UDC 629.735.083.02/.06

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Database structure for aircraft fleet reliability management

Analysis of data necessary for the operation of an aviation equipment reliability monitoring system at an airline level was carried out. The PostgreSQL system was used as the basis for the database. The structure of the database and the diagram of tables interaction in it was shown

Reliability management at the stage of operation is aimed at preserving the flight and technical characteristics of the aircraft during the established life times and service periods defined by maintenance and repair demands. For this purpose, in the process of operation, the airline company solves a set of tasks for assessing and analyzing the reliability parameters of the aircraft.

Reliability parameters monitoring of components and airplane as a whole includes search of the parameters changes regularities, prevention of significant nonaccidental changes in reliability, assessment of maintenance/overhaul efficiency, comparison of reliability characteristics of aircraft and their components.

Initial data and the database structure

One of the effective modern tools for management and optimization of the repair and technical activities of an aviation enterprise is the system for managing the reliability of aircraft functional systems and components [1, 2]. The initial information for reliability management are data about failures and malfunctions identified by pilots and during maintenance, information about unscheduled removals of aircraft components, delays and cancellations of flights, information about aircraft periodic maintenance, aircraft main products and components operating time, data of periodic checks and inspections.

As initial information comments of flight or technical personnel are used. It is fixed up in the form so-called Log-pages, cards for removing / installing units, as well as reports from the planning and dispatching departments of the airline.

Database software

One of the main elements of a computerized reliability control system is a database designed to store all relevant information. For creating system's database a relational server PostgreSQL [3] was used. The software PostgreSQL is an open source object-relational database management system and it is free even for commercial use.

The PostgreSQL database management system has an architecture that ensures reliability, storage integrity and correctness of data processing.

PostgreSQL has full support for secondary keys, tables links, triggers and stored procedures. It includes most of the SQL-2008 standard data types.

PostgreSQL has built-in programming interfaces for C/C++, Java, .Net and Perl

languages.

PostgreSQL supports international character sets, Unicode multi-byte character encoding. Main features and limitations of PostgreSQL servers are shown in Table 1.

Database structure

The structure of the created database should be effective and provide at least such features: fast access to data; no duplication of data; integrity.

To provide such features structure of the database ant its tables must meet following requirements and demands: tables fields contain indivisible information; there are no repeating field groups in the tables: any non-key field must be uniquely identified by key fields; none of the non-key fields must be uniquely identified by the value of the other non-key field(s).

The information stored in the database must be structured and divided into parts stored in separate database tables. In this case, separate tables must be interconnected and between the tables must be relations of the type master-table and slave-table.

Analysis of the mentioned information allows creating database with following tables to story this data:

- Airline Aircraft Types and their characteristics;
- Main Products List (plane, engine, auxiliary power plant) used in the airline. The table is subordinate to the Airline Aircraft Types table;
- Events that took place on the aircraft and ended with filling in Log-page by the flight or technical personnel. The table is subordinate to the Airline Aircraft Types table;

Table 1

PostgreSQL system limitations

Limit	Value
Maximum database size	Unlimited
Maximum spreadsheet size	32 TB
Maximum recording size	1.6 TB
Maximum field size	1 GB
Maximum number of entries in the table	Unlimited
The maximum number of fields in a table	250 - 1600 (it is depending on the types of the fields)
Maximum number of indexes per table	Unlimited

- Events Detailed Description, containing all data of failure/malfunction and their repairing actions. The table is subordinate to the Events table;
- Postponed Maintenance. The table is subordinate to the Events Detailed Description table;
- Flight Delays. The table is subordinate to the Events table;
- Flight Cancellation. The table is subordinate to the Events table;

- Aircraft Periodic Maintenance. The table is subordinate to the Airline Aircraft Types table.

- Aircraft Components Operating Time. The table is subordinate to the Airline Aircraft Types table.

- Periodic Checks and Inspections. The table is subordinate to the Airline Aircraft Types table.

The created scheme of interaction between tables in the database of the reliability control system at the airline level is shown in Fig.1. The database uses a one-to-many relationship to link its tables. Only the Flight Cancellation table is exception/ It is connected to the Events table in a one-to-one relationship. In the figure, the arrows indicate connections between master and slave tables.
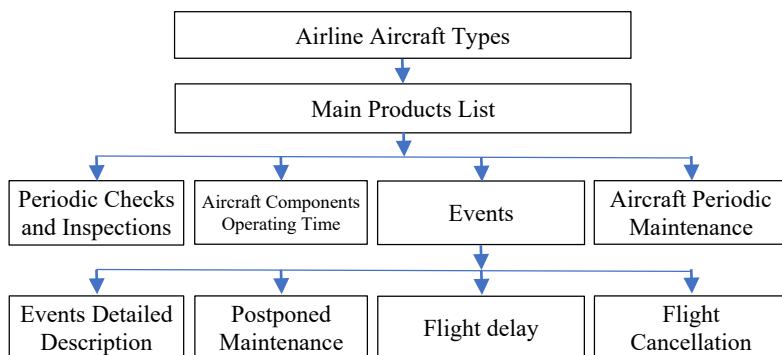

Fig. 1. Diagram of tables relation in the database of the computer reliability control system

The analysis of information flows in the automated system for monitoring the reliability of aviation equipment at the airline level was carried out, a reasonable choice of a database management system was made, and a general diagram for the interaction of tables in the database was developed.

References

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3. PostgreSQL software developer website: https://www.postgresql.org/