

*The Optimal Reference Guide*

# **Management of an Education Information System**

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A Best Practices Paper by ESP Solutions Group

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**ESP Solutions Group**



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Foreword

By C. Jackson Grayson, Ph.D.  
 Founder and Chairman of the American Productivity and Quality Center


The pressure for improved outcomes is not going away—either on the instructional side or the business side of education agencies. Outcomes will not improve without changes in processes. Outcomes and processes are linked and interdependent. This resource guide for education agencies on the management of their data is an excellent example of defining the processes that help an organization successfully manage its data.

There are two types of knowledge that help us run our organizations. There is an over reliance upon **explicit knowledge** (e.g., books, web sites, directories, databases, reports). In the education world, there is tremendous **tacit knowledge** (e.g., insights, judgments, experience, beliefs, know-how), which must be shared among the people that manage data. Best practices for data management are more than the explicit knowledge in the published textbooks. This resource guide enables the move into the arena of tacit knowledge by sharing the characteristics of data management that go beyond the technical documentation of definitions, ownership, data exchange, and security. Characteristics such as oversight, data quality, response to change, and user engagement begin to incorporate a value for tacit knowledge. However, by its nature, a written document such as this one cannot convey the wealth of tacit knowledge available across all the people performing data management tasks within education agencies. That knowledge sharing goes beyond a document. That knowledge sharing is what I want to encourage readers to pursue.

Talk to your counterparts in other agencies. Establish communities of practice within formal knowledge sharing networks. Find out what people already know and share what you know with them. Access to data, information, and studies is important, but access to people with knowledge is just as important.

Many years ago, I borrowed from a colleague a chart on managing complex change. With a few modifications, I present it to illustrate that the action plan your agency creates to manage your data will result in change (i.e., improvement) only if the agency also has a guiding vision and champion, skilled individuals, and adequate resources.

 **ESP Insight**  
*Dr. Grayson, a world renowned expert on organizational efficiency and productivity, developed the Baldrige Awards. He has advised U.S. Presidents, corporate CEOs, and ESP Solutions Group on how to acquire quality data for the improvement of the processes that make an organization successful.*

 **ESP Insight**  
*This resource guide enables the move into the arena of tacit knowledge by sharing the characteristics of data management that go beyond the technical documentation of definitions, ownership, data exchange, and security. Characteristics such as oversight, data quality, response to change, and user engagement begin to incorporate a value for tacit knowledge.*

Managing Complex Change/Improvement When These Factors Are Present...				The Result Will Be...
Vision/Champion	Skills	Resources	Action Plan	If you have all four, you have <b>CHANGE</b> .
	Skills	Resources	Action Plan	Without a vision or champion, you have <b>CONFUSION</b> .
Vision/Champion		Resources	Action Plan	Without adequate skills, you have <b>ANXIETY</b> .
Vision/Champion	Skills		Action Plan	Without adequate resources, you have <b>FRUSTRATION</b> .
Vision/Champion	Skills	Resources		Without an action plan, you have <b>NO IMPLEMENTATION</b> .



This document describes how an education agency can organize its resources for effective management of the information it acquires, stores, processes, and reports.

The complexity of an education agency's education information system (EIS) requires a carefully designed governance mechanism. This document describes a set of operating procedures for a model system as recommended from the EIS study process conducted by ESP Solutions Group for several education agencies. The boundaries between the districts' and the state's responsibilities will be described. An initial set of operational policies and procedures are proposed. Recommendations for the on-going operation of the system were compiled from best practices across all states.

### The Big Picture

Data management is one component among many that make up a successful education information system. A significant part of every other component is also directly related to data management principles and practice. Across the states, four steps common to successful implementation of significant improvements in the technology supporting education information systems have been evident.

1. Evaluate the Current Status: ESP Solutions Group has defined a framework for an EIS requirements study based upon direct involvement with and documentation of major efforts across the states. Among the pioneers in EIS are Florida and Texas. In the latest generation with some new ideas are Iowa, Massachusetts, Mississippi, Oklahoma, Nebraska, Virginia, Wisconsin, and Wyoming. Others are joining in as leaders in clarifying specifications and requirements for a successful system. A self assessment is a great start, but tapping expertise beyond a single education agency has been the typical approach. The National Center for Education Statistics sponsors a personnel exchange that has helped states share their expertise. States and districts have also hired professional consulting firms for formal, independent evaluations.

This guide has been converted into ESP's DocGen™ online application to allow an education agency the opportunity to describe its current status and receive a data management plan that includes detailed next steps.

2. Identify the Gaps: The difference between the findings of the evaluation and the benchmarks established through documentation of best practices across states provides a diagnostic profile for improvement.

3. Develop a Plan: From the requirements study, a formal plan with timelines, budgets, and implementation benchmarks can be developed.

4. Implement the Plan: This typically requires a challenging commitment of resources, continual updates, and careful monitoring.

There are five basic technology-based principles for achieving the Max Yield Data (see *ESP's guide for Max Yield Data*) supportive of a state's assessment and accountability requirements. These can be viewed as the technology performance standards for supporting successful assessment and accountability systems. (See *A Technology Framework to Support Accountability and Assessment: How States Can Evaluate Their Status for No Child Left Behind*, Glynn D. Ligon, White Paper for the U.S. Department of Education Secretary's No Child Left Behind Leadership Summit, March 2004, St. Louis, Missouri.)

#### ESP Insight

*Many of the best practices in data management processes discussed here are occurring at the state education agency level; however, they are just as relevant to the local education agency level. Local agencies are challenged to meet not only their state data requirements but also federal and local mandates.*

#### ESP Insight

*The education information system (EIS) is the interaction of people, data, technology, and policy to support data driven decision making.*

#### ESP Insight

*Web surveys aren't enough. States and districts utilize advanced tools like ESP's DocGen™ not only to gather information from the field but also to produce customized output documents. Some examples include personalized district data management plans, interoperability assessments, and data quality audits.*

*If your agency is interested in ESP's DocGen™ services, please contact Mark Johnson at [mjohnson@espsg.com](mailto:mjohnson@espsg.com).*

*Districts can also create a free SIF Implementation Plan by using ESP's DocGen™ available at <http://siftoolkit.espsg.com>.*

#### ESP Insight

*Max Yield Data are those data that everyone agrees are worth the effort and resources to collect, process, analyze, and use.*



*The right data management processes are required to provide the data driven decision maker the right data at the right time.*

**1. Get the right data.** Validity in an accountability system and specifically in an assessment program begins with a precise definition of what is to be measured and what method of measuring it is the most appropriate. No Child Left Behind requires a state's accountability system to be both valid and reliable. In the data world, this means creating common definitions for data elements (e.g., a data dictionary) to ensure that all providers of data report comparable data (same definitions, codes, and periodicity). Getting the right data begins at the school for most education data. Otherwise, nonstandard data (i.e., different definitions, incorrect entry, etc.) can be passed faithfully along throughout the information system, perpetuating the problem.

**2. Get the data right.** Data quality includes but goes beyond accuracy. As just stated, the data must be right from the beginning. All along the way, the data must be correctly exchanged. The proven way to monitor this is with a set of business rules that describe the format, acceptable values, missing data options, and logical comparisons to prior reports. Automated processes that verify data upon entry contribute significantly to accuracy. (Reducing Cycle Time and Increasing Data Quality for Student Assessments, [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com).) On the other end, access to data and formal reports must protect the confidentiality of individuals and be statistically reliable. (The Optimal Reference Guide: Confidentiality and Reliability Rules for Reporting Education Data, February 2005, ESP Solutions Group. Available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com).)

**3. Get the data right away.** The lag time between testing and availability of the data limits the benefits of assessments and is an Achilles heel for assessments and No Child Left Behind. For any data to be useful and used for decision making, they must be current and timely. This is a major new accountability requirement for many state assessment programs. Cycle times of months to over a year were common prior to No Child Left Behind. Current assessment programs in which steps are linear and sequential (finish testing everyone, clean everyone's data before proceeding, then score all tests at the same time, then analyze results, then report statewide simultaneously, then publish all reports together, etc.) may not be the best model for today. On-line, web-based testing is an effective best practice. The initiatives in progress in leading states should be watched to learn how to take on-line testing to the scale required for widespread implementation. A major focus is replacing dissemination with access—making results available on demand rather than pushing them out to everyone at the same time. (*Implications for Collecting, Storing, Retrieving, and Disseminating National Data for Education, Ligon, in U.S. Department of Education, National Center for Education Statistics, From Data to Information: New Directions for the National Center for Education Statistics, NCES 96-901, 1996.*)





**4. Get the data the right way.** The right way to get data these days is through an automated process. Automated processes can verify data quality and ensure standards are met before data are accepted into the state's information system. States must understand that information exchange processes involve complex systems. For example, examining the complete process flow for student assessments clarifies that schools, districts, states, vendors, delivery services, printers, and web designers all have crucial roles in the process. Improvements at any single point in the flow may not be possible without coordination with other participants. (The Supply Chain of State Assessments and Reducing Cycle Time, [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com).)

**5. Get the right data management.** The assessment and accountability systems must be managed well to achieve maximum yield from the data. Data management encompasses a broad range of administrative activities, infrastructure components, and policy commitments. A long-range plan for exchanging data should include policies, funding, human resources, enabling legislation, hardware, software, and networking. A policy advisory committee, a data provider group (user group), and an internal agency coordination group should oversee data management.


Aligned with these five principles, 10 Education Information Technology Framework components will be used as a checklist for a self-assessment and as a starting point for the more formal, independent requirements process. In the sections that follow, each component is defined and illustrated.

### Get the right data.

1. Academic and Other Performance Standards: Standards should describe in measurable terms the outcomes by which academic performance will be measured. Other areas (e.g., human resources, finance, and support services) should also be held accountable using adopted standards and aligned measures.
2. Data Systems: All required data should be included in the state's data systems. Statewide identifiers for students, employees, courses, facilities, programs, finance categories, etc. should be assigned.

### Get the data right.

3. Data Standards: A comprehensive data dictionary should document definitions, codes, and formats to be followed statewide.
4. Data Quality: Formal processes should verify the quality of data each time they are exchanged.

 **ESP Insight**  
*The National Education Technology Plan includes these 5 technology framework principles and 10 components. A color chart that explains the framework principles can be downloaded by registering for ESP Solutions Group's free member services at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com)*

### Get the data the right way.

5. Aligned Assessments and Other Measures: Assessments and other measures of outcomes should be aligned with the academic and other standards adopted.
6. Automated Data Systems: Data should be collected, stored, and accessed using automated systems (e.g., directories, student/school management [student information system, SIS], discipline, program management, food services, transportation, library, finance, human resources, student performance [assessments], D3M [data driven decision making using a decision support system], instructional management).
7. Data Consolidation and Access: Timely and easy access to data and reports should replace dissemination of reports.

### Get the data right away.

8. Electronic Exchange of Records: Records and data should be exchanged electronically among automated systems. Electronic systems should be interoperable rather than requiring translations at each step.
9. Network Connectivity: Schools, districts, intermediate units, and state education agencies should be connected for fast and large data exchanges.

### Get the right data management.

10. Technology Infrastructure: Assessment and accountability systems should be supported by a technology infrastructure built on adequate resources and policy support.


Component 10, Technology Infrastructure, contains the primary data management activities. This is where the remainder of this document will focus.

### ***Recommended Phases for Developing an Education Information System***

When an EIS is adopted, there are at least three major phases for the development of a fully functioning system; the pre-implementation phase, the implementation phase, and the maintenance phase. The following steps are recommended for management of the EIS. Steps (in parentheses) may vary by agency contingent upon the local context.

#### A. Pre-Implementation Phase: Planning, design, funding, political buy-in

1. Create an EIS Standards and Policy Advisory Group to meet periodically to review policy issues and standards, and to make recommendations to the agency for adoption or submission to the legislative process as appropriate. This group should include broad representation of high-level people with policy expertise, e.g., representatives from districts, schools, the Legislature, the SEA, professional educator association(s), and other agencies.
2. Create the EIS Technical Advisory Group to meet as needed to review and make recommendations for implementation issues, such as timelines, priorities, targeted assistance to trailing districts or schools, coordination of vendors or consortia, and compliance with policies and standards. The members need to have a practical understanding of how the schools and districts conduct their business. This group should create subgroups as needed to resolve specific issues and make recommendations to the group.
3. Create an internal EIS Coordination Team to meet monthly to ensure that current collections are phased into EIS smoothly and to ensure that all appropriate information needs are met by EIS. Both technical and program staff should be represented.
4. Hire required staff or contractors.
5. Create an EIS web site resource for accessing all documents, references, communications, and schedules.
6. Manage the process for legislative action, issuance of requests for proposals, selection of vendors, and communications with stakeholders.
7. Create the final EIS design and specifications with the contracted vendor or relevant staff. Finalize business rules for data validation. Establish the reporting submission timeline.
8. Participate in the Schools Interoperability Framework Association (SIF) and other standards meetings, and partner with other states to submit new state reporting objects and elements to be added to existing objects. SIF is a trademark of the Schools Interoperability Framework Association. More information about SIF can be found at [www.sifinfo.org](http://www.sifinfo.org).
9. Finalize individual district plans based upon budget and timelines adopted. (Compose consortia as desired based upon technical services and shared software applications. Support user groups for districts with the same software applications.)

 **ESP Insight**  
*Each education agency is at its own level of planning and implementation. However, the pre-implementation and implementation phases should be revisited periodically.*

- B. Implementation Phase (varies by information area, e.g., instructional management, student information systems, and library systems.)
1. Establish an oversight consultant or manager to monitor the technical aspects of final design and implementation.
  2. Convene the EIS Technical Advisory Group as needed to review and make recommendations for implementation issues, such as timelines, priorities, and compliance with policies and standards.
  3. Convene the EIS Coordination Team to ensure that current collections are phased into EIS smoothly and to ensure that all appropriate information needs are met by EIS.
  4. Manage the processes for implementation and communications with stakeholders.
  5. Participate in SIF (and other standards) meetings to ensure adopted objects meet the state's needs.
  6. Establish and conduct early adopter and pilot implementations.
  7. Transition from web reports to the EIS (SIF) submissions as the contractor or developer delivers the system components.
  8. Evaluate the success of early implementation across districts to make modifications for on-going processes

C. Maintenance Phase (varies by information area)

1. Manage on-going contracts, system updates, and needs for upgrades across district software applications.
2. Participate in SIF (and other standards) meetings to ensure adopted objects meet the state's needs.
3. Update individual district plans to monitor progress.
4. Continue the active involvement of the advisory groups.

These steps are based upon a review of best practices across states for managing state-level information systems. Regardless of the model and standards adopted within each state, these are over-riding procedures that have been associated with success.


### **Areas of Responsibility**

Several key entities share areas of responsibility related to the EIS. Each agency must determine the ownership of these responsibilities to ensure that there are clear expectations and commitments. These five entities are described here. Others may be present in some states.

1. Schools Interoperability Framework Organization (or other standards groups upon which the agency is relying)
2. School Districts (or intermediate units responsible for a district's state reporting)
3. Consortia (if districts join together to combine resources)
4. SEA
5. Software Vendors

The following chart provides a high-level view of how the responsibilities align with these entities.

The Schools Interoperability Framework is used to represent any standards organization whose requirements are either adopted by or accommodated by the agency's EIS.

 **ESP Insight**  
*Each education agency must determine the ownership of key responsibilities to ensure there are clear expectations and commitments.*

### Where Does the Responsibility Fall?

Where Does the Responsibility Fall?				
District	Consortium	State	Vendor	SIF
Local software (SW). on-going maintenance; upgrade/buy new SW above/beyond state minimum		Requirements by state; initial set-up; purchases to bring each district up to minimum standard	Agents, EIS alignment	Support state efforts on objects
Local data management		Standards and Requirements: SIF & Others	Agent development & maintenance	Define, adopt objects
Implementation of information systems	→	Software requirements	Certification by SIF or compliance with EIS standards	Certify applications and agents
Data quality		Vendor requirements	Mapping to EIS & other applications	Specify security standards
Staffing and help	→	Training and support	Confidentiality options for reporting	Coordinate across states
Adopt SIF compliant applications	→	Technical support	Application technical support	Sub-certification Compliance
Data standards beyond EIS	→	Manage access to data	Application edit checking tools	Non-member compliance options
Aggregate, derive, calculate to get EIS elements	→	Manage use of data	Security	
District decision support system	→	HW and SW outside of buildings	Provide functionality as required by district	
Hardware (HW) and SW inside buildings		Technical support	Event tracking, logs	
District ZIS	→	Edit checking		
User authentication	→	Sub-certification Compliance		
Front-line technical support	→	Registration list of EIS compliant products		
Edit checking process	→	Central data management & application of the business rules		

### **Description of Responsibilities:**

#### Schools Interoperability Framework Association

Generally, SIF is responsible for building and maintaining the standard for data exchange among software systems, so SEA and vendors have a clear reference for expectations and performance. SIF should also support state efforts to build objects that meet their needs.

1. Define and adopt objects within the SIF specification that include the data elements required for EIS; or provide user-defined alternatives that can be certified.
2. Certify applications and agents that pass tests for compliance with adopted objects.
3. Specify security standards to ensure that the SIF/Zone Integration Server (ZIS) data transmissions within zones are secure.
4. Coordinate across states to maximize the utility of adopted objects and increase usage nationwide.
5. Provide for sub-certification compliance to allow vendors needing adoption to do so without undue expenses.
6. Provide for non-member compliance options for vendors not choosing to join SIF as a member.

#### School Districts

Generally, districts are responsible for local hardware and software acquisition, maintenance, upgrades and purchases beyond the minimum required or funded by the SEA.

1. Provide local data management on an on-going basis.
2. Implement information systems in schools and district offices.
3. Ensure data quality during collection, storage, and reporting.
4. Hire and support staff.
5. Adopt only SIF compliant applications or others meeting SEA requirements.
6. Establish data standards that are beyond the SEA's EIS.
7. Aggregate, derive, and calculate EIS elements.
8. Provide a district decision support system.
9. Provide and maintain hardware and software inside their buildings.
10. Provide a district ZIS or other process for managing the exchange of data.
11. Establish and enforce user authentications.
12. Provide front-line technical support.
13. Implement edit checking processes.

#### Consortia

Generally, consortia are responsible for any tasks that are delegated to them from the member districts.

 **ESP Insight**  
*The Schools Interoperability Framework (SIF) provides standards for linking software applications and information systems for secure and timely data exchanges.*

### SEA

Generally, the SEA is responsible for establishing the state's EIS requirements, initial set-up tasks, and purchases to bring each district up to an established minimum level of functionality.

1. Adoption of standards and requirements including SIF.
2. Adoption of software requirements for each information area (or delegation of this to the districts).
3. Publish vendor requirements for supporting EIS.
4. Conduct training and support for district staff.
5. Provide technical support for districts and consortia.
6. Manage access to data within EIS.
7. Manage use of data within EIS.
8. Provide and maintain hardware and software outside of district buildings.
9. Provide technical support for districts and consortia.
10. Develop and implement edit checking processes for the central data management function.
11. Adopt and publish business rules for the central data management function.
12. Define sub-certification processes beyond SIF for vendors.
13. Maintain a registration list of EIS compliant products.

### Software Vendors

Generally, the software vendors are responsible for providing districts with products that meet the requirements for each state's EIS.

1. Development and maintenance of SIF agents.
2. Certification by SIF or compliance with EIS standards.
3. Mapping to EIS and other applications within the SIF/ZIS zones.
4. Providing confidentiality options for reporting (producing reports that mask data appropriately).
5. Providing technical support for their applications.
6. Providing edit checking tools for their applications.
7. Ensuring security for their applications.
8. Demonstrating functionality of their applications as required by EIS and districts.
9. Creating event tracking and logs to provide an audit trail.

 **ESP Insight**

*Software vendors are partners with schools, districts, and states. Standards such as SIF are necessary to ensure that proprietary software applications do not isolate an agency's data.*

**B**est practice can be an elusive term. In a state's schools, best instructional practice must be defined within the context of the school's students, resources, and goals. What works well in one school may not in another. This same reality applies to the management of data within state education agencies. Simply put, best practice for education data management is defined here as a combination of what education agencies are doing successfully and what they believe to be even better practices that they would follow if they could. These best practices are not presented as absolute recommendations for action. Not all the practices described will be practical or appropriate for every agency. This document has been created as a reference, as background for the decisions an agency will make regarding the governance practices that best fit its organization.

### ESP Insight

*Best practice for education data management is defined here as a combination of what education agencies are doing successfully and what they believe to be even better practices that they would follow if they could.*

The processes and governance practices eventually adopted by agencies will not be a copy of any other's design. In reality, no state or district is implementing all of the best practices summarized here.

Some of the best practices are risk-avoidance techniques. They work to prevent problems, useless data, over-burdening of data providers, loss of files, dissatisfaction of users, etc. In mature information environments such as Florida's, the experience of the staff and the well-tuned functioning of the processes can become a disincentive to manage those processes very closely. Staff exercise their judgment rather than refer users to a formal process.

Some of the best practices are valued-added techniques. They work to extract as much return on the investments in dollars and effort as possible. In newer environments where all components are not yet functional, providing value to the data providers is an excellent way to earn their support, cooperation, and quality data.

Some of the best practices are efficiency techniques. They work to reduce costs and time. In any environment, these are the data management processes that ensure success.

Some of the best practices are policy and compliance techniques. These ensure that laws are followed and confidentiality is protected. In any environment, these are the data management processes that raise the odds for survival.

The best practices represent the perspective that an investment in planning and design up front can save time and waste in the end. This is not a difficult concept to sell, but is a difficult one to buy. In other words, most people will agree in concept, but will the money and time be provided?

ESP's work with education agencies has convinced us that education data are indeed different from the data typically encountered in the business world. Education data and the systems that use them are atypical in many crucial aspects from standard business applications. Every enterprise thinks of itself as unique. However, in the education enterprise, the uniqueness presents distinct challenges that are not typically anticipated in data management tools and general business software applications. First and foremost is the fact that education deals with human beings, not products to be sold. Second, the measures we make of these humans are complex, subjective, and numerous.



Some examples that make education data distinctive are:

- Human factors such as changing demographics and behavior
- Confidentiality mandates that require management of small cell sizes
- A preponderance of missing data that must be identified as missing, zero, blank, or null for proper analysis and migration from one file to another
- Special conditions that require special handling and interpretation (e.g., testing conditions)
- Numerous pieces of data of a wide variety
- Numerous areas of data that must be related to each other
- Infrequent, imprecise rules and controls that allow poor data to pass through the system
- People not trained for data processing who have the responsibility for processing data
- Data that begin at the granular level and require tools that aggregate and disaggregate properly
- Data often collected as aggregates; therefore totals may not add up
- Business rules that are not universally known and respected, nor are they monitored by the provider
- Little documentation of the real way business is done
- Lax controls, audit, and evaluation standards
- High number of exceptions within the data
- Unfamiliarity with education processes by the data processing people
- Lack of documentation for exceptions to their business rules
- Imprecise codes
- Loose data standards within and across entities

 **ESP Insight**  
*Education data are more complex, challenging, and ill-defined than most data in other arenas.*

Individual education agencies have addressed these issues in their own ways and are at different stages of solving many of them.

From the Association for Information Management Professionals (AIMP) comes a useful perspective.

How organizations manage information for competitive advantage is dramatically changing as a result of such trends as:

- Globalization of the market economy, the driving force of which is technology
- E-commerce, which is creating new dimensions and concerns for information privacy and security
- Organizational change, resulting from increased outsourcing, business partnerships, and modular relationships

Issues such as what information will be shared and with whom are critical to the future success of 21st century organizations. The greatest challenge is the need to better manage the information flow being created for these new organizations and relationships. This is the role of - and the opportunity that awaits - the information management professional.

Information management professionals must understand and effectively manage information from its conception, including its role in the organization's ability to meet its strategic goals. They must be able to manage information strategically, tying back to the organization's core mission.

Today's information management professionals must possess content skills, an understanding of how and why data are created, who should have access to it, and when it should be destroyed. Further, they must be able to address these and other issues resulting from emerging business trends at the strategic level as business relationships and processes are being developed. This requires skills, knowledge, and perspective that integrate the tactical and strategic aspects of information and records management, information technology, and executive management.

Intellectual capital drives the bottom line. The biggest profits will go to those that manage information; not physical assets. Therefore, organizations and professionals who embrace information management as being strategic and mission critical will ensure their competitive advantage.

With apologies to educators who have grown weary of business practices being cited as models for education, this quote provides support for the importance for an education agency to develop and implement an effective data architecture and management plan.

The AIMP description goes on to distinguish information systems as:


...an arrangement of people, data, processes, interfaces, network(s), and technology that interact to support and improve day-to-day operations in a business, support the problem-solving and decision-making needs of management.

The information system should be defined very broadly to encompass all the parts and players that influence information within the agency. Information management should be defined as the policies and processes that make the information within the system useful. Neither one can be completely described without the other.

The authors have worked over the last decade with education agencies and their information systems. We have facilitated regional and national meetings on best practice for education information collection, management, and reporting. Over that time, the following set of documents referenced in this paper have been created. The references are available by registering for a free “My ESP Page” at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com).

*References:*

- Background Paper on Ideal Education Information for Improving Classroom Practice
- National Meetings Summary for Ideal Education Information
- Current Use of Decision Support Systems in Education
- State Consortium on Statewide Student Information Systems Notes
- Recommendations from the National Meetings on Ideal Information Systems
- Notes from the First National Meeting on Ideal Information
- Comments by Dr. Floraline Stevens on Ideal Information
- Notes from the Wilmington Meeting on Ideal Information
- Education Associations Meeting Notes

 **ESP Insight**  
*States and districts share a common vision for managing the burden of data collection by consolidating collections and improving the use of data with effective data management.*

For our work with clients, ESP reviewed the characteristics of many education agencies. From June 2003 through July 2004, ESP visited every SEA twice to document its EIS and the availability of data for federal reporting as part of the U.S. Department of Education’s Performance Based Data Management Initiative (PBDMI), now referred to as the Education Data Exchange Network (EDEN).

Three SEAs in particular provided examples of working information systems in various stages of maturity. Each of these is the core source of the SEA’s information.

- Florida—recognized as the first comprehensive, statewide, automated education information system
- Massachusetts—recognized for applying proven business practices to the automation of data systems in a state known for local control and a history of late reporting
- Mississippi—recognized for successfully building an ambitious automated system to consolidate data collection and reporting in a state without a widespread technology infrastructure in the schools

These states vary in the age of their systems and the management styles of their governments, but they share a common vision: to manage the burden of data collection by consolidating collections, and to improve the use of data by effectively managing the data collected. In all three states, a central data resource has been built within which data are managed to meet the information needs of policy makers, program managers, and the public.

ESP also reviewed the on-going efforts of the U.S. Department of Education (USED) as they implement data management processes in response to congressional mandates for improvements in data quality and availability.

### ESP Insight

*The U.S. Department of Education's principles for data management should be a model for all education agencies.*

USED has adopted these principles for data management.

#### U.S. Department of Education: Data Architecture Principles

- Data will be entered once, and only once, as close to their source as possible.
- Data are a departmental asset and do not belong to any particular office, program, or individual.
- All users requiring the services of data processing resources (hardware, software, and data) will share these resources.
- Department data will conform to a standardized set of data elements and definitions.

#### Supportive Practices:

- An authoritative data source is identified for each data element or statistic.
- Authoritative data are accessible by all authorized users.
- Data from the authoritative data source are used in lieu of duplicate collections.

From our work with USED and the states, we have concluded that there are three general truths about education data.

- Most education data begin at the school level.
- Many of those data are passed along to the state education agency.
- Most education data collected by states ultimately arrive at the U.S. Department of Education (USED).

When state-level educators and other professionals are asked what percentage of their data is collected to meet a federal mandate, estimates have ranged from a low of 25% to a high of 90%, with the great majority being around 75-80%. What if all federal mandates disappeared? States and districts would continue to collect much of this information for themselves. What these estimates illustrate is that the majority of the education information collected from schools is influenced by federal mandates because it is ultimately reported to a national level.

The significance of these truths is that the USED drives the definitions, the periodicities, and the availability of most of our education data. However, the USED relies upon the efforts of state education agencies, which in turn rely upon the conscientiousness, accuracy, and cooperation of teachers, principals, and school secretaries to get the data. Therefore, for state education agencies to design, select, or manage data successfully, they must balance the realities of a school with the requirements of the USED.

The USED, under the leadership of their Chief Information Officer Craig Luigart, moved forward with a comprehensive effort to improve education data quality and timeliness through automation and the support of standards. The Office of Management and Budget (OMB) requested that USED build a business case for improving data quality and availability through coordinated standards and processes. This business case reflects the education legislation from Congress. This business case uses technology, but features strong data standards because technology is no longer the weak link in the chain of reporting education data across levels. The weak link today is compatibility of data across everyone's information systems.

In 2003, USED began collecting data from states in the Performance Based Data Management Initiative (PBDMI). In 2003 and 2004, ESP Solutions Group visited each state education agency twice to document readiness to report data in a consolidated, automated collection. In 2005, the Education Data Exchange Network (EDEN) began the third cycle of collections, which will eventually replace USED's separate, paper-based collections.

Patrick Sherrill has advocated EDEN's vision since the 1980's, and Hugh Walkup has since joined him as a champion of this system to collect high-quality data, in a timely process that supports data driven decision making.

*Reference:*

- *Our Partnership Path, Author Graham, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com)*

## Summary of Best Practice for Data Management

From the review of the best-practice states, our work with USED, and our visits to all states, we have summarized and organized the 16 characteristics identified as best practice for data management. Where specific references apply, they are provided within the text. Each one is associated with the questions that a state must address and answer when designing its data management processes. Each question is followed by a statement describing what exemplifies best practice. These questions, and certainly the sample answers, are not presented as a blueprint for data management. However, from these, an agency can build its own custom blueprint with the assurance that the interests of schools, districts, state-level decision makers, the public, and other data providers and users are considered.

The summary is formatted into several parts as described below. This description uses the same headers and formatting style as in the summary.

- **Characteristic:** The name of the characteristic from “Best Practice for Data Management.” These characteristics represent successful data management practices. Each is described by the question that must be answered during the planning and design phases for a data architecture and an implementation plan for data management. A data management benchmark is described for each question as a starting point for planning. The characteristics described are:

1. Oversight
2. Management
3. Organizational practices, mandates, and policy
4. Data standards
5. Content
6. Data quality
7. Support
8. Resources
9. Response to change
10. Output and products
11. Response to ad hoc demands
12. Confidentiality and security
13. Data exchange and access
14. User engagement
15. Data storage
16. Infrastructure

- **A brief statement of the characteristic**

- *Links to Comprehensive Education Information System Requirements and No Child Left Behind:* Listing of components “Characteristics of a Comprehensive Education Information System for a State Education Agency.” The components are those identified by ESP for states as being necessary or recommended for meeting the requirements of No Child Left Behind. Benchmarks at three levels of implementation are described (missing, interim, and target). These characteristics provide a broad context for data management activities.

Where there is a specific requirement in No Child Left Behind (NCLB), that is noted in parentheses. The characteristics not specifically attributable to NCLB are noted as management efficiency requirements, meaning that they are components that, in ESP’s opinion, must be in place to facilitate data management.

- a. **Academic Standards** (NCLB Requirement: Reading/Language Arts, Mathematics, and by 2005-2006 Science)
  - b. **Student Performance Measures** (NCLB Requirement: Reading & Math 3-8; by 2007-2008 Science elementary, middle, & high school)
  - c. **Actionable Accountability Reports** (NCLB Requirement: State, District & School Annual Report Cards by beginning of 2002-2003 school year)
  - d. **Actionable Diagnostic Reports** (NCLB Requirement: Assessment reports to schools prior to school year)
  - e. **Automated Data Collection Systems** (Management Efficiency Requirement)
  - f. **Data Standards** (Management Efficiency Requirement; USED Standards Provided for Reporting)
  - g. **Linkable Individual Student Records** (NCLB: Optional Methodology)
  - h. **Longitudinal Data Points** (NCLB Requirement: Two-year trends for assessments in report cards)
  - i. **Course Data** (Management Efficiency Requirement; NCLB: “Highly qualified teachers” by class; optional class size reporting)
  - j. **Program Participation Data** (NCLB Requirement: Migrant, IEP, LEP assessment performance)
  - k. **Enrollment Data** (NCLB Requirement: Graduation, inclusion in assessments; promotion/retention optional)
  - l. **Background and Demographic Data** (NCLB Requirement: Subgroups reporting for assessments and AYP)
  - m. **Staff Data** (NCLB: “Highly qualified” teachers reporting)
  - n. **Financial Data** (NCLB Requirement: Grant accountability, maintenance of effort)
  - o. **Authority to Access Data and Reports** (NCLB: Protection of personally identifiable data)
  - p. **Electronic Exchange of Student Records** (Management Efficiency Requirement; Value-Added Benefit)
  - q. **Network Connectivity** (Management Efficiency Requirement)
- Questions to Answer During the Planning and Design Phases: For each characteristic, some of the basic questions that the agency must address are stated.
  - Data Management Benchmark: For each question, a best practice response is provided.
  - Discussion: Comments on how the information relates to the agency.
  - References: Throughout the document, the references are inserted where they apply.

## 1. Characteristic: Oversight

### How principles and policies are determined and monitored

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: All Components*

**Oversight Question:** Who or what group has oversight responsibility for the data management activities of the agency?

**Benchmark One:** A designated administrator and/or appointed group has the responsibility to oversee all aspects of data management.

**Oversight Question:** With what other agencies will the department exchange data?

**Benchmark One:** Exchange agreements are in place specifying the content and conditions under which data are exchanged.

**Oversight Question:** How are data collections approved?

**Benchmark One:** A formal submission for review and approval process is implemented and overseen by the oversight group.

**Oversight Question:** What is the scope and purpose of data management activities?

**Benchmark One:** The oversight group has adopted or recommended for adoption by a higher individual or group a clear statement of the scope, purposes, and use of the organization's data.

Discussion:

Effective data management requires a focus of resources on clearly defined functions. This is achieved through the oversight and advice of groups of stakeholders. At the highest level, the EIS Standards and Policy Advisory Group, persons who understand what the organization needs from its data and have the authority to advise decision makers, can provide the necessary oversight of management activities and effectiveness. This group can represent the agency when issues extend beyond the agency's authority, such as cooperative exchanges with other agencies. The group may be composed of only agency staff or may include school and district advisors as well. Community or business members are another option.



In Florida, Massachusetts, and Mississippi, steering groups and advisory groups were formed and relied upon during both the initial planning stages and during major change periods. However, all three states made these groups relatively inactive after implementation stabilized. The groups were reconstituted for periodic review or when major changes were being proposed.

The USED follows a very formal review and approval process. A prospective data collector submits a proposed collection to the Office of the Chief Information Officer. After review for redundancies and compliance with USED standards, the proposed collection is submitted to their oversight group, the Office of Management and Budget for approval.

*Reference:*

- *State Education Agency Information Standards and Requirements*, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com)

### 2. Characteristic: Management

#### What staff and responsibilities are necessary

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: All Components*

**Oversight Question:** Who or what office has primary responsibility for the management of data within the education agency?

**Benchmark One:** A designated person or office has the responsibility for the management (or delegation of the management) of all data. A single point of contact is designated for all issues related to data management.

**Oversight Question:** What qualifications should the management staff have?

**Benchmark One:** Management staff are trained and experienced in data management, technology, administration, and public education.

**Oversight Question:** What organization plan provides the best use and supervision of data management staff?

**Benchmark One:** The organizational plan provides data management staff with the technical supervision required while maintaining a close working relationship with the authoritative data sources.

**Oversight Question:** How will the data management staff be incentivised to remain in the department?

**Benchmark One:** Professional development opportunities are provided to staff to remain current with technology and departmental priorities. Staff are involved in departmental activities beyond data management.

**Oversight Question:** How will data providers and users know the schedule for key activities?

**Benchmark One:** An annual calendar is published with key dates for data submissions and availability.

**Oversight Question:** What will guide the data management staff's on-going activities?

**Benchmark One:** The data management staff work from an annual plan with benchmark dates and deliverables.

**Oversight Question:** How will the compatibility of users' workstations and software tools be ensured?

**Benchmark One:** The department has a common or compatible configuration for workstations, operating systems, and software tools to ensure that all users can access and process data as needed.

### Discussion:

Management styles are individual to the state education agencies. Because of the need for objectivity, independence, and integrity for the data collected and reported, data management offices often report to the chief state school officer or a deputy (e.g., CIO or business manager) other than the one responsible for the programs that are to be held accountable with the data. The data management staff in Florida are experienced and tenured because they receive competitive salaries and have considerable independence in their activities. Staff in other states have higher turn-over rates and draw their motivation from being contributors to the public education enterprise.

Good management practices apply to the data management staff as well as to all other administrators. The best-practice states have staffed their data management offices with personnel with a wide range of backgrounds including instruction, instructional technology, and statistical analysis. Project plans, annual calendars, etc. are all necessary to manage the workload and the products.

States vary in whether or not the data management staff are combined with the programming/coding staff. Florida recently separated the duties and the staff in two units. Massachusetts recently combined the two under the same deputy commissioner. Mississippi has had data managers and programmers together since the beginning of their development cycle.

Our analysis of these varying staffing charts is that the fundamental dynamic that must be avoided is the isolation of the data managers from the information technologist (e.g., programmers/coders). Each needs to stay up-to-date with what the others are doing. Whether the data managers have programmers assigned directly to them in the line of authority or whether those programmers are in another unit to which the data managers must go for help is an issue with contrasting solutions across the states.

For the education agency, the data managers must be able to perform some of their own analyses and have access to more sophisticated programming help as needed. As long as the data managers (acting in concert with the appropriate decision makers) influence the proper use of the data in the reporting process, who actually writes and runs the reports is less important.

Mississippi made an effort to include their programmers in the planning and design phases of their system in order to ease the transition from their former roles to the new roles they have with the automated systems.

### 3. Characteristic: *Organizational Practices, Mandates, and Policy*

#### How principles and policies are determined and monitored

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: All Components*

**Oversight Question:** Who must provide data?

**Benchmark One:** A policy is in place describing who must provide data, under what authority, and the consequences for noncompliance.

**Oversight Question:** What federal laws, regulations, or grant requirements must be met?

**Benchmark One:** Agency regulations and procedures are compliant with all applicable federal mandates.

**Oversight Question:** What state laws, regulations, or grant requirements must be met?

**Benchmark One:** Agency regulations and procedures are compliant with all applicable state mandates.

**Oversight Question:** What state education policies, regulations, or guidelines must be followed?

**Benchmark One:** State board of education policies, regulations, and guidelines are up-to-date and comprehensive.

**Oversight Question:** What agency procedures must be followed?

**Benchmark One:** Education agency policies, regulations, and guidelines are up-to-date and comprehensive.

**Oversight Question:** How are enforcement, appeals, or exceptions handled?

**Benchmark One:** Administrative procedures that are compliant with laws, policies, and regulations are in place to prevent, detect, and respond to noncompliance with policies, regulations, or procedures.

Discussion:

Data must be managed within the constraints of all applicable laws and policies. Florida, Massachusetts, and Mississippi all followed state legislative mandates and funding bills when designing their information systems. These states were able to require participation by the data providers and to enforce their deadlines because of the authority (and priority = funding) attached to the data.

There is no substitute when a dispute or problem arises for well-documented departmental procedures. Professional standards alone may be unenforceable when problems arise.

### 4. Characteristic: Data Standards

#### How data elements are defined

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: Academic Standards, Student Performance Measures, Data Standards*

**Oversight Question:** What national or industry data standards should be adopted and followed?

**Benchmark One:** Standards for education data are periodically reviewed for their applicability to the agency's data management. A current list of standards is maintained by the department.

**Oversight Question:** What state government standards must or should be followed?

**Benchmark One:** Standards for state data are periodically reviewed for their applicability to the agency's data management. A current list of standards is maintained by the department.

**Oversight Question:** What are the adopted education agency data standards?

**Benchmark One:** The agency maintains a meta-data dictionary of adopted data elements, definitions, code sets, related national/state standards, related mandates, and related collections and authoritative data sources.

**Benchmark Two:** Each data element is described with a definition, code set if applicable, field type, field length, requirement level (e.g., required, conditional, optional), entities, and periodicity (i.e., the time period measured and the frequency of collection).

**Oversight Question:** How will all the data elements needed be identified and defined?

**Benchmark One:** Existing, approved data collections are analyzed to define the data elements they collect. Existing reports are analyzed to define the statistics they report. Future data needs are determined. The advisory groups and oversight group follow the change management process to adopt elements.

**Oversight Question:** What data model will be followed to organize the tables and files?

**Benchmark One:** A logical data model is developed to illustrate the relationships among the data within the database.

**Benchmark Two:** A physical data model is developed to detail the actual table structures within the database.

**Oversight Question:** How will changes in data definitions and formats be managed to maintain historical views?

**Benchmark One:** The meta-data dictionary will track historical definitions, code sets, and characteristics to allow for crosswalks and translations as required.

**Oversight Question:** What entities need to be linked across data files?

**Benchmark One:** The data management system is able to match records across these data files: students, staff, financial, facilities, programs, and others as identified by the oversight group.

**Oversight Question:** How will these entities be linked?

**Benchmark One:** Unique, permanent identifiers are assigned to students, staff, programs, locations (e.g., schools and districts), courses, and information sources.

**Oversight Question:** What is the periodicity for each data element or statistic?

**Benchmark One:** The periodicity for collection and reporting of all official data and statistics is documented for all users of the data.

Discussion:

Efforts coordinated by the National Center for Education Statistics and the National Forum on Education Statistics have been on-going for over two decades. A comprehensive summary of these activities and the resulting guidance they provide has been compiled by ESP for USED/OCIO.

*References, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com):*

- *National Education Data Standardization Efforts*
- *Standards Group Meeting Notes*

Data definitions and formats should be developed with a school perspective in mind. Definitions and content standards should reflect how data are collected and reported from the schools and districts. A useful perspective on data elements that are applicable to a teacher has been described for the USED.

*Reference, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com):*

- *Case Study of Classroom Data Needs*
  - o *Information Needed on the First Day of School*
  - o *Information Needed on a Daily Basis*
  - o *Classroom Records Needed*

An education agency's data architecture should be designed to reflect how work is done within the agency, how audiences expect their information to be presented to them, and how education data are best defined for compatibility across agencies. There are several dimensions to a functional design. First, there are areas of work that make sense to think of when categorizing data files, e.g., finance, students, human resources. Second, there are users that can be described by their needs and authorized access levels. Third, there are types of formats for the data that match the uses targeted, e.g., raw data, aggregate statistics, and public research files. Across all these dimensions are critical issues such as security, confidentiality, data quality, data standards, and identification codes. Together, the whole logical database design must be multidimensional to reflect the complexities of the organization and the users of the data.

The common characteristic of each best-practice state is the foundation of a well-conceived and constructed data dictionary, which describes in detail the definitions, codes, formats, and periodicities for each data element in the database. The data elements are organized into areas/categories, submission periods, entities described for both collection/submission purposes and storage in the database. A specific data architecture is described for the primary collection of individual student (or staff) data. These specifications document how this authoritative data source is formatted for access by all users.

*Reference:*

- *Meta-Data Dictionary Components*, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com)

Common data elements potentially can be consolidated or managed for collection and reporting across programs, departments, and other data collecting units. These common data elements can be categorized into four types.

- Identification Elements
  - Data elements that uniquely distinguish the reporting unit from others
- Classification Elements
  - Data elements that combine reporting units into meaningful groups
- Contact Elements
  - Data elements for contacting the organizational unit or the persons responsible for the unit
- Descriptive Elements
  - Data elements that describe key values for the reporting unit

All other data elements not considered as common by this classification are generally specific to a single or limited number of programs or organizational units.

This classification can be illustrated with a few examples.

- Identification Element: *School Name*
- Classification Element: *School Type*
- Contact Element: *Principal's Name*
- Descriptive Element: *Official Fall Membership Count*

Non-common data elements would include:

- Enrollment in Title I
- Academically Disadvantaged Count for Program Eligibility

These non-common data elements may be of general interest and use, but they are distinguished as being more specifically critical to a single or limited number of purposes. The key point is that non-common elements may also be shared within the department. An exception would be an element whose nature makes it confidential or of no interest beyond the program collecting it. This element could be compartmentalized for that program. This classification is useful because it helps us to determine how to manage data elements.

ESP developed a metadatabase for USED using the following process:

1. USED collections were catalogued and analyzed over six years. Unique data elements from across 900 collections were described and entered into the data dictionary.
2. Standards were catalogued and entered into the data dictionary as generic elements. Standards included the NCES student, staff, and financial data handbooks (See <http://nces.ed.gov/index.html>, the NCES home page, and search for handbooks under the publications menu item.)
3. Unique data elements (individual elements as they appear on actual collections) are linked to generic elements.
4. Consensus data elements are approved as standards to be used on all collections departmentwide. The consensus data elements are those for which a de facto standard for usage has developed over time.
5. Objects are created from elements that group together into meaningful sets.
6. Attachment sets are created from objects and elements that make up an attachment used with multiple collections.
7. Collections are created from elements, objects, and attachment sets.

*Reference:*

- *Anatomy of a Data Dictionary*, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com)

Florida's data dictionary predates the emergence of national education data standards. However, both Massachusetts and Mississippi used the NCES data handbooks and the SPEEDE/ExPRESS standard as a basis for their own data dictionary.

States are now watching the development of the Schools Interoperability Framework (SIF) standards, based upon XML, to see if they become an education industry standard. NCES, CCSO, and a few other agencies have joined the software vendors in SIF. For a data architecture, the issue is whether to incorporate SIF/XML compatibility into the principles and standards adopted for data exchange.

*Reference:*

- *Summary of Meeting of Assessment Standards Groups*, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com)



### 5. Characteristic: Content

#### Which areas are included in the database

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: Academic Standards, Student Performance Measures, Longitudinal Data Points, Course Data, Program Participation Data, Enrollment Data, Background and Demographic Data, Staff Data, Financial Data*

**Oversight Question:** What areas, categories, fields, domains, or types of data are managed within the information system?

**Benchmark One:** The content areas to be maintained are clearly specified by the oversight group and within the data dictionary. The content areas are aligned with the scope and responsibilities for data management.

**Oversight Question:** What entity directory information will be shared across all users?

**Benchmark One:** Common entity directories are created and maintained to facilitate non-redundant collection of data and sharing of data for all uses. Entity directories provide contact information for students, staff, schools, districts, regional centers, programs, grants, etc.

Discussion:

Linking across areas within the database is a major added value that comes from effective data management of a comprehensive database. At the local level connecting students to courses, assessment scores to instructional interventions, and teachers to certification and courses taught provides an increased return on the investment of resources and effort made by schools and other data providers. These connections across content areas make the whole of the data much greater than the sum of the parts.

A clear delineation of the content that will be in the database and the content that will not is necessary to manage resources and to match user expectations with reality. Entity directories are a key to collecting data once and using them many times. They are also shared resources that ensure that identification and basic descriptive information are current and the same for all users. Data providers can see the benefits to them of common directories because they reduce the number of times the same descriptive data are reported. Entity directories contain the key identifiers that allow for linking data across databases within the organization. The maintenance of these directories is a major responsibility of the data management staff.

The content for EIS was documented from extant data collections.

*References, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com):*

- *Directories Required*
- *Entities Requiring Identifiers*

Florida's mature system has a wide range of content; whereas, both Massachusetts and Mississippi are expanding their content as implementation progresses. All states began with basic student data.

Content within a state database typically is included to meet these basic purposes at a minimum.

- To calculate state funding
- To comply with accountability systems
- To fulfill federal reporting requirements
- To record certification or licensure of teachers and administrators

The oversight and advisory groups should review and assist with the determination of the content.

No Child Left Behind adds a priority to the attention devoted to federal reporting mandates. Several key aspects from the law's provisions for adequate yearly progress determinations for schools and districts, for annual district report cards with school-level data, and other Title I indicators must be considered. Some examples of these are:

- Disaggregation of assessment results for
  - o racial/ethnic categories
  - o limited English proficient students
  - o economically disadvantaged students
  - o handicapped students
  - o migrant students
  - o males and females
- Separate analysis and reporting of proficiency in English/language arts and mathematics
- Annual determination and reporting of accountability ratings
- Classification of student performance as advanced, proficient, or basic in all areas
- Calculation of graduation rates for high school students
- Calculation of at least one additional indicator for elementary and middle school students
- Determining which teachers are highly qualified
- Counting classes without highly qualified teachers
- Identifying truant students and calculating truancy rates
- Determining which campuses are persistently dangerous

In order for the required reports to be generated from the EIS, the data elements for each of these statistics must be available at the required unit of analysis.

*Reference:*

- *No Child Left Behind Reporting Issues*, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com)

### 6. Characteristic: Data Quality

#### How data are guaranteed to be accurate and timely

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: All Components*

**Oversight Question:** Who is the authoritative data source for each datum in the information system?

**Benchmark One:** The data dictionary identifies the person, program, or office that is responsible for the official data files for each area. All users of data in this area go to that authoritative data source rather than collecting duplicative or contradictory data.

**Oversight Question:** How will data be entered or submitted to the system?

**Benchmark One:** Data collection and entry procedures are automated (web-based, client/server, or other application) with validation of users and entries. Prior to acceptance of data, the provider certifies the contents, and the system validates the format and range of the values (against past data or reasonable ranges).

**Oversight Question:** What quality assurance steps must be followed by each authoritative data source?

**Benchmark One:** A quality assurance process is adopted and mandated for all authoritative data sources. See "Steps for Assuring Data Quality."

**Oversight Question:** How are the data standards monitored and enforced?

**Benchmark One:** The oversight group monitors reports prepared by the designated management administrator.

**Oversight Question:** What audit and edit processes are implemented?

**Benchmark One:** Standard audit routines are run against data files periodically to establish compliance.

Discussion:

Data quality is highest when:

- The data providers know what is expected.
  - Data standards are clearly specified and published.
  - Data collection and reporting processes are clearly described and training is provided.
- The data providers use the data themselves for their own work.
  - Data are collected directly from transactional systems.
  - Local information systems use the data first.
  - Data above and beyond what are useful are not collected and reported.
- Everyone, everywhere checks the data.
  - Data providers and users are accountable for accuracy, completeness, and timeliness.
  - Each person who handles the data verifies them before passing them along within the system.
- The data are available and used.
  - Data are reported publicly.
  - Accountability systems rely upon the data.
  - Value-added analyses and comparisons arise from the data.

These generalizations about data quality point out that a significant proportion of data quality is determined outside the departmental database, which is being managed by SEA staff. Again, data quality begins with clear data standards.

Within the SEA the authoritative data source must be identified for each datum. This makes one person/office responsible for the integrity and timeliness of the data. This allows the authoritative data source to be responsible for data quality.

The primary tactic cited by the best-practice states for ensuring data quality is making the data standards clear from the beginning. Then they audit to be sure.

Automated collections allow data to be validated upon entry into a field rather than waiting to run an edit check later.

Steps for Assuring Data Quality: This reference aligns the data quality standards developed by the USED for their program offices with the annual steps that an organization should follow to achieve quality data. Within SEA, these steps would apply to individual data and content areas. The reference provided was adapted for the Colorado Springs Public Schools.

*Reference:*

- *Steps For Ensuring Data Quality, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com).*

### 7. Characteristic: Support

#### How help is provided to users

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: All Components*

**Oversight Question:** How will users be notified of and have access to the instructions, definitions, timelines, and other expectations for them?

**Benchmark One:** Users receive clear and comprehensive communications (either on paper or electronically) about how to use the information system and their responsibilities related to it.

**Oversight Question:** How will users be trained?

**Benchmark One:** A training program is provided to all users. Certification for users is required as appropriate.

**Oversight Question:** What level and type of support will users of the data need?

**Benchmark One:** A phone line or e-mail is available during regular business hours.

**Oversight Question:** How do users know whom to call about what?

**Benchmark One:** Data management issues are delineated from technology or data collection issues for the users. Separate contacts are provided for each or a single contact directs calls to the appropriate person.

**Oversight Question:** Who provides support to users of the data?

**Benchmark One:** A help desk or office functions to receive and process help requests.

**Benchmark Two:** FAQs are available, and updates and follow-up training are provided.

Discussion:

Everyone trains the data providers—annually and on request. Training for data users is less stringent.

The Houston Public Schools train and certify their campus data clerks, and raised their pay accordingly.

A formal one-stop help desk is the goal, but not the reality for each state. Whatever the process, the users need to know where to get reliable responses to their problems. As with data quality, prevention, e.g., training, is the preferred approach.

Massachusetts had 10 data technicians supporting their 371 districts until recent budget cuts reduced the number to four technicians.

### 8. Characteristic: Resources

#### What is required to manage the data

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: All Components*

**Oversight Question:** What types and levels of resources are required to build, modify, and maintain the data management activities and the information system?

**Benchmark One:** An annual budget provides staff positions and resources as required.

Discussion:

All three best-practice states had legislative support for developmental resources. The annual maintenance and operations budget supports Florida's and Mississippi's efforts; however, Massachusetts's data management budget has been reduced along with the overall departmental budget.

### 9. Characteristic: Response to Change

#### How growth and changes are accommodated

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: All Components*

**Oversight Question:** What process manages change?

**Benchmark One:** A change request process is in place. The management person or office handles the requests promptly. As appropriate, the oversight group or the management office takes appropriate action.

**Oversight Question:** How will the information system and the adopted management processes grow as the scale of data tasks increase?

**Benchmark One:** A long-range plan for growth is adopted that envisions how growth will be accommodated.

Discussion:

The changes discussed here are not minor modifications, but changes to content, reporting, access, or another aspect that have a major impact. The data architecture should be designed to accommodate these changes.

Each of the three best-practice states demonstrated the viability of their data standards and information systems in their response to No Child Left Behind's requirements. Because each collects and maintains within their central databases individual student records containing the required data elements for demographics and programs, responding to No Child Left Behind's changes became mostly a matter of changes in analysis and reporting.

The major challenge each state is facing is how to reduce the cycle time for scoring and reporting assessments to meet the No Child Left Behind requirement of reporting at the beginning of the school year. This challenge again points out the need for data to be managed before they reach the SEA.

### 10. Characteristic: Output and Products

#### How users see the data

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: Academic Standards, Student Performance Measures, Actionable Accountability Reports, Actionable Diagnostic Reports*

**Oversight Question:** How do users of the data access the data?

**Benchmark One:** Reports and data files are available both electronically or printed as appropriate.

**Oversight Question:** What dimensions of reporting must be supported?

**Benchmark One:** The information system supports reporting for federal mandates, grants, other state agencies, the state education board, department management, program management, school and district value-added reporting, public reporting, research, and information system monitoring.

**Oversight Question:** What standard reports are published?

**Benchmark One:** A listing of reports and their publication dates is produced and available electronically and printed.

**Oversight Question:** How will the school and district providers of the data see a return of value-added analyses and reports?

**Benchmark One:** User groups representing the data providers assist in the development of reports or reporting processes that return reports with analyses and relationships beyond those schools and districts can produce.

**Oversight Question:** What decision support system will be provided?

**Benchmark One:** A decision support system is in place to provide data to decision makers in a timely and usable manner.

**Oversight Question:** How will the reliability of the data be determined prior to reporting?

**Benchmark One:** The agency has a rule in place that sets a minimum number of individuals in a group before their values are reported.



### Discussion:

Outputs and products are generated by the data system for the users. This is different from access to the database. A hybrid example would be data in a data warehouse or data available to a decision support system.

Unfortunately, even the best-practice states, which carefully documented the basic reports that would be required from their databases, did not anticipate the broad and varied types of standard reports for which a demand would grow over time. The response to this has been to use report generation tools to make custom reports easier to produce.

No Child Left Behind has emphasized the requirement to determine the statistical reliability of a performance indicator before publishing it for a small group.

At every level, the issue of missing data looms large. How blanks, zeroes, and invalid values are handled may not even be fully realized by the staff preparing submissions and reports. Some states and the USED “impute” values when data are missing. This means that a reasonable placeholder value is inserted in the blank field. Typically a prior year’s value or an average value across years or entities is used. This technique allows totals and averages to be calculated, and comparisons to be made across entities and years. Whenever values are imputed, they should be clearly flagged to alert the reader. In fact, imputation is uncommon at the LEA and SEA level.

### 11. Characteristic: Response to ad hoc Demands

#### How new demands are handled

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: All Components*

**Oversight Question:** What ad hoc demands can be anticipated?

**Benchmark One:** The oversight and advisory groups provide expectations for requests and guidance on the appropriateness of responses.

**Oversight Question:** How must responses be managed?

**Benchmark One:** A formal request and approval process is in place that is managed by the person or office managing the information and authorized by the oversight group. This includes requests for research by outside individuals and organizations.

Discussion:

Ad hoc demands fall outside the range of standard reports and even any query or decision support system capabilities. The oversight group can provide guidance on unusual or controversial requests. Confidentiality must be considered.

Analysis tools are a major component in an agency's responses to ad hoc requests. Florida reported providing Access and Excel files to offices for their own analyses. Massachusetts does the same, with users taking advantage of a wider variety of analysis tools such as SAS and SPSS. Mississippi handles ad hoc requests by assigning them to their own programmers.

### 12. Characteristic: Confidentiality and Security

#### How data are protected

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: All Components*

**Oversight Question:** What access to the data is required by each user type?

**Benchmark One:** An authority table is maintained that clearly describes each user type (or individual) and its access to data. As appropriate, individuals are authorized.

**Oversight Question:** What minimum group size will be required before values for small groups are reported publicly?

**Benchmark One:** The agency has established a minimum group size that ensures that personally identifiable information is not revealed in a report.

**Oversight Question:** How can the physical components of the information system be secured from damage or loss?

**Benchmark One:** A security plan has been developed and is updated at least twice a year.

Discussion:

These two issues are often combined, but they are actually very different in most respects. They share the need to keep unauthorized people away from the data. The data architecture must contain tables and elements as necessary to identify each potential user and assign a level of access for each part of the database.

Confidentiality is most important in the public reporting of data. The SEA must have a decision rule that establishes the minimum number of individuals that must be in a group to allow reporting without revealing personally identifiable information that is protected under federal or state law. Techniques are available for making or reporting ranges when actual values cannot be reported.

*Reference, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com):*

- *The Optimal Reference Guide, Confidentiality and Reliability Rules for Reporting Education Data. ESP Solutions Group, 2005.*

### 13. Characteristic: Data Exchange and Access

#### How data come in and go out

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: Automated Data Collection Systems, Authority to Access Data and Reports, Electronic Exchange of Student Records*

**Oversight Question:** How will providers and users of the data exchange them?

**Benchmark One:** A network architecture is in place to support the exchange of data and access to files.

**Oversight Question:** How will data be exchanged across agencies, e.g., other state governmental agencies, and postsecondary institutions?

**Benchmark One:** See Oversight. Standards are followed that allow the exchange of data across applications (e.g., ASCII/CSV, Schools Interoperability Framework/XML).

**Oversight Question:** What levels of access will be allowed to the data?

**Benchmark One:** For each data file, the levels of access are identified for viewing, copying, editing, updating/appending, or reconfiguring.

**Oversight Question:** What authority will be authorized for each user type or individual?

**Benchmark One:** An authority table is maintained for each file specifying which level of access is provided to each identified user group or individual.

**Oversight Question:** How will data be exchanged across applications? (Including submissions of data from schools and districts to the department)

**Benchmark One:** Standards are followed that allow the exchange of data across applications (e.g., ASCII/CSV, Schools Interoperability Framework/XML).

Discussion:

Data exchange and access cannot be separated from confidentiality and security issues. Data management processes must describe how users will be identified and how each file or application will provide only the appropriate access to each user.

The exchange of data across agencies must be considered in the data architecture. Masking or suppression routines (if appropriate) should be implemented when confidential data are part of a file being shared. XML, as used by SIF, is providing a common format for data exchange just as ASCII files have for years. Although SIF has models for exchanging data transactions, additional protocols will need to be developed for large batch file exchanges. These standards are being developed with the assistance of the NCES and CCSSO representatives on SIF working groups.

A graphical representation of how data are shared across the various levels of the education enterprise is provided in the following reference. An example of a single data element (school type) as it moves across these levels has also been developed.

*References, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com):*

- *Data Sharing Across Levels of the Education Enterprise*
- *Data Linkages Across Levels of the Education Enterprise*
- *Levels of Access*

### 14. Characteristic: User Engagement

#### How users are satisfied

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: Academic Standards, Actionable Accountability Reports, Actionable Diagnostic Reports*

**Oversight Question:** Which stakeholders should be involved in decisions about data management?

**Benchmark One:** The oversight group directs the manager to involve stakeholder groups.

**Oversight Question:** What advisory group(s) functions to represent the users' needs and issues?

**Benchmark One:** Advisory groups function to represent all stakeholder groups identified by the oversight group.

**Oversight Question:** What process is in place to pilot/field test modifications prior to implementation?

**Benchmark One:** The manager works with advisory groups to field test modifications prior to implementation.

Discussion:

The best-practice states relied upon advisory groups of users to establish early and lasting acceptance and commitment to the data standards. A standard practice has been to give schools and districts notice of changes in data standards, and to field test them prior to official collection. This is crucial because local systems purchased from a vendor do not adapt to changes quickly. Vendors may be slow to make adaptations for a single state (even the largest one). This is why standards such as XML/SIF have potential for providing common exchange standards that will ease the process of accommodating changes.

### 15. Characteristic: Data Storage

#### Where data are kept

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: Linkable Individual Student Records, Longitudinal Data Points*

**Oversight Question:** How will data be organized and stored within the system?

**Benchmark One:** Raw data are stored in a normalized structure that is efficient and internally consistent. Pre-calculated statistics and data for queries are stored in a structure that is efficient and quick for access and analysis.

**Oversight Question:** How will different file types be managed?

**Benchmark One:** The data management plan specifies the file types that will be allowed and maintained (e.g., raw data, analysis files, statistics files, and products) for each database. Rules are established for the creation and destruction of source files, working files, back-up files, and temporary files.

**Oversight Question:** Will data be available for both snapshots and trends?

**Benchmark One:** Records for individuals and other entities are linked across files by unique, permanent identifiers. Linking is possible across files and across years and other time periods.

**Oversight Question:** What unit of analysis will be maintained within the system?

**Benchmark One:** Data are stored at the lowest (most granular) level available for analysis to avoid losing details collected from the data providers. This includes individual student and staff records.

Discussion:

The definitions of data warehouse and decision support system vary across SEAs. However, in most cases these refer to a selected subset of data and official statistics that are made available to users for query and analysis. The data architecture needs to associate with each element or data file a life span and destruction date. Data management practice should include guidelines for creating, maintaining, and destroying copies of files, and for permanent archiving of source files.

Terms used in describing data storage in a database and in the data dictionary are defined in the first reference below.

*References, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com):*

- *Terms Used with Database Systems*
- *File Types*
- *Salsa Scale for Granularity*

Data should always be stored at its original level of detail to allow analyses at the lowest possible level of granularity.

Data may need to be stored in both a normalized format for efficiency and in a less normalized format for faster analysis. OLAP cubes have become popular for speeding analysis, but they require that someone anticipate all the statistics and drill-down disaggregations that users will request.

General logical data models have been drafted for the OCIO/USED. These provide an excellent high-level view of the contents and relationships of data elements within a school, district, and state database.

*Reference, available at [www.espsolutionsgroup.com](http://www.espsolutionsgroup.com):*

- *Education Data Models*
  - o *School View*
  - o *District View*
  - o *State View*



### 16. *Characteristic: Infrastructure*

#### What must be in place

*Links to Comprehensive Education Information System Requirements and No Child Left Behind: Network Connectivity*

**Oversight Question:** What infrastructure is required to support data management?

**Benchmark One:** An information system architecture is in place that provides the infrastructure to support the features and functions required for data management within the overall information system.

Discussion:

Although the infrastructure is not a data management responsibility, the data management staff must ensure that an adequate infrastructure is in place to support their activities. The organization should have an overall information systems architecture that establishes the principles and standards for hardware, software, and networks.

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### About ESP Solutions Group

ESP Solutions Group provides its clients with *Extraordinary Insight™* into K-12 education data systems and psychometrics. Our team is comprised of industry experts who pioneered the concept of “data driven decision making” in the 1970’s and now help optimize the management of our clients’ state and local education agencies.

ESP personnel have advised all 52 state education agencies as well as the U.S. Department of Education on the practice of K-12 school data management. We are regarded as leading experts in understanding the data and technology implications of the **No Child Left Behind Act (NCLB)**, **Performance Based Data Management Initiative (PBDMI and EDEN)**, and the **Schools Interoperability Framework (SIF)**.

Dozens of state education agencies have hired ESP to design and build their statewide student record collection systems, federal reporting systems, student identifier systems, data dictionaries, evaluation/assessment programs and data management/analysis systems.

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