**A Comparative Illustration of Trip- and Activity-Based Modeling Techniques**

Hayden Atchley1; Kamryn W. Mansfield2; and Gregory S. Macfarlane, Ph.D.3

1Utah Department of Transportation. ORCID: 0000-0002-0815-3488. Email:

2.  
Email: svk5464@psu.edu

3Assistant Professor, Dept. of Civil and Construction Engineering, Brigham Young University, Provo, UT (corresponding author).   
ORCID: 0000-0003-3999-7584. Email: gregmacfarlane@byu.edu

ABSTRACT

# Over the last fifteen years, activity based models have slowly replaced trip based models as the standard tool used for planning and forecasting efforts in the United States. But the general adoption of activity based models has been slowed by a number of factors, including real and perceived costs in terms of data availability, computational resources, and staff training for analysis. In this research, we explore the state of these considerations in light of newly developed open-source platforms for activity based modeling. We do this by applying a trip based model for the Wasatch Front region of Utah and an implementation of ActivitySim in the same region to analyze three scenarios common to transport planners: a change in land use, a change in transport infrastructure, and a change in underlying travel behavior. We find that the activity based approach allows for a more straightforward and intuitive interpretation of model results at little additional cost for scenario configuration, computation, or analysis. Further, we show that the construction of activity based models may make model extension and adaptation to new policies more straightforward than could be undertaken with a trip based model. This suggests that some of the commonly rehearsed justifications for not adopting activity based models may be outdated or irrelevant.

# INTRODUCTION<Heading 1>

Body Text – Autonomous vehicles (AVs) have radically transformed the transportation sector. Several states in the United States now allow them to be tested on public roads to determine whether they function safely in mixed-traffic situations, and this has stimulated a lot of interest among researchers such as Channamallu et al. (2023) who conducted analyses of the collision and disengagement reports published by the California Department of Motor Vehicles to compare the behavior of AVs with conventional vehicles.

## Impacts of Integrating Autonomous Vehicle<Heading 2>

Autonomous driving systems and on-demand mobility are two new mobility trends that have the potential to significantly change travel behavior and the effects of transportation on society (Alexander et al. 2022). This study examines the many aspects of SAVs and explores how they will impact the environment, transportation networks, and public policy. The three categories depicted in Figure 2 are examined in the following sections to provide a comprehensive overview of the implications of on-demand autonomous vehicles. Most of the literature reviewed pertained to modeling the effects of sophisticated, advanced autonomous driving systems, as the technologies are constantly evolving. It is challenging to precisely forecast the overall benefits of this mobility trend for the transportation system, as their impacts rely heavily on advancements in policies, market response, and technological advancements (Massar et al. 2021).

### Effects of SAVs on the Environment<Heading 3>

The transportation industry bears the dubious distinction of being the fastest growing source of greenhouse gas emissions (Pamidimukkala et al. 2023a), accounting for 24% of all greenhouse gas emissions worldwide (Jones and Leibowicz 2019). It uses 27% of the world’s energy, of which 75% originates from non-renewable figure 1 fossil fuels (Dia and Javanshour 2017). Since 75% of transportation-related emissions worldwide are attributed to private passenger vehicles, decarbonizing the unsustainable traditional transport systems is an essential component of any meaningful, large-scale effort to mitigate climate change (Jones and Leibowicz 2019). The expected environmental effects of SAVs are displayed in Table 1.

* A decrease in greenhouse
* As illustrated in Table 1
* As illustrated in Figure 1
* As illustrated in Table 1

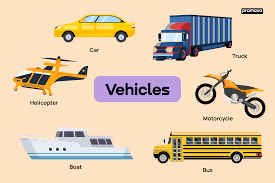


Figure 1. Multistep screening and exclusion process<FigureCaption>

Table 1. Effects of SAVs on the environment<TableTitle>

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID** | **Variable** | **Effect** | **Influential Factor**1 | **Frequency of Citation** |
| E1 | Energy consumption | Decrease | * Reduced traffic congestion | 42 |
|  |  |  | * Decreased parking demand | 25 |
|  |  |  | * Utilizing renewable energy sources instead of fossil fuels | 19 |
|  |  |  | * Increased efficiency | 10 |
|  |  |  | * Compact vehicles | 3 |
|  |  | Increase | * Increased vehicle miles traveled | 36 |
|  |  |  | * Utilization of conventionally powered SAVs | 6 |
| E2 | Greenhouse gas emissions | Decrease | * Reduced traffic congestion | 42 |
|  |  |  | * Decreased parking demand | 25 |
|  |  |  | * Utilizing renewable energy sources instead of fossil fuels | 19 |
|  |  |  | * Replacing existing bus lines with autonomous buses | 14 |
|  |  |  | * Increased efficiency | 10 |
|  |  |  | * Compact vehicles | 3 |
|  |  | Increase | * Increased vehicle miles traveled | 36 |
|  |  |  | * Modal shift from public transportation to SAVs | 34 |
|  |  |  | * Greater car dependency | 17 |
| E3 | Fuel efficiency | Increase | * Utilizing renewable energy sources instead of fossil fuels | 19 |
|  |  |  | * Energy efficient operation | 5 |

1Congestion.<TableFootnote>

(1)

Shared autonomous vehicles (SAVs) are the result of the convergence of autonomous vehicles (AVs) and on-demand transportation. They are expected to significantly impact the mobility landscape; however, they must be thoroughly assessed prior to their widespread deployment.

# CONCLUSION<Heading 1>

ASCE thanks you for your efforts and looks forward to providing a record of this conference that will be useful to you and your colleagues for many years to come.

ACKNOWLEDGMENTS<AcknowledgmentsTitle>

The authors are grateful to the referees for their suggestions. This work was supported by the Trust (grant number HL123451-01A1); the Natural Environment Research Council (grant number CA 00900-04); and the Economic and Social Research Council (AI 12345-02).

# REFERENCES<Heading 1>

Adesokan, B. J. 2015. “Numerical modeling of microelectrochemical systems.” Ph.D. thesis, Technical University of Denmark, Dept. of Applied Mathematics and Computer Science.

ASCE. 2017. *Standard guideline for the* calculation *of saturated hydraulic conductivity of fine-grained soils*. ASCE/EWRI 65-17. Reston, VA: ASCE.

Bentur, A., N. Berke, and S. Diamond. 1997. Steel corrosion in concrete: Fundamentals and civil engineering practice. Boca Raton, FL: CRC Press.

Fowler, D. W., and M. Trevino. 2011. “Overlay design process.” In Bonded cement-based material overlays for the repair, the lining or the strengthening of slabs or pavements, edited by B. Bissonnette, L. Courard, D. W. Fowler, and J.-L. Granju, 5–16. Dordrecht, Netherlands: Springer.

Karam, G. N. 1991. “Effect of fiber volume on the strength properties of short fiber reinforced cements with application to bending strength of WFRC.” In Vol. 1 of Proc., 6th Tech. Conf. of the American Society for Composites, edited by A. Smith, 548–557. Lancaster, PA: Technomics.

Northern Water. 2012. “Water quality monitoring program data retrieval.” Accessed November 14, 2022. http://www.northernwater.org/WaterQuality/WaterQualityData.aspx.

Sabatino, S., D. M. Frangopol, and Y. Dong. 2015. “Sustainability-informed maintenance optimization of highway bridges considering multi-attribute utility and risk attitudes.” Eng. Struct. 102 (November): 310–321.

Yang, S.-I., D. M. Frangopol, Y. Kawakami, L. C. Neves, et al. 2006. “The use of lifetime functions in the optimization of interventions on existing bridges considering maintenance and failure costs.” Reliab. Eng. Syst. Saf. 91 (6): 698–705.

|  |  |  |
| --- | --- | --- |
| **Style** | **Style Tagging** | **Font Style** |
| Article title | ManuscriptTitle | Title case & Bold |
| Authors | Authors |  |
| Given Name | givenName |  |
| Surname | surname |  |
| Connecting given name & surname | connect |  |
| Affiliation | AuthorAffiliation |  |
| Academic designations | degree |  |
| Professional designations | role |  |
| ASCE Membership Grades | degreeMem |  |
| Designators in byline | affCite |  |
| Designators in author affiliation footnote | label |  |
| Institution | institution |  |
| Country | country |  |
| ORCID | orcid |  |
| Email | email |  |
| Abstract Heading | AbstractTitle | All caps & Bold |
| Abstract Content | AbstractText | Single Para |
| Keywords | Keywords |  |
| Keyword Title | kwdTitle |  |
| Every Individual Keyword | kwd |  |
| 1st Level Heading | Heading 1 |  |
| 2nd Level Heading | Heading 2 |  |
| 3rd Level Heading | Heading 3 |  |
| 1st Level Heading | AcknowledgmentsTitle |  |
| Normal Paragraph | Normal |  |
| Acknowledgement Paragraph | Acknowledgement |  |
| Numbered List or Bullet List | List Level 1 |  |
| Figure citation callout | figCite |  |
| Table citation callout | tabCite |  |
| Figure caption | FigureCaption |  |
| Figure callout | label |  |
| Table caption | TableTitle |  |
| Table callout | label |  |
| Table Cells | Table Grid |  |
| Table footnote | TableFootnote |  |
| Table footnote callout in table grid | tableFnCite |  |
| Table footnote callout under table (footnote superscript) | label |  |
| Display Equations | Equation |  |
| Display Equations callout | label |  |
| Indent Paragraph | Extract |  |
| References (Ref. Title) | Heading 1 | All caps & Bold |
| **Journal Reference** | RefJournal |  |
| Article Title | articleTitle |  |
| Journal Title | jrTitle | Italic |
| Volume | volume |  |
| Issue | issue |  |
| Page ranges | fpage & lpage |  |
| Page range starting with zero (e.g. 04016049) | eLocationId |  |
| **Book Reference** | RefBook |  |
| Book Title | bkTitle | Italic |
| Publisher location | publisherLoc |  |
| Publisher name | institution |  |
| **Conference Reference** | RefConference |  |
| Conference Name | confName | Italic |
| Conference Location | confLoc |  |
| **Report Reference** | RefReport |  |
| Type 1 |  |  |
| Source | jrTitle | Italic |
| Standard Number | std |  |
| Publisher location | unknownComment |  |
| Publisher name | publisherName |  |
| Type 2 |  |  |
| Source | articleTitle |  |
| Report No. Content | pubIdOther |  |
| Publisher location | unknownComment |  |
| Publisher name | publisherName |  |
| **Thesis Reference** | RefThesis |  |
| Source | bkTitle | Italic |
| Specific terminology (e.g., “doctoral dissertation”) | unknownComment |  |
| Publisher name | institution |  |
| **Web Reference** | RefWeb |  |
| Accessed date | unknownComment |  |
| URL | website |  |
| Organization name | collab |  |
| Note: In references list, “Italic” needed contents are “Book title, conference name, & Journal title”.  No bold, no underline, & no italics for other content in references list. | | |