Applying Big Data Analytics Techniques to Prevent Emergencies: Results and Issues

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Abstract: The article deals with topical issues related to the need to revise existing approaches to ensuring sustainable development of countries and regions. The thesis about the increased role of information flows in the life of the state, society and each individual person is set out. Based on the analysis of existing approaches, the role of big data and technologies for their processing in solving applied problems of emergency forecasting is substantiated. Examples of working with big data in the situation centers of the Ministry of Emergency Situations of Russia are given.

1 INTRODUCTION

Since the second half of the twentieth century, humanity has been faced with the problem of globalization on a global scale. The process of globalization itself has been historically predetermined and predicted by such philosophers as V.I. Vernadsky, E. Le Roy, Pierre Teilhard de Chardin [1]. Actually, the problem is the fact that the idea of the integrity of the whole surrounding world is elevated to the "Absolute", thereby disrupting the dialectical balance between the whole and the parts [2].

The world, according to the globalists, becomes a kind of single whole with a rigid distribution of markets between transnational corporations and the consolidation of certain roles between states [3]. This circumstance dictates the need to revise some approaches to maximizing economic growth on a global scale.

If the earlier part of the costs could be shifted to national economies, now failures at the regional level can lead to a serious global crisis [4].

The only way in these circumstances is to actually reduce costs, such as, for example, damage from emergencies, climate risks, social instability [5]. The solution of these problems, with a response to sudden arising challenges (such as the COVID-19 pandemic) is possible only by consolidating the efforts of the world community [6].

Currently, the task of ensuring the sustainable development of the regions is faced with a number of issues that are directly related to the problem of "limits to growth" [7], which indicated the following contradiction: on the one hand, significant resources are spent on ensuring the sustainable development of countries and regions within the framework of global international programs, on the other hand, qualitative growth in terms of key indicators is not observed [8].

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This is largely due to the increasing scarcity of resources and extremely inefficient further development due to extensive factors [9].

At the same time, the transition to new forms of economic, political, social relations will allow humanity to reach a new level of development. This concept formed the basis of ideas about the fourth industrial revolution [10].

One possible aspect of this relationship is the fact that to date, about 100 Zettabytes (10,23 bytes) of information are generated annually. Information is now becoming a commodity, opening up promising markets and with large volumes of turnover [11].

2 RESEARCH METHODOLOGY

Naturally, states and transnational corporations are also interested in using the accumulated data to solve applied management problems. With regard to sustainable development issues, from the perspective of emergency protection, emergency prevention tends to be more beneficial than emergency management. This postulate is based on the concept of non-zero, justifiable risk, whereby all participants recognize that, in general, crises are an integral part of development, can only minimize their number and reduce the very damage caused by their occurrence [1 2]. The solution of the problems of emergency prevention should be based on a sufficiently accurate, reliable and timely forecast of their occurrence. Here, the processing of accumulated data arrays of monitoring and observing systems both in the techno sphere and in the natural environment makes it possible to carry out such a forecast with known values of its quality indicator (for example, for wildfires [13] and floods [14]) with the use of technologies for the work of "Big Data".

The starting point for the introduction of artificial intelligence technologies in the system of the Ministry of Emergency Situations of Russia should be considered the order of the Ministry of Emergency Situations of Russia dated 16.11.2020 No. 860 "On Approval of the Departmental Program of Digital Transformation of the Ministry of Emergency Situations of Russia for 2021 and for the planning period of 2022 and 2023".

It was in accordance with this order of the Ministry of Emergency Situations of Russia that a number of bilateral agreements were concluded on the organization of information exchange (in one window) on security issues in emergency situations. This, on the one hand, made it possible to accumulate significant amounts of information, on the other hand, to raise the question of the possibility of their application to solving the problems of creating predictive models.

All this led to the need to set tasks for the implementation of a number of research works, on the use of the artificial technologies. In 2021, 3 such works were performed, in 2022 2 works, for 2023 it is planned to carry out 3 more research works on the stated topic.

3 RESEARCH RESULTS

It should be noted that over the past period, the Ministry of Emergency Situations of Russia has developed a fairly effective system for the development and implementation of artificial intelligence technologies in practical activities to ensure security in emergency situations [15].

The order of working with big data when building forecast models can be illustrated by the following figure:

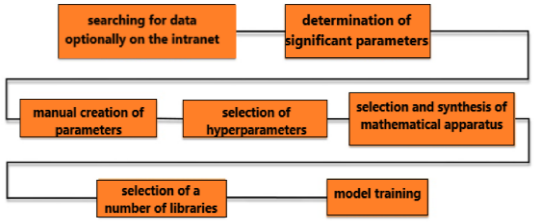

Figure 1: Algorithm for building a forecast model based on algorithms for working with big data.

When performing operations on the presented algorithm, a number of problems arise before analysts and operators, which will be given below:

1. With falsity for the developed methods will have a relative "weakness" of the dataset for areas having a relatively weak database of observations, which is associated with insufficient and uneven development of the surveillance and monitoring system;

2. When determining significant parameters, the choice can be made only from those parameters for which monitoring is carried out, while it is also necessary to take into account the autocorrelation factors among themselves.

3. Design of dimensions and ensuring the necessary accuracy of the model on a given feature space. In other words, it is necessary to understand from what point, an increase in the artificially

generated feature space will not lead to a significant increase in the accuracy of the model.

4. Difficulties in pre-processing data provided by both third-party services and within the departmental database, checking the correctness (adequacy) and filling in "zero" and "missed" values.

5. Formation of hyperparameters, for the case when the identified significant parameters begin to affect the predicted value not actually at the time in question, but starting from some time period, or even with the omission of a number of observations (for cyclic emergency situations).

6. Selection of the appropriate mathematical apparatus for processing the selected data, taking into account the requirements for quality parameters for the developed models.

7. Determination of optimal parameters for training, validation sampling.

4 THE DISCUSSION OF THE RESULTS

It should be noted that the problems presented will be common to those cases when we use big data technologies to build models of emergency forecasting, but the solutions will differ both for each forecast task and for each specific data set.

In general, the ongoing research allows us to conclude that the technologies of big data and artificial intelligence significantly increase the capabilities of management systems in emergency situations at all stages from forecasting and planning to effective response and elimination of consequences. Emergencies. At the same time, without their integrated (interstate) implementation in the practical activities of emergency agencies, it is impossible to ensure the solution of sustainable development problems, since different levels of access to big data databases, models and technologies will lead to uneven development of emergency prevention and response systems and an even greater gap in development levels between countries and regions.

5 CONCLUSIONS

The way out of this situation may be the formation of unified databases, standards for their processing and application to solve the problems of sustainable development using the institutions of interstate cooperation on issues of integrated security. Such an organization can be the International Civil Defense Organization, the purpose of which is to promote the creation by States of structures that ensure the protection of the population and the provision of assistance to them, as well as the preservation of property and the environment in the face of natural and man-made disasters.

Taking into account that the structure of the International Civil Defense Organization includes a scientific and educational committee, the tasks solved within the framework of ensuring the protection of the population, based on the proposed approaches, will be based on a solid scientific base, supported by appropriate organizational and administrative decisions.

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