Information support for decision making on dispatching control of water distribution in irrigation

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Abstract. The research has been carried out on developing the technique of supporting decision making for on-line control, operational management of water allocation for the inter-farm irrigation projects basing on the analytical patterns of dispatcher control. This technique provides an increase of labour productivity as well as higher management quality due to the improved level of automation, as well as decision making optimization taking into account diagnostics of the issues, solutions classification, information being required to the decision makers.

1. Introduction

Development of information - analytical systems providing support of decision making in transportation, power engineering, natural gas allocation, water supply - is of great importance both in Russia and abroad. Integrated automated management systems (IAMS) are being developed in the above branches of industry and cover all services there, but there is another situation in the land reclamation [1-4]. The most important part of IAMS is analytical calculating software for the dispatcher control, software SCADA (Supervisory Control and Data Acquisition) having been used for information selection, processing as well as its visualization and archiving. SCADA-systems are an essential (although they are not always obligatory) part of the automated management systems using the operating procedure control [1, 5].

Development and commercialization of the calculating software packages (CSP) on supporting decision making, as well as their integration into informative automated dispatcher control systems (IADCS), have fallen behind now. Under present-day conditions, the functional approach is more often substituted with or replaced by a decision making procedure which is considered with the management theory as an integrated organizing process that goes beyond the frames of some control functions such as “planning” and/or “organization”. The most actual issues on the decision making automation of the dispatcher control systems on water distribution for the inter-farm irrigation systems are the following [6-8]:

1. The lack of calculating computer programs describing a multilevel distributing system of dispatcher control of water distribution for the inter-farm irrigation systems.

2. Maladaptation of DCS to the use of the modern information resources, particularly the techniques, provides necessary information preparation to formalize subjective requirements of the experts, as well as step-by-step aggregation of information under control of the analyst.

3. Mismatching of the CSP pattern and the multilevel distributing pattern of the collective process of the dispatcher control, which hinders training skills of the cooperative activity of the dispatcher staff.
Theoretical solution of the above-mentioned issues and its practical application will allow transferring the decision-making of the dispatcher control of water distribution for the inter-farm irrigation systems to the new qualitative automated level.

2. Methods and Materials
Strategy development on information technology of the operational management of water distribution for the inter-farm irrigation systems was based on the information-analytical research including: strategies of management decisions’ simulation and calculating-analytical software development of the dispatcher control of water distribution for the inter-farm irrigation systems. A structural-functional decision plan as a logical basis of the decision support system on operational management of the water allocation was developed in the network of computer simulation methodology. It gives opportunity to apply system analysis during solution of semi-structured tasks providing a flexible approach for issues classification according to the structure, as well as decision-making optimization. Management data ware, as well as a cybernetic approach on decision making in the terms of information processing, was considered.

![Diagram of Dispatcher control system of water distribution](image)

**Figure 1.** Functions of decision making and realization of water allocation within information-cybernetic management technique

The following research was carried:

1. Foundations on management process improvement of inter-farm irrigation water allocation with the help of control structures providing high efficiency of water use (social, economic and environmental) were defined.
2. Evaluating selection of simulators of the rational process flow sheet on the water allocation management has been chosen.
3. Algorithms of the control actions as a part of the technique of the automated management to provide more efficient distribution of water have been developed.
4. Evaluative dimensions, simulators, as well as algorithms on management activity rating, have been determined for the inter-farm irrigation projects management taking into account economic, social and environment aspects, which cannot be estimated in terms of money.

3. Results & Discussion
The developed requirements concerning the issues of the prospective analytical calculating software for the dispatcher control were taken into account in the object-oriented and service structure of the information system on creating the water distribution (Figure 1).

The general form of the information technology of water consumption planning as well as an example of the ready table of canals are shown in Figure 2.

Figure 2. The general form of the information technology on water consumption planning

Water consumers’ requests are stored in the special file having been formed in the software DBCS ACCESS. Unified forms are used for data input being provided by the DBCS ACCESS.

The database of the planning water intake and water distribution are automatically created on the base of water consumers requests for the inter-farm water-engineering systems.

Software provides:
1. Storage-and-retrieval, as well as information browsing in the familiar and easy form.
2. Data processing, making up a balance of water supply and water distribution for the every water delivery point, as well as for every water consumer for the concerned interval of the vegetation period.
3. Water use analysis for the every water delivery point, canal and water-engineering system as a whole.
4. Using Data archiving, data storing for timing analysis.

The report on the planning water distribution within the irrigation project being drawn up on the base of the developed requests includes:
1. Information on the water demand of single farms for the every water delivery point, as well as of the system as a whole.
2. Head water flow discharge of the main canal and inter-farm canal, as well as water supply patterns of the farms, being adjusted to the water body pattern.
The developed technique of planning of inter-farm irrigation water intake and distribution was applied on the base of data of the Federal State Board “Board of the Tersko-Kumskii Canal” in the Northen Ossetiya. Techno-economic parameters of the Tersko-Kumskii irrigation canal are shown in the table.

Functioning of the ISAC "Water use" requires the following technical equipment: a personal computer; Pentium microprocessor; operative memory not less than 32 MB; a printer. Specialized software program uses the tools included into the Microsoft Office Windows environment. The semantic database is built on the basis of the ACCESS database. The ACCESS database is used to prepare the required reports; the presentations of output documents, including a set of maps and legends to them as well as tables and other information.

| Indicators                                | Dimension | Amount |
|-------------------------------------------|-----------|--------|
| Irrigated lands                           | th. hectare | 80,5   |
| Including arable lands                    | th. hectare | 65,7   |
| Failure of irrigated lands                | th. hectare | 14,8   |
| Water intake from river Trek              | mln m³/year | 993,1  |
| Water supply to consumers                 | mln m³/year | 887,6  |
| Including: Northen Ossetiya-Alaniya       | mln m³/year | 28,0   |
| Chechenskaya Republic                     | mln m³/year | 154,0  |
| Stavropolskii Region                      | mln m³/year | 382,9  |
| Dagestan Republic                         | mln m³/year | 72,6   |
| FSB "KWES and CW"                         | mln m³/year | 250,0  |
| Water saving                              |            |        |
| in physical units                         | mln m³/year | 10,3   |
| in monetary terms                         | mln rub./year | 3,9    |

4. Conclusion
Thus, information technologies are becoming the perfect tools to solve the task on the designing of the computer systems, Supervisory control of water distribution, regarding the socio-economic needs of the society today. The implementation of such computer systems will require rather high investments, but they will be certainly paid off as one who owns the information, owns the situation, and who knows the situation, owns everything [9-12].

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