Smart growth generally refers to characteristics of the urban form and built environment that are associated with benefits to environmental protection, public health, and quality of life, as well as economic and social benefits. One of the more established benefits of smart growth is reduced travel and the resulting decrease in congestion and delay, along with their costs to businesses and households. Other benefits include reduced infrastructure expansion, energy consumption, and greenhouse gas and other emissions.

While the transportation-land use connection and the impact of various smart growth strategies on travel demand are well-documented, practical guidance and tools for interpreting these insights to make them useful at key project decision points have been lacking. The objective of SHRP 2 Capacity project C16 was to provide transportation planning agencies with improved tools and methods for more accurately and comprehensively integrating transportation investment decision-making with land development and growth management.

The project produced two products to improve communication, interaction, and partnerships between decision-makers and planners in both the transportation and land use arenas:

- A decision support software tool for regional and local planners to test smart growth scenarios and evaluate their impact on travel demand, and
- On-line resources to understand the dynamics and inter-relationships of smart growth strategies with the performance of a transportation investment as background and supplement to the software tool.

These resources can bridge the gap between regional planning visioning exercises and transportation plans in relation to the evaluation of smart growth strategies. This will allow state, regional, and local agencies to evaluate smart growth strategies quickly and easily so that promising smart growth strategies can be identified and pursued in the land use and transportation planning processes. This can also supplement more sophisticated modeling efforts, which can be used to evaluate specific smart growth projects.

The Products

The project produced a synthesis of the extensive research available and a software tool (SmartGAP) that can be used to evaluate the impact of smart growth policies on travel demand. The tools were pilot tested by Maryland Department of Transportation, Atlanta (Georgia) Regional Council, and Thurston (Washington) Regional Planning Council.
light truck proportions by year, induced demand—
short term impacts
• **Transportation Supply**—amounts of regional transit
  service, amounts of freeway and arterial capacity
• **Policies**—pricing (vehicle miles traveled charges or
  parking pricing programs), ITS strategies for freeways
  and arterials, demand management (vanpool, tele-
  commuting, ridesharing, and transit pass programs)

The research identified well-established relationships
between smart growth strategies and various impacts for
five topic areas that would be valuable in the evaluation
of smart growth strategies. In addition, gaps in the exist-
ing research were identified because they represent useful
capabilities in the SmartGAP software, although not all gaps
could be filled in the initial version. Table 1 identifies the
relationships and gaps.

### SmartGAP Planning Tool

SmartGAP evaluates regional scenarios based on changes in
the built environment, travel demand, transportation sup-
ply, and transportation policies being considered.

It is a robust statistical package that tracks the charac-
teristics of individual households and firms in a region and
determines the travel demand from these characteristics.
This tool was designed to address as many of the limitations
identified in the research as possible and to fill a gap in the
set of available tools.

Currently, SmartGAP can provide information on the
following changes in the regional system:

- **Built Environment**—changes to the urban form
  (e.g., proportion of population and employment
  living in mixed use areas, transit oriented develop-
  ments, or rural/greenfield areas)
- **Travel Demand**—changes in population demo-
  graphics (age structure), changes in personal income,
  changes in firms by size or industry, relative
  amounts of development occurring in urban core,
  close-in communities, suburban or rural areas,
  population and employment densities, auto and

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>WELL-ESTABLISHED RELATIONSHIPS</th>
<th>GAPS IN RESEARCH</th>
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<td>Built environment impact on peak auto demand</td>
<td>Impact on daily travel</td>
<td>Impact by time of day</td>
</tr>
<tr>
<td>Mobility by mode and purpose</td>
<td>Impact on daily travel</td>
<td>Impact by trip purpose</td>
</tr>
<tr>
<td>Induced traffic and induced growth</td>
<td>Capacity expansion on an expanded facility</td>
<td>Route, time-of-day shifts and modes shifts, induced shifts, new destinations, growth shifts; effects of operational improvements, land use plans</td>
</tr>
<tr>
<td>Relationship between smart growth and congestion</td>
<td>Localized effects</td>
<td>Macro-level or regional effects</td>
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<tr>
<td>Smart growth and freight</td>
<td>Freight is necessary for population centers</td>
<td>Impacts of loading docks, truck routing, full-cost pricing, freight facilities and crossings, inter-firm cooperation, stakeholder communication</td>
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| Table 1. Summary of Background Research Assessment |

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SmartGAP evaluates a series of performance metrics
resulting from smart growth scenarios: community impacts,
travel impacts, environmental and energy impacts, financial
and economic impacts, and location impacts. These provide
a rich assessment of each scenario at a regional scale and
SmartGAP is flexible in how the place types are applied in
each region. All of the input data can be developed from
available data sources, which are provided with the applica-
tion. If a regional agency has local data, they can be used in
place of the data in the system. To allow for wide distribu-
tion, the software was developed using “R,” an open-source
statistical package.

SmartGAP is designed to be easy to setup and use, so
smaller planning agencies with fewer staff resources can
make use of it. Larger planning agencies can take advantage
of the processing speed and relative ease of use to run mul-
tiple scenarios for screening purposes before more complex
and time-consuming integrated land use and travel demand
forecasting models are needed

### The Pilot Tests

Three pilot tests were undertaken to evaluate the usability of
the software, whether it was difficult to develop input data,
whether the software’s output metrics were clear and useful,
and if the results were reasonable. To provide a range of feedback, three agencies of varying sizes were selected:

- Thurston Regional Planning Council (TRPC) in Washington State represents a small-to-medium sized metropolitan planning organization (MPO)
- Atlanta Regional Commission (ARC) in Georgia represents a large MPO, and
- Maryland Department of Transportation (MDOT) represents a state department of transportation (DOT).

The agencies were provided with the SmartGAP software, a draft of the user’s guide, and preprocessed census population and county business pattern data to simplify some of the base year model inputs. Once the agencies had installed the software and run the included demonstration model, they were asked to run eight standard scenarios and submit the results. Table 2 shows the scenarios.

Pilot test results appear to be reasonable and consistent, with varying degrees of sensitivity to policy changes depending on the level of growth predicted in a region, the existing distribution of land uses,

The SmartGAP software and a user guide are available at http://www.trb.org/main/blurbs/168842.aspx. The final report, The Effect of Smart Growth Policies on Travel Demand (SHRP 2 Report S2-C16-RR), is available at http://www.trb.org/Main/Blurbs/168761.aspx. The report includes two technical appendices: Performance Metrics and Application Tools (Appendix A) providing more detail from the background research, and Smart Growth Area Planning Tool (SmartGAP) Documentation (Appendix B) providing more detail on the individual models in SmartGAP to support Chapter 3.

SmartGAP will also be available through PlanWorks (formerly TCAPP, online at transportationforcommunities.org), which will be released by the Federal Highway Administration in 2014.

### Table 2. Scenarios for Pilot Testing

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th>LAND USE</th>
<th>TRANSPORTATION</th>
<th>POLICY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Baseline</td>
<td>Baseline</td>
<td>Baseline</td>
<td>Baseline</td>
</tr>
<tr>
<td>2. Increase transit supply</td>
<td>Baseline</td>
<td>+ 20% in transit supply</td>
<td>Baseline</td>
</tr>
<tr>
<td>3. Increase roadway supply</td>
<td>Baseline</td>
<td>+ 20% in roadway supply</td>
<td>Baseline</td>
</tr>
<tr>
<td>4. Add ITS</td>
<td>Baseline</td>
<td>Baseline</td>
<td>+ 20% in lane miles with ITS</td>
</tr>
<tr>
<td>5. Shift 10% growth to more dense areas</td>
<td>Shift 10% Population &amp; Employment to close-in community, 10% to Urban Core from Suburban Area</td>
<td>Baseline</td>
<td>Baseline</td>
</tr>
<tr>
<td>6. Shift 20% growth to more dense areas</td>
<td>Shift 20% Population &amp; Employment to close-in community, 20% to Urban Core from Suburban Area</td>
<td>Baseline</td>
<td>Baseline</td>
</tr>
<tr>
<td>7. Shift 30% growth to more dense areas</td>
<td>Shift 30% Population &amp; Employment to close-in community, 30% to Urban Core from Suburban Area</td>
<td>Baseline</td>
<td>Baseline</td>
</tr>
<tr>
<td>8. Shift 30% growth to more dense areas and add ITS and transit supply</td>
<td>Shift 30% Population &amp; Employment to close-in community, 30% to Urban Core from Suburban Area</td>
<td>+ 20% in transit supply</td>
<td>+ 20% in lane miles with ITS</td>
</tr>
</tbody>
</table>
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Jo Allen Gause, TRB Senior Program Officer, managed this project.

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