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BUSINESS CASE FOR RATIONALIZATION OF KNOWLEDGE ACQUISITION IN THE CRITICAL INFRASTRUCTURE SECURITY FIELD THROUGH THE OPERATIONALIZATION OF TECHNICAL SYSTEMS USED FOR MONITORING AND INSPECTION

Dorel BADEA
dorel.badea@yahoo.com

Silviu Mihai PETRIŞOR
robmilcap@gmail.com

Dumitru IANCU
dorin_dan@yahoo.com

Răzvan PARFENOV
parfenov.razvan@yahoo.com

Marian COMAN
coman.marian@gmail.com

"Nicolae Bălcescu" Land Forces Academy, Sibiu, Romania

ABSTRACT

This article brings to the attention of specialists few points related to an improvement of existing situation in the field of critical infrastructure security through the implementation of advanced technologies and employing a scientific research methodology based on project management. For ensuring the functionality of critical infrastructures, the characteristics of current security environment such as volatility, ambiguity and uncertainty, which determine the use of solutions characterized mainly by the operational agility, have been taken into account. The results of this approach can be useful both for the educational field and for the staff who occupy positions inside the critical infrastructure protection departments within organizations holding or managing such critical infrastructures.

KEYWORDS:

Critical infrastructure, project, advanced technologies

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1. The fundamentation of research needs

The opportunity to carry out such an activity, through research project management, aims the improvement of institutional capabilities, both on the educational component and on the practical-applicative component, in the field of critical infrastructure security management. This desideratum can be achieved by studying the defining elements (from a technical, systemic, and operational point of view) pertaining to the use of actual technologies and the implementation of some of them in a integrated way, with first and foremost benefits in the field of collective training for the management of consequences as a topical domain. Then, the achieved outcomes can be corroborated with the other projects' results, in order to form the basis for developing a proper early warning system solution, in line with the requirements in the field and best practices at the national and international level.

The objectives, for which such an approach is addressed, are:

a) investigating the need for developing a dedicated military training infrastructure for critical infrastructure security training;

b) carrying out a study on existing best practices in the field, in terms of the instruments used, based in particular on the experience of specialized emergency management institutions resulting from technical incidents or as a result of human errors during operating and running of critical infrastructures;

c) operationalization of a optimal purpose-cost-performance architecture, based on the implementation of a technical solution that relies in utilizing the drones for this aim.

Given the fact that it is aimed carrying out didactic activities to the disciplines comprised within a postgraduate course for critical infrastructure (Critical Infrastructure Protection Management) and within a master's degree program (Intelligence in Organizations), the main operational use for this project is *Training and Education*. Based on the idea that military institution has some important tasks in support to *Civil Emergency Management* and taking into account the current content and challenges specific to the field of critical infrastructure, it is also possible to appreciate the added value for this domain. Moreover, taking into account the possibility of using the created capability for supporting the command post exercises, the idea of its utilization in the force protection field can be also a feasible course of action.

2. The development and description of the proposed solution

As general performance, the following considerations need to be considered:

– it is necessary to ensure 100 % compatibility between drone, the dedicated software for the information processing and computer;

– the national legislative norms for the use of drone in the military educational institution and for educational applications / exercises, will be respected;

– a cost-effectiveness analysis will be carried out in order to select the elements of the final solution which will be implemented.

The overall performance is related to the main targeted results:

– multidimensional exploratory research (national-international, civilian-military) on the use of critical infrastructure monitoring and inspection systems carried out within the framework of an interdisciplinary analysis of military and non-military security dimensions to highlight the risk's potential under current geopolitical conditions;

– studying the possibilities for ensuring the operational flexibility (updating and upgrading) of the integrated systems, used for monitoring and inspection in the field of critical infrastructure, and elaborating the fundamental requirements of a constructive and functional optimal variant to be implemented mainly for educational purposes;

– ensuring an optimal way of interfacing between the simulated world and the real world;

– materializing the system set up for monitoring, initial interoperability testing of components, and demonstrating its capability in the field of knowledge acquisition for critical infrastructure security.

The central subject addressed by the research project is topical at NATO level through the need to increase resilience (paragraph 12) and the protection of populations and critical infrastructure against hazards (paragraph 13), stated by the CEPC/Civil Emergency Planning Committee (2014-2017). Also, starting 2011, the CPG (Civil Protection Group) has released the report on *Towards a Better Coordination of Critical Infrastructure Protection within the EP*, in which the essential coordinates of the necessary actions in the field are reconsidered. Last but not least, within the specialized works elaborated under the coordination of JFC Naples and analyzing the subject of cyber defense at the Alliance level, within a broader framework (CIKR – Critical Infrastructure KeyResources), the critical infrastructures are considered as possible targets. This fact results in a level of awareness that means a real necessity of the continuous assessment of NATO capability correlated with the rapid evolution of technologies as a response to terrorist threats (AFCEA International, 2018).

The Romanian Government Emergency Ordinance 98 of 03.11.2010 establishes through Annex 1 the list comprising the regulated sectors and subsectors considered as critical, and for the national security sector was stipulated the country defense, public order and national security as the subsectors of it. At the Ministry of National Defence level, specific legislation establishes some particular measures in the field of critical infrastructure protection.

In this context, through this type of approach, the main purpose is to demonstrate the feasibility and viability of the training solution by using modern technologies (drone-based information gathering system, specialized software, laptop for information processing, and listing reports for analysis) based on replication realistic scenarios in relation to the complexity of critical infrastructure security issues. The created capability is used in a strongly regulated educational institutional framework, with the aim of providing specialized knowledge to the staff personnel that attend a specific course and work in the field of critical infrastructure security, and for raising their awareness on the efficiency of the monitoring and intervention actions generated by the risk situations.

The resulting technical study and the functional model (Figure no. 1) will become an integrated part of the *Applied Informatics Laboratory* existing in the institution, with possibilities of use, primarily in the practical activities that are to be accomplished during the study of the *Operational Scenarios and Applied Informatics* discipline, part of the curriculum of *Critical Infrastructure Protection Management* postgraduate course. This course is part of the continuing training and development postgraduate program from the annual educational offer of Land Forces Academy, as a unique postgraduate course in the training plan of the Ministry of National Defense, involving liaison officers and specialists from both military and other ministries with responsibilities in the management of national or European critical infrastructure. Due to specific nature of the host institution of this project, the use of these systems is feasible for the materialization of incidents and events in the framework of specific scenarios related to collective training exercises, which have the crisis management caused by natural or technological disasters as a topic. The outcomes of both educational and operational directions of use will implicitly increase the performance of a broad category of beneficiaries in this field (cadets, trainees, specialists, military cadres, institutional management).

Figure no. 1 The functional solution aimed by the project

The expected steps to be taken (technical study, technical documentation, functional model, prototype, technological demonstrator etc.) are:

a) Stage I (approximately 100 days time span): study on identifying best practices in the field (theoretical and practical), multidimensional (systemic, technically operational), specific to the systems used for monitoring and inspection of critical infrastructure;

b) Stage II (approximately 150 days time span): development and implementation of a cost-benefit optimal functional model (educational and educational) for monitoring and inspection of critical infrastructures.

We estimate that the total value of the project is around 26,000 RON, approximately 95 % of the proposed budget being estimated to be spent on the purchase of necessary software and hardware equipment (drone-based information gathering system, specialized software, laptop information processing, and multifunctional listing reports for analysis).

In the present, there are several unmanned aerial vehicles (UAVs) in the world and are increasingly being used in different areas. A prime example would be the ScanEagle UAV that is used in the theater of operations. ScanEagle is a drone that provides high performance during information gathering and battlefield surveillance, but the cost of using it is high. It uses two special platforms, one catapult and one harness with a recovery hook that requires time for commissioning, and in addition other resources. Another example would be the civilian Alti UAV that is a drone with vertical take-off and vertical landing. This drone uses four wing-set engine for a vertical flight and a rear-end thermal engine for horizontal flight. Also in this case, the drone uses considerable power resources for the operation of the four engines designed for the vertical flight.

The UAV designed for this project is addressing to information collection in real time about the enemy, for surveillance of areas of interest, and for participating in the search and rescue missions. This drone solved much of the technical problems of the drones presented above. First, the technical idea of using a catapult for taking-off and a recovery system after flight has been solved with a technical solution linked to vertical take-off and vertical landing. Then, as for high-energy consumption, the use of only three engines solves much of the problem, in this case. The problem related to the lack of a special engine used for horizontal flight has been solved by a transition system consisting of two front engines working at an angle of 90 degrees to the direction of travel. This drone offers a very simple look, based on a carbon skeleton, the wings and the tail being detachable to provide an easy way for carrying it.

The drone construction (Figure no. 2) is based on a T-shaped carbon skeleton, where B1 and B2 are attached to S.S by help of SU1 and SU2. B1 will support the two engines (M.R1 and M.R2) but is also part of the transition during takeoff or landing. On S.S. there is a servomechanism that will make a 90 degree motion to change the orientation of the engines, from the vertical flight position to the horizontal flight. The 3rd engine, M.R3, is located on the longitudinal axis of the aircraft and operates only in a vertical flight mode. To this drone skeleton is added a wing with a span of 1.8 m and a tail. Being a flying machine, it has 8 degrees of mobility.

The total mass of the aircraft can be between 1 kg and 3 kg, depending on the addition of several navigation systems, sensors and other specific equipment. With a vertical take-off and landing system, it had to be divided into two systems: a drone control and an airplane control system. A switch was used to handle the switching between the two systems mentioned before. Switching the flight modes takes place both the engine transition and the gradual stopping of the engine from the rear, the airplane being sustained in the air after that.

The advantages of this drone would be: the lack of a special equipment for take-off and landing and also the specially arranged area; low energy consumption; fast disassembly for transportation; the weight of drone is quite relatively small; operating in different types of environments; reduced costs for drone building. Being a small-scale and impromptu prototype, the product still does not offer any disadvantage, unable to be compared with other complex flight systems relating to their flight efficiency.

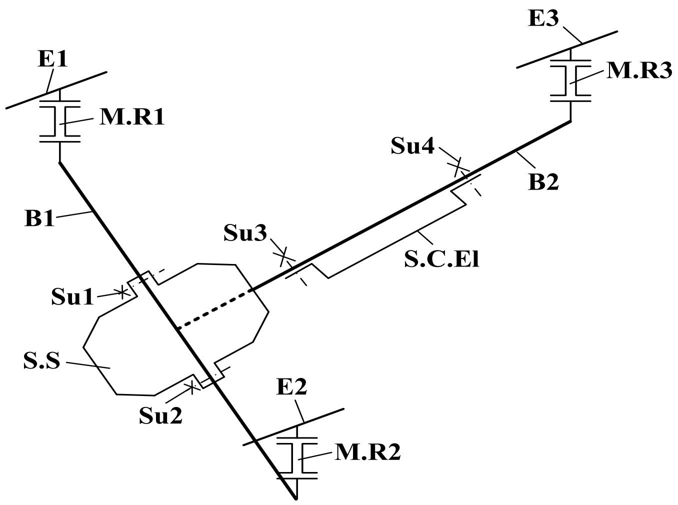

Figure no. 2 The kinematic scheme of the functional product

The notations used above are referring to the following components of the drone: B1, B2 – Bars 1 and Bars 2, respectively, which form the resistance structure of the drone (or resistance frame); E1, E2, E3 – Propellers that help the drone taking-off; M.R1, M.R2, M.R3 – Electric drive motors producing the rotation movement of the propellers E1, E2, E3; S.S – Supporting bracket for mounting bars B1 and B2; S.C.El - Support for the electrical components of the drone; Su1, Su2, Su3, Su4 – the screws, respectively, the clamping of S.C.El and S.S of the drone resistance structure.

On the electronics side, the particularities are as follows (Figure no. 3). C1 will switch flight modes through a command received from a radio remote control, but still in the same command, S.C will make a 90-degree movement. In droning mode, C2 is the one that controls the speeds of M.R1, M.R2, M.R3, always calculating the position of the ground as well as its inclination by reversing the opposite engine, this being made by the three gyroscopes comprised in the C2 block. After changing the flight mode, C1 switches to R for control of M.R1 and M.R2, as well as of S.E. and S.P. By switching to R, C2 will have no control over the plane, and M.R3 will stop without a C2 signal. Upon return for landing, the system will work inversely, switching from R to C2, changing both the orientation of the engines and the start of M.R3.

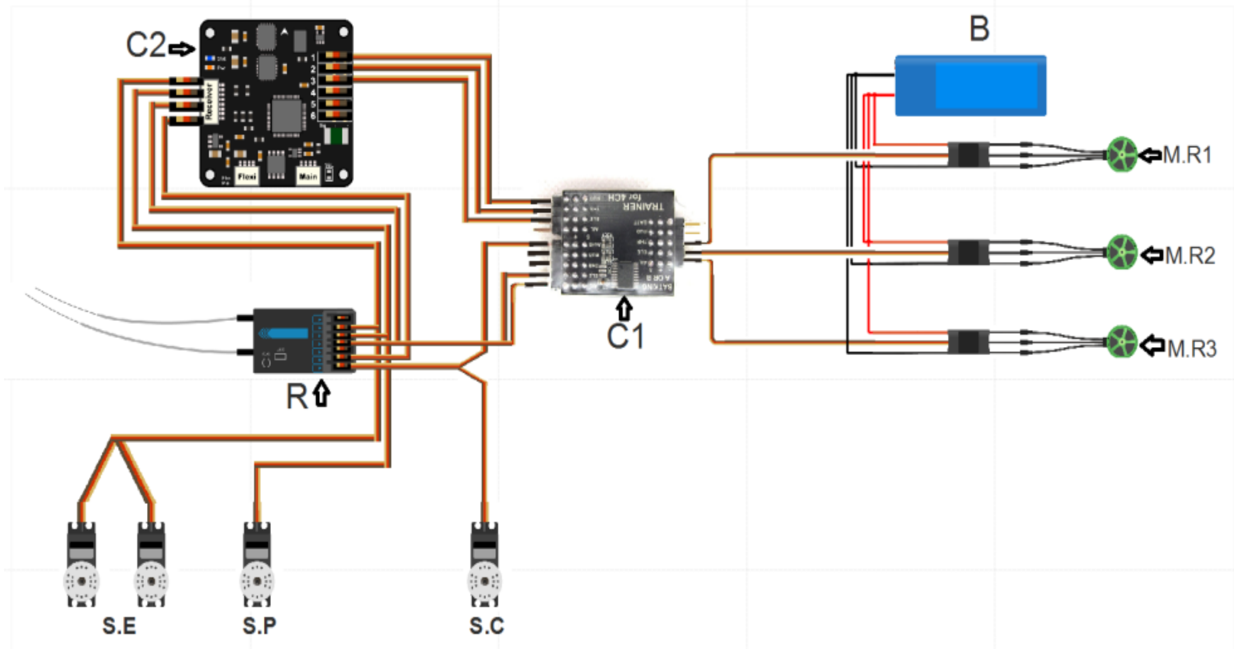

Figure no. 3 Electronic design of the prototype

The notations used for the electrical section of the drone are referring to: C1 – Switch between the piloting system of the drones and the flight control system; C2 – Flight controller; R – Receiver communicating with the radio remote control; M.R1, M.R2, M.R3 – Electric drive motors producing rotational motion; S.C – Servomechanism which provides steering control over the orientation of the motors; S.E – Servomechanism that controls the ailerons; S.P – Servomechanism that provides control of the horizontal depth.

3. Conclusion and further developments

Given the dynamics of the development of high technology applications for defense and security, it can be appreciated that the project and program approach will be a success factor in delivering the desired deliverables and benefits. It is a development opportunity that at NATO (2015) level the *Science for Peace and Security* program is underlined as an area of interest under key priority 1, point c, *Critical infrastructure protection*, including sharing best practices, capacity building and policies. Subsequently, considering the trend of approaches (from a thematic point of view, complexity of themes and achievement) from an international level, a multiplier of performance will be the initiation, planning and realization of the specific activities within the specialized clusters (Mănescu & Kifor, 2015, Mănescu, 2017;), a vital but insufficiently conceptualized and achieved national topic. The aforementioned aspects, in combination with the international determinations of the European funding mechanisms for projects (Ranf, 2014; Ranf, Marcu & Dumitraşcu, 2016), enhance the role and importance of the business case as a basis for the development of a research project. Moreover, the need to achieve such projects falls on achieving strategic development goals.

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