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Towards an agent-based urban transport simulation for the city of Casablanca

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Abstract

The urban public transport system in Casablanca, one of the major Moroccan cities, offers different alternatives. But the system is not efficient enough. Transportation options are rather frustrating, time-consuming, and sometimes risky. Many residents experience long and expensive commutes in often uncomfortable and unsafe vehicles through heavy traffic. In such a context, simulation can help to support urban mobility decision-makers in the task of shaping transportation initiatives. In this paper, we focus on improving the urban mobility system using an agent-based model. It offers the ability to capture and reproduce the mobility behavior of commuters.

Keywords: Agent based simulation; MATSim; Agent-based model, user experience

1. Introduction

Casablanca, the largest economy in Morocco, is the most populated city in Morocco so far. The city has been expanding outward over the last decades. It forms a part of a larger metropolitan area called the grand Casablanca with 4,2 million inhabitants (1). During the period from 2004 to 2014, the population grew by 1.64% per year (1). Along with this increase, there have been many interventions in the transportation system of Casablanca, making the city an interesting case study for analyzing transportation policies and urban mobility. Like many emerging cities, Casablanca faces mobility challenges as road congestions, traffic jams that occur during rush hours, air pollution due to greenhouse gas emissions from many vehicles operating in the city, passengers crowding and waiting at the transport stations, etc. The city offers different transportation options. Buses, run under Public-Private Partnerships, are the most affordable transport option. However, they are over-crowded, and unreliable. Collective “white” taxis are a transport alternative adapted to demand. They can accommodate up to six passengers providing the users with a cheaper solution. They are mainly used for transport between cities and from the airport. They also play a major role in connecting neighborhoods in the outskirts of the city contributing to the improvement of transport offers. Regular taxis, these, are more expensive. Despite the number of available transportation options, their poor quality-of-service impacts negatively the experience of commuters and therefore the efficiency of urban mobility system

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(2), especially passenger crowding on the buses and artisanal taxis. The transportation sector remains inadequate. To remedy this situation, the city has designed a broad program of investments by implementing a network of four tramway lines. Yet, accessibility, critical to the quality of life and social mobility, remains an issue. The focus is toward transport supply rather than on what transport options enable citizens to do get to their jobs/schools and/or having access to various services and opportunities offered by the city. The above description makes Casablanca an attractive case study for the application of agent-based simulation. Urban simulation has been developed to help decision-makers better understand the urban area's growth and thus supporting them in the task of shaping transportation initiatives and alternatives. Agent-based modeling (ABM) is a powerful approach that has been widely used in recent years including applications for transportation. ABM offers the ability to capture and reproduce the mobility behavior of commuters. It is capable of modeling individual decisions and captures emergent phenomena (3) which is convenient because different transportation services coexist, and they are used in a competitive way. This helps in exploring the complex interdependencies, feedback, and heterogeneities of the system.

There are various city and regional level agent-based model applications around the world: Singapore scenario (4), Santiago de Chile scenario (5), Berlin scenario (6), Lisbon Portugal scenario (7), île-de-France scenario (8)...etc. The authors of the latter scenario have pushed the boundaries of the knowledge in this area by creating an open-source pipeline to create a synthetic population and running the simulation in île-de-France. This scenario could be extendable to other cities in France. To the knowledge of the authors, the only attempt to create a multi-agent scenario in Morocco was for Rabat city (9).

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