

Simulating innovation diffusion using agent based modeling, argumentation and the theory of planned behavior

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Abstract

Agent-based simulation has long been used to study the dynamics of innovation adoption and diffusion. However, the vast majority of this work is limited to a simplified representation of this process, which does not make it possible to explain the reasons for an agent's change of opinion, an element that is nonetheless fundamental to understanding the dynamics of innovation diffusion. In order to overcome this limitation, we propose a generic agent-based model in which the knowledge of each agent is explicitly represented in the form of arguments, which carry information about the innovation. These arguments are the objects that the agents will exchange during their interactions. The advantage of this approach is that it allows to trace the state of knowledge of an agent in order to understand the evolution of its behavior in front of an innovation. We also propose to represent the decisional model of the agents with the Theory of Planned Behaviour (TPB). This theory, very classical in psychology, offers an integrative framework to formalize the behavior of agents. In TPB, the intention to behave is derived from three variables: the attitude, the subjective social norm and the perceived control of the behavior (PBC). The attitude represents the knowledge and opinion that an individual has about a behavior - in our case the adoption of the innovation. The subjective social norm is the individual's perception of the adoption intention of his/her social network. Our proposal is to compute the attitude of the agents from their knowledge about the innovation, modeled as an argument graph, using the same approach as the one proposed by [2]. Concerning the social norm, we propose to be inspired by the work of [1], who suggests that during an interaction between two individuals the influence of one on the other depends on the opinions and the certainties that they have on the subject. At last, concerning PBC, which is specific to the type of innovation studied and to the individual concerned, we propose to transcribe it in the form of a variable specific to each individual, which may or may not be constant depending on the case of application. An application of this model is proposed to study the diffusion of communicating water meters by farmers on the Louts River (South-West of France).

References

- [1] Guillaume Deffuant. Improving agri-environmental policies : a simulation approach to the cognitive properties of farmers and institutions. 2001.
- [2] Patrick Taillandier, Nicolas Salliou, and Rallou Thomopoulos. Introducing the Argumentation Framework Within Agent-Based Models to Better Simulate Agents' Cognition in Opinion Dynamics: Application to Vegetarian Diet Diffusion. *Journal of Artificial Societies and Social Simulation*, 24(2):6, 2021.

Additional material

GitHub repository for GAMA implementation: https://github.com/LSADOU/Innovation-Argumentation-Diffusion/tree/ms_dialog-implementation

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