Production Management and Process Control, Vol. 36, 2022, 171–177
https://doi.org/10.54941/ahfe1001632

Designing and Implementing Simulation Exercises for State Sanitary and Epidemiological Service

Tadeusz Nowicki[1], Robert Waszkowski[1], and Agata Chodowska[2]

[1]Cybernetics Faculty, Military University of Technology, 00-908 Warsaw, Kaliskiego 2 Str., Poland
[2]Tecna Sp. Z o.o. 01-496 Warsaw, Piastów Śląskich 47 Str., Poland

ABSTRACT

The article describes the organization of simulation exercises for sanitary services. It is assumed that there is an epidemic of foodborne diseases. Teams of sanitary inspectors conduct simulation exercises to improve the procedures used in the epidemic. The AAR (after action review) module allows us to analyze the course of simulation exercises. The work of the sanitary services allows to control an epidemic of foodborne diseases. The paper contains a description of business processes modeling sanitary services activities. The basic organizational elements related to simulation exercises are also shown. The method of conducting simulation exercises and the analysis of the results of these exercises are presented.

Keywords: Food-borne epidemic, Simulation exercises, Organization of simulation exercises, After action review

INTRODUCTION

Nowadays, simulation exercises are more and more common and are organized for various applications (Lateef, 2008), (Cayirci, Marincic, 2009) and (Schirlitzki, 2007). Controlled training based on computer simulation has already achieved some standardization (IEEE Std 1516 TM, 2010). In the case of an epidemic of food-borne diseases, sanitary inspectors are participants in training teams. Organized simulation exercises make it possible to practice the procedures and roles used by them during the epidemic. Simulation exercises should be organized to increase in complexity. Learning in a safe and managed environment provides essential hands-on experience that integrates key theoretical concepts with interactive, computer simulated situations. Controlled simulation-based training reduces risk as the learning environments are safe, while sanitary inspectors can master the skills needed in a real-life situation. Simulation exercises organized today have a complex structure. There are not only exercise teams - players, but also other groups of participants necessary to carry out this type of exercise. It is worth remembering that each of the possible teams participating in the simulation exercise, including exercise preparation team, exercise management team, team for analyzing the results of exercises and system administrator (see Figure 1).

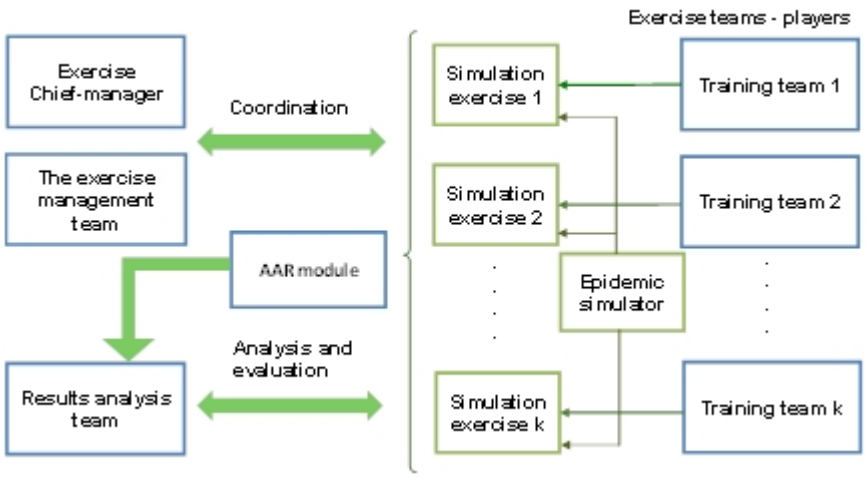

Figure 1: Structure of computer-based simulation exercises.

The paper presents business processes related to the work of sanitary services in cases of an epidemic of foodborne diseases. On their basis, simulation exercises according to given scenarios were developed. The activities of the staff of the county-level State Sanitary Inspectorate were analyzed in terms of actions taken in crisis situations related to the emergence of a large food poisoning outbreak or an epidemic of food-borne infectious disease. The same analysis was carried out in the scope of actions performed by individual teams participating in the simulation exercises.

BUSINESS PROCESSES OF EPIDEMIOLOGICAL INVESTIGATION

Simulation exercises for sanitary services are similar to the anti-epidemic processes carried out during an epidemic of foodborne diseases. Business process for the operation of sanitary inspectors during an epidemic of foodborne diseases specified at the highest level of detail is shown below (see Figure 2).

The epidemiological investigation in the event of an food–borne epidemic is part of the simulation exercise and improving procedures in the activities of the health supervision departments in cases of poisoning and infectious food–borne diseases support system. The process supports the planning and executing activities aimed at detecting the cause, sources, and mechanisms of the spread of food-borne diseases among people in a given area, for a fixed population and assumptions related to the occurrence of various types, essential for the development of disease conditions. All cases of disease or deaths related to food-borne communicable diseases are recorded in the system and the information is based on the relevant paper forms supplied by the system. Each new case registered in the system results in verification of the number of cases - if it exceeds a critical number of cases or deaths defined for the disease. If the check is found to exceed the number of applications which is critical for the disease a new epidemiological investigation is launched. The basic activity of health services in the event of a food–borne epidemic, is an epidemiological investigation. The diagram of an epidemiological

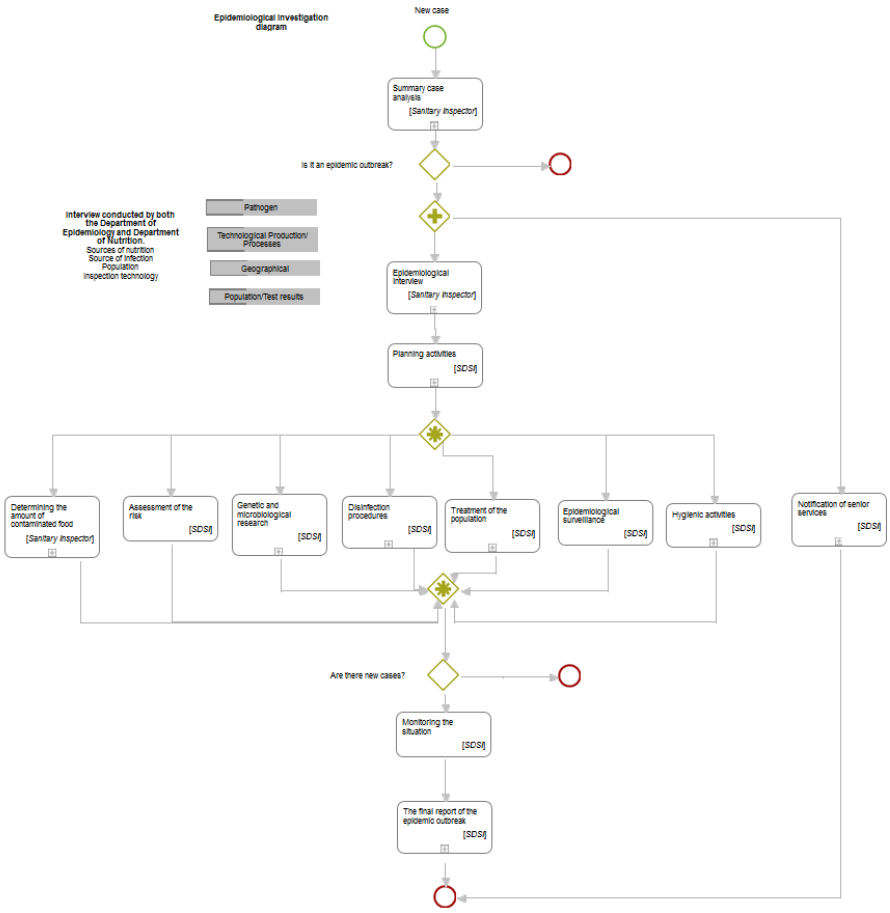

Figure 2: Epidemiological investigation business process diagram.

investigation business process realized in simulation exercise is shown below (see Figure 3).

SIMULATION EXERCISES

The design and implementation of the simulation exercise system was created to improve the procedures of sanitary inspectors during epidemics of foodborne diseases. In other words, the exercises are designed to better prepare inspectors to deal with potential outbreaks of foodborne poisoning or disease.

The Method of Carrying Out Simulation Exercises

Important element used in the organization of simulation exercises is constructed earlier simulator functioning of the organization. It is usually a discrete event-driven simulator allows for adequate reflection of the environment in which they work every day exercising teams. For activities sanitation services in the conditions of emergence and development of disease outbreaks of foodborne simulator is two-fold role by implementing:

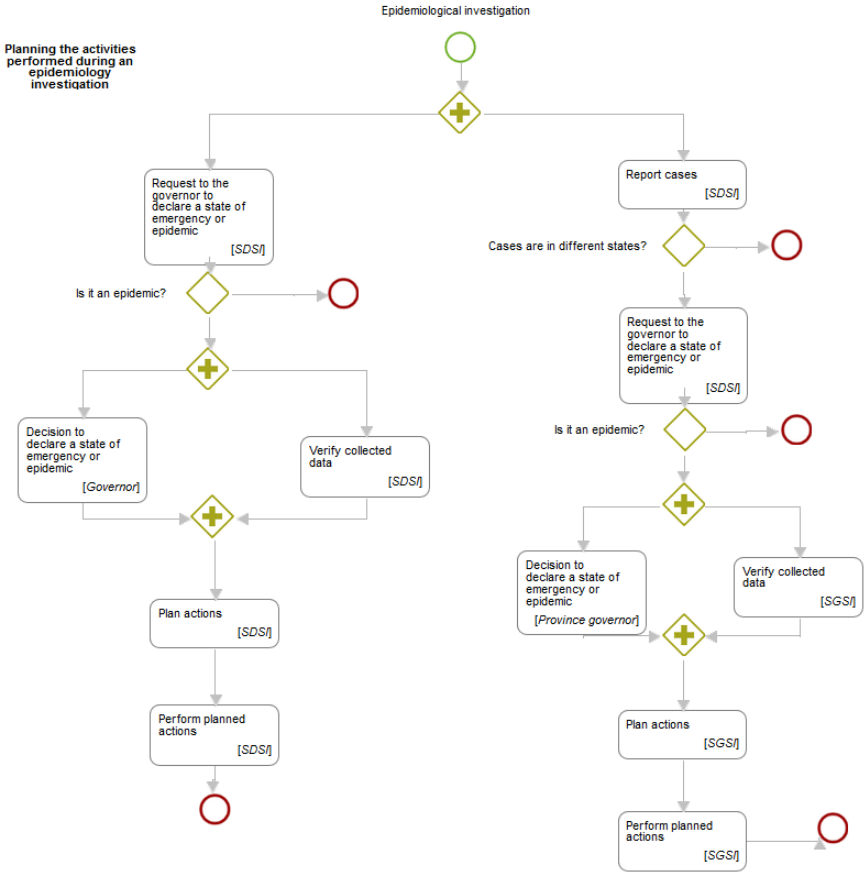

Figure 3: Business process diagram - planning the activities performed during an epidemiology investigation.

- epidemic simulation for training purposes - simulator is used as a system that simulates the rise and the spread of the epidemic (in the relevant processes can be adequately controlled through the transmission and reception of the parameters of the processes of the organization)
- simulation epidemic for decision support - simulator acts as a type system DSS (decision support) during the epidemic (in the relevant processes simulator provides information on past, present and future anticipated course of the epidemic.

In the first stage of preparations, the exercise management team develops a training exercise scenario that defines the course of the simulation exercises. Based on the prepared scenario of exercises, an exercise is carried out to check the professionalism of the team. During the exercise, the exercise management team coordinates and monitors its course. The exercise management team can simultaneously coordinate many simulation exercises that are performed by people exercising. After completing the exercise, the results analysis team presents the results of the exercises for all training teams and evaluates them by showing all the good and bad elements of the recorded

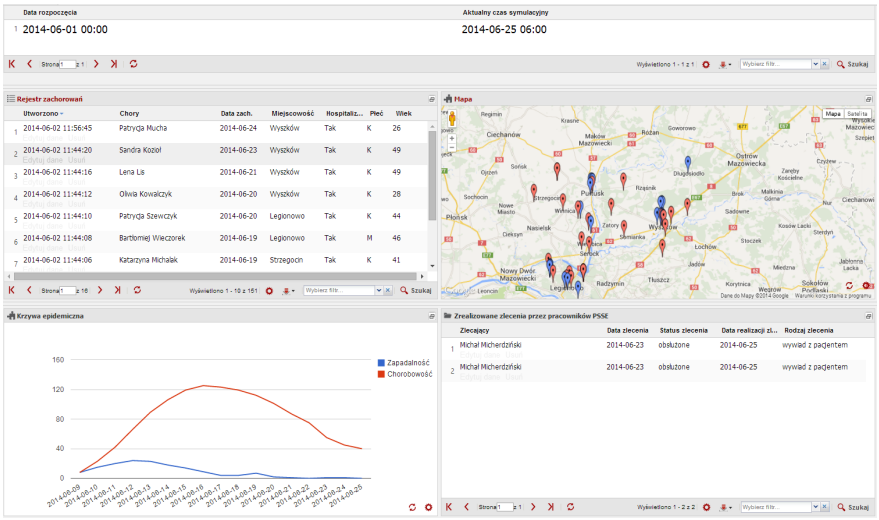

Figure 4: Key performance indicators presented in the form of various tabular reports, charts or graphs.

activities. It uses the AAR module Each practicing sanitary inspector can evaluate his own participation in the simulation exercise.

The AAR Subsystem Concept

During the simulation exercises, the system supporting these exercises allows you to perform ad-hoc actions, which are also recorded in the history of the actions performed. The task of the AAR subsystem is to analyze the history of all actions, regardless of their type - whether they are actions performed as part of investigative processes or ad-hoc actions, however, performed in the context of a given epidemiological investigation, and to create a uniform, complete history of a given epidemiological investigation conducted as part of the exercises. The AAR subsystem also has the ability to add KPIs (Key Performance Indicator), which, by analyzing the status of processes, task execution times, and data entered by users, report the current state of the system, allowing for a more accurate evaluation of the exercise. KPIs can be presented in the form of various tabular reports, charts or graphs (see Figure 4).

Cumulative summaries of many exercises performed by different training teams according to a set scenario are also available, allowing you to compare them and evaluate the progress of the participants (see Figure 5).

Experiences After Conducting the Simulation Exercises

During each simulation step, the time shift of the corresponding interval is also simulated. By using computer simulation in the spread of the epidemic, it is possible to simulate the entire course of the epidemic in a short time. In mature simulation exercises, the AAR mechanism allows us to view and analyze the course of exercises by teams performing exercises. The analysis module with AAR at its disposal will be able to track the history of activities during the simulation step by step. The conclusions of this analysis will be

Figure 5: Cumulative summaries of many exercises performed by different training teams according to a given scenario.

used to evaluate and improve procedures and actions to combat epidemics of food poisoning and diseases. The technology used to visualize the results of the simulation exercises performed in the After Action Review module provides an overview of the process simulation history also during the exercise. Individual results of simulation experiments are stored in a database constructed and at the user's request simulation process is restored to any moment of an outbreak of the disease. Depending on the needs of the simulation process is repeated and simulation exercises is participants demonstrated the epidemic and examines their actions in preventing the development of epidemics. You can also, on request, conducting exercises come back at any moment of the epidemic, and after changing some parameters of the epidemic, sanitary service activities and decisions of the authority of these services may be carried out simulation experiment for the revised terms of development and the prevention of epidemics. Any obtained in this way results are stored in a database and can be used to illustrate the course of the epidemic of foodborne illness. At the same time these results become the basis for assessing the members of the teams participating in simulation exercises. The simulation exercise system was positively assessed by the sanitary services participating in the exercises.

A large series of simulation exercises were conducted for sanitary inspectors (see Figure 6). Various exercise scenarios were used. Each simulation exercise lasted approximately 3-4 hours.

CONCLUSIONS

A programming environment was launched and tested on the food borne disease epidemic development model and the work of sanitary inspectors during the development and duration of the epidemic. The results of solved research problems that appeared in connection with the creation of a simulation environment for the organization of simulation experiments have been published

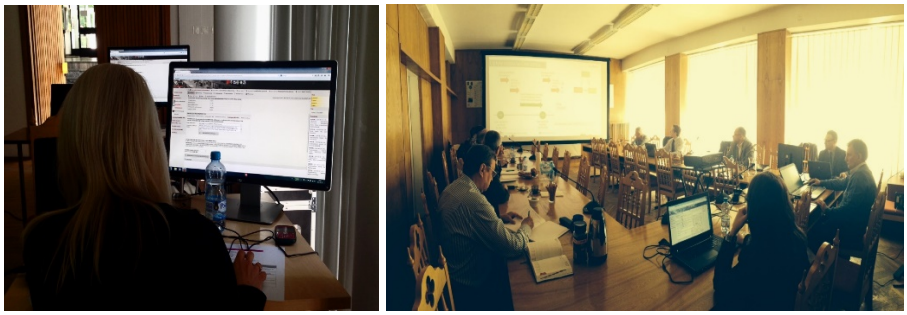

Figure 6: Photo of the person taking part in simulation exercises and post-simulation analysis.

(Nowicki, 2012) and (Nowicki et al., 2014). Simulation exercises are one of the most important elements of consolidating good practices for sanitary inspectors. The organization of simulation exercises for sanitary inspections requires many years of preparation of both training teams and the team preparing the exercises. User interfaces will be characteristic of the natural working environment of sanitary inspectors. Internal interfaces between the components of the simulation exercise support system ensure good communication, archiving, situational visualization and multi-variant analysis of the course of exercises.

This work was created as a part of the project PBS1/A7/6/2012 financed by Polish National Centre for Research and Development.

REFERENCES

Cayirci, E., Marincic, D., (2009). Computer Assisted Exercises and Training: A Reference Guide, John Wiley and Sons.

IEEE Std 1516 TM (2010): IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) - Framework and Rules.

Lateef, F. (2010). Simulation-based learning: Just like the real thing. Journal of Emergencies, Trauma, and Shock, 3(4), pp. 348–352.

Nowicki T, Pytlak R., Waszkowski R., Bertrandt J., Kłos A., (2014). Formal Models of Sanitary Inspections Teams Activities, International Conference on Food Security and Nutrition, Johannesburg, South Africa, February 10 - 11, 2014.

Nowicki T. (2012), "The method for solving sanitary inspector's logistic problem". in: Production Management – Contemporary Approaches – Selected Aspects, Publishing House of Poznan University of Technology, Poznań, ISBN: 978-83-7775-189-3, pp. 23–34.

Nowicki T. et al. (2016) Data flow between RFID devices in a modern restricted access administrative office, MATEC Web of Conferences, Volume 76, DOI: DOI10.1051/matecconf/20167604004.

Schirlitzki H. J. ed. (2007). Exercises – Planning and Execution in Integration of Modelling and Simulation, NATO Research and Technology Organization 2007, ISBN 978-92-837-0046-3.

Waszkowski R. (2018) Multidimensional modeling and analysis of business processes, IOP Conference Series-Materials Science and Engineering, Volume 400, DOI: 10.1088/1757-899X/400/6/062031.