

# From BPMN to GAML: application to crisis management

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## Abstract

Crisis management is by nature a complex situation involving a dynamic alea and various kinds of actors attempting to rescue people and fight this alea. Agent-based models and simulations are particularly useful to model these kinds of complex systems, as the complexity results from the interactions between agents and their environment. In addition, simulation can be a powerful tool to test alternatives, as it can be used during various stages of the crisis management life-cycle, notably pre-crisis stage (more particularly the warning step), and crisis stage (more specifically response definition and evaluation steps). For instance, a situation could be simulated to determine whether it could evolve into a crisis, or the various possible responses can be tested and assessed on the current available data. The GAMA platform is particularly adapted to model this kind of situation, as it is a multi-agent platform that has been designed to build models integrating spatial data. However, modelling specific behaviours relevant to a crisis, like evacuation dynamics or how (first) responders operate, and more specifically the coordination of the actors, can be difficult without a strong relevant background. Thus we need to provide a more abstract representation of the different actors involved in the crisis resolution to ease the modelling of responders' behaviours.

BPMN (Business Process Model Notation) is an appropriate notation for representing the behaviour of actors involved in crisis resolution. It is understandable by crisis cell members responsible for crisis resolution. It allows for the description of abilities and skills of responders as tasks along with the coordination of those tasks using gateways and sequence flows. This notation gives a macro-view on a crisis management process.

The goal of this work is to fill the gap between BPMN, convenient for crisis cell stakeholders, and GAMA, which supports the simulation of the crisis response and gives a micro-view of crisis resolution. We adopt a Model Driven Engineering (MDE) approach aiming at producing GAML (GAMA Modelling Language) code from BPMN diagrams. We choose to rely on a pivotal metamodel, named BPMN4GAMA that is a simplified version of the BPMN metamodel, as an intermediate between BPMN2.0 and GAML. Since we do not need every BPMN concept, having a pivotal model allows us to select the elements that are relevant to our problem, and to add new ones as needed. Furthermore, having a dedicated metamodel gives us the ability to adapt to the technical constraints of the tools used. From this metamodel, we then mapped each BPMN element to a concept in GAML: each BPMN process was encoded as a single GAML reflex embedding the tasks' sequences and parallelisms. From a technical point of view, our starting point is the BPMN2.0 Modeler, an Eclipse-based diagram editor. A model to model transformation using ATL (ATLAS Transformation Language) was used to get a BPMN4GAMA model from a BPMN2.0 diagram. Finally, this model is used to generate a GAML file using Aceleo (an Eclipse-based implementation of the OMG's Model-to-text specification).

Preliminary results show, first, the technical feasibility and the modelling benefits of this model to model transformation. Secondly, the generated GAML model has been shown to be coherent with the BPMN specification: only allowed execution traces are possible.

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