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THE C2 ARCHITECTURE AND INFORMATION SUPPORT OF THE CZECH ARMED FORCES

Topics: C2 Architecture, Coalition Interoperability, Human Factors Engineering

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Abstract

The professional Czech Armed Forces (CAF) needs the complex information support. The key moment is a right C4 (Command, Control, Communication, Computer) architecture. The current state is characterized as set of autonomous information systems (IS). The future is in Cross-Sectional (C-S) IS that should integrate all IS and should include the missing functionality.

The basic concept of the C-S IS is the AIS NATO Bi-SC architecture. The WEB portal is a useful technology for unified information access. The data model consists of databases and data warehouse. Data modeling is supported by Data Warehouse (DW) prototyping in Human Factors Engineering research. The development of C-S IS will be realized in incremental matter.

There is the main goal in CAF C2IS to achieve the Coalition Interoperability. There is only one way to insure for national C2IS the international interoperability: Multilateral Interoperability Programmed (MIP).

1. Preface

The Czech Republic has since January 1, 2005 fully professional armed forces. CAF needs the complex information support of all activities in Command and Control (C2), in logistics and administration area. The key moment is process management and right architecture.

2. The Current State and the Future of the C2IS

The current state of the communication and information infrastructure is characterized as set autonomous ISs, not fully satisfied communications infrastructure and two C2IS (for ground and air forces). More that 10 administration ISs (financial, logistic, personnel, stuff, medical, military police etc.) have their own technology basis, application SW, security policy and data sources. There is partly integration at the E-mail system connection. The common IS is still missing for Command and Control (C2) functions.

All ISs include not only specific business process functions, but the common services as office automation, intranet, E-mail etc. The services are realized thru multiplatform solution, so that user of more IS must be connected to every IS with extra PC.

This situation is for small CAF very complicated and uneconomical. The future is in C-S IS that should integrate all IS and include the missing functionality.

C-S IS will be solved as a secure communication and information system (CIS) supported of this operational capabilities:

- C2 at the strategic, operational and tactical level.
- Control and administration shape for force goals, planning, military activities, NATO cooperation, effective military education and training.

3. Modernization Projects of CIS and Cross-Sectional IS

Modernization Projects include 3 directions of development:

- Cross-Sectional (C-S) IS,
- Communication infrastructure,
- C2 systems for tactical level.

The first project started by Feasibility Study (FS) in that made analysis of ISs and suggested the integration possibilities. The next task of FS was to specify main goals of C-S IS and directions to its realization.

The second project should prepare a modern, robust, secure communication infrastructure for data, voice, image and movies transport.

The last project is oriented to the fully functional and interoperable C2Iss, one for ground and other for air forces that should been integrated with C-S IS.

3.1 The Basic Concept of C-S IS

The basic concept of C-S IS involve process orientation, integration of existing IS, development of missing functions in information support of MoD and CAF. The military professionals need an integrated environment to access information and to help business processes.

The principle idea is the NATO Bi-SC AIS and architecture approach with operational, technical and system view. This architecture should be an open architecture useful for any enlargement, for IS integration and business processes support.

C-S IS should prepare an integrated environment to the Functional Application Services (FAS) for command, control, administration area, and crisis solution.

The IS integration is based on unify user interface (Portal) to various kind of Infrastructure Services, Common Services, and Functional Area Services. The WEB portal is a useful technology for unified information access.

Business processes than will be by C-S IS supported:

1. The main processes:
    - CAF construction and military training.
    - CAF deployment.
2. Control processes:
    - Strategic, doctrinal and conceptual documents preparing.
    - Defense planning and provision.
    - Supervision of processes.
3. Assistance processes:
    - Personnel and financial resources.
    - Logistic and CIS support.
    - Security and intelligent activity.
    - Medical service.
    - Legal service.
    - Public relation.

The development of C-S IS will be realized in incremental matter. There are defined 13 individual projects. C-S IS position in IS environment is shown at Figure 1.

3.2 C-S IS Infrastructure Services

Infrastructure services should support the data flow and are used by applications.

The Directory Services guarantee a unify identity in CAF and NATO, too. Concept is shown in Figure 2. Directory services will be one directional distributed thru the C-S IS, from the lower security domain to the higher security domain. The same concept will be of course implemented by data transport.

The Private Key Infrastructure (PKI) guarantee unambiguous user identification, data authenticity, non-deny service, necessary cryptography. The common part of PKI will be a part of the directory services and the private part of PKI will be placed at the special personal identification device (Smart Card).

There is necessary for the certificate approval to realize the CAF cross certification of hub certification authority to NATO certification authority and the connection of border DSA with NATO Directory Hub must be provided.

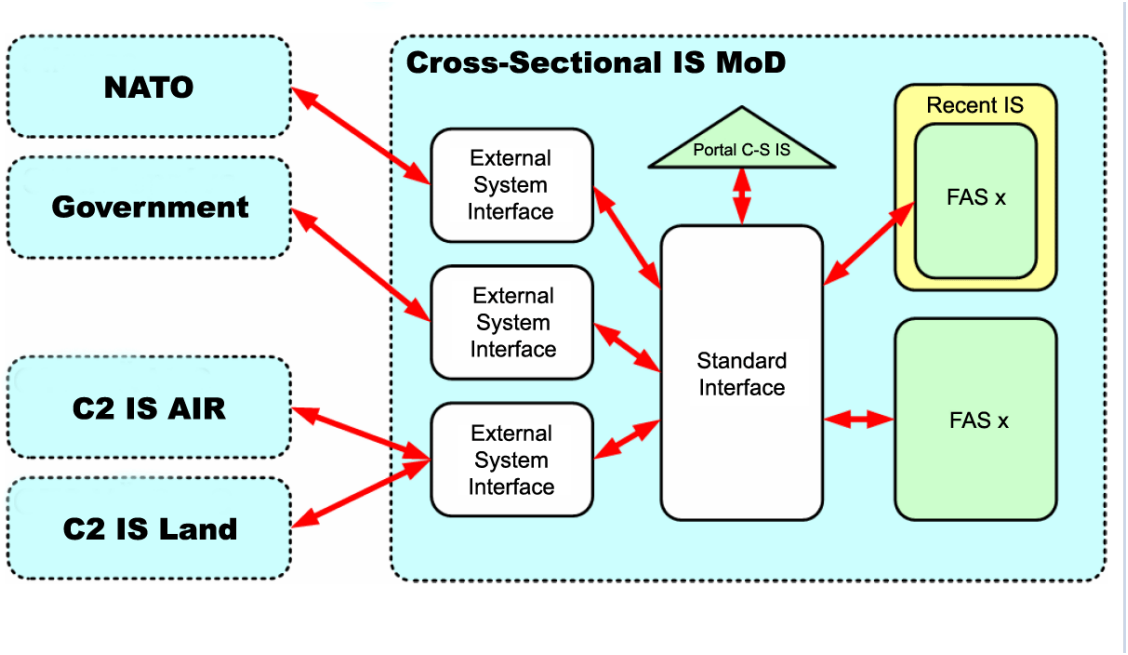

Fig. 1 C-2 IS architecture in IS environment

Security Audit Services execute collection loggable data that are continuous evaluated and set the necessary precaution. These services must be in relation to MoD Computer Incidents Response Capability (CIRC).

Database Services deal with data (store, process, pass) that are used by FASes. There is necessary to keep minimum of database platforms and to centralize all data processing functions.

Management Domains supervise performance any of subsystems (domains) of C-S IS.

Antivirus Arrangement tests data, detects viruses and cleans them. Antivirus services must be in permanent actualization of available antivirus tools.

3.3 C-S IS Common Services

The common services are defined for the support of the data performance and standard operation in the network environment. These services include messaging, office automation, exchange gateway, systems administration, document management and archive, security management, portal.

Common services are in current state implemented in any IS its own matter and are not standardized. The suitable way is to separate and exclude them from IS and operate them unify in C-S IS environment.

Services migration will be accomplish in the three stages:

1. The pilot implementation and testing.
2. Step by step implementation by existing ISs.
3. Full service of common services in C-S IS.

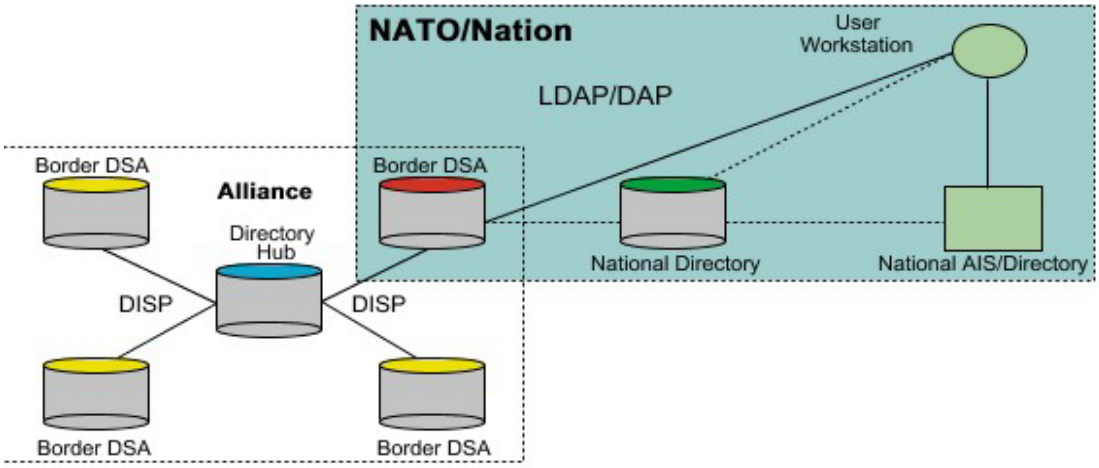

Fig. 2 Concept of Directory Services

Messaging is based on E-mail and system services for message exchange. This service is one of mode for connection among strategic, operational and tactical command level. The next function in this group of services should be enlarged by groupware (time and resource planning, task management, contact list etc.). There is using directory services and PKI in the messaging.

Office Automation is a set of functions that are designed for supporting various kinds of users needs by documents preparing and processing them. The service is provided thru commercial office automation package and its application superstructure. There should be a group of templates for editing frequent artifacts.

Exchange Gateway for information exchange with other external IS (Government, NATO) will be prepared for the data, identity and mail transfer.

Systems Administration should be realized by tools for remote access (remote installation and administration, installation package preparing, supervising other services).

Document Management (DM) is oriented to document (paper, image, voice, multimedia, movie) registration, dissemination, administration, archive. The document registry is a law principle and organization requirement. The best DM combination is with workflow. Both services must be integrated.

Security Management should implement and maintain set of security policies.

C-S IS Portal realizes user's identity services and integrates all information sources.

3.4 C-S IS Functional Area Services

Functional Area Services (FAS) are a set of integrated applications, databases and associated tools for decision support. They are designed according to operational requirements appropriate MoD Departments. The IS integration into FAS is an unify user identity thru the whole systems. Access will be available thru the standard interface or thru the terminal services.

There is a list of FASes integration:

- The Standard C/S IS Interface implementation on basis of http/XML services direct into environment existing IS.
- The proprietary interface implementation between standard interface and existing IS. There is the case that existing ISs are not fit to Bi-SC AIS model requirements.
- Connection to C-S IS using the terminal services. This is the case that is not useful for both above mentioned variant.

The last two mentioned versions are only a temporary solution that should be changed into the standard interface (see Figure 3), but this genesis will be long term solution.

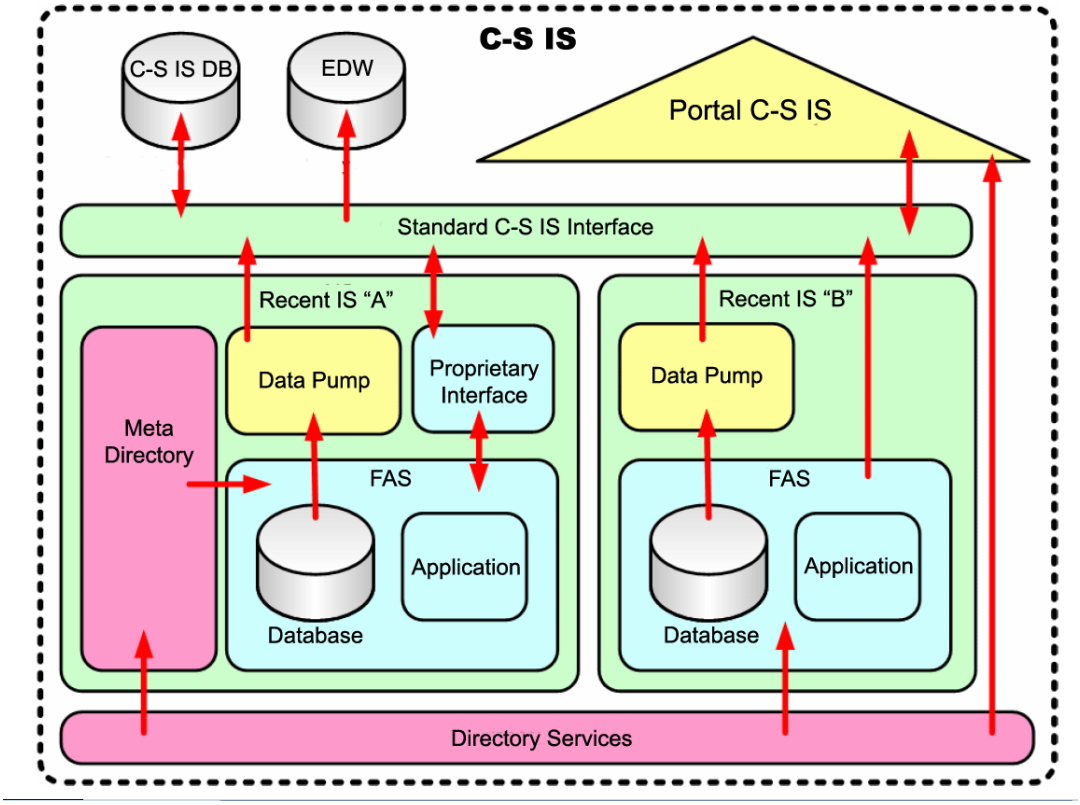

Fig. 3 The relations FAS in C-S IS environment

There is a list of individual FASes:

- Common Operational Picture.
- Common military operations.
- Air military operations.
- Land military operations.
- Intelligent and reconnaissance.
- Operational planning and analysis.
- Personnel.
- Logistics.
- System of electronic marketing.
- Communication and information systems.
- Geographic and hydrometeorology information.
- Military police.
- Public relation.

3.5 One Access Point

The WEB portal is ***one access point*** to information in C-S IS. Portal includes some services that are necessary for cooperation of common services and FASes.

List of one access point parts:

- ***Single Sign On –*** user identifies using its own certificate, corresponding to security domain. This identification is hold by portal and is passed to other services.
- ***Unify user's interface –*** user have thru portal an unify form of information access that can by personalized by user or by administrator.
- ***Dividing services into subsystems (domains) –*** there must be secure separation of all domains (CAF Internet, Restricted, and Secure).
- ***Unify application's interface (Standard C-S IS Interface) –*** preparation of the unify connection between user and service, among services and connection to external IS.
- ***Data exchange –*** data transport across standard interface between data source and service.
- ***System auditing –*** all action in C-S IS will be as loggable entity saved and analyzed. In case of problems will be prepared powerful measures.
- ***System accessibility –*** C-S IS will be designed as a redundant system to suffer high availability of all services.

There is the concept services architecture in the Figure 4.

3.6 The Architecture Approach

The C-S IS architecture approach is solved by NATO documents [7, 8, and 9]. Any architecture is designed in three views: operational, system and technical, see Figure 5.

Parts and means of operational view:

- System C3 elements and their relations (users, configuration, nodes).
- Configuration of C-S IS.
- Information flows and requirements for information exchange.
- Processes that are supported by information flows.

C-S IS is designed for all CAF personnel (professional soldiers and civilian employees). User has assigned a right role that correspondent to its CAF position (access right to system resources, data and services).

Configuration of C-S IS is a set of HW and SW components that provides user's information support at any of installation place. There are in case effective management, administration and operation of working stations, command posts, IS integration centrums, networks with more security modes and configuration C-S IS to external systems. Nodes are the access points into the system.

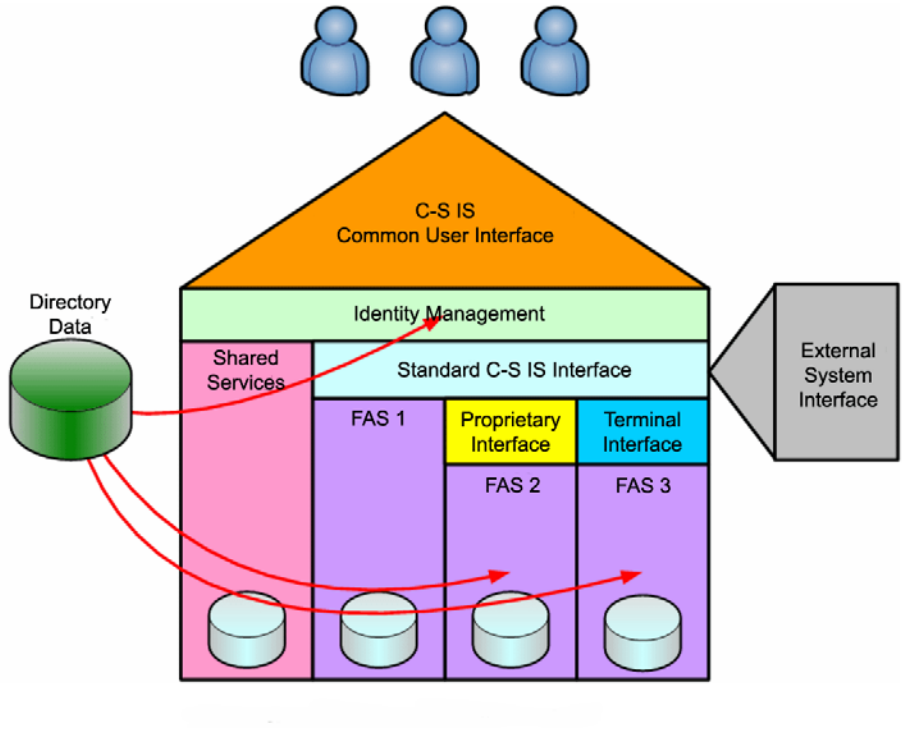

Fig. 4 The concept services architecture

Parts and means of technical view:

- Definition set of standards, tools and rules.
- NATO Common Operating Environment (NCOE) and Common Standard Profile.
- Structure and element relations.

NCOE model consists of following layers:

- Core services.
- Infrastructure services.
- Common services.
- Specific services.
- Applications interfaces.
- Data.

Parts and means of system view:

- Systems structure with platforms, functions and characteristics.
- System interface and interconnectivity.
- Application and physical sources for operational requirements realization.

The system view consists of interrelations into C-S IS functional blocks.

There are following blocks (layers):

- Users with PCs and terminal devices.
- Devices transporting information between users and system.
- Applications with servers performing data.
- Data with data sources.
- Security with security interfaces.

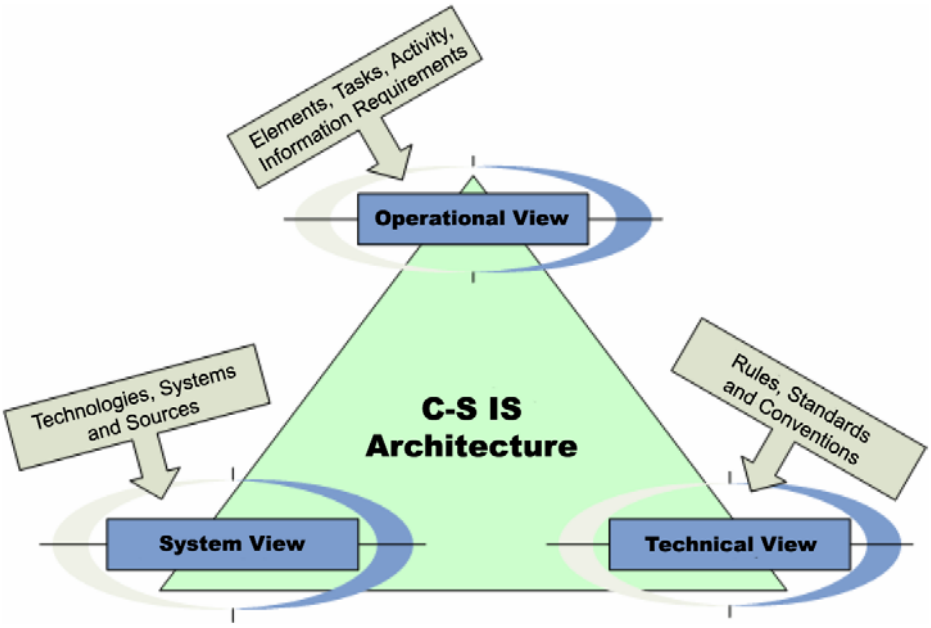

Fig. 5 The operational, system and technical view of architecture C-S IS

3.6.1 NATO Architecture Framework document critique

There was mentioned above that C-S IS was designed according to NATO Architecture Framework (NAF) document [7]. This document is not mature enough by our experiences. The main problem is with templates that have sometimes mistakes according theoretic models (by compare to original methodologies) and templates are very simple unrealistic to IS praxis. There was probably missing a testing phase of NAF at real systems.

3.7 Data Model

Data model includes databases and data warehouse.

Databases are organized according to FASes that support every day activities of military and administration officers by command, control, consultation, economic, financial, personnel, and logistics operations. Data in databases will be prepared, stored and manipulate by every day operations of users.

Data warehouse (DW) is organized for support of decision makers in complex problems of CAF mission, force goals, effective economy and optimal personnel resources. Data into DW

are prepared (ETL-extract, transform and load processes) from databases thru data pumps in regularly time period.

There is mentioned an idea in [4] of preparing one complex enterprise data warehouse (EDW). This idea does not correspondent with author's experiences in preparing of DW prototypes. The most complicated problem is cooperation with decision makers. They mostly have no interest about technical decision support. The next cardinal question is low quality of data. These problems make impossible to construct the complex DW and thus the right way will be to build data marts (DM) for prepared managers that are sure with profit of DM solution and have clear idea about DM using.

3.7.1 Human Factors Engineering

The DW prototyping is a scientific experiment of the decision support in the personal resources solution. The main goals of the experiment are: Specification of the user's analysis needs in information technology personnel in CAF area; Data sources definition, data selection; DW data structure design; ETL processes realization and DW prototype development.

After prototype development execute experimentations, data mining technique and technology application at the DW. Finally find a common solution for the all kind of personnel in CAF. All steps of the prototype experiment should confirm of the useful EDW methodology. The result is to bring knowledge by C-S IS development.

4. C-S IS realization

The above mentioned information about C-S IS was ideas from the feasibility study [4] and our research activity [2, 3]. The current state is an awaiting phase for the acquisition process. It can take one or two years. There is fortunately a lower quality in a project bringing in realization phase.

The main strategy in this situation is preparing the "integration isles" that will correspond with C-S IS vision and future development.

One of those isles is metainformation system (MTIS) of MoD that was started two year ago. This system should collect all MoD data structures and domain values. There is a large task, because it includes some hundredths elements from the various IS.

The MTIS [10] was analyzed, designed and developed according to the latest IS methodology. There was started with process analysis and process design. Process management was followed by object design using UML. The next stage was Java programming. The MTIS is a dynamic WEB application with Oracle database.

Other activities are oriented to project documentation that should be prepared before the system integrator of C-S IS will be selected. The latest of that document is the "CAF Architecture Approach" that corresponds to NATO Architecture Framework (NAF). The principal goal is the right modification of NAF to the CAF conditions and far more to validate this document at the real project. We could bring benefit to NAF that was criticized in the part 2.6.1.

5. The C2 System for Tactical Level and Coalition Interoperability

The CAF C2 system for ground forces was published in conference *CCRT-2004* last year [1]. Main problem of CAF C2IS is to achieve an international interoperability.

There is nowadays only one way for national C2IS to insure international interoperability: Multilateral Interoperability Programme (MIP). MIP goals are to achieve the C2IS interoperability, defined in NATO documents [5, 6]. The basic Principe is a common data model (for current activity block C2IEDM – Command and Control Information Exchange Data Model).

The most important task is to test national C2IS in five level tests stages:

1. Implementation test – check of the national preparation.
2. Technical test –internet connection and communication compatibility test.
3. Data and procedure test – data filling and exchange in C2IEDM, power control.
4. C2IS test – all steps of data exchange.
5. Operational test – real data exchange in operational environment.

The Czech Armed Forces plan of testing C2IS in MIP but in the next block and it is unfortunately late.

5. Conclusion

The primary theme of the paper is C-S IS that is the basic stone of the CAF information support. There was mentioned in the paper the main approaches to construction, problems by its realization and some interrelation ideas.

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