Analytical Processing. OLAP technology is a tool of the DSS design. Today OLAP mechanism is one most spread methods of data analysis. As opposed to classic techniques, the database inquiry is formed not on basic of strictly specified forms but with the help of flexible unregulated approach. OLAP provides revelation of associations, appropriateness, trends, classification, generalization or detalization, making forecasts. OLAP gives a tool for management of an enterprise in real time [7]. Today a whole number of different OLAP systems is available: ROLAP (relational OLAP), MOLAP (multidimensional OLAP) — Oracle Express, Essbase (Arbor Software), MetaCube (Informix) and other.

There are two principal approaches: Multidimensional OLAP (MOLAP) realizes mechanism of multidimensional database on the side of the server and Relational OLAP (ROLAP) suppose to construct cubes on the basis of SQL inquiry to a relational database. It is suggested to use ROLAP technology.

4. Conclusions. DSS developed allows to plan on the basis of analysis of information on competitors and consumers in the market, to define and choose strategies for an enterprise development, and analyze consequences of the decisions made. In this way the presented DSS allows to improve effectiveness of planning at an enterprise. In order to speed up data processing and to reduce the acceptance time for the strategic decisions, it is rational to divide the selected labour resource, financial and material resources.

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TOWARDS DEVELOPING A DECISION SUPPORT SYSTEM FOR STRATEGIC INVESTMENT APPLICATIONS

В даній статті пропонується система підтримки прийняття інвестиційних рішень. Ця система дає можливість оцінки ефективності та ризику інвестиційних проектів. Також система має можливість провести аналіз чутливості інвестиційного проекту, розробляючи рекомендації по збільшенню ефективності та зменшенню ризику проекту та формування портфелю.

In this paper the investment decision support system is offered. This system gives the opportunity of estimation of the efficiency and risk of investment projects. The system can also carry out the sensitivity analysis of the investment project working out the recommendations for increasing the efficiency of the project and portfolio foundation.

1. **Introduction.** Any enterprise in a certain extent is connected with the investment activity. The investment decisions are carried out almost every day at large and small enterprises. They are current decisions on purchasing fixed capital, variation the funds, changing the equipment and purchasing the technologies etc. Special attention is devoted to the strategic planning decisions, which are touched on a long-term period and connected with huge capital investments. They are characterized as the decisions with high risk.

Real investment is the main form of realization of the strategy of economic development of the enterprise. The process of strategic development of the enterprise represents the totality of investment projects which are realized during a period. Exactly this form of investment allows the enterprise successfully penetrates into new trade and regional markets and secures constantly increasing its market cost [1].

Making up the investment decisions, as any other kind of administrative activity, is based on using different formalized and unformalized methods. For transformation huge volume of data, storing the data, its processing and solution difficult management tasks with the help of different mathematic methods the decision support systems (DSS) are used. Modern DSS is the instrument of strategic management. The elaboration of investment decision support system is considered in this paper.

2. **The task and algorithms of its solving.**The problem of formation of the investment decisions is examined. For its solution the tasks of estimation of the

investment projects and portfolio foundation are studied. The aim of the task is to realize the strategic enterprise targets.

The estimation of the investment projects will be considered in two aspects. The first aspect is the estimation of the efficiency of the investment projects. The second one is evaluation of the risk of the investment project.

The strategic direction projects are examined. So estimation of the efficiency of the project will be made with the help of net present value (NPV) and profitability index (PI) Eqs. (1) and (2). This choice is caused by the possibility of estimation of the project from the point of view of the capital investments profitability.

$$NPV = \sum_{i=1}^{n} \frac{CF_i}{(1+r)^i} - I_0 \qquad (1)$$

$$PI = \frac{\sum_{i=1}^{n} \frac{CF_i}{(1+r)^i}}{I_0} \qquad (2)$$

Usually input data of the project is fuzzy determined. So the efficiency of the project is offered to estimate accounting accuracy and subjectivity of information with the help of corrected Net Present Value [2].

$$NPV_{CE} = \sum_{t=1}^{n} \frac{(1-U_t)CF_t}{(1+r)^t} - (1-U_0)I_0 \qquad (3)$$

where U_t - the influence of discrepancy of the information.

It is possible to use for estimation of the risk of the project either probability methods or fuzzy set tool. Using both of this methods is depended on different available project input data.

Project risk is computed on the base of expert methods by this formula:

$$\sigma_{NPV} = \sqrt{\sum_{i=0}^{n} \frac{\sigma_i^2}{(1+r)^{2i}}} \qquad (4)$$

The risk of the project is estimated with the help of value of non-receipt of the expected degrees of profit and profitability if input project data is triangular fuzzy numbers [3].

$$[NPV_1, NPV_2] = (-)[I_1, I_2](+)(\sum_{i=1}^{n}\ )\left[\frac{CF_{i1}}{(1+r_{i2})}, \frac{CF_{i2}}{(1+r_{i1})}\right](+)\left[\frac{\Delta C_1}{(1+r_{n+1,2})}, \frac{\Delta C_2}{(1+r_{n+1,1})}\right] =$$

$$= -I_2 + \sum_{i=1}^{n}\frac{CF_{i1}}{(1+r_{i2})^i} + \frac{\Delta C_1}{(1+r_{n+1,2})^{n+1}}, -I_1 + \sum_{i=1}^{n}\frac{CF_{i2}}{(1+r_{i1})^i} + \frac{\Delta C_2}{(1+r_{n+1,1})^{n+1}} \qquad (5)$$

$$[PI_1, PI_2] = (\sum_{i=1}^{n}\ )\left[\frac{CF_{i1}}{(1+r_{i2})/I_2}, \frac{CF_{i2}}{(1+r_{i1})/I_1}\right] = \left[\sum_{i=1}^{n}\frac{CF_{i1}}{(1+r_{i2})^i/I_2}, \sum_{i=1}^{n}\frac{CF_{i2}}{(1+r_{i1})^i/I_1}\right], \qquad (6)$$

To make administrative decision to decrease the risk you need to carry out the analysis of the influence of different parameters of the investment project on the values of the efficiency and risk of the project. First quantitative changes of project data are determined (ΔI_0, Δr, $\{\Delta CFt\}$, Δn), resulting in change of NPV and σ_{NPV} values to critical or wishful (recommended). Then the recommendations on changing project parameters in order to decrease risk of project failure are working out on the basis of these values.

The efficiency and risk administrative manipulations are elaborated on the basis of received values.

So, the investment project safety margin is determined with the help of sensitivity analysis.

Having received and analyzed investment projects you can form portfolio on the base of criteria maximization of income and minimization of risk of the project.

$$f_1 = \sum_{i=1}^{n} NPV_i \cdot x_i \rightarrow max \qquad (7)$$

$$f_2 = \sum_{i=1}^{n} \sigma_{NPV_i} \cdot x_i \rightarrow min \qquad (8)$$

$$x_i = \begin{cases} 0 \\ 1 \end{cases} \qquad (9)$$

$$\sum_{i=1}^{n} r_i \cdot x_i \leq R \qquad (10)$$

where $x_i = 0$ – if the project isn't accepted, and $x_i = 1$ – if the project is accepted, r_i - initial investments on i project, R - money resources, allocated for investment, σ_{NPV_i} - the mean-square deviation of net present value on i project.

This model is transformed into single criterion optimization task by means of changing risk minimization criterion into constraint.

As a result of solution multicriteria task (7)-(10) effective set of portfolios is formed. Each portfolio corresponds to the certain investment policy of the enterprise.

Thus the task of the acception of the investment decisions is solved. The task consists of such business-processes as estimation the efficiency of the investment projects, evaluation of the investment risk, analysis of the efficiency and risk, portfolio foundation.

3. The creation of the application.
Decision support system for automation all the calculations is offered. In the base of this system offered algorithms are put down. The scheme of proposed decision support system conception is presented on fig. 1.
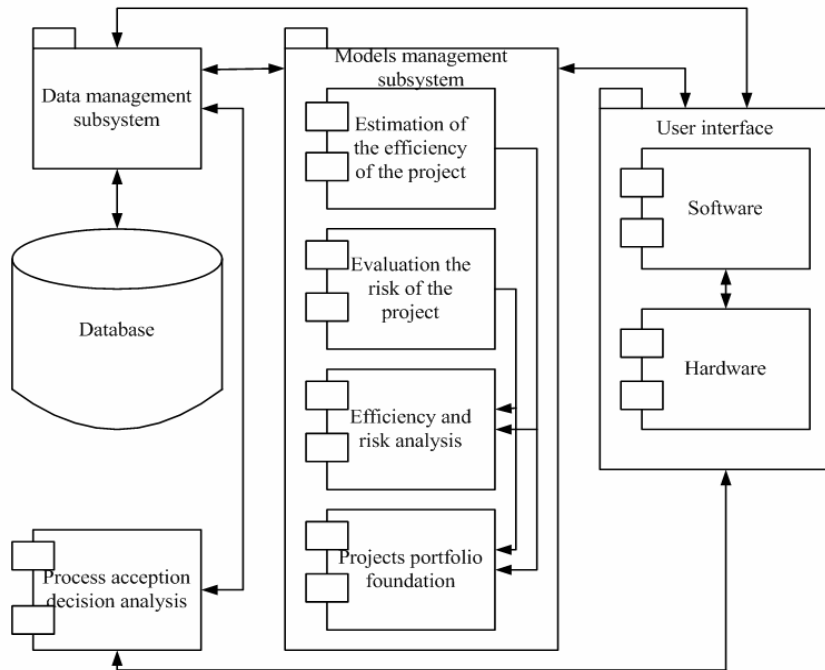

Fig. 1 The structure of decision support system to support the acception of the investment decisions

The application is implemented on C# in Microsoft Visual Studio 2005 with the help of .NET technology. It is offered for implementation the algorithms and realization automation the calculations.

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The choice of this environment is made taking into account possibility of using different languages and applications in it.

Friendly user interface is elaborated for providing entering input data into database, their actualization, for visualization the calculation process and getting resulting efficiency and risk indexes, and for carrying out investment project sensitivity analysis, and portfolio foundation. The main functions of the application are presented in UML notation in view of use case diagram (fig. 2) [4].
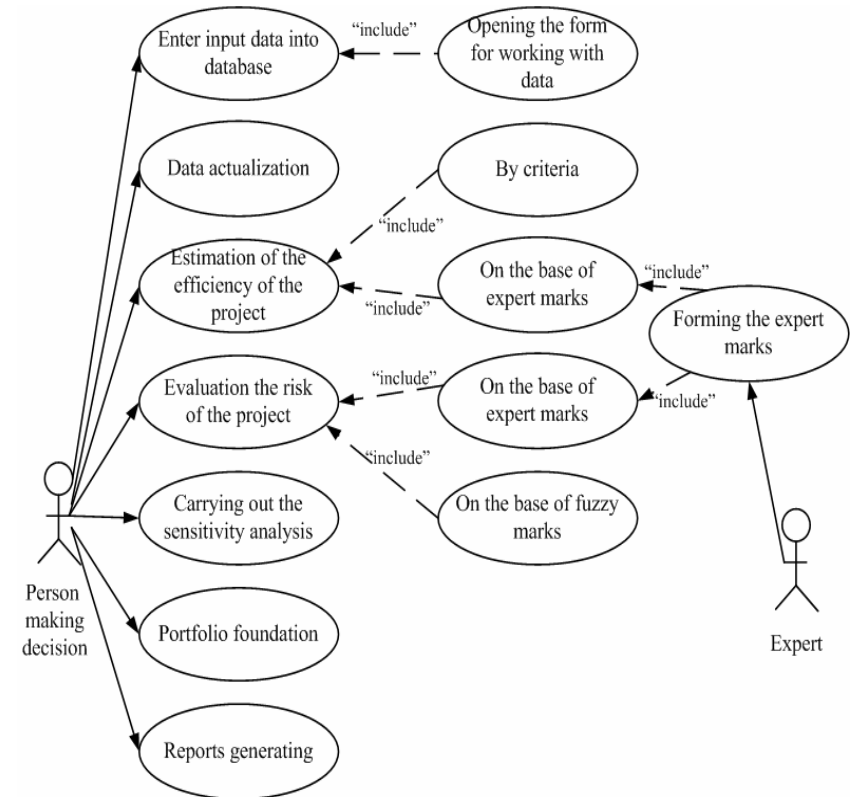

Fig. 2. The key functions of the application

The object-oriented approach was used for development the application. The components diagram is presented on Fig. 3.
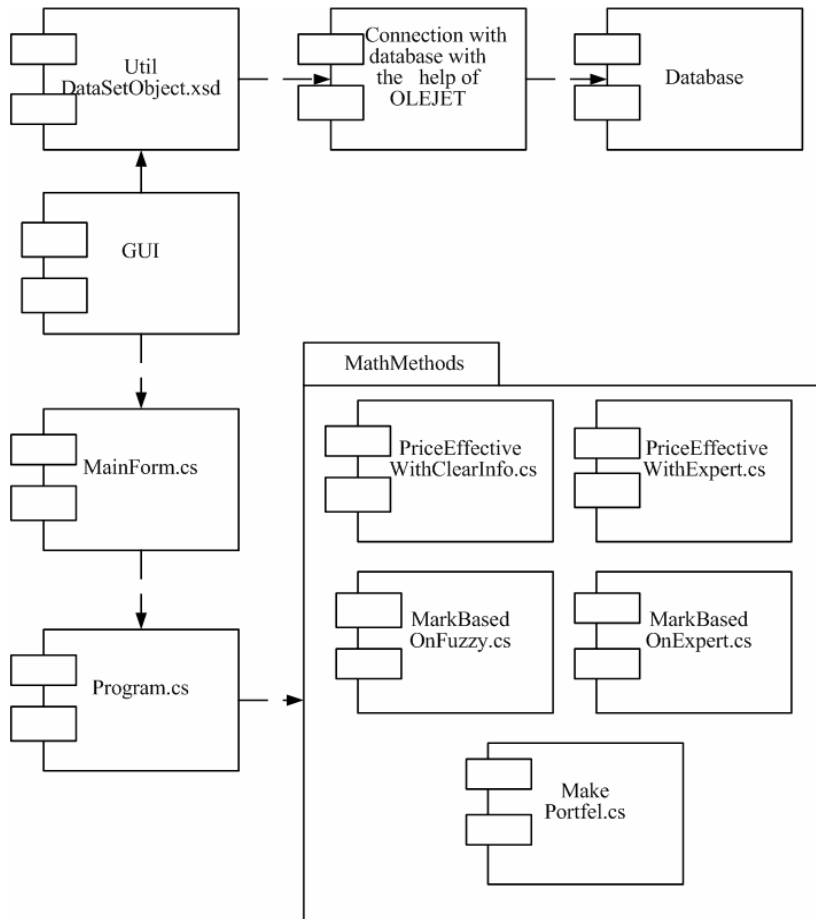
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Fig. 3. Components diagram

Let us consider the main application modules. Application consists of database and program. The program consists of user interface and program code, which realizes the functions of user interface.

GUI is the module which realized graphic user interface. Util module with DatasetObject class is used for connection and working with database. Module MathMethods implements all the necessary mathematic methods for solving the acception investment decision task. Mainform is used for describing the main application form. Program consists of main function, which provides the work of application.

All the necessary data for working with the system are stored in the database. Data modeling is realized with the help of CASE-tool ER-win. IDEF1X - model is presented on fig. 4.

Database is developed in Microsoft SQL Server 2005. Microsoft Visual Studio 2005 gives the opportunity of using ADO technology with the help of ADO OLEJET drivers. The elaborated application performs the existing database files as xml-files.

Database tables' description is presented in Table 1.

Table 1

Brief entity description

Project	The entity describes the project and its main properties
Project_with_precise_data	Certain (precise) input project data
Cash_flow_project_precisedata	Cash flows of project with precise data
Project_with_expert_data	Expert input data
Expert	Information about experts, which take part in project estimation
Expert_Probability	Forecasting by experts project parameters
Project_with_fuzzy_data	Input project data in terms of fuzzy sets
Initial_investments	Initial investments values for project in terms of fuzzy sets
Cash_flow	Cash flows values for project in terms of fuzzy sets
Rate_of_interest	Rate of interest values for project in terms of fuzzy sets
Liquidation_cost	Liquidation cost values for project in terms of fuzzy sets

The elaborated application is designed for acception the investment decisions support. Let us perform user work with this decision support system. On the main form of the user interface such tabs as "Efficiency estimation", "Risk evaluation", "Efficiency and risk analysis", "Portfolio foundation" are given. Choosing a tab the panel has changed. Each panel realizes certain functionality.

For chosen project the efficiency indexes are calculated. The possibility of report generating on all the projects with their calculated indexes is expected. It gives the opportunity of carrying out the comparative analysis.

In risk estimation a user choose the evaluation method depending on input data character. In the case of evaluation the risk on the basis of fuzzy sets you need to determine acceptable levels of efficiency on net present value and prof-

itability and weights of these criteria (fig. 5). As projects estimation is realized by different methods depending on input data so message "The lack of data for this project" will appear and form for filling the data will be shown.
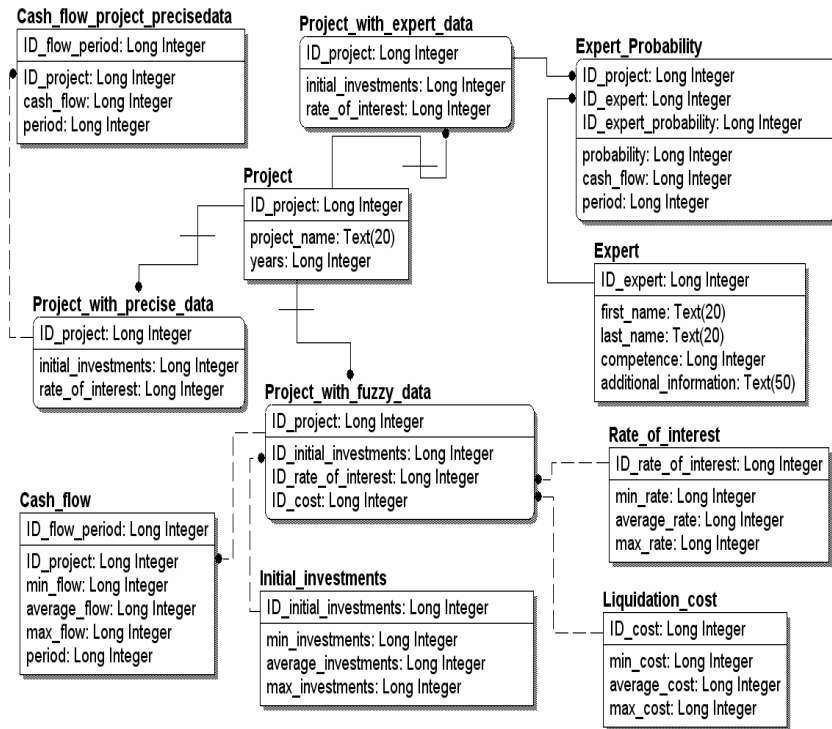

Fig. 4. IDEF1X-model (physical view)

On "Efficiency and risk analysis" panel choosing the project you have to determine wishful level of the efficiency and press "Calculate" button. As a result you'll see the factors deviation leading to efficiency rising and risk falling. It is foreseen to give recommendations on changing project parameters if the project safety margin is low.

Before investment portfolio foundation begins a user has to set the acceptable risk levels and to choose input data character on the basis of which risk and efficiency marks are determined. There is an opportunity of portfolio foundation for projects with precise and expert input data. Pressing on button "Calculate" we receive projects portfolio satisfying the risk constraint (fig. 6).

So setting different risk levels effective set of portfolios will be formed. Each of these portfolios will be provide investment enterprise policy. For example, if the risk degree is high then projects with high efficiency and risk will form the portfolio, which will be correspondent to aggressive investment policy. On the contrary, if the risk degree is low then the projects portfolio will be correspondent to conservative investment policy.
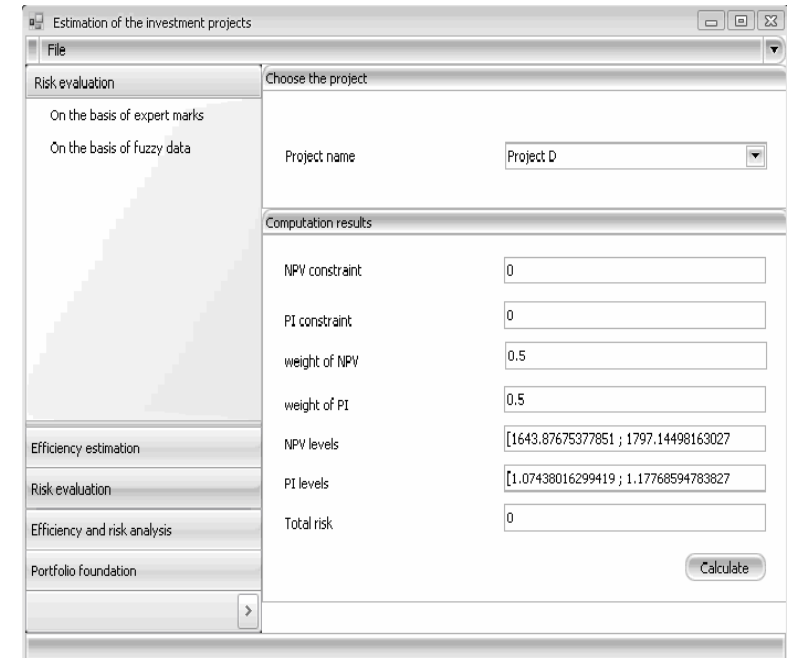

Fig. 5. Screen form of estimation the risk of the project

On the basis of the received results a user can generate reports. These reports will be used in the process of acception of the administrative decisions to implant investment projects for enterprise's development and in the process of the risk management of the chosen projects.

4. Conclusion. The process of the acception of the investment decisions is examined. Also decision support system is created. It allows to store and process data on investment projects, and to estimate investment projects from the point of view of efficiency and risk, to form real investments portfolio on the

basis of chosen enterprise policy. The application can be used by managers for acception of the investment decisions in the theme of commercial enterprise development strategy.

The work on improvement the system is continued. The decision support system, using OLAP-technologies, will be proposed.
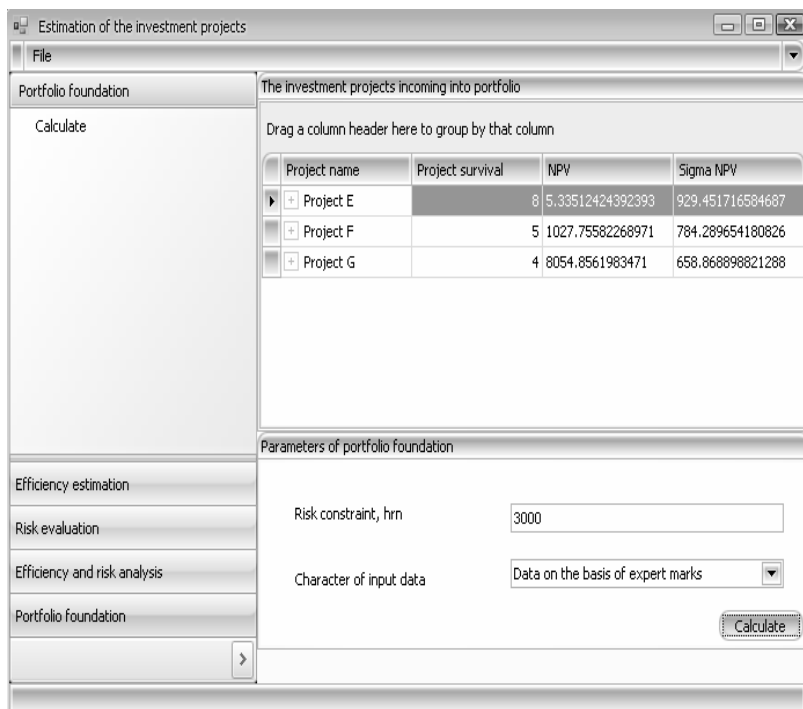

Fig. 6. Screen form of investment projects portfolio foundation

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ТИРАЖИРОВАНИЕ ОПЕРАЦИЙ СОГЛАСОВАНИЯ В ГЕТЕРОГЕННЫХ РАСПРЕДЕЛЕННЫХ БАЗАХ ДАННЫХ

У статті розглядається проблема проектування розподілених баз даних з тиражуванням, які складаються з множини локальних баз даних, що містять логічно різні, але семантично еквівалентні структури даних, та знаходяться під керуванням систем баз даних різних виробників. Запропоновано розширення моделі процесу тиражування даних, яке включає: відповідності між БД з різними структурами, правила перетворення даних та функціональні правила обміну даними та між цими базами даних.

There is described development problem of replication databases, which consist of local databases with logically different, but semantic equivalent data structures, and managed by database systems of different vendors. There is offered expansion replication data process model, which includes: schema matching between databases with different structures, rules data conversion and functional rules data exchange between databases.

Введение. Корпоративная информационная система (ИС), которая разрабатывается на протяжении десятилетий, часто управляет данными, расположенными на множестве автономных (локальных) баз данных (ЛБД). При этом все БД могут содержать логически разные, но семантические эквивалентные структуры данных и поддерживаться системами управлениями (СУБД) от разных производителей. Для обеспечения согласованности данных в ИС необходимо поддерживать тиражирование операций согласования данных в гетерогенной распределенной базе данных (РБД), что является трудоемкой задачей при отсутствии соответствующих инструментальных средств. Существующие системы тиражирования *OpenSource*-типа, которые являются расширением стандартных библиотек доступа к БД, требуют перепроектирования существующих программ [1], а специализированные не поддерживают гетерогенности [2]. Для объединения свойств этих систем была разработана система [3]. При увеличении размерности ЛБД и числа типов СУБД процесс администрирования гетерогенной РБД становится трудоемким. В статье предлагается механизм сокращения трудоемкости за счет формализации процессов гетерогенного тиражирования операций согласования ЛБД.

1. Расширенная модель процесса гетерогенного тиражирования данных. Для решения поставленной задачи предлагается на основе модели