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Realizing the Future State of K-12 Public Education: Data Exchange and Functional Integration with Local Government

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ABSTRACT

It is no news that K-12 school districts can more effectively provide instruction and support services by leveraging current and emerging information technologies. Nor is it news that when districts fail to adopt up-to-date IT-based systems, endemic underfunding gets the blame. In fact, however, districts can leverage existing funding sources and ROI from early projects to support later projects and sustain services over the long term. What is required is a thorough understanding of functions and dependencies in the local school, school district, and community; structured planning and functional alignment in the district and its IT organization; and ongoing commitment by all stakeholders. A central technology goal is establishment of secure, properly controlled electronic data exchange. Implemented within the district and between the district and municipal government and services agencies, it enables all partners to eliminate redundancies, enhance quality of service, and reduce costs.

INTRODUCTION

The Condition of Education 2008 (Planty, 2008) has addressed the areas that most concern the public about U.S. public education. It reports

- Persistent disparities in educational performance between Hispanics, other minority students, and whites
- Rising public school enrollments
- Lagging public high school graduation rates
- A long-term rise in spending on public education, and, on the positive side,
- A long-term rise in students' reading and math performance.

These concerns reflect the embedded logic behind national and state policies and actions:

- The problems of public education can be traced to minority and immigrant populations.
- These problems are growing quickly.
- Success is possible, but only over the long term.
- Success is linked to increased funding.

- Problem districts have the least financial resources.
- The only hope for success is increased state and federal funding.
  Thus, too often, school districts spend grant money on projects that promise to solve problems and improve student performance, but are not truly sustainable and fail to deliver over the long term.
  School districts can, however, focus their efforts toward a practical future state that, at the highest level of generality, comprises
- A reduced achievement gap
  - By providing instructional opportunity with current resources and best methods
  - By providing support services in the school and in the community.
- Accommodation for changes in the size of student populations
- Cost containment and reliable funding.

This paper proposes a best-practices approach that school districts can take, using current methods and resources, to achieve possible goals. It entails

- Planning around local conditions and current resources
- Planning for sustainability
  - Maintaining ongoing stakeholder and leadership commitment
  - Aligning functions and processes
  - Establishing continuity of funding
- Establishing integrated, aligned IT functions
- Leveraging current and emerging technologies
- Involving partner institutions
  - Establishing data exchange relationships
  - Consolidating common functions.

Opportunities for improving K-12 education are all around. But few are sustainable, few are sustained, and few survive to deliver real benefits (U. S. Conference of Mayors, 2006, p. 29). Sustainable improvement begins with understanding that dreams entail responsibilities: success comes from institutional alignment behind the vision and not just from the vision alone.
Planning receives strong emphasis because it is a process of developing self-knowledge. It opens opportunities, but also exposes vulnerabilities. Emphasis falls especially on understanding the services that information technology provides in the K-12 context and the functions and dependencies that affect service delivery. Institutional planning leads to setting the right priorities, but also to anticipating and remedying causes of failure.

Understanding the functional dependencies in the institutions of K-12 education is essential for taking advantage of the opportunities that current and emerging technologies offer for reaching the future state. Emphasis here falls on the opportunities opened up by data exchange technology and the organizational and technical requirements for realizing data exchange between school districts and communities.

The methods and considerations discussed here are not new. They are just seldom if ever put together as a strategy for success.

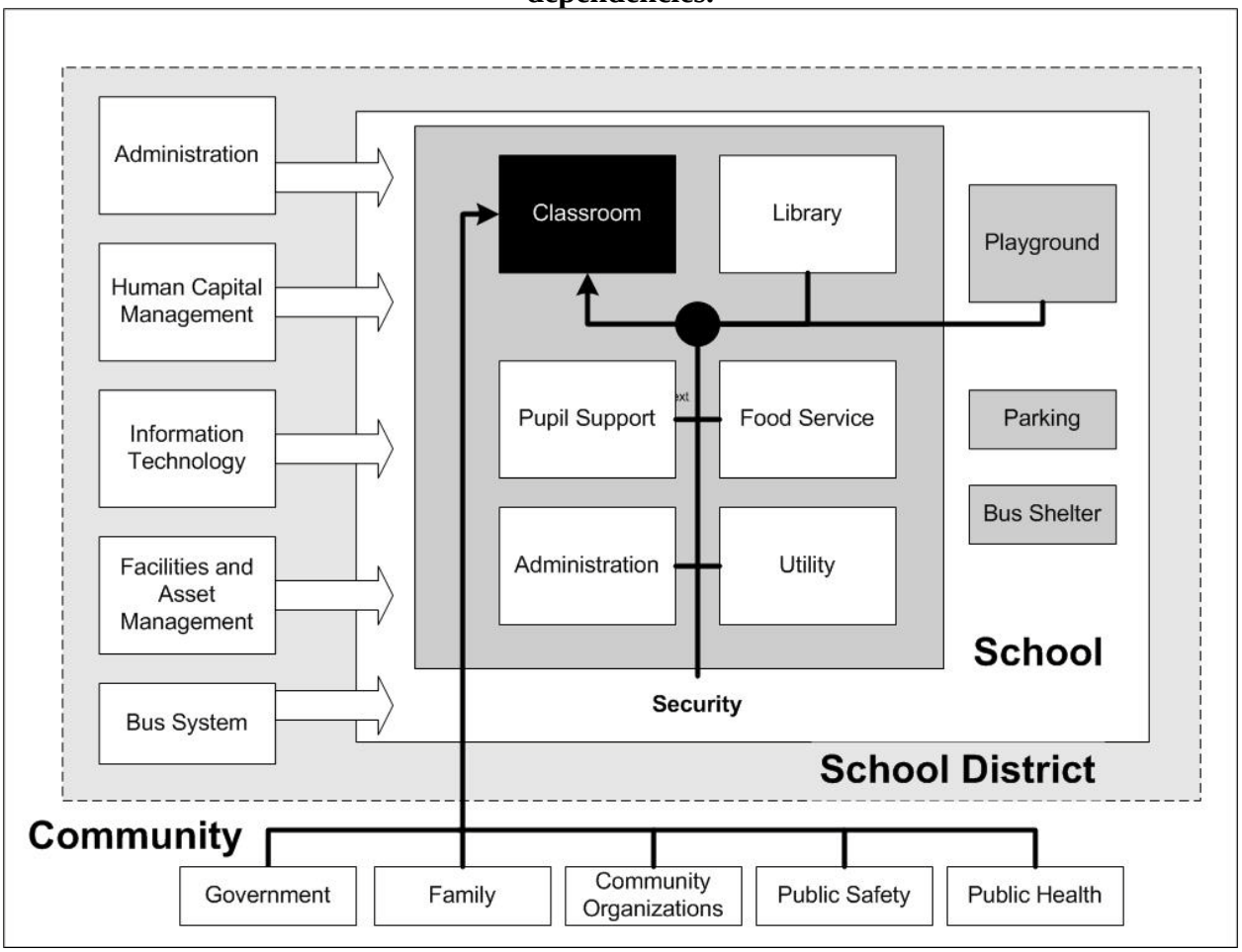
PLANNING AROUND LOCAL CONDITIONS

State and federal governments commonly attempt to advance K-12 educational improvement by enacting programs that target specific high-level, high-visibility problem areas. The problems are real, and the money is needed. But if the availability of money becomes the principal driver of local improvement projects, there is a strong risk of failure. If, on the other hand, allocated money is regarded as an enabling resource, it can be used creatively, as seed money for improvements that are designed to survive on their own.

Understanding the actual situation on the ground is key, and it is one result of pursuing a structured planning process that will ultimately identify the root causes of problems and the resources that are available to address them. The project that seems to address obvious problems most directly may turn out to be doomed to failure, while another project will enable success across a number of fronts. The following analysis of school, district, and IT functions and dependencies is intended to assist in identifying areas needing attention during planning and prioritization.

School and school district functions and dependencies

Figure 1: School and school district functions and dependencies.



The schematic view in Figure 1 can be used as a framework for defining local conditions and areas needing attention. This division of functions is based primarily on the U. S. Census Bureau study *Public Education Finances 2006*, which is also a primary source of definitions provided in the Glossary.

The core function of the school system resides principally in classroom instruction in the local school. What goes on elsewhere in the school should serve that core function. The library and media center, school administration, via instructional support, and the family, via homework, provide front-line support to classroom instruction. But enabling functions are critical to classroom effectiveness:

- Pupil support: Students cannot learn if they are sick, physically or emotionally.
- Food services: They cannot learn if they are hungry.
- Security: They cannot learn if they feel they are in danger.
- Playground: They cannot learn if they are distracted by their own physical energy.
- Utilities: They need bathrooms; they need clean hands.

School districts provide essential third-level functions:

- General administration
- Human Capital Management (HR)
- Facilities and asset management
- Information Technology
- Bus service.

Some support functions that are delivered at the school level may be managed at the district level—most commonly, food service, security, building and grounds maintenance, and sports facilities. Table 1 presents a view of dependencies from the ground up:

Table 1: School and school district functions classified.

	School	**School District**
Core Function	Classroom Instruction	Administration
Support Functions	Administration, Library, Pupil Support, Food Services, Physical Education (Playground)	Human Capital Management, Information Technology
Functional Support Services	Security, Utility, maintenance, storage	Facilities and Asset Management, Bus System, Security, telecommunications
Infrastructure Services	Power, water, sewer, HVAC	Power, water, sewer, HVAC
Infrastructure	School building and grounds	Administrative buildings and grounds, warehouses, bus storage and maintenance facilities, sports facilities

For the most part, core and enabling services are delivered within or around the school building. That building may be new, comfortable, and designed to support all necessary functions. On the other hand, it may date from the baby boom years—the 1950s or 1960s—and be in a serious state of neglect, as in the case of New Jersey's Abbott schools (Education Law Center, 2007).

Older buildings are more expensive to maintain and operate, and they make uneconomical use of utilities. Poor heating, ventilation, and air conditioning (HVAC) undermine the effectiveness of classroom instruction and support functions.

Community functions and dependencies

In public discussion of education performance and policy, gaps in academic achievement are usually described in terms of ethnic and racial difference—white, Asian, Latino/Hispanic, African American—and less often in terms of socioeconomic status, e.g. affluence versus poverty. As discussions turns more directly to school and school district performance and educational funding, measures of difference shift to include

- Percentage of students in the district who live in poverty
- Percentage of students from immigrant, transient, or homeless families
- Percentage participating in the USDA Free/Reduced Lunch Program
- Number of Title I schools in the district.

To a large extent, the support services that schools provide are services that many families cannot provide and that government and community organizations may not provide conveniently. As Table 2 indicates, the family is the foremost provider of services that support individual student performance, and socioeconomic disadvantage impacts the ability to provide those services:

Table 2: Community-based support for education.

Support service	**Provided by**
Food	Family
A place to do homework	Family, government, community organizations
Discipline	Family
Safety and security	Family, government/public safety
Recreation	Government, community organizations
Physical and emotional health	Family, government/public health, community organizations
Setting examples and standards	Family, community organizations

Disadvantaged families in particular risk being left behind as instructional technology and performance objectives change. Children of these families generally have less access to academic and enrichment opportunities, including exposure to the arts, travel and exposure to other cultures, books in the home, educated role models, and day-to-day parental involvement with their education. They have less access to broadband internet connectivity, whether in the home or in the community, and are less likely to engage in the variety of online activities that school and employment may demand (Tabernik & Associates, 2007, pp. 3-4, citing National Telecommunications and Information Administration, 2004).

The engagement between community and school district has two aspects: involvement and accommodation. On the one hand, families, community organizations (churches, civic organizations, and businesses), and local government are stakeholders in the school system, and involvement means marshalling their resources in support of local education. On the other hand,

each of these groups has limitations and interests that must be defined, accepted, and addressed during the process of planning for improvement.

Realizing the desired future state of K-12 public education is impossible without increased integration of school district and community functions and services. The fundamental interests and responsibilities of district and municipality overlap significantly, as Table 3 shows:

Table 3: Common ground between schools and municipalities.

Common problem areas	Shared areas of responsibility
Hunger	Food service (breakfasts, lunches)
Homelessness	Before- and after-school programs
Gang violence and other security	Safety
Demographic change	Health services
Aging physical infrastructure	Transportation
Fixed expenses (e.g. retiree benefits)	Libraries
Funding (e. g. declining tax base)	Sports and recreation
Emergency readiness	Emergency response

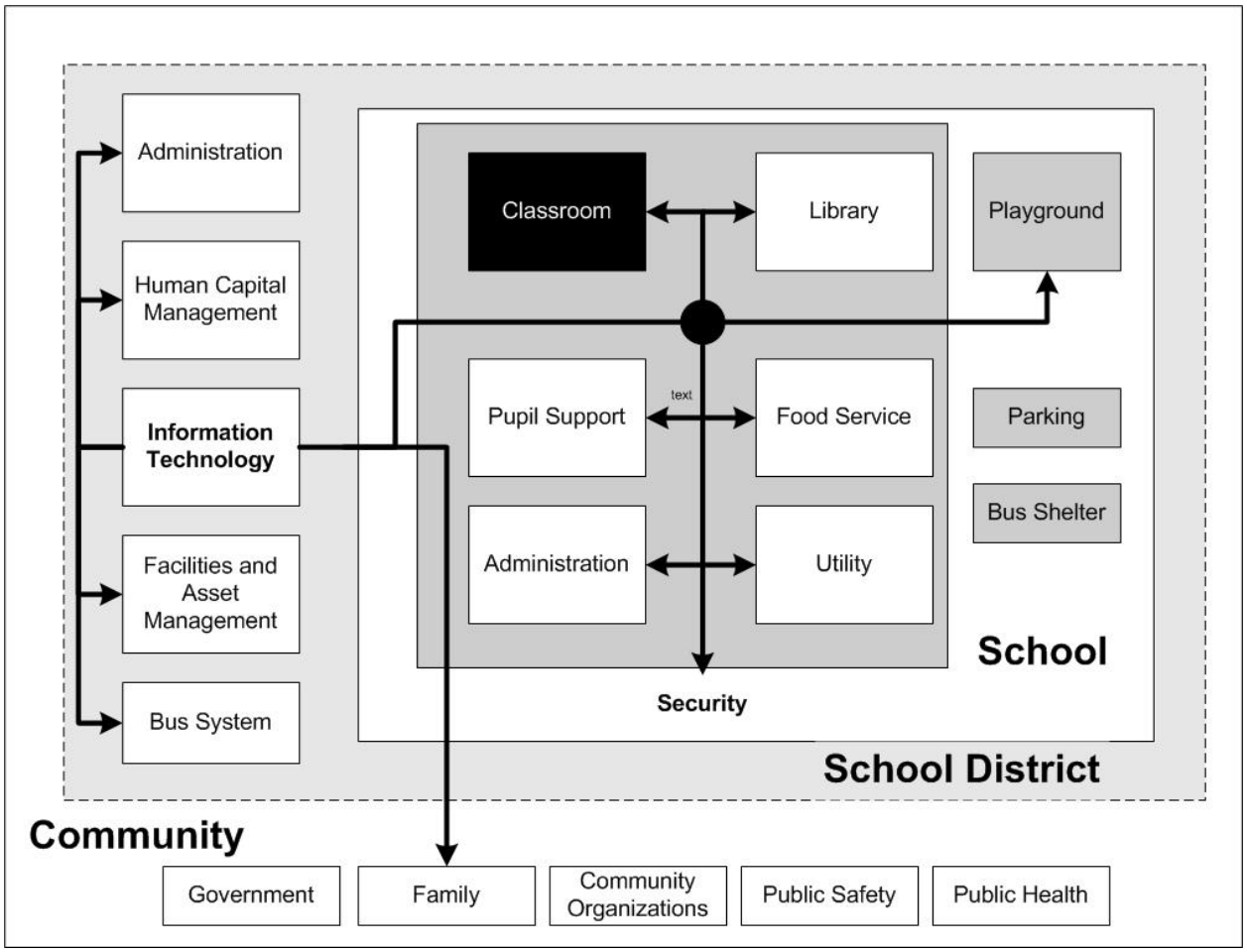
In extreme cases of financial and/or governance failure, the school district has been taken over by the surrounding municipality: Chicago, Washington, DC, and now Detroit. Less noticed are cases where district and municipality have addressed financial pressures by sharing common functions or combining to contract for outsourced services. In many communities, functions such as health, public safety, and emergency response are provided by semi-autonomous agencies that present a coordination challenge to school districts and municipalities alike.

For school districts to reach the future state, they must expand their vision beyond district boundaries, as indicated in Figure 1, to include government, family, community organizations, public safety, and public health as essential functional resources. Institutional planning considers these groups and organizations as stakeholders, but they must also be considered as receivers and providers of information and as partners. A key enabler here is data exchange, which is a combination of relationships and technologies that automates cooperation between partners for mutual benefit.

Information technology dependencies and opportunities

When it comes to delivering K-12 core and support functionality, all roads lead to and from information technology (IT), as illustrated in Figure 2. This section describes services that IT provides, how it provides them, and why improvement in IT infrastructure is a necessary step along the road to the desired future state.

Figure 2: Information Technology dependencies.



Some, but hardly all, of the school's first- and second-level computer-based services are listed in Table 4:

Table 4: IT-enabled school functions.

Classroom instruction	**Library/media center**
- Collaboration and messaging, e.g.	- Collections management
o Interactive whiteboard	- Online catalogue
o Student laptops	- Online access to information sources
o Online instruction (distance learning)	- Multimedia
- Instructional software	- Instructional software
- Classroom multimedia	- Self-instruction software and media
- Productivity software (e.g. word processing)	
- Web access to assignments	
School administration	**Pupil support**
- Student attendance monitoring	- Services recording
- Student performance recording	- Incident reporting

- Instructional support (e.g. curriculum development)	- Student status records
- Incident reporting	- Other reporting
- Time and attendance	
- Printing services	**Sports facilities and physical education**
- Reporting to district level	- Instructional software and media
- Student performance reporting (website, email)	- Environment monitoring and control
Security	**Food services**
- Incident reporting	- Student status verification
- Patrol verification	- Electronic cash register
- Access control	- Back office functions
- Monitoring (e.g. CCTV, metal detection)	
- Alarm systems	**Utilities**: environment monitoring and control

In general, IT user-level solutions can be categorized as function-specific (e.g. instructional software) or generic (e.g. productivity software, collaborative systems). Issues of importance are what core or support functions a solution serves and how effectively the solution is used.

IT-enabled district functions (Table 5) tend to be generic—i.e. general business functions--and thus more amenable to commercial-off-the-shelf (COTS) solutions and outsourcing:

Table 5: IT-enabled district functions.

District administration	**Human Capital Management**
- Financial management	- Online recruiting
- Enterprise resource planning (ERP)	- Time and attendance
- Enterprise content management (ECM)	- Compensation and payroll
- Project management	- Benefits administration
- Contracts administration	- Training management
- Compliance monitoring and reporting	
- Presentation technology	**Facilities and asset management**
- Events scheduling	- Operations and maintenance management
- Productivity software	- Equipment management
- Website	- Procurement
	- Warehouse management
Bus system	- Utilities management
- Fleet management	- Environmental control
- Route optimization	

At the most basic level, all these applications depend on five functions, which the school district's IT organization must support and/or provide:

1. Data collection: getting the required data into the system
2. Data storage: holding the collected data in an organized and accessible form
3. Data processing: making sense of the data for specific purposes
4. Data communications: getting the data where it is needed
5. Data output: presenting the data as information or as action (as in digital control systems).

School functions, in particular, are bound together by data collection, communications, and output:

- Interactive and collaborative classroom applications can collect attendance and performance data.
- Pupil attendance data supports
  - Headcount-based funding
  - Truancy administration
  - Pupil support administration
  - Food service qualification
- Pupil performance data supports
  - Regulatory reporting
  - Performance reporting to student and family
  - Data mining, for identifying patterns for remediation.

Current and emerging technologies are key to effective cross-functional data collection, communications, and output:

- Electronic identification: RFID, smart card, barcode
- Wireless communications: wi-fi, smart phones
- Internet: delivery of software and information
- Electronic communications: email, text messaging, SMS
- Real-time digital monitoring and control
- Geographic Information Systems (GIS).

It is the business of the IT organization to provide the electronic technology that serves school and school district core and support functions. Table 6 provides a vertical view of standard IT functions (what IT does) and possibilities for bringing IT up to date in methods and technology.

Table 6: What IT does--and can do.

What IT does	**What IT can do**
Provide services	Do the right things right
- User applications	- Alignment
- Digital control	- Effective governance
- Data-based reporting	- Optimized processes
Manage service delivery	Manage service delivery
- User hardware	- Software-as-a-Service (SaaS)
- Application servers	- Leased equipment
- Incident response	- Outsourced services
- Develop, implement, and maintain	
Manage integrative systems	Manage integrative systems
- Database	- Database, data warehouse
- Network	- Service-oriented architecture (SOA), enterprise service bus (ESB)
	- Wireless network and telecommunications (wi-fi), virtual private networking (VPN)
Manage systems	Manage systems using Service Level Agreements (SLA)
Provide a secure computing and telecom environment	Provide a secure computing and telecom environment

The public face of educational technology is e-learning in digitized, active, integrated classrooms, supported by a multimedia library providing internet access and web-based applications. The unseen body comprises wireless networks, data integration layers, data warehouses and data analytics, integration layers, data models, and a physical infrastructure for deploying the components.

Currently, educational IT organizations are unlikely to be capable of dealing with this complexity and with the speed of change in technology and organizational needs. IT renewal may require

- Improved site security and upgraded physical plants
- Development and maintenance of network and security architectures (Finkelstein, 2006)
- Adherence to a governance scheme (Nelson, 2008), to standards-based project management, and to best-practice IT management methods and standards such as are defined in the ITIL framework
- Ongoing rationalization of the IT infrastructure, including network, hardware, operating systems, tools, and utilities) for efficiency, effectiveness, and agility in deploying applications (Robertson, 2002)
- Changes to database systems and implementation of an integration layer, preferably based on Service-Oriented Architecture (SOA).

Institutional planning

The desired future state of K-12 education is generally the same for all school districts. The possible future state, given current resources, differs markedly from district to district. School districts differ in wealth, age of physical plant, the mix of students served, and the breadth and depth of enabling services provided. Individual schools may vary within the same district. Problems tend to cluster in school districts that have the least financial resources to address them and have had few resources for most or all of their history.

The particulars of the local district's problems and resources reveal themselves to structured planning. Planning is not sufficient for success, but it is necessary, because lack of planning, lack of clear communications, and lack of clear division of responsibilities are the most common reasons for the failure of projects and programs. The best-practice approach is to develop an enterprise architecture (Finkelstein, 2006). This process results in a 3-5 year strategic plan, improved and documented institutional and IT governance, methods and standards (including project management and quality assurance) that will apply during the improvement program, and models that are used in prioritizing projects. Essentially, the process helps district leadership to define institutional alignment—the marshalling of resources behind institutional goals—and to define a roadmap for applying resources according to institutional priorities.

The following discussion does not reiterate the substantial literature on strategic planning. It emphasizes key areas planning for sustainability. These include

- Leadership continuity,
- Stakeholder management,
- Institutional governance,
- Institutional alignment, and
- Financial viability.

Success stories of public education improvement tend to emphasize the leader and his or her role in defining a vision, then marshalling critical stakeholder groups—usually teaching staff, followed by community groups—behind that vision (e.g. Aldine ISD, Texas, Togneri & Lazarus, 2003; Duval County, Florida, Supovitz & Taylor, 2003). But success is a moving target, and when the leader moves on, focus and commitment may wane.

Second, building sustainable success depends on establishing and managing stakeholder commitment—to the organization, the future state, and the process—over the long term. As public institutions, school districts have external and internal stakeholder groups with interests that reach beyond and past essential district and school functions. The planning process includes stakeholder definition as a basis for ongoing, politically savvy stakeholder management:

- who has what interests
- who has to know
- who has to be reassured and
- who has to be involved in what decisions.

Stakeholder analysis and management are written into the school district's enterprise architecture, along with considerations of leadership continuity.
Third, success depends on clearly defined institutional governance, which ensures that when priorities are set, projects are defined, and assignments are made, the inevitable questions can be answered:

Table 7: Planning issues for ground-level questions.

Governance question	**Human question**
Who has what responsibilities?	What am I expected to do?
Who has oversight?	Who cares if I do my job?
Who needs to know?	How does my job fit into the plan?

Fourth, success depends on aligning school district and school functions behind the essential mission of K-12 education and the vision based in local conditions. High-level frameworks for the school district and IT have already been provided in this paper. The local planning process identifies functions and processes that serve or fail to serve *this* district's expressed mission and vision, and it defines gaps and weaknesses in the network of dependencies that characterizes *this* school district. The most important projects from a dependencies standpoint may not be the most obvious from an external point of view, and here is where early stakeholder management becomes important. A common tactic is to select projects that can be used to establish an early track record of success and thereby promote stakeholder support.

During the process of identifying and prioritizing projects, a critical qualifier is financial sustainability. Seed money may be available; it may be discoverable. But early projects in particular should be selected for their ability to produce productive systems that can operate at projected long-term funding levels.

Planned investments in educational improvement can be radically affected by changes in revenue; lack of transparency in financial accounting systems contributes to the difficulty of predicting the availability of money (U. S. Conference of Mayors, 2006, pp. 19-20). There is all the more need, then, to seek out projects that can, out of their own ability to save money, fund

their own operations and provide operating support for later improvements. Such projects might include

- Physical plant improvements that include green architecture design and integrated environmental and security controls, resulting in reduced utilities expense as well as improved work and study conditions
- Improvements in IT management and provision of services that save software licensing and hardware maintenance costs while increasing agility and flexibility (responsiveness to change).

These infrastructure projects enable dependent functions and thus can be funded through grant and bond-issue funds. Business planning processes can demonstrate the return-on-investment over short and long terms, and operational savings can be funneled to other operations down the line. Optimization of school bus routes using GIS technology need not be expensive and can result in reduced fuel costs as well as environmental benefits. Even a direct improvement of school-level core and support functions, such as implementing integrated collaborative/interactive instructional and instructional support technology, can be shown to support itself: better attendance data can produce more formula funding while reducing costs and complexities in areas such as food services and pupil support.

Ultimately, sustainability requires commitment to self-maintaining and self-correcting organizational systems. The best-practice management system for business and private non-profits, the Balanced Scorecard (Kaplan, 1996), may not be the best approach for public school districts, with their complexities of stakeholders and governance. Nonetheless, the basic principles of the Balanced Scorecard provide a checklist of characteristics of sustainable organizations:

- The organization, e. g. the school district, exists to further its core mission.
- Success depends on
  - Operating within budget
  - Responding to the needs of the principal stakeholders (students and community)
  - Providing support to employees (teachers and staff)
  - Adhering to effective internal processes
    - Governance
    - Business processes
    - Information systems.
- Success is the result of
  - Planning
  - Prioritization
  - Measurement
  - Accountability
  - Sustained commitment.

DATA EXCHANGE AND CROSS-BOUNDARY INTEGRATION

The future state of K-12 education and especially of pupil and instructional support depends on data exchange. Within the school and school district, data exchange entails breaking down the

barriers between legacy computer systems. It also means reaching across the boundary lines between the school system and external agencies—municipal governments and public safety, health, and emergency response agencies—that have clearly defined interests in the shared domain of community services.

Data exchange within the school system

Automation has come to the public schools in three waves.

1. Schools and school districts participated in the general press to automate generic business functions.

2. School districts responded to state and federal demands for financial accountability by automating data collection and reporting purpose by purpose. If formula funding depends on headcount, systems are implemented to collect attendance data. If a free lunch program requires reports on who was qualified and who was served, that data must be collected during the food service process.

3. Programs for, in particular, reducing the achievement gap require data at the level of the individual student, data that can then be aggregated (rolled up) at higher levels, analyzed, and reported for many purposes, including teacher bonus schemes, school recognition or remediation, and qualification for district, state, and federal programs.

The second wave ran into difficulties from the start. It was driven by district priorities, yet data collection was at the local school level. As a result, teaching and support staff complained of the burden of additional recordkeeping. Also, automation was spotty, because of ROI considerations, and systems were not integrated, because of piecemeal implementation and the state of technology at the time.

This third wave, in progress, is running into problems, as one typical report indicates:

> To bridge . . . performance gaps, principals and teachers are told to use data to drive instruction—examining carefully where students have strengths, weaknesses, and gaps in knowledge, so that instruction can be differentiated to meet the precise needs of individual students. However, this is bound to be an empty exhortation if teachers do not have ready access to student data. We are not simply talking about last year's test scores or a student's Grade Point Average. Teachers need information about how students are doing in other classes, their attendance rates, how they have done on assessments, what their Special Education goals and needs may be, whether they are on track to complete college entrance requirements and how they have done on the high school exit exam. (Tabernik & Associates, 2007, p. 2)

A major barrier to realizing the promise of the third wave is dependence on second-wave information systems:

> The current state of [district] student information systems does not allow teachers, administrators, or our partner agencies this level of access to information. Student data are stored in multiple legacy systems that do not allow for facile linking of information

and, in most instances, their user interfaces are only useful for someone who is technically sophisticated. (Ibid.)

The goals of third-wave automation are generally aligned with the desired future state of K-12 education. Thus, "data-driven instruction" is inseparable from the functional dependencies inherent in schools and school systems, the dependence of core instruction on support functions inside the system and, increasingly, outside it as well.

A data-driven instructional methodology can significantly reduce the achievement gap. As teachers use digital teaching/learning tools, as students and community take advantage of 24/7, multichannel (voice/video/data) access to instructional content, usage data is collected, and teachers, parents, the school, and the school district know that the student is actually attending each class and making measurable progress. The school district and the school get the headcount they need to assure funding levels. Truancy is reduced, and administrators, teachers, and parents can monitor progress via easy-to-read digital dashboards.

Data integration and exchange from a technical standpoint

The core and support functions that are most immediately involved with third-wave goals—classroom instruction, administration, library, pupil support, and food service—share a common set of data needs:

- Student identification
- Data collection, the simpler the better
- Common data store
- Transparent data access.

These needs can be met collectively with current best-practice methods and technology:

1. A statewide Student Identifier (primary database key) is first among the "Ten Essential Elements" for educational data that have been defined by the Data Quality Campaign and its member organizations and adopted widely (Dougherty, 2007). This identifier serves to link student data, current and historical, collected by automated systems across functional areas.

2. Attendance and performance data can be collected automatically in the classroom, with a minimum of teacher administration, as the result of interaction with computer-based instructional systems. Smart card and RFID technology can be used for recording events and transactions in areas like food service and pupil support.

3. Data associated with an individual student can be assembled into an individual Student Profile, a record in a common data store (database) administered by the district IT organization. In the case of legacy systems, data extracts can be summoned as needed.

4. Web-based portal technology can present information on an individual student, or summary information, in a form specifically fitted to the information needs and authority of the user.

The principal enabling technology is Service-Oriented Architecture (SOA), which allows rapid implementation of workflow, user interfaces, and the integration of legacy systems. Security within the organizational firewalls and across boundaries is ensured by web services encryption methods. Privacy is enforced primarily by user profiles.

Data exchange with external agencies

Support services in the schools—in particular, pupil support, security, and food services—are community services in small, and they are best provided in partnership with community agencies. Students may miss school because they are sick or emotionally disturbed or because they must care for family members at home. They may be involved with gangs or be in trouble with the law. They may come to school needing help that requires community and not just school resources.

Addressing these and other issues effectively at school and district levels requires developing partnerships with government and community agencies that enable transparent data exchange at the individual student level. The following scenario shows how this exchange can work at the school level:

> The school has collected data about each student in authorized ways, from authorized sources, and through routine transactions. This data is held in trust by the district in the form of a student profile. This profile documents all and only those aspects of the student's history, circumstances, and status that the school requires to exercise its mandated authority. Extracts of this student profile are available to the teacher and to authorized instructional support personnel at the desktop via browser-based portal applications.
>
> Social services agencies likewise have data profiles of their clients, including students. School instructional support staff can, on a need-to-know basis, summon specific kinds of data from these outside agencies over secure channels. If, for example, a student misses school, staff can check for events or circumstances that might require different kinds of intervention—perhaps a call from a health worker—and apprise the external agencies.

Overall, the benefits of this kind of data exchange are (1) faster identification of and response to problems, (2) administration of appropriate services, and (3) better coverage of the population being served.

Service-oriented architecture (SOA) is best fitted to provide the kind of secure, transparent, and administratively controlled data exchange—if it is enabled at both ends of the line of communication, on both the school district and the agency side. Different organizations are usually at different stages in the process of IT architectural integration. Most need awareness of benefits and solutions, and this is where stakeholder management begins. Forging data exchange partnerships entails entering into formal data sharing agreements, including agreement on a common set of standards and best practices, for IT in particular.

Partnerships are partnerships, and work toward data exchange is only part of broader cooperative service and technology integration efforts. For example, agreements between districts and municipalities to share common maintenance and administrative functions can include adoption

of integrated technology solutions. These solutions implement computer control of safety/security, HVAC, and energy use. They provide community benefits like reduced emissions, and they save money for district and government. But they require, among other things, the rewriting of building codes to reflect 21st century technology standards, and this is the province of local government.

Partnership and data exchange between school districts and regional public safety agencies focus especially on emergency management and emergency response. Major technical concerns are to integrate communications across many channels—TCP/IP, radio, 911 services, etc.—and to make substantial and heavy use of GIS spatial data. Some jurisdictions—for example, the State of Idaho—intend to integrate public safety communications with educational communications (Key, 2008).

WHAT IS HAPPENING NOW

Currently, there is no school district or city that has put together all these parts—enterprise architecture, IT architecture, technologies, data exchange, and an operable governance framework—into an integrated program. Certainly, however, there are initiatives that implement parts of the program, especially the most important IT components. Two of the more promising are to be found in California and Texas.

Hayward Unified School District

The Hayward (California) Unified School District (HUSD) is a large district with an 89% minority, 35% immigrant student population and a history of serious, ongoing financial and management problems. Under CIO and Education Technology Director Patrick Simon, the district engaged the Hayward Partners in Education (PIE), a broad-based community group, in a strategic partnership to improve quality of education. PIE's initial commitment to improving district and school voice and data systems evolved into a more comprehensive model dubbed eDistrict (Tabernik & Associates, 2007; Myers, 2006).

The public face of eDistrict is an online, web-based e-learning center. Behind it, a project called Education Process Re-engineering comprised district-wide assessment of current practices and alignment of processes behind strategic goals. eDistrict was funded by canny use of federal and state grants, by bond issues, and by the Return on Investment realized by upgrading physical infrastructure and implementing digital controls in areas like HVAC and energy utilization.

eDistrict's classroom interface includes an interactive whiteboard, wireless stylus, projector, laptops, student response devices, and lesson plan development software. Outside the classroom, eDistrict facilitates online student learning and assessments, staff professional development, and digital document management (Myers, 2006).

Key success factors included improving communications with stakeholders and vendors and developing IT staff skill sets. Significant initiatives include

- Forging vendor partnerships that enabled
  - optimized printing/duplication services
  - upgraded telephony network to a VoIP-based system

  - digitization of documents, including student records
- Implementing wireless networking, allowing students, parents, and HUSD staff secure access to progress reports, attendance records, and homework assignments over a variety of devices
- Deploying Software-as-a-Service (SaaS) applications, delivered via the internet, in place of resource-hungry traditional solutions
- Distributing leased laptops in the community at the end of lease, to provide low-income students with home computing and internet access.

Hayward USD is a work in progress. Since its inception, administrative changes have delayed full-scale deployment of the program across the entire district.

Plano Independent School District

The Plano (Texas) ISD has a student population 73% white and Asian, 26% Hispanic and African American. The percentage of economically disadvantaged families in the district is roughly a third that for Texas as a whole.

The district's mission and high-level assumptions do not explicitly emphasize action to close the achievement gap. Instead, they emphasize "understanding the demographics of the student population and adequately supporting their needs through the education of families" and "improving and expanding our school infrastructures to accommodate our large number of students" (Plano Independent School District, 2009). The district looks to more affluent local stakeholders for financial support of improvements through its Plano ISD Educational Foundation.

The district is committed to a 5-year strategic plan focusing on four strategic goals:

- Student Learning: expanding the district's capacity to perform core and enabling functions
- Community Connectedness: enhancing connections with the Plano community
- Capacity Development: emphasizing teacher training and the acquisition, management, and ongoing evaluation of student learning resources and support services
- Data-Informed Decision-Making.

Goals for financial stewardship are conceived in these same terms. The district defines its high-level improvement goals according to numerical measures mostly related to testing:

- Performance on the various Texas Assessment of Knowledge and Skills (TAKS) tests
- The number of students taking college entrance and advanced placement examinations
- The number taking certification examinations for certain vocations
- The graduation rate and
- The dropout rate (Plano Independent School District, 2008).

This approach to planning and management shows strong affinities with Balanced Scorecard.

Plano ISD has opted for a single integrated solution for student data management: Prologic's Total Education Administrative Management Solution (TEAMS) Student Management. This module provides a web-based user interface, data security, and integration with business functions. Teachers can enter grades, track attendance, and access student demographic and emergency data, attendance history, and schedule (Prologic Technology Systems, 2007). The district has committed to implementing the TEAMS financial module, which includes automated compliance to Texas regulatory standards.

GLOSSARY

Definitions of school and school district functions are based substantially on U. S. Census Bureau, 2006, Appendix A. Different systems distribute functions differently, and the distinctions made in these definitions should be understood accordingly. IT terms are given commonplace definitions.

Administration (school) includes the principal's office and the offices and staff that provide instructional support and general administrative coordination on school grounds.

Administration (school district) includes school board (responsible for policy and oversight), superintendent, and units that provide or manage general and business support services, including planning, finance, accounting, and central procurement.

Bus system refers primarily to the provision of bus transportation between the school and the neighborhoods within the school's designated service area. It is regarded as a district function. Fleet management may be the province of district facilities and asset management. In many communities, public buses provide student transport to school by arrangement between the district and the local transit authority.

Classroom instruction includes regular classroom instruction; special instruction for bilingual, disabled, and immigrant students; and vocational/technical education.

Community organizations include churches, cultural organizations, neighborhood organizations, taxpayer groups, recreational and athletic clubs (e.g. YMCA), businesses (e.g. bookstores that provide study facilities for students), and business interest groups.

Enterprise Content Management (ECM) refers to computer-based systems that combine document and media file storage with collaboration and workflow, records management, forms development and management, desktop faxing, and other document-centered business functions.

Enterprise Service Bus (ESB) is a class of "commoditized" (proprietary) forms of **Service-Oriented Architecture (SOA)**. In exchange for full adherence to SOA's open standards, the customer has the support resources of the vendor organization, graphical tools for rapid development, and a variety of standard adapters for connecting common legacy applications to the system. ESB solutions are available from Microsoft (BizTalk), Oracle (Fusion Middleware), IBM (WebSphere), Sonic Software, Cape Clear, and many other vendors.

Facilities and Asset Management (FAM) includes the identification and tracking of equipment and the maintenance of physical infrastructure (buildings and grounds). Often, functional areas

have responsibility for their own assets (e.g. Information Technology), are self-contained FAM areas (e.g. bus system), or have FAM responsibilities outsourced in whole or in part (e.g. food service).

Human Capital Management is the term used for "human resource management" in the federal government under government accountability guidelines.

Instructional support includes instruction service improvements, curriculum development, instructional staff training, and media, library, audiovisual, television, and computer-assisted instruction services.

Library (school) includes, in addition to reference and media resources, student internet access, research and study skills instruction, and study facilities (study hall). Public municipal and county libraries usually provide study facilities and resources to students outside school hours.

Playground serves here as shorthand for the range of facilities that serve a physical education or sports function, including multi-purpose spaces (stage/assembly/basketball) within the school building, locker rooms, athletic fields, and sports complexes under full district control.

Pupil support includes attendance record-keeping, social work, student accounting, counseling, student appraisal, record maintenance, and placement services, as well as medical, dental, nursing, psychological, and speech services. Pupil support services vary widely from district to district, according to community makeup and values, problem areas, and the availability of resources. Compare, for example, Sarasota County School District, 2009, with Santa Ana Unified School District, 2009.

Service-Oriented Architecture (SOA) is a framework for using messaging and XML to transfer requests for data and the data itself between applications and systems. SOA itself is based on open standards and can be implemented piecemeal, but many organizations opt for the **Enterprise Service Bus (ESB)**. For more information, see Erl, 2005.

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