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Editorial

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This journal, like many others, is written and read by people who presumably consider that the words within it can provide some knowledge that should increase their ability to deal with situations that they may be called upon to deal with. In other words, we live in the hope that reading the results of the experiences, experiments and reflections of others can improve our interpretive framework and lead to better responses to given problems or an improved ability to the recognition of problem types. In this way, the 'information' carried within the communication reduces uncertainty and improves outcomes. And information can be acquired either simply from experience—ordinary pragmatism, or as the result of deliberate experimentation and acquisition of data which is really the scientific method.

It seems probable that most people, firms and organizations actually function on the basis of simple pragmatism and the learning obtained by practical experiment and the rejection of unsuccessful initiatives. The question then is whether a 'scientific approach' to problems can really reduce inherent uncertainties and lead to higher performance? If knowledge is supposed to reduce uncertainties then how do we get knowledge—and can we separate it from belief?

The answer is that we obtain knowledge by making successive assumptions that constrain what can happen—and so reduce the freedom of the elements present until the future is forced into a single trajectory into the future—and prediction appears possible.

The first assumption concerning a situation is to say that there is a 'boundary'—and that some things will be considered to be inside and others will be outside in the environment. In other words this corresponds to saying that the inside can be understood in its own terms, in the context of the outside. This assumes that we know *enough* about the links between the inside and the outside to be able to get understanding just from the elements within. The second assumption concerns our knowledge of those elements within—the components of which the inside is made. This assumes that we have sufficient ability to be able to 'classify' the elements within into the different types of objects and their characteristic behaviors. This might be biological species and perhaps their age cohorts, or in social systems people classified according to their ethnic, politic or philosophical beliefs, or their skills, professional activities etc. When we do this for any system of interest we find that over time the constituent types have changed. New types and activities have emerged and others have left. Classification shows us that over time qualitative evolution occurs and the system is not structurally stable in that the variables, and therefore the equations describing the mechanisms and processes at work within it must change over time. This is the key territory and realization of complexity thinking. It recognizes that 'systems' do not simply run according to fixed mechanisms but undergo qualitative evolution through a series of instabilities as new things emerge and others disappear. Although this is illuminating it remains a situation of real 'uncertainty' since we know that the current system we perceive will change qualitatively—but we don't know when and we don't know in what way. However, merely stating that things change qualitatively at times and in ways that we cannot predict does not, in our society, "bring home the bacon"! Our society demands more than this—it demands prediction.

Further assumptions have to be made in order to appear to achieve this. Firstly, one can take the current entities of the system and include their mechanisms of interaction. Here the micro-events - of birth, death, production, sales, migration etc. - can take place according to some probability distribution. If we allow for events to occur with their actual probabilities then we arrive at a dynamical description that includes fluctuations and generates endogenously both average behavior and the deviations around it. These are stochastic differential equations—known also as the Chapman-Kolmogorov equations, and allow the study of system resilience the effectiveness of different possible contingency plans. However, it does assume the absence of new behaviors and types within the system, as well as of learning behavior on the part of participating agents. So, it is now better able to 'predict'—providing that the internal elements are considered as fixed, mechanical objects incapable of experiment or learning.

In our quest for understanding and prediction we find two choices for our next assumption:

1. That the probabilistic dynamics in fact moves to a stationary solution rapidly giving us 'self-organized criticality';
2. That the probabilistic dynamics can be approximated by retaining only the most probable events leading to 'System Dynamics'.

The first of these leads particular probability distribution functions shaped by the mechanisms contained in the stochastic equations. For particularly simple mechanisms this can lead to the emergence of power-law distributions and rank-size rules for earthquakes, city sizes, firm sizes etc. In reality though the charts of city and firm size shows a great deal of dynamic change as cities and firms grow and decline, and it seems by no means obvious that the probability distribution must be stationary. In other words, although the model results in a probability distribution, it pushes the 'uncertainty' into that of the assumptions on which the result rests.

If we take the second route to greater 'prediction, we assume that only the most probable events occur. This lead us to 'system dynamics' which is in general a non-linear set of dynamical equations that appear to be predictive and deterministic. In other words, they seem to allow the future trajectory of the system to be calculated, and to provide a basis for policy and strategy analysis by seeing the differences made over time by one intervention as opposed to another. This is a very tempting picture for any decision or policy maker or indeed manager. It appears to offer a way to test different decisions and allow their advantages and disadvantages to be compared.

But the important point that we need to reflect on is that such apparent power of prediction is only real if, and only if, the assumptions made in achieving it are in fact true. In other words the real uncertainty that we know to characterize the long term evolution of an ecology, economy, market or firm is only banished by assumption. In this light therefore, we must admit that understanding and predictions will only hold until things change and our expectations are confounded. Our methods therefore do not scientifically eradicate the uncertainty of an evolving world, but instead mask it and tell us that providing the system doesn't change then we can predict what it will do. But clearly the uncertainty is now as to whether the system will change or not.

While it may be reasonable to believe that the system may hold its structure for short times, then this becomes increasingly unlikely for longer times, since history has shown us that over longer time periods everything of interest seems to change as new entities and types appear in the system and others become extinct. Ultimately, the uncertainty remains. All that we can say is that for short times we may have a coherent structure in which we can talk of prediction and calculate the 'risk' involved in fluctuations around the average values of variables. However, the system will, over longer times possess uncertainties associated with the emergence of new variables, mechanisms and features in the future, where new dimensions of will be turned on and new factors become relevant.

Ultimately then, we may say that if our assumptions are true then our predictive models, either probabilistic or deterministic will hold. In reality though we have exchanged one ill-defined uncertainty for another, that is the uncertainty as to whether the system is structurally stable or not. If we own and control firmly the situation in question, then our current interpretive framework will probably be a good indicator of what will happen. But often our very first assumption about how the system connects to the environment can still trip us up and invalidate our predictions. Essentially we push uncertainty into the question of whether or not the situation, system or organization is structurally stable, and in general do not attempt to answer the question. The first difficulty being—unstable to what disturbance? If we want to study this, then we must examine in more detail both the internal levels of detail within our system and the external world in which our system is located, and without knowing what to look for, this is a difficult task.

In summary then, complexity really recognizes these limits to knowledge and shows us that our quest to banish uncertainty and replace it with knowledge is in fact bound to fail eventually. We only get 'certainty' by closing our minds and pretending that the situation we are faced with is also 'closed'—however, it is indeed wisdom to know that 'knowledge' concerning particularly social, economic and cultural systems is really only current 'belief', and that surprises and uncertainty will always be present. In an evolutionary universe, we are destined to continue a perpetual learning process without end, as we develop, correct and adapt our interpretive frameworks to gradual fossilization which, fortunately, we then fail to pass on to the next generation.

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