# Empirical Research on Business Intelligence System Architecture

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## Abstract

*Domestic Lottery industries are accelerating the construction of information systems. On the project background of Shanghai Welfare Lottery Issue Center (SWLIC), this paper conducts lottery business information system framework, the functional structure of business intelligence system, the data warehouse architecture of business intelligence systems, applications topics analysis of data warehouse etc., and it is aimed to provide the reference and help for the research and planning of SWLIC projects and other relevant research and application..*

**Keywords:** Business intelligence; Architecture; Lottery; Data Warehousing

## *Introduction*

In the past few years, with the increase of enterprise information systems, the problems of information silos have become particularly significant. Thereby the concept of business intelligence has come into being. Business Intelligence (BI) was first proposed by Howard Dresner in 1989. Business Intelligence refers to the use of the data warehouse system to systematically store and manage operational data, and through a variety of statistics and analysis tools and data mining techniques to analyze operational data in order to provide analysis reports and decision support information for various business activities.

The business intelligence analysis in normal corporations include the contents from many sides such as dashboard, score card, OLAP, reporting and operation analysis and prediction, the execution of business strategy etc.. Through the model construction of data warehouse, using the centrally managed KPI to solve the problems of corporate operation performance, monitor the development of enterprises, thus implementing displaying complex reports in simple ways. In existing business intelligence systems, statistical analysis function is still needed to help analyze customer segmentation, forecast customer behavior, predict the customer's business trends, and identify fraud etc..

From the perspective of the lottery business, you can accurately determine the lottery business trends and data mining are the main contents of the analysis of business intelligence systems, including analysis of topics: the correlation analysis between the products, product & regional sales characteristics, product betting numbers analysis etc[1~4].

## *1. Lottery business information system framework*

Lottery business is divided into business system and management system according to its different functions. The business system mainly solves the practice operation of Welfare Lottery center business operation, including computer lottery system, online bank card sales, cell phone betting system and immediate invoice system. Management systems including financial systems (FI), Human Resource Management System (HR), collaborative office systems (OA), as well as management and decision-making information systems (DSS, BI), and other systems, such as enterprise information portals.

Through the construction of business intelligence system, lottery center has formed a structure taking business intelligence system as the core, and combining operation system and management system together. The operation system and management system provide real-time data and the historical data for business intelligence system decision-making. The overall information system architecture of Welfare lottery is shown as in Figure 1.

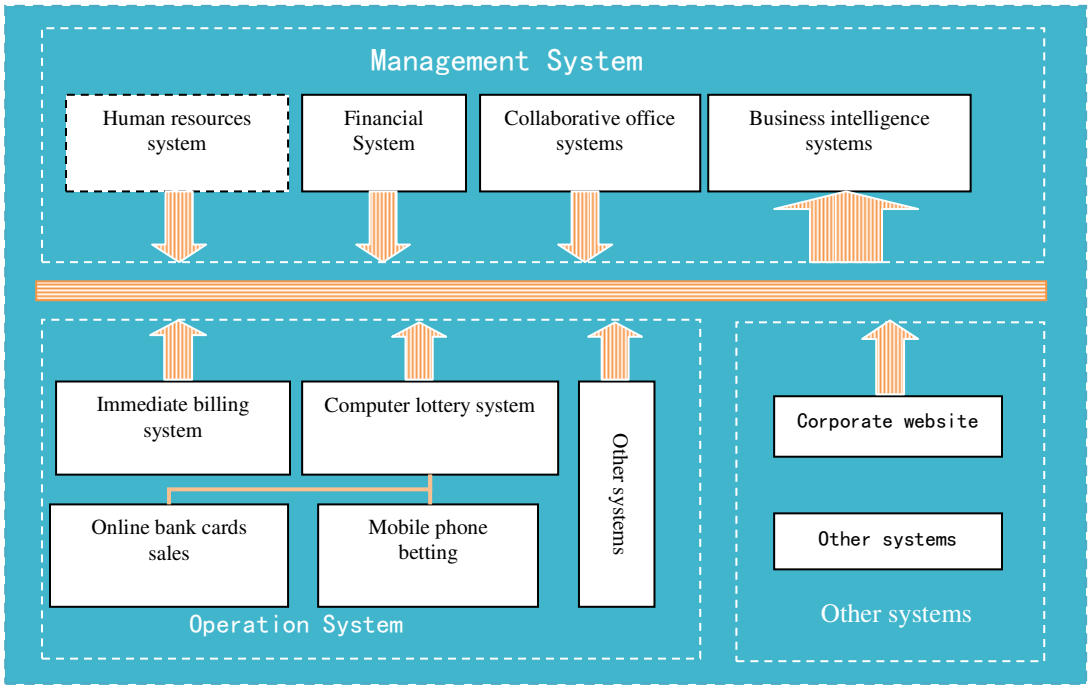


Figure 1 Shanghai Welfare Lottery Center information architecture blueprint

## *2. The functional structure of business intelligence system*

Aimed at the situation of Shanghai Welfare Lottery Center, business intelligence systems should be able to provide full range of management support to top levels of welfare center, thus realizing the sharing and security management of data and it can also help to facilitate the retrieval, query and control of data from superior level to lower level. Different people shares and store different data according to respectively permissions. Decision level can get the whole and decision-supportive information from the system, and can carry out the detail mining of data; while management can obtain the ordinary course of business information that assist the management requirements. At the same time, the system should consider the data reliability, security, sharing, integrity and also the monitoring capabilities of business, in order to being able to provide support for the day-to-day operational management of Shanghai Welfare Lottery Center and analyzing and decision support functions. Business intelligence system is divided into decision-making information management, market analysis management, sales information management, logistics information management, financial information management and data analysis mining module and data mart is built respectively on this basis.

**Decision-making system:** Decision-making information management module is a center high-level oriented application. The main role is to use the most convenient and simple way to provide center senior management with the statements and information needed for management and decision making, and support center senior management to manage and make decisions.

**Market analysis management:** Provide the required business information and reports for marketing managers and research analysts, and also strong data analysis tools.

**Sales management:** Provide sales managers and operational staff with the needed business information, reporting and simple data analysis tools. Reduce the manual, semi-manual work of current sales departments, and support sales management.

**Logistics management:** Provide welfare lottery sales network management and operational staff with the operational information and reporting needed, and also simple data analysis tools.

**Financial management:** Provide finance managers and operational staff with the needed business information, reporting and simple data analysis tools. Reduce the manual, semi-manual work of current sales departments, and support sales management.

**Data analysis mining:** it provides the environment and tools for business analysts to obtain data, establish models and analyze problems. The analyst can make use of regression analysis, time series models, neural network models, Bayesian methods, seasonal model to make analysis and forecasting of business data; cluster analysis and discriminant analysis can be used to make classification analysis towards the welfare lottery sales network. Some analysis models will be developed gradually according to the business development and data analysis requirements. This function module is mainly used by marketing analysts.

## *3. The data warehouse architecture of business intelligence systems*

The data warehouse architecture determines the business intelligence systems architecture. There are many kinds of data warehouse architecture; the commonly seen ones are Data Mart Bus Architecture, Federated Data Warehouse Architecture, Hub-and-Spoke etc. The advantage of bus architecture is that this architecture can guarantee to ensure the consistency of business data in the process of the gradual establishment of data mart. But, of course, the bus architecture also has shortcomings. The central data warehouse is preserved as dimensional model, and there will be limitations for special non-dimension analysis applications for the bad support. Federal framework must adopt a method which is similar to the bus architecture at the beginning of the establishment of the data warehouse in order to achieve data consistency. Otherwise, data inconsistency may appear and this may lead to incomplete integration. The structure of "Hub and Spoke" means that the system has collected the data from all kinds of business processing systems, at the same time it is also responsible for providing information to the dependent data mart, so it looks like a hub; but the operational staff will get connected to different data mart according to the needs when conducting data analysis and information access, so it looks like a Spoke when doing this kind of cross complex connection. According to business needs and information status of the lottery center, we believe that the way of the Hub and Spoke architecture is the ideal choice. Data warehouse architecture of Shanghai Welfare Lottery Center business intelligence system is shown as in Figure 2.

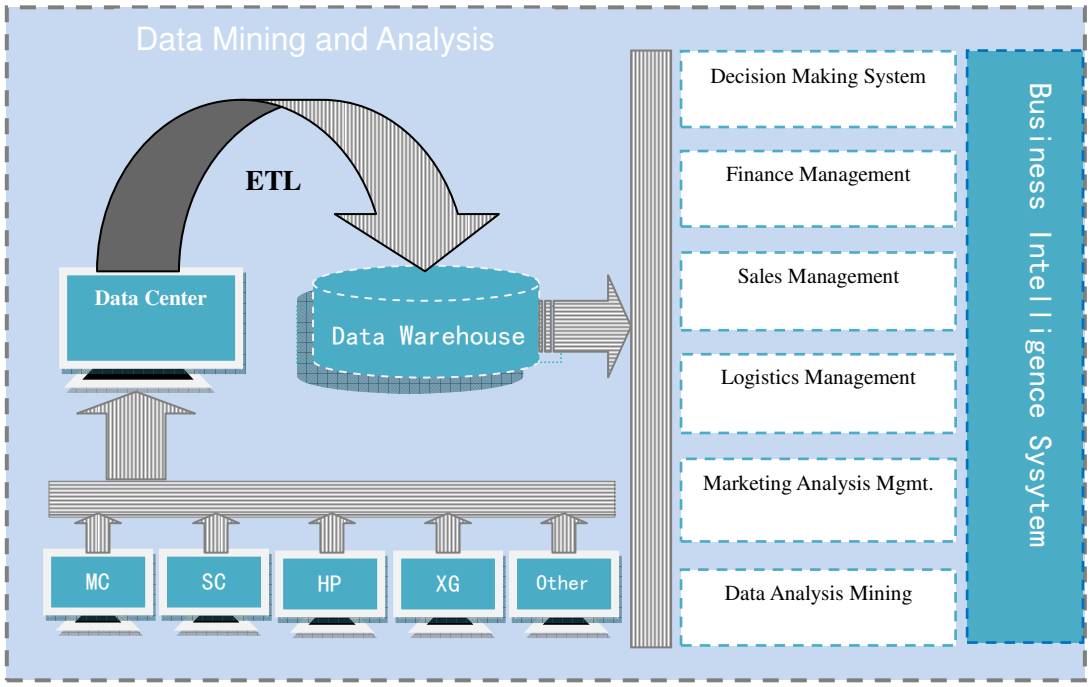


Figure 2 Data warehouse architecture of SWLIC business intelligence system

## *4. Applications Topics analysis of data warehouse*

The data warehouse is the foundation of business intelligence data mining. Through the establishment of the market forecast analysis model, the analysis of various types of historical data of lottery sales, the master of the characteristics of lottery sales and ranking, the effect of marketing and sales results can be conducted. The data warehouse server can quickly analyze up to several billions of lottery sales results of the historical data, which can help companies make decisions, launch proper products in line with customers' demand. By personalized design, different people can get the report form and content they want to see.

The data warehouse is subject-oriented database, the function of the system can be fully developed by research on the application topics. Lottery sales is a complex system, and the system environment is changing all the time. We hope to establish the model of a parameter change according to the changes of environment. The common database can have a variety of statistical information, such as annually, quarterly, monthly report of production, according to certain indicators. However, more advanced intelligence database, in addition to the statistical functions, also has advanced features such as analysis, learning, prediction. Lottery sales forecast is extracted from the regularity in historical lottery sales data, and use this regularity to forecast future sales.

Lottery sales data has a clear periodicity, because the lottery dates are fixed. Lottery sales data with both the growth trend over time, but also has the same seasonal characteristics to the volatility trend, growth trends are often not simple linear regression, volatility trends also show a complex non-linear sexual function characteristics. Therefore, it is difficult to single fixed prediction model to describe the complexity of these two different trends. In summary, the lottery sales data is a complex time series. Combination of these characteristics, we believe that we can analyze the characteristics of business data from the following aspects.

**The sales characteristics of each district and county**: Aggregate the product sales in all outlets in accordance with the administrative area of Shanghai. Examine each district's sales levels by means of per capita purchases, the population of the stand-alone service and the increased sales ratio. In addition, the comparison of these indicators and previous years of historical data can be taken.

**Correlation analysis between the products:** Shanghai's existing product range is divided into three categories: computer lottery, instant lottery and lottery online. We conduct comparative analysis of our three categories of products and its breakdown product sales in all districts and counties to draw the data we need, such as sequential growth, year on year growth, market share etc.

**The bet number analysis:** the lottery players have their own different spending habits and characteristics when purchasing lottery tickets. Different lottery players may take different approaches. Whether is directly to the spot or through sending SMS. Whether is simplex or duplex at each bet? We believe that the behavior of the Lottery provides a supporting role for the development of new products from the perspective of behavioral economics.
**Analysis of the winning numbers:** the statistical analysis of frequency of the winning numbers according to the historical data will help the lottery players develop a rational purchasing strategy to a certain extent. And it can also increase the interest and attention of the lottery players, which can do good for the lottery sales.

**The analysis of welfare lottery products and sports lottery products:** because there are many similarities between welfare lottery products and sports lottery products, so the different data of the sports lottery products can provide certain help for the sales of welfare lottery products. For example, through the comparison between the sales proportion of instant lottery in Sports Lottery and the sales proportion of instant lottery in Welfare Lottery, reference can be provided for the enhancement of welfare lottery instant lottery market share.

## *5. Conclusion*

Business intelligence system provides a feasible way for the welfare lottery center to comprehensively utilize business data and management data for scientific decision-making. The first and second section discussed the overall architecture of the welfare lottery system and gave the functional architecture of business intelligence system. And on this basis, the BI system data warehouse architecture is given, and the detailed analysis of the related applied theme is done. The study of this article can provide theoretical support and reference for the implementation of the related airport business intelligence systems.

## *References*

Negash, S (2004). *Business Intelligence: Communications of the Association of Information Systems.* 13: 177–195.

F McFadden, H.J Watson (1996). *The world of data warehousing: issues and opportunities Journal of Data Warehousing*. 1(1):61–71.

Zhang Shuming (2009). *Discussion of Data Architecture Design for Data Warehousing: Information and Communications Technologies.* 6:11-15.

Thilini Ariyachandra, Hugh J. Watson (2006). *Which Data Warehouse Architecture Is Most Successful: Business Intelligence Journal.* 11(1)4—6.