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Final Report

School Transportation: Development of an Education Module and Workshops on Multi-modal Costs

Project No. 2013-032s, 2015-002

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ABSTRACT

This research project presents a conceptual overview of the policy issue of school siting via an education module and introduces a practitioner tool to support the school siting decision making process. As previous research outlines, school siting, or the physical location of a school, can impact school travel rates and costs. This module and decision support tools enables practitioners to identify and compare the tradeoffs in up-front land costs with ongoing transport costs. The education module, hosted online, was developed for use in graduate courses in urban planning, engineering, and education and continuing education workshops in school siting and pupil transportation.

EXECUTIVE SUMMARY

According to the US Department of Education, Americans spend $20 billion annually to bus 25 million elementary and secondary children to school. Not only is this annual educational expenditure sizable, trends indicate that the cost of busing children to school are increasing. Between 1995 and 2007, constant-dollar school busing costs increased 51%; yet, student enrollments only rose by 11% over the same period (U.S. Department of Education, National Center for Education Statistics 2009; National Center for Education Statistics 2009). Declining state and local revenues make it imperative for school districts to efficiently manage transport costs in order to preserve funding for classroom activities without sacrificing students' ability to get to school.

School districts and municipalities regularly make educational facility and land use decisions without fully understanding the impact of such decisions on overall school transportation costs. For example, school district facility decisions on whether to build, renovate, or close a district's schools directly influence the location of schools within the district and, correspondingly, the district's school transportation network. These land use and transportation issues are particularly relevant for the southeastern United States, where, during the 2000s, the regional cost outlays averaged $9.4 billion per year for school construction and $3.1 billion per year for school transportation. These costs represent between 3.5 % and 4.8 % of all education expenditures for each state in the southeastern region.

This project builds on the STRIDE-funded project, *Quantifying the Cost of School Transportation*, in which we selected 20 recently-built schools in North Carolina (11 schools in urban, suburban and rural contexts) and Florida (9 schools in urban and rural contexts) and collected data on the multimodal costs of school transportation. These schools were selected to document the variation in school costs by location type (urban, suburban, and rural) and nearby

built environment characteristics. Using these results, we developed a decision support tool, referred to as the School Transportation Cost Calculator, to estimate the public and private transport costs of potential school sites. This tool provides a multi-modal perspective on school transportation costs and school location selection by estimating the public capital costs on developing a transportation system in conjunction with annual public and private school transportation operation costs.

Our study integrates the decision support tool developed in our previous research into a newly created education hub for school transportation planning and policy that can be used by transportation, land use and school planning professionals. In addition to supporting public decision making, this school siting hub introduces an education module developed for use in courses offered in graduate programs in urban planning, engineering, and education and in the continuing education programs of organizations involved in school siting and pupil transportation. With support of an add-on grant from STRIDE, extensive dissemination of the tool was undertaken including workshops and webinars with practitioners. Stakeholder audience organizations include: US Environmental Protection Agency, American Planning Association, American Institute of Certified Planners (AICP), Council of Educational Facilities Planners International (CEFPI), Florida Educational Facilities Planners Association, National School Boards Association (NSBA), National School Transportation Association, and the Institute of Transportation Engineers. By exposing educational facility, transportation and land use planning graduate students and professionals to school travel issues and transferring decision support technology, this project promotes the policy issue of school siting and enable local decision makers to make more efficient use of scarce infrastructure resources in the future.

I. INTRODUCTION

This project entails the development of a comprehensive education and decision support resource that addresses the STRIDE themes of livability and safety. Schools are a critical part of public infrastructure contributing to economic and community development, and social integration (Vincent 2006). Getting children to school safely and at reasonable cost to the public sector are crucial elements of a livable community. Despite the importance of schools in our communities, educational facility planning has typically been disconnected from transportation and local land use planning (McDonald 2010; Steiner et al. 2011). Our project bridges this gap by developing an education module that serves as a hub for planners and engineers - sharing essential concept information highlighting the relationship between school facility siting and pupil transportation and presenting decision support tools to aid school siting professionals.

The issue of school siting and transportation is particularly relevant for the southeastern United States. Outlays for *school construction* averaged $9.4 billion per year in the late 2000s across the states of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee (Filardo et al. 2010). In addition, the *school transportation* costs were $3.1 billion for these eight states in fiscal year 2010. Currently, southeastern states spend between 3.5 and 4.8% of all education expenditures on school transportation (U.S. Department of Education, National Center for Education Statistics 2012). Financial pressure on municipal and school budgets makes it critical that investments in school facilities and transportation be efficient and minimize lifecycle transportation costs. Our project benefits the region by helping engineers, planners, and academics understand the interconnection between school location decisions and school transportation expenses. Our module includes examples of schools located in North Carolina to ensure the concepts are directly applicable to the southeastern region.

This project builds on the findings of STRIDE project number 2012-022S, *Quantifying the Costs of School Transportation.* The *QSTC* project documented the multimodal costs associated with school transportation and the variation in school transportation costs by location type and nearby development patterns. In total, that project inventoried transportation system costs for 20 recently-built schools in North Carolina and Florida. Results were used to develop a decision support tool for estimating the transport costs of potential school sites. This project introduces that tool, referred to as the School Transportation Cost Calculator, which enables school staff to compare estimated school travel costs by local school site characteristics.

This project accomplishes three distinct objectives. First, we have developed an education module that uses the results from our earlier STRIDE study to introduce the physical location of a school, commonly referred to as school siting, as an important policy and planning issue to graduate students and practitioners. The research team presents the issue of school siting broadly and focuses the content on the implications of school siting decisions for school transportation modes and public and private costs through a website. Second, we pair this information with embedded online resources; not only do we provide background planning and policy information for students and practitioners, but we also share tools, such as the recently developed School Transportation Cost Calculator, that empower decision makers, planners and the public to evaluate school siting decision with as much information as possible. Third, we have developed a coordinated outreach strategy for the education module and School Travel Cost Calculator that includes an in-person presentation at the American Planning Association's North Carolina Chapter conference in October 2015 and an online webinar hosted by STRIDE in November 2015. These live and digital outreach efforts were cross-promoted with industry partners.

II. BACKGROUND

Americans spent $21.8 billion to bus students to school and invested $50 billion in school construction in 2010 (Filardo et al. 2010; U.S. Department of Education, National Center for Education Statistics 2012). These investments in public infrastructure and services are massive and on-going. Despite the size of these investments, little attention has been paid to school transportation and planning outside of experts in educational facilities and pupil transportation.

Yet, research indicates that decisions about where to locate schools and how to provide transportation have important impacts on the larger transport system and community development and deserve wider attention from planners and engineers (Vincent 2006; McKoy, Vincent, and Makarewicz 2008; Vovsha and Petersen 2005). At the same time, municipal governments, state transportation departments, and school districts are entering an era of reduced fiscal capacity where they are required to provide better results with less funding. Given these responsibility, planners and engineers from local government agencies and school districts must understand the short- and long-term cost considerations of student transportation and the connections with school location decisions.

The 2012 STRIDE-funded project, *Quantifying the Costs of School Transportation*, evaluated the full costs of getting children to school and developing a pilot decision support tool to help planners and decision-makers minimize transport costs when selecting a school site or improving an existing school. The goal of this proposal is to develop an educational module that provides a foundation in school transportation planning and policy for students and professionals and provides resources to encourage the use of the school transportation costs decision support tool. The benefit of this project is making transportation and planning professionals aware of the critical issues involved in school transportation and school location, thus enabling decision makers to make more efficient use of scarce infrastructure resources in the future.

School Transportation & School Siting

In the United States, the federal government has delegated responsibility for school transport policies to the state and local school districts. The result is a patchwork of policies (McDonald and Howlett 2007; Safe Routes to School National Partnership 2014). Some states, such as Texas and California, do not require districts to provide school transport. Many other states do require their school districts to transport children to school but differ in defining exactly who must be transported. For example, Idaho requires that all children who live more than 1.5 miles from school receive transport, while New York mandates a distance of two miles. Most states provide options to bus children living closer to school if hazardous walking conditions exist. The one exception to this varied playing field is the transport of students with disabilities. Under the Individuals with Disabilities Education Act, all states must transport special needs students at public expense.

States also set policies about the school parcel's physical design as it relates to transportation. For example, the *North Carolina Public Schools Facilities Guidelines* (Department of Public Instruction 2010) suggests providing on-site parking for "all staff, itinerant specialists, and [more] for visitors" and providing student parking for "a third or more of the student population" at high schools. These requirements carry clear cost implications and make assumptions about students' travel behavior in accessing school. Furthermore, the guidelines do not reflect the variation in parking needs between denser cities and more rural areas. Because the guidelines may require a larger site for the school to accommodate more parking, and the inherent challenges in assembling large land parcels, the number of children who can live close enough to the school to walk may decrease.

Much of the research on school transportation has focused on optimization algorithms for school bus routes (see Jozefowiez (2008) for summary). However, missing from the optimization algorithms literature is consideration of other transport modes and how school location affects the population that requires busing. Studies of economic production functions generally account for school bus costs to assess the merits of school consolidation and optimum school size. For example, Andrews, et al (2002) found that "moderately sized" elementary (300-500) and high (600-900) schools balance savings on administrative and infrastructure costs without the negative impacts of large schools, such as increased violence and the costs of longer trips to school for students and parents (Ferris and West 2004).

The lack of comprehensive analysis of multi-modal school transport costs is problematic because these costs appear to be increasing. Between 1995 and 2007, constant-dollar school busing costs increased 51%; yet student enrollments only rose by 11% during the same period (U.S. Department of Education, National Center for Education Statistics 2009; National Center for Education Statistics 2009). At a time when transport busing costs are rising more quickly than student enrollments, significant limits have been placed on school budgets due to the economic recessions of the late 2000s.

Declining school budgets have caused districts to make cuts, and, understandably, many districts have opted to cut school transport rather than teachers. Still, there are clear concerns about equity of school access due to busing cuts. To manage these situations, local governments and school districts need better information about the up-front and on-going costs associated with school transportation. Selecting school locations to minimize overall transport costs, as opposed to just school bus costs, could save districts money and provide a system that is more resilient to exogenous shocks, such as gas price increases or school budget decreases.

During the initial STRIDE *QSTC* project we worked closely with school district staff and officials at each of the twenty study school sites and districts. A common theme in discussions with transportation and facility planners was that, while each understood that the other impacted the transportation system and associated costs, neither facility construction nor transportation operations staff have a *comprehensive* understanding of the costs associated with the development and operation of a school transportation system. This perspective informed our intent and approach to this project.

The results of the initial STRIDE-funded study on the multi-modal costs of school transportation shed light on the issue of institutional siloing around site selection and provided core material for the development of an education module supporting the school siting decision making process. Congruent with previous research, education leadership consultation of local government officials in school facility decisions doesn't always happen; when it does, local government officials' comments have little influence (Norton, 2006). As a result, education on this topic must be integrated into training and curricula of the many different professions involved in decisions related to education facilities and community development.

City and regional planners assess demographic trends, using population estimates to develop land use and transportation plans that influence the location of educational facilities and residential developments. Transportation engineers design the roadways and network that connect homes to schools; in so doing they influence the modes accommodated in a transportation network. Educational leaders shape district and school policies and educational facility plans that have the potential to enable or discourage various transportation modes. School planners and architects are responsible for the physical development of the education facility and

involved with the project from inception to completion; their understanding of the interrelated concepts of school site selection and travel costs are essential.

In addition to professionals of the built environment, elected and appointed officials, administrators and educators play a crucial role in the selection and design of a school site. City and county elected officials often help negotiate and secure school sites and funding for the project. School district superintendents and board members are tasked with balancing built environment considerations with political, budgetary, and operational realities; they are thus a natural audience in consideration of the full cost outlays associated with site selection and school travel planning (Norton, 2006). In addition, school principals and teachers are key stakeholders and leaders in the facility design process; thus their understanding of the long-term school travel costs associated with the design of a site is critical.

III. RESEARCH METHODOLOGY

Emerging from the larger project objective and background regarding the intersection of school siting and transportation, the goals of STRIDE project number 2013-032s were threefold:

1. Develop an education module on school siting and transportation planning
2. Develop materials to assist with technology transfer of decision support resources
3. Develop an outreach strategy to disseminate the module and resource hub

Below, we highlight the process and approach to accomplishing each of these three goals.

1. Develop an education module on school siting and transportation planning

The initial step for developing the education module was to inventory and catalogue existing school travel and educational facility planning professional guidelines and resources. Involving industry stakeholders in North Carolina and Florida in formal and informal feedback early on was essential to our understanding of the need and use of existing resources and tools intended to assist planners. After identifying resources, we focused on areas that the existing resources did not address. It became readily apparent that, while there were resources and general guidelines around school siting, there were very few resources or guides which systematically approached school siting and transportation impacts as a comprehensive policy and planning issue. Module components drew from existing educational materials in educational facility planning; land use planning; transportation planning and policy. We then developed the education module, classroom PowerPoint and illustrated examples.

The education module targets two audiences. The first is students and faculty in the professional fields of city and regional planning, transportation engineering, educational leadership, school facility planning, and architecture. The second audience is practitioners or administrators involved in school operations budgeting, planning and oversight. Potential

practitioners include elected city and county officials, principals, and school board members, as well as current school transportation and facility planners.

2. Develop materials to assist with technology transfer of the decision support resources

A primary goal of this project was to understand how the results from the *Quantifying School Travel Costs* project would be beneficial and best utilized by professionals across the industries of the built environment. After discussions with practitioners, researchers and academics, we considered whether the decision support tool that emerged out of the QSTC project, referred to as the School Travel Cost Calculator, would pair with the education module's background information that we had already gathered. It was through this development process that we came to the realization that an integrated web-based resource could present graduate students and practitioners with a comprehensive information and decision-support hub. It was determined by the project team that a comprehensive website would allow users to access background information on the concept of school siting, policy implications of school siting decisions, vivid examples of how these concepts play out through real schools, and embedded links to other tools and resources that would support the decision making process.

3. Develop an outreach strategy to disseminate the module and resource hub

The final goal of this project is to ensure that the developed educational materials are widely disseminated and lead to increased understanding of the relationship between school site selection and cost-efficient school transportation planning and policy. The digital nature of the education module, embedded decision support resources, such as the School Travel Cost Calculator, and comprehensive website that serves as a hub for these project components necessitated a comprehensive outreach strategy. Interviews with partners and stakeholders

solidified the understanding that an outreach strategy should digitally connect message recipients through industry networks and institutions already in place. The primary benefit of developing the comprehensive education module and resource hub on a Carolina Transportation Program website (http://schoolsiting.web.unc.edu/) is that we can link to this site throughout digital platforms, including email messages, social media campaigns, and through announcements for presentations and webinars.

IV. FINDINGS AND APPPLICATON

This project brings together the long-standing, but traditionally disconnected, pedagogies of city and regional planning and educational facilities planning into a coherent narrative and toolkit accessible to practitioners, decision makers and educators involved in shaping the policies and design of the school facility and travel environment. Traditionally, the fields of city planning and educational facility planning have been separated by focus and funding, with educational facility planning concerned with the design and function of the school site and city planning interested in the school site in the context of the broader community and region.

Education Module

In order to bridge these professional worlds, we developed an educational module and decision support resources designed to collaboratively share representative interests, goals, challenges, and procedures as each field relates to school transportation planning. The module is designed to address different levels of interest in the subject matter with corresponding resources that together can be used as a comprehensive resource on the school siting and transportation nexus. Taken together, the module and resource hub is designed using a framework consisting of four themes: (1) a conceptual overview of school siting and implications for public policy and transportation planning; (2) an overview of factors that influence school transportation mode rates and costs; (3) an introduction to the innovative School Travel Cost Calculator; and (4) tools and potential opportunities for increased coordination and efficiency.

All materials are hosted on a project-supported website to allow easy access for all audiences (https://schoolsiting.web.unc.edu). This is particularly intended for educators and academics of university programs in the built environment and educational leadership, as digital resources allow for ongoing distribution and integration into course syllabi. The website is

design in the form of a flipboard-style web presentation that expands on the classroom presentation material and includes external links to relevant resources and citations. A screenshot of the website is located in Figure 1.

Practitioner Toolkit

The QSTC project served as a data source to develop a decision support tool we refer to as the School Travel Cost Calculator. The STCC is an interactive project dashboard based in Microsoft Excel that uses Education Facility Planner input variables to estimate public capital, public operational and maintenance, and private operational and maintenance annual school travel costs. A screenshot of the School Travel Cost Calculator is located in Figure 2. The STCC is available for download through the School Siting and Transportation website under the "Cost Calculator" embedded navigation bar.

In addition to the interactive cost estimator, we also developed a five-step instruction manual that is located on the website in the same area as the STCC download link. This user guide walks students and practitioners through the use of the tool and general instructions for its layout and modifications. Importantly, the STCC uses a number of pre-loaded assumptions, such as the cost of a school bus. The estimates can be modified by district users by simply unlocking the associated spreadsheet tab (no password necessary).

Outreach and Dissemination

This outreach strategy includes the following elements:

- November 2015 digital presentation (webinar) hosted for the Southeastern Transportation Research, Innovation, Development and Education Center (STRIDE)
- October 2015 oral presentation (in-person) at the American Planning Association's North Carolina Chapter conference held in Raleigh, North Carolina

- Alert faculty in relevant disciplines, including transportation and land use planners, transportation engineers, school planners, and educational leadership
- Include information in newsletters and email updates that reach practitioners throughout the southeastern region, as well as those practicing across the nation. Professional organizations include the National School Transportation Association, Council of Educational Facility Planners International, Florida Educational Facilities Planners Association, National Association of Elementary (Secondary) School Principals, and the National School Boards Association

V. Conclusions, Recommendations and Suggested Research

The research project finds that while the multi-sector issue of school siting is one that fields associated with the built environment, like city planning and policy, are perhaps loosely familiar with, general awareness of these issues and resources dedicated to support school siting decisions have, to this point, been lacking. In discussions with stakeholders, we have found that many districts and planners have attempted on their own to perform some costing analysis for different school siting scenarios. Through this project, we have brought together the background information and resources into one place – and in so doing offered the education module as a hub for students and practitioners to understand and evaluate school siting decisions.

Practical implications for this study

This project has direct practical implications for planners, decision makers, and the general public – we introduce a complex policy issue and break it down into components that are approachable and tied to illustrated examples from real schools. Further, this project partners this background information and research with tools and resources that are accessible and useful. Thus, the practical implication for this study is that we've created an information and resource hub that supports decision making around school siting. In addition, this project is about the development of an education module designed to include in city planning, educational leadership and public policy graduate courses. The education module may also be used for practitioner workshops in transportation, land use and educational facility planning.

Long term expectations

We anticipate the use of the website and tool by graduate students and faculty in planning departments. The topic of school siting and the impacts of school location on transportation costs is not only relevant to school transportation practitioners; it is an approachable example of

transportation and land use dynamics and the interdependency of these two planning domains. Further, the Cost Calculator is readily accessible and potentially useful for planners, decision makers and the general public interested in where a school is built. In order to achieve these expectations, a key to this project is communication and outreach to industry partners and stakeholders across planning, education and public policy, which highlights the importance of the November 2015 STRIDE webinar.

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VII. GRAPHICS

Figure 1. Screenshot of the School Siting Education Module and Resource Hub

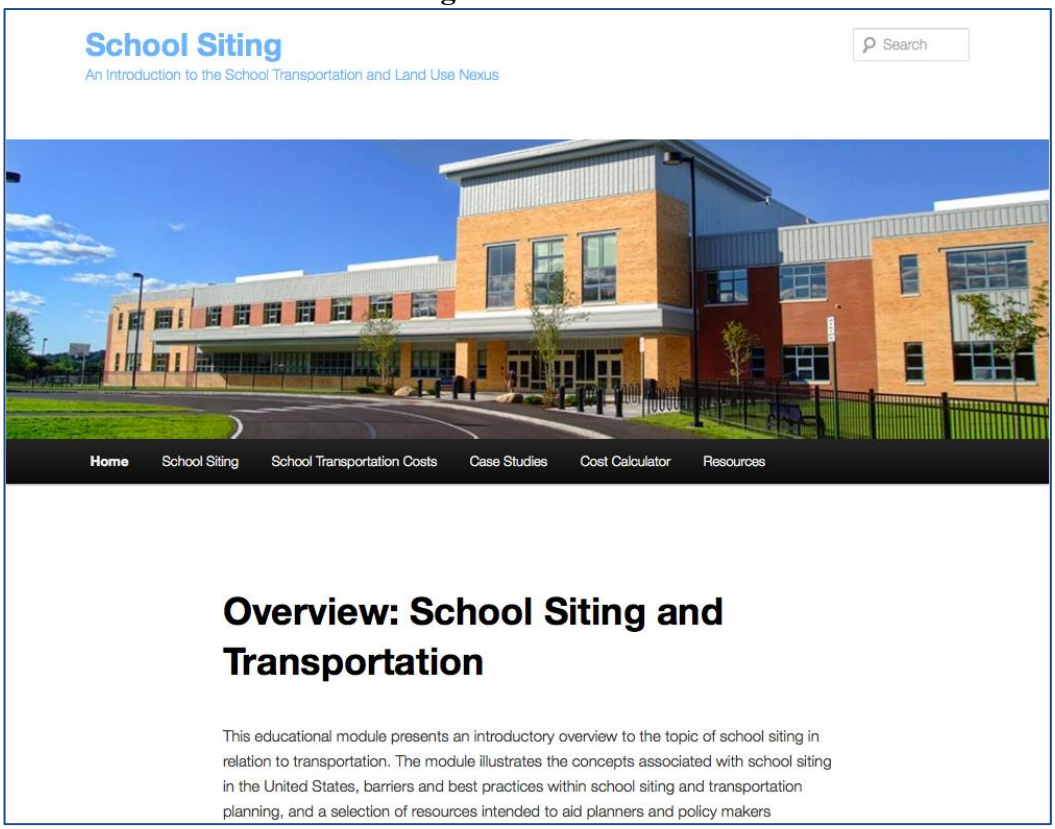

Figure 2(A). Screenshot of the School Travel Cost Calculator Input Variables

School Site and Population Variables (Inputs)	
School Population	375
Percent of Pop w/in 2 Mile	100%
Number of School Days	170
Number of Tiers	1

Figure 2(B). Screenshot of the School Travel Cost Calculator Estimated Costs

School Travel Costs (Estimated)	
Upfront Costs	
Public Capital	$644,008.24
Annual Costs	
Public Operating & Maintain	$83,683.24
Private Costs	$129,024.13