



**SOUTH CAROLINA
TECHNICAL COLLEGE SYSTEM**

**ENTERPRISE DECISION
SUPPORT SYSTEM**



Contents

CONTENTS	2
1. INTRODUCTION.....	3
1.1 MISSION-CRITICAL PROCESS	3
1.2 LEGACY SYSTEM CHALLENGES.....	4
1.3 MISSION-CRITICAL SOLUTION.....	5
2. INNOVATIVE FEATURES.....	6
2.1 DATA WAREHOUSE FOR EDUCATORS AND ADMINISTRATORS.....	6
2.2 CONFIGURABLE DATA ACQUISITION AND VALIDATION.....	7
2.3 COHORT SUBSYSTEM FOR GRADUATION RATE ANALYSIS.....	10
3. iSOLUTION SUITE® FOUNDATION	12
4. ABOUT TiBA SOLUTIONS.....	13

iSOLUTION™
Methodology

1. Introduction

The South Carolina Technical College System (SCTCS) is an educational and economic powerhouse for the state¹. SCTCS is producing graduates in critical workforce areas, improving overall quality of life for its citizens, and enhancing economic development. Through its credit and continuing education enrollment, SCTCS touches nearly one in 14 South Carolinians over 18. For example, in the fall of 2005 49% of all undergraduates in the state's public higher education institutions were enrolled in the S.C Technical College System. In fact, since 1995 SCTCS has enjoyed 70% of all public undergraduate growth in South Carolina. This strong technical college system, with its reputation for providing innovative, high-quality workforce training opportunities as well, is recognized as a magnet for attracting business opportunities integral to South Carolina's economic development efforts.

SCTCS includes sixteen technical colleges distributed throughout the state, and a System Office located in Columbia, South Carolina. The management and staff of the System Office provide direction and support for SCTCS in its educational mission, and also serve as an interface to other governmental agencies on behalf of the colleges. Given the large numbers of students educated by the system, its critical contribution to the business community, and the vested interest of citizens and government, there is an ever-growing demand for information, analysis, reporting, and decision support capabilities.

1.1 Mission-Critical Process

In order to fulfill the reporting mandates of federal and state legislation, data from the sixteen member institutions is compiled at least twice each semester. The compiled data, both academic and operational, has to be validated, processed, and submitted to appropriate state and federal agencies. The System Office performs this service on behalf of the sixteen technical colleges.

This college data is used by the state to provide indicators of mission performance, to determine state funding based on performance, and to provide a basis for shaping educational programs and policies.

In addition, as with all U.S. institutions of higher education, the data is required for submittal to the National Center for Education Statistics (NCES), Integrated Post Secondary Education System (IPEDS) in compliance with federal reporting mandates.²

¹ South Carolina Technical College System website (<http://www.sctechsystem.com>).

² National Center for Education Statistics website (<http://nces.ed.gov>).

1.2 Legacy System Challenges

The System Office recognized that the tools it was using for this mission-critical process were not up to the task:

- System Office staff used a mixture of outdated and/or limited technologies to acquire and process college data.
- Validation programs, reports and other software tools used in the process were highly manual, and based on technologies that were becoming obsolete or difficult to support in the IT marketplace.
- Data had to be fragmented into separate data stores for processing, and data correction processes were convoluted.
- The overall process of submitting validated data to other agencies was labor-intensive, and required too much elapsed time in a tight deadline environment.
- Internal use of the data was also cumbersome and limited.
- There was no centralized data repository for data for analysis and research. When a researcher or state legislator raised a question about enrollment or financial assistance to students, a new report had to be developed, which was time-consuming and an inflexible, inefficient use of resources.
- Transmittal of data from colleges to the System Office was being accomplished via plain-text files transferred over the State Wide-Area Network without encryption. These transfers included sensitive data such as student and instructor personal information, and state and federal privacy policies were mandating the elimination of this vulnerability.

A more efficient process was needed for acquiring, validating and submitting college data for compliance purposes, and the data needed to be more accessible for internal analysis, research and business reporting. The System Office concluded that their existing technologies and processes had reached the limits of their capabilities.

1.3 Mission-Critical Solution

To establish a more efficient and reliable system for collecting, checking, storing, archiving and reporting college data, a new browser-based data management and reporting solution was proposed. The new system, designated the Enterprise Decision Support System (EDSS), was phased into operation over the course of several semesters, with ownership and technical support transferred to the System Office at the end of Spring semester 2006.

With EDSS, the South Carolina Technical College System is well-equipped to provide the indicators of mission performance required for state funding, and to maintain compliance with federal reporting mandates, including Graduate Rate Survey (GRS) data required by the National Center for Education Statistics.

The system is hosted at the System Office, and is accessible to member institutions and authorized agency personnel via the State Wide-Area Network. It is accessed only by SCTCS, and is not accessible to the public. Executives, academic staff and business users are routinely and securely accessing current and historical institution data – on demand, on line and from anywhere within the State Wide-Area Network – using standard web browsers.

Today, the mission is the same, and SCTCS continues to support compliance with state and federal accountability mandates, performance measurement, internal reporting and research. But the tool set is state-of-the-market, flexible, and capable of supporting continued growth. The solution was developed for SCTCS by TiBA Solutions.

2. Innovative Features

The innovative features of the Enterprise Decision Support System have greatly increased SCTCS effectiveness and productivity in using this strategic information resource.

2.1 Data Warehouse for Educators and Administrators

EDSS delivers a forward-looking data warehouse system built with state-of-the market technologies for educators, administrators, and executive decision makers. The South Carolina Technical College System Office and sixteen technical colleges are using EDSS to meet compliance and funding requirements, conduct internal analysis and research, and continually improve educational programs and policies.

Features include:

- Import, validation, and storage of enterprise data extracted from external technical college business systems. This data spans multiple subject areas, including Student Enrollment and Completions, Student Scholarships, Courses, Faculty and Staff, and Facilities.
- Inclusion of system-wide financial and human resource data previously housed and processed separately. This enables integration of human resource employee data with course instructor data.
- Housing of current and historical data from all colleges. Data is organized to support routine business reporting as well as ad-hoc research queries, and to facilitate system-wide studies as well as individual institution statistics.
- Comprehensive tools for forming, tracking and reporting on cohorts for the Graduation Rate Survey.
- Flexible on-line reporting for defined subject areas, with user-selected parameters to control the breadth, depth and sub-grouping of the data reported. Subject areas include Student Enrollment, Courses, Faculty and Staff, Facilities, Financial Aid Disbursements and System Office Finance.
- Report Configuration components facilitate the addition of new reports and allow the presentation layout of a report to be specified.
- Comprehensive and highly configurable application security that controls access to import, reporting and configuration features.

EDSS is a browser-based data warehouse application, developed using Microsoft's .NET Software Development Framework, SQL Server Relational Database Management

System, and TiBA Solutions' *iSolution Suite*® of development tools and reusable components. Application logic is implemented in the C# language, and in database stored procedures using T-SQL. Users interact with EDSS via standard web browsers to initiate imports of college data, view reports and maintain system configurations.

2.2 Configurable Data Acquisition and Validation

Authorized personnel at member institutions are initiating and tracking the secure transfer of institutional data to a centralized data repository, subjecting the data to a set of powerful and configurable validation rules, and employing a disciplined process to review and release the data for business use.

Data Acquisition

Technical colleges manage and maintain academic and related information in academic business systems specific to each college. In the pre-EDSS environment, data was extracted from these autonomous systems into flat text files by custom-built programs executing locally at each college. IT personnel at each college then uploaded these flat files into the VAX-based environment at the System Office.

Concurrent with the EDSS project, the System Office made plans to build a new generation of college extract processes that would be capable of streaming extracted data directly to EDSS, thereby replacing legacy flat file extracts and imports. EDSS, through the use of Service Oriented Architecture (SOA), supports both streaming and legacy flat file extracts, using a predefined exposed interface known as a Web Service. The benefit of using a Web Service is that the caller of the service does not know, or need to know, how the software behind the service is implemented. In addition, the service does not know, or need to know, specific aspects of the caller environment. Web Service-based transfers of legacy flat files, and data streams, are implemented with secure sockets layer (SSL) technology to ensure secure transmittal of sensitive data, such as student and faculty personal information, over a wide-area network.

A college import consists of one or more related flat files that could reside anywhere on the college's local-area network. EDSS was designed to enable college-based users to easily initiate imports regardless of local file locations or naming conventions. To import data, a college user logs into the EDSS web site, specifies a context by which the file set will be uniquely referenced (such as the year and semester imported), selects the local files to be imported, and tells the system to begin the import.

The web application invokes the EDSS import Web Service, which transfers the files from the college to the EDSS host, and begins validating the contents of each file. The user is presented with an in-progress message, and can then use one of several utility reports to check import status. In addition, EDSS can be configured to send email notifications of import status to college-based or System Office users having an interest in the data being imported.

College-based extract programs can invoke the same Web Service programmatically, sending an XML-based data stream that includes the college, year and semester context as well as the extracted business data. Extracts can be scheduled for automatic execution, and user initiation of imports can be eliminated or greatly reduced, while all downstream processes such as email notification, viewing of status reports, and validation remain the same.

Data Validation

New data being imported into EDSS must be checked, and data errors must be eliminated before the data is made available for business reports and other uses. In addition, key college personnel need the ability to review the data, verify that it is complete and consistent with known business conditions (such as enrollment levels), and accept accountability for the data.

EDSS employs a structured, multi-level, approval process with three distinct sequential validation levels. A set of imported data must be successfully validated at a lower level before validation can begin at the next higher level. The three levels are listed below:

- **Level 1, Record Checking** utilizes programmatic checking of the new data by EDSS, at the individual record level. Validation ranges from simple data type checks (*for example, does a date field contain a valid date string*), to referential integrity checks with respect to standardized codes (*for example, does a record refer to an undefined degree code*), to complex consistency checks across multiple subject areas (*for example, actual financial aid disbursements versus student financial aid qualifications*).
- **Level 2, Accuracy Verification** provides a review of new data by subject matter experts, using EDSS reports defined for this purpose. The objective is to provide a “human sanity check”, to ensure that the new data accurately reflects the business conditions it is intended to reflect (*for example, total enrollment headcounts may look correct, but the percentage of students designated as first-time freshman may not look correct*). Programmatic checks, such as those in Level 1, are not an optimal way of recognizing this type of inconsistency. Through verification, data owners can review and approve their data before it is released for general use, thereby assuming accountability for data accuracy.
- **Level 3, CHE Acceptance** is the export and submittal of certain parts of the new data to the South Carolina Commission on Higher Education³ (SCCHE). SCCHE performs its own checks on the data, and notifies the System Office of the outcome (alternatively an SCCHE representative could be authorized to approve or reject the data directly as an EDSS user). SCCHE uses the data in the determination of state funding for SCTCS.

Each college controls its own validation and approval process with an easy-to-use EDSS configuration capability. A college can require one, two or all three levels of validation for its data. The college can also designate one or more business data owners to be

³ South Carolina Commission on Higher Education website (<http://www.che400.state.sc.us>).

accountable for the data and require their approval before the data is allowed to be accessed by the user community.

Validation of imported data is important because mistakes or inconsistencies in college data are inevitable. These errors typically exist in the college business systems that are the source of the data, and must be corrected in those systems. A successful import usually requires more than one upload-validation-correction cycle. To minimize the number of iterations, EDSS is designed to detect as many validation errors as possible in a given cycle. For example, even though an error in one field of a data record is detected, EDSS will continue checking other fields and other records to the extent possible in the same data file.

Data from a college is imported as a set of related subject-area-specific files, (for example, student enrollment, courses, financial aid disbursements, and building and room usage). Each college initiates the import of its data on a when-ready basis. The individual files can be uploaded separately at different times. EDSS will recognize which validations can be performed with the available data and which validations can be performed only when all files have been uploaded. Partial validations are performed in a cumulative manner, until all files have been received and validated.

EDSS supports both configurable and programmable validation rules:

- Simple data type checks and referential integrity rules can be configured by knowledgeable users from the application's configurable, pre-defined, and user-selectable validation checks (*for example, a birth date can be checked against a date range, or a funding code can be validated against a set of pre-defined accounting codes*). No programming expertise in C# or T-SQL is required. This capability utilizes the *iValidation*® framework from TiBA's *iSolution Suite*®.
- For more powerful validations that require more complex operations, EDSS uses another of TiBA's *iSolution Suite*® modules – *iDEC*® – to deploy a snippet of code independent of the source code of the application. An entry-level developer can create several lines of C# code in a text box. The code is stored in the database and the EDSS application compiles the code and integrates it into the automated validation process. *iDEC*® can even be used to invoke database stored procedures (T-SQL) to perform checks that require complex SQL operations. The developer need not be concerned with classes, assemblies or other aspects of a software development environment.

When validation of a set of import files has completed, EDSS generates an on-line report of validation errors, for use as a task list in making corrections. As validation progresses to higher levels, EDSS generates another on-line report to indicate the progressive validation status for each set of college data being imported. If the imported data is rejected, a college makes corrections or adjustments in the source business system, then re-extracts and re-imports the data to EDSS. This import/validation/approval cycle is repeated as needed to eliminate data errors and ensure validity.

When a data set has been accepted at all three levels, the data is moved into the data warehouse, where it becomes available for general use and business reporting.

2.3 Cohort Subsystem for Graduation Rate Analysis

A cohort, in an educational context, is a group of students who begin their education at the same time. Each cohort is tracked through its years of higher education experience, and this information is valuable for college, state, region, and federal analysis (*for example, the relative success rates of various student groups*). In particular, Graduate Rate Survey (GRS) data is provided to the National Center for Education Statistics per federal reporting requirements.

This previously labor intensive and tedious effort has been replaced by the flexible and powerful EDSS Cohort Subsystem, which provides SCTCS with a comprehensive tool for automatically forming, tracking, and reporting outcomes for a cohort. To support cohort processing, the EDSS Cohort Subsystem includes background processes, data entry forms, and managed data, including historical records of changes in student status and when they occurred.

For each college, a new GRS Cohort is automatically formed by EDSS each year, using the routine import of fall semester data. Cohort members are defined as first-time freshman who are enrolled full-time in a fall term and who are 'degree-seeking' (that is, students enrolled in degree, diploma, or certificate programs), but who are not transfer-in students.

The completion (graduation) outcomes of cohort members are tracked over three years. At the end of this tracking period, four primary statistics are produced:

1. **Completions:** The number of students in the cohort who earn a degree, diploma, or certificate within a specified period of time. This includes students who successfully complete a two-year equivalent transfer-preparatory program defined as an AA/AS degree. This is used as a key indicator of success in the education process.

Completion status is determined automatically from imported graduation data collected in September, reflecting degrees, diplomas, and certificates awarded to students as of August 31.

2. **Transfers:** The number of cohort non-completers who were identified as having enrolled in another institution (transfer-out students) during the tracking period.

Once a student transfers out, the student will always have transfer-out status for GRS Cohort tracking purposes, even if the student transfers back into the institution in the future.

Transfer status is captured using an on-line EDSS data entry form and can be done by the college any time during the year as status changes become known.

3. **Exclusions:** The number of cohort non-completers who were identified as having left the cohort institution for one of several pre-defined reasons (*for example, enlisted in the armed forces, deceased, or disabled*).

Exclusion status is captured using an on-line EDSS data entry form and can be done by the college any time during the year as status changes become known

4. Still Enrolled: The number of cohort members that are still enrolled after the end of the cohort's tracking period (not including successful completions, transfers, or exclusions).

Still Enrolled status is determined automatically from imported data collected in September for the fall semester.

When the tracking period for a GRS Cohort ends, the cohort is frozen by EDSS and changes in status are no longer accepted for members of the cohort.

The EDSS Cohort Subsystem generates a set of four reports to be sent to the National Center for Education Statistics: two reports that constitute Section III of the IPEDS GRS survey, a report that mimics the IPEDS GRS Worksheet, and an IPEDS GRS detail report. These reports are used in lieu of IPEDS forms that were completed via a semi-manual process in the pre-EDSS environment.

In addition to final statistics after tracking period closure, interim statistics can also be examined during the cohort tracking period. This provides a "snapshot" of completion rates at a user-selected point in time (the "As-Of" semester) and is based on historical data from the time the cohort was initially formed up through the opening of the "As Of" fall semester. The snapshot ignores any cohort status changes that occurred after that point in time and performs its calculations based on the status of each cohort member at that point in time. Snapshots reflect how cohort status would have looked if status changes had ceased to occur after the selected point in time. Snapshot reports executed at different times during a cohort's tracking period can yield different results, due to status changes occurring between reports.

Methodology

3. *iSolution Suite*® Foundation

EDSS leverages TiBA's *iSolution Suite*® to deliver key capabilities. Below is an overview of the *iSolution Suite*® modules employed:

- *iFramework*® streamlines the complexity inherent in the powerful .NET Framework with a set of reusable components and extensions, providing a standard quality implementation for high-usage application capabilities.
- *iSecurity*® is a privilege-based, proactive, application-level framework that provides authorization for an action down to a single line of code. *iSecurity*® not only provides authentication and authorization for individual applications but can also be used as a single sign-on repository for multiple applications.
- *iDEC*® is a module that supports the storage of code snippets in the database to be called at run time, thus facilitating complex validation rules that can be changed without recompiling the application code.
- *iValidation*® is a framework to define and execute simple data type checks and referential integrity rules from a list of configurable, pre-defined, and selectable validation options.
- *iForms*® provides a rich set of custom user interface controls used to generate database-driven data entry forms.
- *iReports*® is a reporting publisher that integrates with multiple reporting vendors (including Microsoft Reporting Services and Crystal Reports) providing consistent user interface screens for parameter collection and report display. *iReports*® uses *iSecurity*® for authorization to execute reports and *iForms*® to configure the user interface screen for entry of report parameters. This module allows the reuse of a library of legacy reports and greatly reduces the cost outlay to reengineer reports, while at the same time eliminating legacy report development licenses.

4. About TiBA Solutions

TiBA Solutions LLC, headquartered in Greenville, S.C., provides customized information technology solutions for mission-critical business needs. TiBA offers a full line of services: strategic planning, business consulting, project management, and customized software application design and development. These flexible service offerings can be combined to provide a complete tailored solution with a single point of accountability. The effectiveness of TiBA's project approach and technology experience produces solid results – quality solutions delivered on time and within budget.

TiBA Solutions' comprehensive *iSolution Suite*[®] of reusable software modules greatly reduces the complexity and effort required to create a state-of-the-art software application. Each *iSolution Suite*[®] module is designed to integrate into a wide range of applications via a rich set of configurable options that tailor functionality to the needs of the business system. *iSolution Suite*[®] modules have been rigorously tested and extensively documented, thus greatly reducing development effort for new business systems. More importantly, the modules reduce the design decisions required during any application development, such as how to provide application authorization or proper error handling.

TiBA Solutions is a Microsoft Gold Partner specializing in Custom Software Development services for State and Local Government and Education clients. TiBA received the 2006 Winning Customer Award for .Net development from the Microsoft Partner Program.

For more information on EDSS and TiBA's *iSolution Suite*[®], please call David Friedline at (864) 679-3413, or email David.Friedline@TiBASolutions.com.