How the Size of Elementary Schools Impacts Cost of Ownership

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How does a district balance economy of scale and a learning community size that enhances student achievement? Many districts have realized such a balance by creating smaller learning communities within a larger campus. Examples include school within a school, grade level houses and splitting an elementary in primary-intermediate halves. The result has been smaller learning communities and the benefits of economy of scale. Such economy of scale can free up operation funds for education programs and teacher salaries.

The enclosed case study focuses on the long term cost of ownership for various campus sizes. This fast-growth Texas school district was looking to house 5,000 elementary students in the coming decade. A 30-year cost of ownership was compared for designing all elementary schools to house 500, 750 or 1,000 students per campus.

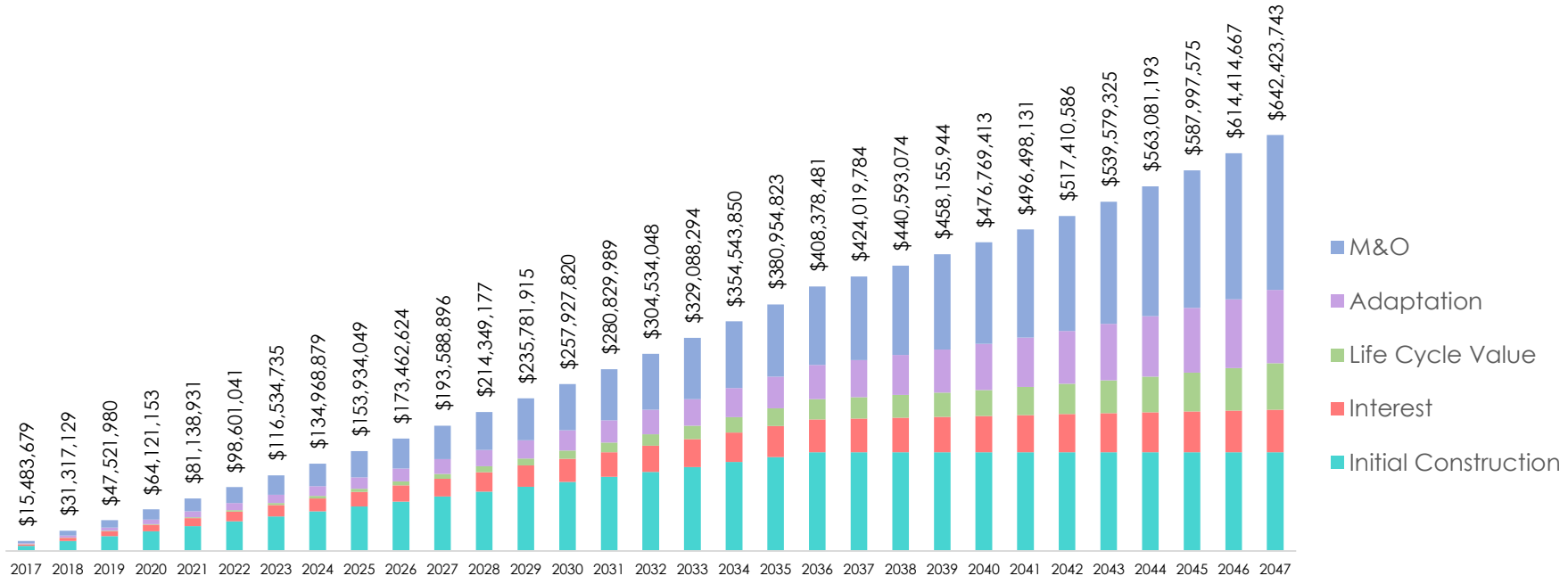
A 30-year term was chosen to include bond interest and renewal (systems life cycle) costs. The model includes construction cost, bond interest, maintenance cost, renewal, and adaptation costs. Assumptions used in this estimate were 5 percent annual inflation, 20-year debt, 3 percent interest rate and $250 per square foot for initial construction.

The elementary schools were sized using a scalable metric developed from the statistical analysis of more than 300 elementary schools. Thus, an overall space efficiency of the larger campuses was realized due to the economy of scale.

Cumulative Cost of Ownership

The chart below shows the cumulative 30-year cost of ownership for building all 750 student elementary schools. This demonstrates how the different cost categories accumulate over the years. Initial construction cost was spread over 20 years, just as a district would pay out the cost in a bond. The renewal (life cycle value) and adaptation values represent the estimated accumulating value based on proven forecasting methods developed by the Association of Physical Plan Administrators (APPA). The APPA models have been validated with 38 different facility assessments performed by 11 architectural firms.

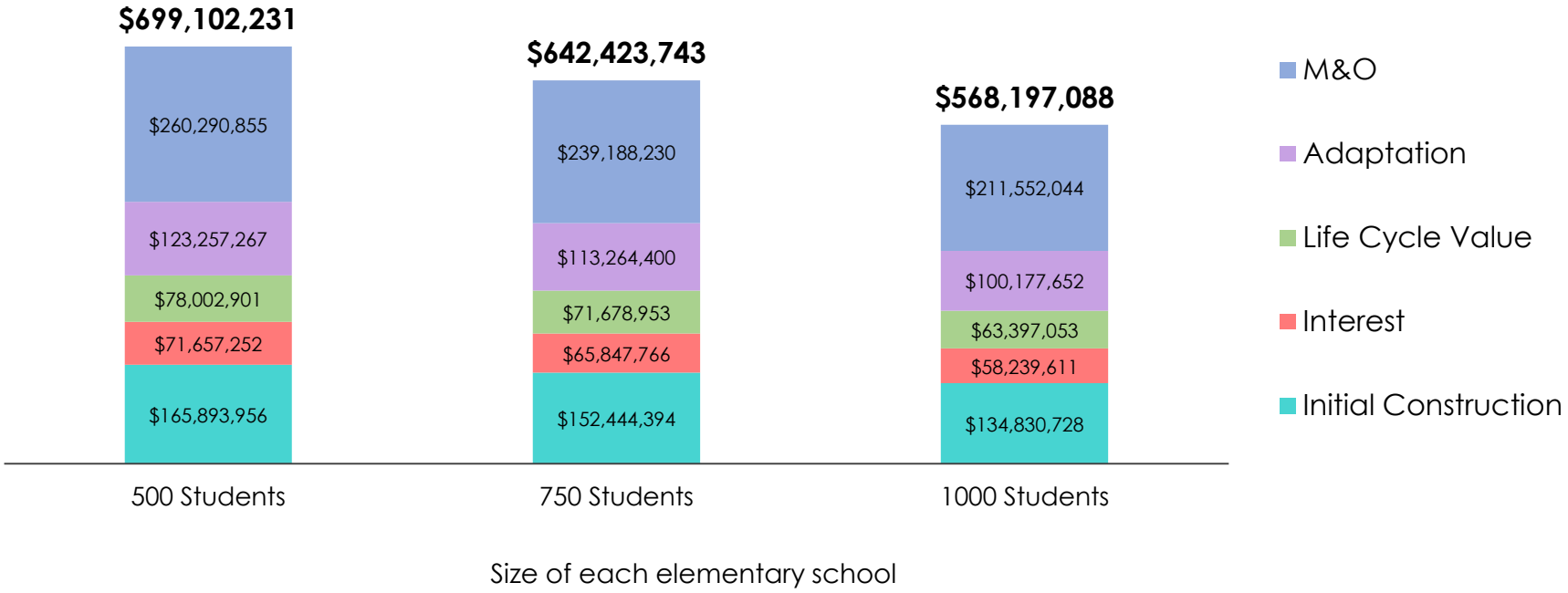
Forecasts include bond funding of 100% of accumulated renewal (life cycle value) and adaptation when the building reaches 20 years. The associated bond interest is also included. This model assumes funding 100% of accumulated renewal. Districts should consider the level of renewal to be funded and adjust the model accordingly.



Cost of Ownership Comparison

The chart below shows the cumulative 30-year cost of ownership of the 5,000 students being housed in all 500 student, 750 student or 1,000 student elementary schools (e.g. housing all students in 750 student elementary schools would cost $642M over 30 years).

These models include facility-related costs only. Case studies have indicated non-facility staffing and other operating cost savings can be realized from a district having fewer campuses.



Long Term Difference in 500 vs 1,000 Student Elementary Schools

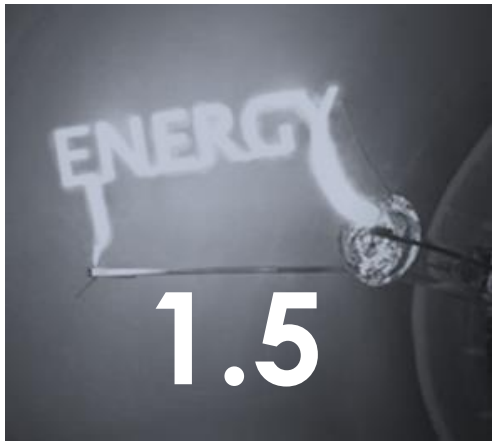
These images show the difference between housing all of the 5,000 students in 500 vs 1,000 student campuses. Maintenance cost, teacher pay and student funding are based on Texas averages.

Energy equivalents
This is the energy consumption difference. The savings represents the energy to heat, cool and light 1.5 elementary schools every year.

Teacher salary equivalents
This is how many annual teacher salaries could be funded by the maintenance and operations (function 51) difference.

Student funding equivalents
This is how many annual student education equivalents could be funded by the maintenance and operations difference.

30-year cost of ownership



Annual elementary energy equivalents

Annual teacher salary equivalents

Annual student funding equivalents

Elementary Campus Size Impact on Learning

Research regarding the impact of campus size on student achievement has been mixed as indicated in the summary below. However, a solid body of research indicates a correlation of smaller class size with improved student achievement. See the following page.

Author	Year	Summary of Findings
D.J. Lamden	1995	Study of 91 Baltimore schools found no relationship between student performance and the size of the school.
J.P Hoagland	1995	Study of California schools found possible correlation between reading and school size, but no correlation between size and math/writing.
K. Cotton	1996	Concluded smaller schools produce better academic results.
Florida Dept of Education	1997	Studied 1500 elementaries, middle schools, and high schools in Florida. When expenditures were controlled for, overall size was not a predictor of student performance.
North Carolina Board of Education	2000	Found smaller elementary campuses had a small (1 to 2 points) impact on student achievement.
C. Howley	2001	Research suggests size impacts students in lower socioeconomic groups. Students from affluent backgrounds tend to perform better in larger schools.
K.R. Stevenson	2001	Concluded that the impact of poverty was so large that the effect of other variables may be masked. Impact of poverty could approach 70%.
D.A. McCathren	2004	Study of South Carolina elementary students did not find association of size and student performance. Greatest indicator of student achievement was students on free and reduced lunch.
S.M. White	2005	Study of 267 South Carolina elementaries. Found association of size and retention. Most significant factor in student achievement was poverty.
K.R. Stevenson	2006	Concludes finding ideal school size is at least elusive, and possibly so complex that an absolute ideal does not exist.
I. Kuziemko	2006	Smaller schools have postiive impact on math scores and attendance. Recommended further study with a larger data set.
A.J. Egalite	2013	Review of campus size research. Concludes correlation of smaller schools postivie impact on student achievement, more in high school than elementary schools.

Q&A

What is predictive analytics?
Predictive analytics is a planning tool based on the statistical analysis of similar data, in this case facility information from more than 300 Texas school districts. The result is a series of predictive formulas that project square feet, renewal, etc.

What are data sources?
Facility data was collected from 300+ Texas school districts over a two-year period and is updated monthly. Districts ranged from an enrollment of 200 to 200,000. Districts included a cross section of wealth and socioeconomics factors.

How do metrics factor in current school design trends?
The database is updated monthly with recently completed schools. This inclusion of schools that are designed for current programs provides a metric that factors in evolving trends.

Have the analytics been peer reviewed?
Methodologies and models were validated by a Ph.D. with the Division of Statistics & Data Sciences at the University of Texas in Austin.

How accurate are the predictive analytics?
Predictive formulas for district-wide projections have a correlation greater than 95. Correlations for campus level and renovation cost predictive formulas are greater than 80.

Are forecasts guaranteed?
Forecasts are based on predictive analytics, which in a sense are the continuation of recent trends. These forecasts are not a guarantee of future events or conditions.

How are facility renewal costs forecast?
PSC uses a proprietary method (patent pending). It is based on a tool developed in the 1980's by the Association of Physical Plant Administrators (APPA), and the statistical analysis of facility assessments by multiple K12 consulting firms. The result is a renewal forecasting tool blending actual assessments and the APPA tool that has proven reliable over decades of use.

Does class size impact student achievement?
A robust body of research indicates smaller class size (lower teacher-student ratio) has a positive impact on student achievement. Below are some such studies.

Glass and Smith, 1978
Mitchell and Mitchell, 1999, California schools
Molnar et al, 1999, Wisconsin schools
Kureka and Claus, 2000
Munoz, 2001
Fidler 2001, California schools
Finn et al, 2005, Tennessee schools
Speas, 2003
Jepsen, 2009
Fredriksson, 2013
Schanzenback, 2014

About the author:

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