

Cost-Effective K-3 Classrooms Assessment

An Analysis of Advanced Sustainable Materials, Innovative Design and Procurement Options

Section 1019, Chapter 35, Laws of 2016, 1st Special Session

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Research Services

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Executive Summary

The 2016 supplemental capital budget (Section 1019, Chapter 35, Laws of 2016, 1st Special Session) directed the Office of Financial Management (OFM) to analyze cost-effective options for the procurement of high quality, sustainably built, energy efficient, and health classroom space to address the need for K-3 classrooms statewide. OFM contracted with the state Department of Commerce to perform the analysis.

This report builds upon the significant investment the state has made in researching public school conditions and facilities costs. Cost-effective options are presented for the procurement of K-3 classrooms statewide based upon an analysis of the potential use of advanced sustainable materials, innovative design and production, and procurement processes for K-3 classrooms statewide.

Using various methods, including interviews, policy comparison and statistical analysis, this report sought to better understand the factors that affect K-3 procurement costs. This analysis involved three phases:

Phase 1 – A literature review was conducted on public school construction costs, trends and class size reduction programs nationwide.

Phase 2 – Case studies were researched on 12 recent elementary school projects. Interviews were conducted with school district facility and construction professionals to gather insight on factors affecting school construction timelines and costs. These interviews informed the design of Phase 3. In addition, a method for evaluating the timeline and barriers of school construction was developed.

Phase 3 – A survey was sent to all school districts. Follow-up interviews were conducted with district administrators. The impact of salient metrics on elementary school and K-3 classrooms cost was evaluated.

FINDINGS AND RECOMMENDATIONS

Finding 1 – Cross-laminated timber and other permanent modular facilities are more cost-effective to construct than traditional stick frame facilities and are more cost-effective than purchasing portables.

Two different permanent modular buildings options were analyzed: facilities built using cross-laminated timber (CLT) and those using stick-frame construction. Both modular options have comparable up-front costs and expected life cycles to traditional facility construction (nonmodular construction). The CLT facilities have the lowest cost per square foot of \$6.72 per year, whereas portables have the highest cost per square foot of \$26.88 per year. Both modular options require a relatively short production timeframe, lasting between seven to 12 months from design to completion. In contrast, traditional construction requires 27 to 42 months from design to completion. A major caveat for CLT is that the industry is not yet capable of large-scale K-3 construction.

Recommendation 1: Incentivize school districts to build additions or new facilities using modular construction options by the following methods:

- Increase the School Construction Assistance Program (SCAP) allocation for modular-permanent buildings;
- Provide standard project planning and management for permanent modular buildings; and
- Implement design guidelines for modular-permanent buildings and materials to encourage design innovation.

Recommendation 2: Assess the feasibility of implementing CLT for elementary school construction projects by addressing the following questions:

- Can districts use the pilot project-produced designs with different contractors?
- How can districts ensure pricing consistency when taking a pre-existing design to other contractors?
- Can districts expect to see the promised iterative efficiency gains when working through different contractors?

	Traditional		Modular-Permanent	
	(Nonmodular stick frame)	Portable	CLT – 4 classroom	"8-Plex" (Stick frame)
Design, permit, construction time	27-42 months	Less than 3 months	7-12 months	10 months
Requires permitting	Yes	No	Yes	Yes
Total (avg.) cost per classroom	\$291,160	\$250,768	\$302,300	\$269,760
Cost per square foot	\$316	\$268	\$336	\$344
Life cycle	30 years	10 years	50 years	30 years
Cost per square foot per year	\$10.54	\$26.88	\$6.72	\$11.47
Initial cost	Moderate	Low	High	Moderate
Long-term cost	Moderate	High	Low	Moderate
Timeliness	Low	High	Moderate	Moderate

Table 1: K-3 Procurement: comparing cost, time, quality of materials and design

Finding 2 – Value engineering had no identified cost reductions for prototypically designed schools.

Previous reports indicated that school districts may be using value engineering sub-optimally by employing it after the design process has been completed. Survey respondents, in contrast, indicated that the design and value engineering process is valuable, especially in the beginning stages of a construction project. School districts often implement the majority of value engineering suggestions for new designs provided by their consulting teams in pursuit of cost-effective construction options. However, the majority of value engineering recommendations for prototypical designs were rejected because they did not meet school district standards.

Recommendation 3: Streamline the D-form process by removing the value engineering requirement for previously constructed prototypical designs.

Finding 3 – All regions of the state are facing similar issues affecting the cost and timeliness of constructing and/or procuring new K-3 classrooms.

School districts statewide face similar issues in meeting the class size reduction mandate regardless of assessed valuations, urban-rural differences or student population growth. Survey respondents

identified the following issues as impeding the procurement process, presented here in order of frequency:

- 1. Difficulty of municipal bond passage
- 2. Lack of a capital budget
- 3. Length of construction process
- 4. Length of permitting process
- 5. SCAP July 1 release date

Recommendation 4: Conduct further research on the impact of school construction timelines on cost, including:

- The time it takes to construct a school, from conception to school opening; and
- The relationship between the ability of school districts to pass bonds and the capital project delivery schedule.

Finding 4 – Stakeholders provided the following suggestions for shortening the facilities production timeline and reducing construction costs:

- Alter the funding distribution by moving the SCAP fund release date to April or releasing "stop-gap" funding covering bidding and early construction in March or April;
- Study the impact of the supermajority requirement for municipal bond passage;
- Lower the bond approval threshold from 60 to 50 percent;
- Renew the K-3 class size reduction grant program;
- Streamline the permitting process by giving school districts county-level permitting priority;
- Have OSPI provide consultation services to districts that do not have in-house project management; and
- Alter the SCAP formula by:
 - o Considering portable age and condition in assessing need; and
 - \circ Only including those classroom spaces designed as classrooms when determining capacity.

Recommendation 5: Conduct further research on the feasibility of implementing these stakeholder suggestions.

Acknowledgments

The research team extends its appreciation to all the people and organizations who shared their expertise and experience with us during the preparation of this report. We thank the representatives of other states' education and school facilities departments who informed our review of established best practices for class size reduction. We also acknowledge the representatives who met formally and informally with us as we gathered information for the case studies – school principals and superintendents, and representatives of school facilities, capital projects and value engineering interests. Our discussions were frank and informative. In the end, however, the research team claims sole responsibility for the content and recommendations of this report.

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Almira	Evergreen	North Mason	Selah
Anacortes	Freeman	North Thurston	Shelton
Bainbridge Island	Grand Coulee Dam	Northport	Snoqualmie Valley
Battle Ground	Granger	Northshore	South Bend
Bellingham	Kalama	Oakville	Spokane
Bethel	Kennewick	Ocosta	Tekoa
Blaine	Kettle Falls	Okanogan	Toledo
Bremerton	Kiona-Benton City	Orondo	Tonasket
Bridgeport	La Center	Orting	Touchet
Carbonado	La Conner	Palisades	Toutle
Castle Rock	Lake Washington	Pasco	Tumwater
Centerville	Lakewood	Pateros	Union Gap
Central Kitsap	Liberty	Paterson	University Place
Chehalis	Lynden	Peninsula	Vancouver
Chimacum	Manson	Port Townsend	Walla Walla
Cle Elum-Roslyn	McCleary	Puyallup	Wapato
Colville	Monroe	Rainier	Wellpinit
Cosmopolis	Morton	Raymond	West Valley
Darrington	Mt. Adams	Reardan Edwall	White Salmon
Dieringer	Mukilteo	Renton	Willapa Valley
East Valley	Naches	Richland	Wilson Creek
Eastmont	Napavine	Rosalia	Winlock
Eatonville	Naselle	Royal	Yakima
Everett	Nespelem	Seattle	

The state of Washington has mandated class sizes be lowered for kindergarten, first, second and third grades (K-3). This mandate, combined with the change from half-day to all-day kindergarten and an increasing population, is driving the need for additional classrooms. As noted in the budget proviso below, the 2016 Legislature directed the Office of Financial Management to conduct a study on cost-effective options for the procurement of K-3 classrooms statewide to meet this increased demand. OFM contracted with the Department of Commerce's Research Services unit to perform this analysis.

The office of financial management shall analyze cost-effective options for the procurement of high quality, sustainably built, energy efficient, and healthy classroom space to address the need for K-3 classrooms statewide. The analysis may include the potential for use of advance sustainable materials and innovative design, production and procurement processes. The office of financial management may contract with one or more consultants to assist with the analysis. (2016 Supplemental Capital Budget - Section 1019, Chapter 35, Laws of 2016, 1st Special Session)

This report provides cost-effective options for the procurement of K-3 classrooms statewide from an analysis of the impact of time, building-material choice and design on procurement. We also assess value engineering as a cost savings tool, analyze the timing of the state reimbursement system and explore which construction, procurement or nonprocurement options may be sufficient to meet the need for more classrooms.

1.1 Background

Research over the last few decades has shown both 1) the importance of low student-to-teacher ratios to enhance student learning and 2) the direct relationship between school facilities and educational performance. Multiple long-term studies, most notably *Project STAR*^{*}, have demonstrated that low student-to-teacher ratios in kindergarten, first, second and third grades lead to greater educational outcomes. Other studies have shown the importance of lighting, noise-level, air quality and temperature on student well-being and learning.^{1,2} It is this evidence that led the Legislature to enact a class size reduction (CSR) goal of one teacher to 17 students in K-3 by the 2017 to 2018 school year and to implement the high performance school (HPS) standards.

The state provides financial assistance for school construction, primarily via the School Construction Assistance Program (SCAP). In an effort to provide high-quality facilities for students, the state of Washington has been a leader in building sustainable, energy-efficient and healthy schools through the implementation of the High Performance School (HPS) Buildings Program.³ All state-funded school construction projects greater than 5,000 gross square feet must meet the HPS standard.⁴ A highperformance school is energy- and resource efficient, is designed to reduce its impact on the environment and provides a healthy and comfortable indoor environment. The state has implemented two rating and certification systems school districts may use to design high-performance schools: the Washington Sustainable Schools Protocols and Leadership in Energy and Environmental Design,

^{*} *Project STAR* (Student/teacher achievement ratio) was a large controlled randomized experiment conducted in Tennessee from 1985-1989. The experiment tested whether K-3 students attending class with small student-to-teacher ratios (13-17 pupils vs. 22-26 pupils) led to higher academic achievement. (Word et al., 1990)

commonly known as LEED. Both incorporate high-performance features into school design and construction, such as energy management and the use of life-cycle cost analysis.

The 2008 supplemental capital budget directed the Joint Legislative Audit and Review Committee (JLARC) to develop a pilot to determine the feasibility and costs of statewide data collection on K-12 facilities. In 2010, JLARC published, *K-12 Pilot Facility Inventory, Condition & Use System*. The study concluded "there is no comprehensive system in place that can serve as a single source for standardized facilities information for all of the schools in the state." As a result, the Washington State University (WSU) Energy Program produced a report, *Assessing the Conditions of K-12 Public Schools*, which collected and verified statewide public school inventory and condition data.

The JLARC study also recommended the further study of facilities costs. In 2016, the Legislature passed Engrossed Substitute House Bill 2380, which directed the Washington State Office of the Superintendent of Public Instruction (OSPI) to conduct a study "identifying and analyzing the major sources of potential variations contributing to capital project cost differences"⁵ for K-12 schools and skill centers. The Educational Service District (ESD) 112's Construction Services Group (CSG) was contracted to conduct the study. Major recommendations include:

- Assessments of cost savings achieved by each project through value engineering studies and
- Collecting additional information on school construction to create effective cost management resources, innovative options and clear accountability in the use of capital dollars.

The School Construction Technical Work Group (2017) compiled key elements and issues about improving K-12 construction, such as improving the transparency of the SCAP and determining whether:

- The state reimbursement system or timing for capital projects ought to be updated
- School districts possess insufficient bond capacity to address capital needs
- Reliance on portables for enrollment growth is sufficient to meet K-12 needs.

The Common School Long Range Projection^{*} projects the statewide K-3 population will grow by 2,896 students per year through 2027.⁶ The projected growth in school-age population (9,200 persons per year through 2025) will increase demands on existing assets and new public-funded K-12 schools statewide.⁷

The 2015-17 capital budget appropriated \$200 million towards this effort through the creation of the K-3 CSR Grant Program. The 2016 supplemental budget appropriated an additional \$34.5 million. Ninety school districts completed the application process for a K-3 CSR grant. Of those districts, 55 had their classroom data validated by the WSU Energy Program and qualified for funding of one or more K-3 classrooms. Due to the limits of available funding, only 21 districts were eligible to receive grant funding for 488 classrooms. These districts are in various stages of planning and construction. To date, four districts have completed their projects.

The 2015-17 capital budget appropriated \$5.5 million for the Department of Enterprise Services to construct 20 CLT modular classrooms to support K-3 class-size reduction. The Seattle, Mount Vernon, Sequim, Wapato and Toppenish school districts were selected for the pilot and each classroom was constructed in time for the 2017-18 school year.

^{*} Unofficial projection as of June 2017

As of July 2017, 35 elementary school construction projects were approved for SCAP funds. There are nine elementary school projects pre-approved for SCAP funding in July 2018. For the 2017-19 Biennium, the funding for these 44 projects will total \$227.9 million. Fifteen of the 44 projects have not, or will not, be front funded. Due to the lack of a 2017-19 capital budget, seven of the projects approved in July 2017 have not begun and eight of the July 2018 approved projects have an unknown status. Funding for these projects totals \$84.4 million.

1.2 Project Overview

The above discussion draws from the first phase of the study, which synthesized information on public school facilities and procurement. In the second phase, a literature review of national and regional studies and reports on school construction costs and facility outcomes was conducted. The research team identified a gap in the state's current understanding of cost-effective procurement of elementary schools: the time it takes to construct a school from conception to school open.

The research project's second phase focused on understanding the planning, funding, designing, permitting and construction processes for elementary schools. The research team undertook a comprehensive examination of the 12 elementary school construction projects previously analyzed in the ESD 112's CSG report (2017) to build on the foundations of knowledge that have already been established. Descriptive and quantitative project data was cataloged on schedules, value engineering, high-quality materials use and cost-saving innovations from the "D-form" packages, as provided by OSPI and available within the CSG report.

The research team also explored how project timelines impact choices in materials, design, production and procurement processes and innovations. The studied projects were each completed between July 2014 and September 2016. Multiple procurement barriers were found, including the impact of regulatory and funding environments on the timelines of school districts, the transition to modular buildings, the procurement of sites and the use of portables.

The research project's third phase further explored these and other issues in a survey distributed to each school district. The survey reached capital project directors, operations directors, finance directors, superintendents and principals from the state's 295 school districts. In addition, a literature review was conducted on 31 other states that have implemented K-3 class size reduction measures. Representatives from 13 of these states were interviewed.

Two approaches to modular construction were evaluated for cost-savings from the use of advanced sustainable materials: a modular eight-plex produced with traditional construction materials and a CLT-based four-plex. These designs were compared with portables and traditional construction techniques. Data on eight-plexes was drawn from this report's case studies. CLT data was provided by a Washington Department of Enterprise Services (DES) pilot project.

To determine potential options to decrease the costs associated with new K-3 classrooms or facilities, the research team examined procurement using multiple variables. These included SCAP grantee status, K-3 CSR grantee status and basic demographic characteristics such as geographic region, urban versus rural, elementary school population differences and assessed valuations.

1.3 Stakeholder Engagement and Feedback Plan

The research team generated feedback through 12 case studies and a statewide survey of school districts. Stakeholders representing OSPI, school boards, school principals and superintendents, school facilities, capital projects and value engineering interests, as well as experts of CLT and forestry were interviewed.

A case study approach was used to understand the full procurement process for the 12 identified elementary school projects. This included interviews conducted from May 31 to June 6 with the six school districts that constructed the projects. These districts have many similar characteristics, including district population and assessed value. The projects themselves are also similar, having comparable projected student populations, design processes, funding and project types. For these reasons, the projects lent themselves to a comparative analysis. To ensure accuracy of the case studies, drafts were validated by the respective interviewees.

Findings from the case studies were used to develop a statewide survey. The research team reached out to the Washington Association of School Administrators to forward the survey to their membership. The survey had 107 respondents representing 96 school districts. The research team also conducted two follow-up interviews, which occurred on September 7 and 14.

1.4 Delimitations and Limitations

The breadth of this report precluded an in-depth study of each identified barrier to procurement and construction. Furthermore, this report reviewed procurement at the K-3 and elementary school levels and did not consider kindergarten through twelfth grade (K-12) as a whole.

This study also did not evaluate the impact of bond elections on a district's ability to fund procurement nor did it evaluate the potential safety implications of the facilities considered.

Procurement may be considered from multiple perspectives, including environmental, social equity or comprehensive public health. This report primarily is concerned with sustainable expected longevity of various school facilities and materials.

2.0 Class Size Reduction Options

2.1 Nationwide K-3 Class Size Reduction Review

Washington is one of 32 states that has instituted laws either recommending or mandating a maximum number of students per teacher in K-3 classes. Eighteen of the 32 states do not provide substantial facilities-related funding to their school districts and do not collect information related to facilities funding. Of the remaining states, six have faced decreased enrollment since instituting class size reduction policies, and thus have not been reliant on facilities construction to meet requirements. Only California, Florida and West Virginia have evaluated strategies for class-size reduction that consider facilities construction.

In California several studies of an initial class size reduction effort address funding and facilities issues.^{8,9},^{10,11} Subsequent studies of facilities maintenance and construction reference the impact of class-size reduction.^{12,13,14} In 2007, Florida published a report reviewing the implementation approaches used by schools, with a focus on challenges to implementation and opportunities for cost savings.¹⁵ West Virginia requires that teachers receive differential pay for every student in their classroom above the mandated maximum.¹⁶

	Strategies	Impediments	
	Combine nonCSR grades	Increases higher-grade class sizes	
Short-Term	Reduce noncore courses	Reduces enrichment opportunities;	
Teach in nonclassroom spaces displaces special edu		displaces special education programs	
Provide differential pay*		Increases cost	
	Co-teach/combine classes	Undermines CSR benefits; reduces per-student class space	
	Re-draw attendance zones	Increases busing time/cost	
Long-Term	Lease or purchase portables	Limited to available space; reduces	
	Renovate/add to facilities	outdoor school areas (e.g. playgrounds)	
	Construct new facilities	Permitting time; unpredictable resource cost increases; siting affordability; land-use regulations	

 Table 2: K-3 class size reduction cost-saving measures in California, Florida and West Virginia

As illustrated in the above table, school district response to K-3 class-size reduction has been largely consistent in Florida and California. School districts accomplished initial class size reduction goals

^{* &}quot;Any ... classroom teacher of grades one through six who has more than twenty-five pupils [the West Virginia maximum class size] shall be paid additional compensation based on the affected classroom teacher's average daily salary divided by ... twenty-five ... for every day times the number of additional pupils enrolled up to the maximum pupils permitted in the teacher's classroom." (W.V.C. §18-5-18a)

primarily through nonprocurement options. Initial procurement options primarily took the form of renovations or additions to existing schools, or the purchase or lease of portables. The majority of school districts from both states aimed to reduce co-teaching and to replace portables with a mixture of additions, renovations and additional school facilities when available.

California state officials involved in evaluating class size reduction goals noted the following issues with short-term nonprocurement options:

- Enrichment spaces and special education classrooms were converted to K-3 classrooms, as were cafeterias, theater spaces, hallways, break rooms.
- Outdoor spaces, such as playgrounds, were used for portable space. A subsequent stateimplemented program aimed to eliminate portables.
- The class-size reduction initiative was criticized for producing smaller classrooms, which fostered a weaker learning environment, partly because of acoustical and lighting issues.

2.2 Washington State Implemented Strategies

Washington state school districts have implemented procurement and nonprocurement options to address K-3 class-size reduction, all-day kindergarten and student population growth. While nonprocurement options offer school districts a means to meet K-3 class-size reduction without the funding required to construct or renovate a school, literature from other states indicates nonprocurement approaches are often exhausted within the first several years following a class-size reduction mandate.





One-fifth of survey respondents are building or renovating elementary schools to add a second story or multiple stories. These projects involve modernizing or replacing elementary schools, constructing additions and building new elementary schools. A further one-third of respondents who require additional classroom space indicated they are unable to pursue new construction in the next 10 years.

Forty-four elementary school construction projects lack funds due to the lack of a 2017-19 capital budget. Seven capital budget-funded projects are delayed and eight are expected to be delayed. The

impact of these delays on the long-term supply of construction for class-size reduction needs is unknown.

To accommodate K-3 class-size reduction and student population growth, some school districts are building or renovating schools to include multiple stories that include added classrooms. However, this option presents student safety issues for kindergarten, first, second and third grade.

Converting K-6 to K-5 elementary schools is an effective strategy to accommodate all-day kindergarten and K-3 class-size reduction. However, in the case studies, Pasco School District's primary concern prior to K-3 class-size reduction was overcrowding middle schools. Consequently, the district converted its K-5 elementary into a K-6 to take pressure off the middle schools. Pasco then split an elementary school into an upper elementary (third through sixth grades) and lower elementary (kindergarten through second grades) so the original elementary school exclusively housed K-2 students.

Survey respondents were not asked about combining grades, reducing courses or redrawing attendance zones. Therefore, it is unknown if these class size reduction options are being used in Washington. Survey respondents have predominantly employed the class size reduction strategies adopted in California and Florida, as school districts in those states faced similar challenges about increasing classroom demand and insufficient classroom supply.

What is known is that Washington school districts are implementing a variety of nonprocurement and procurement strategies. For example, some school districts are placing two teachers in a classroom. An analysis of *Project STAR* demonstrated the increase in learning outcomes as a direct result of decreased student-teacher ratios per classroom, but no consistent increase from placing multiple teaching staff in a single classroom.^{*}

	California and Florida Strategies	Used in Washington
New facilities	Use space-efficient designs	Yes
cost savings	Seek out multi-use designs	Yes
	Emphasize function over form	Unknown
	Combine nonclass size reduction grades	Yes
Other cost	Reduce noncore courses	Unknown
savings	Teach in nonclassroom spaces	Yes
	Re-draw attendance zones	Unknown
	Co-teach/combine classes	Yes
	Lease or purchase portables	Yes
	Renovate/add to facilities	Yes

 Table 3: Comparing Washington to California and Florida

^{*} Results from *Project Star* indicated that adding a teacher's aide did not improve outcomes in grades 2 and 3, and did not improve outcomes as much as class-size reduction in any grade. (Word et al., 1990)

3.1 Issues Impeding Production

The lack of sufficient K-3 classrooms statewide raises two production-related questions: How quickly can new classrooms be constructed and what preventable barriers occur during production? This section assesses cost impacts on construction, which is divided into four distinct phases: 1) pre-planning and bond election(s), 2) design and value engineering, 3) permitting and 4) actual construction.*



Figure 2: Production timeline of elementary school construction projects

■ Length of school district elementary school permitting process

The average timeline for the procurement process is between 27 and 42 months. The design and value engineering phase averages between 12 and 24 months. The permitting phase frequently varies from three to nine months. The construction phase has the least variance -- between 15 to 18 months.

Despite the general adoption of cost-saving measures, school districts are frequently unable to procure new facilities when required. Survey respondents identified the following issues as impeding the procurement process, presented in order of frequency:

- 1. Difficulty of municipal bond passage
- 2. Lack of a state capital budget
- 3. Length of construction process
- Length of permitting process
- 5. SCAP July 1 release date

Length of school district elementary school construction process

^{*} Go to Appendix A for a supplementary analysis of production timelines and Appendix D for 12 case studies that further analyze all four phases.

3.2 Pre-planning Process

The July funding release is an issue affecting school districts unable to front fund construction. Projects that are dependent upon state funds to construct are required to wait until July 15 to obtain secured state funding to move forward with contract bidding and awarding. Without secured funding, projects that otherwise could bid at an optimal time (March-April) must wait until July. This necessitates construction waiting until mid-August to begin. This, in turn, requires additional costs to address winter weather protection and loss of efficiency constructing the facility superstructure during winter months.

An April bid is substantially different from a July bid. For a typical school construction project, an April bid will have a roof installed and a complete building envelope prior to adverse weather arriving. In contrast, an August bid does not leave enough construction time to complete the building envelope. Without the enclosed structure, many projects shut down during the winter months. This results in additional costs to accelerate the project during spring and summer to open the school on time. Districts with the ability to front fund are able to avoid adverse winter weather and, thus, do not have the associated cost increases.

3.3 Design and Value Engineering Process

Survey respondents indicated the design process is distinct from permitting. Districts often work with multiple agencies, each with a different approval process. Each agency has their own jurisdiction in the city or county, and each requires a different process and different timelines. These compounding requirements substantially complicate the design process. The average design time is 10 months. The design process timeline is heavily influenced by the value engineering process and whether the district is using a unique or prototypical design.



Figure 3: Length of design and value engineering phase, by region

Previous reports indicated that school districts may be using value engineering sub-optimally by employing it after the design process has been completed. The survey responses and case studies did not uphold this concern.

Survey respondents indicated that the design and value engineering process is helpful, especially in the beginning stages of a construction project. School districts often implement the majority of value engineering suggestions provided for new designs by their consulting teams in pursuit of cost-effective

construction options. However, the majority of value engineering recommendations for prototypical designs were rejected because they did not meet school district standards.

Meanwhile, in the eight prototypical school projects researched in this report's case studies, value engineering appears to have been *pro forma* and had no discernable impact on final construction costs. For all 12 case study projects, there were concerns that the value engineering studies did not consider the unique needs and standards of individual school districts. The cost savings potential of value engineering was found to be comparable whether performed near the beginning, in the middle or after the design process. Because prototypically designed schools frequently have value engineering studies performed during their first implementation, subsequent studies on prototypical designs often failed to identify cost savings.^{*}

3.4 Permitting Process

Forty-five percent of survey respondents identified their permitting process as taking three to six months. Six to nine months was the second most common permitting timeline at 25 percent. Survey respondents and case study participants identified key areas that have continued to increase the permitting timeline in recent years. The most common challenge was lack of local permitting staff to handle an increase in the number of construction projects. This, in turn, has extended the turnaround time for construction permit approvals.

School districts may work with multiple agencies to acquire construction permits, which are issued at the city, county and state levels. Each agency and type of permit has different requirements and timelines. Survey respondents indicated that some permitting processes are faster than others, which can be problematic because construction cannot begin until all permits have been approved.

In the case studies, the permitting process in the three Western Washington districts extended the project design times up to 12 months longer than the three Eastern Washington districts. For two Western Washington projects, this limited the effectiveness of value engineering due to changes in market conditions. In the last five to 10 years, all three Western Washington districts have altered their project planning to assume a 12-month-long permitting process. The three Eastern Washington districts have not altered their planning processes.

A longer permitting process caused all three Western Washington projects in the case studies to bid later than intended, which led to higher construction costs. The original planning costs were unable to account for changes in the market for labor and material costs. Survey responses echoed this challenge.

^{*} For more information see Appendix E





SCHOOL PERMITTING TIME INTERVALS

In a follow-up conversation, a survey respondent from a Northwest urban region explained that their school district had paid extra for expedited permitting during a recent school construction addition. This decision was driven by a need to circumvent the additional costs incurred from a later construction start date. However, the cost paid for the expedited permitting did not actually decrease the permitting time and the project's construction timeline was delayed.

The same survey respondent recently attempted to build another school. Their school district had passed a bond to cover the projected cost of a \$1.25 million. Bond issuances are calculated on "dollars certain," which refers to the value of the dollar at the time of the issuance and is not based on the project's square feet. Due to increased permitting time, the construction start date was delayed. This increased construction costs from \$1.25 million to \$1.75 million – \$500,000 more than the bond issuance -- due to inflation and variability in market prices and labor costs. Consequently, five classrooms were removed from the design of the school.

Additions to the school that were supposed to be done by the end of July were a month behind because the county did not complete the permitting paperwork in time. The school district paid a premium for Saturday and Sunday time worked. The school district thought that the bond money could be used to repay the Limited General Obligation bond (LGO) it received to front fund the school. However, the bond was insufficient to cover both construction and the LGO. As a result, the school district covered the difference with general fund monies.

3.5 Construction Process

Forty-five percent of survey responses identified 15 to 18 months as the average time it takes for their district to construct a school; another 38 percent of the survey respondents identified 12 to 15 months as the average time.

Of the total number of respondents who chose 15 to 18 months, 63 percent were from Northwest Washington. On average, these respondents have experienced longer construction timelines than those from other regions.

The length of the construction process is heavily influenced by the length of the design, value engineering and permitting process. An ideal construction scenario involves beginning construction in the spring at the end of one school year so that the building envelope can be completed before cold, wet weather shows up in the fall. Construction on the interior then occurs throughout the winter so that the building can be occupied by the beginning of the following school year.



Figure 5: Length of construction process, by region

School districts have recently been limited in their construction options due to the lack of a capital budget. Survey respondents who have not or will not be impacted most frequently cite not qualifying for SCAP funding as the primary cause. Due to the SCAP funding eligibility formula, many schools in the Northwest region do not qualify for state support. School districts that primarily receive funding through their communities will likely be able to continue their school construction projects despite the lack of a capital budget, either through front funding projects until the state provides financial support or through relying entirely on their community. Survey respondents entirely dependent on state funding have delayed or halted elementary school construction projects due to the lack of a capital budget.

The below pie charts represent survey respondents from school districts that are affected or unaffected by the lack of a capital budget. Thirty percent of surveyed school districts were affected and 70 percent were unaffected.

Figure 6: School districts affected and unaffected by the lack of a capitol budget, by region



4.1 Cross-Laminated Timber Construction

This report's CLT construction data comes from an in-progress pilot project conducted by DES. Two issues impacting the feasibility of CLT-based modular construction in Washington are the nascent state of the industry and lack of comprehensive research on the "progressive design-build" method. DES studied single-floor buildings, while CLT is most cost-effective in constructing multi-story buildings.¹⁷

While the pilot project produced prototypical designs, those designs may not be available for use by school districts in the future. This because of the impracticality of re-using a design while following the legal requirement relating to bidding contracts. Further, cost evaluations from the pilot project are based on the assumption that the contractor has experience with CLT. It is unknown how future CLT construction projects can:

- Pay for the previously-constructed design for use with other contractors;
- Ensure pricing consistency when presenting a contractor with a pre-existing design; and
- Produce the promised efficiency gains when working through different contractors.

Designing plans that account for funding limitations can obviate the need for costly re-designs. In the DES study, one contractor-designer team defined limitations based on the budget and cost of materials and considered them in producing the design plan. In contrast, another team produced a design plan before considering those limitations, requiring several revisions. The team that designed to the limitations saved several weeks of planning time and spent the cost savings on enhancing construction.

The architectural firm Atelier Jones was commissioned by DES to coordinate the design and construction of CLT modular classrooms for Wapato and Toppenish. An architectural designer with the firm stated:

The pod of four classrooms ... is designed to be expanded in the future, to add another four modular schoolrooms or, potentially, more. The CLT modular classrooms are up to seismic code, as required for the region where they are situated ... Harriott Valentine Engineers provided structural engineering services for the project, which included compliance with seismic requirements. The ... classrooms have adequate ventilation and each classroom has a corresponding roof top unit. Air supply and intake vents are located in the soffits in each classroom. Each ... classroom has a sink and drinking fountain combination. There are [facilities] in the ... complex that are outside the classrooms containing two restrooms, a mechanical and electrical room and a circulation corridor. The ... classrooms are arranged in a pod of four, however the arrangement is unique at each site, to respond to the site conditions. The classrooms are lockdown capable in case of [emergencies,] ... one of the requirements presented by the school districts.¹⁸

A 2015 report by a Washington state land conservation organization, Forterra, looked at the viability of CLT. Barriers to fully implementing the construction method in Washington state are 1) the high cost associated with the material, 2) the lack of contractor and construction worker experience with CLT and 3) differences between traditional and CLT permitting process.¹⁹ A member of the Forterra Coalition

Leadership Committee noted that prohibitive adoption costs suggest no foreseeable timeline for CLT to become viable within the industry.²⁰

4.2 Portables

Portables are a quick option for school districts to quickly add more classrooms. They are often a prebuilt classroom constructed and installed on the grounds next to an existing school. Portables are not installed onto a permanent foundation and can be relocated.^{*} Therefore, they are considered temporary classrooms and are not eligible for SCAP funding. Portables are designed to be in use for up to 10 years.

In the case studies, two districts have relied heavily on portable classrooms in the last 20 to 30 years to meet the growing needs of student populations. Many portables do not meet safety, health or building code standards for their districts because the portables have not been decommissioned at the end of their useable life span. Both districts have lower-to-moderate funding environments that resulted in an over-reliance on portables.

Figure 7: School district portable procurement by region



The above pie charts represent school districts that have purchased new portables in the last 10 years and will purchase new portables in the next five years. Each percentage was calculated from the total number of school districts that identified as having purchased or intended to purchase portables. The Northwest region accounts for 57 percent and 50 percent, respectively of the total number of portables purchased or that will be purchased by survey respondents.

Portables have been viewed as a rapid classroom procurement option and have often been used during a permanent school construction project. However, in a follow-up interview a survey respondent explained that this situation is changing. Portables that were once used to house students only during construction of their permanent school buildings are now being used full time, year round because the demand for classroom space is so high.

As a consequence of the Northwest region's growing population, this region of the state is where the majority of portables will be purchased by survey respondents. The following figure illustrates the number of portables each region expects to purchase within the next five years. Of the school districts that will purchase 10 to 15 portables, 83 percent are in the Northwest region. Of those school districts

^{* &}quot;While many newer portables provide quality educational space, some older portables are substandard... about one-third of the portables used in the state [of Washington] are more than 24 years old." (Washington State University Energy Program, 2016)

that indicated they would purchase more than 15 portables in the next five years, 70 percent are from the Northwest region.



Figure 8: School district portable purchase estimates, for the next five years, by region

Portables are prone to certain issues not faced by other classroom options. The WSU Energy Program (2016) concluded in a recent census on school facilities that "[w]hile many newer portables provide quality educational space, some older portables are substandard. . . . It is important, therefore, to ensure that [portables] are providing quality learning environments. Design and retrofit standards that include windows, energy efficiency and ventilation upgrades, and restrooms (where appropriate) can help ensure that these facilities are providing the highest quality learning environments possible."

This finding reflects the results of an earlier WSU study, which developed technical assistance designed to promote the provision of "an enhanced learning environment, high indoor air quality, and energy savings that are both substantial and cost-effective,"²¹ found that several concrete retrofitting options for portables improve air quality and temperature control while simultaneously reducing heating costs.

4.3 Comparison of Materials and Designs

While generally quicker and less expensive than traditional construction, the production timeline and construction cost of modular procurement varies substantially among options. Thirty-six percent of surveyed school districts have used – or plan to use – modular construction. The primary reason cited is not having the time or funding to build traditionally constructed buildings. One school district mentioned using modular construction "for smaller choice schools in [their] district for cost savings and faster completion times." Another school district stated modular construction has enabled it to begin "front loading projects with available impact fee funding" due to the lower cost of modular buildings.

The four-classroom CLT portables are designed to meet the HPS standard for at least 50 years. The modular eight-plex is designed to the current 30-year standard. Modular-permanent construction is, in general, more sustainable and energy efficient than traditional construction due to the decrease in

waste generated during the construction process.^{*} Portables are not required to meet the HPS standard and are typically built to a 10-year life span.

	Traditional		Modular-Permanent	
	(Stick Frame)	Portable	CLT – 4 Classroom	"8-Plex" (Stick Frame)
Design, permit, construction time	27-42 months	Less than 3 months	7-12 months	10 months
Requires permitting	Yes	No	Yes	Yes
Total (avg.) cost per classroom	\$291,160	\$250,768	\$302,300	\$269,760
Cost per square foot	\$316	\$268	\$336	\$344
Life cycle	30 years	10 years	50 years	30 years
Cost per square foot per year	\$10.54	\$26.88	\$6.72	\$11.47

Table 4: Time-cost comparison: elementary school classroom procurement⁺

The design processes for modular buildings varied within our case studies. The CLT pilot project employed progressive design-build to reduce the length of the production timeline. Progressive designbuild involves hiring the contractor and designer based solely on qualification at the beginning of a project. Throughout the design process, the contractor and designer work together to solicit and incorporate stakeholder feedback.

The North Thurston stick-frame eight-plex[‡] used a design-bid-build contracting method to ensure that the contracted architecture and engineering firm was sensitive to students' needs. Design-bid-build is a traditional bidding method in which the school district engages a designer and a contractor under separate contracts. The award of the construction contract is typically based solely on the lowest responsive and responsible bid. Since the school was being remodeled while still occupied, the bidding process needed to consider more than simply the lowest bid. Portables, being pre-constructed, do not require a design process.

While construction time differs among modular building types, all times are significantly shorter than traditional construction. According to a representative from DES, if prototypical CLT-based designs were available in Washington, construction time could be reduced to as little as two weeks for a four-classroom modular building. While there is insufficient industry capacity to support large-scale CLT construction,²² there is sufficient capacity to support stick-frame modular-permanent construction

^{*} A 2011 survey of architecture, engineering and construction professionals noted "77% [of respondents] report that construction site waste is decreased [when employing prefabrication and/or modularization]—44% by 5% or more." (McGraw Hill Construction, 2011) An earlier case study found that volumetric (modular-permanent) construction reduced waste by 48% per unit of floor area constructed in comparison to site based (traditional) construction. (Waste & Resources Action Programme, 2008)

⁺ Refer to Appendix G for more information and sources.

^{*} The data related to eight-plex stick-frame modular construction comes from the North Thurston school district case study, described in Appendix D. An eight-plex is an eight-classroom modular building containing full facilities, bathrooms, teacher spaces and extras such as security systems.

projects, such as the eight-plex.^{*} According to a North Thurston School District official, eight-plex construction took three to four months. This construction practice has also resolved many of North Thurston's winter weather construction issues – which resulted in cost savings. Portables are constructed before being ordered by school districts and do not require foundation work. Therefore, they require effectively no construction time during the procurement process.

North Thurston and Richland school districts have begun transitioning to modular construction to eliminate their portable classrooms. Both stated that a prime reason for the switch is due to their portables being unsafe and unhealthy. Many or most of the districts' portables were more than 20 years old and, as temporary buildings, had outlived their expected occupancy and not kept up with energy efficiency or building code standards.

North Thurston aims to eventually build all-modular school buildings. A district official suggested that the state look more closely at this construction method:

There are cost advantages of economies of scale to produce modulars. One 'eight-plex' can be built over a summer and be ready to house students come fall. Around here mold is a major problem for typical construction. But [modular buildings] are built in a controlled environment where there are no mold issues. [The district] doesn't have to spend extra money drying out the buildings. And since the [modular] buildings are permanent and look nice, the students are happy and the community doesn't have a problem with them. The community has a problem with portables....

This could be a critical factor at the state level for cost-savings. Let's say modular construction is the way to go, but currently there [aren't] enough firms to build all the K-3 classrooms needed in a two year time – maybe a 10-year time – but not immediately. The state would save itself and the school districts a lot of money if [it] just purchased modular classrooms in bulk. There would be cost savings from economies of scale and bulk buying. . . .

Why does the state have individual districts purchase portables and modulars when [the current process] is inefficient and more costly?

	Stick Frame	Portable	Modular-	Permanent
	(Traditional)	FUITADIE	CLT	8-Plex
Capacity	Permanent	Temporary	Permanent	Permanent
Site feasibility	High to low	High to low	High to low	High to low
Initial cost	Moderate	Low	High	Moderate
Long-term cost	Moderate	High	Low	Moderate
Timeliness	Low	High	Moderate	Moderate

Table 5: Quality comparison of elementary school classrooms

^{*} The Washington State Department of Labor and Industries issued 255 permits for modular-permanent educational buildings in 2005, 186 in 2006, 434 in 2007 and 338 in 2008. (Modular Building Institute, 2009) Demand has grown since. There are five factories that produce stick-frame permanent-modular structures for Washington, but only 2 that produce CLT.

Additions built using the progressive design-build" process and CLT construction techniques required between seven to 12 months to design, permit and construct. The modular eight-plex built using the design-bid-build process required 10 months. Because portables require no design or construction time, permitting and acquisition typically requires less than three months.

There are also potential site feasibility issues with the four identified classroom construction types. A modernization project of an elementary school may be feasible in situations where new construction may not be. Both portables and modulars present the same issue: an elementary school site may lack the necessary space to add an eight-classroom "8-plex," a four-classroom CLT or even one portable. The following table explores this and other considerations related to school additions.

Building Type	Fulfills Amount of Need	Satisfies Period of Need	Requires Additional Space	Can be Multiple Stories
Portable	2 Classrooms	Temporary	Yes	No
CLT 4-plex	4 Classrooms	Permanent	Yes	Yes
8-plex	8 Classrooms	Permanent	Yes	No
Existing facility alteration	Various	Permanent	No	Yes

 Table 6: Considerations for fulfilling capacity needs through school additions

5.0 Recommendations

School districts have begun to meet class-size reduction requirements by new construction, purchasing new portables and a variety of nonprocurement methods. School districts may be able to make further marginal class-size reductions through nonprocurement options, such as reducing noncore courses and teaching in nonclassroom spaces. However, literature from other states indicates that these approaches are often exhausted within the first several years following a class-size reduction mandate, and are supplanted by procurement options. Many school districts have already exhausted nonprocurement options and are reliant on the procurement of new classroom space.

This report finds stick-frame modular-permanent construction provides a cost-effective alternative to traditional construction, portables and CLT for the following reasons: modular-permanent requires less time to construct, is supported by a viable industry familiar with applicable building codes, produces less waste in the construction process while fulfilling the HPS standards, and is more cost-effective in both the short and long term. Modular-permanent construction entails lower up-front costs than traditional construction, and accrues lower lifetime costs than traditional construction. Furthermore, the shorter construction time required for modular-permanent construction allows construction to be completed over a single spring and summer, avoiding costly winter construction.

While CLT-based modular-permanent construction provides the same benefits in construction time, waste generation, HPS adherence and long-term costs, there is not currently sufficient industry support to play a significant short-term role meeting Washington's need for more K-3 classroom space. Meanwhile, portable classroom spaces are not cost-effective when considering life-cycle costs.

Recommendation 1: Incentivize school districts to build additions or new facilities using modular construction options by the following methods:

- Increase the SCAP allocation for modular-permanent buildings;
- Provide standard project planning and management for permanent modular buildings; and
- Implement design guidelines for modular-permanent buildings and materials to encourage design innovation.

Recommendation 2: Assess the feasibility of implementing CLT for elementary school construction projects by addressing the following outstanding questions:

- How can districts pay for the pilot-project produced designs for use with other contractors?
- How can districts ensure pricing consistency when taking a pre-existing design to other contractors?
- Can districts expect to see the promised iterative efficiency gains when working through different contractors?

This report assessed the use of prototypical designs, the use of the progressive design-build process, and the use of value engineering for new building designs as providing time and cost savings. Previous reports indicated that school districts may be using value engineering sub-optimally by employing it after the design process has been completed. In contrast, this study's survey respondents indicated that value engineering produces cost savings regardless of the point in the process at which it is employed,

with the greatest savings being realized in the beginning stages of a construction project. School districts often implement the majority of value engineering suggestions for new designs provided by their consulting teams in pursuit of cost-effective construction options. However, the majority of value engineering recommendations for prototypical designs were rejected because they did not meet school district educational standards.

Recommendation 3: Streamline the D-form process by removing the value engineering requirement for previously constructed prototypical designs.

This report's timeline assessment assessments identified districts that lack the ability to fund construction for new elementary schools. The case studies suggest poor funding environments are not necessarily associated with district size, growth or assessed value, although it is unclear if these findings hold true for distressed, small or rural districts.

Recommendation 4: Conduct further research on the impact of school construction timelines on cost, including:

- The time it takes from conception to school open to construct a school and
- The relationship between the ability of school districts to pass bonds and the capital project delivery schedule.

Recommendation 5: Conduct further research on the feasibility of stakeholder suggestions for shortening the facilities production timeline and reducing construction costs:

- Alter the funding distribution by moving the SCAP fund release date to April or releasing "stop-gap" funding covering bidding and early construction in March or April;
- Study the impact of the supermajority requirement for municipal bond passages;
- Lower the bond approval threshold from 60 to 50 percent;
- Renew the K-3 CSR grant program;
- Streamline the permitting process by giving school districts county-level permitting priority;
- Have OSPI provide consultation services to districts that do not have in-house project management;
- Alter the SCAP formula by:
 - o Considering portable age and condition in assessing need; and
 - Only including those classroom spaces designed as classrooms when determining capacity.

To meet the class size reduction mandate, the state must consider both cost and speed of construction to construct facilities quickly enough to meet increasing demand. Only stick-frame modular-permanent construction can demonstrably reduce construction costs while simultaneously meeting demand.

General Terms and Definitions

Building envelope: The physical separator between the interior and exterior of a building. Components of the envelope are typically walls, floors, roofs, fenestrations, and doors.

Cross-laminated timber: A modular solid engineered wood and laminate wall panel that can integrate structural openings.²³

D-form: School district project paperwork required to receive state funding. D1: Study and Survey Grant Application. D3: Project Application. D5: Application for Preliminary Funding Status. D7: Application to proceed with bid opening; application to negotiate MACC; area analysis summary form; summary of assignable square feet by building. D9: Application for authorization to sign contracts; GC/CM application for authorization to sign MACC agreement. D11: Application for release of retainage. Odd-numbered D-forms are approvals of the prior form.

Design-bid-build: The traditional bidding method in which the public owner engages a designer and a contractor under separate contracts. The award of the construction contract is typically based solely on the lowest responsive and responsible bid.²⁴

Design-build: The public owner engages a single firm to both design and build the project. The award of the combined design and construction contract typically is based on the public owner's evaluation of a cost and technical proposal from the bidding firms.²⁵

Progressive design build: The public owner engages a contractor and designer at project outset. The contractor and designer work closely together and with all other stakeholders in the design process. Hiring is primarily based on qualifications, in contrast to the traditional bidding process.

Front fund: A school district front funds when it uses local funds to begin bidding and construction for approved projects prior to the July state funding release for school construction assistance program from the office of superintended of public instruction.

General contractor/construction manager: The public owner engages both a project designer and a qualified construction manager under a negotiated contract to provide both preconstruction and construction services. The GC/CM provides consulting and estimating services during the design phase of the project and acts as the general contractor during construction. The degree to which the GC/CM provides a cost and schedule commitment to the public owner is determined during the negotiation of the final contract. At this point, the contract price for the project (including the GC/CM's fee and reimbursable costs) will be set. This ensures that the owner will get competitive bids for cost of the work from the subcontractors and does not require the GC/CM to include as much risk protection contingency to cover this risk.²⁶

Low bid: The contract is awarded to the lowest-priced bid submitted for performance of the work, in accordance with the plans and specifications.

Modular building: A permanent structure primarily built off-site. The building blocks are near completion with flooring, walls, ceilings, lighting, and systems built indoors under controlled conditions,

then transported to site and erected. Modular buildings can be single- or multi-story, steel, and/or concrete structures and can be arranged in a variety of ways to meet design specifications.²⁷

Portable: A nonpermanent, relocatable structure built off-site.

Prototypical school design: A school building plan developed for initial use at one location and reused either concurrently or subsequently at a different site or sites by the same school district within its district boundaries.²⁸

Rural school district: A local education agency located entirely within counties with a population density less than 100 persons per square mile or counties smaller than 225 square miles.

School Construction Assistance Program: A grant reimbursement program administered by the Office of Superintendent of Public Instruction to school districts for capital construction funding. Financial assistance is based on a formula that considers the amount of square feet needed for the number of students in elementary schools, middle schools, and high schools (student enrollment cohort projections); multiplied by an assumed cost per square foot for construction (construction cost allocation); multiplied by a state fund matching rate. The match rate depends on the relative value of assessed property in the district per student. Funds may be used to expand and modernize permanent school facilities, but not temporary portable classrooms.

Stick-frame modular-permanent: A modular wall panel made with traditional framing (stick-built) techniques. The panels are built in a factory setting and then transported to the building site.

Stock plan: One or more standardized school design plans that are issued to and used by all school districts in the state.²⁹

Swing school: A designated building, usually a decommissioned school, which houses students during major construction of a school building.

Urban school district: A local education agency located within densely populated territory of 2,500 or more people.

Value engineering: An organized effort directed at analyzing designed building features, systems, equipment, and material selections for the purpose of achieving essential functions at the lowest life-cycle cost consistent with required performance, quality, reliability, and safety. In the design phase, value engineering considers alternative design solutions to optimize the expected cost/worth ratio of projects at completion.³⁰

Endnotes

⁸ Illig (1997)

¹⁰ Schwartz & Warren (1997)

- ¹² Stecher & Bohrnstedt (2002)
- ¹³ Vincent & McKoy (2008)
- 14 Vincent & Gross (2015)
- ¹⁵ Summers et al (2007)
- ¹⁶ (W.V.C. §18-5-18a)

- ¹⁸ O. Amigud, personal communication (September 15, 2017)
- ¹⁹ Forterra (2015)
- ²⁰ Vaagen, R. (2017)
- ²¹ Washington State University Energy Program (2003)
- ²² Vaagen, R. (2017)
- ²³ Washington State Department of Enterprise Services (N.D.)
- ²⁴ National Association of State Facilities Administrators (2007)
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- ²⁷ Triumph Modular (2017)
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² Cheryan, S., et al. (2014)

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⁴ Office of Superintendent of Public Instruction (2017)

⁵ Washington State Office of Superintendent of Public Instruction (2017a)

⁶ Washington State Caseload Forecast Council (2017)

⁷ Washington State Office of Superintendent of Public Instruction (2017b)

⁹ School Services of California, Inc. (1997)

¹¹ Wexler et al (1998)

¹⁷ D. Delzell, personal communication (September 8, 2017)

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Appendix A: Production Assessment Supplementary Research Data

Research Questions:

- 1. What is the average number of months required for Washington school districts to design and construct an elementary school?
- 2. Is there a relationship between the number of months required for elementary school construction and school district assessed value and population?

Hypothesis: The number of months required to construct an elementary school is significantly correlated to a school district's assessed value, student population, region and urban or rural designation.

This study's research questions about the relationship between timelines, assessed values and student populations were a product of participant trends in the Phase 2 case studies. The survey in Phase 3 was designed to research these variables for further statistical analysis to determine if there are statewide correlation. The research team concluded there is no significant correlation.

Average timelines were calculated for each survey respondent's answer to their assessment of the time in months it takes to fulfill the design and value engineering phase, the permitting phase and the construction phase. The averages were calculated against the frequency with which each total timeline occurred. The overall timeline to build a school from design to school opening is 35 months.

		Assessed value	School District Population by 2010 Census
Timeline to	Pearson Correlation	0.107	0.123
Build a School	Sig. (2-tailed)	0.464	0.400
(months)	Ν	49	49

Assessed values and school district populations were analyzed against production timelines using a Pearson Correlation to determine if there were significant relationships between the three variables. For this analysis, Lake Washington School District was removed as an outlier. Lake Washington's assessed value, school district population and production timeline were the highest of any school district and significantly swayed the results or the correlation test. Without Lake Washington there is no significant correlation between the time in months a school district requires to construct a school and either the district population or assessed value.

Figure 9: Project timeline correlated with assessed value and school district population



The timelines for each district are analyzed against school district assessed values and populations according to the 2010 Washington state census. A multivariate linear regression analysis was used to determine the relationships between these measures. The line of best fit is almost completely horizontal, illustrating the lack of correlation between these variables. Despite the high variability each region in Washington state exhibits in populations and assessed values, these variables are not able to predict the number of months each school district needs to construct a school.

Figure 10: Timeline to build an elementary school in Washington state



Region	Timeline
Northwest	36 Months
Southwest	35 Months
Northeast	34 Months
Southeast	35 Months

The four regions of Washington state are analyzed against each region's production timeline in months to construct an elementary school. Averages for each region of Washington state were calculated from the total number of survey respondents that indicated their region against the production timeline questions. School district assessed values are analyzed against each region to determine the variability in assessed values within each region and compare the average assessed values from each region to

each other. The Northwest region demonstrates the highest average assessed value overall. This region also has the largest variability with the most extreme assessed value ranges than any other region. The Northeast has the lowest assessed values overall with the most limited assessed value range.

Of the school districts experiencing student population growth, 25 percent were from the Northwest portion of the state. This region is also where the majority of survey respondents are planning to construct or are currently constructing K-3 classrooms and elementary schools. The Northwest region accounts for the majority of Washington state's population and is seeing the most rapid increase in student population growth.



Figure 11: School district assessed value, by region

Appendix B: Research Survey

General district information

- 1. Which school district do you represent?
- 2. What is your position within the school district?
- 3. Which area of the state is your district located?
- 4. Is your district currently experiencing K-3 student population growth?
- 5. Is your district currently planning to build new K-3 classrooms or an elementary school(s) to meet either projected growth or the K-3 classroom-size-reduction levels?
- 6. Is your district currently designing or constructing new K-3 classrooms or an elementary school(s) to meet either projected growth or the K-3 classroom-size-reduction levels?
- 7. If yes to the previous question, has this or will this project be front funded?

The only six required questions

- 8. In general, when building a new elementary school, how long does your design and value engineering process take?
- 9. In general, when building a new elementary school, how long does your permitting process take?
- 10. In general, when building a new elementary school, how long does your construction process take?
- 11. For new elementary school projects, does your district generally aim to front fund those projects?
- 12. For your district, please rank the following issues from highest to lowest priority. Highest priority means that the state should focus on that issue first.
 - a. Difficulty finding appropriate land to purchase for new school sites
 - b. Meeting the 60-percent threshold to pass bonds
 - c. Difficulty qualifying for state match funds
 - d. High volume of sub-standard portables
 - e. Permitting requirements / permitting process length of time
 - f. Accommodating the July 1 funding release date
- 13. Do you have suggestions for how the state may improve the elementary school procurement process to quickly increase K-3 classrooms statewide (other than increasing state funding)?

Portables, modulars and permanent construction

- 14. To meet the facilities requirements for K-3 students, has your district purchased new portables (nonpermanent, relocatable classrooms) in the last 10 years?
- 15. To meet the facilities requirements for K-3 students, will your district or is your district likely to purchase new portables in the next five years?
- 16. If yes to either or both of the previous two questions, what is the total number of new portables your district has purchased and/or is likely to purchase?
- 17. Does your district currently use or plan to use modular construction (factory-built, permanent classrooms or buildings)?
- 18. If yes to the previous question, why is your district using or planning to use modular (permanent) school construction?
- 19. To meet the class size reduction requirements for K-3 students, has your district considered or implemented any of the following options? (Please select all that apply.)
 - a. Building K-3-only schools
 - b. Creating larger elementary schools (more K-3 classrooms per school)
 - c. Converting K-6 elementaries into K-5 elementaries
 - d. Building or renovating elementary schools to include a second story or multiple stories
 - e. Building or renovating elementary schools to have smaller K-3 classrooms (such as halving a classroom to create two smaller rooms)
 - f. Placing two teachers in a classroom
 - g. None of the above

Capital budget questions

- 20. Has the lack of a 2017-19 capital budget affected a current K-3 project or your district's future plans for a K-3 project?
- 21. If yes to the previous question, how has the lack of a capital budget affected your current and/or future K-3 construction projects? (Please select all that are applicable.)
 - a. The project has been suspended or cancelled
 - b. The project has been delayed
 - c. The project is unlikely to be completed on time
 - d. The project is likely to have increased costs
 - e. Other (please specify)
- 22. Has the lack of a capital budget caused your district to reconsider front funding in the future?
- 23. Is there anything else you would like to tell us about the capital budget or lack thereof?

Thank you

- 24. Yes, I would like to have a follow-up conversation about my school district's response to the K-3 class size reduction requirements. Please email me at:
- 25. Yes, I would like to be informed about the results of this survey and the final report. Please email me at:

Appendix C: Stakeholder Feedback

RESPONSES TO SELECTED SURVEY QUESTIONS

Is your district currently planning to build new K-3 classrooms or an elementary school(s) to meet either projected growth or the K-3 classroom-size-reduction levels?¹

Yes:

- Considering bond election to replace ageing schools.
- There are plans for a new school due to the age of the current school not because of class size reduction.
- Need to pass bond. The last 3 summers we have added a 10 plex modular with impact fee funding
- We are just completing classrooms the community funded to address the 19/22/22 class sizes. Unfortunately, the further reduction to 17 will cause us to keep the portables we leased to house students during construction.

No:

- We added 4 classrooms, 2 double portables for 17-18
- Completed new build in 2016
- We know a Bond will be needed, and anticipate that we will be building a new elementary school in the early 2020's.
- Unable to secure funds
- We are building a new school, but not due to population growth in K-3
- If bond success or huge grant
- At this point, no plan to run a bond for capital expansion

Unknown/No Response:

- We are currently adding 4 portable classrooms to two of our primary school sites.
- We do not have funding to add capacity and are considering a bond in 2018.
- Construction or portables
- We will have a high need to build additional elementary classrooms but would not have the bond capacity to do so.
- We have attempted, but were unable to secure funding. We continue to review funding options.
- We don't have the capitol to build any elem. classrooms
- We are over capacity and are exploring opportunities for adding additional classrooms.
- Yes, but in the earliest stages

¹ Responses to this and the following questions have been edited to normalize spelling and grammar, but have not been edited for content

- We would like to but do not have specific plans right now
- Purchasing portable space for additional kindergarten space.
- We hope to, and we are in the early stages for a problem we have now.
- We are the recipients of the K-3 capital moneys a couple of years ago. The elementary that this funded is being constructed at the present time. Two of our other elementary schools need to be replaced as they are becoming unacceptable learning environments.
- Depending on a committee recommendation, we may choose to pursue a bond issue
- It will become necessary but no current planning underway
- We just built a 6 classroom extension

Is your district currently designing or constructing new K-3 classrooms or an elementary school(s) to meet either projected growth or the K-3 class size reduction levels?

Yes:

- New 500 Elementary and 15 classroom addition to be completed by 2020 for elementary growth
- Currently replacing at least 1 old portable classrooms.
- We are updating our long range facilities plan, which includes modernization of several elementary schools to accommodate unfunded K-3 classrooms.
- We are just completing new space that will now be inadequate.
- Our new school has smaller classrooms than if we did not have the 17 student target.
- Trying to modify existing spaces. Also, ending a lease arrangement with YMCA pre-school to reclaim classrooms.

No:

- We currently do not have any capitol to build any K-3 classrooms
- Depending upon K-3 student growth the next two years and our secondary construction schedule we will likely move portable classrooms from the secondary level
- But we are out of space, with specialists sharing portables and the behavior teacher in a small office.
- We do not have the tax base to support new construction.
- We recently built a new middle school and moved our elementary into the larger "old" middle school building.

No Response:

- The district will be putting a bond before voters to improve entire district
- We are exploring options for constructing classroom space in the near future.
- Depending on a committee recommendation, we may choose to pursue a bond issue
- We are planning for growth in general: the K-3 classrooms are a consideration within that planning. The additions are not K-3 specific.

If [applicable], why is your district using -- or planning to use -- modular (permanent) school construction?

- It was a much quicker process to get the project constructed and we were on a short timeline. We don't have plans to do it again.
- Substitute for portables while district seek Bond funding approval (4 year funding cycle)
- More cost effective
- Because we do not have adequate funding for bricks/mortar buildings, and it takes to long to respond to the need.
- To replace aging portables.
- Cost of build.
- We have used this option for smaller choice schools in our district for cost savings and faster completion time
- If we did, modular might be something we would consider if cost effective,
- To meet the needs of the students we currently serve
- Cost and lack of state matching funds.
- We received an Impact Aid grant that required alternative construction techniques. We also were a recipient of the CLT project and those classrooms are open this fall.
- Funding
- Currently have a modular Choice High School and may look at expense versus brick and mortar for future building. Will need to add additional classrooms by 2020 to accommodate space
- Faster than new construction, less expensive than an entire school, expected to last 30 50 years, allows local customization, enlarges existing schools.
- Front load projects with available impact fee funding.
- Cost
- Cost
- We can afford to build a new building.
- Trying to solve the immediate need while figuring out what to do long term.
- We do not have sufficient tax base to be able to build without special funding options.
- Used for small choice schools (elementary and middle school) particularly when there is not space within a permanent building
- For Preschools only.
- Space would warrant the need.
- Less expensive
- Our district passed a construction bond due to start construction July of 2018.
- Yes, this is a real possibility -
- Unknown will depend on the number of new students.
- If experiencing a spike in population growth.

The following six narratives summarize the unique construction timelines, obstacles and opportunities for 12 elementary school construction projects completed between July 2014 and September 2016. The summaries are based upon interviews conducted between May and June of 2017. The interviews asked open-ended questions about 1) long-term planning and bonds, 2) funding, procurement and contracting, 3) designing, engineering and permitting, 4) construction and 5) overall impressions and recommendations for improving the procurement process.²

Project	Project Type	Est. Pop.	Assign. Sq. Ft.	Front Fund	Proto. Design	Mod.	Bid Type	Permit	Study
Richland SD									
Lewis and Clark	New-in-Lieu	630	64,390	Yes	No	No	DBB	5	2
Sacajawea	New-in-Lieu	630	64,390	Yes	Yes	No	DBB	5	1
Marcus Whitman	New-in-Lieu	630	64,390	Yes	Yes	No	DBB	5	1
Orchard	New	650	49,025	Yes	Yes	No	DBB	5	0
Kennewick SD									
Eastgate	New-in-Lieu	540	38,890	Yes	Yes	No	Low-bid	5	0
Sagecrest	New	500	38,890	Yes	Yes	No	Low-bid	5	1
Pasco SD									
Rosalind Franklin	New	730	70,891	Yes	Yes	No	Low-bid	6	0
Barbara McClintock	New	648	47,144	No	No	No	Low-bid	6	0
Marie Curie	New	730	50,355	No	Yes	No	Low-bid	6	1
Evergreen SD									
Crestline	New-Emerg.	650	47,307	Yes	Yes	No	GC/CM	6	2
Mukilteo SD									
Lake Stickney	New	648	61,167	Yes	No	No	Low-bid	5	7
N. Thurston SD									
Evergreen Forest	Add., Mod.	550	37,889	Yes	No	Yes	DBB	7	2

Table 8: Major characteristics of 12 elementary school projects

It was expected that the six districts would have little-to-no issues with funding projects due to district size, growing student populations and high assessed valuations. Each district is in the state's top 10 percent by population size.³ All are also in the top quintile for assessed valuations.⁴ Five districts (Richland, Kennewick, Pasco, Evergreen and North Thurston) are ranked in the top 20 for school district

² Refer to Appendix B for a list of the interview questions asked.

³ Pitts, R. and Tigas, M. (2017)

⁴ Bond Users Clearinghouse (2016)

growth in the state.⁵ Mukilteo is in the top 100 and is ranked 66 for growth in the state.⁶ Nevertheless, we have found that two districts have lesser funding environments as identified in the table below.

School District	County	District Pop.	Assessed Value (millions)	Funding Envir.	Reg. Envir.	Project Man.	No. of Portables	Going to Modular
Richland	Benton	49,656	\$6,966	Greater	Lesser	Contract	Unknown	Yes
Kennewick	Benton	68,202	\$7,118	Moderate	Lesser	In-house	115	No
Pasco	Franklin	75,097	\$5,141	Greater	Moderate	In-house	235	Maybe
Evergreen	Clark	139,009	\$13,287	Moderate	Moderate	In-house	142	No
Mukilteo	Snohomish	93,222	\$15,079	Lesser	Greater	In-house	64	No
N. Thurston	Thurston	94,104	\$9,983	Lesser	Greater	Contract	N/A	Yes

 Table 9: Major characteristics of the six school districts

The funding environment and regulatory environment columns reflect qualitative assessments using scores from lesser to moderate to greater. The funding environment score refers to the district's relative willingness to put forth a bond election and the community's relative willingness to vote for the bond passage. The regulatory environment score refers to the average number of permits and studies per district. A lesser score refers to the bottom third districts for willingness to fund or number of regulations, whereas moderate refers to the mid third and greater refers to the top third.

School District	Construction Project	Total Time: Design to Open	Total Time: Concept to Open
	Lewis and Clark	26-months	66-months
Richland	Sacajawea	26-months	66-months
	Marcus Whitman	29-months	78-months
	Orchard	25-months	65-months
Kennewick	Eastgate	24-months	24-months
	Sagecrest	26-months	35-months
	Rosalind Franklin	20-months	55-months
Pasco	Barbara McClintock	25-months	67-months
	Marie Curie	24-months	54-months
Evergreen	Crestline	19-months	19-months
Mukilteo	Lake Stickney	30-months	201-months
North Thurston	Evergreen Forest	37-months	65-months

 Table 10: Comparison of D-forms timelines versus production timelines for all 12 projects

⁵ Berk and Hodgins (2008)

⁶ Berk and Hodgins (2008)

One identifiable issue did increase the project timelines. The permitting process in the three Western Washington districts extended project design times up to 12 months longer than the three Eastern districts. This caused value engineering to be less effective due to changes in market conditions. In the last five to 10 years, these three districts have changed their project planning to assume a 12-month-long permitting process. The three Eastern districts have not implemented changes to their planning processes.

Winter weather, front funding and the state funding release date for construction was expected to be of primary concern to the districts. The six school districts are concerned with winter weather, state funding, and having to increase bond issuances to front fund. SCAP provides partial funding to school districts for new construction or modernization that meet eligibility requirements based a need for more space or on age and condition. These funds are available for release annually in July. The case studies suggest the districts have adapted to the state funding release date with front funding, which is now a standard practice. The districts have not had issues opening a school on time.

This report found no identified cost reductions for elementary school procurements associated with the alternative contracting method, general contractor/construction manager (GC/CM). Value engineering also had no identified cost reductions nor cost-effectiveness for schools built using prototypical designs. The case studies suggest modular may be an effective option to implement statewide stock plans.

	Plan			Design			VE occurred
Project	Begin Date	Value Engineer.	Begin Date	Value Engineer.	End Date	Value Engineer.	when during the design process?
Lewis and Clark	Jan-10		May-13		Sep-13	Oct-13	End
Sacajawea	Jan-10		May-13		Sep-13	Nov-13	End
Marcus Whitman	Jan-10		May-13		Sep-13	Jul-14	End
Orchard	Jan-10		May-13		Sep-13	Jan-14	End
Eastgate	Aug-13	Dec-13	Jul-14		Dec-15		Beginning
Sagecrest	Aug-13	Nov-13	July-15		Mar-16		Beginning
Rosalind Franklin	Jan-10	Sep-10	May-12	Sep-12	Sep-12		During
Barbara McClintock	Jan-10		Jul-13	Oct-13	Jul-14		During
Marie Curie	Feb-11		Jul-13	Jan-14	Jul-14		During
Crestline	Feb-13		Mar-13		May-13	Jun-13	End
Lake Stickney	Jan-00		Apr-14	Jul-14	Jan-15		During
Evergreen Forest	Jan-10	Jun-13	Jan-14		Jan-15		Beginning

 Table 11: Value engineering timelines all 12 projects

We expected to find that value engineering is primarily used after the design process has neared completion -- and thus is not being used optimally. However, many of the districts implemented value engineering near the beginning or in the middle of the design process and are employing a best practice approach. The bid type also had no discernable impact on the design or construction timelines. An alternative bidding method was only used by one district in emergency situations to allow for greater flexibility. However, it is known that alternative bidding methods are used during for many projects.

Lewis and Clark Elementary, Sacajawea Elementary, Marcus Whitman Elementary and Orchard Elementary

The Richland School District began facilities planning for four new elementary schools in 2010, with the intention of funding each project using a bond in February 2013. This bond package was successful, and allowed the district to front fund each project. This allowed the district to:

- Move forward on projects without relying on the state for funding.
- Increase the construction timeline, which in turn, moves construction up to include summer. Construction during winter causes increased costs for Richland due to high wind, snow, hail, and rain. It costs the district approximately \$100,000 more to heat the buildings when they do not have the building envelope finished. The district has found the construction process to be limited to 11 months for projects that lack front funding.

Three of the elementary schools -- Lewis and Clark, Sacajawea and Marcus Whitman -- were schools undergoing construction in-lieu of modernization. The new Lewis and Clark and Sacajawea schools were both built next to the original school buildings. Neither project required swing schools to temporarily house the students. Marcus Whitman, however, shares its site with district administrative buildings and there was not enough space to build the new school next to it. The original building was demolished to create space for the new school building, which was built on the original site. To house the students during the year Marcus Whitman was built, the district chose to maintain the original Sacajawea school as a swing school. The original Sacajawea building was demolished after Marcus Whitman was built.

The three construction in-lieu of modernization projects used prototypical designs. Richland School District prefers building prototypical schools because staff has found that it is generally less expensive to bid the same design. In addition, school maintenance is less expensive. The district also prefers to leverage economies of scale per bid, such as bidding multiple schools under one design process. This has led to cost savings when the schools are built simultaneously or are slightly staggered. However, the district has discovered it must reevaluate the prototypical designs every few years due to recommendations for building layout improvements or changes in educational school specifications.

Orchard was the only new school. Its land was purchased in 2012 with the intention of building a new elementary school. This school did not use a prototypical design because the surrounding community had home owners association covenant restrictions that required an original design.⁷ Richland used a design-bid-build contract to choose the final two architecture and engineering (A&E) firms.

The four projects each began the design process in May 2013. Six A&E firms submitted proposals for the prototypical schools. The bid process for Marcus Whitman began a year later. The design process took 12 months for each project. Once construction began, Lewis and Clark and Sacajawea took 14 months to complete. Orchard took 13 months. Marcus Whitman took 17 months, which included two school demolitions -- both the original school building and the original Sacajawea building.

An interview with district staff included the following three questions.

1. How does the current project climate compare to five or 10 years ago?

"The current project climate is pushing the limits of available local subcontractors and labor pool required to support the quantity of projects occurring in the general vicinity as well as

⁷ Construction Services Group (2017)

statewide. The impact of the current and forecasted volume has become more apparent the first five month of 2017. Five years ago a higher than state average amount of construction volume was occurring within the current project general vicinity. The volume was not prolific statewide and the quantity experienced was considered isolated to the roughly 45-mile radius. In other words, construction volume was a fraction throughout the remainder of the Washington State. Hence, general contractors, subcontractors, and skilled labor availability was not similar to the current status. Construction costs have steadily increased roughly two to three percent per year since 2012, matching the 10-year average."

2. How does the regulatory environment and permitting process affect the construction timeline?

The district has found the permitting process to be smooth and does not impede construction.

3. How long is the design, permitting and construction process?

It typically takes 12 months for the design process and another 15 months to construct an elementary school in Richland.

	Plan	Land	Des	ign	Bo Elec		Permit		Bid		Construction	
Project	Begin Date	Buy	Begin Date	End Date								
Lewis and Clark												
Planned		N/A	Jul- 13		2013				Mar- 14		Apr- 14	
Actual	Jan-10	N/A	May- 13	Sep- 13	Feb- 13	Feb- 13	Jan- 14	Mar- 14	Mar- 14	Apr- 14	May- 14	Jul- 15
Months			10 mc	onths			2 mo	nths	2 mo	nths	14 mc	onths
Sacajawea												
Planned		N/A	Jul- 13		2013				Mar- 14		Apr- 14	
Actual	Jan-10	N/A	May- 13	Sep- 13	Feb- 13	Feb- 13	Jan- 14	Mar- 14	Mar- 14	Apr- 14	May- 14	Jul- 15
Months			10 mc	onths			2 mo	nths	2 mo	nths	14 mc	onths
Marcus Whitman												
Planned		N/A	Jul- 13		2013				Mar- 14		Apr- 14	
Actual	Jan-10	N/A	May- 13	Sep- 13	Feb- 13	Feb- 13	Jan- 15	Mar- 15	Mar- 14	Apr- 14	Feb- 15	Jul- 16
Months			10 mc	onths			2 mo	nths	2 mo	nths	17 mc	onths

Eastgate Elementary and Sagecrest Elementary Projects

The Kennewick School District began facilities planning for Eastgate Elementary in 2005 and Sagecrest Elementary in 2008. Both projects were part of larger bond packages. Eastgate was funded by a May

2009 bond. This was after a bond measure initially failed to pass in March 2009. However, Eastgate was not originally scheduled to be a part of the 2009 bond. The district chose to put it up early due to other construction bids coming in much lower than anticipated and opening up money for another project. The district speculates that this was due to the Great Recession. Sagecrest had been intended for a 2015 bond, which passed in February of that year. Kennewick front funded both projects.

Kennewick chooses to front fund for the following reason. Front funding allows the district to begin projects early enough to bid in March and have a full 15 months to complete school construction. The district has completed elementary school projects quicker than this, but it has found a shorter timeframe difficult. The school year starts in August in Kennewick. If the district waits until July for state funding, then it only has 12 months to complete a construction project. The district aims to have contractors on-site by mid-April to have the building envelope finished prior to winter, when it is too cold to work. The building envelope must be finished prior to winter to heat the building and continue construction.

The district completed the bidding process and began the design process prior to bond passage. The district used a low-bid process for both projects, with a formal interview, and the same firm was chosen for both. Eastgate and Sagecrest both use a prototypical design. Kennewick has found that this has led to cost savings of approximately 20 percent for each project after the initial design.

Sagecrest was a new school, but Eastgate was a pre-existing school. After Eastgate was demolished, the students, faculty, and staff were moved to Fruitland Elementary.⁸ The state has grandfathered in Fruitland to be used exclusively as a transitional space. The district observed it would have to delay construction by an extra 12 months if it did not have the Fruitland property available.

An interview with district staff included the following three questions.

1. How does the current project climate compare to five or 10 years ago?

"The process hasn't changed. The only difference that [we have seen] is the Recession. We've started to get some less attention from contractors lately, because the economy is booming again, but it isn't significant."

2. How does the regulatory environment and permitting process affect the construction timeline?

The district has found it difficult to find appropriate sites for new construction due to the GMA requirements. There is not currently enough land within the city limits or urban growth area to find a site for a new school.

3. How long is the design, permitting and construction process?

It typically takes 15 months for the design process and another 15 months to construct an elementary school in Kennewick.

⁸ Construction Services Group (2017)

	Plan	Land	Des	Design		Bond Election		Permit		Bid		struction
Project	Begin Date	Buy	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date
Eastgate												
Planned		N/A			2015				Mar- 14		Apr- 14	
Actual	Aug- 13	N/A	Jul-14	Dec- 15	May- 09	May- 09	Nov- 13	Feb- 14	Mar- 14	May-14	Jun- 14	Aug-15
Months			17 mc	onths			3 mo	nths	3 m	onths	14 months	
Sagecrest												
Planned		2013			2015				Apr- 14		Apr- 15	
Actual	Aug- 13	2013	Jul-15	Mar- 16	Feb- 15	Feb- 15	Dec- 14	Apr- 15	Apr- 15		Apr- 15	Jul-16
Months			18 mc	onths			4 months		1 month		16 months	

Marie Curie Elementary, Rosalind Franklin Elementary and Barbara McClintock Elementary Projects

The Pasco School District did not initially plan to build these three elementary schools in 2013. The projects were in response to a failed bond election in April 2011. A major component of the 2011 election was to build a middle school. The district chose to move the sixth grade into elementary to alleviate a substantial overcrowding problem. Consequently, the Marie Curie project is a third through sixth grade elementary and both the Barbara McClintock and Rosalind Franklin projects are kindergarten through sixth (K-6) grade elementary schools. Marie Curie is adjacent to a kindergarten through second (K-2) grade elementary school. The district made these significant changes to the planned schools for a new bond measure in February 2013, which was approved by voters.

Only one of the projects was front funded -- Rosalind Franklin. The district prefers to front fund because it has found a primary advantage to be the ability to bid ahead of the state funding match release in July. However, the other two projects were not front funded because the district thought that doing so would have increased the size of the bond measure too much. Despite the lack of front funding for the other two projects, the district found no significant difference in the timeline. The district assumes the construction timeline was manageable due to the use of prototypical designs.

Both Marie Curie and Rosalind Franklin used the same A&E firm because they used the same prototypical design. The only difference between these two schools is how the classrooms are used. Pasco stated that prototypical designs can result in significant cost savings. The district estimates it saves up to \$500,000 in A&E costs per project. The district has also found construction cost savings, because prototypical designs "keep construction costs at a more stable price point." Another advantage found is that construction time is quicker, because the A&E firm has "a better idea of what it takes to get something built" and is able to mitigate obstacles in future construction projects.

Barbara McClintock Elementary did not use a prototypical design. This school was originally intended to be another K-3 facility but the Pasco School Board changed it to a K-6 during the construction process. At that point, it was too late to use a prototypical design.

For these three projects, the district used a low-bid contracting methodology. This is the district's preferred method except during emergency declarations. During one such emergency, a high school gym roof needed to be immediately replaced. In that instance the district chose to use the GC/CM method.

Pasco has found the design, engineering, and permitting process typically takes a year. This was generally true for the three elementary school projects. The district noted that this is driven to a large degree by the OSPI funding schedule and fund release. Typically when a project is front funded the district will begin designing a new building in the fall of the first year and building the following year. This process is shortened when a project requires state funds. However, the three projects each took 11-and-a-half months to be constructed. This allowed the schools to open on time, exactly two days after construction was completed. The total process takes upwards of two years.

An interview with district staff included the following three questions.

1. How does the current project climate compare to five or 10 years ago?

"Four years ago there was an owner's climate. I mean we could expect to get a real good bidding climate. In the four years from then to now, it has swung back to a contractor climate. Because the Richland School District just passed a \$98 million building bond and [the] Kennewick School District is just now finishing a \$90 million building bond, there's a lot of school construction in the Tri-Cities right now and upcoming. It makes the contractors and suppliers happy, but everything is at a premium cost right now."

2. How does the regulatory environment and permitting process affect the construction timeline?

The district has found the permitting process to be smooth and does not impede construction.

3. How long is the design, permitting and construction process?

It typically takes 11 and one-half months for the design process and another 12 months to construct an elementary school in Pasco.

	Plan	Land	Des	ign	Bo Elec		Per	mit	Bi	id	Con	struction
	Begin Date	Buy	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date
Rosalind Fr	anklin											
Planned		N/A	Nov- 10		2011				May- 13		Jun- 13	Jul-14
Actual	Jan- 10	N/A	Мау- 12	Sep- 12	Feb- 11	Feb- 13	Sep- 12	Dec- 12	May- 13	May- 13	Jun- 13	Jul-14
Months			4 mo	nths		3 months		1 m	onth	13 months		
Barbara Mc	Clintock											
Planned		N/A	Jul-13		2011					Jul- 14	Jul-14	Jul-15
Actual	Jan- 10	N/A	Jul-13	Jul- 14	Feb- 11	Feb- 13	Jan- 14	Jun- 14	Jun- 14	Jul- 14	Aug- 14	Jul-15
Months			12 mc	onths			6 mo	onths	2 mo	nths	11	months
Marie Curie												
Planned	N/A	N/A	Jul-13		N/A					Jul- 14	Jul-14	Jul-15
Actual	Feb- 11	N/A	Jul-13	Jul- 14	Feb- 13	Feb- 13	Apr- 14	May- 14	Jun- 14	Jul- 14	Aug- 14	Jul-15
Months			12 mc	onths			2 mo	onths	2 mo	nths	11	months

Table 14: Planned vs. actual construction timelines for Rosalind Franklin, Barbara McClintock and MarieCurie projects

Crestline Elementary Project

The Crestline Elementary school burned down on February 3, 2013. In late February 2013, the school board declared an emergency by resolution to expedite the reconstruction of Crestline Elementary using a modified GC/CM procurement process rather than traditional design-bid-build. The project was front funded with capital fund balance, supplemented by insurance proceeds and state match.

Evergreen prefers to front fund their construction projects. Although, front funding was not an issue for this particular project, the district noted that state approval for the release of funds in July and the typical design/bid/build process forces the district to do earthwork at the worst time of the year – winter.

The original school was built in 1973. The district chose to use a prototypical model from a 2008 with updates due to energy code changes in 2012. Evergreen has traditionally used prototypical designs for all its elementary schools. A unique feature of Crestline was the ability to add four pre-kindergarten classrooms during design (the prototype included four more classrooms than what was needed to accommodate enrollment at Crestline).

The district stated that its design, engineering, and permitting process was fast-tracked by the City of Vancouver for both a temporary and permanent school. While the new Crestline was being built, a

temporary school was built to house the students for the remainder of the 2012-2013 school year. This school was characterized by the district as basically a warehouse with cubicle walls to form classroom space. The district stated it would normally be a year to a year and a half to move through the design and permitting process, but instead the process took just a couple of months, in part because the district used a prototypical plan.

Construction of the new school began in July of 2013 and it opened on-time a year later. The district found it "had a bit of flexibility with the GC/CM procurement method," which allowed for an overlap of design and construction phases and the use of early bid packages for a faster project completion time.

An interview with district staff included the following three questions.

1. How does the current project climate compare to five or 10 years ago?

"After the recession, [the district has] been heavily impacted. In 2013 and 2014, we were still able to get fairly good contractor and subcontractor coverage, [But now] there's just not enough workers – you know, people going into the trades. We are experiencing a lack of bidders on Small Works projects now and anticipate challenges getting good bid coverage on school construction projects in the future.

"In the 1980s and 90s, [the district] failed nine bond measures. And then in the mid-90s, there was an explosion of students. [Evergreen] had to use portables to temporarily house students to accommodate growth. In 1993, the seismic code changed in southwest Washington, and those portables no longer meet the new code. [Recently,] the structural engineer that OSPI retained recommended that [the district] take action on the portables. Portables older than 1992 do not meet the current seismic code and in general aren't conducive to safety and security... If portables are counted as permanent inventory in SCAP, the district will not have unhoused elementary students and therefore will not be eligible for state match. "

2. How does the regulatory environment and permitting process affect the construction timeline?

The permitting process varies by jurisdiction (City of Vancouver and Clark County) and can be cumbersome. The lack of usable land has made it difficult for the district to meet its K-3 class size reduction goals using a traditional school model. The district is currently considering either building larger schools or smaller classrooms.

3. How long is the design, permitting and construction process?

It typically takes 12 to 18 months for the design process and another 12 to 13 months to construct an elementary school in Vancouver. The permitting process starts when the design is about 95 percent complete and typically takes three months to complete.

	Plan	Land	Design		Bond Election		Permit		Bid		Construction	
	Begin Date	Buy	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date
Crestline			•		•		•		•			
Planned	N/A	N/A			N/A							
Actual	Feb- 13	N/A	Mar- 13	May- 13	N/A	N/A	May- 13	Jul- 13	Jul-13	Jul- 13	Jul-13	Jul-14
Months			2 mo	nths	1		2 months		1 month		12 months	

Table 15: Planned versus actual construction timeline for Crestline project

Lake Stickney Elementary Project

The Lake Stickney Elementary project had been a component of the Mukilteo school district capital facilities plan since 2000, but the project did not begin until 2014. The district experienced three bond measure failures -- February 2006, February 2008, and May 2008 -- prior to passage in February 2014. Despite each bond having more than 50 percent support, the first three failed because they did not meet the supermajority requirement. Mukilteo speculates that the 2014 bond passed because it included a kindergarten center with 24 classes.

In general, Mukilteo has found it difficult to pass bonds. Prior to 2014, the district had only two bond passages since 1992 (May 2000 and February 1992). Passing bonds has become more difficult since the supermajority requirement for maintenance and operation (M&O) levies was removed in 2008.⁹ The district used to run both M&O levies and capital bonds together, to increase the likelihood of bond passage. The stated reasoning is that failure to pass the bond package would cause drastic cuts in school operations. However, the district is pleased that M&O levies only require majority passage now. The district suggested that majority passage for bonds would help create greater equality among schools.

The Lake Stickney project was built on an elementary school site that had been abandoned in 2003. The project was front funded. The district stated it has few projects, if any, that are not funded in this manner. This is due to the district qualifying for and receiving only 20 percent of state match funds. The district noted that due to this and to its historically low bond passage rates, it is difficult for the district to build new elementary schools.

The district used a low-bid contracting method for the Lake Stickney project. However, Mukilteo had begun designing the elementary prior to the bond passage. The district had no contingency plans for if the bond did not pass. The total risk was approximately \$1 million in upfront costs already paid or contracted for.

Mukilteo has found that it takes two years to complete the design, engineering, and permitting process in Snohomish County. It takes another 17 months to complete the construction process. It used to take 14 months. The district speculates that the longer time is due to increasing competition for subcontractors. Some district schools have been unable to open on time, but Lake Stickney did so. This

⁹ Billinghurst, B. and Shutz, Jr., B. (2007)

was despite extremely wet weather and the accompanying issues with keeping the building dry and mold free.

An interview with district staff included the following three questions.

1. How does the current project climate compare to five or 10 years ago?

"[The district hasn't] built anything since 2003. So, we don't have a basis for comparison."

2. How does the regulatory environment and permitting process affect the construction timeline?

The district stated that a local issue that causes delays is the building departments and their use of conditional-use permitting.

3. How long is the design, permitting and construction process?

It typically takes 24 months for the design process and another 17 months to construct an elementary school in Mukilteo, Lynnwood, Everett, and Edmonds.

	Plan	Land	Design		Bond Election		Permit		Bid		Con	struction
	Begin Date	Buy	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date
Lake Stickney												
Planned			Mar- 13		2006				Jan- 15		Apr- 15	
Actual	Jan- 00	2003	Apr- 14	Jan- 15	Feb- 06	Feb- 14	Jun- 14	May- 15	Mar- 15	Apr-15	May- 15	Sep-16
Months			9 mo	nths			11 months		2 months		16 months	

Evergreen Forest Elementary Project

The North Thurston School District began facilities planning for the Evergreen Forest project in 2010. However, the district delayed the bond election until February 2014. The weak economy in 2011-2013 caused the district to push back the election. Due to this large gap in time, the bond package changed.

The district's research suggested that the community would be favorable to a larger bond package. This research proved correct and the 2014 bond did pass. The original ask in 2010 would have been up to \$160 million; the 2014 ask was \$175 million. North Thurston expects its next potential bond to be in 2022, with facilities planning beginning in 2019. The district uses the OSPI schedule of school life cycles in determining when to pass which kind of bond package.

The Evergreen Forest project was front funded. North Thurston noted that it typically front funds for the initial aspects of a project until state assistance comes in. The stated reason for this is to show rapid progress to voters. The district passes the bond and then the design and construction process can begin immediately.

The district has found it historically took one year of designing, engineering, and permitting. However, due to environmental permitting issues, the district has begun moving towards a two-year total design process. It typically takes another three months for the district to finish its bidding process and then 15 months to construct a new facility. The district stated it now takes 24 months to fully design and permit to go to construction. The schools would not open on time without modular construction.

The district does not have empty schools to serve as "swing" schools for students during construction. Since it takes North Thurston one full school year and two summers to remodel a school, the district uses a phased construction model to move students during the school year. During the first summer, the district builds an eight-classroom modular building, called an "eight-plex" facility. Eight-plexes have full facilities, bathrooms, teacher spaces, and extras such as security systems. When the school year begins, the district moves out eight classrooms to the eight-plex and then remodels that section of the school. When construction has finished, then another eight classrooms are moved out. This modular facility allows the district to create temporary extra capacity.

North Thurston used a DBB contracting method for this project to ensure hiring an A&E firm that is sensitive to the students' needs. Since, the district must remodel its schools while they are still occupied, the bidding process cannot be concerned solely with lowest bids.

	Plan	Land	Des	ign	Bo Elec		Per	mit	B	Bid	Con	struction
	Begin Date	Buy	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date	Begin Date	End Date
Evergreen Forest												
Planned			Mar- 13		2011						Jan- 15	
Actual	Jan- 10	N/A	Jan- 14	Jan- 15	Feb- 14	Feb- 14	Sep- 14	Mar- 15	Mar- 15	Mar-15	Mar- 15	May-15
Months			12 mc	onths			6 mo	nths	1 m	onth	15	months

 Table 17: Planned versus actual construction timeline for Evergreen Forest project

An interview with district staff included the following three questions.

1. How does the current project climate compare to five or 10 years ago?

"It's starting to feel like 2008 again. It feels bubble-like. [The district hasn't] recovered the supplier capacity for contractors since the Recession, but we also are having huge construction needs. It's causing prices to skyrocket.

"My questions are: What is a reasonable limit to cost for building a new school or classroom? At what point is the cost per square foot too high? What is the median price point that is reasonable? What is the median price point that districts statewide should be aiming for?"

2. How does the regulatory environment and permitting process affect the construction timeline?

The district has found compliance with local environmental standards has begun to impede the construction of new schools. As the local community has grown, it has become increasingly difficult for the district to find suitable sites. The sites chosen have

needed more development to begin construction. The district has begun buying larger sites with more land to have "enough usable land to build upon."

3. How long is the design, permitting and construction process?

It typically takes 24 months for the design and permitting process and another 18 months to construct an elementary school in Lacey.

Appendix E: Value Engineering

Project	Value Engineering Recommendations				
Floject	Total	No. Accept.	Reject Rate		
Richland School District					
Lewis and Clark	98	40	0.59		
Sacajawea	60	47	0.22		
Marcus Whitman	60	40	0.33		
Orchard	103	75	0.27		
Kennewick School District					
Eastgate	8	3	0.63		
Sagecrest	5	2	0.60		
Pasco School District					
Rosalind Franklin	21	13	0.38		
Barbara McClintock.	45	12	0.73		
Marie Curie	28	12	0.57		
Evergreen School District					
Crestline	68	32	0.53		
Mukilteo School District					
Lake Stickney	22	13	0.41		
N. Thurston School District					
Evergreen For.	27	8	0.70		

Table 18: Rejection rate of value engineering recommendations

The total number of value engineering recommendations refers to the suggestions from each districts' value engineering team. The total number of accepted refers to those suggestions adopted by the district either wholly or with modifications. The rejection rate is the total number of outright rejected proposals divided by the total number of recommendations.

Within the value engineering team costs section, the report costs refers to the total cost for the value engineering study. The total proposed savings are the potential cost-savings from value engineering recommendations during construction. The district accepted savings are the potential cost savings during construction that may come from either the wholly adopted or modified value engineering recommendations.

This table suggests value engineering does provide savings for uniquely designed schools, but it is a mixed result. Three of the four nonprototypical schools -- Lewis and Clark, Lake Stickney, and Barbara McClintock -- show low overrun costs suggesting savings were found. However, the Evergreen Forest project had a significant (approximately \$5 million) cost overrun. This is the only project with modular

building components. Thus, it is unclear whether value engineering is useful for modular construction or mixed modular and traditional construction.

Five of the six districts noted that the value engineering team may suggest valid cost-saving recommendations that do not meet the districts' standards and are immediately rejected. The rejection rates, as shown in the above table, bear this out. The eight prototypical schools have greatly reduced total recommendation numbers than the nonprototypical schools. Even with so few recommendations, the rejection rates remain fairly high. Forty-four percent of all value engineering team recommendations for prototypical schools were rejected. The rejection rate for nonprototypical schools was even higher – 61 percent.

Appendix F: Best Practice Cost Reduction Table

The state has explored many ways of reducing costs by comparing procurement processes with other states. In general, Washington uses similar procurement processes to other states and there are few readily apparent changes or tweaks that would be viable options.¹⁰ The structure to make incremental improvements exists. Washington state has established key mechanisms designed to produce high-quality school facilities at the lowest possible cost. School districts utilize or aim to utilize each of the following best practice options. The state incentivizes and supports these best practice options through the OSPI D-form process and the Washington State Sustainable Schools Protocol.

	Standard Imple	mentation?
Planning	School District	OSPI
Develop facility master plan	Yes	
Determine early whether to front fund or wait for state match	Yes	Yes
Plan for bond elections	Yes	Yes
Begin to scope project	Yes	
Joint use	School District	OSPI
Identify potential joint use opportunities	Certain districts	
Utilize formal agreements	Certain districts	
Consider special security issues and local requirements	Certain districts	
Ensure commitment and capability to fund project	Certain districts	
Establish clearly defined management responsibility	Certain districts	
Site procurement	School District	OSPI
Do environmental investigation prior to buying		
Collaborate with developer community	Yes	
Work within the bidding climate	Yes	
Consider the pros and cons of land banking	Yes	
Design phase	School District	OSPI
Utilize prototypical design	Yes	
Consider incentive agreements	Yes	Yes
Assign district representative for day-to-day management	Yes	Yes
Manage the bid date to minimize the impact of peak construction cycles	Yes	
Minimize district requested changes during construction	Yes	Yes
Agree to a formal dispute resolution process	Yes	Yes

Table 19: Cost reduction best practices used by school districts and the Office of Superintendentof Public Instruction

¹⁰ Office of Financial Management (2008)

Construction phase	School District	OSPI
Seek standardized details and repetitive models	Yes	
Try to keep the design model simple	Certain districts	
Consider using a multistory versus single-story design	Yes	
Establish the proper life expectancy	Yes	Yes
Consider the durability of materials	Yes	Yes
Consider alternative materials/construction types	Certain districts	Yes
Undertake value engineering	Yes	Yes
Select HVAC system carefully	Yes	Yes
Consider regional standards	Yes	
Use timesaving techniques	Yes	
Aim to complete building envelope prior to winter	Yes	
Use a "systems" approach of factory-built components		
Understand and work with the design limitations	Yes	

Appendix G: Facility Cost Comparison Data

Table 20: Classroom building type comparison

Facility	CLT	Stick Frame	Portable
Subtotal (including site- work, utilities, foundation and bldg. costs)	\$270,000	\$252,000	\$214,600
Sales Tax @ 9%	\$24,300	\$24,696	\$19,314
DES project manage.	\$8,000	\$8,000	\$8,000
Total cost per classroom	\$302,300	\$284,696	\$241,914
Cost per square foot	\$335.89	\$316.33	\$268.79
Life cycle	50 years	30 years	10 years
Raw Data Source	CLT Pilot Project	Local Contractors	Pacific Mobile Structures

Adapted from data prepared by Debra Delzell/Bob Bourg based on 2016-17 CLT Construction Pilot Project and research by DES

Table 21: K-3 modular-permanent CLT classroom – cost	per classroom
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Facility	C	LT
Design/Construction	\$250,000	
Change orders (average – 5 school districts)	\$20,000	
Subtotal		\$270,000
9.0% sales tax	\$24,300	
0.0275% DES project management fee	\$8,000	
Total cost per classroom (Based on building 4 classrooms)		\$302,300
Cost per square foot (Based on 850 square feet per classroom)		\$356

Adapted from data prepared by Debra Delzell/Bob Bourg based on 2016-17 CLT Construction Pilot Project and research by DES

	Square Footage	Cost
Base Bid	4,260	\$1,450,306
Alternates	2,015	\$535,047
Total Base Bid + Alternates	6,275	\$1,985,353
7.0% Eligible Tax		\$138,975
Subtotal		\$2,124,327
Excess Tax Above 7.0%		\$33,751
Total Cost		\$2,158,078
Total Cost per Classroom (Based on building 8 classrooms)		\$269,760
Cost per SF		\$344
Life cycle		10 years
Raw Data Source	OSPI	OSPI

 Table 22: K-3 modular-permanent '8-plex' classroom – cost per classroom

Source: North Thurston School District Case Study

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