

## **BUSINESS MODELS OF SANITARY INSPECTION OPERATIONS**

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**Abstract** The paper presents a method of modeling processes connected with the activities of sanitary inspection during the development of the epidemic of food-borne diseases. There is also shown a way of testing the basic characteristics of the development of the epidemic and how to examine the dynamic properties of the epidemic processes. Examined processes can be studied, among others, from the point of view of time and cost of sanitary inspection activities.

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## 1. INTRODUCTION

An interesting trend in studies, which analysts of organizations of different types deal with, is analyzing business processes of the organization. Research in this matter is conducted in different countries. Also in our national literature we can point out the positions in which authors refer to this type of research. Primarily the research is conducted around the dynamics of the business processes. They have a reference for a variety of applications, including medical operations. Business processes are often placed in a broader public service digitalization, taking account of numerous problems related to integration of developed information systems. Business processes form a system called Workflow.

The resulting models specify both organizational units and subordinate groups of workers, or even individuals, depending on the needs and objectives of modeling. However, this is only the background for process activities and specific tasks. It is them which are the primary components of a workflow system. They illustrate the sequence of procedures in different circumstances as specified detail activities and events. Workflow systems take account of the natural conditions and transform models into working applications.

Taking into account that any modeling activity is related to various information systems, the existing integration platform must be explicitly mapped. The implementation of business processes is increasingly being placed in cloud computing environments and due to the fact, that sanitary services are part of the public administration, one of the main problems to overcome, is maintaining data security.

The paper considers the problem of modeling the functioning of sanitary services. As used herein, the functioning of business processes remain static. However, you can show that it is possible to study the dynamic properties of these processes. This is a typical approach in the study of properties of the organization on the basis of the process model. In the following sections we present business models of functioning sanitary services in the events of food-transmitted diseases, and further research will be shown of their dynamic properties.

## 2. EPIDEMIOLOGICAL INVESTIGATION PROCESS

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 sanitary 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 dis-

eases 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. For some diseases a single occurrence of disease or death triggers the epidemiological investigation procedure. This applies to any region of cholera (it occurs sometimes in facets of water) or toxins (assumed than that it could be an intentional act, such as terrorism). The basic activity of sanitary services in the event of a food – borne epidemic, is an epidemiological investigation. The diagram of an epidemiological investigation business process is shown in Figure 1.

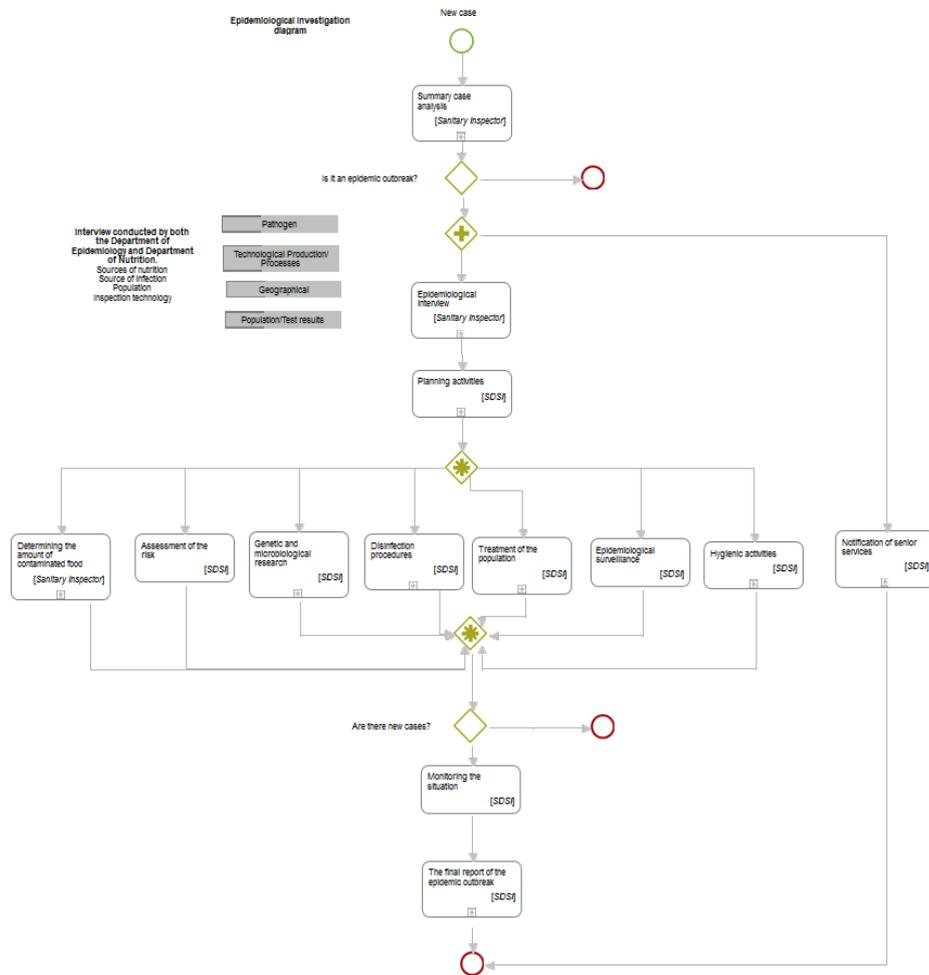


Fig. 1 Epidemiological investigation business process diagram (source: own)

As a result of starting the process of epidemiological investigations, a sanitary inspector analyzes the cumulative number of reported cases. The result of the analysis is a decision of the inspector as to whether the reported cases concern an outbreak of disease or infection. In the event of an outbreak further action is triggered in the investigation. Otherwise, the investigation ends. Further activities carried out within the investigation focus on the Sanitary Inspectors conducting interviews with patients and sanitary inspection in places where contaminated products may be found. Results and conclusions from interviews are recorded in the system based on the appropriate form of paper taken from the system. After completing interviews, sanitary officers plan further actions that should be executed as part of the epidemiological investigation.

**Table 1** Epidemiology investigation tasks (Source: own)

No.	Task name	Task description	Task role
1	Collective case analysis	The analysis of cumulative reported cases and decision whether it is an outbreak of disease or infection.	sanitary officer
2	Epidemiology interview	Interviewing patients and sanitary inspection in places where there may be infected food.	sanitary officer
3	Action planning	Planning further actions that should be executed within the epidemiological investigation.	SDSI
4	Determining the amount of contaminated food	Determining the amount of contaminated food and its potential location..	sanitary officer
5	Risk assessment	Risk assessment for the whole population.	SDSI
6	Genetic and microbiological tests	Genetic and microbiological tests for determining the pathogen.	SDSI
7	Disinfection procedures	Disinfection procedures in contaminated spots.	SDSI
8	Medical treatment	Medical treatment of patients	SDSI
9	Epidemiology supervision	Systematic collection of data on the epidemiological investigation, analysis and interpretation in order to better understand the directions of further development of the disease / infection.	SDSI
10	Sanitary actions	Development and implementation of recycling post-epidemiological (current disinfection, final disinfection, physical, disposal chemical ).	SDSI
11	Notification of senior services	Notification of relevant services in relation to the occurrence of an increased number of cases (notification PWIS, GIS, Ministry of Health).	SDSI
12	Monitoring the situation	Further monitoring of the activities carried out to combat the disease / infection (monitoring new cases).	SDSI
13	Final report	Development of the final report of the epidemiological investigation carried out for the outbreak of the disease / infection.	SDSI

The following activities are executed:

- Determining the amount of contaminated food, and the potential place of its occurrence,
- Assess the degree of risk to the population in relation to the diagnosis of disease or infection outbreak,
- Genetic testing and microbiology to identify the pathogen,
- Disinfection treatments in areas where there are contaminated products found,
- Medical treatment of patients,
- Epidemiological surveillance involving the collection of data during the epidemiological investigation, their analysis and interpretation in order of better understanding the directions of further development of the disease or infection,
- Carry out hygienic measures aimed at the development and execution of post-epidemiological disposal,
- Notification the appropriate services in connection with the occurrence of an increased number of cases.

After carrying out planned activities to combat illness or infection, and finding that new cases no longer appear, we can proceed to further monitoring the situation. In particular, the occurrence of new cases is monitored. Upon completion of the monitoring of the situation, sanitary inspectors draw up a final report of the epidemiological investigation carried out for the outbreak of disease or infection. The following table describes the various tasks performed during the epidemiological investigation including the task role.

Each of the actions contained in the diagram in Figure 1 is in fact a separate business process. It is not possible, due to the volume of the work, describe in detail all of these processes. However, it's worth discussing one of them. This is the most important process and on its basis the study shows the dynamic properties of business processes.

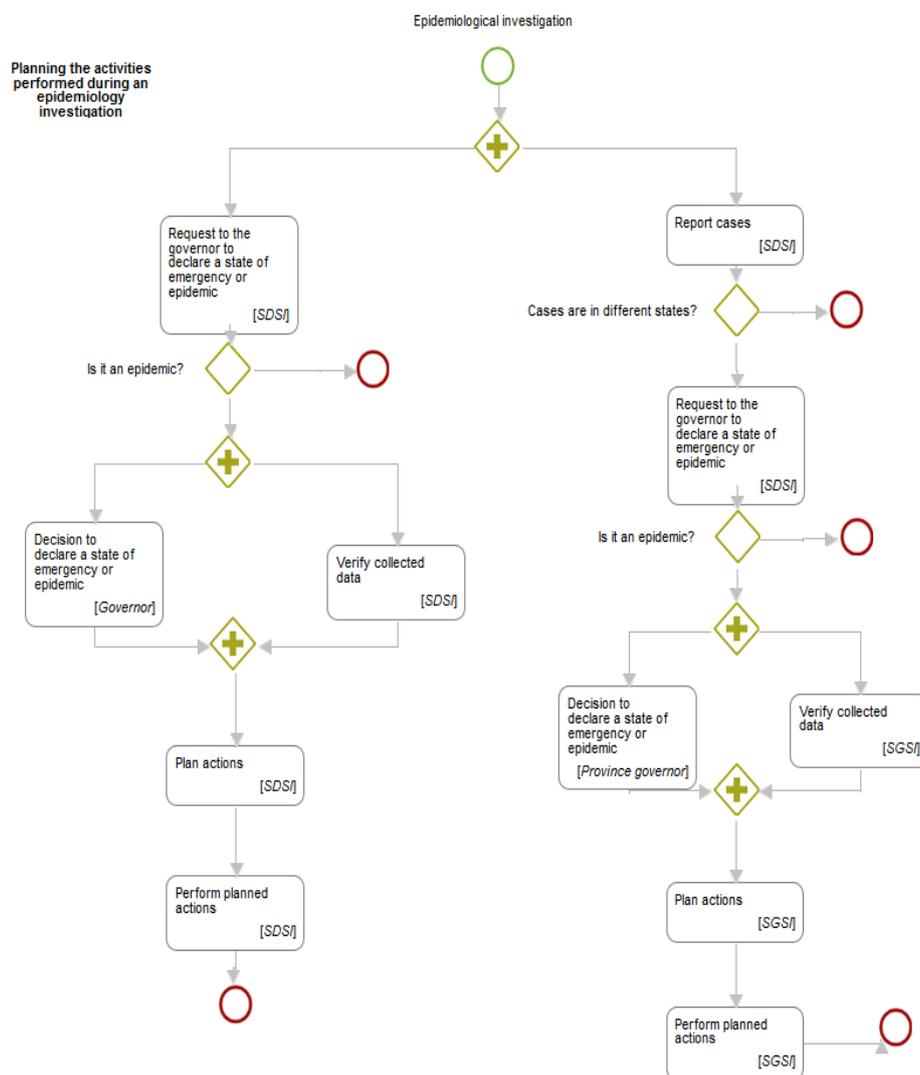
### **3. PLANNING THE ACTIVITIES PERFORMED DURING AN EPIDEMIOLOGY INVESTIGATION**

The process allows both planning actions, based on current situation evaluation and informing appropriate authorities. The diagram of the business process in question in which schedule tasks are located is shown in Figure 2.

A detailed description of the business process is as follows.

- SDSI (State District Sanitary Inspector) performs the task "Request to the governor to declare a state of emergency or epidemic". Request is completed by phone call or e-mail,

- SDSI (State District Sanitary Inspector) performs the task „Verify collected data”.
- Governor performs the task „Decision to declare a state of emergency or epidemic”. The operator must make a decision that will affect the control gate. The decision will involve the threat or occurrence of epidemics,



**Fig. 2** Planning the activities performed during an epidemiology investigation business process diagram (source: own)

- SDSI (State District Sanitary Inspector) performs the task „Plan actions”. Depending on the complexity of the situation SDSI decides to take action against epidemics or epidemic threat,
- SDSI (State District Sanitary Inspector) performs the task “Perform planned activities.” It is a wide variety of activities that sanitary officer must take into action. These activities are properly documented in the document repository and records related to the epidemiology investigation.

### 3. SANITARY INSPECTION PROCESS STUDIES

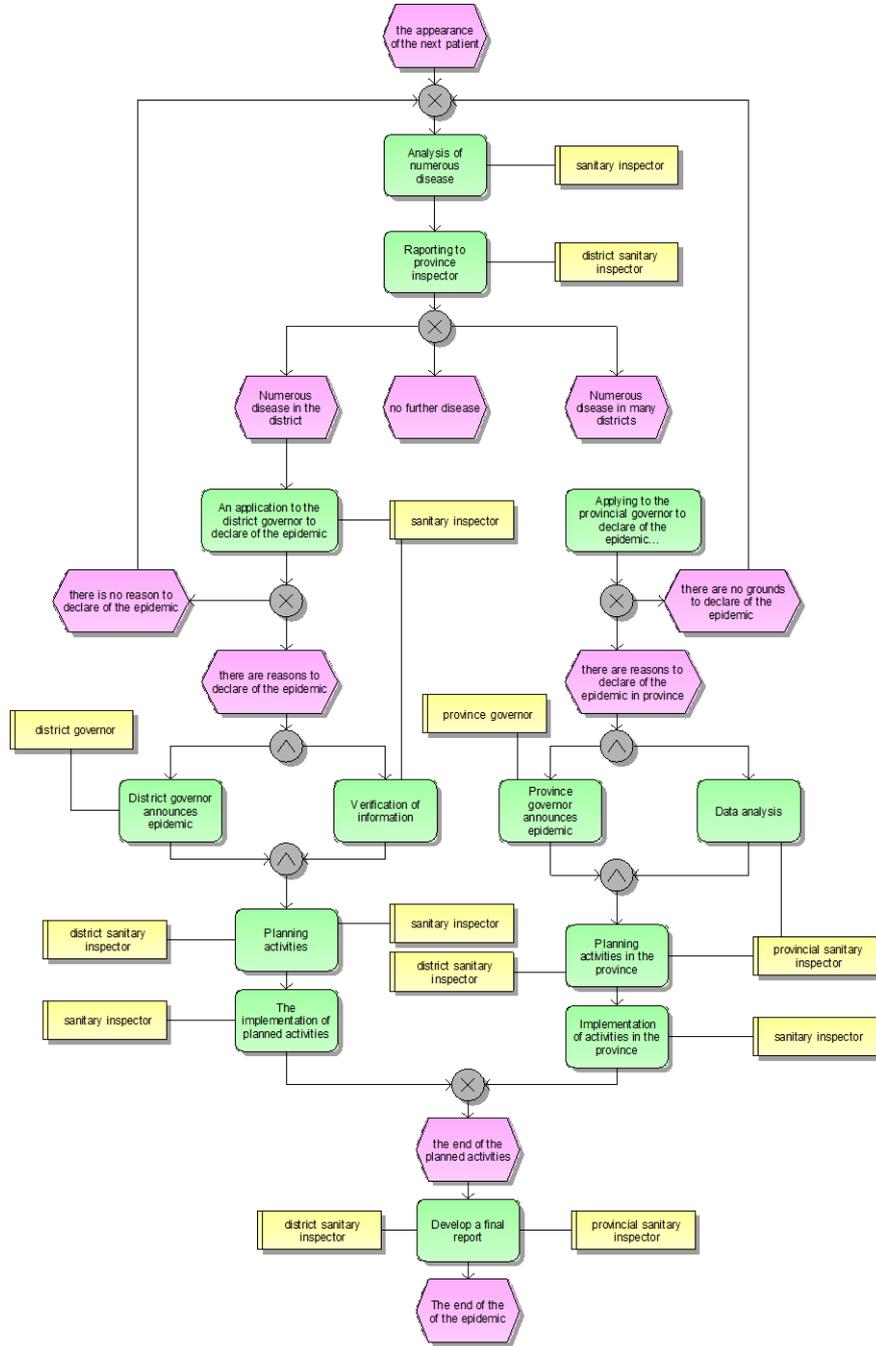
In the market there can be found advanced programming environments supporting the process of modeling business processes, their simulation and analysis. Popular software include the ARIS software by Software AG, Websphere Business Modeler by IBM, Corel iGrafx software, Sybase Power Designer and others. In most of them it is possible to simulate business processes in order to obtain the dynamic characteristics of the modeled organization. It is worth remembering that while modeling a system, including its business processes, it should not be done without defining requirements in this area. Analysis of the system may be performed in two ways:

- Static tests - are made on the basis of the diagram overview of business processes and are usually a simple analysis,
- Dynamic test - the system is analyzed on the basis of the conducted simulation experiments that allow you to explore the dynamics of their operation.

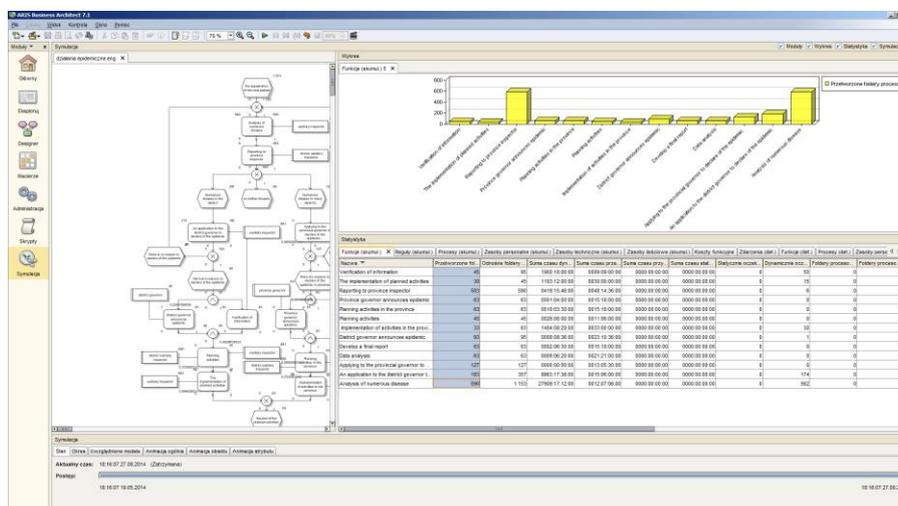
The study of dynamic properties of the system through simulation experiments allows, among other things: presentation of activities of the business process for various scenarios of its operation, to estimate the execution time and the cost of the system and its components, examine the impact of the type and amount of resources available on the effectiveness of the system, effective control chain supply of resources, investigate the effect of changes in execution times of tasks on the efficiency of the system, examine the impact of changes in the cost of performance of the tasks on the efficiency of the system, examine the properties of the system for high loads and the designation for the critical paths and bottlenecks and generally to optimize the efficiency of the system.

The paper shows the way the study of dynamic properties of the process using environmental modeling, simulation and analysis of business processes with ARIS Software AG. A business process in that environment corresponding to the diagram of Figure 2 is shown in the figure below.

The resulting model of planning sanitary services during the epidemiological investigation was created in a software environment ARIS Software AG, which was used to carry out simulations of the operation of sanitary services relating to the planning of their activities (Figure 4).

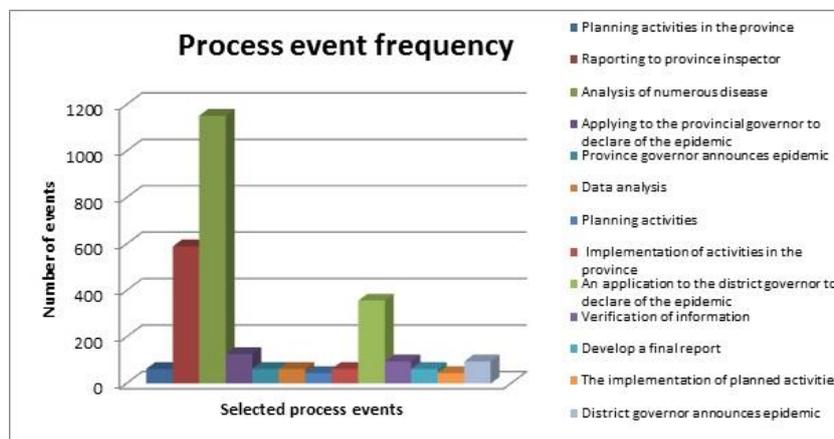


**Fig. 3** Planning the activities performed during an epidemiology investigation business process diagram in ARIS (source: own)



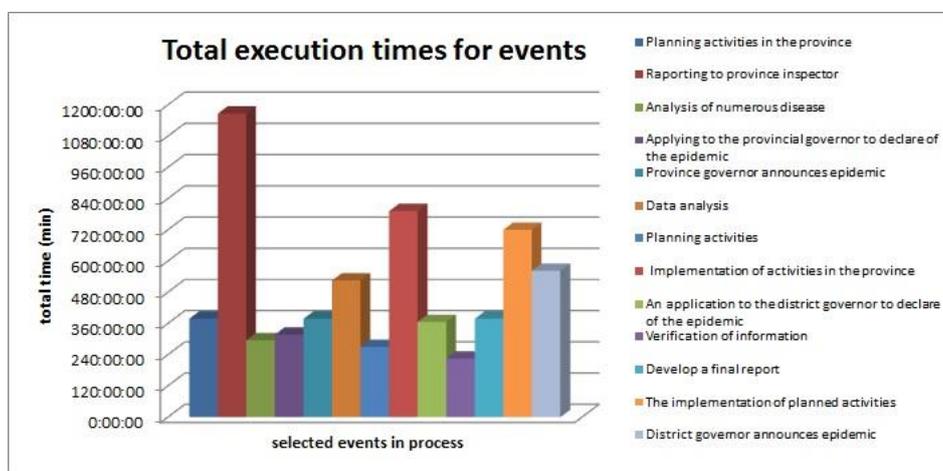
**Fig. 4** Modeling and simulation in ARIS environment business process for planning sanitary services during the epidemiological investigation (source: own)

As a result of simulation experiments a number of interesting results was obtained related to the functioning of sanitary services. They are not achievable in the static analysis of a business process. For example, we can show the frequency of the various significant events during the outbreak (Figure 5).



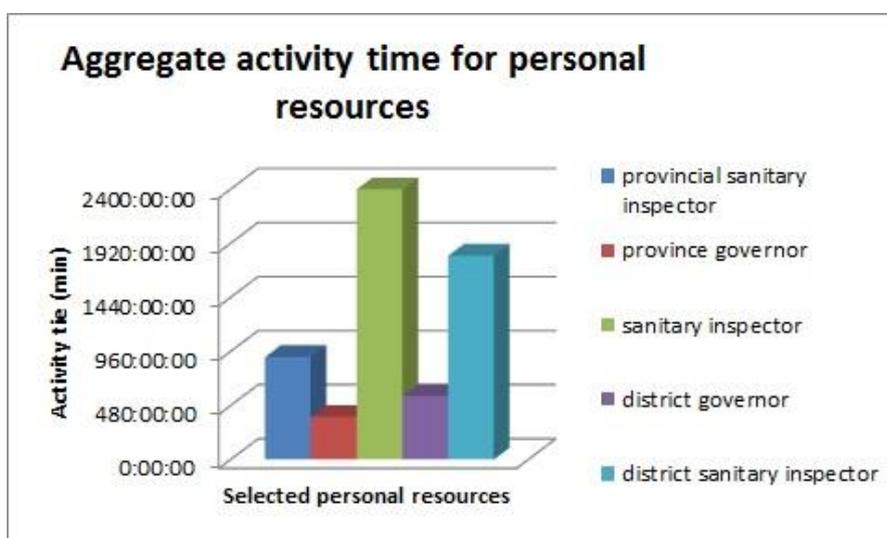
**Fig. 5** Frequency of important events in the planning of sanitary services during the epidemiological investigation (source: own).

In the same way we can also be illustrate summary time execution for separate activities that occur during the planning of sanitary services (Figure 6).



**Fig. 6** The total execution times of selected activities of sanitation services during the epidemiological investigation (source: own).

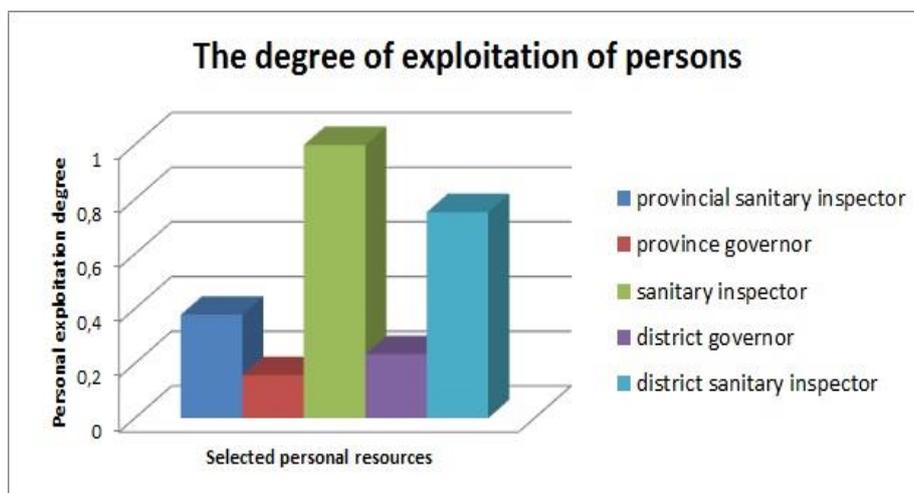
Also interesting can be combined time of activities of individuals (Figure 7).



**Fig. 7** Aggregate times of functional activities during the epidemiological investigation (source: own).

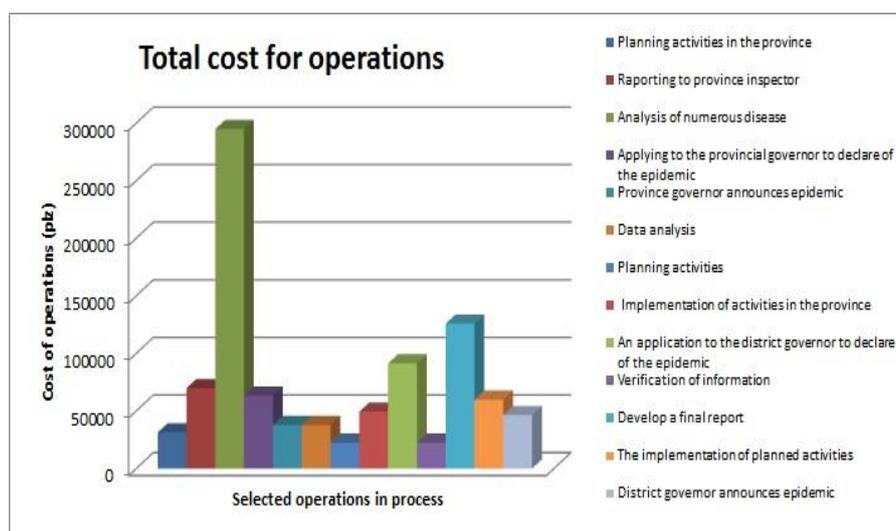
One of the fundamental questions that appear in the analysis of the effectiveness of sanitary services, is how heavily burdened are process participants from the point

of view of the investigation. This graph illustrates the degree of persons exploitation (Figure 8).



**Fig. 8** The degree of exploitation of persons during the epidemiological investigation (source: own)

You can also get an estimate of the cost of against epidemiological activities (Figure 9).



**Fig. 9** Total cost of operations incurred during the epidemiological investigation (source: own).

### 3. CONCLUSION

This paper contains a description of modeling the business process in sanitation services in the course of an epidemiological investigation during food-borne diseases. It also shows how to examine the dynamic properties of the resulting business processes. This can be done both for the individual processes, as well as their full set (model Workflow).

### ACKNOWLEDGEMENTS

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### BIOGRAPHICAL NOTES

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