at various levels of analysis, the same object can be investigated as a system or as a nonsystem. Thus, for example, an airplane can be studied as a system in the process of describing its whole function, phenomena of the dynamics of various internal and external interconnections. However, to solve other problems, this same airplane can be studied as a body characterized by a specific resistance to the air current flowing around it or as a structure having specific rigidity. Analogously, the description of a sequence of events of some historical process differs greatly from the analysis of structure in the same process; although in both cases we are dealing with the same object, only in the second case does the investigator operate with them as with a system, investigating those of its characteristics and components that stabilize and preserve the object while also determining the type and direction of its changes. Consequently, the object as such, independent of the problems of its investigation and the use of specific cognitive means, cannot obtain the system character (or nonsystem character). The possibility of a nonsystem investigation of complex objects helps to explain why it took so long to adopt the systems approach.

Thus, the term "system" characterizes not so much a specific class of objects as an approach to the investigation of these objects, an approach based on the study of properties and features of an object from the *systems point of view*. In this plan, the relationship of the designation of an object (its "name") to its "system" status carries special interest. The point is that the term "system" often enters into the designation of an object. A clear example of this is the *information retrieval system*. The presence of the word "system" in the designation does not make this object a system. We can consider this a system, that is, use the ideas and methods of the systems approach in the process of the object's creation or development or the analysis of its operation. However, if the systems approach is not used in the investigation, which is often the case, then an information retrieval system is not a system. This apparent paradox results from the designation of the object, which can also take a completely different "name."

1.3 The Main Characteristics of the Systems Approach

The origin of the systems approach in its modern form can probably be attributed to Norbert Wiener, professor of mathematics at MIT, who near the end of the 1940s published his well-known book *Cybernetics or Control and Communication in the Animal and the Machine* (Wiener, 1961). Wiener bases the idea of cybernetics on the unification of control processes and information processing in complex systems of any nature. At practically the same time, von Bertalanffy developed a program to construct a general systems theory, specifying the

formulation of general principles and laws of the behavior of systems, independent of their form and the nature of their constituent elements and the relations among them.

One of the basic ideas that the systems approach has introduced into our worldview is a new perspective on the components from which the world surrounding us is constructed. The classical representation of the world, consisting of matter and energy, had to give way to a representation of the world consisting of three components: energy, matter, and particularly information. Without information, organized systems are impossible, and living organisms observed in nature and systems created by humans are organized systems. More than that, these systems are not only organized, but also preserve their organization over time, not dissipating it, as should have resulted based on the second law of thermodynamics. Continuous retrieval from the external world of the flow of information about phenomena occurring in it, and about processes taking place in the systems themselves, explains the fact of the preservation of organization.

The systems approach considers not isolated systems, but some collection of them, into which, generally speaking, the whole universe enters. It is distinguished by the relativity of the point of view in the sense that the same collection of elements in one case can be considered a system, and in another case for the solution of other problems it can be considered a *subsystem* of some larger system into which it enters. Thus, for example, an electric drill by itself can be considered a system, but it is possible to consider also the man who is performing work with the help of the drill as a system. In turn, both the drill and the man can be considered subsystems of a system such as a construction company. In nonorganic systems, planets, for example, the atmosphere, lithosphere, or nucleus can be considered a subsystem. As a subsystem of a living organism, one might consider its organs, circulatory system, lymphatic system, nervous system, and so forth.

The properties and features of any object cannot be correctly evaluated and studied without considering the manifold connections and interactions regularly formed between individual objects and the environment surrounding them. Consideration of the effect of the environment is characteristic in the systems approach during the process of investigating phenomena taking place within systems. However, no matter how detailed or rigorously we study the behavior of a system, we can never succeed in studying all the infinite set of factors directly or indirectly influencing its behavior. Therefore it is inevitable to assume the existence of some random factors that result from the action of these nonstudied processes, phenomena, and connections.

A *concrete system* consists of concrete objects (for example, machines, natural resources, models); its connections with the surrounding environment are expressed in the form of specific physical–chemical quantities (forces, flows of energy or matter, etc.).