

Framework for developing quantitative agent-based models based on qualitative expert knowledge: *an organised crime use-case*

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In order to model criminal networks for law enforcement purposes, a limited supply of data needs to be translated into validated agent-based models [1, 2]. What is missing in current criminological modelling is a systematic and transparent framework for modelers and domain experts that establishes a modelling procedure for computational criminal modelling that includes translating qualitative data into quantitative rules [3, 4]. For this, we propose FREIDA (Framework for Expert-Informed Data-driven Agent-based models).

Throughout the paper, the criminal cocaine replacement model (CCRM) will be used as an example case to demonstrate the FREIDA methodology.

For the CCRM, a criminal cocaine network in the Netherlands is being modelled where the kingpin node is being removed, the goal being for the remaining agents to reorganize after the disruption and return the network into a stable state. The agents are simultaneously embedded in multiple social and business networks and possess heterogeneous individual attributes which determine the probability of shared ties, and the possibility of new relations being formed. Qualitative data sources such as case files, literature and interviews can be translated into empirical laws, and combined with the quantitative sources such as databases form the three dimensions (environment, agents, behaviour) of a networked ABM.

Finally, FREIDA introduces sensitivity statements and validation statements to transition to the computational model and application phase respectively. In the last phase, iterative sensitivity analysis, uncertainty quantification and scenario testing eventually lead to a robust model that can help law enforcement plan their intervention strategies.

Keywords: methodological framework, criminological modelling, computational networks, validation methods

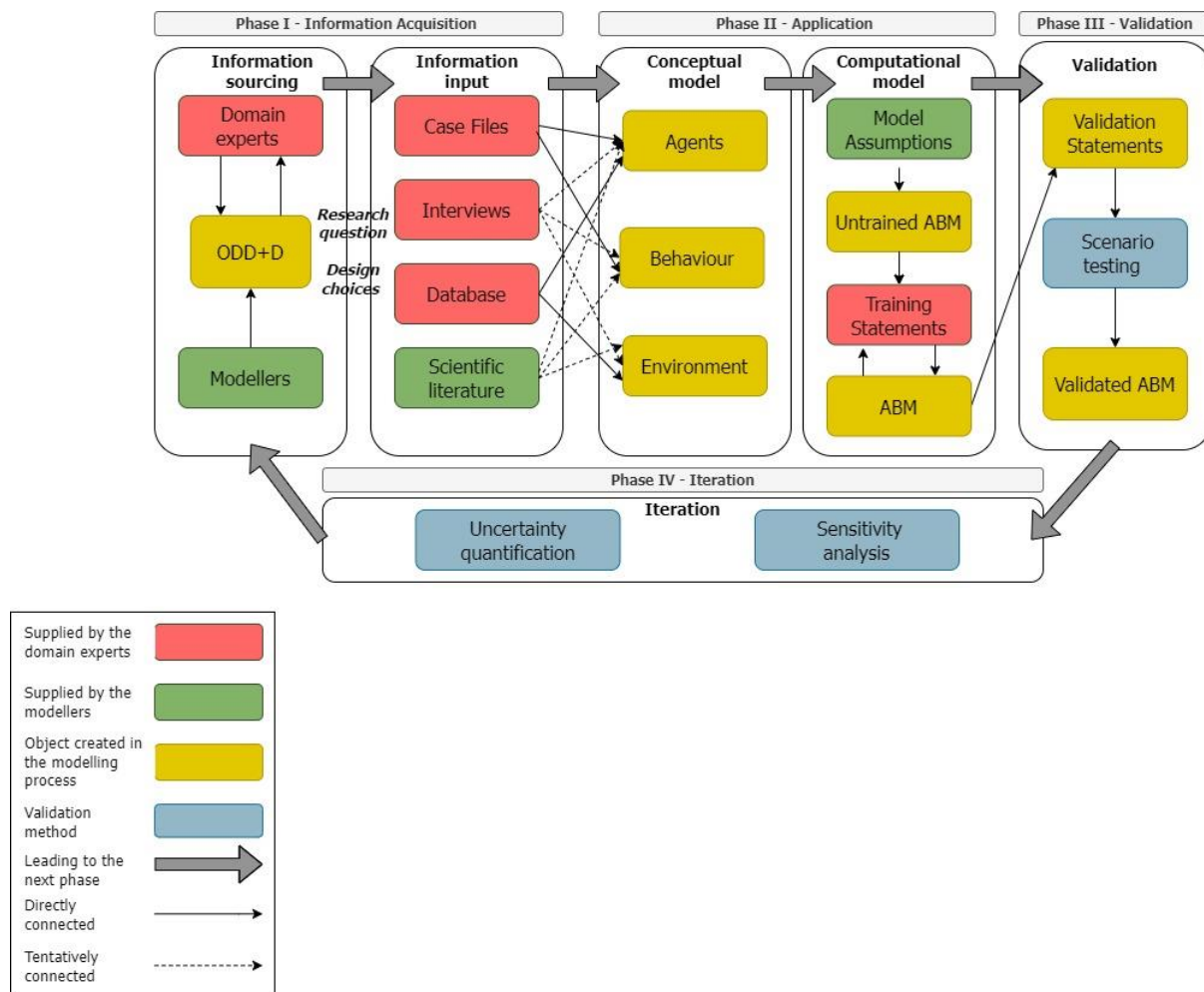


Figure 1: FREIDA methodology, with the four methodology phases (information acquisition, application, validation and iteration).

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