IMPLEMENTATION OF DIGITIZATION ELEMENTS AS A SOLUTION OF RISK MANAGEMENT IN MAINTENANCE OF RADIOLOCATION SYSTEMS

Liviu GĂINĂ*, Mircea BOȘCOIANU**

*"Henri Coandă" Air Force Academy, Braşov, Romania, (liviu.gaina@afahc.ro)
**"Transilvania University", Brasov, Romania (boscoianu.mircea@yahoo.com)

DOI: 10.19062/2247-3173.2023.24.2

Abstract: *We increasingly identify in our lives the presence of devices equipped with recording cameras, as well as facial recognition to unlock devices. At the same time, we notice the increasing presence of technologies capable of identifying different objects, manoeuvres or actions, as well as detecting actions performed in error. This article highlights how these digital devices can be integrated to improve the quality of maintenance and to achieve effective risk management in this sensitive segment of military RaDaR technology and equipment. The data acquisition elements (CWB/AR) can produce records that can be uploaded to a secure government cloud, which can be accessed by teams of appropriately skilled and qualified technicians. An IA structure can be adequately trained to notice, highlight and alert in case of deviations from the maintenance protocol, thus achieving quality management of the monitored equipment.*

Keywords: *government cloud , BodyCam, AR, AI, technical audit, radiolocation systems maintenance*

1. INTRODUCTION

In everyday life and especially in the professional environment, the concept of Double L (Lessons Learned) and also that of Good Practices is increasingly used. Since in the maintenance of radiolocation systems, the working environment involves the interaction of man with / on the technical component, in what is defined as Complex Socio-Technical System (CSTC).

Since 2017, military use has been assigned to policemen in territorial units **MOTOROLA** audio-video devices, type Body Worn Camera (BWC) (Figure 1). The purpose of implementing the project for equipping policemen with BWC was based on 3 important objectives:

- Making the evidentiary material for the deviations from the law found by the policeman;
- Realization of the evidentiary material in the situation of the offense of outrage;
- Carrying out the protection of the policeman in relation to false accusations of abusive conduct.

FIG. 1 Motorola BWC equipment from romanian MAI policeman

Technical features BWC, Motorola, VB400 series:

- resolution 1920x1080P@30fps, HD 1080p (2mp);
- WiFi 802.11 a/b/g/n (2.4GHz & 5GHz);
- storage capacity 64GB;
- Bluetooth monitoring sensor;
- audio: dual microphone.
- built-in GPS sensor;
- Li-Pol battery - up to 12 hours of operation;
- dimensions 68mm x 89mm x 26.6mm;
- weight 162g.

2. PURPOSE AND OBJECTIVES OF THE PROPOSED PROJECT

In order to achieve the desideratum of the research theme, I propose the implementation of an IRMRSM (Improving Risk Management in Radiolocation Systems Maintenance) project containing and using BWC systems similar to those used by the MAI policemen. A practical and up-to-date, but more expensive, alternative is the use of AR glasses. e major purpose of the proposed project is to identify the factors in the radiolocation maintenance that have an impact on the operational availability. In other words, the project aims to minimize the occurrence rate of failures that can remove radars from operational availability within the national airspace surveillance system. This is based on the following important objectives:

- carrying out maintenance operations in time, qualitatively and in full volume;
- ensuring the collection of data by the system by categories of radars and subsystems;
- setting up a database (like a black box – maintenance log) available to be technically audited in real time or later;
- storage of audio-video material on each system / equipment separately to keep clear records of operations on the system / equipment;
- protecting the personnel involved in carrying out maintenance in relation to the technical audit staff that could invoke before the use of the platform, inconsistencies between the planning and execution of maintenance operations;
- identification of risk elements by omission / commission by the personnel involved in carrying out the maintenance of radiolocation systems;
- improving the didactic base for the training of technical staff in educational institutions / specialization courses by using sequences;
- making a map that highlights the critical failures of the equipment / subassemblies / installations that lead to the operational unavailability of the radar systems;

- the establishment of remedial packages for critical elements within radar systems;
- making intuitive decisions related to risk management by the decision-maker.

3. THE PRECEDING PHASE

For the efficient development of the project, it is necessary to go through successively the proposed phases. This phase involves the collection of data from the territory, the categorization of the equipment by the degree of interest and importance as an operative availability, the categorization of the maintenance personnel on the level of training, the realization of the IT application, the organizational chart of the system and the establishment of the attributes of the personnel involved in the project, the writing of the project, the simulation of the project run, the realization of the feedback loops with specialized personnel, the correction of the identified gaps, the finding of the identified gaps, the finding of the variants of project financing, proposal and support of the project to the beneficiary for approval and implementation.

Table 1. Correspondence between the degree of complexity of the operation and the level of qualification of the maintenance staff

Degree of complexity of the operation	**Qualification level of maintenance staff**	**The need for remote auditing**	**Restrictions**
Very complex – operations provided by the manufacturer	N0 - operators designated by the manufacturer	Optional at the decision of the field team	Operators N3 and N2
Complex–	N1 – operators certified by the manufacturer	Optional by the manufacturer's support team YES in the case of operators lower level N2	N3 Operators
Medium	N2 – operators trained and certified by the op. N1	Optional by specialists technical audit level N1 or N0 YES for N3 operators	
Easy – current operations	N3 – operators trained and certified by the op. N2	Upon request by specialists higher technical audit level N2	

A. Implementation phase

This phase is carried out in parallel in several directions:

a. Setting up the specialized technical commission for drawing the directions for project implementation and categorizing the maintenance operations according to the type of equipment and responsibilities of the staff;

b. The realization of the material base involves the purchase of BWC devices / AR glasses (Figure 2), the labeling of the work areas (preferably with QR codes) based on the categorization of the specialized technical commission;

c. Training of the maintenance staff in order to correctly use the BWC devices, to register the essential data in the platform (the person performing the operation, the subassembly subjected to maintenance, the types of materials used, the time allocated) and to save the recording of the executed maintenance operation;

d. Realization, by the designated IT support team, of the platform with files and files, hosted by the Government Authority specialized in the cloud area with the possibility of accessing depending on the level of access of users and administrators.

FIG. 2 AR gloves – HoloLens2 (left), capture from op.maintenance using HL2 (right)

B. Scrolling phase

This phase of the project involves the audio-video recording of maintenance operations. The maintenance staff must additionally follow a series of activities such as: starting the BWC device, logging into the system and starting the recording on the device. From this moment on all the data will be recorded at the device level in the storage space (requiring to be loaded into the platform later) or if the operation with a higher degree of complexity requires real-time technical auditing, live transmission can be performed using the Wifi feature of the device.

The operator designated for the execution of the maintenance operation is authenticated on the IRMRSM platform. with the unique data and starts the maintenance works according to the schedule and the standard sheet. Based on the GPS data and authentication data, as well as the QR code of the respective equipment of the standard maintenance sheet, the identification of the system to which the intervention is performed is carried out, the planned operation is certified and also recorded in the log of the equipment maintenance. Live technical auditing is carried out in fortuitous cases and has the role of carrying out the remote assistance of the technical staff who have a training of a lower level than the operation to be performed.

C. Technical audit phase

This phase is designed to meet the requirements in several plans, two of which are essential. The way to choose the audited operations can be:

- Pareto model, by identifying the most common 20% of events;
- Following a predetermined schedule;
- randomly (random function);
- upon notification of the activity of an operator;
- by category of systems.

We have previously defined that the data is recorded and saved in such a way that the operation can be identified at the IRMRSM platform level, both as an operation in succession at the level of equipment and as a specific operation of a subassembly. Thus, at the level of the platform, an analysis can be made that identifies several aspects:

a. On the one hand, based on the general analysis of the system, when identifying the failure of a critical subassembly to a radar system, the technical audit committee has at its disposal the records of maintenance operations from all systems in a designated category. This allows the causes and their nature to be identified (e.g. it is possible to identify whether the operations in full volume or with the appropriate tools or materials are carried out at the level of that subassembly, so errors of omission or commission can be identified). As a result of this type of technical audits, conclusions can be drawn and decisions can be taken:

- to improve the standard maintenance sheet at the level of that subassembly;
- specific training of personnel strictly on that operation;
- of categorization of the operation to another level.

b. On the other hand, a second scenario is the critical failure of a radar system with its removal from the state of operational availability and in order to identify the causes of the failure, the chain of maintenance operations performed on the system is monitored (like the black box investigation of aircraft). The conclusions of the report of the technical audit committee may constitute a package of measures for the other radars of that type in operation.

An extremely important aspect of this audit phase is the realization of the feedback loop, with a defining role in the development of the IRMRSM platform. and implicitly its resilience.

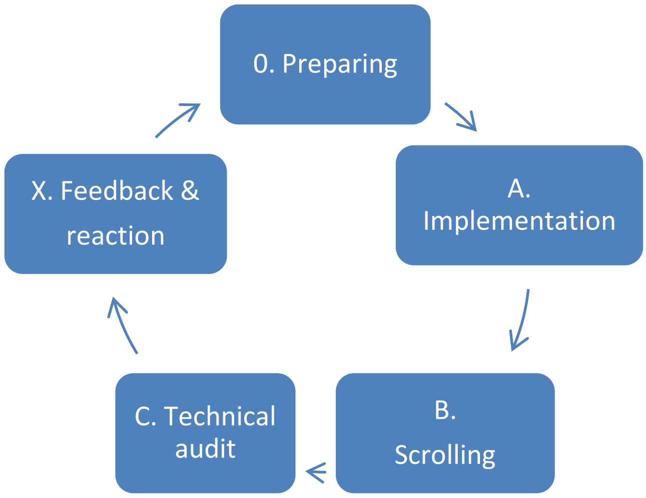

FIG. 3 Stages of the IRMRSM project.

4. ADVANTAGES AND DISADVANTAGES OF IRMRSM PROJECT

The advantages of the platform relate to:

- real-time identification of risks that may arise due to human errors of omission or commission, using reduced staff in audit committees
- protection of the personnel involved in carrying out the maintenance in relation to the technical audit staff that could invoke before the use of the platform, inconsistencies between the planning and execution of the maintenance operations
- achieving a correct norming of the maintenance operations with visible effects on the working climate of the staff, which will lead to the reduction of the probability of producing the risks caused by the human factor
- the awareness by the maintenance staff of the importance of observing all the steps in the standard maintenance sheet

- the realization of the overall picture with the malfunctions that may imminently cause the removal from the operative availability of a system with adverse influences on the national air surveillance system;
- the establishment of a robust database to identify deficiencies in the maintenance of radar systems, which properly exploited, can make recommendations for the system manufacturer.

Disadvantages of the platform:

- Project implementation costs
- Resistance to the new from the staff involved in the project, motivating the occurrence of additional operations.

5. CHALLENGES AND FUTURE DIRECTIONS: THE BET WITH THE FUTURE – THE INTEGRATION OF ARTIFICIAL INTELLIGENCE IN RISK MANAGEMENT IN THE MAINTENANCE OF RADAR SYSTEMS

To understand what AI can change in our lives, Professors Yolanda GIL and Bart SELMAN mapped out the AI development directions map for the next 20 years. The authors anticipate that AI will reduce health care costs, personalize education, accelerate scientific breakthroughs, help the national defense system, and more.

In the section dedicated to digitization and the identification of obstacles in the implementation of AI, we concluded that AI, although so publicized, is to a small extent integrated at the level of companies and society. This last proposed solution is at the moment ideational and represents **a bet with the future**. At this point AI is only able to relate to text and incipient voice databases. The evolution of AI, however, is spectacular. It is estimated that in the not too distant future, based on an analogy with the STEM cell sampling model, the video recordings of the operations in the technological systems will represent the database, already collected, necessary for the development of an AI engine dedicated to the maintenance of the radiolocation systems and implicitly to the management of their risks. Establishment of a digital register in which each element involved in maintenance is classified for human reliability analysis.

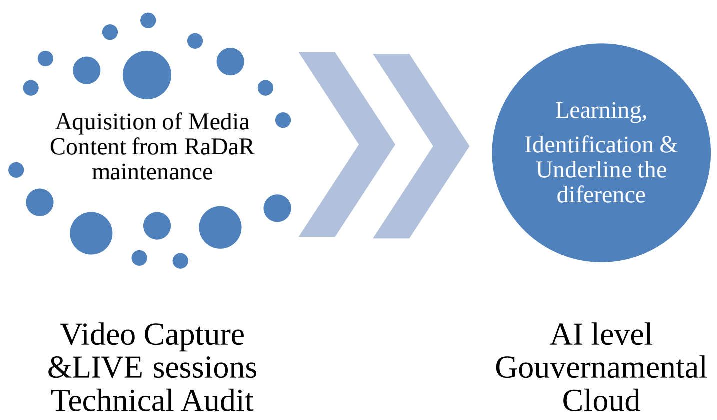

FIG. 4 Basic Structure of AI Technical Audit from media recording from RaDaR Maintenance

CONCLUSIONS

It is obvious that digital equipment can be integrated to improve the quality of maintenance and to achieve effective risk management in this sensitive segment of military RaDaR equipment and technology.

The data acquisition elements (CWB/AR) can produce records that can be uploaded to a secure government cloud, which can be accessed by teams of appropriately trained and qualified technicians. An AI structure can be adequately trained to notice, highlight and alert in case of deviations from the maintenance protocol, thus achieving quality management of the monitored equipment.

The model can also be applied to other areas of activity, with the final beneficiary being responsible for the appropriate learning of IA through the experience gained by specialists in the operational environment.

REFERENCES

[1] E.L. Miron, L. Gherman, *A new age in the Air Force: the digitalization of military higher education*, AFASES2022, pg.99-102, Brașov, DOI: 10.19062/2247-3173.2022.23.14;

[2] S.S. Wang, A.M. Meclea & others; IoT Of Artificial Intelligence In Blochchain;

[3] S.Ganguly, H.Harreis, B.Margolis, K.Rowshankish, *Digital risk: Transforming risk management for the 2020s*, feb.2017,

[4] Survey - Barriers to AI implementation, https://www.ipsos.com/en/european-enterprises-and-ai-technologies, accessed 14.05.2022;

[5] Ipsos, European enterprise survey on the use of technologies based on Artificial Intelligence, 2020.