Firtst results of automatizing the unit management system in the US Army II.

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Abstract:

This article is the next partial result of a planned long-term research. The ultimate goal of the research is to present a history of the REVA service from the perspective of technical devices. Continuing the previous part, this article presents the artillery subsystem (TACFIRE), one of the three subsystems of the field army automated command and control systems in the US Army, and some other artillery systems and this article presents the Combat Service Support System (CS3), one of the three subsystems of the field army automated command and control systems in the US Army, and some other the military supply system to automate tasks.

Keywords: computers, information, management, history

The large scale scientific and technical improvement of the decades following World War II had a great impact on the weaponry and other technical tools of the army. This huge technical improvement resulted in such fast locomotion in military affairs too, that the registration and evaluation of the combat situation was only possible through the process of large amounts of data, however, that couldn't entirely be done manually. Most forces, but especially the ones of leading world powers made great efforts in researching the usage of electronic computers on the field to solve this problem. Automatizing the duties of the artillery received special attention, because these duties always included processing large amounts of data.

The aim of this article was to present the Tactical Fire Direction System of the artillery (TACFIRE), but primarily from the perspective of the IT devices facilitating automation. I was trying to present the duties of the artillery to an extent that helps the presentation of the technical background and provides a basis for future analysis. It was my sub-goal to introduce a new possibility for automatizing military activities which can be an example for the Hungarian military leadership.

In the second part of the article I present the third main system of the data processing system of the US ground forces, the Combat Service Support System (CS3), primarily from the perspective of the IT devices facilitating automation. In this part of the presentation too I was trying to introduce the duties of the military supply service to an extent that helps the presentation of the technical background and provides a basis for future analysis.

In addition to these the aim of the article was to also introduce and analyze the contemporary American and Hungarian principles which had an impact on the control of automatization and the vision.

The beginnings of automatization in performing the duties of the artillery

In ground units the automatized team management system of the field (all-arms) army had three subsystems: Tactical Operations System (TOS) and the aforementioned TACFIRE and CS3. From these the TACFIRE, despite its name containing the word 'tactical' based on further interpretation used in the US Army, was an operational-tactical automatized fire direction system.

The operational-tactical automatized fire direction system was an integrated electronic computer system working in on-line mode, which was made suitable for operation in field conditions from 1971 to 1974 and was adapted in the artillery units of the ground forces.

The development of the TACFIRE began in the beginning of 1960 within the framework of an artillery live firing codenamed “White Plan”. The drill sequence held in Fort Huachuca (USA, Arizona) was intending to examine the possibilities of the usage of electronic computers in firing tasks in the artillery.

Based on the experiences in the end of the drill sequence the composition of the TACFIRE system was defined, which was approved by officials in January 1966. They entered into contracts with the manufacturers of electronic computers selected according to the approval until December 1967. The contracts included development, production, the trial of the developed system in field conditions, the direct participation of the producers and the army in experiments, and they specified the service and technological requirements for the experiments. For one of the main goals of the program they specified the creation of a universal military electronic computer that could also be used in other data processing systems (mainly TOS-75) of the land forces.

Trough automatic data processing the system served as a great help for artillery commanders and their staff in carrying out their tasks. The authorized electronic computers were able to reduce the workload of the computing and information processing tasks of the artillery, which was mostly done manually until then. The goal of the system was to increase the efficiency of the artillery support while enhancing the accuracy, be able to process and use the information concerning the targets fast and well, reduce the reaction time, to assure bigger efficiency in determining the ability to fire and the distribution of the targets among the artillery sub-units.

Using the automatized data processing technology the automatized fire direction system could help completing the following tasks of the artillery:

- technical preparations
- artillery fire detection
- artillery inspection
- fire control
- fire planning
- processing meteorological data
- registering the status of the ammo
- registering the position of artillery units

The large scale scientific and technical improvement of the decades following World War II had a great impact on the weaponry and other technical tools of the army. The ever-growing amount of information required – taking advantage of the large technological improvement – the commencement of automatization of completing tasks in military affairs too. Great efforts were made to examine the usability of electronic computers on the field in favor of solving the problem. Automatizing the duties of the artillery received special attention, because these duties always included processing large amounts of data, one of its systems was the TACFIRE.

In conclusion we can say that this chapter only offers a general description which, however, shows that there is no change in the tasks of the artillery, so the amount of data to process will continue to constantly grow. It follows directly that the development of the technical tools of automatization will continue to be on the agenda.

Technical background of the TACFIRE-system

Let's take a look at what parts was the TACFIRE made of and what parameters did it have. The nerve center of the system was the third generation computer manufactured by the Control Data Corporation (CDC), which besides being designed for military use also made the further increase of the available capacity possible.

The question may arise that why did the CDC get this order from the military. The computer manufacturing company was one of the bigger American computer companies which were well known and honored in the USA in the 1960s. The others (IBM, Burroughs Corporation, NCR, General Electric, Honeywell, DEC, RCA and UNIVAC) could also boast significant results. The background of the decision if of course not known, but it is a fact that the CDC already made the Naval Tactical Data System (also known as NTS), which after its introduction in 1950 was successfully used as an information processing system by the US Navy until 1960. It is also a fact, that the CDC considered IBM to be their biggest rival, and it was one of their principles to produce 10% faster devices 10% cheaper. (Cheaper manufacture could be a determinant factor because after World War 2 the military had a smaller budget). It could also influence the decision that the TACFIRE was part of the Automated Data Systems within the Army in the Field (ADSAF) it adjusted to the other important part, the operational-tactical control's automatized data processor system (TOS), whose core was provided by a CDC 1700 type supercomputer.

Naturally this would be too much of an easy answer to the question, especially knowing that the third system belonging to ADSAF, the logistic supply's automatized data processing system, the CS3 used IBM computers. However, it can be safely stated that the CDC developed the computer on the picture below in 1964 under the name CDC 6600, which may not have been the cheapest, but it was surely the fastest computer of its time. The 6600 CP (Central Process) containing 10 parallel functional units was able to process multiple commands at a time. Today this is the superscalar design, which was unique in its time.

The acknowledgement of the CDC6600 type computers' achievements was indicated by the fact that the institution dealing with the analysis of the USA's defensive problems stated referring to their own research that by 1975 bodies of the Department of Defense will need 125 computers like this only for the elaboration of meteorological information.

After the analysis of the financial and economical background of the beginning of the automatization let's move on to the analysis of the technical background. To every computing center belonged an artillery control desk, which provided the program's supervision for the operating staff. This appliance was able to draw up messages during the input to the computer, the highlighting of the supplied data according to the messages, and it could also retrieve them, put messages and data in the computer and indicate mistakes. For filling the computer's internal memory and for the containment of large amounts of data they used external memory devices which were most likely drum or replaceable disk memories. In every computing center a line printer was placed. The line printer was directly attached to the output of the computer and provided necessary amounts of prints of the stored data. For the depiction of the current combat situation they used a digital map drawer attached to the computer, which had pages sized 122x122 centimeters. In higher level artillery centers they also installed a CRT indicator to the map drawing unit. This appliance was also operated by the computer and it was used for magnifying certain parts of the map.

Outsourced message input units belonged to the system, which could transmitted the data to the computing centre from great distances. Two types of these were developed. The standard shaped message input unit was a small sized, portable appliance, which were installed at forward observers. The messages were forwarded as a digital sign via the ground radio or telephone news system to the computer. The variable shaped message input unit provided transmission without the use of the standardized form trough radio or telephone. To the artillery batteries they provided the needed

information visually represented. The connection of the news system with the computer, the input units, the electronic plan boards, and coder tools was possible trough the data input terminal.

The system's software consisted of such computer programs that provided the possibility of completing artillery tasks. In line with the tasks the application of the software happened in different areas:

- utilities (translation programs);
- controller programs operating peripheral units;
- programs completing TACFIRE's tasks, which made the constant supervision of the program possible, and also the indication and elimination of malfunctions and their causes.

First the camp artillery units, then the division artillery strains were equipped with the TACFIRE system. The other elements belonging to the artillery units and division artillery strains (forward observers, exploratory groups, meteorological departments, etc.) were connected to the computing centers with input/output tools. The system was connected in the camp artillery's news system. The transmission of the digital and analog signals was provided based on time-sharing.

The time-sharing allows the sharing of the computer's sources between multiple users and/or processes trough a possible method of multitasking. During the time-sharing a central server distributes its sources between the users/processes by assigning "time slots" to every user/process. If the time slot is chosen, the machine runs the program of the user assigned to it, but only if it's not currently carrying out input/output activities.

The pace-setter module of the operation system controls the distribution of the time slots between the users. If the control picks a certain user, then the pace-setter sets the new or saved program parameters and starts running the certain program. When the assigned time slot expires it stores the metadata, then it could retrieve the program with it.

The length of the time slot depends on the number of users and the other parameters of the system; usually it varies between a few milliseconds and a few hundred milliseconds. The implementing of the time-sharing was made possible by increased speed and the realization that while the currently running program is waiting for the user, the machine in fact is not doing anything, so these times are unproductive, and could be used for other purposes. The possibility of reaching the mainframe (computer networks) from a great distance also had to be provided.

The TACFIRE system was installed to S-280 type cross-country vehicles with a container-like solution, which provided running order, deployment, fast reaching of viability and also transportation on land, water and air.

The TACFIRE appliances of the artillery unit were installed to one, and the appliances of the divisionary staff were installed to two S-280 vehicles. According to the plans the system also provided help for the tactical-operational center's fire support element in the preliminary aim analysis and in the prediction of the nuclear waste's fall-out.

The operation of the system is not complicated. The forward observer, with the help of a message input unit trough the connection of the camp radio or telephone, transmitted the request related to induction of fire to the computer in the fire control central of the artillery unit. The computer analyzed the aim, calculated the ballistic data and compiled the advised fire order or fire orders. After this the computer marked the location of the aim on the digital map drawer, and gave the fire order on the control panel. The report of the forward observer reached the control desk in the duration of 6,3 seconds. If the fire controlling officer decided to ignite fire, the computer forwarded the fire order in the form of a digital signal to the battery which's cannons had to fire.

The fire control officer was of course able to change the input data anytime, however, this meant that the computer had to work out new commands and instructions. The computer automatically transmitted the commands to the computer placed in the division's fire control center, where they were registered for fire planning and aim registration purposes.

The problems and possibilities of the automatization of logistic supply tasks in the 1950s and 1960s

The principles

The third main system of the US land forces' data processing systems was the CS3. The system was created with the intention to satisfy the needs related to the automatization of basic data processing systems in both war and peace. In the 1950s it was already stated that the possibility of fixing logistic supply operations can be provided by the usage of automatic data processing systems in personal, administrative, accounting and supply areas. The CS3 was based on the principles and methods already in force. They offered a completely new perception in the area of logistic supply data processing rather than support methods. The aim of the system was:

- to increase the influence of the all-arms commanders by decreasing the amount of administrational work in supply, personal, and administrative issues;
- to offer an opportunity for the maximal usability of the tools at hand by decreasing the demand for human resources (conditions);
- the appliance to be able to respond to the informational demand of superiors in high-speed.

The system's creation made the automatization of the following areas possible:

- financial and technical preparedness of the troops
- making systematic and special reports
- financial management
- military salaries
- military police service
- reporting losses of manpower
- medical service
- any material supply
- financial preparedness, being stocked up, and maintenance service
- technical constructions
- army-scale transportation

The Hungarian political and military leadership also recognized that for waging modern wars the usage of great amounts of military technology is necessary, which is only possible trough the automatization of the management. The problem of management mechanization was of particular importance for the logistics supply, because the data communication tasks occurred in great numbers. The increased requirements for the logistics supply management were unanimously concerning every process of the management, which were summarized in the following:

- clarification of the task, collecting data related to logistics supply;
- fast and punctual processing of the data at hand;
- decision making for the logistics supply;
- operations related to the logistics supply, fast transmission of commands to the ancillary;
- registering of tasks, supervision of completed tasks;
- analyzes, drawing conclusions based on the completed tasks.

All these tasks were such a major burden for the management that modern mechanical and automatic management systems became essential. The good example was before the eyes of the Hungarian management of logistics supply, because the automatization of the fire control and the mechanization of the movement of troops were relatively advanced. Naturally the improvement of leadership tools was not able to provide the fast fulfillment of logistics supply tasks by itself.

Step by step, in parallel with the modernization of management tools the forms of the logistics supply management corps had to be improved, and changes also had to be made in the staff of the logistics supply troops and the organization of work (the two latter were not part of this article).

The tools

Functioning as a part of the automatic camp data process system of the USA ground forces the base of the logistics supply's automatized data processing system was a camp edition IBM 360/40 computer, which was built in to a trailer just like they did with the TOS. The following units belonged to the IBM 360/40 computer's system in the US ground forces:

- IBM 2040 central data processing system.
- IBM 2540/1 punch-card reader/puncher unit.
- IBM 1403-N1 line printer unit.
- IBM 2821 control unit for controlling the line printer.
- IBM 1443-N1 line printer unit (printing 600 lines or 10 pages in a minute).
- IBM 2520 punch-card reader/puncher unit.
- IBM 2314 changeable disc storage unit.
- IBM 2401 magnetic tape storage unit.
- IBM 2702 data transmission supervisor unit (the 2702 could accept up to 31 communicational lines, but slower than the 2701).
- IBM 1012 perforated tape punching unit.
- IBM modulator-demodulator unit.
- IBM 557 punch-card puncher unit.
- IBM 029 punch-card puncher unit.
- IBM 059 punch-card supervisor unit.
- IBM 1056-1 card reader unit.
- IBM 1013 punch-card transmission terminal.

- IBM 1051 supervisor unit.
- IBM 2740 informant terminal.

The computer centrals and various data transmission stations were compiled from these units and appliances depending on the application (army, corps, and divisions). The building of the system made land, air and water transportation possible.

The testing of the system took place at the 3rd army corps stationing in Fort Hood. The 1st and 2nd armored corps were each given a computer to try. The employees of the IBM corporation took part in the experiments as the hardware's transporters and the employees of the URS corporation who tested the transported softwares.

In Hungarian relations in the beginning of the 1960s significant arrear could be experienced in the areas of automatization. In means of the automatizaton of logistics supply two basic functions were involved: management and data communication. In the areas of simplification of management, the recording and storage of data certain accomplishments were already made. Such as:

- formation of operative registers;
- unification of mobilization plans;
- formation of the content and form of reports and commands;
- preparation of coded data transmission.

The used technical tools were tabulated according to the following considering the tasks to be carried out:

- Sound recording (magnetophones, Dictaphones). Aim: reporting and reconstructing measures and reports with portable appliances made for military use.
- Transmitting graphic data (picture telegraphs). Aim: speeding up the data transmission from the command post to the logistics supply point. Encryption was not possible.
- Sound-based data transmission (wired dispatcher and radio dispatcher). The wired dispatcher system could not be used on the move. The radio dispatcher was restricted by the danger of wire-tapping.
- Automatic encryption technology (perforated tape appliances) (hectographs and document photo applications). Colored copies of a graphic document could be made in the duration of

2-3 minutes with a colored duplicator. Tempocop copy machines were used to make black and white copies in 1,5-2 minutes.

- Registry appliances (edge punch-card registry pages). On the edge of the paper classification, manipulation openings were placed, so they could be summarized fast after settlement. It was first used by the transportation service.
- Tabletop mechanic, electromechanic calculators. They were able to carry out four basic operations in operational conditions. The results were recorded on a punch tape and forwarded to a data processing center. The next step were accounting automats which could also carry out more complicated accounting tasks.
- Tabletop electronic computers (IME-84, HUNOR-131 and their descendants).

Conclusions

The main aim of this article was to introduce the TACFIRE system, but mainly from the viewpoint of IT appliances' automatization. The tasks of the artillery were introduced in a level that helped to present the technical background and served as a base for the following events.

My aim was to demonstrate the technical environment trough the presentation of automatization endeavors in which later the REVA service was born. The process of the improvement can be easily followed up in those times and today too, so I'm planning to write additional articles in the topic of automatization of the artillery.

The second main aim of the article was to introduce the USA land forces' camp data processing system's third main system, the CS3 system, but mainly from the viewpoint of IT appliances' automatization. All this was limited to a certain part of the technical background, which was used to introduce and analyze the American and Hungarian principles and methods influencing the directions and future of automatization. Besides these I made a short outlook on the calculator (computer) market of the 1960s, and I introduced the beginnings of the Hungarian development trough the short presentation of the HUNOR machine-family.

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