INFORMATION FLOW MANAGEMENT REGARDING THE FUNCTIONING OF PUBLIC AUTHORITIES IN CRISIS SITUATIONS

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For the management of information flow, the use of the functional modelling methodology is proposed, as part of the graph theory for describing the functioning of systems, such as public authorities as organizational-management structures. The methodology is based on concepts such as functional block and interface arc (flow). In organizational-management structures, one of the functional blocks is the manager, and the others are managed. Each of the blocks is a source of information and generates information flows, transferring information to a managed functional block or several ones. For the implementation and management of information exchange by the public authorities in crisis management, processing and protection of data flow, when working in a group environment, it is proposed to build an adequate communication and information system using the methodology of functional modelling.

Keywords: functional modelling; information flow; crisis management; public authorities;

INTRODUCTION

In order to describe information flows, the methodology of functional modelling is used, as part of the graph theory for describing the functioning of systems, such as administrative structures. As a standard, it was developed in 1981 and offered to the United States Air Force. The methodology is based on concepts such as functional block and interface arc (flow).

The functional block is expressed as a rectangle with an input, an output, a controlling effect and a mechanism.

Between two blocks flows are created, called interface arcs and expressed by arrows. Flows could be as follow:

- Material (materials, details, goods);
- Financial (money, investments);
- Resources (employees, machines, equipment);
- Informational (information, data, documents, oral orders etc.).

In organizational-management structures, one of the functional blocks is the manager, and the others are managed. Each of the blocks is a source of information and generates information flows, transferring information to a controlled functional block or several such blocks. They, in turn, transform the information and create new flows that carry information to other subsystems, data stores or external entities.

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DATA FLOW, INFORMATION ENVIRONMENT AND GROUPWARE

Data flow defines the information transmitted by a given transport (communication) medium from a data source to a data receiver. Information can be transferred between:

- Two devices, such as service control signals circulating between modems or more modern data transmission equipment – hub, switch and others;
- By non-electric means, such as military postal and signal;

- Through an electrical medium, such as wired or wireless means and networks – radio, radio relay, tropospheric, satellite, optical and others.

The flow of data can go through or bypass the routes created by the communication environment built, through different communication means and networks.

Each data stream has a name that defines its intended use structure. For example, leadership, management, interaction, coordination or cooperation etc. Such flows circulate, both horizontally and vertically, between officials from the various organizational units of the organizational structure.

Information flows represent the sequential movement of information, data and documents from the moment of their creation or receipt, through processing and use, to the moment of their transmission for storage in or outside a given functional (organizational) unit.

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Streams have the following characteristics:

- Every object has flows – incoming and outgoing;
- Control flows are only information flows and document flows. For document flows, the following is important:
  - The mutual relationship between the documents;
  - Timeliness of their preparation;
  - The rationality of processing;
  - The route taken by each document and the operations performed on it sequentially by the different organizational units.

Functional modelling methodology is also associated with the theory of Data Flow Diagrams (DFD).

For the implementation of information flows in the organization, the information environment is built. It is part of the functional (working) environment of the command-and-control authorities and consists of **information resources** and an **organization created for their use.** The goal is to optimize the processes of perception and processing of information flows, by meeting the quality requirements, presenting data and information in the appropriate type, form and manner (method), in order to maintain general situational awareness (Demirov, 2019).

Thus defined, the information environment is both a subsystem of the Communication and Information System (CIS) and an important component of the process that supports decision-making in a crisis situation. Thanks to the performed functions, conditions are created and monitoring is carried out on the optimal perception of the generally connected operational picture, as well as proposals for corrective actions in case of their violation.

Information resources cover:

- the individual means of exchange, display and primary processing of data and information (directly or indirectly);
- End terminal devices, for the relevant type of data and/or information;
- Local networks, distinguished by the type of exchanged data (information);
- Systems for storing information arrays and data arrays, on a local scale;
- Systems for secondary processing of data and/or information forming the set of information services provided to a specific authority for command and/or control and its infrastructures;
- Software applications for monitoring the processes of perception of the provided data and information, as well as for developing proposals for their correction;
- Software applications for the management of the information environment.

The information environment is both a subsystem of the Communication and Information System (CIS) and an important component of the process that supports decision-making in a crisis situation. Thanks to the performed functions, conditions are created and monitoring is carried out on the optimal perception of the generally connected operational picture, as well as proposals for corrective actions in case of their violation.

The organization for the use of information resources is a system of rules, procedures, activities, protocols, standards, which describes the specifics of working with the provided information resources and is based on the requirements arising from the accumulated knowledge. It should be taken into account that the basis for the creation of such an organization is represented, first of all, by the accepted concepts about the use of forces and means, supplemented by regulatory documents related to the use of a given information technology.

As it is known, the most popular model for making a management decision is described by the conditional division of the activities of the command-and-control system into four processes – **observation, orientation, decision** and **action**. The effective and efficient running of these processes and their results, as well as the characteristics

of the management system depend significantly on the availability of data and information, on their quality indicators and on the processes and speed of perception and processing by the subjective factor. At the same time, the optimal information environment provides not only the appropriate conditions for it to take place, but also allows:

- Additional redirection of data and information flows to those elements of management bodies (departments/teams of experts) that have defined needs and are authorized users, in accordance with their duties and area of current tasks;
- Prioritization if necessary;
- Monitoring and evaluation of the relevance of the developed general operational picture to the real operational situation.

For the achievement of information flows in a group environment, the created information environment for groupware is based on the classical approach of the methodological sequence of describing the structure of the environment, by using three types of architectures: functional, system, and technical.

In the day-to-day management activity, things depend on the repeated implementation of events related to the change of the operational environment in the functioning of the organization. For its continuous and reliable existence, the main activities of the management cycle are carried out, and these are the collection and processing of data about the situation, decision-making and the setting of tasks for implementation. Since these activities are repeated and labour-intensive, they are automated by creating an information environment for group work (Groupware). Thus, the accepted understandings of daily operational work are the main factor determining the content of the information environment. Working in a group environment (Groupware) can be defined as an activity carried out by employees to perform tasks in real time (on-line) using a set of information and communication services based on modern technical and software solutions.

In an informational aspect, working in a group environment (Groupware) is seen as the integration of applied software products to support employees in their daily activities.

For the achievement of information flows in a group environment, the created information environment for groupware is based on the classical approach of the methodological sequence of describing the structure of the environment, by using three types of architectures: functional, system, and technical (NATO Open Systems Working Group).

The **functional architecture** describes the functions that the created information environment must provide. The **system**

architecture is a description of the integration between the individual systems, subsystems and modules providing information services. The **technical architecture** covers the implementation of these services, through appropriate technical and software tools and their standards.

Functionality is related to the description of the purpose, services, processes, flows and tasks that are for a particular operation. The services and information flows depend on the assignment of the specific command and control system, the mutual relations and dependencies between the officials in the collective body (headquarters) and what part of them is subject to automation.

Flows in groupware are physical and virtual sequences of activities – actions, connections, dependencies and others, which result in a certain completion (achievement of a certain result), for example, organizing a document flow.

The flows are related to the tasks and processes performed by the officials in the course of the execution of certain collective activities, for which the implementation of certain information services is necessary.

Information services are developed based on the use of the methodology for the architectural configuration of the information environment (NATO Open Systems Working Group). It passes successively through three levels – functional, technical and software. Each of these levels consists of three groups of physically distinct objects or interfaces and delegated subordination (or coordination) relationships to them. The latter represent the directions for integration of the respective objects according to the one-to-many, one-to-one or many-to-many rules.

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The definition of information services is the starting point for meeting the information needs of the management bodies at a given

level. In this regard, user services are defined and individualized, and adequate work or information processes are organized.

Workflows for collaboration include:

- Defining a work process and determining a process schedule;
- Definition of sub-processes and assignment of tasks between officials;
- Publication of process execution results;
- Starting a stopped process and operational jump;
- Managing and administering processes.

The management process includes the definition of a process related to the management of various objects and entities, for example, material, technical and informational resources, personnel, transactions etc.

Tasks are elements of the workflow, which is accompanied by a certain information flow, for which an information environment and information networks are created, for which software and technical means are needed. These are, for example, MS Office and a suitable computer and computer network.

A process can consist of one or more streams and in general can be considered as a graph. The flow is actually a one-dimensional process, i.e. a chain sequence of activities, such as:

Document flow – organizing a flow for working with a document (Workflow) in the Web – the environment between users who have different roles: creator of a document, approver, readers of documents, filing the document with a registration number, printing the document and others;

Work flow – organizing a flow related to the execution of a sequence of activities between different users or groups during data processing (collection, processing with relevant mathematical means, publication);

Information flow – organizing a flow related to receiving, processing, summarizing, analysing and providing information to the relevant head of the organization.

Tasks are elements of the workflow, which is accompanied by a certain information flow, for which an information environment and information networks are created, for which software and technical means are needed. These are, for example, MS Office and a suitable computer and computer network.

Operations are components of tasks (subtasks) and describe specific actions that can be automated through the capabilities of the collaborative environment. For example, preparing a table or graph in a given document.

Summarizing, it can be concluded that in group work, activities such as *information processing, joint discussion, document handling, workflow management* are performed (Vasileva, 2020). Some examples and characteristics are briefly presented as follows:

❖ *Information processing*

- E-mail: preparation of messages; send/receive messages; file sharing;
- Geographic information system (GIS): use of map information – 2D and 3D images; use of geographic database and analysis of information; means of depicting situations etc.

❖ *Joint discussion (briefing)*

- Information exchange of the *"black (white) board"* type: exchange of graphic information – maps, schemes, diagrams etc.; exchange of text information – sending messages – between two and more users.
- File transfer: file sharing (text, graphics, audio, video etc.) between two or more users.
- Video and audio conferencing: video and audio connection between users; videoconferencing mode.
- Web-portal: publishing documents and information; this also applies to the use and exchange of information from a website.

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❖ *Document handling:*

- Office services: document preparation; use of spreadsheets; preparation and presentation of reports; preparation of event schedules; file management and more.
- Compilation of tabular and text documents: entering information; summarizing information from different users; collaborative work on documents; integration with automated information systems and GIS; publishing and electronic signing.

❖ *Task setting.*

- Sending/receiving commands and alerts.
- Workflow Management
- Creation and transfer of mobile user profiles: user authorization; loading the user profile from a given workplace.
- Use of common network resources: printers, faxes, scanners; projection device with a screen for presenting information.

- Connection between two separate points: data exchange; video and audio connection.
- Connection with automated and field security information systems.
- Internet connection (on a separate network).
- Integration of the systems from the individual points: organizing a distributed database; creating a virtual user environment for accessing information; use of shared information resources.

The next step of the approach is to define the system characteristics, i.e. how the described functionality is provided at the system level. An important element in the system design is to have a clear vision of the collaborative environment that will be built. For example, it should correspond to the actual state of affairs, be based on the corresponding information and communication platforms that will be used, analyse the existing experience in this field etc. Before defining, in detail, the individual subsystems, it is necessary to clarify the system integration between them, i.e. the degree of dependency, compatibility, and interface connections that will be built.

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The **functionality** set above, based on the relevant **services**, **processes**, **flows**, **tasks** and **operations**, is achieved through the design of appropriate **functional subsystems**, **operational subsystems** and **software-technological subsystems**.

The **functional subsystems** are mainly information and communication subsystems, through which the necessary spectrum of services is provided. Examples of such systems providing the above services are the following: groupware system, geographic information system, modelling and simulation system, decision support system; messaging system; video conferencing system and communication system.

Operational subsystems are various information-accounting, planning and other subsystems, which serve mainly for data processing, calculations, performing various operational actions etc.

The software-technological subsystems ensure the functioning of the remaining subsystems – operational and functional, being the basis that the latter use. The most important systems (subsystems)

from this group for building the information and communication work environment are as follows:

- Operating systems –MS Windows server, Linux server, MS Windows, Linux, Ubuntu, Mac OS, Android OS etc.;
- Database management systems – MS SQL, Oracle, IBM Db2 DBMS, Amazon RDS, Postgres SQL etc.;
- Technological systems – MS Share Point Portal server, MS Office Communicator, GIS-server, Web-server, Cisco Call Manager (IP-telephone exchange) and others.

The final step of the approach to building an information system for collaborative work is defining the technical characteristics, i.e. the technical means employed to achieve this environment (at the physical level). Initially, an overview is given of the **overall technical implementation** of the collaboration environment, paying attention to all the more essential components. This is followed by a **check of the technical compatibility** of the various software and technical tools that make up the information and communication work environment, a check of the standardization of the interfaces etc.

The final step of the approach to building an information system for collaborative work is defining the technical characteristics, i.e. the technical means employed to achieve this environment (at the physical level).

The information and technical means serve to provide information to the systems. As such, the following can be mentioned:

- Information servers – physical computer machines with specified parameters for providing general (mainly information) services;
- Personal computers or other user devices (BYOD – Bring Your Own Device) – physical machines for individual work and for obtaining information services;
- Peripheral and auxiliary devices – printers, scanners, plotters, web cameras etc.

The communication-technical means serve to ensure communication of the systems. As such, the following can be mentioned**:**

- Communication servers – physical computer machines with specified parameters for providing general communication services;
- IP-phones – physical machines for individual work and for receiving communication services;

- Network devices – switches, routers and other intermediate devices, structured cabling system, communication cabinets and more.

The general technical means serve to provide the information and communication environment for reliable work. As such, the following can be specified: guaranteed power supplies, air conditioning installations, electric cable network etc.

Based on the characteristics specified in this way, by using the proposed approach, an architecture of the information environment is defined to support both the daily activities of the administrative employees of public authorities and the activities in crisis situations.

The proposed communication and information infrastructure for ensuring the information flows of the management system in organizations has the possibility of achieving reliable functioning in daily activities, as well as in crisis situations management.

CONCLUSIONS

In conclusion, it can be summarized that the information environment is built for each specific organizational unit, therefore it has a distributed nature and fully follows the structure of the management system of the organization. It can also be pointed out that the proposed communication and information infrastructure for ensuring the information flows of the management system in organizations has the possibility of achieving reliable functioning in daily activities, as well as in crisis situations management. The created information environment and information services provide an opportunity to work in a group environment and secure the subordinate structures, both at the local level and when performing daily tasks in the most remote (geographically isolated) areas of the organization. In addition, the information needs and the building of adequate information environment impose important requirements on the quality of the communication and information systems. That is why it is necessary to plan the information environment to precede the planning of the communication and information systems.

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