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We Live Under the Permanent Conviviality of Norms and Chance--Understanding It Is Key to Building More Resilient Complex Systems

Petre Roman

Department of International Relations, Swiss Umef University, Geneva, Switzerland

Email address:
proman@clubmadrid.org

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Abstract: People have always tried to make predictions; they are necessary and useful, but very often they commit obvious errors, which have negative consequences on decision-making. Prediction errors are in some cases, not few, unavoidable, because the world itself is unpredictable, subject to chance (or randomness in mathematics). Chance is a property of nature. The causes of random events are physically determined, but so numerous and complex that they (the events) are unpredictable. Science is not about certainty. Human knowledge itself is not certain. We can only have provisional truths. Therefore, we must manage to reach a state of accommodation with uncertainty and unpredictability. The complexity of natural phenomena generates events that we cannot control through theoretical modeling precisely because of the ignorance of the causal mechanisms, which exist in their privacy but have not (yet) been revealed by the data and observations at our disposal. We have, on the one hand, life experience taken over and assimilated and established in society and, on the other hand, experience gained from real life. Norm and chance follow each other rather chaotically. The duration of validity of a norm and the moment of occurrence of the random event are unpredictable. However, norms and events coexist in our consciousness. Order and predictability are born (formed and exist) from rules; chance and unpredictability are born from the lack of rules. The highest truths, recognized as such by society cannot be transposed into the life of society only by the force of reason. It is imperative that they are reinforced and embedded in the social behavior of all citizens. Rules are needed. Without rules there is no freedom.

Keywords: Norm, Chance, Random Events, Natural Accidents, Unpredictability, Complex Systems, Risk society

1. Introduction

Bringing the past into the present and preparing the future by trying to imagine it in the present are mental actions in all spiritual spheres of humanity: history, exact sciences, politics, literature, art and architecture, etc. In this way, for example, we prepare a mixture of useful norms (from the past) and try to adapt to unpredictable/random situations (from the future).

In many natural (hydrological and meteorological - such as floods, droughts, tornadoes and hurricanes, forests, arable and non-arable land, etc.) or social (economy, finance, insurance, etc.) systems and phenomena, decisions are made under conditions of uncertainty in the totality of time. Often even under severe or grave uncertainty. Whether it is economics, physics, chemistry, biology or natural systems, discerning the behavior of a complex system means being able to find certain sufficiently correct (consistent) rules in the way the complexity of the system is born.

Whatever the mechanism that generates randomness, there is infinity behind it: whether it is the absence of infinite knowledge, infinite power, or the interaction of an infinite number of agents. Only in the (overall) domain of the interaction between rules and randomness do we have the real developments, which are often unpredictable. If the field of interaction no longer existed, all developments would be doomed to repeat themselves. Things simply start over and evolution becomes periodic. Obviously, nature and human society are not like that. An absolute predestination is both terrifying and utterly uninteresting. Our universe appears to be both intrinsically deterministic and unpredictable, as

shown by quantum reality. All physical systems behave the same: they are predictable on a short time horizon and unpredictable on a long horizon. The bottom line is that natural systems are both random and deterministic, the difference being that of time scale and time horizon.

Theoretically, we could perfectly know the initial conditions as well as the equations of motion and thus specify the evolution of a phenomenon with accuracy. Practically, however, this is impossible: small variations of the initial conditions or external factors or the very lack of a calculation model, generate randomness. In addition, note that a die has only six sides, while patterns in the case of rain or wind are infinite. In the long term, therefore, there is, as a permanent feature: unpredictability.

The connection between physical and social systems is a fundamental feature of natural risk. This requires a vast interdisciplinarity. Take as an example a natural phenomenon such as floods or landslides. They can be considered symptoms of systems sensitive to initial conditions. Subjected to a major disturbance, systems develop a drastic reaction of incapacity to function. There follows a period of time necessary to recover and return to a new balance, whatever that balance looks like.

The behavior of the complex system is obtained after a very long calculation on the computer and in many cases without understanding the deep reasons of the final result. We do not obtain a prediction of system properties, but a probability distribution of these properties as the system changes. We are content with finding out some features of the system belonging to a certain class, and not finding the specific behavior of the particular system under examination. What was a virtually impossible prediction becomes a useful tool in understanding deeply complex systems.

In today's world we speak of Risk Society, a concept used to understand how the results of social activities manifest themselves powerfully but unpredictably in time and space. It is a fact in modern societies that coping with risk can be more important than the distribution of power and wealth. We find ourselves in almost all situations between the extremes of complexity: between the zone of certainty beyond all doubt and the zone of incomprehensible uncertainty, the sources of which are nothing but chance. Certainty breeds superiority while uncertainty breeds insecurity.

We want the future not to be an illusion or an absolute unknown. We want to extend the present of an order that we understand and is within reach, into the future. We start from the conviction that chance exists in the very intimacy of nature, of society. Even if we know that a certain thing will happen but we do not know with sufficient certainty when it will happen, we are under a state of unpredictability. Norms decisively help us to live orderly and even in a certain peace, safety, which make our life more normal.

2. Chance Is a Property of Nature

The future can be seen as a result of the interaction between natural states on the one hand and our choices on the other. But the natural state includes in its very essence chance. When we say that life is a mixture of norm and chance, we have a meaningful and attractive expression; it seems simple to understand. However, it does not define anything in definitive, predictable, usable form. How much is in this mixture?

The norm is rigor, a form of stable existence, permanence, symbol. It's the familiar.

The random event is the surprise, the novelty, the authentic. It's the unknown.

People have always tried to make predictions; they are necessary and useful, but very often they commit obvious errors, which have negative consequences on decision-making. The fact should not upset or alarm us. Prediction errors are in some cases, not few, unavoidable, because the world itself is unpredictable, subject to chance (or randomness in mathematics). Chance is a property of nature. The most enlightened minds of mankind bent on understanding randomness. Mathematics defines the random state. But reason and logic are not enough even in mathematics to substantiate a theory of random states. Mathematicians discover new mathematical results not only through reason and logic. They admit that in their results there was inspiration and intuition, very similar to those of artists. Gödel himself says that mathematics, systematically and fully developed, shows beauty and perfection because "completely unexpected laws and procedures are tools with which all relevant problems have been solved in a beautiful and entirely feasible manner" [1]. Gregory Chaitin, one of the founders of the algorithmic theory of information, essential for the development of computer programming, brought an extreme interpretation: "Randomness is where reason stops; it is a statement that says that things are accidental, meaningless, unpredictable and happen without a certain reason" [2]. He argues that chance exists in most of the foundations of mathematics, surprisingly stating that some mathematical proofs are true without any particular reason: "true entirely by accident" [3]. It is an interpretation with ambitious philosophical connotations, contested within mathematics. But coming from the inventor of the number Ω, exceptionally useful for defining complexity by computing power, Chaitin's interpretation interests us.

In the world of physics, we remember Einstein's famous phrase, faced with the revolution of quantum construction of the world governed by random chance: "God does not play dice with the universe!". It turned out that he was unfortunately wrong, and Stephen Hawking put it as metaphorically: "Not only does God play dice, but He rolls them where we can't see them."

The definition of chance given by von Mises [4] is the inability to find a system that allows us to make a prediction about the place in a sequence (a string) where a certain particular situation (observation) will occur without prior knowledge of the entire sequence. In other words, a sequence is random if there is no rule or law that produces it: each step is completely independent of the previous steps. Order and

predictability are born (formed and exist) from rules; chance and unpredictability are born from the lack of rules. A picture of the types of randomness starts from the finding that unpredictability and therefore randomness can be born from irreversible programs or procedures, which inhibit when we have certain rules to follow. The lack of rules, here in a general sense, does not mean that in mathematical systems or in the physical world there is no rule in the substrate, at the base.

Chance pushes the norm into new forms, creating circumstances that must be brought under control. The norm cannot be perfect; it leaves room for chance, sometimes even provokes it. The unpredictable implies the norm and explains the accident.

It cannot be an equation, an equality with two terms. It is not the coexistence and completeness of mathematics and physics. We have, on the one hand, life experience taken over and assimilated and established in society and, on the other hand, experience gained from real life. Norm and chance follow each other rather chaotically. The duration of validity of a norm and the moment of occurrence of the random event are unpredictable. However, norms and events coexist in our consciousness. Their cohabitation is in our minds because it results from our accumulated experience. The meaning of rules in society is given by the way in which they function in reality, by social practice. As the well-known British philosopher Roger Scruton says:"It is what we do that becomes the arbiter of what we mean" [5]. It is of course about how we understand what we do or have done. Indeed, we place these facts in an order of importance dictated by our own decisions. But the number of applications of the rule is theoretically infinitely large and includes those that we have never used. And then how could we know now what we must do sometime, at a time we shall touch and cross? Scruton believes that Wittgenstein's most popular argument concerns the learning and fulfillment of a rule. Whatever a deviant may have done in the past, those actions may or may not show what he is doing now. Thus, Wittgenstein states that facts, in their most elementary form (entities or objects so simple that they cannot be analyzed or composed of other entities) do not refer to necessities but to contingencies of the human condition: our habits, practices and competences, "unalterable forms of life" [6]. Whether or not all this manifests itself is subject to chance, but we know we will return to it. We have no definitive answers without them. Our decision must include both the norms (rules) and the chance. Rational decision-making is shaped by a combination of deterministic, risky, or uncertain consequences [7]. For example, the absence of evidence (deterministic) does not necessarily constitute evidence of their absence (non-existence), which is in the domain of uncertainty.

The highest truths, recognized as such by society - the great mass of citizens - cannot be fulfilled, cannot be transposed into the life of society only by the force of reason. It is imperative that they are reinforced and embedded in the social behavior of all citizens. Rules are needed. Without rules there is no freedom.

Hannah Arendt, in her text about oases in the desert [8], thought as a possible conclusion about politics, says that what Hamlet cries is always true: "Time is out of its joint! O cursed spite, That ever I was born to set it right!" [9].

Because the world feels the need to start over every time the desert seems to settle upon it. The world feels that order must be restored. Rules are needed, as I said, so that those who rule in society, with the consent of the people, adopt measures of eventual punishment (by virtue of the rule) not driven by anger or revenge but from a sense of fairness. The value of an act is not only in its material realization, but also/especially in the will that produced it. At the same time, in another work [10]. Arendt values the contingency of the human world because only in a contingent world can action be truly innovative and unpredictable.

The presence of chance, whether as a sign of divinity or as a fundamental concept in the physics of probability, continuously traverses human history. The two famous causes (motivations) of the civil war between Caesar and Pompey, says Cicero that they are sensibly equal and that each of the two has good arguments, but"we must consider that the best is that which the gods themselves supported [11]. *Fortuna*, (luck, chance) obeys Caesar; by this the cause is effective. It is a guarantee of divine favor.

For the Stoics of Plato's Academy, wisdom needed nothing external, outside itself. The righteous action of the wise ensures good, even happiness. Therefore, the sage is independent of chance, of luck. Aristotle, however, sees and recognizes a reality, that chance makes its contribution beyond morality.

In Kant 's ethics a starting point is that Must implies Can. For David Hume there is a clear distinction between norm and fact, between Ought and Is. Between Kant and Hume the conflict of principles is only apparent. Specifically, do not confuse norms with judgments about norms. Von Wright interprets the principle Must implies Maybe in the sense that "the question of whether or not there is a norm that provides for certain things cannot be decided without prior knowledge of the facts about human ability. The existence of a rule logically depends on the facts about the ability" [12]. Everything happens between the norm and the random, in a mixture of them, as I said from the beginning. The purpose of the norm is to reduce the occurrence of the accident, the unpredictability. Moreover, the norm can also generate a positive emotion when it is perceived, and often is, as order-in-complexity. Understanding this emotion helps and strengthens critical thinking. This thinking, subdivided into five components - interpretation, analysis, inference, evaluation and self-regulation- could show us whether order-in-complexity withstands detailed analysis [13].

3. Natural Accidents and Random Events in Complex Systems

Complex systems are all around us. They are made up of many components, each governed by its own set of rules and

yet interacting with each other in such complicated ways that it is impossible for us to identify a picture of the system based on these interactions. We face unpredictability. Whether it is economics, physics, chemistry, biology or natural systems, discerning the behavior of a complex system means being able to find certain sufficiently correct (consistent) rules in the way the complexity of the system is born. In recent years the study of complex systems has revolutionized physics and other fields mentioned above. The definition and in-depth knowledge of complex systems is linked to the name of Giorgio Parisi, Nobel Prize in Physics in 2021. Predicting the behavior of a system starting from the knowledge of the equations of motion is no longer possible in the case of complex systems. The large number of particles/elements is the main motivation for introducing probability."In these systems, also called chaotic, the trajectory cannot be predicted for a longer period of time, being too sensitive to (modification of) the initial conditions. even a very small uncertainty on the initial conditions leads to the complete loss of knowledge (of the state of the system) after a characteristic time" [14], explains Parisi and then clearly defines: "There are many possible definitions of a complex system. I will use the following one. A system is complex if its behavior crucially depends on the details of the system" [14].

Natural accidents are not isolated events but complex aspects that are connected to social systems. The elements at risk and their vulnerability are in an accentuated dynamic over time. Natural risk is a mixture of chance and vulnerability and therefore the behavior over time must be analyzed each time. The connection between physical and social systems is a fundamental feature of natural risk. This requires a vast interdisciplinarity. Take as an example a natural phenomenon such as floods or landslides. They can be considered symptoms of systems sensitive to initial conditions. Subjected to a major disturbance, systems develop a drastic reaction of incapacity to function. There follows a period of time necessary to recover and return to a new balance, whatever that balance looks like. The time is divided, as a rule, into that of "reaction" and that of "relaxation". It is also possible for the transition to persist if the relaxation is prolonged beyond the appearance of a new disturbance. One such catastrophic phenomenon occurred in the 2011 Tohoku earthquake that shook the Fukushima nuclear power plant, followed by a devastating tsunami. The history of natural and social events offers us many examples that show how strong the imprint of unpredictability is in human society as well. The cause-effect connection is thus revoked. Daniel Kahneman calls this disruption the "illusion of validity" and states: "The idea that great historical events are determined by chance is deeply shocking, even though it is a demonstrable truth" [15]. In my book I present three such events: *The Cuban Crisis in 1962, The Plane Crash with Happy End in New York in July 1999* and *The End of the "Terror" in the French Revolution* [7].

4. The Risk Society: Behavior and Vulnerability of Complex Systems

The triggering of a phenomenon with a radical manifestation in the evolution of a system often occurs (perhaps always?) upon reaching a *critical threshold* [7]. Thus, the evolution of the system is known as *the transition phase*: a type of behavior in which, as we have already shown, small changes of a parameter of the system produce radical transformations in its overall behavior. Well known examples are the critical points of the melting temperatures of ice or the boiling points of water. This type of phenomenon also occurs in many mathematical and computing disciplines: statistical physics, evolutionary graph theory, percolation, the complexity of computer calculation, artificial intelligence, etc. The best known example is found in natural phenomena, and nowadays in the case of climate change. The moment of reaching the critical threshold is unpredictable. We do not know, for example, when the energy accumulated in a fault in the earth's crust is triggered in the form of an earthquake. Why do we have small and large earthquakes? Why sometimes the accumulated energy is discharged to barely perceptible and sometimes at devastating levels?

Starting from 1970, the concept of vulnerability appears as a way to deal with major impact events. Vulnerability is studied in the natural and engineering sciences as well as in the social sciences. It is associated with the concept of system resilience, which means that they organize themselves structurally to minimize the effects of disasters, and at the same time possess the ability to return as quickly as possible to normal operating levels.

We need a solid foundation, well-established and rationalized rules, as well as the research of the unknown, the exploitation of the circumstances of chance. The birth, then emergence of a property means that it is the product of collective interactions between components at the atomic level, where the property does not manifest itself.

Connecting the complexity of systems with quantum phenomena has become imperative. Quantum mechanics has two fundamental features: discreteness and riskiness. Discreteness means that any finite system has a number of states that can be identified as different. Risk means that the outcome of a (quantum) event is inherently probabilistic. The interesting thing about any system study is that it is necessarily from the combination of the two quantum features that complex systems are born, including life itself. Complex behavior is born spontaneously and, as I mentioned before, has an obvious sensitivity to the initial conditions. Small and/or weak signals are amplified in the system. A very small fluctuation ultimately leads to an effect on the scale of the macroscopic world, the one we perceive.

Any complex system processes information through linear or, which is the same thing, through logical operations. Human intelligence processes information using a rule that allows us to solve complex problems with simple and elegant solutions at the same time. Intelligence, through experience

and analysis, "will never succeed in reducing everything that exists to combinations of intelligible elements", says the Romanian philosopher D. D. Roşca [16], otherwise, the reason itself would cease to exist „ because essential determinations are impossible to control".

The behavior of the complex system is obtained after a very long calculation on the computer and in many cases without understanding the deep reasons of the final result. We do not obtain a prediction of system properties, but a probability distribution of these properties as the system changes. We are content with finding out some features of the system belonging to a certain class, and not finding the specific behavior of the particular system under examination. What was a virtually impossible prediction becomes a useful tool in understanding deeply complex systems. The probabilistic study of the equations of motion provides a probabilistic picture of the system's behavior. The applications have proven to be particularly important in very varied fields, such as, for example, biology.

The art of analyzing complex systems is to find the means by which we extract from the theory no more information than we need. For example: knowing the speed of a particular molecule in a gas is of little value. But knowing what speed a certain fraction of molecules possesses is of some value. Logical descriptions of complexity focus on decision problems or research problems. The guiding principle is to choose the simplest explanations or models for the observed phenomenon. The great sculptor Constantin Brancuşi, confronted at the beginning of his career with critical remarks about the *„excessive simplicity"* of his sculptures retorted flatly: "Simplicity it's not a lack of complexity. It is the resolve of it "[17].

Being in possession of deep knowledge we also have a predictive capacity. Human history is marked both by unpredictable events and discontinuities and by long-term trends (Fernand Braudel calls it *la longue durée*). The National Intelligence Council in the US identifies two categories of unpredictability: strategic *surprises* and *ruptures.* A strategic surprise is defined as a brutal and unpredictable event (sometimes it can be predictable), with a major impact on society - in economic, social or military policies. A rupture has a stronger impact: it is the event after which we say that *"nothing will be the same again".* Why are there surprises or ruptures? Because, in the intimacy of nature, but also of society, there is unpredictability. Our long-term forecasting ability is limited.

Learning from examples consists in selecting the correct rule among those that constitute the set of rules in the system architecture. Not all rules come from experience, from an existing, normalized set. Many come from the need for order to deal with accidents. We have a permanent tendency to generalize rules but this can only be done according to the architecture of the system.

In today's world we speak of *Risk Society* [18], a concept used to understand how the results of social activities manifest themselves powerfully but unpredictably in time and space. It is a fact in modern societies that coping with risk can be more important than the distribution of power and wealth. The COVID pandemic is a clear example. Indeed, many of the unplanned outcomes of the processes that developed in these societies produced negative effects, and the change was found to have become the norm itself. We are witnessing a process of dissolution of norms and change of power structures both at the level of the states and at the international level. An absolutely significant example, precisely because of the extent of the breach of norms, is Russia's aggression against Ukraine.

We find ourselves in almost all situations between the extremes of complexity: between the zone of certainty beyond all doubt and the zone of incomprehensible uncertainty, the sources of which are nothing but chance. Certainty breeds superiority while uncertainty breeds insecurity.

We want the future not to be an illusion or an absolute unknown. We want to extend the present of an order that we understand and is within reach, into the future. As a rule, the incident "hits" the norm, defies it, even ridicules it. A norm (law) can be invalidated. We start from the conviction that chance exists in the very intimacy of nature, of society. Even if we know that a certain thing will happen but we do not know with sufficient certainty when it will happen, we are under a state of unpredictability. Norms decisively help us to live orderly and even in a certain peace, safety, which make our life more *normal.* What can a political leader offer to the citizens he leads? Often and with priority, a normal life.

People can rightly imagine that luck could also bring them good. The anguish of an unfavorable, even tragic, outcome is thus lessened, if not removed. "The year does not bring what the moment brings!" is a perfectly illuminating (Romanian) popular exclamation in this regard.

5. Conclusion

People have always tried to make predictions; they are necessary and useful, but very often they commit obvious errors, which have negative consequences on decision-making. The fact should not upset or alarm us. Prediction errors are in some cases, not few, unavoidable, because the world itself is unpredictable, subject to chance (or randomness in mathematics). Chance is a property of nature. The future can be seen as a result of the interaction between natural states on the one hand and our choices on the other. But the natural state includes in its very essence chance. The history of natural and social events offers us many examples that show how strong the imprint of unpredictability is in human society as well. The cause-effect connection is thus revoked. Even if we know that a certain thing will happen but we do not know with sufficient certainty when it will happen, we are under a state of unpredictability. Norms decisively help us to live orderly and even in a certain peace, safety, which make our life more normal. Our decision must include both the norms (rules) and the chance. Rational decision-making is shaped by a combination of deterministic, risky, or uncertain consequences. Natural accidents are not isolated

events but complex aspects that are connected to social systems. The elements at risk and their vulnerability are in an accentuated dynamic over time. Natural risk is a mixture of chance and vulnerability and therefore the behavior over time must be analyzed each time. The connection between physical and social systems is a fundamental feature of natural risk. This requires a vast interdisciplinarity. Indeed, as we find ourselves in almost all situations between the extremes of complexity: between the zone of certainty beyond all doubt and the zone of incomprehensible uncertainty, the sources of which are nothing but chance, we need to use solid results from a variety of disciplines, from physics and mathematics to psychology, biology, neurosciences, economy and philosophy. Certainty breeds superiority while uncertainty breeds insecurity.

We want the future not to be an illusion or an absolute unknown. We want to extend the present of an order that we understand and is within reach, into the future.

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