than that caused by an external action in the absence of feedback. An example of a process with positive feedback is any chain reaction, and an example of negative feedback is any mechanism of homeostasis. Negative feedback has in fact proved to be a valuable principle to which controlled systems owe their progress. The stabilizing action of negative feedback is an important element of both monitoring and adaptation.

During systems analysis, processes with negative feedback may be somewhat hidden from direct observation. However, consideration of these processes is extremely important for understanding the nature of these systems. Thus, stabilization in an economic system is illustrated by the following example showing the action of negative feedback. The higher the price for pork, the greater the number of farmers who will raise pigs; but the more pork produced, the lower the price for it. However, the lower the price for pork, the fewer the number of farmers who will want to produce it; but the fewer producers, the less pork is produced and the higher the price for it. An analogous example is the establishment of balance in ecology. The more hares (food), the more wolves (consumers). But the more wolves, the fewer hares. The fewer hares, the fewer wolves, and so on. Usually when a different use of automatized controlled systems is being created, basic attention is focused on the creation of efficient feedback, because the quality of system operation on the whole depends on the quality of the feedback.

1.8 System Design

One of the most important results of the systems approach is the development of unique methodological principles for the creation of systems of the various classes. This advance was mostly due to the work of Rosenblueth, Wiener, and Bigelow (1943) and, in particular, the later work of Wiener. In these works the authors point out the causality in the creation of systems, their goal. Essentially the goal always appears in the form of some standard to which one must strive. Thus, the goal can be considered a theoretical model carrying subjective character. Any goals in the final analysis result from human needs and thus their achievement is always considered a fulfillment of a need. For this reason, the first step in system's creation includes the investigation of concrete need and, based on this investigation, the formulation of the system's goal. This step is called the *goal definition stage*.

Usually realization of a goal does not cause great difficulties, because as a rule it is preceded by a detailed analysis of the nature and peculiarities of some specific human need. However, a rather natural idea of looking at the goal of a system proved to be revolutionary, because it led researchers to view systems as functional essences. It became obvious that it is conceptually more useful to

move from functionally representable wholes to structurally representable parts, and not vice versa. Before the appearance of the above-named works, systems creators typically constructed their understanding of a whole by unifying the results of the analysis of separate parts, while today the understanding of different parts is obtained by decomposing a representation of the whole. This orientation of investigations came to be called *the systems point of view*.

Within the framework of the systems point of view, determining the whole function of the system becomes especially important. This is the *function determination stage*. We say the "whole function of the system," because it is necessary to formulate the function of the system as a whole and not of its separate parts.

The concept of "function" in the systems approach is understood as the purpose of the system, its obligation. The function can be represented as some law that governs how the system behaves in order to fulfill its purpose or as a set of rules to achieve the goal that dictate how the elements of the system interact. In other words, function is the description of a requirement for the system's output that explicitly or implicitly indicates the quality of the output characteristics. Thus, in determining the function we in essence assign an "obligation" to the system with the subsequent stages of the system's creation geared toward the realization of the function. Because the quality of system operation is determined by the level to which it achieves the goal of its creation, it becomes obvious that in determining the function it is necessary to orient oneself to this goal while, whenever possible, taking into account more completely the available characteristics and needs.

Thus, it was noted earlier that before the revolution in viewpoints, scientists strived to understand the functioning of a whole based on an analysis of the structure of parts and structural connections between parts. At present, scientists increasingly are trying to penetrate the structure of parts of the system, relying on an understanding of the functioning of the entire system as a whole. For exactly this reason, at the third stage of a system's creation, starting with the formulation of the system's function, the system's structure is determined. This is the *structure creation stage*.

The concept of "structure" came from the Latin *structura*, which means formation, arrangement, and order. When applied to the systems approach, structure refers to the formation of a system, that is, a collection of elements included in the system and their interactions. By definition, a system is a complex of interacting elements intended for the fulfillment of a whole function. It is obvious, then, that the complex itself and the interconnections (i.e., the structure) depend on a specific function. In other words, different functions predetermine different structures. In fact, the requirement to fulfill the function determines the presence of a specific element in the system and stipulates the order of their interactions. Note that by defining the structure, one is also defining the boundaries of the system. Therefore the assertion that a specific element is part