

11th International Workshop  
Krasnoyarsk, RUSSIA  
22-24 November 2022

HMMOCS-2022



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**IWMMA 2022:**

# **The Eleventh International Workshop on Mathematical Models and their Applications**

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«OLAP concept as a basis for business for analysis of multidimensional  
data structures»

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# Problem statement

The problem of the rapid increase in the volume of heterogeneous information necessary for making managerial decisions served as a trigger for the search for a technology that allows you to quickly process the summarized information coming from different sources (including geographically remote) and bring it to decision makers in convenient form with the possibility of detailing the received information.

The main problem of obtaining analytical indicators for organization's managers in this paper is the speed of obtaining such information.

# Research Questions

- How to increase the speed of obtaining analytical indicators for making managerial decisions when working with Big Data?
- How to ensure the relevance of the obtained analytical indicators?
- How to demonstrate different analytics based on user needs?

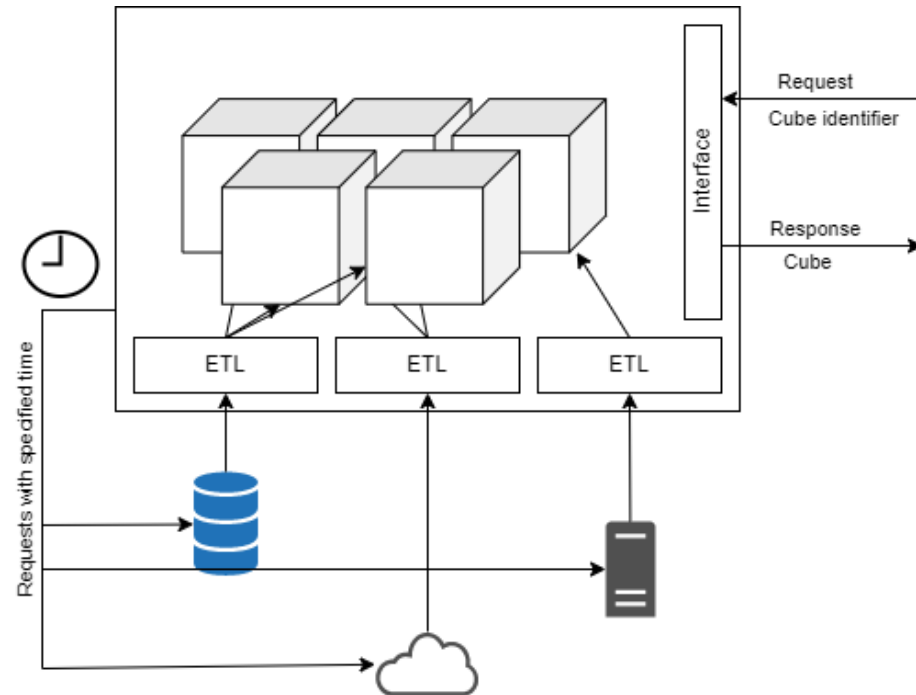
# Purpose of the Study

The answers to these questions will lead us to the development of a concept for the transition from requesting data at the request of the user to requests within periods specified by the frequency of updating information and requirements for relevance, as well as performing all necessary calculations with storing the results of calculations of analytical indicators.

At the same time, a new request for indicators coming from the user (decision maker) does not refer to data sources, but to the storage of already calculated indicators distributed in the context of vectors useful for user analytics. This is exactly what the OLAP concept offers.

# Research Methods

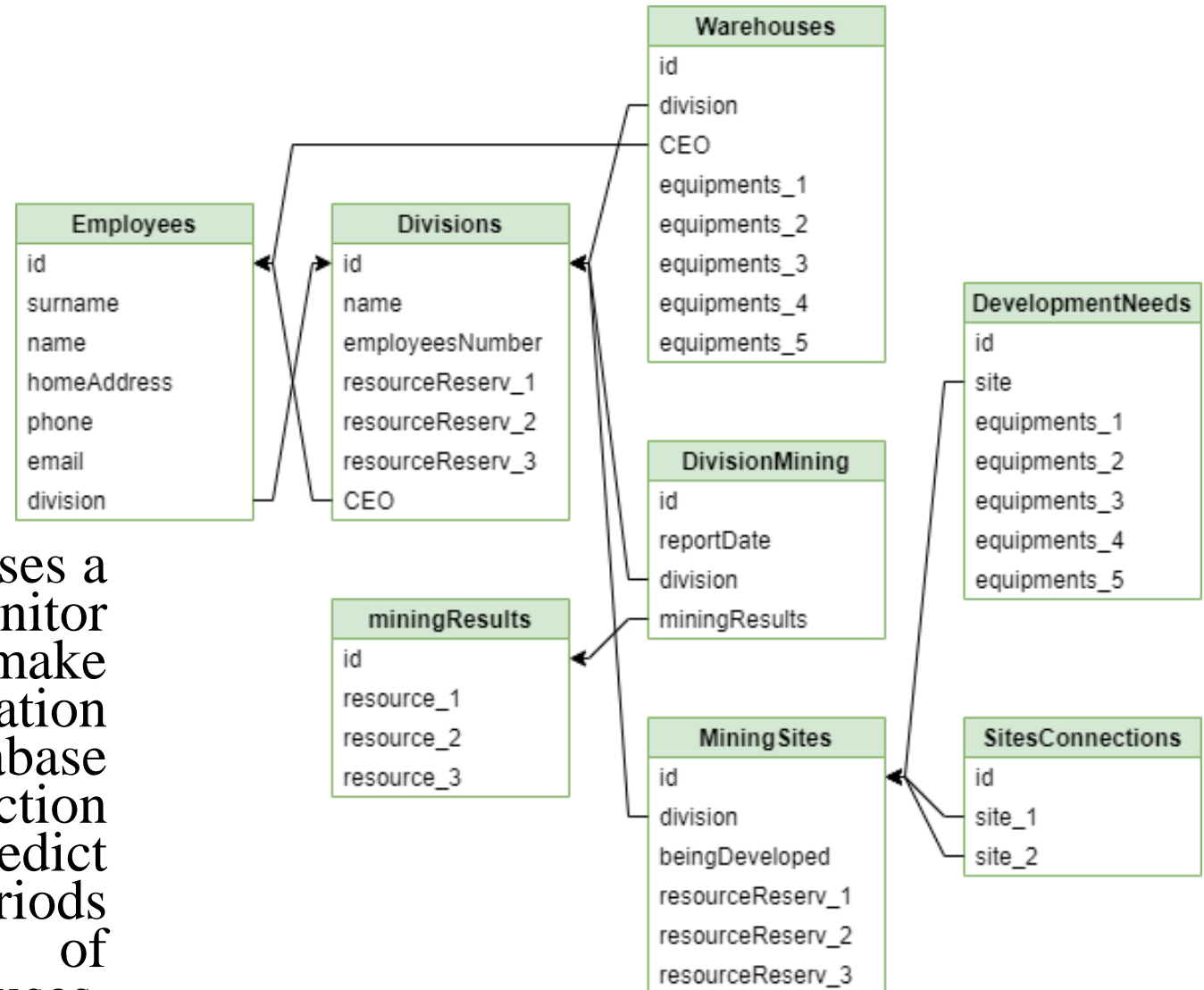
OLAP (On-line analytical processing) is a concept that describes the loading and storage of analytical indicators using a specialized intermediate layer (data cube, hypercube) that stores data using a multidimensional structure (MD, Multidimensional representation of data).



**Figure 1.** Data acquisition scheme according to the OLAP concept

# Findings

An organization of mining industry uses a BI system in its activities to monitor analytical indicators used to make management decisions by organization managers. There is a centralized database that collects data on actual production and indicators necessary to predict production opportunities in future periods (exploration data, availability of development equipment in warehouses, work schedule of employees).



**Figure 2.** Simplified data schema of a mining organization

# Findings

District	DemandResource	DemandDate	DemandValue
District 1	Resource 1	2022-12-01	59 361
		2023-01-01	58 687
		2023-02-01	58 653
		2023-03-01	56 391
	Resource 2	2022-12-01	29 361
		2023-01-01	27 682
		2023-02-01	31 734
		2023-03-01	48 356

District	DemandDate	CostOfDemand	DemandResource	CostOfDemand
District 1	2023-02-01	26 663 992	Resource 2	3 458 631
			Resource 3	17 856 203
	2023-03-01	26 375 817	Resource 1	5 142 863
			Resource 2	3 525 223
District 2	2022-12-01	35 714 955	Resource 3	17 707 731
			Resource 1	5 758 828
			Resource 2	5 270 233
			Resource 3	24 685 904

District	Division	Resource	Current production	Development opportunity - Value	Development opportunity - Equipment	Development opportunities - Equipment count
District 1	Division 1	Resource 1	57 422	2 198	Equipment 1	7
					Equipment 3	9
		Resource 2		1861	Equipment 4	2
					Equipment 2	18
	Division 2	Resource 2	13 256	3 781	Equipment 4	3
					Equipment 2	7
		Resource 2	14 168	1 175	Equipment 5	6
					Equipment 5	3

**Figure 3.** Options for presenting analytical data on the predicted demand for products (left), the cost of products to meet the predicted demand (right) and the possibilities of developing new areas of divisions (bottom) for the regional manager of the mining organization

# Findings

After analyzing the tables, we can formulate a number of conclusions that come from Figure 3:

- when a regional manager works with the BI system of an organization, it is not required to make many complex queries to each of the sources, some of which, among other things, are external (predicted demand), three simple queries to the generated hypercubes are enough;
- the received data is brought to a single format, does not require additional operations (for example, obtaining the structure of table records from a JSON string);
- if mistakes occur in the process of loading data from sources, they can either be processed, or, if processing does not occur, do not overwrite the data obtained during the last loading of data from the source;
- a request for obtaining data from sources is made according to the schedule, and not during the user's session;
- now, data storage requires some amount of disk space in addition to the initial data, however using of random access memory has been significantly reduced.



# Using OLAP Structures Data

In view of the possibility of obtaining data from different sources, it is inappropriate to talk about uniform practices for entering data into an OLAP system. However, getting data from a hypercube structure has several characteristics.

1. First, the hypercube data consumer only needs SELECT queries. There is no need on the part of the user or the BI system to make changes or delete cube records, as well as change the structure of tables (set of columns, data types) and their data schema – these are all tasks of the OLAP engine.
2. Secondly, the use of OLAP is focused on response speed, so when choosing a technology for a number of parameters, speed usually comes first. The structure of requests and their channels of receipt must also follow this rule.

# Conclusions

Currently, OLAP technology is widely used in analytics and data consolidation systems. So, in addition to BI systems, OLAP technologies have found application in accounting support programs, organization management systems (for example, r-keeper for managing a public catering organization), and CRM systems. However, BI systems and accounting information systems are still considered to be the largest coverage.

At the same time, the potential of the technology can be called not fully disclosed, since even in those situations where multidimensional data storage is required; more familiar relational databases are often used.

# Contacts

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