Probabilistic Framework for Agent-Based Modelling within Public Space

"Let's take two hypothetical identical subway stations, and place one station in the centre of Copenhagen and the other in the centre of Tokyo. Also, ask yourself, in the case the subway stations need to be evacuated - at which location will the evacuation be faster? And how will demographics, social-group behaviour, and occupancy conditions affect the evacuation dynamic?"

Admittedly, there are no simple answers to these questions. To seek the answers, one should start to recognize the variability in the demographic composition of people at different locations and times – accounting for differences concerning the distribution of age, gender, education, and physical abilities. Also, the occupancy rates of public areas will vary significantly according to the type of public space, time, social-behaviour, etc.

Besides the demographic characteristics of groups of people, each individual reacts according to their physical and interactive capacity to escape unsafe situations. In risky scenarios, individuals will generally attempt to reach a safe area by trying to recall their knowledge about their surroundings. The behaviour of people may cause a negative or positive effect in evacuation dynamics, affecting the chances to escape hazardous situations.

Agent-Based Modelling (ABM) is a modelling method to represent individuals and groups of individuals in evacuation situations. ABM is a popular tool in fire engineering, and a fair amount of research has been developed to calibrate ABM to real situations concerning the behaviour of individuals and groups during evacuation. However, one should recognize that the modelling of evacuation scenarios is strongly affected by uncertainties associated with the dynamics of group behaviour, occupancy conditions, and human interactive and cognitive competencies to escape.

This project funded by COWIfonden will be carried out at the research group *R2+SBE* at Aalborg University. The objective is to develop a probabilistic framework for the modelling of evacuation scenarios using ABM for a specific public space. This framework is a tool to randomly consider: occupancy states, spatial location, social characteristics (demographic composition, group-social behaviour), in-site cognitive model, and interaction characteristics. This tool can be used to optimize strategic and tactical decision making for evacuation scenarios for different categories of incidents such as fire and smoke, toxic fumes, radioactive releases, and unlawful-provoked harmful situations.

The project's overall focus is to enhance the safety of individuals in the public space by understanding and modelling the behaviour of individuals and groups in evacuation scenarios.