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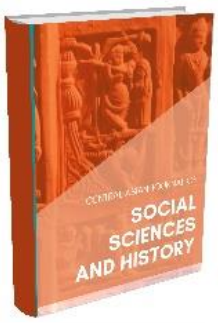

On Natural Disasters, their Predictability, and Crisis Management Culture

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Abstract:

The article discusses the possibility of confronting destructive crises because of a sensible understanding of the experience of human relations with unfriendly manifestations of nature. The main features of anti-crisis management culture, the formation of which will allow more successfully resisting natural disasters, reduce their negative consequences for the human society, are considered.

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The diversity, multidimensionality and polyscenarity of crises cannot but strike the imagination of the researcher. Even a cursory enumeration of crises that have occurred in the world in recent times literally before our eyes, gives an impressive idea of the richness of their manifestations.

Crises include, first, natural disasters of all kinds (earthquakes, tsunamis, hurricanes, avalanches, volcanic eruptions, fall of celestial bodies, etc.). Each of these types not only caused by different geophysical causes, but also subdivided into subspecies with different intensity and character of course. For example, researchers distinguish between three types of tsunamis: simple tsunamis, large tsunamis, and mega tsunamis. “We have a global database of more than 2,200 tsunami genic events over the past 4,000 years. Most of them are weak and moderate, a few hundred strong ones, and about ten of the largest when waves crossed the ocean and caused damage on its opposite shores” [2].

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Another type of large-scale crises are techno genic accidents, which differ in the nature and intensity of anthropogenic impact. First, these are accidents at nuclear and hydroelectric power plants, on water, in the sky and in space, and at chemical plants. All of them are associated with the risk of significant human and material losses (it is enough to recall Chernobyl and Fukushima).

One cannot get past purely corporate (organizational) crises, such as those related to innovation, when a previously successful company suddenly loses its market position and suffers great losses. Kodak is a perfect example of a great company that collapsed due to the introduction of a new technology – digital photography – even though it was Kodak who developed the first digital cameras. These cameras were expensive and bulky, and their picture quality was not only inferior but also even inferior to film cameras. However, when the race to cut prices and bring the quality of digital photography closer to the quality of film began, Kodak did not pay due attention to digital technology, believing that it has no future. Despite the fact that the company's main competitors began actively develop this new direction, Kodak did not see this as a potential danger and lost its competitive advantage. No less interesting are banking and financial crises affecting not individual organizations, but entire conglomerates (the events of 2008 and several subsequent years). Not to be left out are crises concerning the functioning of states and their relations with each other (for example, the Cuban Missile Crisis, which recently celebrated its fiftieth anniversary, with its real threat of nuclear conflict, or the unceasing events in the Arab East).

The attentive reader will surely find examples of crises that do not fit into this list. For example, the failure of the British Special Operations Command's network of agents in France during World War II, when hundreds of agents were arrested by the Germans in a short time, or the Spanish pandemic that ravaged Europe in 1918.

Of course, this list is far from complete, but we do not seek to list every possible type of crisis, especially since a typology, however comprehensive it may be, not created for its own sake. The aim of any typology is to identify the general characteristics of the phenomena of interest and try to create a theoretical vision of them, in other words, to build a general theory of crises.

It is interesting to note that an unbiased and attentive study of the crisis processes of the past, with all their diversity (and we have studied more than two hundred crises), evokes an overwhelming sense of their striking similarity. It is similar in living nature: “On the one hand, we can be surprised with the luxury and variety of forms and manifestations of terrestrial life; on the other hand, with the same, if not with greater right, we can be surprised with how schematically all life on earth, from viruses to humans, is arranged in a monotonous way” [3].

The presence of common features characterizing the emergence and course of various crises and their scientific analysis allow us to hope for the formulation of strategic recommendations to prevent or reduce the impact of future crises.

Without setting out here the global goals of constructing a general theory of crises, we will focus on crises that either created by, or have an impact on, human actions. Such crises are a constant companion of the human community: they have happened, are happening and will continue to happen in the future, with particularly devastating ones arising, as a rule, suddenly, disrupting, often irreversibly, the established, habitual course of events and the sequence of phenomena. This is not surprising, since any complex system consisting of a huge number of interacting elements with diverse, often antiphase evolutionary tendencies (interests, if we are talking about anthropogenic or

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suicidogenic crises) initially contains the potential for crisis. Moreover, it argued that crises are a necessary phenomenon in the development of such a system.

"Anything can become a destructive factor – from earthquakes to human errors – but the cause of the crisis lies in the inability of the system to resist destruction" [4].

Of course, anti-crisis practices depend substantially on the specific characteristics of this or that particular crisis. Nevertheless, something unites all these practices. This is an anti-crisis management culture, the need for which is being felt more and more acutely. This culture will make it possible to take managerial actions aimed at reducing the negative effects of the crisis, minimizing, as far as possible, human and material losses, and in some cases, even using the crisis as a springboard for further development. For example, one of Japan's oldest banks, Sumitomo Mitsui, was able to use the current financial and banking crisis "to increase its presence in the markets of other countries – primarily in Asia. In 2012, it continues to increase its lending" [5].

Historically, much, if not most, of humanity settled in places where destructive manifestations of nature are not so rare. It can be said that natural disasters are an old and, in their own way, a loyal companion of man. Man has been living next to them for such a long time those descriptions of particularly large natural disasters found in the folklore of various peoples. Therefore, in the piggy bank of natural manifestations accumulated quite a lot of statistical information, which allows make some interesting conclusions, especially if you consider that the degree of availability of information from open sources, extraordinary in their nature natural cataclysms noticeably ahead of crises caused by human activity. Large-scale crises of quite different, not natural origin began to appear much later, as scientific and technological progress became an increasingly important factor in people's lives, and with them grew the anthropogenic impact on nature. Until the middle of the XX century, manufactured and synthetic crises were inferior in power and consequences to natural disasters, but the experience of the bombing of Hiroshima and Nagasaki and the phenomenon of nuclear winter discovered in the 1980s show that humans could already successfully overcome such a lag. It is useful to note that some researchers quite reasonably see natural geophysical traces behind major fabricated disasters (Chernobyl, Sayano-Shushenskaya HPP, and Fukushima).

The mentioned circumstances push us to comprehend the rich experience of human interaction with nature, especially in its extreme manifestations, which formed the culture of human behavior in extreme situations of natural nature. Our Earth has existed for so long that it is normal to assume. during its long history, all natural cataclysms have happened, and we should not expect any new ones at all. So man has to some extent learned to consider nature's insidiousness and even to counteract it, sometimes quite successfully. Nevertheless, more and more active human actions multiply the treasury of crises and disasters, not only in number, but also in novelty. A striking example of such crisis novelty is the 2008 Spitak earthquake. In his memoirs about his work, rescuer E. Buyanov notes: "The naked eye could see that the construction of the houses was carried out with numerous violations of SNIP (building codes and regulations). The slabs of shabby concrete were cracking after being hit with a crowbar, and they crumbled into small pieces when people tried to lift them with a crane's hook on the rods or bars of the reinforcement. Usually the iron bars torn from the concrete, crumbling like light plaster. More than half of the cement stolen from this "sandy" concrete at various stages of production. It is clear that the slabs and beams were "stamped" in factories in an accelerated mode with gross violations of production technology, without the necessary steaming and curing. This kind of

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“entrepreneurship” of some cost others their lives, blood and serious injuries [6].

The uncivilized behavior of the workers of the house-building plant during construction of houses in an earthquake zone and the lack of effective construction control significantly multiplied the number of victims of this earthquake. The inhabitants of the Japanese islands, on the other hand, do not think of economizing on the seismic stability of buildings under construction, nor do they consider the need to improve warning systems for residents about approaching earthquakes and tsunamis. This comparison in human behavior allows us to classify it in a sense.

Even N.K. Roerich, in his article “Synthesis”, pointed to the interaction of two concepts: “culture” and “civilization”. “... Now I would like to clarify the definition of these two notions, which we have to deal with in our everyday life. We have to repeat the notion of Culture and Civilization. Surprisingly, we have to notice that even these concepts, seemingly so refined by their roots, are already subject to interpreting and perversion. For example, many people still think it is quite possible to replace the word Culture with civilization. It is completely missed that the Latin root Cult has a very deep spiritual meaning, while civilization has a civic, social structure of life at its root. It would seem quite clear that every country passes a degree of public, that is, civilization, which in high synthesis creates an eternal, ineradicable concept of Culture. As we see in many examples, civilization can perish, it destroyed, but Culture in ineradicable spiritual tablets creates a great heritage, nourishing the future young shoots.

Every manufacturer of standard products, every factory worker, of course, is already a civilized person, but no one will insist that every factory owner is already necessarily a cultural person. In addition, it may very well turn out that an inferior factory worker can be a bearer of unquestionable Culture, while the owner of it will find himself only within the limits of civilization. One can easily imagine a “House of Culture”, but it would sound very clumsy: “House of Civilization”. The title “Cultural Worker” sounds quite definitive, but it would be quite different to denote “Civilized Worker”. Every university professor will be quite satisfied with the title of cultural worker, but try telling a venerable professor that he is a civilized worker; for such a nickname every scientist, every creator will feel inwardly uncomfortable, if not offended. We know the expressions “civilization of Greece”, “civilization of Egypt”, “civilization of France”, but they do not at all exclude the following expression, supreme in its inviolability, when we speak of the great Culture of Egypt, Greece, Rome, France” [2].

If we analyze these concepts in relation to crises, we can note that a civilized attitude to them involves the application of those forms of organization of life that, based on available experience, allow us to anticipate the impending crisis and reduce or completely prevent it.

In the opposite case, with uncivilized attitude, the complete disregard of available experience, scientists' forecast and, as a consequence, disastrous consequences even of those crises, which predicted earlier, revealed. A vivid example of such an attitude are the above observations of a rescuer who participated in the liquidation of the consequences of the Spitak earthquake.

How can we learn to deal successfully not only with the consequences of ill-conceived human actions that violate the simple rules established at the dawn of our civilization, but also with the surprises of technological progress that never existed before? It seems to us that it is the development of anti-crisis culture, when anti-crisis measures become natural and inherent in the relationship between people, can help to solve this very difficult problem. At the same time, the concept of anti-crisis culture in its content is deeper than just civilized behavior, and includes not only behavioral facets, such as anti-

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crisis policy, practice, forecasting, but also worldview, moral and spiritual aspects.

The development of modern science and technology has made significant progress toward predicting natural crisis situations (meaning primarily the development of technical monitoring tools and the methodology of computer modeling based on the application of mathematical models), although it has not yet been possible to achieve predictive accuracy sufficient for practical purposes. It is possible, however, that this achieved in principle. Predicting the possibility of a tsunami, hurricane or earthquake, we can hardly ever accurately (and early enough to have time to prepare!) localize the event by place and time; give a realistic assessment of the scale and intensity of the predicted phenomenon, its impact on other crises. Discussing the peculiarities of forecasting are dangerous natural phenomena, it is important to note that it is necessary to be able to predict the very fact of the occurrence of such a phenomenon and assess what intensity of development it will reach, if it takes place. In addition, especially dangerous manifestations of nature are not just extreme states of some indicators, but very rare states. "Only in this way can they lead to disastrous consequences, because during the period of evolutionary development societies have long ago adapted to the states of nature that are regularly recurring extremes" [7].

Because the probability of a crisis with catastrophic consequences is extremely low, the probability of its successful prediction in the sense we mentioned above is not very high either. Hence the hypothesis about the mandatory need for redundant technological and managerial solutions (for example, construction of redundantly stable buildings in earthquake-prone areas, redundantly stable dams in crisis-prone zones) to successfully counteract the crisis and reduce the negative consequences. Here we can draw an analogy with the principle of excessive defense of a piece or a point in a chess game, formulated by grandmaster A. Nimzowitsch: "Own strategically important points must be defended with excess (in other words – to defend more than the number of attacks requires it). In addition, the contact between the defended point and the figures "carrying out redundant defense, contributes both to strengthening the point itself, by defending it in advance against possible attacks, and to increasing the value of the pieces defending this point, for they draw new strength from it" [5].

Using this analogy, it can be argued that the implementation of redundant management measures, will not only prevent (or at least significantly reduce) the consequences of the impending crisis, but will probably strengthen the position of the system in a rapidly changing world. Of course, implementation of such measures is associated with significant material costs and is especially burdensome in conditions of constant shortage of resources, but post-crisis analysis on a large number of examples shows that the presence of even a small "redundant protection" would prevent much greater material (and indeed human) losses. We hope to talk about this in more detail in our next papers.

However, here, as in virtually all areas of human activity, there is a sad pattern that people, including those in the highest levels of government, do not tend to learn from historical examples and behave in a civilized manner. It is much more habitual to step on the same rake repeatedly.

However, let us return to the manifestations of nature. The most predictable crises are hurricanes and tornadoes, supervolcano eruptions, and asteroid falls. In our opinion, specific quantitative characteristics here are approximate. More important is the ranking of crises in terms of their predictability. As for hurricanes (cyclones), scientists, using satellite images, can see the process of their formation, but since the models of atmospheric phenomena, which slightly differ in their initial conditions, give significantly different forecasts concerning their further motion, a completely accurate

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prediction of the spatial and temporal localization of their main strike seems practically impossible. The best solution for today is to use an "ensemble forecast", which takes into account the average of the various predictions. Although cyclones very often cause enormous damage, a timely warning usually avoids the worst.

It is much harder to predict the behavior of a dense clot of tornado energy. Despite early warnings, the 305 tornadoes that swept across the U.S. in April 2012 killed more than 300 people. Perhaps less predictable than hurricanes and tornadoes are pandemics like the 2009 swine flu outbreak, but the predictive lead time is much longer – not a few days, but weeks to months. "The study of ecosystems has provided fundamental insights into the precursors of critical transitions (points of no return)" [6]. At the same time, the prediction time can vary from several weeks to several years. Note that if we consider these two most important factors – prediction probability and predictability in a complex, we can say that the crisis situations considered above (hurricanes and tornadoes, pandemics, ecological crises) are quite close to each other. Floods, forest fires, and earthquakes have quite different characteristics. Forest fires are in a slightly better position, because the predictability of the overall fire situation can be several weeks ahead of time, although it is extremely difficult to predict their spatial localization. Earthquakes are the worst case: the best we can do is to alert people when an earthquake has already started. In light of the above, the decision of an Italian court sentencing six seismologists to prison for underestimating the risk of an earthquake in 2009 is somewhat perplexing. At the time, 309 people were victims of the natural disaster that struck the vicinity of the city of L'Aquila.

"In their search for harbingers of catastrophe, seismologists point to a variety of phenomena: increased frequency of small ground shocks, changes in local electric and magnetic fields, the release of radioactive radon gas from cracks in the Earth's crust. The problem, however, is that these signs change from earthquake to earthquake. Therefore, there is still a long way to go before advance predictions made. The Japan Meteorological Agency is Earthquake Early Warning Service, launched in 2017, uses a network of seismographs covering the archipelago's islands. When the powerful earthquake struck northeastern Japan on March 11 this year (2018. Authors), an automatic alert appeared on TV and cell phone screens just seconds after it started. It came 60 to 90 seconds before the seismic waves and saved many people. Unfortunately, it was not enough for the tens of thousands of people who were in the path of the tsunami half an hour later [7]. At the same time, it noted that the spatial and temporal localization and intensity of earthquakes predicted with the accuracy necessary for carrying out effective management measures. Here we would like to emphasize the fundamental difference between the probability of occurrence of a crisis and the probability (possibility) of its prediction (predictability).

Summarizing the above, we can assert that the typology of crises on the scale of "probability of predictability and predictability" should serve as a compass for making decisions in terms of scope and timeliness of technical and managerial measures to protect against devastating consequences of crises. The lower on this scale is a possible crisis; the more redundant and timely should be the set of corresponding measures.

Understanding the inexhaustible experience of the not always simple relationship between man and nature can make a significant contribution to the formation of anti-crisis culture. However, on this path there are many obstacles, the main of which is ignoring the experience of this many thousands of years of communication. Natural disasters have happened, are happening, and will continue to happen.

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Understanding this, people living in various parts of the Earth have learned to pick up even the faintest signals of early warning of impending threats and to consider them sensibly. Studies of specific crises (manufactured, anthropogenic, suicidogenic, ecological) show that in many cases even the possibility of crisis phenomena denied; varieties of arguments were used [3]. Early warning signals – these invariable precursors of impending crises – are often not taken into account at all, even the most obvious ones. There is a widespread belief that crises caused by human fault are controllable and can be quite successfully resolved. It is fair to say that there are such examples, albeit few.

Much evidence suggests that it is unwise to rely especially on the heads of the upper levels of management in this matter. A more fruitful way is to train highly qualified personnel for crisis management. According to S. Fink: "An experienced crisis management specialist will be able to handle a crisis in an industrial group just as a good specialist in higher mathematics can solve a complicated problem that he or she has never encountered before" [5].

The authors of this article were educated in mathematics at the University of Moscow. We therefore think it appropriate to first dwell on the important question raised by S. Fink. The most important question of formation of mathematical culture in future mathematicians discussed in more detail.

When we speak of mathematical culture, we mean, above all, a certain discipline of thinking, which to a greater or lesser degree formed when studying mathematics. This discipline includes, first, the striving for the greatest possible, within the limits of the situation under study, precision in formulating the problem, without which one can hardly hope for a structured discussion of it and an effective solution. Secondly, it is the striving for the fullest possible justification, within the limits of the possible, of the solution of the problem posed. This justification need, consist only of a string of strictly logical arguments, but knowledge of mathematical culture, in our opinion, at least enable us to avoid not only the vicious circle, but also the introduction of arguments frequently used in commonplace discourse. In addition, finally, thirdly, a certain level of mathematical culture forms the ability of algorithmic planning of thought and action, which includes not only the development of a systematic solution to the theoretical or practical problem facing an individual. But also the ability to assess the duration of the algorithm and its comparative complexity, which, in turn, is very important in optimization of certain procedures in a variety of fields of activity.

Just in the process of teaching mathematics a person forms a certain level of mathematical culture, which, relatively independent of the specific mathematical knowledge, has an implicit. but quite effective influence on the algorithms of thinking and action chosen by a future specialist, one of the goals of management education should be the formation of the student's anti-crisis culture, possession of which, along with specific managerial heuristics and technologies, will provide him competitive advantages on the fast-changing [6-12].

The anti-crisis managerial culture, formed in the process of training at the Faculty of Management, will allow graduates to gradually change the unconstructive attitude to possible crises, which has prevailed in most organizations, and over time to ensure that more effective and timely action will be needed at all levels of the organization and at all stages of the crisis [13-20]. This is one of the most important tasks of management training at the university. In addition, studying and comprehending from managerial positions the possibility of predicting natural disasters and the anticipation of this prediction, successfully confronting natural crises and reducing the negative consequences considered as a major contribution to the formation of anti-crisis culture.

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