

UTC Project Information	
Project Title	MPC-458 – Application of a Multi-Agent System with the Large-Scale Agent-Based Model for Freight Demand Modeling
University	North Dakota State University
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Agency ID or Contract Number	DTRT12-G-UTC08, Modification No. 1
Project Cost	\$128,498
Start and End Dates	April 1, 2014- July 31, 2017
Project Duration	3 Year
Brief Description of Research Project	<p>Statewide freight demand modeling is important in North Dakota to support agricultural logistics and energy development due to the recent oil boom and the long-term importance of the agricultural industry. We assume that a group of travelers, or agents, would provide a variety of driving patterns. Predicting travelers' behavior has been a cumbersome task in transportation planning because of the wide variation of behavior among travelers. With the advance of simulation and data mining, the agent-based model (ABM) has emerged as a solution. The agent-based modeling technique would provide a high level of detail for travel patterns in a region or state. The ABM includes three elements: agents, agent relationship, and agent's environment (Macal & North, 2011). The individual is known as an agent is an entity for decision-making. When an agent uses a vehicle, ABM is also called vehicle-based modeling. Agents interact with each other and in response to transportation infrastructures and policies. The agent-based freight demand modeling has been emerging as critical component in transportation planning to represent realistic travelling activities throughout the road networks and among facilities. ABM allows aggregations and disaggregation of agent characteristics, behaviors, and interactions under the freight demand context (Harper, et al., 2011). However, the agents should interact with environments for a long term such as in mid-term and long-range transportation planning. By simulating the agents, the freight movement in a large-scale network can be aggregated to provide critical information for statewide freight demand modeling without losing details. As a result, macro-level agent-based modeling benefits statewide freight demand modeling. In large-scale of road networks, the agents interact over</p>

	<p>space and time in response to information about transportation infrastructure and logistics facilities as well as policy. Thus, the multi-agent system is designed for the statewide macro level in response to the changes in these environments. Agent groups interact with other agent groups, and each agent within a group interacts with others within the group. Thus, the behavior (i.e. principle decision rules and response rules) of the agent group and each agent of a group can be simulated in transportation operations and planning. The multi-agent system includes decision-making rules such as destination choice, departure time, mode choice, and route choice, and sensitivity to travel impedance.</p> <p>This research will:</p> <ul style="list-style-type: none"> • Review state-of-art agent-based modeling in transportation • Develop an survey instrument • Determine agents’ travel behavior in rural and small urban freight movement • Design an multi-agent systems • Apply the agent’s travel behavior to statewide freight demand modeling • Develop scenarios to improve safety and sustainability throughout the rural highway network.
<p>Describe Implementation of Research Outcomes (or why not implemented)</p> <p>Place Any Photos Here</p>	<p>The research was implemented with Cass County in North Dakota. The case study can be applied to the North Dakota statewide freight demand modeling. It was not implemented in this study since the existing modeling efforts for the statewide demand modeling uses a different tool. However, the agent-based modeling can be implemented with TransCAD or CUBE in the near future.</p>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>Previous studies focused and narrowed their agents for modeling purpose; however, this study reviewed agent-based simulations used for transportation planning and management.</p>
<p>Web Links</p> <ul style="list-style-type: none"> • Reports • Project Website 	<p>https://www.ugpti.org/resources/reports/details.php?id=926</p>