Abstract—The kindergarten through twelfth grade student information systems market is large, complex, rife with opportunity, and difficult to navigate. Student web portals that store and display a wealth of student and school information, student data warehouses used for statistical analysis and reporting, and a range of commercially available analytical tools have propelled educational school systems into modern technology times. This paper explores the industry, the market, the uses, and history of existing K-12 student information systems tools.

I. INTRODUCTION

According to the National Center for Education Statistics, in 2011 there were 54,790,000 total students enrolled in the K-12 educational system in the United States. This number includes public, private, and charter school enrollment figures. Establishing this number is a challenging task, because education is regulated by and reported on by state and local governments, which is why in 2015 actual enrollment data is only accurate through 2011. In the 2011-2012 school year, there were 129,189 elementary and secondary schools between public and private institutions. Each of these students, at the very least, has grades, attendance, standardized test scores, behavioral and personal information that needs to be captured by their educational institution. In an ideal world, this data would follow the student from school to school, as they grow from elementary to secondary or transfer from one school system to another.

Although this is not a new phenomenon, as schools have been tracking this information for years, it is now a technology problem. Schools are moving to more robust technology systems to comply with the requirements of the No Child Left Behind Act (NCLB) of 2001. One of the goals of NCLB was to improve school administration by making data driven decisions. Additionally, NCLB instituted requirements for school systems to submit annual reports, detailing student achievement scores, disaggregated by subpopulations, which impacts federal funding. This offered an incentive to educational institutions to collect, analyze and report data in a timely and efficient manner. To facilitate this data driven decision making and annual reporting, NCLB encouraged educational systems to invest in good quality, user-friendly data management systems.

To support the understanding of the intentions of NCLB, the U.S. Department of Education (USDE) released guidelines to help guide educational institutions through the process of improving the quality of their data. Those guidelines describe the steps to make sure data collection, processing, and reporting systems are automated and that the data can be transmitted in an electronic, interoperable format. It also laid out instructions on instituting data dictionaries, business rules defining acceptable values, data definitions and granularity.

According to a report by the USDE, teacher-reported access to student data systems has grown rapidly since 2005, but the data systems themselves have not been supporting instructional decision making at the school level. District data systems often cannot share data across systems, are not user friendly, contain limited data, and lack instructional tools to help teachers act on the data provided to them. The organization also showed that even though teacher access to data systems is growing, systems often lack the kinds of data that teachers find most useful for instructional decision making.

II. MARKET OVERVIEW

The new regulations resulting from NCLB meant that many schools had to invest in either upgrading database tools or converting from paper based systems and acquiring an electronic student information system (SIS). This has created a large opportunity for educational technology companies, given that global spend on education technology in classrooms was $13 billion in 2013. The rapidly increasing size of the
The education technology market has attracted a range of companies to offer solutions, from large vendors such as Oracle, providing data warehouse solutions, to education startups offering data analytics services.

Although SIS tools make up only a portion of the education technology market, it has still proved to be attractive enough for vendors which continue to design products specifically for the K-12 schools. A handful of schools are so large, their annual revenues make them comparable to the size of some familiar Fortune 500 companies. Table 1 shows how the largest four school districts in the United States compare to some of the largest global companies. With revenues of this magnitude, many schools have the IT budgets to afford enterprise grade solutions for their technology needs.

### III. IMPLEMENTATION OPTIONS

The Los Angeles Unified School District (LAUSD) utilizes Oracle’s Business Intelligence Enterprise Edition, for its student data warehouse, a tool typically used by corporations to manage their data. LAUSD also designed a web portal that pulls information from the data warehouse to be used for dashboards, reporting, ad-hoc querying, and analysis. The web portal provides up-to-date student information for a range of data points which could include enrollment, attendance, grades, academic interventions, counseling, discipline, and health, to name a few of the many entities represented. The web portal integrates and displays information from multiple sources such as the data warehouse and student assessment applications.

LAUSD’s web portal serves as the districts SIS and is currently being custom developed and deployed using an iterative approach. This means that some of the features of the site are working as intended but there are other enhancements that are not currently operational. Some of the functionality to be released in future iterations are mobile device access and parent access.

As an alternative to the custom development of a SIS, there are a growing number of companies that market customizable preconfigured web based solutions. These systems are sold to school districts and state education departments where the districts can select the prebuilt features they would like included in their implementation. Districts with smaller budgets or fewer requirements may only be interested interested in purchasing the grade management functions of and SIS and larger school districts may use the full suite of a vendor’s product offerings. Chicago Public Schools, which was using Pearson’s PowerSchool tool for its student web portal, paying annual maintenance fees of $750,000, recently completed a Request for Proposal (RFP) that contained around 1,500 different requirements, for which the winning vendor needed to be able to facilitate with their product.

<table>
<thead>
<tr>
<th>School District / Company</th>
<th>Revenue</th>
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<tbody>
<tr>
<td>United Services Automobile Association (USAA)</td>
<td>$20,971,000,000</td>
</tr>
<tr>
<td>New York City DOE (NY)</td>
<td>$20,600,000,000</td>
</tr>
<tr>
<td>Texas Instruments Incorporated (Rank #227)</td>
<td>$12,205,000,000</td>
</tr>
<tr>
<td>Los Angeles Unified School District (CA)</td>
<td>$12,030,000,000</td>
</tr>
<tr>
<td>McGraw Hill Financial, Inc. (Rank #484)</td>
<td>$5,143,000,000</td>
</tr>
<tr>
<td>Chicago Public Schools (IL)</td>
<td>$4,893,900,000</td>
</tr>
<tr>
<td>Yahoo! Inc. (Rank #522)</td>
<td>$4,680,000,000</td>
</tr>
<tr>
<td>Miami-Dade County Public Schools (FL)</td>
<td>$4,575,215,000</td>
</tr>
</tbody>
</table>

Table 1: Largest US school districts compared to Fortune 500 companies
Unlike LAUSD’s custom built SIS, most of the currently available preconfigured solutions come with mobile functionality, parent access, and even customizable push notifications sent to parent’s mobile devices which alert them to information they indicate is important to them. These preconfigured SIS tools are useful for districts because managing multiple systems is an issue for teachers that have to interact with them and school IT departments that have to support them. It is painful for teachers to have to interact with three or four different tools to manage their tasks. SIS tools attempt to merge these dispirit systems into a single tool. The integration these functions makes things easier for the end users and their IT departments. Most of these full service tools offer some combination of the many features listed on Table 2.

The education technology market is very fragmented, in that each vendor is offering a different set of product features. Some of them offer the basic functionalities of the SIS, some of them offer just the student data warehouse, there are vendors that supply the data warehouse and the full service SIS features, there are some companies that just specialize in creating connectors that integrate all the different tools and pull data into a single source, and there are companies that focus solely on analytics of existing data. Because there are so many options for states or districts to select from, it becomes difficult for vendors to gain a foothold in the market and with no front runner in the industry it is difficult for districts to identify the product that is going to be the best fit for their needs because they become inundated with so many products to analyze without having the proper evidence to make informed decisions.

IV. STATE VERSUS LOCAL DEPLOYMENTS

In most states the SIS tool selection and requirements process is conducted at the district level. This means that one school district may use a product from Pearson while a neighboring school district may use a product offered by a Pearson competitor, Infinite Campus and have different requirements for the system. The benefits of the districts having this flexibility is that each school system has its own unique needs, so being able to pick a product that facilitates those needs and meets the school system’s budget can prevent the district from being constrained by a one size fits all approach.

Some states chose to do state wide implementations forcing all the districts in the state to use the same tool and vendor. A large burden on local school systems is state reporting. So when the state SIS systems and the district SIS systems are integrated together by a single product, all the district data is transparent to the state and it is updated in real time, relieving the encumbrance of district-to-state reporting. Additionally, it is typical for vendors to provide volume based discounts by doing state wide implementations, making it more economical for a state to implement one tool across all the districts, instead of each district purchasing and maintaining individual tools, typically saving the state significant amounts of money.

<table>
<thead>
<tr>
<th>Common Student Information System Functionality</th>
<th>Document Management</th>
<th>National Records Exchange</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ad Hoc Reporting</td>
<td>Document Management</td>
<td>National Records Exchange</td>
</tr>
<tr>
<td>Assessments: Test Score Import</td>
<td>Electronic Transcript</td>
<td>Online Assessments</td>
</tr>
<tr>
<td>Assignment Management</td>
<td>Fees</td>
<td>Online Assignments</td>
</tr>
<tr>
<td>Attendance</td>
<td>Free and Reduced Application Management (FRAM)</td>
<td>Finance/HR/Payroll</td>
</tr>
<tr>
<td>Behavior</td>
<td>Grade Book</td>
<td>Special Education</td>
</tr>
<tr>
<td>Calendar</td>
<td>Health</td>
<td>State Reporting</td>
</tr>
<tr>
<td>Census</td>
<td>Locker Management</td>
<td>Survey</td>
</tr>
<tr>
<td>Course Management and Scheduling</td>
<td>Messenger</td>
<td>Transportation</td>
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<tr>
<td>Course Registration</td>
<td>Mobile Portal</td>
<td>Food Service</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>Multi-year Academic Planner</td>
<td>Staff Evaluations</td>
</tr>
</tbody>
</table>

Table 2: High Level SIS Features
A number of states have chosen to use this statewide implementation approach. Software vendor Infinite Campus has completed statewide deployments in Hawaii, Kentucky, Maine, Montana, and South Dakota. Pearson has implemented statewide in North Carolina, South Carolina, North Dakota, and had a failed $61 million implementation in Idaho. In 2013 Infinite Campus won an $80 million contract through an RFP for a statewide implementation across Wisconsin but the funding for the project was rescinded after strong opposition and lobbying efforts from Skyward, a smaller SIS vendor headquartered in the state. Wisconsin remains on the district model and, as of writing this paper, Infinite Campus has enough of the state’s school districts on its platform that it earns more in annual revenue from those districts than it would have if the state continued with the bid to migrate to the statewide model.

V. BARRIERS TO ED TECH

The largest K-12 information systems provider in globally and in the US, Pearson, recently sent a communication to its customers and Independent Software Vendors of one of its flagship products, PowerSchool, indicating a pending sale of the tool and its customer base. PowerSchool, the most-widely used SIS tool in the US, has 13 million students on the platform and had $97 million in revenues with $20 million in operating income, in 2014. Pearson is moving towards a more cash generative strategy, which is why it is selling this product.

Pearson selling a large SIS product shines a spotlight on the difficulties in the K-12 educational technology market. Long sales cycles, difficulties in the generation of large revenues unless the vendor lands a large district or a state sale, politics and lack of technical investments make the K-12 environment resistant to change, and the large amount of competition makes it difficult for companies to differentiate themselves and to grow. As a result of all of these things, it is difficult for educational technology companies to raise capital, making startups in the industry less sustainable.

Even with those difficulties, some startups have managed to succeed and gain recognition. One example is BrightBytes, a San Francisco-based K-12 start up that has created a data analysis and planning platform. The company has recently differentiated itself by using data science and research to link money spent on classroom technology solutions to learning outcomes. BrightBytes is offering a research and data driven approach to evaluating the efficacy of different technology tools or school programs. As evidence of the company’s recent success, through multiple rounds of fundraising it has received over $17.5 million since July of 2014 and is expanding into Chinese and Australian markets.

VI. DATA APPLICATIONS FOR SCHOOL IMPROVEMENT

Comprehensive school improvement calls for a multifaceted approach that utilizes data-driven decision making through program evaluation. Ideally, student information systems are at the center of the decision making process. Information systems store data that can be disaggregated, used to monitor school initiatives and student progress, and even provide a means for communication within school and between school staff and parents. Having an information system in place that offers educational stakeholders the ability to store and efficiently access data does not simply boost efficiency, but creates opportunities for the effective delivery of calculated curriculum that meets student needs.

All schools have different cultures, climates, and areas for improvement. To identify the unique needs, educational stakeholders analyze critical data elements such as standardized test scores, behavior referrals, GPA, incident reports and attendance. Ideally, a program evaluation team could utilize information systems by querying any or all of the data elements previously mentioned. Through an inspection of the data, educators identify achievement gaps and then target those achievement gaps with evidence-based interventions.

Academic, social/emotional, and career readiness domains are all areas which countless evidence-based interventions target. For instance, a school could use an information system to identify a group of students who receive free/reduced lunch are earning lower scores than the rest of the school on standardized tests. Perception data also indicates that students who
receive free/reduced lunch report having high levels of test anxiety. An intervention that could be useful would target small groups of economically disadvantaged students. The intervention might entail small group counseling that addresses anxiety and test taking skills, and an after school program that provides meals and tutoring. This is simply an example of a hypothetical intervention, there are many interventions that have been statistically shown to impact students.

After identifying a need, and then choosing and implementing an intervention to respond to the need, information systems can help program evaluation teams report results. Educational stakeholders need access to data elements in a table format that can easily be transferred to an inferential statistics program. Many educators will be asking if their school initiatives and interventions are helping subpopulation students grow at a faster rate than the control group (students not receiving services). The professionals who create program evaluation teams/committees are educators first, and time spent formatting data is time best spent in direct contact with students. However, thorough evaluation of school programming allows a school to show parents, school board members, and the state government what the school is doing is effecting and worth the investment. Reporting results promotes buy-in, and invites support from community and parents.

Parent involvement is a common challenge for many schools, and another domain that could be targeted by an effective school information system. Digital progress books are commonplace in the education system. The more access parents have to student progress, the more connect they are to their child’s education. Parent portals would ideally include grade checking and a messaging system. The messaging system could alert parents when their child has been given a new assignment, fails to turn in an assignment, or receives a new grade. The portal would also ideally be available in browsers and mobile application.

From an educator’s perspective, information systems can make schools more effective by storing data and providing easy access to that data. Educational stakeholders can use the data to identify achievement gaps among subpopulations of students, and track the progress of the schools interventions on the achievement gaps. Lastly, information systems ideally allow student and parent access to individual information and monitoring. All of these elements aid schools in delivering effective curriculum with efficiency.

VII. CONCLUSION

The student K-12 student information systems market is fragmented, difficult to break into, slow to innovate, and is full of complex restrictions. Even with those difficulties, there is funding and an inherent need for new and improved tools, exciting challenges to overcome, and the opportunity to make a positive impact in an industry that could use the help. With the proper tools and business model, vendors have the ability to make change in the educational space and rapidly expand their market share.

VIII. FUTURE AREAS OF RESEARCH

- Security: Student information systems have security requirements through the Health Insurance Portability and Accountability Act (HIPAA) & Family Educational Rights and Privacy Act (FERPA). Making sensitive student data available electronically makes it vulnerable to accidental exposure or to malicious actions. There are noted cases of security issues with some of the student information systems currently implemented. Here is an example: http://www.chieftain.com/news/education/3131669-120/students-student-district-access
- Analysis: There is a large opportunity to explore the vast amounts of existing student data, using predictive analytical techniques or even to conduct basic analysis by giving data access to the proper users. The existence of these integrated data repositories make it possible to think about new insights to the outcome of a decision that was previously unforeseen.
- Regulations: There is the opportunity to conduct further exploration of federal, state, and local mandates on student information systems use and implementation. There is a large source of government funding for classroom technology tools and for increased performance on assessments. The
regulations imposed by No Child Left Behind and the rules for technology and reporting are going to change in the near future. The impacts of these changes and the financial benefits or burdens they offer to educational systems could be significant.

**REFERENCE**


