Proceedings of the 2023 Winter Simulation Conference
C. G. Corlu, S. R. Hunter, H. Lam, B. S. Onggo, J. Shortle, and B. Biller, eds.

CONSTRUCTING AN ABM TO ENHANCE RESIDENTS' CONVICTION REGARDING THE EFFECTIVENESS OF TOWN DEVELOPMENT MEASURES

Ibu Ueno
Shingo Takahashi

Waseda University
3-4-1 Okubo
Shinjuku-ku, Tokyo, 169-8555, JAPAN

ABSTRACT

When evaluating town development measures, social simulations have been attempted to be employed. In recent years, it is essential to involve diverse stakeholders in the modeling process and feedback of simulation results. This paper aims to construct a method using Gaming Simulation (GS) to allow participants to experience an Agent-Based Model (ABM), comprehend the model, and gain a sense of convincing from the simulation results.

1. INTRODUCTION

Amidst the rapid aging and declining population, creating a society where people can live energetically in their communities even in old age is a pressing need. In order to make town development measures useful, it is necessary for residents living in the town to participate in and understand the measures from the planning stage. However, due to differences in expertise and perceptions, it is difficult for residents to understand and accept town development measures as their own.

In recent years, social simulations have been attempted to promote residents' understanding of town development measures. Japanese government is promoting Smart Planning (Ministry of Land, Infrastructure and Transport 2018), aiming for stakeholders to share a common understanding and engage in effective discussions on town development measures. Smart Planning involves using behavior data of individuals categorized by attributes to simulate town development measures, visualizing their effects, and fostering discussions among government, private sector, and residents.

Social simulation is considered to be useful for residents to view town development as their own affair and to accept it with a sense of conviction. However, it is not clear how to construct a simulation model and how to visualize the results to enhance residents' conviction.

In this paper, we construct a model of residents' daily life behavior using Agent-Based Model (ABM) and visualize the behavior of residents before and after town development measures. We propose a method using Gaming Simulation (GS) to validate the convincing of simulation results by allowing participants to experience the ABM. We conduct experiments with participants to verify the effectiveness of the proposed method.

2. METHOD

2.1 GAM

In this paper, we adopt a methodology called GAM, which combines ABM and GS. Szczepanska et al. (2022) classified research methods that combine ABM and GS into six types according to four characteristics: sequencing of GS and ABM, correspondence, relationship with real phenomena, and

objectives. In this paper, we use a method that performs GS after ABM, which is classified as Type 3. ABM is validated through GS that participants experience ABM.

2.2 Agent-Based Model (ABM)

ABM is a suitable approach for evaluating the impact of individual actors, called agents, who autonomously make decisions within a system. Our model represents each resident as an agent, representing their daily activities within the town environment.

The internal model of each agent is composed of attributes such as gender, age, and occupation, as well as their behavioral history and decision-making model. The agent's living environment includes geographic information, roads, routes, and time. Based on the attributes, behavioral history, and environmental conditions, agents make decisions about their actions. Agents start their day from home and initially decide whether to leave their home. If they choose to leave, they determine the purpose, destination, mode of transportation, route, and duration of their action. For the duration decision, we use the survival time model (acceleration model), while for other decisions, we employ the logistic model. The logistic model allows for probabilistic selection of the chosen action from multiple options, which enables us to identify the factors influencing agents' action selection probabilities.

2.3 Gaming Simulation (GS)

GS is a method where actual human participants make decisions under game rules, and the results are analyzed. In our paper, we have participants experience the behavior of agents and verify whether they find the simulation results convincing as a personal experience. We construct GS from ABM by using UML to bridge the gap, referring the method of Goto et al. (Goto et al. 2014).

To evaluate the effectiveness of our proposed method, we conduct participant experiments, involving role-playing. GS is conducted following the steps below:

1. Participants are assigned attributes such as gender, age, occupation, etc.
2. Based on their attributes, behavioral history, and environment, participants choose their daily actions.
3. Within the ABM simulation results, the closest match to the actions selected by participants is retrieved and presented to them.
4. Participants compare the ABM simulation results with their chosen actions through debriefing and record whether they are convinced by the simulation results and what factors contribute to their degree of conviction.

3. EXPECTED RESULT

In this paper, we propose a method to construct an agent represents behavior that convince participants by performing GS based on ABM and validate its effectiveness through participant experiments. To analyze the relationship between the degree to which the sequences match and the degree of conviction, we conduct a comparative analysis of the action sequences from the logs of ABM and GS. Several indices are used to measure the degree to which action sequences match, such as the number of times to which the purpose of action matches and the number of times to which the purpose and the order of action.

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