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A Business Intelligence Solution to Improve Educational Standards and Performance for an Australian State Education Authority

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ABSTRACT

This paper describes the business intelligence (BI) solution developed by TCS using SAS®9 products for an Australian state education authority. The state education authority was in need of an improved BI solution that would support the decision-making and reporting needs of its many internal and external constituents. One of the key outcomes that the authority sought was to provide information that would assist teaching and learning to become more effective. The BI solution provided by TCS enabled the authority to make critical education policy decisions to improve the education performance management and standard in the state.

INTRODUCTION

The last few years have seen the Australian continent emerge as a favored higher education destination for students across the world. Along with higher education, the Australian government is equally focused on the formative years of education. Its regulatory bodies are mandated to design the curricula and its progression over the years, track performance and make course corrections as required to ensure that education and aptitude are aligned. To do justice to this responsibility of educating an entire generation, educationists from these regulatory bodies need data points around student performance, trends over years to make informed decisions.

This paper describes such a solution for an Australian state education authority implemented using SAS®9 Business Intelligence platform.

The state Curriculum Assessment Authority (CAA) is a statutory authority serving government and non-government schools in the state of Australia that reports directly to the Minister for Education. Among its several activities, the CAA is responsible for development of the Preparatory to Year 12 school curricula and overseeing the delivery of, and conducting assessments for a qualification awarded students upon graduation. In addition, the CAA also oversees the delivery and quality assurance of statewide literacy and numeracy assessments at two year intervals, namely Years 3, 5, 7 and 9. It also prepares and maintains student assessment records, which in some cases can combine information from all periodic assessments with students' classroom performance data.

The CAA was in need of improved BI solution that would support the decision making and reporting needs of its internal and external stakeholders. One of the key outcomes desired was to provide information for making teaching and learning more effective. As the solution implementation partner for the authority, TCS was responsible right from concept to rollout.

The authority's unique business processes and legacy applications presented a challenge to the solution team. The solution has empowered the Authority to make informed education policy decisions to improve education performance management and standard in the state. In the process, the Authority has gained valuable insights that it can apply to future projects and share with peers in the field of education.

BUSINESS NEED

CAA's existing system was not capable of supporting longitudinal student performance data analysis and reporting. The data was stored in multiple operational tables, preventing efficient integration and aggregation on demand. The authority was looking for a comprehensive solution on a proven BI platform to:

- Establish generic processes for assessment, registration, enrolment and qualification to support the changing education environment
- Create a Preparatory to Year 12 student-centric view of information
- Reduce the burden of reporting on operational systems

- Enable users to generate reports without IT assistance, including ad hoc reports

Widen user base beyond authority staff, school principals and administrators to include students, parents and other stakeholders

SOLUTION

The implemented solution leverages the Business Intelligence capabilities of SAS®9 product suite to deliver an integrated BI platform right from data acquisition to information delivery. The following sections describe the solution subsystems

DATA AQUISITION

Transaction data like student registration, student enrolment, student assessment, student results is available in the Authority's operational systems. The external data containing Assessor details is also stored within the Authority's environment. Other operational systems include details of transactions related to the qualification, provider, registration, enrolment, assessment, and result.

Operational data from the source systems is extracted using SAS DI Studio into a staging area which allows basic data validation, verification and data massaging before loading to the data warehouse. It consists of two sets of data structures.

Landing Area: Data extracted from authority's existing operational system is held here without transformation. The data model is similar to Operational system data model i.e. qualification centric data model.

Quality Assurance (QA) Staging Area: Data is loaded here with transformations required by the data warehouse's dimensional data model. The data model for Staging is very generic and is a student centric data model as compared to qualification centric data model

DATA STORAGE

This is the central repository for decision support data across the authority and consists of following two layers:

Dimensional Layer: It stores data required to facilitate reporting and analysis in the facts and dimension tables. Data in this layer is loaded from the Staging area. The data in this layer provides longitudinal student information (Preparatory to Year 12)

Derivation and Aggregation Layer: It stores derived and aggregated data from the Dimensional layer of the Data Warehouse. This layer has aggregated data for advanced statistical analysis.

DATA MOVEMENT

SAS Enterprise DI was used to extract, transform and move data from one subsystem to another. All ETL jobs were designed in SAS DI Studio. SAS Management Console was used to deploy workflows modelling job dependencies. The job execution was scheduled and monitored using LSF scheduler and LSF Console respectively.

INFORMATION DELIVERY

SAS Enterprise BI server provided users information on-demand by allowing them to author and share reports, includes charts and plots and schedule reports.

SAS Web Reports Studio was used for online reports and Enterprise Guide for ad hoc reports. User authentication is enforced through SAS Web Report Studio using an LDAP based Microsoft directory. SAS Metadata server is integrated with this directory for authentication. The authorization of various reports for different users is configured through SAS Management Console.

SOLUTION HIGHLIGHTS

- Expected life of the system - 10 years
- Percentage growth in concurrent users per year - 1%
- Data warehouse size - 2.5 TB
- No. of advanced analytics power users - 60+
- No. of business analysts - 60+
- No. of concurrent users – 10

PRODUCTION SERVER CONFIGURATION

Server	Software Configuration
Web Server	<ul style="list-style-type: none"> IIS 6.0
Application Server	<ul style="list-style-type: none"> IBM WebSphere 6.0.2
Database Server - Operational	<ul style="list-style-type: none"> Oracle 10G Enterprise Edition Toad 7.5 or higher Design tools (ERWin or QDesigner) RAC for 10g
Database Server - Data warehouse	<ul style="list-style-type: none"> Oracle 10g Enterprise Edition Toad 7.5 or higher Design tools (ERWin or QDesigner)
SAS DI Server	SAS Enterprise ETL Server C Class
SAS BI	SAS Enterprise BI Server B Class
SAS Metadata Server	SAS Enterprise BI Server B Class
SAS Client	<ul style="list-style-type: none"> SAS enterprise Guide Oracle 10g Client
SAN Drive (Clustered)	<ul style="list-style-type: none"> Clustered Software Clustered Switch Fabric

BENEFITS OF THE SOLUTION

The solution has resulted in the following three major areas of benefit:

SAVINGS ON TECHNOLOGY

Each November the Authority evaluates assessment data for more than 65,000 students. Each test, with its multiple questions and responses, results in millions of records being created. Reporting on this volume of data required substantial resources of the operational systems. With the new solution, the Authority has been able to relieve the operational system from the burden of reporting workloads, which has also resulted in the elimination of the dependency on the old, substandard reporting software. The IT group has also been able to consolidate the data warehouse and query, reporting, and analysis technology, thus optimizing ongoing maintenance and management costs.

The solution's generic data model for the data warehouse allows easy incorporation of ongoing changing end-user requirements. For example, there is now only one set of enrollment tables, rather than having different set of tables for each qualification the Authority delivers. This standardized data model reduces implementation time, cost, and therefore risk. When changes do occur, the Authority can now effectively address them with internal staff or by utilizing local contractors.

PRODUCTIVITY GAINS

The Authority has benefited from the solution flexibility both at the ETL and end-user BI layers. For example, IT now has greater flexibility in timing ETL jobs, including running them on a daily basis or periodically running less-frequent batch jobs. The newly deployed report development environment enables business analysts to address end-user (administrators and teachers) needs directly, rather than relying on IT. For example, comparing test results for a group of students from one school with their test results during the previous year at a different school. In the past, this type of request would have required lengthy custom development of a new report. With the new system, an ad hoc query can be run to respond to the inquiry almost instantly.

OPERATIONAL PROCESS IMPROVEMENTS

The most important benefit to the Authority has been the availability of query, reporting, and analysis functionality based on an integrated set of historical and current data that allows the Authority to demonstrate the effects of the curriculum and teaching on student performance. The data warehouse provides a student-centric view by tying all historical records to a single student ID. The resulting "single version of the truth" enables tracking of performance from Preparatory to Year 12 for each student or groups of students. The analysis of the data can also be used to target improvement of students with learning issues by the most appropriate educational programs. The newly gained insight is also enhancing the Authority and individual schools' ability to allocate funding and resources more efficiently.

CONCLUSION

The above mentioned BI Solution along with strong SAS® tool capability provided the authority with operational and long term benefits of a Data warehouse solution which in turn will work as backbone for major external and internal curriculum based decisions for the state

CONTACT INFORMATION

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