
Fig. 14.   *Screenshot of Navigation in the Available course*

A.   Educational Structure

Specifically, in the case of ALADDIN, the structure of training program contains:

- Theoretical training: it will be divided into two types of courses:

   o Distance (e-learning) courses using an online platform providing through open source Learning Management System (LMS) those general knowledge modules related to UAVs, which are openly available to the public with no confidential content. E-Learning sessions will enable large number of geographically spread users to participate and have anytime, anywhere on-line access to the training material.

   o Traditional class courses, as closed group of users training form with physical participations, for confidentiality purposes of the operations modules which are related to the description, use and interaction with the ALADDIN platform.

- Practical training: it will be split into two types:

   o Simulation on ALADDIN platform which will take place after the theoretical training and before practicing on the field.

   o On the Field training with exercises on all the operations involved in the three (3) - upon availability - sub-systems of ALADDIN.

B.   Integration

Specifically, in ALADDIN case, the total structure of training platform & program shows the next figure:
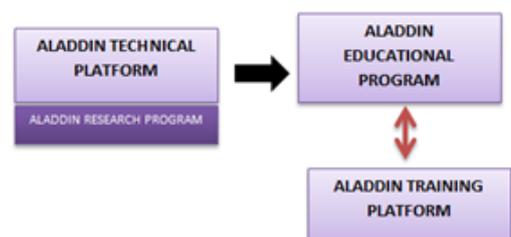

Fig. 15.   *ALADDIN integration concept*

IV.   CONLUSIONS

The upper purpose of this innovative platform & training program, as it will be evolved with the subsequent versions, is to act as a self-training tool, so that the users of ALADDIN technical platform should have an overall understanding of all the aspects related to UAV threats and should be able to be completely autonomous with the use of the system.

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