Behavioural survey for cognitive agent modelling in earthquake evacuation

T.A. Rollan [a,b] (ID), **L. Marquez [a]** (ID) **and C. Chua [b]**

[a] CSIRO Data61, Clayton, Australia
[b] Swinburne University of Technology, Hawthorn, Australia
Email: leorey.marquez@csiro.au

Abstract: Evacuation planning typically involves analysing the spatial configuration of a structure to optimise evacuation performance. However, one of the critical components that needs more research is evacuee behaviour dynamics and how it affects the conduct, progress and outcomes of the evacuation. Our research looked at the development of a decision support tool for earthquake evacuation for a metropolitan university in the Philippines, which is situated along the Pacific Ring of Fire and is overdue for a "Big One" earthquake.

The cognitive agent component of the decision support framework represents evacuees as agents possessing attributes and performing actions in response to information, stimuli and interaction rules. The cognitive component uses the Belief-Desire-Intention-Event (BDIE) model, an extended version of the well-known BDI agent architecture. Within a BDI simulation, individual agents can be assigned profiles representing archetypes that capture the expected behaviours of identified groups in the population in given emergency situations. The archetype's characteristics and attributes influence its attitude and responses to various drivers to action. In order to assign archetypes to a population of agents, the distribution of relevant attributes and characteristics is usually obtained using some form of survey or census. The assigned archetypes are then used to perform a simulation of the population under a given evacuation scenario.

This paper presents the online behavioural survey that was designed and conducted to gather information on the demographics, earthquake evacuation awareness and experiences, personality traits, emotions and possible evacuation behaviour. The survey questions aimed to estimate the distribution in the evacuee population of crucial attributes related to spatial familiarity (SF), earthquake awareness (EA), evacuation protocol awareness (EPA), survival-oriented personality (SP), emotional control (EC) and decision-making (DM). The levels from these attributes were then used in classifying the evacuees into four basic archetypes: Leader, Protocol-Follower, Emotionally Stable and Guidance-Seeker. The Leader archetype is characterised by a very high DM and EPA. The Protocol-Follower archetype is characterised by a relatively high SF and EPA while the Emotionally Stable archetype is characterised by high EC and above-average DM. The Guidance-Seeker archetype is characterised by low scores for all factors. The archetypes assigned to the agents will determine their behaviour and decision-making during simulations of earthquake-related situations. Outputs from the simulated behaviour include characteristics such as evacuee details involving a unique identifier, role, emotional state and whether the agent is currently supervised; evacuation details including start and end timestamps, activity log and whether the agent had already successfully evacuated; location details such as the initial location, the instantaneous coordinates and floor level; navigation details including speed and total travelled distance; and other details related to file writing.

The paper will present sample questions from the survey, the summary of results and an analysis of the profile constructed for the university population. The discussion will also include insights on improving future behavioural surveys.

Keywords: Behavioural survey, cognitive modelling, agent-based modelling, earthquake evacuation simulation