

SOA IMPLEMENTATION IN PASSENGER TRANSPORT MARKETING AIDED DECISION SYSTEM

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Abstract: Business Intelligence (BI) technology is researched in the first part of this paper, and application with Service-Oriented Architecture (SOA) is built with IBM Cognos BI components to implement Railway Passenger Transport Marketing aided Decision System, which providing intellectual query and analysis solution for China Ministry of Railway and all railway bureaus in China. Finally, A development flow of multi-dimension cube and its application of analyzing railway passenger data is presented to describe the flexibility and high reliability.

1 INTRODUCTION

Railway Passenger Transport Marketing aided Decision System (RPTMD) is used for collecting passenger transporting information and processing data, which can reflect railway transport capacity, passenger send count and income, etc. There are many kinds of complex business data, so Business Intelligence technology is introduced into this system to provide a united data view, and user administration function based on role with light directory access protocol (LDAP). The China ministry of railway, bureau and station are authorized to visit data and analyze railway transport information to predict the passenger flow trends, which can help the supervisor to make an optimized decision. Here we make a research on Cognos BI platform based on RPTMD.

2 BUSINESS INTELLIGENCE

Business Intelligence (BI) was first supposed by Howard Dresner of Gartner Company in 1996. BI is an enterprise solutions integrating data warehouse, OLAP and data mining, which aims to collect data from different business system. Extracting, transforming and then loading into data warehouse, which is an ETL process (Kimball and Ross, 2002).

Via query and analysis tools, data mining and OLAP tools to analyze, which can product knowledge to support managers to make decision. Nowadays, BI products include data warehouse, data extracting tools, OLAP tools and presentation tools and their integration (Han and Kamber, 2001).

2.1 Cognos

Cognos is a BI platform built on WEB application, which composes three components: BI Modelling, BI Server for Reporting, BI Server for Analysis. It also can be divided into four logical layers (Volitich, 2008).

- Data source layer: Data source layer includes business database, data market, data warehouse, cube and other non-relational data.
- Model layer: This layer provides two functions, one is defining logical model using metadata to make user apprehend easily, the other is to build cube with pre-defined dimension and set permissions to all of the roles.
- Application server layer: Both BI Server for Reporting and BI Server for Analysis publish model and cube by Web services, query model is linked to cube by “drill-through”.
- User layer: User layer is a virtual layer to describe authenticated users who can query and analyze.

2.2 Integrate BI with Decision Support System

Recently years, BI technology is commonly used in decision support system. Decision is a complex process that persons participate in and take many aspects into account, such as passengers' demand, flow prediction and marketing analysis, make a certain aim with restrictions and search relative cases in decision history. In this system a generalized model is built by analyzing relative cases. Integrating BI and decision support system makes human and computer complementary. (For instance, man-machine conversation is often used to diagnose the boundary condition when solving an ambiguous boundary problem.)

BI is also able to simulate reasoning mechanism on the basis of demand, through man-machine conversation and related rules. Furthermore, BI leads decision makers to select appropriate model. Decision makers can get information by so-called information push and pull technology, navigate the system, query and analyze data and authorize the roles.

3 APPLY BI IN RPTMD

3.1 Function

Passenger Transport Marketing aided Decision service to Ministry of Railway, railway bureaus and stations. The users are staff of passenger transport company in China, who demand for:

- Easily access by Web. There are 18 bureaus and thousands of stations in china. However, Data are gathered in Ministry of Railway, system must be Browser and Server architectural to be convenient for maintain.
- Loosely coupling software architecture. Changing on demand and service oriented application are required in modern enterprise, which appeals for software designer building loosely coupling software and publishing business with accessible services. It's preferred to develop software with SOA application composition (Newcomer and Lomow, 2004).
- Flexible analysis basis on schema and multiple representations. Railway passenger transport indexes are flexible. For example, passenger send count can be viewed in many

dimensions, such as ticket type, seat type, train type, depart time, etc. Otherwise, there're also many layers (time dimension includes year, quarter and month). In a word, business data is a multi-dimensional information and suitable to described by super cube (or multi-dimensional cube). In a word, every cube is a schema reflecting business in reality.

3.2 Network Topology

A clustered network structure is used for getting through fastigium. Business logic and Cognos portal applications are running on Web application server, several BI servers support BI analysis service with cluster structure and scheduled by Web application server. A content database is installed in content manager server, which initialized by Cognos configuration tools. LDAP service is running on Directory server to supply directory managing and certification based on role.

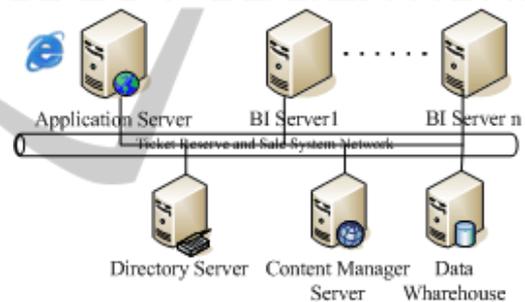


Figure 1: Network topology.

Under control of a directory manager server, users are able to browse the permitted directory. When users logged in the website, the request is dispatched to directory server, and a session including user information is stored in the namespace.

After a signal of self-help query or browse a report is sent, the request dispatches among these BI servers, load balance is kept by gateway with weighted distribution strategy. Finally, the request will be sent to a relatively SOA composition application development.

As Cognos supports Web Service interfaces and open service contracts, a SOA System can be composite with Cognos. As Javier et al. (2010) content that Business functions are provided with SOA models, and application developers can loosely access all the available services, shorten the

developing cycle and reduce expenses and emphasize more on business problems. As shown in figure 2, Cognos kernel service and Passenger Transport Marketing aided Decision service are registered in service base with WDSL. When a user log in a sub system of RPTMD though client gateway, the client gateway will search for costumed server relative services in sub-system, such as viewing reports based on report service, report data server and batch report service, or designing query based on report data service and managing users and defining function options based on Content manager service. However, nothing service detail is necessary but service contract for developers.

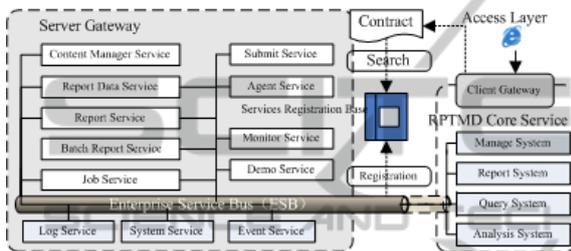


Figure 2: SOA synthesise application development.

4 DEVELOPMENT

A developing case of Cube is introduced to explain Cognos Multi-Dimensional Analysis development technique, and the develop flow is shown in figure 3.

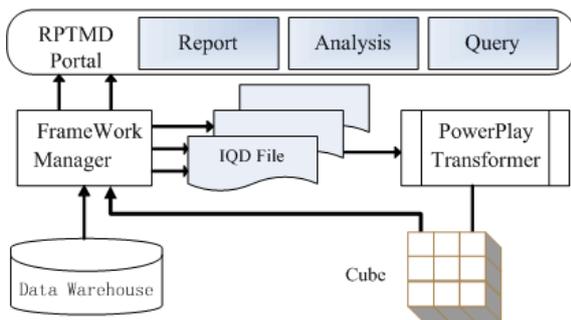


Figure 3: Multi-Dimensional Analysis development.

4.1 Data Source

A connect preference is set up to define destination business database or plain file. There are two ways to define, one is to select “running metadata wizard” option in Namespace by Framework Manager, the other is to open Cognos Connection interfaces, then

select “directory” option in tools menu, click icon “new datasource” in “datasource” page to create a new datasource. Oracle, MS SQLServer, Sybase and ODBC are supported by Cognos.

4.2 Metadata

A Metadata model project can be created by using Framework Manager with define its name and saving path. Choose the metadata with type “datasource”, and Import the database table for working. After that there’re follow steps is necessary:

- Define table relationship. This step is to define connection condition between imported data tables. When a table is selected and after choosing the option “creating relationship”, another table should be chosen in Query Subject to make relationship. One or more table field will be involved in relationship. There are four kinds of relationship including 1:1, 1: n, 0:1 and 0: n. The former two kinds represent a common join relationship in database and the later two kinds represent an outer join relationship.
- Create view. When a Namespace is selected, right button of mouse should be clicked and menu option “Create” should be selected to create a Query Subject. Firstly, the view name and type should be defined, and then some useful fields of database table should be dragged in the query subject and renamed to a virtual name.
- Assign externalize method. Sometimes some view has to be published as external file. For example, the Query Subject should be selected, and modify its Externalize Method to IQD, it’s a file format which means external query define.

4.3 Publish Metadata

Firstly, packages category should be selected to create a package. Secondly, package name is needed and related views should be chosen. Finally, “Publish Packages” menu option can be selected while selecting the package. If an IQD file should be publish as an alternate, an optional checkbox titled “Generate the files for externalized query subject” should be checked and it’s saving path is indispensably.

4.4 Create Model

Now a database view is created and can be use for report and query. However, to an extend OLAP application, multi-dimension model is pressed for. As shown in figure 4, firstly, a model name should be defined by PowerPlay Transformer tool and datasource type should be assigned by inserting data source or creating an IQD file. Secondly, dimension and index are defined by dragging database fields into “Dimension map” work zone and dragging database fields into “Measures” work zone. Finally, a Cube definition should be insert into cube by “insert cube” operation in PowerCubes interface.

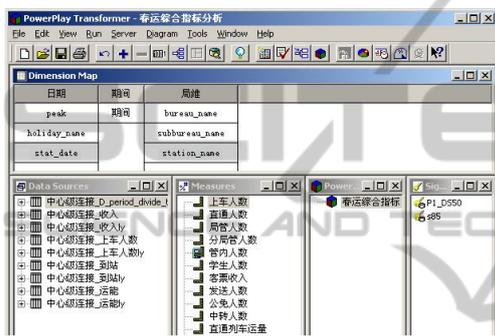


Figure 4: Create Cube.

4.5 Cube

Cognos Cube is including metadata and values data. Metadata is the attributes data of values data and values data are visual data like dimension, layer and class. Cube can be imported into Framework as data source, then a cube file (*.mdc) will be published on web, and the cube will be integrated into model by PowerPlay Transformer tool as a model file (*.mdl). As described in the cube design document, data for query will be load into datasource from data warehouse and dimension view is built which shape the basis of cube. Several IQD datasources are supported in the above process.

Here we make a experiment of Spring festival Passenger transport in China, date and bureau conclude the dimension, the former consists of fastigium, festival and statistic date and the later consists of bureau, branch bureau and station. Index consists of passenger send num, bureau send num, student send num, pre-sale num, seat utilization rate and income, etc. All the indexes can be integrated into a cube as shown in figure5. Users can connect to the portal of RPTMD to create report, analysis and query by themselves.

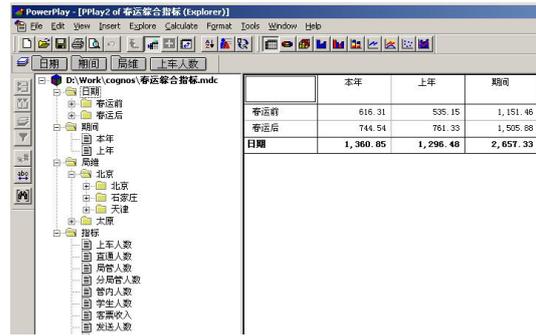


Figure 5: Publish Cube.

5 CONCLUSIONS

RPTMD has provided a large amount of data report and analysis resource for China ministry of railway and all railway bureaus in China. Especially in Spring festival and so-called “Golden week”, RPTMD has produced reports which offered scientific evidence for passenger transport department of railway aided on train plan, transport capacity scheduling, assign ticket reasonably. SOA architecture makes it possible to build loosely coupling system and publish business with accessible services. Furthermore, versatile representation of query and report meets different users’ demands and open analysis tool provides a friendly develop condition. A farther research of BI will be hold for deeply data mining and extracting available information to guide passenger transport plan, which will lead RPTMD embedded into business flow.

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