What Models for Complex Systems?

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Following Bar-Yam ["*Overview: The Dynamics of Complex Systems*"], one approach to the study of complex systems begins from an understanding of the relationship of systems to their descriptions. In this context, our enquiry focuses on the construction of rigorous easy-to-use models to describe complex systems. In particular, we consider a model as defined by a mathematical structure, where the expression "mathematical structure" aims to indicate a combination of different kinds of sets through an arbitrary order. The concept of "set" and the modalities to construct sets are defined through the following axioms and corollary ("Elementary Set Theory"): Axiom I (extensionality): A set is completely determined by its elements and by the composition relations among the same elements. Element of a set is always a set. The composition relations are not commutative. Axiom II (construction): It is possible to construct a set through the execution of the algorithm < Df1, Df2, Df3>, where Df1 represents the operation of elements definition, Df2 represents the operation of composition relations definition, Df3 represents the operation defining the membership relation among elements and set. Corollary: Given two sets A and B between which there exists a composition relation r, it's always possible to determine a set C, having A and B as elements, ordered through the composition relation r. Having defined the mathematical structure, in order to complete our task, we have to call the different sets and composition relations (namely, create a label for the variety of sets and composition relations): as result, we obtain a model, mathematically exact and linguistically precise. Our goal is to introduce this technique in order to construct models able to describe the different typologies of systems (e.g. biological, physical, economical, social ones) keeping intact, in the complexity, the precision degree.

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