USING UNVALIDATED PROTOTYPE MODELS IN THE PROBLEM DEFINITION PHASE FOR AGENT-BASED SOCIAL SIMULATION: PRACTICAL INSIGHTS

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ABSTRACT

This study investigates the use of a prototype model, which has not been validated, to define the policies and Key Performance Indicators (KPIs) that an Agent-Based Social Simulation (ABSS) should evaluate during the problem definition phase, before the model construction. An experiment was conducted using the prototype model in discussions with officials in Kamo City, Japan, on health promotion policies. Similar to the effects observed in a previous study with validated ABSS models, the prototype facilitated new perspectives and made it easier for stakeholders to express their opinions. However, it showed limitations in bringing to light concerns that had not been previously shared. Overall, while the prototype was not perfect, it proved useful in stimulating dialogue and eliciting ideas for policies and KPI considerations.

1   INTRODUCTION

This study focuses on the process of defining policies and KPIs when utilizing ABSS for policy decision-making. Specifically, it explores the use of an initial, provisional model (referred to as a prototype model in this paper) that only presents a demonstration version of ABSS without being validated, which we expect to facilitate early-stage discussions on setting policies and KPIs. Validation is essential for reliable agent-based models. Troost et al. (2023) describe validation as a twelve-step process to ensure that models are contextually adequate and documented. The prototype model used in this study has not undergone such validation. This study addresses how such a prototype model can aid stakeholder dialogue in the problem definition phase and effectively help set policies and KPIs.

Figure 1 illustrates the ABSS process and stakeholder involvement perspectives. In the development of ABSS models for policy decision-making, it is crucial to involve stakeholders, including policymakers, from problem definition to result interpretation to meet policy needs (Gilbert et al. 2018). While various stakeholder engagement techniques have been proposed during the model construction and simulation implementation phases, there is no established methodology for determining the policies and KPIs to be assessed with ABSS before the model construction. Validated ABSS models have been shown to facilitate new perspectives and aid in the sharing of previously unshared problem concerns among stakeholders during the phase of policy decision-making (Ohori et al. 2014). Therefore, the question this research addresses is whether, even as a prototype, it can support stakeholder communication and effectively contribute to setting the policies and KPIs in the problem definition phase.
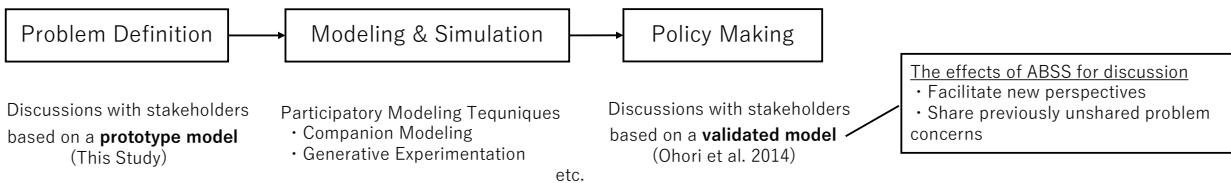

Figure 1: Policy decision-making process using ABSS and stakeholder involvement perspectives

2   EXPERIMENT DESIGN

The authors are advancing a project in collaboration with Kamo City in Niigata Prefecture, Japan, to employ ABSS aimed at addressing the social issue of maintaining and promoting residents' health. The challenge of this project lies in the vast number of potential policies due to its focus on a significant social issue, making it difficult to determine which policies should be evaluated. Through dialogues with city officials, two policy categories such as restructuring community centers and implementing park-and-ride systems have become apparent. However, translating these into specific policies for evaluation with ABSS is not straightforward. Therefore, we focused on these two policy categories and constructed a prototype model. Utilizing the prototype, the discussions were conducted in a workshop format to broaden the range of opinions about policies and KPIs. The discussion involved seven key officials associated with the policy categories. Although the prototype incorporated geographic information of Kamo City, the agents representing resident behaviors were based on partial data, resulting in a model that lacked validity. Importantly, participants were informed of the model's unvalidated nature prior to the discussions.

3   EXPERIMENT FINDINGS AND ANALYSIS

Policy proposals, such as autonomous buses for shopping districts, and KPIs such as tracking visits to city shops, were discussed. After the discussion, a questionnaire survey was conducted to assess whether new perspectives were gained and whether previously unshared opinions were shared, based on the previous research (Ohori et al. 2014).

In the survey, five of seven participants reported gaining new perspectives, specifically mentioning increased public transportation use. The survey also included 9-point scale (from 0 to 8) questions. The average score for sharing previously unshared concerns was 3.57 (SD=2.38). The question "Has it become easier to express opinions?" had an average score of 6.29 (SD=0.86). The question "Did the opinions expressed cover those traditionally shared among officials?" received an average score of 5.50 (SD=1.55).

4   CONCLUSION

The experiment showed that while the prototype model helped gain new perspectives, it had limitations in sharing previously unshared concerns. However, the prototype model positively impacted the ease of expressing opinions. Many participants felt more comfortable expressing their views, and the coverage of traditionally shared opinions was rated favorably. Through the discussions using this prototype, specific policies and KPIs to be evaluated by ABSS model were identified, allowing the project to move into the modeling phase. Overall, the prototype model, though not perfect, proved useful for invigorating dialogue in problem setting and eliciting specific perspectives and ideas. The use of ABSS by municipalities in Japan is still in its early stages, and this study was only a trial in one municipality. We aim to explore the potential of ABSS prototypes in other municipalities and develop a methodology for their effective use.

ACKNOWLEDGEMENT

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