ATLANTIS PRESS
Advances in Economics, Business and Management Research, volume 156
2nd International Scientific and Practical Conference on Digital Economy (ISCDE 2020)

Application of Digital Technologies for Solving Optimization Tasks

Eleusov A.A.[1], Saparbayev, A.D.[1,*] Makulova A.T.[2]

[1] *International Academy of Innovative Technologies, Almaty 050059, Republic of Kazakhstan*
[2] *University Narxoz, Almaty 050035, Republic of Kazakhstan*
[*] *Corresponding author. Email: sad171@mail.ru*

ABSTRACT
The article discusses the issues of digital technology of optimization calculations in real time. Working on a real-time scale allows the user to start calculations at any point in time convenient for him, to continue their required amount of time until they get a completely satisfactory result or to interrupt them at any time at their discretion. A simple dialogue language with computer technology allows you to perform calculations directly from the specialist's workplace in the area under consideration. The value of the work is to develop an economic-mathematical model of the optimization problem under consideration and a specialized dialogue complex for solving various optimization calculations. Digital (interactive) technology of optimization calculations, implemented on the basis of standard software tools, can be applied to a wide class of tasks of optimizing the transport and logistics systems of grain processing enterprises in real time during the planning process. Thus, in order for the solution of the optimization problem to become a management tool based on computer technology with the crowding out of existing manual calculations, it is also necessary that it be used in real time in combination with dialogue support tools.
Keywords: *digital technology, system, information, planning, management, technology, programming, optimization, transport, logistics*

1. INTRODUCTION

In modern conditions, information technology and digital transformation are the main factor in technological change and a condition for ensuring competitiveness both at the level of individual enterprises and at the level of countries and national associations, leading to the restructuring of all economic and production processes, a radical increase in productivity, improving quality and reducing costs goods and services.

Information and communication technologies have launched a new branch of economic development. After all, technological discoveries are fundamentally changing the structure and needs of world markets.

Most world studies show that there are a number of extremely positive influences that affect the development of countries and the economy, and this: a significant increase in labor productivity; increased demand for goods and services; lower production costs [1-3].

The reorientation of planning bodies to solving strategic problems of economic development, increasing the share of long-term tasks involves updating the management methodology and technology, and opens up new possibilities for using an arsenal of economic and mathematical methods and models. In the medium term until 2025, the task is to create a unified automated control technology based on the latest achievements of innovative technologies. At the same time, it is supposed to widely use the network of workstations of managers and specialists of planning bodies.

The approach of computer equipment directly to workplaces became possible at a certain stage with the advent of supercomputers, the proliferation of multi-display systems and teleprocessing facilities, and the creation of information and computer networks. A new form of using computer technology, which is an automated workstation, creates a favorable condition for improving the technology for developing and verifying the fulfillment of plans, and makes significant adjustments to the strategy for organizing the management process.

Economic and mathematical modeling as a direction of improving the methodology and practice of management is now undergoing a period of technological development, which is characterized by a transition from the active development of mathematical methods and models of optimal control to the equally active construction of tools on their basis that ensure the practical implementation of planned calculations.

2. MAIN PART OF RESEARCH

We have developed economic and mathematical models for calculating the plan for the optimal use of transport and logistics systems (TLS) when transporting grain and grain products (GGP) in a complex system of grain processing «field – harvesting – processing – market» in various settings [2, 3].

Let us consider the solution to the problem of transporting grain and grain products in the production complex "field – harvesting – processing – market".

The development and placement of grain farms, procurement, processing and trading industries, subject to the laws of the market, are not focused on the final national economic results. The existing territorial disunity of technologically interconnected industries, the lack of close information interconnection between subsystems according to transportation plans at various stages of management does not make it possible to effectively realize the enormous potential of the raw material base of the republic.

Therefore, the most important feature is the systematic approach, complexity, linking, combining the efforts of both the grain farm and the industries serving it, transport, trade, subordinating all their activities to a common ultimate goal - the production of high-quality food products and bringing them to the consumer.

To solve this problem, one of the most important is the task of optimizing the system for transporting grain and grain products in the «field - harvesting - processing – market» complex.

Transportation of grain and grain products in the field-harvesting-processing-market complex is carried out between interrelated subsystems, which are illustrated in figure 1.

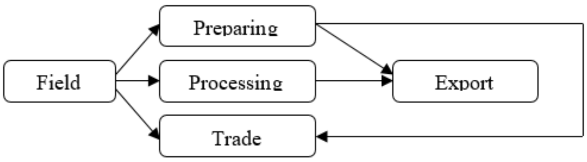

Figure 1 General functional interrelation between subsystems of an industrial complex

The solution to the problem of transporting grain and grain products in the field-procurement-processing-market complex can be viewed as subtasks, taken in stages between subsystems (figure 2).

The mathematical model of the problem of transporting grain and grain products in the field-procurement-processing-market complex is formulated as a multi-index production-transport problem of linear programming of high dimensionality.

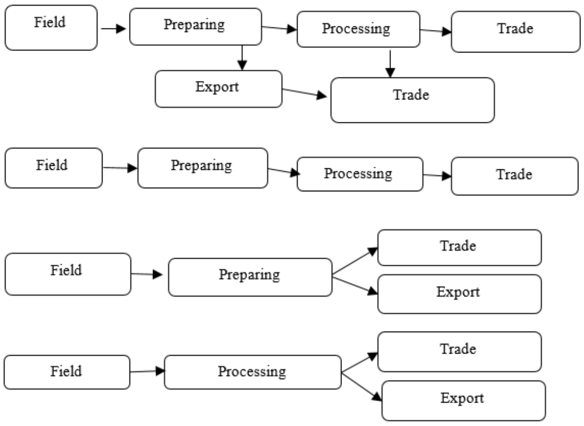

Figure 2 Stages of solving the problem of transporting grain and grain products in the production complex

Let us proceed to the consideration of the general mathematical model of the problem (figure 2, a).

required to minimize

$$\min W = \sum_{i=1}^{m} \sum_{k=1}^{k} \sum_{t=1}^{T} C_{ikt} X_{ikt} + \sum_{k=1}^{K} \sum_{b=1}^{B} \sum_{t=1}^{T} C_{kbt} U_{kbt} + \sum_{k=1}^{K} \sum_{j=1}^{n} \sum_{t=1}^{T} C_{kjt} Y_{kjt} + \sum_{j=1}^{n} \sum_{p=1}^{P} \sum_{t=1}^{T} C_{jpt} Z_{jpt} + \sum_{j=1}^{n} \sum_{l=1}^{L} \sum_{t=1}^{T} C_{jlt} W_{jlt} \quad (1)$$

under restrictions

on the volume of grain produced

$$\sum_{k=1}^{K} X_{ikt} \le A_{it} \cdot V_{it}, \quad i = \overline{1,m}; \quad t = \overline{1,T}, \quad (2)$$

on GRE power

$$\sum_{i=1}^{m} X_{ikt} \le D_{kt}, \quad k = \overline{1,K}, \quad t = \overline{1,T} \quad (3)$$

for the supply of cereals from GRE to processing plants and for export

$$O \le \sum_{i=1}^{m} X_{ikt} - \sum_{j=1}^{n} Y_{kjt} - \sum_{b=1}^{B} U_{kbt}, \quad k = \overline{1,K}, \quad t = \overline{1,T}, \quad (4)$$

on the capacity of processing enterprises

$$\sum_{k=1}^{K} Y_{kjt} \le F_{jt}, \quad J = \overline{1,n}; \quad t = \overline{1,T}, \quad (5)$$

on the volume of exported grain crops

$$\sum_{k=1}^{K} U_{kbt} \le E_{bt}, \quad b = \overline{1,B}; \quad t = \overline{1,T}, \quad (6)$$

for deliveries of grain products from processing plants to trading enterprises and for export

$$\sum_{k=1}^{K} Y_{kjt} - \sum_{p=1}^{P} Z_{jpt} - \sum_{l=1}^{L} W_{jet} \geq O \quad J = \overline{1,n}; \quad t = \overline{1,T}, \quad (7)$$

on the need of trading enterprises

$$\sum_{j=1}^{n} Z_{jpt} \geq R_{pt}, \quad p = \overline{1,P}; \quad t = \overline{1,T}, \quad (8)$$

on the volume of exported grain products

$$\sum_{j=1}^{n} w_{jlt} \leq E_{et,} \quad l = \overline{1,L} \qquad t = \overline{1,T} \quad (9)$$

non-negative variables

$$X_{ikt} \geq 0, y_{kjt} \geq 0, u_{kbt} \geq 0$$
$$Z_{jpt} \geq 0, W_{jlt} \geq 0, i = \overline{1,m}; k = \overline{1,K} \quad (10)$$
$$J = \overline{1,n}; p = \overline{1,P}, b = \overline{1,B}, l = \overline{1,L}$$

where:

i is the region index of the produced crops, $i = \overline{1,m}$;

k – region index of available GRE $k = \overline{1,K}$;

j is the region index of the existing processing enterprises $j = \overline{1,n}$;

b – index of the region exporting grain crops, $b = \overline{1,B}$;

p – the index of the region engaged in the sale of processed products, $p = \overline{1,P}$;

l – index of the region exporting processed products, $l = \overline{1,L}$;

t is the index of the time sub-period, $t = \overline{1,T}$;

A_{it} – the sown area of the *i*-st region of produced crops in the subperiod *t*;

V_{it} is the yield of grain crops of the *i*-st region in the subperiod *t*;

D_{kt} is the GRE power of the *k*-th region in the subperiod *t*;

F_{jt} is the capacity of processing enterprises of the *j*-go region in the subperiod *t*;

E_{bt} is the volume of exported grain crops in the *b*-th region in the subperiod *t*;

R_{pt} is the power of the trading enterprises of the region *p* in the subperiod *t*;

E_{lt} – the volume of exported processed products of the *l*-st region in the subperiod *t*;

C_{ikt} – the cost of transportation of grain crops from the produced *i*-th region to the CCP region *k* in the sub-period *t*;

C_{kjt} – the cost of transportation of grain crops from the KPI region *k* to the processing enterprises of the region *j* in the sub period *t*;

C_{kbt} – transportation cost of cereals GRE *k*-go region exported to *b*-th region in the sub-period *t*;

C_{jpt} – the cost of transportation of processed products from the *j*-th region to the trading enterprises of the region *p* in sub-period *t*;

C_{jlt} – the cost of transportation of processed products from region *j* to region *l* for their export in sub period *t*;

X_{ikt} – the volume of supplied grain crops from the produced *i*-th region to the CCP of the *k*-th region in the subperiod *t*;

Y_{kjt} – volume supplied by crops from GRE *k*-th region to refineries in the region *j* in sub-period *t*;

U_{kbt} – volume supplied by crops from GRE *k*-th region to region *b* for their exports to the sub-period *t*;

W_{jlt} – is the volume of the delivered processed products from the region *j* to the region *l* for their export in the sub period *t*;

Z_{jpt} – the volume of the delivered processed products from the *j*-th region to the trading enterprises of the region *p* in the sub-period *t*.

The task of transporting grain and grain products in the field-harvesting-processing-market complex set (1) – (10) belongs to the class of large-scale linear programming problems, which is the most developed section of mathematical programming [3].

The specificity of the constraint system (1) – (10) allows the use of the aggregation method: the process of solving the original problem is replaced by solving a number of problems of a much smaller dimension with the corresponding linking of the solutions obtained.

The task is implemented on computer technology using the QSB application software package, designed for solving problems of mathematical programming.

Experimental calculations of problem (1) – (10) were carried out on the basis of factual information from the regional departments of agriculture of the republic and the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan for the latter, which we prepared at the stage of the pre-design survey of the current planning plan for transporting grain and grain products in production complex "field – procurement – processing – market" at the republican level.

The features of the economic content of the task of calculating the plan for the optimal use of transport and logistics systems (TLS) when carrying out the transportation of grain and grain products (GGP) in the complex system of grain processing enterprises «field-harvesting-processing-market» are described in previous chapters. Here we dwell on the features of the existing technology for its solution in practice.

In practical calculations of the optimal plan for using TLS when transporting GGP in grain processing enterprises and linking grain producers with consumers, a large number of different factors and parameters are taken into account. The large range of types of GGP, grain farms, grain receiving, processing and trading enterprises, as well as the need to take into account the seasonality of GGP and varieties of crops make it difficult to choose the best plan for using TLS and linking suppliers with consumers using traditional settlement methods (using manual technology). Quickly balance resources, while taking into account all significant technological limitations and choosing the best plan for the optimal use of TLS and linking allows an optimized economic and mathematical model implemented on computer technology.

3. SOLUTION

With the construction of an economic-mathematical model, the most complex work of this stage begins - the sequential adjustment of the model in accordance with the requirements and comments of the planned workers obtained in the process of analyzing the results. A prerequisite for the successful implementation of this work is an ongoing dialogue between developers and the end user.

Using models (1) – (10), you can calculate the optimal transportation plan and linkages. However, the constraints and relationships taken into account in it are not enough to develop a fully justified and practical solution. Experimental calculations have shown the need to take into account a whole series of conditions and limitations, moreover, those that, as a rule, can only be updated by a planning specialist directly in the process of creating a plan. Basically, it reflects the specifics of individual TLS for the served areas, grain producers or grain storage enterprises and often are temporary (situational) in nature. In the process of managing the planner, new versions of the plan and restrictions are developed that reflect the newly emerging (current) situation, of course, are not known in advance. It is this information that mainly requires real-time recalculation of the plan of the planned work, and also leads to the need to make repeated changes of both numerical and structural nature to the model during the development of an acceptable version of the plan. In this regard, an essential feature of the process of solving the problem (1) – (10) is the need to identify and formalize the system of preferences established by the decision maker, who acts as the end user who forms the task, which plays a decisive role in choosing the solution and responsible for this decision. Therefore, this is one of the actors in the process of solving the problem, which plays a role in the end of this process (in assessing the quality of calculation results) and which needs a special support system for decision-making (instrumental, methodological and organizational) [3].

Thus, the success of solving the TLS problem during the transportation of GGP and linking suppliers with consumers largely depends on the relationship between the model developers and the decision maker. They should be based on a clear identification of the main functions performed by developers and decision makers. The following should be included in the circle of the main functions of the developers: analysis of the planning and working documentation related to the simulated problem; preparation of the initial version of the model, initial versions, their tabular presentation; establishing the degree of validity of the requirements put forward by planners in the process of analyzing options for the optimal plan, the significance of their impact on the calculations, the duration and priority of taking them into account in the model; processing of methods, techniques and procedures for the operational and effective model adjustment, and at the initial stage of development, the direct implementation of model adjustment in accordance with the requirements of practice; software and technical bordering of the model with elements that make it possible to integrate it into the existing technology of planned calculations.

The decision-makers are mainly assigned the functions of experts. This determines their range of action: analysis of options for optimal plans, assessment of their practicality; establishment and justification of additional requirements for the optimal plan (model); presentation of the sources of information necessary to account for requirements in the model or its expert formation; transfer of complete information about the main elements of the established technology of planned calculations and demonstration of these elements by developers in the process of real planned calculations; the formation of practical requirements for the elements of software and technical bordering of the model; direct participation in experimental calculations, controlling their progress and evaluating their results. In other words, the role of the developer is to develop and organize procedures; models and methods by which the decision maker will be able to solve the problem.

Due to the variability of the planned situation and the lack of all the information necessary for calculating the plan before the start of management, as already noted, a necessary condition for embedding the models of planned calculations is to carry out calculations according to the model in real time. This is due to the fact that it is practically impossible to take into account in the model all the experience accumulated by the planner. This implies the need for multiple recalculation of the options for using the TLS and linking grain farms with grain receiving and trading enterprises in real time. Otherwise, calculations on computer equipment will not be suitable for practical use. Here, undoubtedly, the role of dialogue (human-machine) control technology is growing with the use of dialogue tools that make it possible to search for a solution to a problem even in the case when the decision-making system of preferences cannot be generally well formalized before starting to solve the problem and is determined only jointly with the study of her (or effective) plans.

Using the developed optimization models, we can calculate the optimal plan for various tasks. However, the constraints and relationships taken into account in it are not enough to develop a fully justified and practical solution. Experimental calculations showed the need to take into account a whole series of conditions and limitations, moreover, those that, as a rule, can only be updated by a planning specialist directly in the process of creating a plan. In the process of managing the planner, new versions of the plan and restrictions are developed that reflect the newly emerging (current) situation, naturally, are not known in advance. It is this information, mainly, that requires the recalculation of the plan in real time of the planned work, and also leads to the necessity of introducing into the model in the process of developing an acceptable version of the plan multiple changes of both numerical and structural nature. In this regard, an essential feature of the process of solving the optimization problem is the need to identify and formalize the preference system established by the decision maker, which acts as the end user who forms the problem, which plays a decisive role in the choice of the decision and responsible for this decision.

Therefore, this is one of the actors in the process of solving the problem, which plays a role in the end of this process (in assessing the quality of the results of calculations) and which needs a special support system for making decisions (instrumental, methodological and organizational).
Thus, the success of solving any optimization problem largely depends on the relationship between the model developers and the decision maker. They should be based on a clear identification of the basic functions performed by developers and decision makers.
At present, economic and mathematical modeling as a scientific direction is experiencing a shortage of methodological and methodological developments in terms of compiling and solving optimization problems in a dialogue mode that would allow for the systematic use of the results of optimization calculations in management practice. Creating a dialogue system puts forward new requirements for models, given that they should become a working tool for the planner. This is, first of all, taking into account in solving problems additional requirements that are not formalized in the model; exclusion (through appropriate adjustments to the model and its information content) of obviously unrealistic initial data - for example, clearly overstated needs - to ensure the reality of the plan and the possibility of carrying out calculations according to the model in real time. Work in real time allows the user to start calculations at any time convenient for him, to continue their necessary amount of time until a completely satisfactory result is obtained, or to interrupt them at any time at his discretion.
The dialogue serves as a method for solving problems, where the “initiator” of the dialogue (user) knows the task, and the “interlocutor” in the “dialogue” (system) is used to solve the subtask [4]. Thus, the dialogue system imitates the activities of the user in clarifying and agreeing on the values of indicators during the formation of options for the plan and their justification.
The interactive component is a superstructure over a specific optimization task and helps the user to clarify the statement of the corresponding problem, providing for this the appropriate linguistic forms and a set of service functions. The dialogue in this case is carried out in terms of the dialogue system and enables the user with special knowledge in his field to obtain the desired results without first studying the dialogue system. Therefore, the availability and prevalence of the use of the system largely depends on the quality of construction of the dialog add-on and on how it implements the following dialogue features [4-6]:
the ability to directly and quickly exchange a user with a message system of information and control nature;
convenience for the user during the exchange of messages (descriptiveness and visibility of descriptions, proximity of the dialogue language to the natural language of the end user, the availability of advanced display tools, etc.);
high level of partner interaction (two-way management in the dialogue, the use of various text analysis procedures and "technology" of problem solving, etc.).
The specifics of the requirements and implementations of the interactive mode in optimization problems is determined by the need to ensure high performance when working with the system [7].
The interactive mode for calculating optimization tasks should provide users with the ability to manage the calculation processes and perform the following functions: adjustments to the autonomous database (AD); viewing, editing input data and task calculation results; management of phased problem solving. All these functions can be involved in solving each specific optimization problem, including the tasks of using TLS when transporting GGP and linking grain farms with grain receiving and trading enterprises.
The effectiveness of determining the optimal plan for using TLS and linking grain farms with grain receiving and trading enterprises can be increased by creating interactive management systems, where the source data and the results of solving the problem are presented in a user-friendly form. At the same time, without complicating the initial model, it is possible to adjust the condition matrix in the dialog mode, introduce the necessary restrictions and, as a result, obtain the model with a satisfactory degree of adequacy.
Thus, in order to solve the problem of using TLS and linking suppliers with consumers in the future, it becomes a control tool on computer technology with the crowding out of existing manual calculations, it is also necessary that it be used in real time in combination with dialogue support tools.
Thus, in order for the solution of the optimization problem to become a management tool based on computer technology with the crowding out of existing manual calculations, it is also necessary that it be used in real time in combination with dialogue support tools.

4. RESULTS AND DISCUSSION

Consider some of the software features of the dialogue technology of optimization calculations (DTOC). There are various approaches to the implementation in software of a digital (dialogue) method for solving optimization problems. Digital procedures that ensure active access of decision makers in the process of calculations using computer technology should help bring the developed optimization models closer to the practice of planned calculations, which will make them a real tool for planners. The essential elements of such a dialogue should include the following features: generation and filling of the AD; viewing, control and analysis of source information; the formation of the initial version of the model and the initial solution; system optimization; data adjustments; the formation of tables of planning documents [3].
The meaning and significance of the DTOC is described as follows: "The ability to conduct a dialogue with computer technology in real time directly from your workplace, to request a language accessible to a non-programmer and to quickly receive information about the object on the screen or in the form of solid media, to formulate it at a meaningful level for solving computer and analytical tasks of an analytical and analytical nature, in an

acceptable time to get results - this is a qualitatively new level of operational management and control technology using computer technology and economic and mathematical methods.

The methodological foundations of building a mathematical support system designed to solve optimization problems in a dialogue mode are developed in the works of academician V.M. Glushkov, and the general issues of organizing and constructing a human-computer dialogue, as well as issues related to the construction of specific dialog systems, including systems for solving various classes of problems, are considered in the works of Yu.S. Arkhangelsky, A.M. Dovgyallo, A.N. Timchenko et al [5-8].

The DTOC is provided by the development and implementation of special software tools. The basic elements of the software necessary for the development of the DTOC are:

– software tools that support the interactive mode of calculations;
– software tools for the computing process.
– When creating special DTOC software, automation of the following functions is provided:
– ensuring control of the correctness and structure of the model;
– pre-calculation preparation and data conversion;
– actually optimization calculations;
– providing an analysis of the decision and choosing the option of targeted adjustment of the model;
– transforming the optimal solution into the structure of the plan indicators and the formation of planning documents;
– ensuring the necessary speed, reliability and accuracy of calculations, the visibility of their current state, the safety of the source data and intermediate results;
– operational control of the sequence and mode of performing calculations in an interactive mode.
– As software for implementing DTOC, to the maximum extent and with high efficiency, publicly available (standard) software tools for various purposes can be used:
– mathematical programming packages (PMP) designed to solve optimization problems;
– programs and packages providing task generation in the input PMP - format;
– programs and systems providing an interactive environment for performing calculations;
– programs and packages providing generation of reports on their solution in tabular form.
– In order for digital (interactive) technology to be successful, when solving various classes of optimization problems, the following technological stages of its construction must be provided;
– input and control of source data;
– model generation (in PMP - format);
– optimization itself;
– post-optimization analysis of the solution (analytical tables of the results of various contents);
– sampling model procedure (may be based on dual estimates);
– correction input procedure (in PMP format);
– generation of final documents based on calculation results.

In applied economic and mathematical modeling for solving various kinds of optimization problems on computer technology, application software packages (PSP), commonly referred to as PMP. The most common among them: PMP-2, OMEGA, SQG-PC, LINDO, QSB, which are analogues of foreign commercial systems MPSX/360 and MPSX/370 [9. 10]. Practically each of these packages is suitable for solving the widest range of linear optimization problems: arbitrary structure, small, medium, and even large dimensions. And using high-performance computer technologies, a quite acceptable speed of performing optimization calculations is achieved even for large-dimensional tasks.

At the Institute of Cybernetics named after V.M. Glushkov National Academy of Sciences of Ukraine developed and widely used PSP solutions to various optimization problems [11].

Thus, in order to ensure the efficiency of management of the code of optimization calculations, an essential requirement is the maintenance of the interactive mode «man - computer» in the calculation process. And the use of the above software as a base software for the implementation of the DTOC will significantly improve the efficiency of the optimization calculation technology and take into account a number of the requirements of planned practice in digital format.

The development of software that creates a technological environment for working with universal PMP is carried out in two directions.

The first is the development of specialized software systems that implement the technology for solving one or more interconnected optimization problems. The second is the development of universal software tools that increase the manufacturability of the process of optimization calculations for any of the tasks being solved. Both of these areas are aimed at solving the same problems:

– to simplify the procedures for entering information specifying or correcting the structure of the model and the numerical values of its parameters;
– to reduce the time of converting information from the format - for the user to the format - for PMP (model generation time);
– to provide the earliest and most accurate diagnosis of the generated model, which allows to identify significant defects in its structure and the incorrectness of the set values of its parameters at the additional stages of information input, model generation;
– to simplify and focus analysis of the solution results in order to reduce the time for the user to develop an assessment of their quality and the strategy for their further actions;
– to simplify, make more flexible and quick the procedure for compiling and issuing calculation results in tabular form.

However, the most effective calculation technology for a specific optimization problem can be realized only by a specialized software package. And such a software package, first of all, should provide opportunities for carrying out optimization calculations in real time of planned work and implementation, for end users (planner) to directly control the course and content of calculations at all stages of their implementation. In order for the complex to meet these highly interrelated requirements, it is in turn necessary for it to have:
sufficient functional completeness;
high processing speed, each of its functional procedures;
interactive tools for managing processes and calculations;
user-friendly tabular presentation of input and output information and advanced means of its video terminal processing;
digital (interactive) means of maintaining the AD.
The completeness of accounting in the complex of these requirements depends both on the complexity of the functions for developing plans implemented in it, and on the set of software tools with which these functions are implemented.
Dialogue specialized complexes, allowing to carry out scheduled calculations in real time, are focused on decision makers and include:

- table layout of the AD;
- filling in or updating the AD tables in dialogue mode;
- diagnosis of the source data for the correctness of the model generated by it;
- generation of the model or its corrected fragment in the standard MPS format;
- flexible tuning of the program for generating the resulting tables to the specific configuration of the model and the structure of the optimal solution;
- actually optimization calculations;
- the issuance of the resulting tables of analytical and documentary nature on the display screen or print;
- restoration of AD and MPS tables - task file;
- accumulation and comparison of calculation options.

The general functional structure of the complex and the scheme of interaction of its functional blocks as a whole correspond to their representation in figure 3.

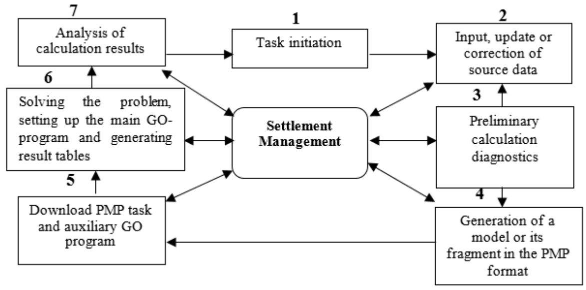

Figure 3 General functional structure of the specialized dialogue complex

Such an organization of the complex, on the one hand, strictly unambiguously, sets the full working cycle of calculations, consisting in the sequential processing of blocks 1-7, and on the other - provides the possibility to interrupt this cycle or the continuation of the previously interrupted. This provides the possibility of sufficiently flexible control over the course of payments by the user [12-19].

5. CONCLUSION

The developed specialized dialogue complex provides a high speed of calculations and the possibility of their implementation in real time, scheduled work at the enterprise. A simple dialogue language with computer technology allows you to perform calculations directly from the workplace of a specialist in the field in question. Digital (interactive) technology of optimization calculations, implemented on the basis of standard software tools, can be applied to a wide class of tasks of optimizing the transport and logistics systems of grain processing enterprises in real time during the planning process. Thus, in order for the solution of the optimization problem to become a management tool based on computer technology with the crowding out of existing manual calculations, it is also necessary that it be used in real time in combination with dialogue support tools.

REFERENCES

[1] Automated system of scheduled payments in transport, ed. B.S. Kozina, I.T. Kozlova. – M.: Transport. – 262 p., 2012.

[2] A.I. Iztaev, K.S. Kulazhanov, A.D. Saparbayev, Innovative technologies and logistics of agricultural processing industries – Almaty: Fortuna Polygraph LLP. – 722 p., 2019.

[3] A.D. Saparbayev, Transport logistics in grain processing. – Almaty: Fortuna Polygraph LLP – 242 p. 2019.

[4] V. Dennig, G. Essig, S. Maas, Dialog systems "man-computer". Adaptation to user requirements – M .: Mir. – 112 p., 2004.

[5] A.M. Dovgyallo, Dialogue of the user and the computer: Fundamentals of design and implementation. – Kiev: Science, Dumka. – 232p., 2001.

[6] V.M. Glushkov, Basics of paperless computer science. – M .: Nauka. – 552 p., 1987.

[7] B.C. Mikhalevich, Yu.S. Arkhangelsk, On interactive planning models, Modeling and informatics in RAS and OGAS. – Kiev: Institute of Cybernetics named after V.M. Glushkova, Academy of Sciences of the Ukrainian SSR, (1993) 4-16.

[8] A.N. Timchenko, A.D. Saparbayev, Report generation in mathematical programming packages: directions of development and efficiency of using software tools, Usim, 4 (1999) 63-68

[9] Application Packages: Optimization Methods, ed. A.A. Samara – M.: Nauka, 161 p., 1994.

[10] Application package "OMEGA". Kalinin: NPO Centprogrammsystem, 1995, 354 p.

[11] B.C. Mikhalevich, V.A. Trubin, N.Z. Shor, Optimization problems of production and transport planning: models, methods, algorithms. – M.: Nauka, 264 p., 2006.

[12] A.D. Saparbayev, Innovative systems and optimization of technological and logistical flows during transportation of food products, Int. scientific j. «Austria-science», 19 (2018) 43-47.

[13] A.D. Saparbayev, On dialogue technology of optimization calculations (paper), Int. scientific j. «LINGVO-SCIENCE», 16 (2018) 30-34.

[14] A.D. Saparbayev, Modeling logistic flows in the transport of cereals, Int. scientific j. «Austria-science», 2 (2017) 126-130.

[15] A.D. Saparbayev, A.A. Demesinova, Development strategy for the energy sector in a region with scarce power resources: Approaches and principles, Actual Problems of Economics, 152(2) (2015) 262–272.

[16] N. Bayboltaeva, A.D. Saparbayev, A. Ismailova, A. Makulova, A. Imatayeva, Problems of accounting and reporting of small agricultural businesses in the Republic of Kazakhstan, J. of Social Sciences Research, 3 (2018) 67-75.

[17] A.D. Saparbayev, A.A. Demesinova, V.K. Seydahmetov, Zh. Sh. Kydyrova, A.A. Shadiyeva Renewable energy sector of Kazakhstan: Factors of its sustainable development, Int. J. of Management and Business Research, 8(1) (2018) 34-51.

[18] A.T. Makulova, Z.S. Mukhametzhanova, G.K. Zhanibekova, K.K. Khasenova, A. Zhildikbayeva, Forecasting production output of JSC RG BRANDS on the basis of the econometric modelling, Int. J. of Applied Engineering Res., 10(20) (2015) 40976-40982.

[19] N. Bayboltaeva, A.T. Makulova, Poblems of development of accounting on peasant (farm) enterprises in republic of Kazakhstan, Asian Social Science, 11(14) (2015) 211-219.