

**NCHRP REPORT 750 VOLUME 6:
STRATEGIC ISSUES FACING TRANSPORTATION—
THE EFFECTS OF SOCIO-DEMOGRAPHICS
ON FUTURE TRAVEL DEMAND**

FINAL RESEARCH BRIEF

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Research Brief

This brief summarizes the research conducted and documented in NCHRP Report 750 Volume 6: Strategic Issues Facing Transportation—The Effects of Socio-demographics on Future Travel Demand (See box for other research products contained in this volume). It introduces the research need, presents how the research addresses the issues surrounding the need, discusses eight socio-demographic trends, describes Impacts 2050 and its scenarios, and concludes with a set of strategic responses transportation agencies might take when applying the scenarios .

RESEARCH PRODUCTS

- *Impacts 2050 Tool*
- *Impacts 2050 User Guide*
- *Power Point Presentation*

1. The Issue

Long-range transportation planning involves many difficult choices, especially in an era of constrained resources. Which modes of transportation should be prioritized? Which investments should be funded? And how can the outcome of the investments be predicted? These questions are difficult to answer, particularly since transportation planners must make decisions within a time horizon that extends 30 to 50 years into the future. And it is virtually inevitable that the socio-demographics of a society as diverse as the United States will shift over this time period.

A key challenge for transportation decision makers is to understand how the population might change over time, and how socio-demographic changes will affect the ways people travel and the kinds of transportation modes and infrastructure that will be needed. State departments of transportation (DOTs) and metropolitan planning organizations (MPOs) need high-quality information that will help them to act—rather than react—in a way that best meets future transportation needs.

This challenge is evident in the process for producing the required long-range plans for up to 20 years or more into the future. The beneficial outcomes of these plans are the policies and strategies that balance current needs with making responsible, cost-effective, and sustainable long-term decisions. However, state DOTs and MPOs are not always in control of the factors that define the assumptions that go into the long-range plans. These assumptions often focus on socio-demographic factors and trends; how they may play out in the future is uncertain. The resulting plans too often are reactive to the transportation issues currently facing a region or state, instead of being proactive in adapting to future uncertainties.

2. The Solution

This research helps DOT's, MPOs, and other transportation agencies to better cope with the effects of uncertainty in their long-range planning process by increasing their awareness and understanding of socio-demographic trends and how these might affect long-range transportation conditions or needs.

It also addresses a gap inherent in current planning tools and models—the inability to produce accurate long-range forecasts—by introducing the tool *Impacts 2050* to help transportation planners and decision makers apply a scenario approach.

Users of this study will be in a position to improve their long-range planning and make better related decisions (Box 1). Questions are routinely raised during the long-range planning process about the potential consequences of a new trend (e.g., fuel prices, travel tendencies of Millennials), policies to respond to such trends as tolling to enhance revenues), or about the potential impact of a major new transportation investment. *Impacts 2050* is a new a tool for testing and accounting for socio-demographic trends and other related factors in projects, plans, and forecasts and examining policy or other interventions that may offset these trends.

BOX 1: APPLYING THE RESEARCH

This research can assist state DOTs and MPOs and other transportation decision makers by:

- Supporting long-range plan development.
- Supplementing the capabilities of existing planning models.
- Formalizing the consideration of uncertainty in the planning process.
- Facilitating participation in the planning and decision-making process.
- Serving as a sketch-planning tool for providing quick and timely answers, as well as supporting sensitivity and exploratory analysis.
- Serving as a “utility” program for providing data inputs to models and the planning process.

3. Eight Socio-demographic Trends

Eight national socio-demographic trends reflect the many changes occurring in the United States spanning population, demographics, and travel patterns and illustrate the fact that the future is difficult to predict and is shaped by many interacting factors. For each, this section presents the key socio-demographic drivers and their respective impacts on travel demand (for details on each, see NCHRP Report 750 *Strategic Issues Facing Transportation*, Volume 6, Chapter 3).

Trend 1: The next 100 million

The United States is growing more slowly. The 2000s marked the lowest decennial rate of population growth since the Depression.

- **Drivers:** Population growing but aging, declining fertility rates among white women, extended life span, and less immigration.
- **Impact on Travel Demand:** Overall increase in total VMT due to population growth; VMT per capita appears to be declining.

Trend 2: The graying of America

America is becoming “grayer.” The population age 65 and older will significantly increase as the Baby Boom generation enters this demographic group.

- **Drivers:** Population aging, extended life spans, “boom and bust” birth rate patterns.
- **Impact on Travel Demand:** Decreased per capita VMT, decreased in work trips, increased vehicle age, decreased auto ownership, increased carpooling, decreased transit use.

Trend 3: The browning of America

America is becoming “brownier.” The white population has grown more slowly than every other race group in the second half of the 20th century.

- **Drivers:** Structural changes in population distribution by race/ ethnicity, relatively high fertility rates among Hispanic women, continuing immigration in younger age groups.
- **Impact on Travel Demand:** Increase in VMT per capita, increase in auto age, greater public transit use.

Trend 4: The changing American workforce

America’s workforce is growing older, more female, and more diverse.

- **Drivers:** Boom-and-bust birth rate patterns, population aging, female work participation patterns, female longevity, structural changes in racial/ethnic distribution of labor force, immigration.
- **Impact on Travel Demand:** Decreased VMT per capita, increased work-related VMT, lower growth in work-related VMT, increased carpooling.

Trend 5: The blurring of city and suburb

The differentiation between cities and suburbs is fading.

- **Drivers:** Population growth, housing starts, population aging, age structure, household structure.
- **Impact on Travel Demand:** Decreased VMT per capita, increased nonmotorized trips, increased transit trips.

Trend 6: Slow growth in households

The rate of new household formation has plunged since 2006, creating more single households and also more multigenerational and larger households.

- **Drivers:** Poor labor market, aging population, lifestyle choices of Millennials.
- **Impact on Travel Demand:** Decreased per capita VMT, decreased auto ownership among young people, increased carpooling, increased public transit use.

Trend 7: The Generation C

Mobile broadband will become increasingly more important and ubiquitous, creating a new Generation C.

- **Drivers:** Technology evolution, lifestyle choices, age structure.
- **Impact on Travel Demand:** Reduced VMT per capita for some trip purposes, decreased car ownership.

Trend 8: The salience of environmental concerns

Generational divide over nation's energy and environment priorities is still strong but will decrease over time.

- **Drivers:** Age structure, population aging.
- **Impact on Travel Demand:** Lower car ownership, more transit and nonvehicle travel by younger generations due to elderly population shrinking.

4. *Impacts 2050*

Impacts 2050 opens a window on how future socio-demographic changes could affect regional travel demand through the year 2050, and helps policymakers plan for those possibilities.

Impacts 2050 is a menu-driven spreadsheet model that state and regional transportation decision makers can use to play out the many ways changing socio-demographic factors in a region might affect travel demand over time (Box 2). The tool helps users develop a realistic, inclusive understanding of:

- Which are the most important trends to watch for and monitor over time;
- How demographics, economics, land use, and travel behavior are likely to interact over time under a wide variety and range of scenarios; and
- Which are likely to be the most effective policy variables and intervention points in the system over time.

The tool integrates two elements:

1. A systems dynamics model that represents regional links among population, land use, employment, transport supply, and travel behavior; and
2. Scenarios representing visions of possible futures, considering basic demographic trends, globalization and immigration policy, economic growth, energy supply and demand, technology advances, transport governance and funding, land-use policies, shifting social attitudes, etc.

BOX 2: SAMPLE QUESTIONS IMPACTS 2050 CAN ADDRESS

- What would happen if the aging of the population causes the typical retirement age to increase?
- What influence would a pandemic have on travel demand?
- How would a large shift in preference toward urban locations affect travel demand?
- How would an aggressive immigration policy influence work trip rates?
- What would happen if no new roads were built in the next 30 years but the region's population continued to grow?
- How would making telecommuting available to a majority of future employees affect travel demand?

4.1 Using *Impacts 2050* for Long-Range Planning

Decision makers have regularly used travel demand models to assist with long-range transportation planning. Every metropolitan area has a regional plan informed by a model that looks ahead 20 to 30 years. Traditional travel demand models typically provide a forecast of future travel needs; however, in most cases they pay little attention to the level of uncertainty in the forecasts and the possible risk entailed. For example, in most forecasts for 2035, the future tends to look “just like now, only more so.” Because traditional travel demand models tend to ignore uncertainties, these models can leave planners with incomplete, and often inaccurate, visions of the future on which to base policy and investment decisions.

Because *Impacts 2050* takes a different approach from traditional models, it can better account for uncertainty and minimize risk in long-range transportation planning.

Note that *Impacts 2050* is not intended to replace existing travel demand forecast models.

4.1.1 A Strategic Model

Impacts 2050 is a strategic model. Its purpose is not so much to predict travel behavior as to realistically illustrate a *range* of future scenarios that might occur under varying sets of assumptions. Strategic models represent an emerging trend in long-range planning.

4.1.2 A Systems Dynamics Approach

Impacts 2050 uses a systems dynamics approach to understanding the fundamental relationships between social and demographic factors and travel demand, and how these relationships might change over time. The system dynamics approach also accounts for feedback within the system. For example, an increase in road supply might increase VMT, which leads to increased traffic congestion and then to road construction and expanded road supply. Alternatively, population growth might lead to increased traffic congestion, which, in the absence of road construction or other infrastructure improvements, could lead to an increase in the number of people leaving the region. Thus, the emphasis for long-range planning shifts from arriving at numerically accurate forecasts toward developing qualitatively accurate depictions of how different variable relationships will evolve over time.

4.1.3 A Fast, Path-Based Model

Impacts 2050's focus on multiple scenarios implies the need for a fast model. It is designed to run easily and quickly so that many different future scenarios can be played out. It accounts for the path taken through time into the future, unlike the traditional approach used in almost all local, regional, and statewide travel forecasting models, which focuses on a specific end state. The *Impacts 2050* approach facilitates rapid, “hands on” analysis of multiple alternative futures.

5. Scenarios Test the Impacts of Socio-demographics on Travel Demand

The study team created four alternate future scenarios based on expert opinion that can be used to test varying impacts of socio-demographics on travel demand. The scenarios encompass four different versions of how the world (and in particular the U.S. transport system) could look in the future. Each scenario has its own set of structuring assumptions and/or underlying theory about the future, and each prioritizes certain driving forces in the future to create a different interpretation of how present-day uncertainties will move to resolution.

The scenarios from the perspective of 2050 are:

- **Momentum** – The current state of the country in 2050 would still be recognizable to a visitor from the 2000s. Change is based on population dynamics, and the United States has not experienced any major shifts in demographic, economic, or technology trends. Nor have there been major policy shifts, as the two political parties have held firm to positions, and divided government remains a feature of national politics. Travel demand and funding have changed a bit more. Commute travel has decreased somewhat, thanks to telework. People are still on the road a fair amount for shopping and personal business, but congestion levels are manageable. Federal gas taxes have risen a few times, but not enough to keep up with the increases in fuel economy. As a result, with less federal funding, many states have had to increase their own funding streams if they want to maintain their existing road network.
- **Technology Triumphs** – Technology has saved us from ourselves. While the United States faced some difficult challenges in the 2010s, many of these have been mitigated by innovations that helped us live longer, reduce our carbon footprint, connect our world, and travel more easily and safely. Autonomous vehicles have changed how people travel, and data-intensive communications technology has also affected how much people travel. Commute travel has declined, since a high proportion of office workers now work from home, and fewer people live near their jobs, since their physical presence is seldom required. Much socializing also takes place virtually, and many weekly necessities are delivered to peoples' doors. The travel that does take place tends to be faster, cheaper, and more convenient than ever.
- **Global Chaos** – The past few decades have challenged Americans' general optimism, and where they work has become a far different and more difficult place. Several trends intersected to bring about this distressing "new normal": the increasing impact of climate change, financial instability at a global scale, and a new isolationism. The results, which affect not only the United States but most of the world, are heightened insecurity, lower life spans, and chronic conflicts. Widespread unemployment means that far fewer people are on the roads and transit systems. With state and local governments collecting relatively little revenue, they have a hard time maintaining the existing infrastructure or responding to crises like returning travel to normal after a major storm. Walking and cycling are far more popular now, but generally out of necessity than choice, and people with cars often make extra money on the side as gypsy cabs.
- **Gentle Footprint** – After droughts and "superstorms" began plaguing the United States in the 2010s, both public consciousness and political will began shifting toward taking more serious action to slow climate change. While it was too late to curb the rise in carbon concentration in the atmosphere, the United States has made surprisingly good progress in adopting a variety of means to reduce energy consumption. Many lifestyle changes that might once have been considered radical are now mainstream. Federal, state, and local governments have responded by shifting their focus to investments that support these modes, rather than cars. Most cities and suburbs have good networks of bicycle lanes, and transit systems have expanded, while the size of the road network has barely budged in 20 years. High-speed rail has been built in a half-dozen corridors, and it captures a healthy percentage of travel between those cities.

The three alternative scenarios represent “what if” conditions that moderate the outcome of the Momentum population-based scenario. The scenarios are shaped by government policies, but also by other factors that cannot be reliably modeled or predicted, such as attitudes toward the environment, the development of social trends, or the rate of economic growth.

5.1 How Impacts 2050 Works

Figure 1 provides a simple illustration of the way *Impact 2050* models changes in a population over time.

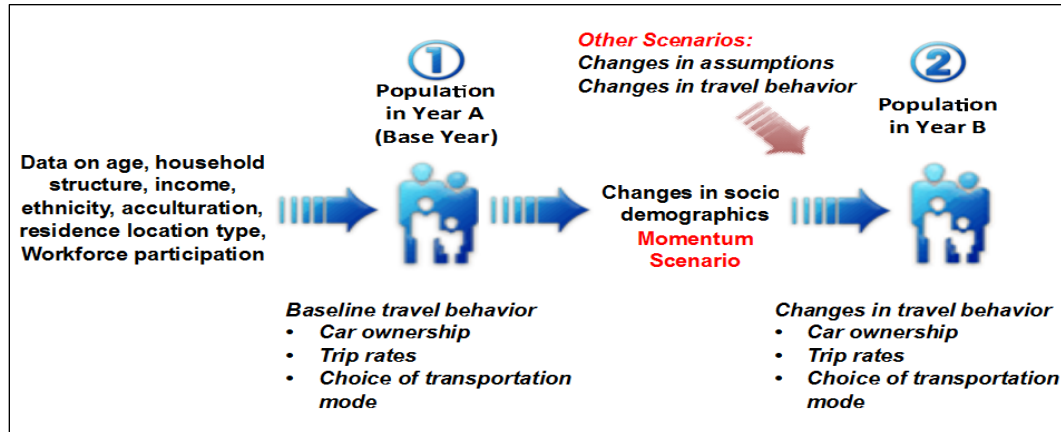


Figure 1: Impacts 2050—Evolving the Population over Time in Travel

First, *Impacts 2050* profiles a regional population in a base year according to a set of attributes that are known to have an association with travel behavior. Then, it “evolves” this population over time, simulating the population’s transitions from one category in each of these variables to another category. The model defines the impacts on travel behavior in terms of car ownership, trip rates, and choice of transportation mode. Changes in expected transitions may be tested as policy or scenario variables.

Impacts 2050 models the following changes in five sectors:

- **Socio-demographics:** Changes in population demographics (age and household structures, acculturation and employment status, household income, and area type of residence location).
- **Travel behavior:** Changes in car ownership, work and nonwork trip rates, work and nonwork mode choice (car, transit, bike, walk).
- **Employment:** Changes in the number of jobs by retail, service, and other categories in urban, suburban, and rural area types.
- **Land use:** Changes in the amounts of commercial, housing, developable, and protected space in urban, suburban, and rural area types.
- **Transport supply:** Changes in the amounts of freeway, arterial capacity, and regional transit service (bus, rail) in urban, suburban, and rural area types.

In *Impacts 2050*, the socio-demographics and travel behavior sectors are given the most emphasis. However, the land use, employment, and transport supply sectors are also important because they have a crucial influence on the evolution of the population, residence and household location decisions, and travel within a region. *Impacts 2050* also accounts for time delays that can occur within the inter-relationships between sectors. For example, an increase in traffic congestion might lead to a decision to supply new transportation infrastructure, but only after a significant delay. Even decisions to change residence or business locations can take some time to occur, and so cannot adjust immediately to changes in prices, congestion, job availability, etc.

6. Applying the Scenario Outcomes: Strategic Responses

The four scenarios were intentionally designed to encourage transportation agencies to think “outside the box”—and consider what they might do if the future took a sudden and decidedly different turn from the trajectory defined by the previous 50 years. It is certainly reasonable to assume that transportation agencies using *Impacts 2050* might end up with many different scenarios about the future.

What next? What are some of the strategic responses a transportation agency might take to better cope with future uncertainties? *Impacts 2050* was especially designed to assist this process by providing enhanced insight into the potential impacts of major trends. However, the tool is only an aide to what must be a planning process that is better able to deal with the uncertainties of change.

The following set of response mechanisms provides potential guidance to transportation agencies in applying scenario outcomes to better meeting the needs of an uncertain future.

- Establish an indicator monitoring system.
- Stimulate wider awareness and dialogue about possible futures and potential responses.
- Increase stakeholder participation and buy-in.
- Recognize the need for organization growth and change.
- Provide financing and political support.