Agent Oriented Methodology for Crime Modelling and Simulation

Cheah Wai Shiang, Sim Yee Wai, Nurfauzabt Jalia, Muhammad Asyraf bin Khairuddin

Abstract—Agent-oriented methodology (AOM) is a comprehensive and unified agent methodology for agent-oriented software development. The potential of Agent Oriented Methodology has been revealed in domains like collaborative technology, video surveillance, and economics. However, it has not been explored in crime modelling and simulation. Although AOM is claimed to be able to cope with a complex system development, it is still not yet determined up to what extent this may be true. Therefore, it is vital to investigate to validate this methodology. This paper investigates the adoption of AOM in crime modeling and simulation. The novelty of this paper is to introduce a systematic way to model crime simulation. Through the AOM simulation, it is proven that the AOM can model the complex system in crime domain with various outcomes which supported a few existing research theories such as routine activity theory. AOM can provide a wider research platform which is useful for translating theories and micro-level behavior into models and simulation that can be studied, shared, tested and enhanced.

Index Terms: Agent-oriented methodology, agent simulation, crime modelling, simulation.

I. INTRODUCTION

Agent Oriented Methodology [1]-[3] provides a way to represent a complex system of autonomous agents or actors and simulates the multiple potential results of these agents' behaviors and interactions between the desired agents. To date, it has been used in rural ICT study, disaster management, military training, collaborative learning [7], sustainability study [4], mathematical science and simulation [8]-[10], security[5], games[6]. An agent-oriented model is usually comprised of virtual "agents" who owns unique behavior and able to act autonomously without a central controller. They exist in a virtual environment which is often spatial. They can navigate around their environment, interact with each other and make decisions. The advantages of AOM [19], [20] over any other modeling approaches can be described as AOM captures emergent phenomena, AOM provides a natural description of a system and AOM is flexible.

Obviously, the ability of AOM being able to captures the emergent phenomena is what makes AOM greater and better than any other modeling techniques. Although AOM has been introduced since 1990s, the adoption of AOM in

industry is still low. Among the reasons is the lack of case studies to support the current agent-oriented methodology as a great approach to study a complex system, specifically in crime domain. This is perhaps because many people consider them as in-transparent and unreliable (as compared to analytical or statistical method) or as an unsuitable approach for prediction. Hence, the paper is carried out to investigate the adoption of AOM in crime domain and simulation at the same time, recommend the improvement of AOM for crime modeling and simulation. We adopt the Agent oriented methodology (AOM)[11]-[16] to study the crime modelling and simulation in this paper. This paper aims to promote a new insight into how crime modelling can be benefits from the agent-oriented methodology (AOM). This is important to showcase what can work and what does not work for AOM. Thus, it can promote the AOM to a wider audience. To date, AOM has been explored in ICT4D, collaborative learning technology, video surveillance, games, sustainability modelling.

Section two presents the related work on crime modelling. This is followed by a section to present a systematic way to model a crime study through agent-oriented methodology (AOM). The simulation of the crime is presented after the modelling section. A model validation is discussed after the simulation together with the lesson learnt.

II. RELATED WORKS

Crime can be an extremely complex event which consists of a lot of uncertain factors. Crime is not a random event that just occurred. There is a numerous on-going research trying to explain some of the patterns underlying criminal occurrences. The statistical methods are usually used to study crime. Typically, there is one dependent variable of interest for example, crime rates and model accuracy are usually determined through statistics. However, statistical models also have its own flaws such as system complexity and inaccurate data input. For example, statistical models generally utilize simple functional relationships and fail to capture the current emotion or routines of individuals and its effect on their behavior.

The use of Agent Based Modeling and Simulation (ABMS) in the study of crime is not uncommon. The first work about Agent Based Simulation in crime domain was proposed by Brantingham in 2005 [21]. In their work, they suggested a framework how to simulate individual's activities in a

CheahWaiShiang, Senior Lecturer , Faculty of Computer Science & IT, UNIMAS,Malaysia.

Sim Yee Wai, Associate Professor , School of Computing and Creative Media, University College of Technology Sarawak, Malaysia

NurfauzabtJaliis a lecturer at Faculty of Computer Science and Information Technology, UNIMAS,Malaysia.

Muhammad Asyraf bin Khairuddin,Lecturer ,Faculty of Computer Science & IT, UNIMAS, Malaysia.