

COMPARATIVE ANALYSIS OF THE ARMAMENT AND EQUIPMENT SUPPORT MODULES IN THE FIELD OF COMMAND AND CONTROL INFORMATION SYSTEMS OF NATO ARMIES

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Abstract: *In the paper is made a comparative analysis of the armament and equipment support modules in the field of information systems for command and control of NATO armies and the main functions of each information system for maintenance of the logistical assurance.*

The classification of information systems is made depending on the integration capabilities with Microsoft products, as well as depending on the capabilities of deploying emerging technologies such as remote monitoring, remote control, and more.

Keywords: EQUIPMENT, MAINTENANCE, INFORMATION SYSTEMS, CLASSIFICATION

1. Introduction

Command and management information support is designed to assist with decision making by assessing the suitability, feasibility and eligibility of defined action options through the use of information systems.

The informational support for the exploitation of armaments is an aggregation of activities for the creation and implementation in the work of the military formations and headquarters of computer networks and systems, as well as various coherent high-performance technical devices (sensing and for disclosure) with corresponding possibilities for information and programming to ensure the effectiveness and efficiency of the NATO Army weapons management process.

The purpose of this paper is to analyze the existing information systems for the management of the operation of the armaments and equipment, both in the Bulgarian Army and in some other NATO member states. On the basis of this analysis the characteristics and the possibilities for their classification will be determined, depending on the possibilities for integration with different software products, as well as depending on the possibilities of applying the incoming technologies, such as remote monitoring, remote control etc.

2. Information systems for managing the use of material resources in the civil sector.

An information system in an organization helps reduce the cost of upgrading and maintenance of equipment in a workable condition. With an appropriate information solution, production processes can be synchronized so as to avoid forced inaction, reduce repair times, schedule maintenance and replacement of equipment without suffering production. The software products that are capable of doing this are developed in accordance with several popular concepts: for resource management (Enterprise Asset Management (EAM)), computerized service and repair management systems (Computerized Maintenance Management Systems (CMMS)), Plant Maintenance and more.

The concept of business asset management was introduced by the Gartner research company in the late 1990s.¹ It implies the integration of tools for controlling technical service and repairs with the most widely used modules (finance, production, etc.) of Enterprise Resource Planning (ERP) systems as asset management information systems and repair activity, which is Enterprise Asset Management.

In fact, EAM develops the idea of Computerized maintenance management system (CMMS), which have been developed over the past 20 years, designed primarily to reduce equipment maintenance costs and increase productivity.

The basic functionality of CMMS systems includes:

- Data maintenance for equipment, technical installations, components;
- Registration of technical parameters, specifications for installation, repair and servicing of the equipment;
- Planning of prevention and repairs by generating execution orders;
- Accountability for the activity performed – volume, materials used, time spent, etc.;
- Managing warehouses for materials and spare parts;
- Managing the supply of materials and spare parts;
- Report statistical information.

To all this, EAM systems add:

- Process modeling tools for technical maintenance and modernization of equipment;
- Capabilities of managing the supply of equipment;
- Management of the staff involved in the repairs, qualification analysis and required competence;
- Data collection with external sensors, etc.;
- Registration of all costs of repairs in the financial system (materials, time, labor) and comparison with the values that are planned for them etc.

Companies often use their EAM solutions in combination with other modern information technologies - for example: business analysis tools-means; remote monitoring; remote control based support; mobile solutions and more. For example, the Targets Related Infrastructure Management (TRIM)² program provides enterprise infrastructure management that contributes to achieving its strategic goals. The TRIM complex and the solutions based on it implement modern management methods and refer to the already mentioned and the following classes of software (systems): Enterprise Asset Management - management of core business funds; Maintenance, Repair and Overhaul (MRO) - maintenance, repair and modernization; Computerized Maintenance Management System; Business Process Management System (BPMS); E-procurement - e-commerce. An element of it is also a Maintenance, Repair and Operations system (MRO).

In many Bulgarian companies EAM solutions have been implemented³. For example:

- In the ContourGlobal Maritza East 3, the maintenance and repair of the machinery and equipment is monitored and managed with the Q4 PowerEngineering and Q4 Safety modules implemented in 2005. For each facility, specifications are defined for scheduled repairs, the steps that have to be carried out, the devices and the details (products) that it consists of (Bill of Materials) and the parts that are subjected to repair and replacement. Q4, however, does not provide resources for long-term planning of activities as well as for the effective management of current tasks in modules and technological dependency of activities from one another. Therefore, in 2010, MS Project Server 2007 was introduced as a tool for effective management of repairs planning. This solution provides centralized management of activities related

to the renovation planning. Later, in 2011 the iShare portal was realized in the company. The solution is based on MS SharePoint Server, the primary purpose of which being to provide tasks and processes management and to facilitate collaborative work. The portal is divided into sites with different targeting, one of which (Maintenance) manages a shared calendar of the department "Repair Planning", and provides task information with the respective person that is responsible, the end date, technology dependency, and so on.

- In Sofia Med, since the beginning of 2010 is being used the Infor Enterprise Asset Management support system (planning and management system of maintenance). The solution consists of several modules, including "Machine Management", "Maintenance and Repair Management", "Preventive Maintenance". The system provides a systematic registry of interruptions, preventive repairs and other issues. An important advantage of using the solution is that any activity such as repair or maintenance of a machine can be bound to spare parts and it's time to become valuable. This in turn provides a basis for analyzing and finding the most effective approach.

- ITW Israpconrols Bulgaria launched the implementation of an EAM system in the summer of 2011. The Bulgarian subsidiary of the leading US producer of electrical components for household appliances has made its decision based on the Infor EAM system⁴. The project envisages-predicts the introduction of functionality for the planning of preventive maintenance, company asset management and day-to-day control of emergency repairs. Infor EAM is a scalable asset management application that can improve the service, through its forecasting as well.

- At Titan Gold Panega Cement, where for 10 years, has been used an SAP⁵ based ERP solution, in early 2011 new system modules were introduced to provide EAM functionality.

Now the Preventive Maintenance (PM) module ensures the preventive maintenance and repair process and provides a set of useful mechanisms and accompanying structures in order to improve the planning and control of repairs, both from a pure technical and engineering perspective, as well as a financial one. The second SAP Material Requirements Planning module connects planning processes with the even and tracked material spending, the timely booking in warehouses or ordering as needed.

3. Information support for the operation of arms in the Bulgarian army.

The information support for armaments management is expressed as support to decision-making on its operation by defining, forecasting and registering regulatory activities by assessing the suitability, feasibility and eligibility of specified options for the necessary service activities through the use of information systems.

The essence of the information system of the Bulgarian Armed Forces, which is related to the maintenance of the armament in an organizational aspect, can be defined as an organizational and technical union of organs, information resources (forces, means and systems), procedures and documents to ensure the processing, storage and provision of information on the operational support of the missile-artillery armament of the Bulgarian Armed Forces, coordinated by purpose, tasks, place and time for the accomplishment of the assigned tasks according to the different modes of operation.

The Bulgarian Army has put into operation two information systems that serve different functional regions involved in the arms exploitation process - the automated subsystem NIKE and the information system "Logistics of the Bulgarian Army".

The automated Nike Subsystem records and reports on the availability, qualitative and quantitative status of battle and blank stock and their elements by unit code, production data, components

and category, control of combat and blank stockpiles allowed during the school year, and report on the launching, their operation and control of the prohibited BPs and their elements from the level of "reporting unit" to the central security body (CST) for peace time.

A specific central insuring establishes regulatory information on subordinate reporting units, new unified material codes for battle and blank and their components, their technical characteristics, the periodicity of technical review, technical maintenance, repair, regulatory work, laboratory and field tests, a list of the prohibited for shooting combat supplies and the values of the current price lists.

The report of the active (battle) and blank stock and their elements in the automated subsystem "Nike" is based on the entry reporting of the cost-effectiveness documents that are inserted into the logistic structures of the formations, which documents carry the primary information.

Information System "Logistics of the Bulgarian Army" is an integrated information system for monitoring, management and control of material and financial resources used by the Ministry of Defense and the Bulgarian Army. In order for these tasks to be accomplished, a unified, integrated work environment is created for all management levels and all logistics procedures are unified.

The Information System "Logistics of the Bulgarian Army" implements a number of functionalities directly related to the management of material and financial flows, such as:

- Management of the Material Resources - Maintaining the required quantities of material means in warehouse stores, and solving operational tasks;
- Planning and budgeting – Defining the hierarchy of programs / tree structure / and limits of individual paragraphs through elements of the hierarchy. There are seven areas of planning: material, ammunition, use of transport, railway services, utilities and release, material insurance, construction and construction services. There are also included processes for request submissions, aggregation, drafting of material and technical support plans, generation of a single material plan and budget for its implementation-realization, a plan to buy material means following a single material plan (SMP) are included. An important point is that the implemented areas of planning are integrated into a single process;
- Negotiation and purchase – registration of the SMP purchase contracts and reporting the invoices and payments in relation to this these contracts; ;
- Delivery and storage - service of external and internal supplies; allocation and decommissioning-deduction of material resources (MR) under different warehouse operations; re-categorization and change of parameters;
- Out-of-demand (Off-plan) requests and deliveries – serving emerging needs that are not predicted in the SMP;
- Utilization of the material resources - transmission and decommissioning, transmission for consumption, reporting of the use of ammunition, transmission of fuels and lubricants, reporting of the delivered for repairs material resources;
- Composite products - registration of hierarchical structures of the constituent composition of elements of serial and batch materials;
- Maintenance - monitoring of the performance of material means and preparing a schedule for carrying out certain maintenance activities when certain values of these indicators are being reached;
- Individual Substantial Provision – preparation, aggregation and inclusion of individual Substantial Queries in the SMP. Providing and selling through the system of territorial points to provide servicemen with tangible property.
- Reporting and Accountability - A set of reports on the quantity, status and value of MR based on data from other groups of processes;

- Financial control - budget control, accounting operations in relation to invoices, payments and implementation of the accounting cycle in the system.

Suite The Bulgarian Army Logistics Information System is built on the basis of a ready-made software product Oracle e-Business Suite⁶ adapted to the needs of the Bulgarian Army.

In the presence of a large number of maintained logistic procedures and processes, the information system provides the necessary reporting and analytical requirements on an administrative, operational and management level. Despite the satisfactory organizational and structural scope of the system, there is no provision to monitor document flow in the logistics support armament, which is the backbone of the accompanying operating accounting processes.

As a result of the analysis of the information systems for the management of the operation of the armaments in the Bulgarian Army, together with their characteristics, it can be summarized that these are systems, procedures, organizational structures, staffing, technical and programming means for introducing and administrating performance data designed to assist commanders and headquarters in the organization and management of logistics, in particular the operation of arms.

On the other hand, besides being adjusted to the needs of Bulgarian Army in peacetime, the information systems for the management of the armaments operation must ensure operational and technical compatibility with those of the allies and provide:

- Integration with other modules for logistics support to automated command and control information systems;
- To hold information on the residual resources of the missile-artillery armament of the tactical formations, their characteristics and the history of each product's function from all stages of its life cycle (entry, diagnosis, malfunctions and damage, repair and release);
- Based on the residual resource of each individual item, automatically to generate a plan for maintenance and repair of the armaments and based on that to determine the needs for consumables and spare parts;
- Analysis of the data that summarizes the individual operational parameters of the armament, analysis of the errors and defects;
- Report of input materials for maintenance and repair;
- Providing the means to manage and control the real-time logistical processes on the armament of the Bulgarian Army;
- Providing each user with access to a set of references and reports related to their activity.

4. Information systems for the management of the use of weapons used by the logistics authorities of NATO countries.

NATO's main automated logistics systems are a Logistics Functional Area Services subsystem (LOGFASS)⁷ logistics functional subsystem.

The components of LOGFASS are: Logistics Database (LOGBASE), Movement and Transportation (M&T), Allied Command Resource Optimization Software System (ACROSS), and Logistics System accounting (Logistic Reporting (LOGREP)).

The LOGBASE Logistics Database includes⁷: Geographical Data Manager (GeoMan), LOGFAS Data Management Module, and Sustainment Planning Module. It is described in the Supply Distribution Model (SDM). The main tools for working with LOGBASE are currently M&T, ACROSS and LOGREP.

The Resource Optimization Software System ACROSS maintains the work of planning the allied forces stockpiles in the field of land, naval and air operations. This automated system uses a threat-based methodology. There are opportunities to threaten the

alliance's combat capabilities in order to prepare the necessary reserves of ammunition needed to destroy this threat by conventional means.

The logistics system LOGREP is the tool for ensuring that the exchange of information meet the requirements as outlined in Chapter 6 - Operations logistic planning of the NATO Logistics Handbook. Regarding operations, LOGREP is a tool for timely provision of up-to-date material and mission information for all functional areas in logistics. NATO commanders and their respective headquarters parties receive transparency for logistics and planning in peacetime as well as for the logistics insurance for each operation.

The Mobility and Transport System (M & T) is used to plan, assess and monitor transport and transportation operations when insuring NATO missions. The system assists authorities that are responsible for planning the transport in developing plans to deploy and verify their feasibility by rapidly preparing, resolving conflicts and distributing plans between NATO and NATO Commands. In addition, during the implementation, planners can monitor the progress of the planned activities and adjust the plans to meet the operational objectives.

Modules in the LOGFAS program:

- User Management Module (UMM) - for user management using "LOGFAS" applications. It provides the user with access rights to the various LOGFAS applications.
- Supply Distribution Model (SDM). SDM is a decision support tool that allows logistics planners to try re-procurement and support policies within the scope of the "what-if" scenarios.
- Data Migration Tool (DMT).
- Administrator for installing Logfas Connection Manager (LCM).

The armament in the NATO armies includes field communication and information systems. Almost all field systems^{8, 9, 10, 11} have logistics management modules that support and process information about:

- reinforcing, imparted and redeployed forces and material means;
- maintenance of reorganization, pre-placement and allocation of material resources, etc.

They are based on database models that are continually evolving as a result of the Multilateral Interoperability Program (MIP). The original Generic Hub (GH) Data Model becomes Land Command and Control Information Exchange Data Model (LC2IEDM) in 1999. For example, the Field Integrated Communication and Information System 8 uses a Land Command and Information Exchange Data Model (LC2IEDM) Data Sharing Model that is part of a common NATO armament data model standard defined by the Army Tactical Command and Control Information System Task Force (ATCCIS).

The development of this model is in the Command and Control Information Exchange Data Model (C2IEDM) in 2003. It's unification with the NATO Corporate Reference Model led to the emergence of the Joint Command, Control and Consultation Exchange Data Model (MIP JC3IEDM) 12.

The concept underlying the design of the JC3IEDM model is to present a common set of data for exchange in the command and management process. The data model describes all objects in the field of military operations - organizations, people, logistics infrastructure, equipment, facilities, geographic objects, meteorological phenomena, etc.

From the data model analysis of logistics infrastructure systems, it appears that only information on the type of equipment and consumables (ammunition, clothing, medical supplies, fuels, food and water) is maintained, which is not enough to manage the operation of the weapons and technology.

5. Classification of information systems of the arms exploitation management.

As a result of the analysis carried out, the main functions of an information system (information system module) for the management of the exploitation of armaments and equipment can be summarized as follows:

- Management of the organization of forces;
- Management of the operational material and technical situation;
 - Introduction of a material part – consumables (ammunition, clothing, construction materials, food, medical supplies, water, fuels, etc.) no cost materials (vehicles, combat machines, weapons, etc.);
- Report and description of the maintenance and repair facilities;
 - Creating and using a stockpile and materials guide;
 - Planning of periodic maintenance and repair work;
 - Reporting of stocks in inventories;
 - Forming of spare parts and materials needs;
 - Order of spare parts for repair and restoration work;
 - Shaping of revenue / expense of deliveries;
 - Keep a log of planned and executed maintenance work;
- Registration, classification and analysis of defects, keeping a diary of defects and refusals;
 - Reporting for the execution of the planned works and defect repair work;
 - Output of the spare parts used in the process of work;
 - Formation of inventory acts;
 - Reporting of the processing of equipment by counters;

- Registration of the current meanings of the technical parameters for the condition of the equipment;
- Performance report of the equipment;
- Define and analyze performance indicators for maintenance planning and repair;
- Analysis of failures, their types, causes, consequences and criticality;
- Keeping the technical documentation;
- Other.

The analysis of the available IT management and repair information systems allows them to be classified according to several criteria, namely - used software products (systems), Microsoft software products / Microsoft integration capabilities, basic functionality and capability for using advanced technologies such as remote monitoring, business analyzes, mobile solutions, and more, as well as and some additional signs (figure 1).

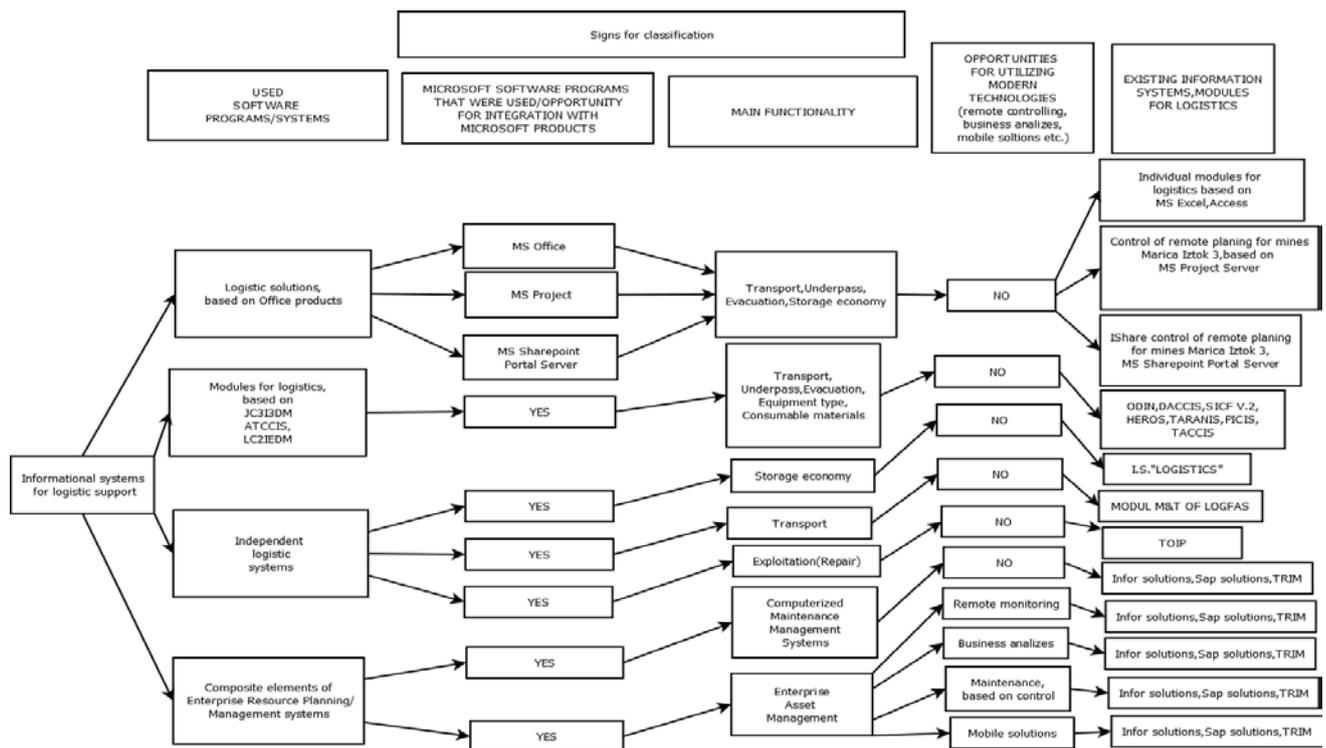


Fig. 1. Classification of information systems (information system modules)

Conclusion.

The effective Bulgarian Army governance in the context of collective security systems requires the acquisition of special capabilities, consisting of a streamlined system of tied, interdependent and growing responsibilities for managing the operation of armaments and armament techniques. The analysis carried out in the present work provides the basis for the following conclusions:

1. In the Bulgarian and most NATO armies there is no developed document management application in the arms exploitation process. No automated reporting of the technical condition of the armaments and the risks associated with the occurrence of possible malfunctions is conducted;

2. Not all field communication-information systems have capabilities to record and report on arms exploitation activities. The data models used, do not provide the ability to maintain the necessary management data used for maintenance and repair of armaments and equipment.

3. The contemporary-current practice makes successful attempts to master IT excellence, applied in the management of sophisticated organizations, including in the management of the operation of the technique. Specially developed exploitation reporting systems are costly, and the variety of databases, system and application software makes it difficult to select an information system for managing the operation of armaments and equipment as well as the training and preparation of the service staff.

4. For the automation of the arms exploitation process, there can be used: MS Office applications (Excell and Access), MS Project Server and / or collaboration tools such as MS Sharepoint Portal Server.

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