

Proposal of Simulation-Based Management of Biological or Chemical Incidents as a Smart Solution

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Abstract – Management of biological or chemical incidents represents a challenging and demanding issue since it consists of several complex activities and important decisions. In case of accidents in agricultural or industrial mills or plants these decisions have to be made by personnel who are usually not primarily trained for such situations. From the technological perspective, various approaches or principles have been already applied and intended for computer-based support of biological or chemical incidents management. However, few of them incorporate principles of smart solutions which can make decisions even more precise and appropriate. This paper presents model utilizable for the management of biological or chemical incidents created in the multi-agent NetLogo environment and outlines possibilities of its extension by smart solution elements. Furthermore, together with the description of the simulation model, its parameterization is explained, and areas for further research are depicted.

Keywords: Biological Incident, Chemical Incident, Decision Support, Multi-agent Technologies, Simulation, Smart Solution

I. Introduction

Current society is closely connected with advances in the area of biology and chemistry. Occasionally, biological or chemical incidents occur. Due to the development rate in a given domains connected with more sophisticated biological agents and chemical compounds, increasing value of endangered assets and also fast development of technologies within last few decades, these incidents happen more often and they have more serious consequences than ever before. Incidents caused by the biological or chemical weapons, the leakage of a dangerous substance from a plant or laboratory, or natural incidence of a disease within animal herds can serve as examples these incidents. Hence, sustainability of the current development becomes a key issue [1]. Considering all possible impacts, any available tool for decision support and for the improvement of the effectiveness of the course of action needs to be used. Modern technologies based on smart sensors or wireless networks can help with exact identification and provide us with data that needs to be used as inputs to decision-making processes. Therefore, the critical assets can be recognized faster and adequately protected. The problem is that these accidents have to be managed firstly, in time of occurrence, by untrained people such as managers, technicians or heads of particular departments in an affected company. Therefore, the main goal of this paper is to develop agent-based model usable for simulation of biological or chemical incidents progress and suggest its possible extension towards smart and intelligent solution.

The paper is organized as follows. In the following section the brief problem formulation is presented. In the next section the research methodology is introduced. The fourth section outlines and discusses acquired results together with possibilities of their extension towards a smart solution. Paper is concluded in the last section of the paper.

II. Problem Formulation

Apparently, the management of biological and chemical incidents represents the unstructured problem. For the purposes of its resolution, a vast amount of various real data must be considered. The determination of the appropriate combination of available reactions and suitable countermeasures should be supported by the data describing both the environment, where the incident proceeds, and the agent, which has spread within the environment [2]. Nevertheless, the problem complexity is not the only issue. Related decisions are made by humans who are not absolutely reliable. The responsible people who make crucial decisions and give orders to coordinate the situation are not infallible. Additionally, they are usually not experts in biology, epidemiology or toxicology and their decisions are made under pressure and in stressful settings. It is well-known that they use different criteria during the decision-making processes than experts in a certain domains such as medicine [3] or information technologies [4]. That is the reason why these decisions necessitate to be supported and improved to ensure higher reliability as well as appropriateness of the actual course of action. Therefore, it is suitable to

support the reliability by the employment of smart and intelligent technologies. The ability to find the scenarios describing the incident development and their simulation can ensure better resource planning. Likewise, they guarantee faster response to the certain incident and higher accuracy and adequacy of particular steps of countermeasures during the incident management process.

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