

## **Diffusion of Eco-Innovation through Inter-firm Network Targeting: An Agent-Based Model**

Shyaam Ramkumar, Department of Social and Political Sciences, University of Milan, 20122 Milan, Italy; [shyaam.ramkumar@unimi.it](mailto:shyaam.ramkumar@unimi.it)

Matthias Mueller, Department of Innovation Economics, University of Hohenheim, Wollgrasweg 23, 70599 Stuttgart, Germany; [m\\_mueller@uni-hohenheim.de](mailto:m_mueller@uni-hohenheim.de)

Andreas Pyka, Department of Innovation Economics, University of Hohenheim, Wollgrasweg 23, 70599 Stuttgart, Germany; [a.pyka@uni-hohenheim.de](mailto:a.pyka@uni-hohenheim.de)

Flaminio Squazzoni, Department of Social and Political Sciences, University of Milan, 20122 Milan, Italy; [flaminio.squazzoni@unimi.it](mailto:flaminio.squazzoni@unimi.it)

This model is developed as a theoretical agent-based model to study the general phenomena of network-based targeting strategies on eco-innovation adoption and diffusion through inter-firm networks.

During the initialization of the model, firms are populated based on a specified number of firms in the network. Each firm is assigned an Environmental Orientation [EO] factor that represents the firm's internal factors for adopting the eco-innovation, drawn from a random normal distribution with a mean of 0.5 and a standard deviation of 0.1. The model constructs theoretically generated networks of firms using the Erdős–Rényi Random Network, Barabási–Albert Scale-Free Network, and Watts–Strogatz Small World Network models. The links between firms are assumed to be partnerships, collaborative alliances, and the exchange of knowledge and information connected through collaborative relationships. The links between the firms are assigned a non-zero weight from 0 to 1, drawn from a random uniform distribution, to reflect the strength of the relationship between the firms.

After the initialization of the model, the simulation follows a two-phase information and adoption process. First, in the information phase, firms need information about the existence of the eco-innovation, which occurs through network-based targeting or if contact with their connected neighbors exceeds a certain globally defined information threshold. We assume that firms have no prior knowledge of the eco-innovation and are informed by an agent outside the network using one of 6 network-based targeting strategies. At every time step, each firm that has not adopted the eco-innovation and not targeted by the network-based targeting strategy will be exposed to connected neighbor firms that have adopted. If the link-weighted percent of connected neighbor firms who have adopted [PP] exceeds a globally specified information threshold [IT], then the firms will be informed about the eco-innovation. Once informed, the firms decide to adopt the eco-innovation if the average of their internal factors, EO, and their external pressures from peers that have adopted, PP, exceeds a globally specified adoption threshold.

The model runs multiple simulations in Behaviorspace for each of the network-based targeting strategies and under various network structures and parameters – varying thresholds for adoption and diffusion, varying network degree, varying network size, and varying clusters of firms. To account for randomization, the model is run 1000 times for every combination of model parameter and the results are averaged to compare the average number of adopters under the different network-based strategies.

The model output and more detailed documentation is part of a manuscript, Ramkumar, S., Mueller, M., Pyka, A., Squazzoni, F., 2022. Diffusion of eco-innovation through inter-firm network targeting: An agent-based model. *Journal of Cleaner Production* 335, 130298. <https://doi.org/10.1016/j.jclepro.2021.130298>